



Artist's Impression

Environmental Impact Statement – Appendix M: Socio-economic, Land Use, and Property Assessment Report

Warragamba Dam Raising

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Executive summary

Introduction

The Warragamba Dam Raising project (the Project) proposes to facilitate flood mitigation by increasing crest levels of the central spillway by approximately 12 metres and increasing the dam abutments by 17 metres. WaterNSW, a New South Wales (NSW) state-owned corporation, is the owner and operator of Warragamba Dam.

The purpose of the Project is to reduce flooding impacts on downstream communities and reduce risk to lives and property in the Hawkesbury-Nepean Valley. WaterNSW is seeking approval for the Project under Division 5.2 (s5.12) (State Significant Infrastructure) of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act). An Environmental Impact Statement (EIS) is being prepared as part of the approval process and this Socio-Economic Impact Assessment (SEIA) has been prepared as a technical study supporting the EIS.

Purpose

The purpose of the SEIA is 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 might be mitigated and benefits could be enhanced. The SEIA has been prepared to meet the relevant Secretary's Environment Assessment Requirements (SEARs).

Associated 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 might 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.

SEIA study area

SEIA study areas have been identified in four areas including: local communities, upstream communities, downstream communities, and estuary communities.

Local communities study area

The local communities study area encompasses the area in close proximity to the Project footprint which is likely to experience direct impacts primarily due to Project construction. The Project footprint includes the dam wall, ancillary facilities (such as coffer dams, batch plants, and material storage areas), and access roads. The Project footprint is geographically centred in Warragamba (and neighbouring Silverdale) in the Wollondilly Local Government Area (LGA) (including the main dam site, ancillary facilities, and transportation routes) and 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.

Upstream communities study area

The upstream communities study area is identified as the area to be directly influenced in the event of upstream inundation. 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. The potential impacts on the upstream area would occur in the World Heritage Area and the Blue Mountains National Park with an increased inundation area around Lake Burragorang and watercourses which flow into the lake. It is noted that the World Heritage Area and Blue Mountains National Park is 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.

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, 74 suburbs will be affected by a Probable Maximum Flood (PMF), and they collectively constitute the downstream communities study area.

In addition, flood events also generate wider socio-economic changes such as the 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 collectively comprise of five LGAs— Liverpool, Penrith, Hawkesbury, Blacktown, and The Hills. The 74 PMF-affected suburbs are located across the five LGAs. These include 4 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 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.
- 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.

Estuary communities study area

The estuary communities study area constitutes the estuarine area of the Lower Hawkesbury River which is defined as downstream of Wisemans Ferry. The estuary communities study area was identified as being potentially impacted by altered dam operation and subsequent flood patterns such as 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 estuary communities study area are as follows:

- Hornsby LGA: Berowra Creek, Berowra Heights, Berowra Waters, 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.

Socio-economic baseline

A socio-economic baseline for the SEIA study areas has been provided in Section 6. The socio-economic baseline of the Project study areas aims to describe the key socio-economic conditions with an emphasis on the resources and receptors that may be impacted by the Project and to inform judgement where possible about the sensitivity, vulnerability and/or importance of resources and receptors. The findings of the baseline study have been used to assess the potential impacts and opportunities of the Project on the socio-economic characteristics. The following

summarises key findings of the socio-economic baseline of each SEIA study area, including local communities, upstream communities, downstream communities, and estuary communities.

Baseline characteristics of the local communities study area

The following summarises the key characteristics of socio-economic indicators in the local communities study areas.

Land use and planning

- The total area of the construction zone is 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 Project footprint 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 Wollondilly Development Control Plan (2016). Substantial population growth is predicted in Wollondilly Shire over the next 30 years. A major proposed development in the Warragamba/Silverdale area is the subdivision of 79 lots on 65 Marsh Road; however, this application was rejected in 2017 by the Council. Concerns were raised about increased traffic, lack of infrastructure, and loss of the town's rural character.

Demographic characteristics

- According to the 2016 ABS Census, the Wollondilly LGA had a total permanent population of 48,519 people. Population density in the Wollondilly LGA in 2016 was 20 persons per square kilometre, which is higher than NSW with nine persons per square kilometre. Warragamba township 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 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 is significantly lower than the Greater Sydney area where the population density is 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 accounted for 3.2 percent of the population of Wollondilly. The proportion of the Indigenous Australian population in the LGA was more than double that of Greater Sydney (1.5 percent of the population). At the local level, the percentage of Indigenous Australian people in Warragamba (5.8 percent) was considerably higher than Wollondilly LGA and Greater Sydney, while Silverdale recorded an Indigenous Australian population of 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 LGA 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 LGA was 37 years old whilst in Warragamba and Silverdale, the median age was 36 years old.

Employment and industry

- According to the 2016 ABS Census, the labour force participation rate in the Wollondilly LGA was 60.9 percent which was higher 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 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.

- In 2018, 34.0 per cent of businesses in Warragamba and Silverdale were 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 construction phase.

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, whilst median weekly household income in Silverdale (\$2,220 per week) was substantially higher.
- With regard to the ABS Socio-economic index for areas (SEIFA) advantage/disadvantage score, 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.

Housing and accommodation

- In 2016, more than 93 percent 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 whilst in Silverdale it was \$510/week. 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 footprint was a single hotel in Wallacia, followed by 10 motels and hotels located in Penrith area.

Community values

- Community identity is strongly linked to sense of place. Review of planning documentation (Local Environmental Plan (LEP) and 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 also valued cultural sites and recreational areas including Warragamba Dam, Warragamba River and Eugenie Byrne and Haviland Parks. 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.

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 Warragamba Public Primary School and Silverdale Childcare Centre. Warragamba Public School is located in the town centre on the corner of Fourth Street and Farnsworth Avenue, 2.1 kilometres away from the Project footprint. Silverdale Childcare Centre is located within the main residential area of the suburb and approximately five kilometres from Warragamba Dam.

- 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 reserve. 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.

Community health and safety

- As per the NSW Health Wollondilly health needs assessment (2014) (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. Compared to the whole of NSW, residents of Wollondilly recorded: (i) higher rates of overweight and obesity and higher rates of hospitalisation and deaths attributable to high body mass index; (ii) lower levels of adequate physical activity and fruit consumption; (iii) higher levels of alcohol consumption; (iv) higher rates of smoking, especially during pregnancy, and deaths attributable to smoking; (v) 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 Wollondilly LGA. Residents of Wollondilly depend on facilities in adjoining LGAs, 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 LGAs, such as Penrith Community Health Centre, Narellan Community Health Centre, or Hoxton Park Community Health Centre.
- The numbers of offences associated with malicious damage to property were highest in both Wollondilly and Warragamba-Silverdale¹. This was followed by the number of crimes relating to intimidation, stalking, and harassment. It should be noted that 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.
- 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 high levels of performance and minimal delays. It is anticipated that the future northbound and southbound through traffic at Park Road/Northern Road intersection would use the new link between the Elizabeth Drive/Existing Northern Road intersection and New Northern Road/Existing Northern intersection to reach their destination. It is noted that a major upgrade of this section 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, 68.9 percent of which were fatal. This proportion was lower than the Outer Sydney area average (76.4 percent) and the NSW average (78.7 percent). This suggests there is a lower risk of road accident fatalities in Wollondilly LGA than elsewhere in the outer Sydney area.

Baseline characteristics of upstream communities study area

The following summarises the key characteristics of socio-economic indicators in the upstream communities study area.

Land use

- The land use profile is dominated by environmental conservation land. According to the 2016 ABS Census, land for environmental conservation in the Blue Mountains LGA accounted for 91.0 percent. Agricultural land made up 6.0 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.

¹ Warragamba and Silverdale have the same post code – 2752. Therefore, crime data recorded for these two towns are merged.

Demographic profile

- In 2016, the total population of the Blue Mountains LGA was 76,904 people. The population density of this LGA was only 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 (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 Mountain LGA was 1,823 people, which accounted for 2.4 percent of the total population. The proportion of the Indigenous Australian population in this LGA was higher than that of Greater Sydney (1.5 percent of the population).

Economic and employment profile

- In 2016, the labour force participation rate in the LGA was 59.9 percent, which was 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). Regarding the SEIFA advantage/disadvantage index, the LGA had a decile rating of 9 and a SEIFA score of 1,045. 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.

Housing profile

- Housing in the Blue Mountains LGA is concentrated in townships and small villages accompanied by peri-urban and 'wilderness' style and low-density housing.
- There was a total of 32,827 private dwellings with 88 percent of which were occupied, reflecting the prevalence of homes only occupied occasionally during holiday periods and weekends. There were 397 State Housing Authority and 197 community/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 (2017) which formed 0.2 percent of the total population.

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 (GBMWH). The GBMWH is listed on the World Heritage register 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 setting². There are many sites and landscapes of Aboriginal significance throughout the Blue Mountains National Park.
- Based on online google search, as of January 2019, there were 46 recorded recreational areas around Lake Burrangorang and in the surrounding national parks. These recreational features include mountain bike trails, walking tracks, look-out points, and campgrounds. For instance, key regional open space and recreational areas in the affected upstream area include McMahon's Point, Burrangorang-McMahon's walking track, WSD Dallawang Ridge trail, Birrel Lake bush camping area, Fletcher's lookout, and Dunphys Campground.

Community values

- The Blue Mountains community has strong 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 GBMWH 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

² Retrieved from <http://www.environment.gov.au/heritage/places/world/blue-mountains>

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.

Baseline characteristics of downstream communities study area

The following summarises the key characteristics of socio-economic indicators in the downstream communities study area.

Land use and planning

- The total land area predicted to be affected by a PMF within the downstream communities study area is 438 km². 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 (Airport) Priority Growth Area and the North West Priority Growth 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 and NSW Government 2017). The Northern road upgrade is a key part of the WSIP and will be completed in six stages.

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. The 21 affected suburbs in the Penrith LGA had the highest number of residents (126,487 residents). This was followed by 10 affected suburbs in the Blacktown LGA (70,636 residents) and 32 affected suburbs in the Hawkesbury LGA (51,419 residents). The average population density across all 74 affected suburbs was 192.6 persons per square kilometre, which was significantly lower than Greater Sydney (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 only 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 PMF-affected suburbs comprising the downstream communities study area was variable. Overall, the total population of the 74 PMF affected suburbs had increased by 9 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).
- There are a diverse range of communities in the downstream 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 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.

Economic and employment profile

- In 2016, the total size of the labour force was 133,293 people, which represented a labour force participation rate of 65.1 percent. The unemployment rate across the downstream communities study area was 4.5 percent, which was lower than that of Greater Sydney (6.0 percent). The suburbs with the highest unemployment rate were in Liverpool LGA, with a collective unemployment rate of 7.5 percent. The construction industry accounted for the highest proportion of occupations.

- With regard to the SEIFA advantage/disadvantage score, the downstream communities study area collectively recorded a decile rating of seven indicating that the population within the downstream communities study area are experiencing levels of advantage. Suburbs with the lowest SEIFA Scores were in The Hills, Hawkesbury, and Blacktown LGAs.

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.
- Over the last 30 years, the Western Sydney region has increasingly been targeted by families seeking affordable detached housing close to employment hubs, such as Sydney CBD. Sydney is predicted to be facing a housing shortage of 190,000 homes by 2024. Areas within and adjacent to the downstream communities study area are key locations for planned residential growth.

Regional open space and recreational areas

- Throughout the Hawkesbury-Nepean Valley, there is 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.

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 Brigade), six police stations, two State Emergency Stations and eight justice facilities. Provision of infrastructure and services varies across the downstream communities study area, ranging from high levels of service provision in community hubs such as in Penrith LGA to low levels of service provision 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 Commonwealth and NSW governments are investing \$3.6 billion over 10 years in major road and transport infrastructure upgrades (Australian Government and NSW Government 2017).

Evacuation routes

- Evacuation routes within the Hawkesbury-Nepean Valley are designated in the 2015 Hawkesbury-Nepean Flood Plan (NSW State Emergency Service (SES) 2015). The most effective means of evacuation from the Valley is via road, using private vehicles and public transport (such as buses). The road evacuation routes are categorised into sector evacuation routes and regional evacuation routes. Responsibility for planning and management of evacuation routes is shared across a variety of agencies including local Councils, State Emergency Services, Police and NSW 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 Government 2015a). 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 inundated as floodwaters increase. For example, suburbs such as Richmond, Windsor, South Windsor, Pitt Town, and McGraths Hill will all become inundated flood islands during large flood events.

Perceptions of flood risks

- Research completed by Infrastructure NSW 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, at the time of the research, is that relatively few members of the community have experienced severe flood events. However, following the research period the 2021 March Major Flooding Event occurred, which might have changed the community awareness of flood risk. Subsequently, flood risks

are perceived as a remote event, 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 this perception, and a low level of preparedness for a flood, the communities in the Hawkesbury-Nepean floodplain may be highly vulnerable to the devastating environmental, social, economic, and psychological impacts of a major flood.

- It has been recognised by NSW and other agencies that there is a need for better education and awareness regarding flood risk. Increased awareness would not only help elicit an effective response during a flood event, but also will minimise social disruption, subsequently assisting in the recovery process.

Baseline characteristics of estuary communities study area

The following summarises the key characteristics of socio-economic indicators in the estuary communities study area.

Land use

- 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 due to the high levels of restriction on residential development enforced by state 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.

Demographic profile

- In 2016, the total population across all the 26 affected 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 (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.
- Cultural diversity in the estuary communities study area was relatively low. In 2016, the percentage of residents who were born overseas in the estuary communities study area was 14.5 percent, 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 1.0 percent.

Economic and industry profile

- In 2016, the total size of the labour force across all suburbs in the estuary communities study area was 4,861 people, accounting for 64.6 percent of the population. This labour force participation rate was higher than that of Greater Sydney (61.6 percent). The unemployment rate was relatively low at 5.1 percent, which compares to a rate of 6.1 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 \$1,243.54 per week. Suburbs in the Central Coast LGA had the lowest median weekly household income.
- With respect to the SEIFA advantage/disadvantage score, there was considerable variation across the estuary communities study area. Suburbs in the Hornsby and Northern Beaches LGAs recorded scores which indicate relatively high levels of advantage whilst the 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 is an economically important industry, particularly in the lower reaches of the estuary.

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 are 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.

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 (Hornsby Shire Council 2008) and included highly 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 including: (i) risk of water quality and sediment quality not meeting relevant environmental and human health standards; (ii) risk of climate change; (iii) risk of regulated freshwater inflows; (iv) risk of inappropriate land management practices; (v) risk of over-exploiting the estuary’s assets; (vi) risk of introduced pests, weeds, and disease; (vii) risk of excessive sedimentation; (viii) risk of residents and user lacking passion, awareness and appreciation of the estuary; (ix) risk of inappropriate or excessive foreshore and waterway access and activities; (x) risk of inadequate facilities to support foreshore and waterway access and activities.

SEIA stakeholder engagement

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. The following provides a summary of stakeholder engagement undertaken to date which has informed the SEIA.

EIS engagement

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 Project. These included the following:

- **Meetings and briefings:** The project team provided briefings and held with relevant councils across the study areas, as well as local MPs, senior government executives and their support staff, and special interest groups.³
- **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) (DECCW 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’s 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.
- **Surveys:** Engagement with a broad range of stakeholders was conducted, including interviews with councils and other stakeholder groups, council briefings, meetings with relevant government agencies, and briefings provided and meetings held with three special interest groups. In relation to the Project as a whole, there were 552 subscribers registered to receive updates and over 1,500 phone calls and emails received via the free call

³ Special interest group is a group of people or an organisation that uses various form of advocacy in order to influence public opinion and ultimately policy. They play an important role in the development of political and social systems.

1800 number and Project email address. Consultations with landowners upstream of the Warragamba dam who would possibly be affected by temporary upstream inundation as a result of the Project were undertaken. Members of the EIS team visited properties in the *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.

Issues raised during the EIS consultation were captured and recorded in a database using Consultation Manager software. The SEIA has been informed by key issues and concerns raised by stakeholder groups throughout the course of the EIS.

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. The outcome of stakeholder sentiment shows that whilst the majority of sentiments captured were neutral (79 percent), negative sentiments (15 percent) were higher than positive sentiments (6 percent).

SEIA stakeholder engagement

Stakeholder engagement has been a key element informing the completion of the SEIA. Specific engagement activities undertaken as part of the SEIA included scoping interviews, a phone-based survey, a web-based survey, a business survey, and two stakeholder workshops. The following provides an overview of each of these activities and the feedback they generated.

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. 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 Section 5 of this report.

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 was vulnerable groups. 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 and 220 businesses. Contact was made with all identified stakeholder representative organisations. Of the 310 organisations contacted, 85 either did not answer (to multiple calls at different times), subsequently did not respond to messages or phone details were invalid and an alternative number was not available. An additional 28 organisations stated they specifically did not wish to participate. A total of 69 surveys were completed.

Key feedback from the phone-based survey is summarised as follows:

- Around 49 percent 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.
- More than half of participants had previously heard about plans to raise the Warragamba Dam in order to reduce the frequency and severity of flooding; however, 60 percent of participants from the upstream communities study area 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).
- A total of 43 percent of respondents from the downstream area supported the raising of the Warragamba Dam whilst 60 percent of participants from the upstream opposed the Project. The most prevalent response in Warragamba/Wollondilly was neutral (40 percent). Reasons provided for as to why the respondent was opposed to the Project primarily related to concerns regarding environmental and cultural damage (respondents from both upstream (80 percent) and downstream (61 percent)). In Warragamba/Wollondilly,

60 percent of respondents raised concerns surrounding the increased traffic during the Project's construction phase.

Web-based survey

A web-based survey was conducted to allow stakeholders to provide more detailed feedback on local level perceptions of Projects risks and benefits. The web-based survey also included the provision of a visual representation and supporting information (in text boxes) explaining the predicted effects of a 1 in 100 chance in a year event if it were to occur. This information was provided for Warragamba, Silverdale and Wallacia along with upstream and downstream localities. Using a 'Survey Monkey' based platform, an invitation to participate in the survey was sent to 197 stakeholder organisations. A total of 61 surveys were completed. Of these, 5 percent were from organisations located upstream, 30 percent in the downstream area, and 67 percent in the Warragamba/Wollondilly area.

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

- Local communities study area:
 - 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 communities study area, potential negative effects associated with the Project were identified by participants 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 respondents within the upstream communities study area 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
- In the downstream communities study area, 60 percent of respondents reported that raising the Warragamba Dam would reduce risk of damage to and loss of property and would reduce insurance costs. It would also reduce flood-related anxiety for residents and reduce costs for emergency services with the potential to lower the loss of life due to a major flood event being the overriding consideration.

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 50 business surveys being completed. Key issues from the business survey are summarised as follows:

- Businesses in the local communities study area: Of the 20 business respondents in Warragamba/Silverdale, most recorded a neutral response as to potential effects of the Project's 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). 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. 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.
- Businesses in the upstream communities study area: 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. Of the four businesses surveyed in the upstream communities study area, it was reported that the Project would have a negative effect on employee and customer safety and would have an extremely negative (50 percent) or negative (50 percent) effect on business revenue from tourism.

- Businesses in the downstream communities study area: There were 26 businesses which participated in the business survey in the downstream area. Overall, the perception of the Projects potential impacts on business operations recorded predominantly neutral responses from downstream businesses. There was an even split of 43 percent of respondents stating there would be no impacts or minor impacts. Positive perceptions reported included improved employee and customer safety; customer and employee access; business revenue and sales; and distribution and supplier access. Forty-eight percent of the downstream respondents perceived that the Project would have no notable impact on business activity, and they were therefore indifferent/neutral to the Project being advanced.

Stakeholder workshops

Two stakeholder workshops were held on 11 April 2019 at Warragamba Town Hall. The first was with representatives from relevant government agencies and the second workshop with local communities and organisations. The purpose of these workshops was to provide an opportunity for government representatives, community representatives and organisations that serve the Warragamba, Wallacia and Silverdale townships to gain an understanding of the Project and preliminary findings from the EIS technical studies, and to provide feedback on issues and concerns regarding the construction phase of the Project. The workshops were structured under three key themes including: (i) local traffic and transport management; (ii) socio-economic impacts and opportunities; and (iii) environmental management of the local area during construction.

Key stakeholder groups invited to participate in the workshops included:

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

A recommended list of 38 participants was developed, informed by those people who registered their interest during the Warragamba community pop-up session, registrants for community updates, local community email/phone enquirers, entities who were previously invited to participate in SEIA surveys, and relevant staff who attended the council briefing session.

Stakeholder feedback was captured and analysed to inform the SEIA and is summarised below:

- Workshop theme 1: Socio-economic impacts and opportunities:
 - Economic vitality of local communities: Tourism infrastructure is needed to improve to attract and maintain a tourism to the Dam and Warragamba town. There is a need for greater opportunities for tourists and non-locals to spend money in Warragamba. 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 attract additional visitors.
 - Impacts associated with influx of workers and local economic opportunities: An external workforce coming to Warragamba will impact on the existing infrastructure and facilities. Local employment can be utilised during the construction phase. There might be local supply opportunities during the construction phase.
 - Impacts associated with public access to social infrastructure, services, and facilities during construction phase: Over the last 20 years, there have been changes to how visitors access and experience the Dam and the surrounding areas. The potential temporary closure of the Visitor Centre and Haviland Park during the construction phase will have negative consequences on the community and tourism to Warragamba.
- Workshop theme 2: Environmental management of the local community area during construction:
 - During the construction phase, the Project would create noise, vibration, dust and waste. This would impact community amenity, especially for more vulnerable community members.

- Mitigation measures were proposed. These included: (i) For noise and vibration: 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; and (ii) For dust: Mitigation and management of dust and construction activities should be provided (such as covering vehicles, curtaining/confining concrete batching facilities and water carting).
- Construction activities might 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.
- Workshop theme 3: Local traffic and transport management
 - Safety: There may be a safety risk for children travelling to/from school during the construction phase. There are issues related to an incoming workforce and increased construction traffic, including fatigue-related accidents, animal strikes 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.
 - Congestion: 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.
 - Cumulative impacts: Cumulative impacts from the airport construction at Badgerys Creek would occur. There would be conflicts with planned road upgrades especially Silverdale Road.
 - Community amenity: Noise would impact Warragamba Public School. An incoming workforce of approximately 500 workers will 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 elderly residents, would be unable to access health services.

Research and engagement activities undertaken by INSW

WaterNSW has been conducting numerous engagement activities as part of the Hawkesbury-Nepean Valley Flood Risk Management Strategy. Newgate Research was commissioned to undertake social research on public opinions and perceptions of flooding, evacuation, and social networks in the Hawkesbury-Nepean Valley. *Social research on floods in the Hawkesbury-Nepean Valley* was completed in 2014, the *Social network analysis* report was completed in 2015 and the final report on *Flood evacuation social research for the Hawkesbury-Nepean flood risk management directorate* was completed in 2018. Key outcomes of these studies were analysed to inform the SEIA.

Impact assessment and mitigation measures

Impact identification and assessment of this SEIA has been undertaken. Types of impacts which have been identified, defined, and assessed in the SEIA include:

- property and land use
- environment including effects on amenity, aesthetics, and access
- community health and wellbeing including effects on community safety, recreation and access to, and use of, infrastructure, services, and facilities
- culture 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).

Impacts have been assessed in each identified SEIA study area (including local communities, upstream communities, downstream communities, and estuary communities). Identified impacts have been evaluated in accordance with the NSW Social Impact Assessment Guideline (refer to Section 8 of the SEIA). Mitigation and enhancement measures have been proposed to enhance the benefits for the stakeholders and communities as well as mitigate negative impacts from the Project. Once the mitigation and enhancement measures have been proposed, the identified impacts have been re-assessed to assign residual impact significance (refer to Section 9 of the SEIA).

In summary, the significance rating of most identified impacts has been able to be reduced subject to the application of the recommended mitigation measures. The achievement of the residual significance levels is contingent upon the

implementation of the management measures. A summary of residual significance ratings in the SEIA study areas is summarised in the following table.

Impact description	Impact nature	Residual significance rating
Local communities study area		
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
Upstream communities study area		
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
Operation - Health effects associated with heightened anxiety	Negative	Low
Operation -Changed access to properties at Yerranderie	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

Impact description	Impact nature	Residual significance rating
Downstream communities study area		
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation – mainly for larger floods around 1 in 2,000 chance in a year event) in the LGA of Liverpool (primarily limited to Wallacia)	Positive	Extreme
Operation - Reduction in the impacts of flooding (including reduction in the number of properties inundated by flooding and improved evacuation - about 95% reduction for a 1 in 100 year chance in a year event) 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 - about 88% reduction for a 1 in 100 year chance event) 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 - about 74% reduction for a 1 in 100 year chance in a year event) 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 - about 5% reduction for a 1 in 100 year chance event) in the LGA of The Hills (primarily limited to Wisemans Ferry)	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
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 for 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 - 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

Impact description	Impact nature	Residual significance rating
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
Estuary communities study area		
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 for fishing, recreation and aquaculture-related businesses	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 aqua-culture businesses	Negative	Low

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Abbreviations

Abbreviation	Name
ABS	Australian Bureau of Statistics
ABSBR	Australian Bureau of Statistics Business Register
AoI	Areas of influence
ACHA	Aboriginal Culture Heritage Assessment
ACHCR	Aboriginal cultural heritage consultation requirements
AFZ	Alcohol-Free Zones
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
CBD	Central Business District
CEMP	Construction Environmental Management Plan
CSEP	Community and Stakeholder Engagement Plan
CZ	Character Zone
DCP	Development Control Plan
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
FMZ	Flood mitigation zone
FSL	Full supply load
GBMWhA	Greater Blue Mountains World Heritage Area
GIS	Geographic Information Systems
GP	General Practitioner
ICNG	Interim Construction Noise Guidelines
ILUA	Indigenous Land Use Agreement
INSW	Infrastructure New South Wales
LCZ	Landscape Character Zone
LEP	Local Environmental Plan
LGA	Local Government Area
LOTE	Language Other Than English
NCA	Noise Catchment Area

Abbreviation	Name
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NHL	National Heritage List
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NT Act	<i>Native Title Act 1993 (Cth)</i>
PCT	Plant Community Type
PMF	Probable Maximum Flood
PLDC	Penrith Lakes Development Corporation
PLB	Personal Locator Beacon
POMS	Pacific Oyster Mortality Syndrome
RAPs	Registered Aboriginal Parties
RMS	Roads and Maritime Services (now part of Transport for NSW)
RNP	Road Noise Policy
SE	Stakeholder Engagement
SEIA	Socio-Economic Impact Assessment
SES	State Emergency Service
SIA	Social Impact Assessment
SDD	State Significance Development
SEIFA	Socio-Economic Indexes for Areas
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
WHL	World Heritage List
WSIP	Western Sydney Infrastructure Plan

1 Introduction

The Warragamba Dam Raising project (the Project) proposes to facilitate flood mitigation by increasing crest levels of the central spillway by approximately 12 metres and increasing the dam abutments by 17 metres. WaterNSW, a New South Wales (NSW) state-owned corporation, is the owner and operator of Warragamba Dam.

The Project is required to mitigate potential flooding impacts on downstream communities including reduced risk to lives and property in the Hawkesbury-Nepean Valley. WaterNSW is seeking an approval for the Project under Division 5.2 (s5.12) (State Significant Infrastructure) of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act). An environmental impact statement (EIS) is being prepared to support the Project and approval. This socio-economic impact assessment (SEIA) has been prepared as one of the specialist impact assessments for the EIS.

1.1 Purpose of the report

The purpose of the SEIA is 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 might be mitigated and benefits 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 has been prepared to meet the relevant Secretary’s Environment Assessment Requirements (SEARs) which is further discussed in Section 2.5).

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 might 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.

1.2 Structure of the report

The SEIA report is structured as follows:

- **Section 1 – Introduction:** This Section introduces the Project and outlines the purpose and structure of the SEIA.
- **Section 2 – Legislation, policy, and guidelines:** This Section provides a summary of relevant legislation, policies and guidelines applicable to the Project.
- **Section 3 – Project description:** This Section describes the need for the Project, its location, and activities associated with the Project.
- **Section 4 – Methodology:** This Section outlines the approach to the SEIA and details the steps undertaken to complete the assessment.
- **Section 5 – SEIA scoping:** This Section outlines the scoping of the SEIA and identifies areas of influence.
- **Section 6 – Socio-economic baseline:** This Section provides a comprehensive socio-economic characteristics and values of the SEIA study areas. This includes results of desktop assessments and stakeholder consultations where applicable.
- **Section 7 – SEIA stakeholder engagement:** This Section outlines stakeholder engagement undertaken as part of the SEIA preparation.
- **Section 8 – Impact assessment:** This Section examines the potential socio-economic impacts associated with the construction and operation of the Project.
- **Section 9 – Impact mitigation measures and residual assessment:** This Section provides impact mitigation/enhancement measures and assesses the residual significance of impacts.
- **Section 10 – Conclusions:** This Section presents the conclusions to the SEIA.

2 Legislation and guidelines

2.1 Overview

The proposed Project requires an EIS to be conducted under Division 5.2 (s5.12) (State Significant Infrastructure) of the EP&A Act. WaterNSW lodged its Warragamba Dam Raising State Significant Infrastructure Project Application with the NSW Department of Planning and Environment (DPE) in December 2016 and the Secretary's Environmental Assessment Requirements (SEARs) were subsequently issued on 13 March 2018. This section describes the legislation, legal requirements, and guidelines applicable to the Project as they relate to the SEIA.

2.2 Environmental Planning and Assessment Act

As described in the EP&A Act (Section 1.3), the NSW Government aims to:

- (a) promote the social and economic welfare of the community and a better environment by the proper management, development, and conservation of the State's natural and other resources
- (b) facilitate ecologically sustainable development by integrating relevant economic, environmental, and social considerations in decision-making about environmental planning and assessment
- (c) promote the orderly and economic use and development of land
- (d) promote the delivery and maintenance of affordable housing and protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities, and their habitats
- (e) promote the sustainable management of built and cultural heritage including Aboriginal cultural heritage
- (f) promote good design and amenity of the built environment
- (g) promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants
- (h) promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State
- (i) provide increased opportunity for community participation in environmental planning and assessment.

The key aims of the EP&A Act have been appropriately considered in the methodology and conduct of the SEIA.

2.3 Native Title Act 1993

The *Native Title Act 1993* (NT Act) provides legislative framework for the recognition and protection of native title and its coexistence with the national land management system. Native title recognises the traditional rights and interests to land and waters of Aboriginal and Torres Strait Islander people. Under the NT Act, native title claimants can make an application to the Federal Court to have their native title recognised by Australian law.

There is an active native title claim over a large area of land which includes the Warragamba Dam site and catchment which was lodged by three organisations representing the Gundungurra people in 1997, with the claim registered in 2000. One of the mechanisms provided under the NT Act is an indigenous land use agreement (ILUA) between native title claimants and government agencies for the purpose of managing the use of land and waters. The Gundungurra People, Gundungurra Tribal Council Aboriginal Corporation, Gundungurra Aboriginal Heritage Association Inc. and various NSW Government agencies entered into an ILUA in February 2015.

The ILUA includes the establishment of a consultative committee and input by the Gundungurra people for management of land and waters covered by the ILUA, including Lake Burragorang and the Warragamba area. Consultation has been undertaken with this committee as part of the Project development and approval processes. Issues identified during the consultation have been addressed in the design, operation and mitigation measures developed for the Project.

While works associated with the Project would not occur directly in any native title land area, upstream areas (around Lake Burragorang and the Warragamba area) may be impacted by temporary inundation due to the operation of the Project.

2.4 National Park and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of designated conservation areas as well as the flora and fauna within conservation areas. Conservation areas declared under the NPW Act near the Project footprint include:

- Warragamba Special Area (refer to Chapter 20 of the EIS)
- Kanangra-Boyd and Nattai Wilderness Areas (refer to Chapter 20 of the EIS)
- Kowmung, Colo and Grose Wild Rivers
- Kanangra-Boyd, Blue Mountains and Nattai National Parks
- Burratorang, Yerranderie and Nattai State Conservation Areas
- Yerranderie Regional Park.

Project works and the provision of environmental flow infrastructure would be undertaken only within the Warragamba Special Area. Special areas are designed areas of the declared catchment directly surrounding the water storages where access is prohibited or restricted by law. Special areas aim to provide a natural buffer to stop pollutants entering water storages.

The WaterNSW Amendment (Warragamba Dam) Act 2018 No. 61 was passed on 26 October 2018. This amendment allows the temporary dam inundation of national park land resulting from the raising of the wall of Warragamba Dam and the operation of the Dam for downstream flood mitigation purposes. While works associated with the Project would not occur directly in any conservation area declared under the NPW Act, conservation areas both upstream and downstream may be impacted by changes in temporary inundation and flooding. The impacts of any changes to inundation and flooding due to the Project on conservation areas are assessed in this SEIA.

2.5 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARs) provide the standards and key issues required to be addressed in the Project EIS. The SEARs were issued on 13 March 2018. Table 2-1 provides the SEARs requirements relating to the assessment of socio-economic, land use, and property, and flooding impacts associated with the Project.

Table 2-1. SEARs requirements: Socio-economic, land use and property, and flooding

Desired performance outcome	Requirements	Where addressed
14. Socio-economic, land use and property The Project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities. 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.	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.	Throughout this SEIA report (Appendix M of the EIS)
	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: <ul style="list-style-type: none"> ▪ Identification of the affected community and other interested stakeholders, specifying in what way each might 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 proposal; ▪ A quantitative and qualitative community profile, including values and aspirations; 	Sections 5, 6, and 7 in this SEIA report (Appendix M of the EIS)

Desired performance outcome	Requirements	Where addressed
	<ul style="list-style-type: none"> Identification of any diversity of views/concerns that might exist in the community/ies; Relevance of any previous, current, and anticipated relevant developments and resultant cumulative impacts. 	
	<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. 	Section 8 in this SEIA report (Appendix M of the EIS)
	<p>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.</p>	Section 8 in this SEIA report (Appendix M of the EIS)
	<p>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.</p>	Section 9 in this SEIA (Appendix M of the EIS)
	<p>6. Where land is reserved or acquired under the National Parks and Wildlife Act 1974 (NPW Act), the EIS must detail:</p>	AS BELOW
	<p>(a) effects of accurately predicted intermittent inundation regime, and predictions of habitat, biodiversity and cultural heritage loss or change within the OEH estate</p>	Chapters 8, 9, 10, 17, and 20 of the EIS
	<p>(b) expanded consideration of indirect effects of inundation, especially in the context of land reserved under the NPW Act</p>	Chapters 8, 9, 10, 17, and 20 of the EIS
	<p>(c) consider impacts of the Project on visual amenity and visitor experience in land reserved under the NPW Act</p>	Section 8 in this SEIA report (Appendix M of the EIS) Chapters 20 and 25 of the EIS

Desired performance outcome	Requirements	Where addressed
	(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	Section 8 in this SEIA report (Appendix M of the EIS) Chapters 20 and 24 of the EIS
	(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	Sections 8 and 9 in this SEIA report (Appendix M of the EIS) Chapters 8, 9, 10, 17, and 20 of the EIS
	(f) consideration of alternative options to avoid reserved lands and justification	Chapters 4 and 20 of the EIS
	(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 of the EIS
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 flood, 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 probably 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 8 in this SEIA report (Appendix M of the EIS) Chapter 15 of the EIS
	(h) any impacts the development may have on the social and economic costs to the community as consequence of flood. 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 8 in this SEIA report (Appendix M of the EIS) Chapter 15 of the EIS
	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 8 in this SEIA report (Appendix M of the EIS) Chapter 15 of the EIS

Source: SEARs issued for Warragamba Dam Raising Project 2018

In addressing these SEARs requirements, this SEIA report will:

- describe the legislation and guidelines relevant to socio-economic impacts in the context of the Project (section 2)
- identify the affected communities and other interested stakeholders (sections 5 and 7)
- describe the socio-economic environment, as far as it is relevant to that issue and provide a quantitative and qualitative profiles of affected communities, including values and aspiration (Section 6)
- identify any diversity of views/concerns that might exist in the communities (Sections 6 and 7)

- identify and describe the impacts associated with the issue, including the likelihood and consequence of the impact (Sections 5 and 8)
- assess social and economic impacts in compliance with the relevant guidelines (Sections 2 and 8)
- demonstrate how potential impacts may be avoided, managed, or mitigated (Sections 8 and 9)
- assess the significance of residual impacts following the assumed effective implementation of mitigation and management measures (see Section 9).

2.6 Guidelines

The SEARs issued for the Project did not specify any guidelines to be met in the assessment of socio-economic, land use and property impacts. However, as per accepted good practice in NSW, the SEIA has been prepared in accordance with the following guidelines:

- Social impact assessment (SIA) guideline for state significant mining, petroleum production and extractive industry development and SIA Scoping Tool (DPE 2017c)
- Environmental planning and impact assessment practice note: socio-economic assessment (Roads and Maritime Services (RMS) 2013).

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

2.6.1 SIA Guidelines

The SIA guideline is a non-statutory guideline that provides direction on assessing the impacts of state significant resources under the EP&A Act. The SIA guideline's principles are relevant to infrastructure projects and are summarised in Table 2-2 along with the SEIA's response and the applicable SEIA sections in this report.

Table 2-2. SIA Guidelines - principles

Principles	Description	SEIA response	SEIA sections
Action-oriented	SIA delivers outcomes that are practical, achievable, and effective.	Mitigation/enhancement measures	9
Adaptive	SIA establishes systems to actively respond to new circumstances/information and support continuous improvement.	Stakeholder engagement to inform the SEIA and EIS	7
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	8
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	8
Impartial	SIA is undertaken in a fair and 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	7
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	7
Material	SIA identifies which potential social impacts matter the most, and/or pose the greatest risk to those affected.	SEIA scoping	5
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	9
Proportionate	Scope and scale of SIA should correspond to the potential social impacts.	SEIA scoping to define potential material impacts	5

Principles	Description	SEIA response	SEIA sections
Rigorous	SIA uses appropriate, accepted social science methods and robust evidence from authoritative sources.	Methods and evidence sources are described and justified	4
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	7

The SIA guideline recommends the application of the SIA scoping tool (2017) as published on the DPE website, for the rigorous scoping of all potential impacts and their relative 'materiality'. This informs the identification of the issues upon which the SEIA should focus. As discussed in Section 5, the matters checklist of the SIA scoping tool was completed as part of the scoping phase of the SEIA.

2.6.2 Road and Maritime Services' environmental planning and impact assessment practice note: Socio-economic assessment

The RMS Socio-Economic Practice Note forms part of the common procedures under the RMS 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, RMS 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 (RMS, 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.'*

2.7 Summary

In summary, the SEIA has been conducted in accordance with the applicable legislations, SEARs, and relevant guidelines, including:

- completion of scoping and preliminary significance assessment at an early stage of the SEIA
- an inclusive stakeholder engagement process
- presentation of suitable indicators is chosen and developed 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 design of the SEIA methodology has been specifically tailored to meet the requirements of the SEARs outlined above (refer to Section 4).

3 Project description

3.1 Project background

During the 1980s and 1990s evidence emerged that floods significantly larger than any yet historically recorded could occur in the Hawkesbury-Nepean Valley. In the late 1990s, major upgrades of the Warragamba Dam were undertaken to prevent dam failure during extreme flooding events in order to protect Sydney's water supply and to prevent catastrophic downstream floods from dam failure. However, these works primarily dealt with dam safety issues and did not fully address the major flood risks to the people and businesses in the Hawkesbury-Nepean Valley.

In 2013, the NSW Government initiated the Hawkesbury-Nepean Valley flood management review to consider flood planning, flood mitigation and flood response in the Hawkesbury-Nepean Valley. The review found that the current flood management and planning arrangements were insufficient in mitigating the risk, and no single mitigation option could address all the flood risks present in the Hawkesbury-Nepean Valley. The raising of Warragamba Dam to capture inflows was concluded to be the most effective infrastructure measure that could have a major influence on flood levels during those events where the majority of damages occur. Other non-infrastructure options were also identified to mitigate flood risks.

In June 2016, the former Premier and Minister for Western Sydney, the Hon Mike Baird MP, announced the NSW Government's plan to raise the Warragamba Dam to create a dedicated flood management zone (FMZ) behind the Dam which would significantly reduce the risk of flooding in the Hawkesbury-Nepean Valley. This announcement followed a review of flood mitigation arrangements and the establishment of an independent taskforce, under the direction of Infrastructure NSW (INSW) to investigate feasible options to reduce overall flood risk to the Hawkesbury-Nepean Valley. The cost-benefit analysis modelled by INSW demonstrated that Warragamba Dam raising would provide up to a 75 percent reduction in flood damages on average and reduce current predicted levels of flood damages associated with a major flood from \$5 billion to \$2 billion.

While raising Warragamba Dam was found to significantly reduce flood risk, it would not eliminate it, regardless of the increase in the Dam's height. As a result, the raising of Warragamba Dam would be complemented with other non-infrastructure and policy actions. In May 2017, INSW published *'Resilient Valley, Resilient Communities'* which outlines the Hawkesbury-Nepean Valley Flood Risk Management Strategy (INSW 2017). The Hawkesbury-Nepean Valley Flood Risk Management Strategy covers the geographic region between Bents Bridge and the Brooklyn Bridge, encompassing the fast-growing Local Government Areas (LGAs) of Penrith City, Hawkesbury City, The Hills Shire and Blacktown City.

The Hawkesbury-Nepean Valley Flood Risk Management Strategy objective is to reduce flood risk to life, property, and social amenity from floods in the Hawkesbury-Nepean Valley. The strategy includes nine key recommendations; a combination of infrastructure and non-infrastructure initiatives to mitigate the risk of flooding to 425 square kilometres of floodplain which lies below the Warragamba Dam. Actions include:

- coordinated flood risk management across the Hawkesbury-Nepean Valley now and in the future
- strategic and integrated land use planning
- engaging and providing flood risk information for an aware, prepared, and responsive community.

The Hawkesbury-Nepean Valley Flood Risk Management Strategy provides the context and policy impetus to mitigate flood risk in the Hawkesbury-Nepean Valley. The overall project objective for the Flood and for the Project is 'to reduce flood risk to life, property and social amenity from regional floods in the Hawkesbury-Nepean Valley now and in the future'.

3.2 The Project

Warragamba Dam Raising is a project to provide flood mitigation to reduce the significant existing risk to life and property in the Hawkesbury-Nepean Valley downstream of the dam. This would be achieved through raising the level of the central spillway crest by around 12 metres and the auxiliary spillway crest by around 14 metres above the existing full supply level for temporary storage of inflows. The spillway crest levels and outlets control the extent and duration of the temporary upstream inundation. There would be no change to the existing maximum volume of water stored for water supply.

The NSW Government announcement in 2016 proposed that the dam wall be raised by 14 metres. Subsequently, the SEARs required the project to be designed, constructed and operated to be resilient to the future impacts of climate change and incorporate specific adaptation actions in the design.

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

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

The Project would include the following main activities and elements:

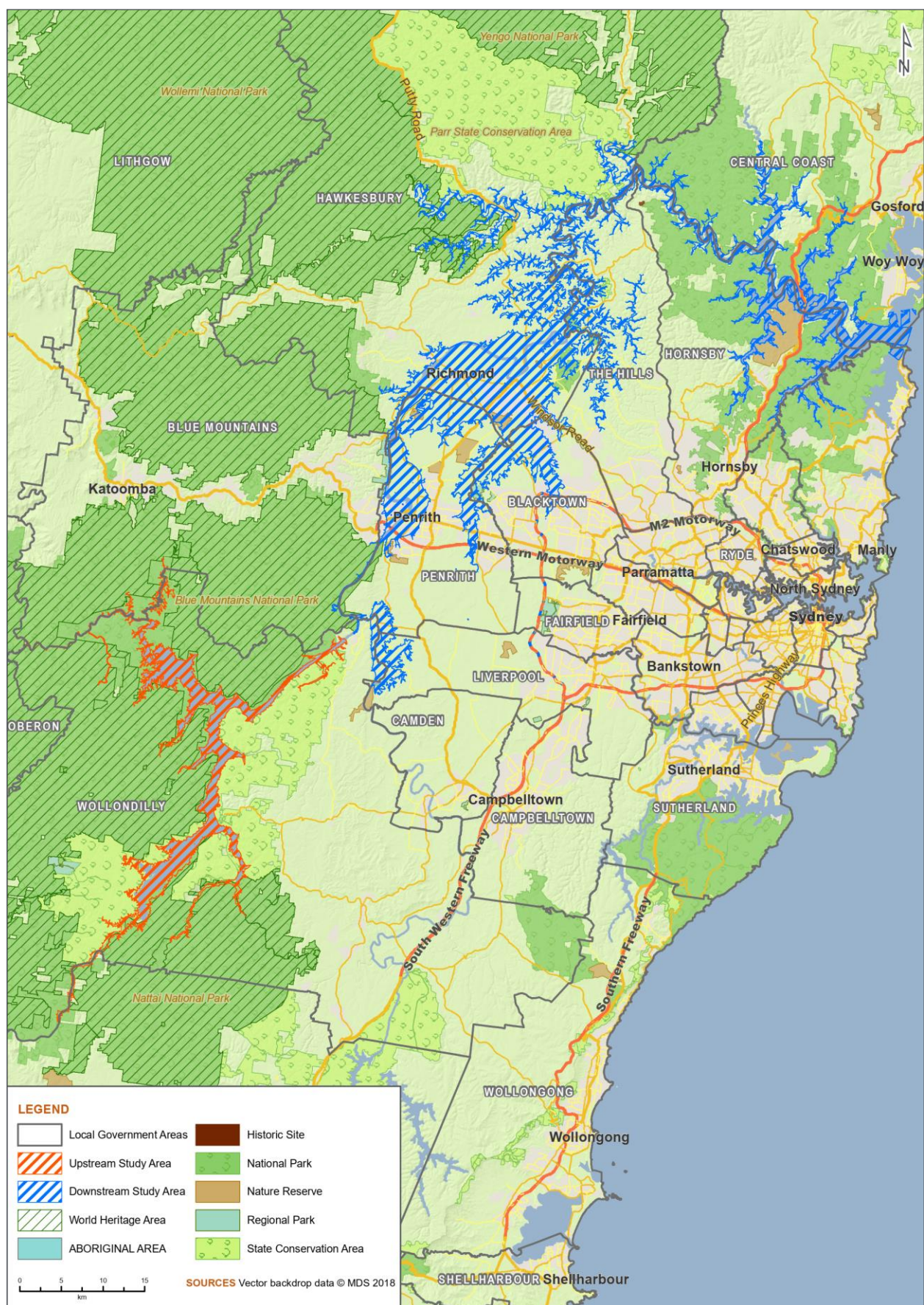
- demolition or removal of parts of the existing Warragamba Dam, including the existing drum and radial gates,
- thickening and raising of the dam abutments
- thickening and raising of the central spillway
- new gates or slots for discharge of water from the FMZ
- modifications to the auxiliary spillway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

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

3.3 Project location

Figure 3-1 shows the local and regional context of the Project. The Project footprint is located approximately 65 kilometres west of the Sydney Central Business District (CBD) in the Wollondilly LGA. To the west of the Project footprint are the Blue Mountains and various national parks and state conservation areas which make up the catchment of Lake Burragorang – the water storage formed by Warragamba Dam. To the east of the Project footprint are the Warragamba and Silverdale townships and surrounding rural residential areas.

Figure 3-1. Location of Project



3.4 Main activities and elements

The Project works include:

- demolition
- thickening and raising of dam abutments
- thickening and raising of central spillway
- modifications to the auxiliary spillway
- other infrastructure and elements
- environmental flow infrastructure.

These are described in greater detail in the following sections.

3.4.1 Demolition

Elements of the existing Warragamba Dam require demolition or removal to enable dam raising construction to proceed. These include:

- the existing road and main spillway bridge across the top of the Dam
- the drum and radial gates, and associated mechanical and electrical infrastructure, and portions of the piers within the central spillway
- minor concrete structures to allow the tie-in of the new dam and spillway
- the valve house control room building located at the rear of the valve house
- areas of roads, operational laydown areas, drainage systems and other infrastructure external to but associated with the Dam
- the existing gantry crane and associated equipment
- the existing hydroelectric power station equipment to allow for new environmental flow infrastructure
- miscellaneous dam crest services and equipment.

3.4.2 Thickening and raising of the dam abutments

The dam abutments located either side of the central spillway would be modified:

- the dam abutments would be thickened on the downstream side with additional concrete. The face of the abutments would be smooth as with the existing dam
- the abutment height would be increased by around 17 metres
- the left abutment would extend into the surrounding rock to suit the thickening and raising.

3.4.3 Thickening and raising of the central spillway

The existing central spillway would be modified as follows:

- the spillway would be thickened on the downstream face with concrete and it would have a smooth surface
- the spillway crest would be raised by approximately 12 metres to create a FMZ, including the use of post tensioned anchors within the wall for stability
- gated conduits Or slots would be constructed within the central spillway to allow for the controlled discharge of inflows. These openings would be located so the FMZ could be drawn back down to the full supply level.

3.4.4 Modifications to the auxiliary spillway

The following modifications would be undertaken on the auxiliary spillway:

- removal of the existing fuse plugs (earth/rock embankments designed to wash away in a major flood) and replacement with a concrete spillway crest
- the spillway floor slabs and walls would be modified and reinforced to suit discharging of flood water from the raised dam
- erosion protection would be provided downstream from the auxiliary spillway.

The existing bridge across the auxiliary spillway would be retained for access to the valve house and the base of the Dam and spillway.

3.4.5 Other infrastructure and elements

Other infrastructure and elements would include:

- a new bridge would be built above the auxiliary spillway crest to provide access to the raised dam
- the raised abutments and central spillway bridge would allow for vehicle and pedestrian access across the top of the dam, connecting to the approaches and road network on either side of the dam
- new control and instrumentation equipment including mechanical, electrical and communications elements
- new landscaping and urban design features would be provided for areas disturbed by construction and for other areas that require improved integration to the new dam structure
- ancillary works to tie existing services into the raised dam
- the existing two lift towers would be modified to suit the raised dam
- the eel passageway on the left bank would be modified to continue to allow the migration of eels from the river to Lake Burragorang.

3.4.6 Environmental flows infrastructure

In 2017, the NSW Government released the 2017 Metropolitan water plan (www.planning.nsw.gov.au/about-us/Sydney-Metropolitan-Water) which included the introduction of new, variable environmental flows from Warragamba Dam to improve the health of the Hawkesbury-Nepean River.

The Project would provide the infrastructure to enable environmental flows to be released from the Dam. Procedures would be developed as part of the implementation of the Metropolitan water plan.

Environmental flow releases would be designed to mimic the natural flow of the river if the Dam did not exist.

The environmental flows infrastructure would include:

- a multi-level offtake concrete tower on the upstream face of the Dam wall to draw water from Lake Burragorang
- the use of existing pipeline, formerly for the hydro-electric power station, to transfer the water to a valve house
- a new valve house, downstream of the existing hydro-electric power station, to discharge the water into the river.

3.4.7 Operation of the dam for flood mitigation

Operational objectives in order of priority are to:

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

There would be two different modes of operation for the raised Warragamba Dam: normal and flood operations. In both modes, the Warragamba Dam would continue to store and supply up to 80 percent of Sydney's drinking water. The storage capacity, which is the Dam's full supply level, would not change. The current and future operation of the Dam is shown in Figure 3-2 and Figure 3-3, respectively.

Figure 3-2. Existing operation of the Dam

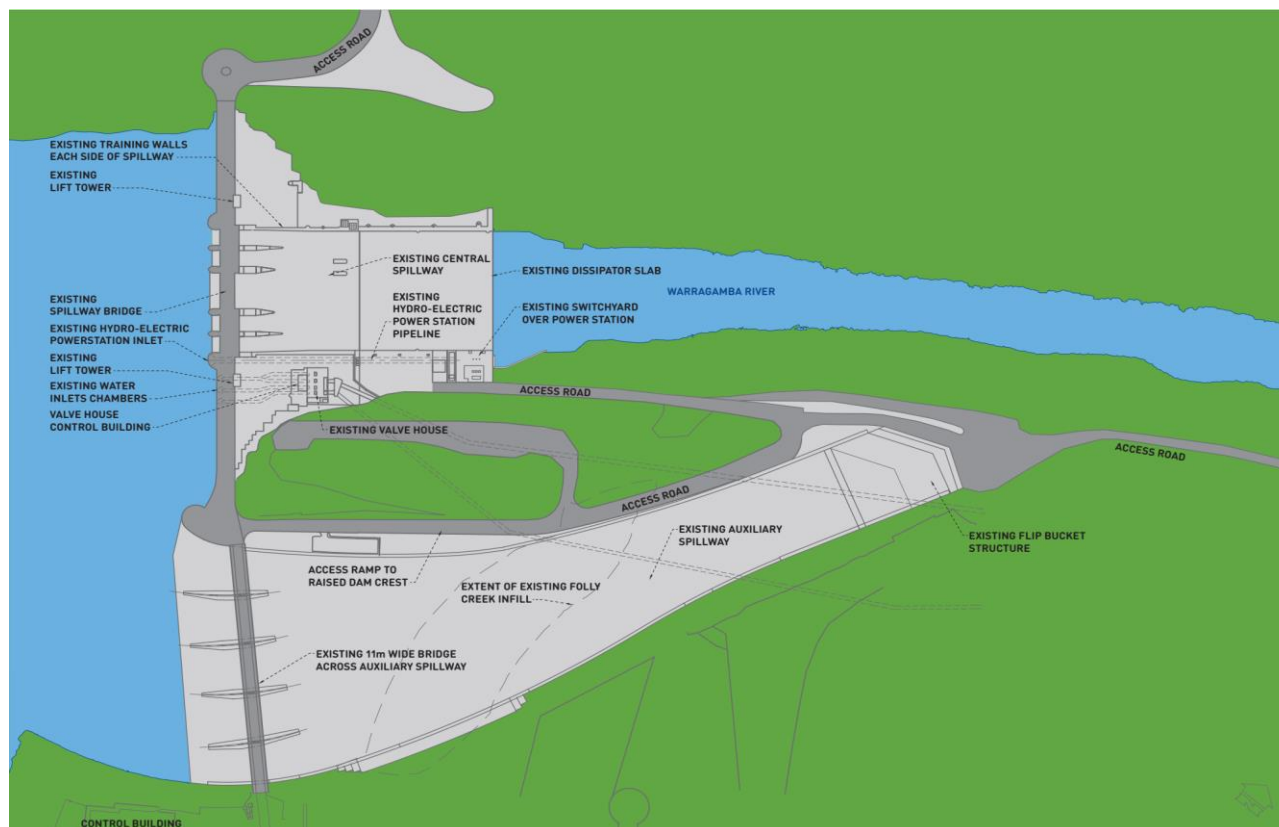
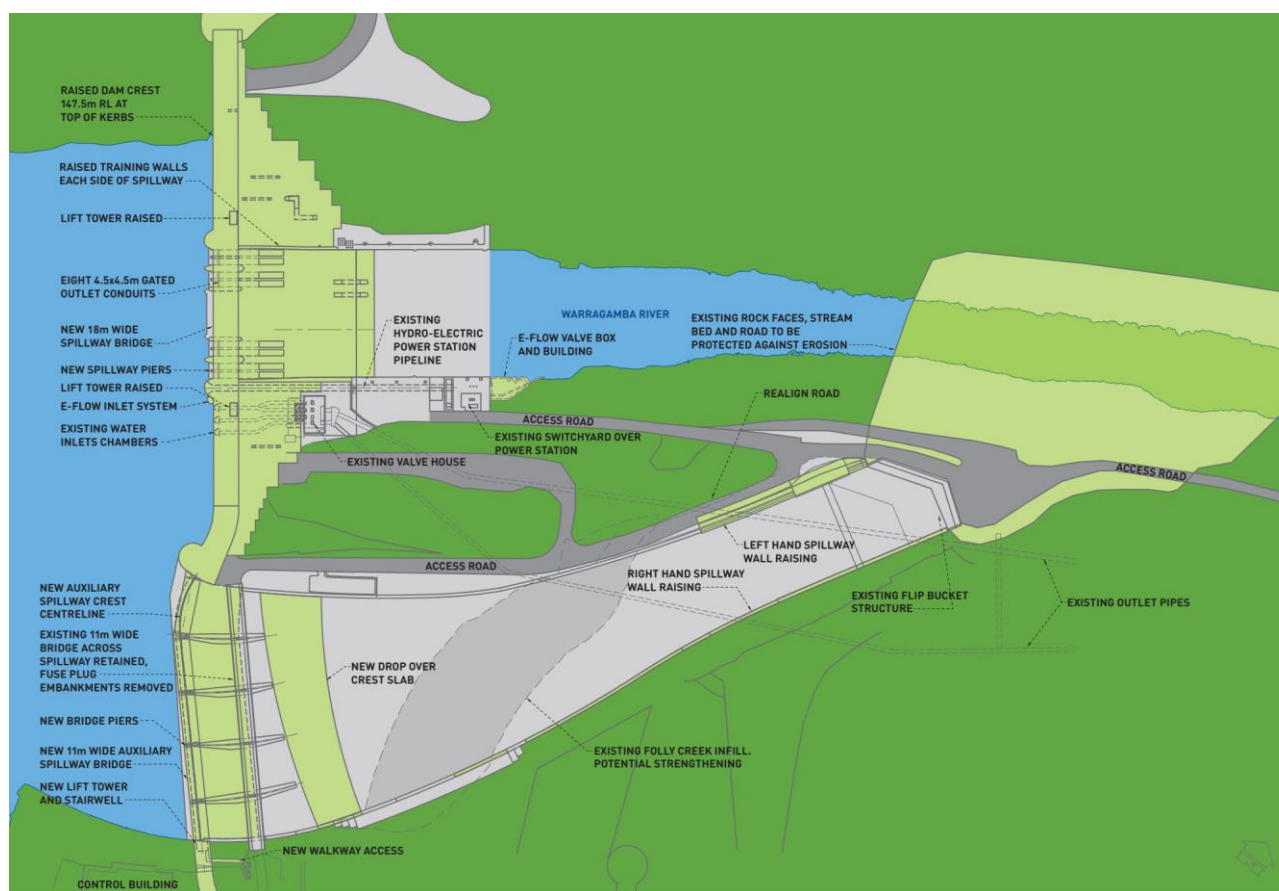


Figure 3-3. Future operations of the Dam



3.4.7.1 Normal operations

Normal operations would occur when the Dam storage level is at or lower than full supply level. Normal operations mode for the modified dam would be essentially the same as current operations. Inflows would be captured up until the full supply level after which flood operation procedures would be implemented.

3.4.7.2 Flood operations

During large rainfall events when the storage level rises above full supply level, flood operations mode would commence. In this mode, flood inflows to Lake Burragorang would be captured and temporarily stored (increasing water levels in Lake Burragorang and upstream tributaries). The raised dam would provide a flood mitigation zone (FMZ) to temporarily capture around 1,000 gigalitres of water during a flood event.

Water would be discharged in a controlled manner via the gated conduits until the dam level returns to full supply level. FMZ operating protocols would guide this process and be developed for approval by the relevant regulatory authorities.

The raised dam would not be able to fully capture inflows from all floods. For floods that exceed the capacity of the new FMZ, water would spill firstly over the central and then, depending on the size of the flood, the auxiliary spillway.

The FMZ created by the flood mitigation zone will allow for around two Sydney Harbours of water to be temporarily held back during a large rainfall event to reduce flooding downstream.

3.5 Project construction

This section describes the proposed approach to construction. If the Project is approved, further detailed construction planning would take place prior to commencement to inform a construction environmental management plan (CEMP). This plan would consider methods and the scheduling of activities to minimise impacts on the community and the environment such as noise, access and amenity, and would detail mitigation and management measures.

3.5.1 Construction area

The proposed construction area is located within the Project footprint and is shown in Figure 3-4. This area may be refined as part of detailed design and construction planning. The construction area includes:

- areas directly impacted by construction
- areas where access for construction is required
- concrete batch plants and material storage and handling areas
- offices and worker amenities
- visitor and education centre
- other ancillary sites.

Figure 3-4. Map of Project footprint, which includes construction area

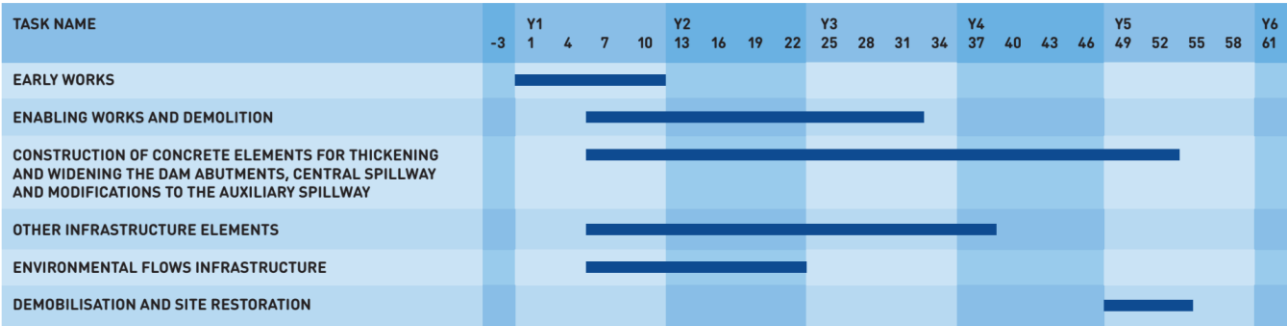


Source: SMEC 2019

3.5.2 Construction program

A preliminary construction program is presented in Figure 3-5 with the project likely to be completed between four-to five-years from commencement.

Figure 3-5. Preliminary construction program



3.5.3 Construction workforce

The number of workers would vary over the program. Up to 300 workers would undertake establishment activities, including setting up offices and compounds, assembling the concrete batch plants and beginning early and enabling works. The number of workers on site would increase during construction to around 500 during peak construction periods.

3.5.4 Construction hours

The majority of works would take place during **standard construction hours** for NSW which are:

- 7 am to 6 pm – Monday to Friday
- 8 am to 1 pm – Saturday
- no work on Sundays and Public Holidays.

This includes the majority of high noise generating activities such as:

- deliveries of materials including concrete, sand, and aggregates for concrete production
- demolition work including hydro-blasting (a concrete removal technique that uses high pressure water)
- earthworks, excavations, drilling and blasting.

Some activities would need to take place **outside of standard construction hours**. These activities may include:

- Operation of chilled water plants for cooling and curing of concrete. Continuous cooling of the concrete as it cures is required to ensure that heat does not become excessive and cause cracking and loss of strength of the concrete.
- Operation of the batching plants for the delivery and pouring of concrete. In warmer periods, concrete pours may not be able to take place in normal working hours. High temperatures may cause thermal issues and cracking during curing. Concrete pours may be required at night-time when temperatures are lower.
- Preparatory or emergency works for a flood during the construction period including removing equipment and materials from the construction area, minor earthworks, and other activities.
- Work outside the nominated working hours may need to occur in the case of emergencies or unexpected issues.
- The local community would be notified of construction activities including any activities taking place outside of standard construction hours in accordance with the community consultation plan developed by the construction contractor.

3.5.5 Access to Warragamba Dam during construction

The operation of the visitor and education centre may be impacted by construction activities. Options to continue operating the visitor and education centre within the existing site during construction or at alternative locations are being considered. Factors to be considered include safety, impacts to construction, and the visitor and educational experience. There would be no public access to Haviland Park during construction. Access to the Warragamba Dam WaterNSW offices would be maintained for WaterNSW staff and other authorised personnel.

3.5.6 Construction methodology

3.5.6.1 Early works

Early works are activities that may be able to commence before main construction works and would include:

- further investigations including surveying, geotechnical studies, building and utility condition and location surveys, and other studies as required to assist in the design and construction of the Project
- installation of security fencing and site environmental controls including heritage item protection/relocation, water management, soil management, and noise management measures
- establishment of temporary site offices, and worker facilities
- procuring of concrete batching facilities, cranes, conveyors, and other infrastructure
- clearing of vegetation
- adjustment and provision of utilities for construction facilities
- minor road works and establishment of site access roads including a temporary access bridge downstream of the dam
- establishment of areas for stockpiling of materials such as aggregate and fly ash.

3.5.6.2 Enabling works and demolition

Enabling and demolition works are required to be undertaken before commencement of concrete placement to raise and thicken the dam wall. These would include:

- upgrading the existing boat ramp, pontoon, and access road upstream of the dam to allow for water access to the dam wall
- establishment of batching plants on site so concrete can be poured almost immediately after batching to maintain adequate concrete placement temperatures. Potential on-site locations are Havilland Park or the terraced gardens
- releasing water from the dam until the water is five metres below full supply level. This is required to provide a buffer for floods during construction and allow construction of the new crest in the auxiliary spillway
- emptying (dewatering) the dissipator pool at the base of the dam to enable works to be undertaken
- construction of coffer dams at multiple locations around the dam wall to manage the impact of works on the Warragamba River and protect the site from river backflows. Indicative locations are shown in Figure 3-4 and include at the end of the existing central spillway dissipator, immediately upstream of the auxiliary spillway and downstream of the auxiliary spillway. The number and size of the coffer dams would be confirmed by the detailed design
- construction of the raised dam would require demolition of several existing structures and removal of machinery, pipes and operational equipment.

3.5.6.3 Construction of concrete elements for thickening and widening the dam abutments, central spillway and modifications to the auxiliary spillway

Warragamba Dam is a concrete gravity dam which uses the weight of the concrete to resist the horizontal pressure of water. The same design and construction approach would be used for raising the dam wall. Mass concrete would provide the strength to enable the dam height to be increased. Reinforced concrete would be used to construct elements such as bridges, walls, piers, conduits, chambers, etc.

Work would include:

- installing formwork to create concrete blocks. The blocks have been sized to match the existing dam block dimensions and for structural performance. Generally, the formwork would be lifted into place by a crane
- where cooling of the concrete is required after the pour, small pipes may be cast into the concrete to allow chilled water to be pumped through the concrete during curing
- pouring concrete into the formwork and allowing the concrete to set and start to cure. The concrete would be delivered from on-site batch plants by a crane or cableway with a concrete bucket and/or a conveyor
- chilled water may be pumped through the installed pipe systems to assist in curing, if required
- removing formwork and repeating the process for the next concrete block.

Most of the concrete works for the Project would involve mass concrete, however, certain parts would require reinforced concrete. Work would include:

- installing formwork to allow concrete placement as determined by the design. Generally, the formwork would be lifted into place by a crane
- placing reinforcing steel in the formwork in the required locations and patterns. Reinforcement would be either lifted into place by a crane or would be placed by hand
- pouring concrete into the formwork and allowing the concrete to set. The concrete would be delivered from the on-site batch plants by a truck, a crane, a cableway and/or a conveyor
- removing the formwork and repeating the process for the next concrete element.

3.5.6.4 Thickening and raising dam abutments

Works would include:

- excavation and earthworks at the base of the dam wall to provide a key for the concrete buttress used to increase the thickness of the dam wall
- excavation and removal of material for about 30 metres east of the left abutment at the raised dam crest location
- grouting of foundations for the raised dam crest on the left abutment
- controlled blasting to excavate approximately 58,000 m³ of rock at the toe of the dam and on the left abutment
- hydro blasting the existing concrete wall; between 20 and 50 millimetres of the existing concrete surface of the dam wall would be removed to facilitate the bond between the existing and new concrete

- thickening the abutments on the downstream face using the placement methodology
- raising the abutments about 17 metres higher than the existing dam crest level
- raising of the two lift towers including installation of two new lifts.

The profile of the new abutment would be constructed to mirror the existing profile.

3.5.6.5 Thickening and raising of the central spillway

Works would include:

- excavating the foundations to allow the tie in of the new works
- hydro blasting the existing concrete wall. Between 20 and 50 millimetres of the existing concrete surface of the dam wall would be removed to facilitate the bond between the existing concrete and the new concrete
- installing stress bars in the base of the thickened dam. Holes for the stress bars would be drilled and the stress bars inserted and then grouted
- thickening the central spillway wall on the downstream face using the placement methodology
- raising the central spillway crest about 12 metres higher than the existing full supply level
- extending the existing training walls downstream on either side of the spillway, which would tie in with the existing dissipater walls
- constructing two new reinforced concrete bridge piers within the central spillway crest
- constructing eight four-and-a-half metre by four-and-a-half metre conduits through the new central spillway
- installing hydraulically controlled gates in each of the conduits and their control systems
- installing a new maintenance gate including guides for each conduit
- commissioning and testing electrical and mechanical elements for operating the gates.

3.5.6.6 Auxiliary spillway modifications

Works would include:

- removal of the existing earth/rock embankments (fuse plugs) in the crest of the auxiliary spillway
- preparation of the existing bedrock for the foundations of the new auxiliary spillway crest including grouting
- constructing a new uncontrolled concrete spillway crest across the width of the auxiliary spillway. Most of the spillway would consist of mass concrete, however, reinforced concrete sections would be required on top of the crest of the spillway
- constructing of four new reinforced concrete bridge piers within the spillway crest
- installation of additional anchor bars from the spillway floor into the underlying rock. Holes for the anchor bars would be drilled, the anchor bars inserted and then grouted in place
- constructing a 30 to 50-metre-long reinforced concrete drop-over slab across the width of the spillway about 130 metres downstream of the new spillway crest to allow for changed spillway flows
- increasing the height and/or strength of the existing spillway chute walls in various locations. Construction would be either mass or reinforced concrete depending on the degree of heightening or strengthening required, and location of the wall
- raising and/or replacing of shotcrete wall lining with reinforced concrete or new shotcrete in various locations.
- additional scour protection would be required downstream of the auxiliary spillway. Activities would include removing soil, excavation of rock to the required level (including blasting if needed) and installation of rock scour protection, concrete and anchor bars.

3.5.6.7 Other Infrastructure and elements

A new road and pedestrian access would be built along the top of the abutments, the auxiliary and central spillway. These would connect with the approaches and road network on either side of the dam to provide access and provision of services across the dam crest. Timing of construction of the new access would be linked to raising of the auxiliary, central and abutment crests.

Areas for spoil emplacement may be used for disposal of some excavated materials on-site. Material from the earth/rock embankments removal, the temporary coffer dams and other excess spoil from other excavations may be

emplaced into these areas. Activities would include site preparation, emplacing material, site stabilisation and landscaping.

3.5.6.8 Environmental flows infrastructure

Works would include:

- underwater construction of a concrete base for a multi-level water intake tower on the upstream face of the dam
- underwater and above water construction of the new tower using precast concrete units connected to the upstream face of the dam
- underwater excavation of a section of the existing hydro-electric power station intake tower to allow water to pass between the new tower and the existing tower
- installation of hydraulically operated gates into the intake tower
- installation of concrete panels to block off the existing hydro-electric power station intake tower openings
- relining of the existing 4.2 metre diameter hydro-electric power station pipe with epoxy or a new pipe grouted in place
- removal of existing generating equipment within the existing downstream hydro-electric power station including hazardous materials
- construction of a new valve house building, downstream of the existing downstream hydro-electric power station, using reinforced concrete
- installation of new steel pipes within the existing hydro-electric power station and new valve house including new valves.

3.5.6.9 Demobilisation and site restoration

Demobilising and rehabilitation of the construction site would be undertaken progressively, as work in an area is completed, and include activities such as:

- removing temporary construction infrastructure, plant and equipment
- earthworks
- site stabilisation and landscaping
- reinstatement of public areas and facilities.

4 Methodology

4.1 Overview

This Section presents the methodology that has been used to conduct the SEIA. In accordance with local and international social impact assessment standards, the methodology applied for the SEIA aligns with the *Social Impact Assessment Guideline* (NSW Department of Planning and Environment, 2017). In addition, the SEIA methodology has been specifically tailored to meet the SEARs as outlined in Section 2. Figure 4-1 below illustrates the steps of the SEIA methodology which have been adopted based on the applicable requirements and standards. These steps are described in the following sections.

Figure 4-1. Steps of SEIA methodology



4.2 Scoping

Scoping is the first phase of the SEIA process. Scoping was conducted to highlight elements of the natural or human environment which have the potential to be impacted by activities associated with the Project, whether negatively or positively, and how these impacts should be assessed (DPE 2017c). Overall, two core objectives were met during the scoping phase of the SEIA, including:

- (i) identification of the area of influence (AoI) for the Project
- (ii) preliminary identification of social risks and issues generated as a result of the Project which require further investigation in the EIS

The 'area of influence' or 'SEIA study areas' for the Project was defined based upon a range of factors including:

- the Project layout (that is, direct impact associated with the footprint)
- the nature of the surrounding environment including proximity of sensitive receptors, 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. Perceptions raised by stakeholders during scoping interviews are opinions only and not necessarily actual effects associated with the Project.

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. The outcomes of the scoping phase informed the study areas for the SEIA, the information gathered for the existing social baseline and assessment of potential impacts and benefits. The findings of the scoping exercise are reported in Section 5.

4.3 SEIA baseline analysis

To provide a context within which the impacts of the Project can be assessed, a description of socio-economic and cultural conditions that would be expected to prevail in the absence of the Project is required. The socio-economic

baseline concisely documents relevant social, economic and land use characteristics within the SEIA study areas. This baseline provides a benchmark against which direct and indirect impacts can be predicted, analysed, and measured.

The scope and content of the socio-economic baseline study has been tailored to the specific Project context and only included indicators and information that were useful and meaningful for the SEIA. The socio-economic baseline has drawn on a range of primary and secondary sources. Quantitative information derived through Australian Bureau of Statistics (ABS) census data and other secondary sources of information is complemented by primary information obtained through scoping interviews as described above. 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 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 reported in Section 6 of this SEIA report.

4.4 Stakeholder engagement

The SEIA engagement process was undertaken to ensure the SEIA was informed by inputs from affected and interested stakeholders. A defining feature of the Project is the extent and diversity of stakeholders, with the 'area of influence' encompassing communities local to Warragamba Dam along with those upstream (including the Blue Mountains and Wollondilly LGAs) and downstream, stretching to the estuary of the Hawkesbury River. Information collected through SEIA stakeholder engagement has been used to verify socio-economic baseline characteristics, to identify potential socio-economic impacts and benefits associated with the Project, and to assess how such effects might be avoided, mitigated, or managed, or benefits enhanced. The SEIA has been informed by both engagement activities specifically undertaken as part of the SEIA along with the community engagement program associated with the EIS. The SEIA is further supported by engagement activities undertaken by INSW to inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy.

A community and stakeholder engagement plan (CSEP) for the Project has been prepared with the aim of providing a platform for consultation and disclosure with Project stakeholders through all phases of the development (refer to Chapter 6 and Appendix D of the EIS). The CSEP has set out the approach to implement an effective engagement program with stakeholders throughout the EIS process and beyond. Good relations between the Project and its affected communities and relevant stakeholders will be an essential condition for the Project to establish and maintain a social licence to operate, providing an important mechanism for receiving community feedback on project-related concerns, and disseminating project-related information back to the community.

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

- 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 area of influence
- identification of communities affected and other stakeholder groups (such as government agencies) with an interest in the SEIA.

During the preparation of SEIA, 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, including upstream, downstream, and specifically the communities of Warragamba and Silverdale. Direct forms of engagement which were undertaken specifically to inform the SEIA were:

- scoping interviews with local government authorities and other key stakeholders to document key social trends in local areas and build an understanding of the stakeholders potentially affected by the Project
- a SEIA phone-based survey which captured the level of appreciation of flood risk and perceptions regarding the proposal to raise the dam wall
- a SEIA web-based survey which allowed stakeholders to provide more detailed feedback on local level perceptions of risks and benefits of the Project

- a business survey which recorded the sensitivities and dependencies of businesses in potentially affected areas and how the Project's activities and outcomes might affect business operations.

The SEIA stakeholder engagement process and its outcomes are detailed in Section 7. The results of stakeholder engagement have been incorporated throughout the assessment as referenced.

4.5 Impact assessment

4.5.1 Overview

Impact identification and assessment were undertaken in accordance with the methodology, assessment criteria and definitions described in the SIA Guideline (DPE 2017b). Impact identification and assessment of this SEIA began with the completion of preliminary risk assessment as part of the scoping stage. Drawing on the information derived through the scoping interviews along with analysis of the Project's description and other technical studies being undertaken to inform the EIS, the matters checklist as part of the SIA Scoping Tool was completed as per the *SIA Guideline for State significant mining, petroleum production and extractive industry development* (DPE 2017c). According to the SIA Guideline (DPE 2017c) the definition of a social impact is "a consequence experienced by people⁴ due to changes associated with a State significant resource project". 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, household 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. While all impacts raised by stakeholders, either experienced or perceived, are recognised by the SEIA, not all are considered reasonable or valid.

The categories of impacts which have been identified, defined and assessed in this SEIA accord with those specified in the SEARS 14(3), and include:

- property and land use
- environment including effects on amenity, aesthetics, and access
- community health and wellbeing including effects on community safety, recreation and access to and use of infrastructure services and facilities
- 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 impact categories, consideration was also made of decision-making systems and the capacity and power of stakeholders to influence decisions that affect them. Matters relating to justified fears and aspirations is also considered across each of the impact categories, as this SEIA identifies impacts that are both experienced and perceived.

Social impacts vary in their nature. Impacts can be positive or negative; tangible or intangible; direct, indirect, or cumulative⁵; directly quantifiable, indirectly or partly quantifiable, or only able to be described and assessed in qualitative terms; and experienced or perceived differently by different stakeholders or at different times and stages of the Project (NSW DPE, 2017). Impacts of this SEIA were identified and described using data triangulation of multiple sources of information to identify the social impacts. Sources of information to inform impact identification include primary and secondary data. The primary data, for example, included the outcomes of stakeholder engagement activities as described in Section 7. Secondary data informing the SEIA comprised:

- project description information
- social research undertaken to inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy (INSW)
- demographic, health, and other data available from the Australian Bureau of Statistics (ABS), government agencies, and local government

⁴ People includes individuals, households, groups, communities, organisations and the NSW population generally.

⁵ 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 2017c).

- 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 heritage, non-Aboriginal heritage
- desktop research of websites, databases, high quality “grey literature” as referenced (such as government reports, issue papers, conference papers, articles, and research reports etc.).

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 following describes the respective steps of the impact assessment process.

4.5.2 Impact prediction

Prediction of impacts is essentially an objective exercise to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified in the scoping, the impacts to the various resources/receptors are elaborated and evaluated. The diverse range of potential impacts considered in the impact assessment process typically results in a range of prediction methods being used, including quantitative and qualitative techniques.

To predict social benefits and impacts resulting from the Project, this SEIA considered the precautionary and uncertainty principles (Vanclay et al 2015). The precautionary principle means that even though impacts may not be fully defined, they were still considered as part of the assessment. By adopting the uncertainty principle, there is recognition that the predicted impacts may change from place to place and people to people over time due to ever-changing social processes and as knowledge of these social processes increases.

The predicted impacts were identified based on the social conditions in the study areas at the time when the SEIA was undertaken. It is recognised that the predicted social impacts and their assessments may change with any alterations to the socio-economic and political context or as stakeholder perceptions change over time as more information about the Project becomes available.

Once the impacts were identified, they were categorised based on the nature of each impact:

- Positive impact/benefits – where the impacted stakeholders would be ‘better off’ or would benefit due to the proposed development.
- Negative impacts – where the impacted stakeholders would be ‘worse off’ due to the proposed development.

The positive and negative impacts identified were further evaluated to determine their impact significance. The impact evaluation method is described in the following section.

4.5.3 Impact evaluation

The identified positive and negative impacts are evaluated to determine their relative level of significance. In accordance with the NSW Social Impact Assessment Guideline (DPE 2017c), 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, that is, 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, 1 in 5 chance in a year event, 1 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 (that is, it is assumed that the flood event will occur).

As outlined in Section 4.4, 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.).

Based on this impact evaluation approach, the positive and negative impacts associated with the Project were evaluated to determine their impact significance, using the interaction between the likelihood of impacts and severity or 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 4-1 below describes the likelihood of impact.

Table 4-1. 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 how social impacts, both negative and positive, are experienced by the stakeholders. Consequence criteria are shown in Table 4-2 below.

Table 4-2. Consequence model

Rating	Consequence level	Negative impact	Positive impact
1	Minimal	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. Those affected will experience minor enhancement to livelihoods and quality of life.
2	Minor	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.	Short-term benefits emanating from the project which have a minor level of community interest and/ or derive minor relative improvement. ⁶ 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	Medium-term benefits emanating from the project which have a moderate level of community interest and/ or derive a moderate

⁶ 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	Negative impact	Positive impact
		with some difficulty and regain their pre-impact livelihoods and quality of life.	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.
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. Figure 4-2 below presents the impact significance matrix for negative impacts.

Figure 4-2. 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

The following table presents the impact significance matrix for positive impacts.

Table 4-3 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

4.5.4 Mitigation and management

The social impact management strategies outlined in this SEIA seek to both enhance the benefits for the stakeholders and communities as well as mitigate negative impacts from the Project development. 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 8. The recommended management strategies were developed using adaptive management principles, recognising that impacts may change over time, and that ongoing monitoring of impacts would provide the flexibility to accommodate such changes.

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.

4.5.5 Residual impact evaluation

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 4.5.3, considering the assumed effective implementation of the proposed mitigation and enhancement measures.

5 SEIA scoping

5.1 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 2017c), scoping of potential socio-economic changes 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 the identification and preliminary assessment of all possible socio-economic impacts. This Section provides an overview of the engagement which was undertaken to inform SEIA scoping and the subsequent completion of the matters checklist as part of the SIA Scoping Tool.

5.2 Stakeholder engagement

In accordance with the NSW SIA Guideline (DPE 2017c), scoping of the SEIA was informed by direct engagement with key stakeholders. Local governments play 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 local council, where effects associated with the Project may be experienced, participated SEIA scoping surveys. However, Central Coast Council declined to participate due to the negligible nature of potential Project-related effects in this area. In addition to local government authorities, many other key stakeholders were invited to participate in scoping surveys including, Hawkesbury SES, WaterNSW, Turf Australia, National Parks and Wildlife Service, NSW Police and Cumberland RFS. Each entity was contacted via letter and nominated relevant individuals to participate in the SEIA Scoping surveys. Feedback provided through the scoping interviews directly informed the completion of SEIA scoping tools.

Table 5-1 below summarises key matters raised during the scoping interviews with key stakeholders. A scoping interview protocol is provided in Appendix G of this report.

Table 5-1. Summary of key matters raised during scoping interviews with key stakeholder groups

Stakeholders	Key matters raised in 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 will 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 are low levels of awareness/complacency about flood risk, since the most significant shifts in population have occurred within the last twenty years. Sackville, Wilberforce, Windsor, Richmond, North Richmond, and Yarramundi considered the most flood vulnerable communities within the LGA. Effects on Yarramundi Reserve during Project operation should be further investigated including potential effects on sand and gravel businesses.

Stakeholders	Key matters raised in scoping interviews
	<ul style="list-style-type: none"> 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/internet usage and are likely to present higher risk in a flood emergency. The Project will provide more time to evacuate, possibly more roads open, which will 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 considered marginal, as they would already be subject to significant damage by a severe flood regardless. The position of the Hawkesbury City Council is that the Project will not lead to increased development/greater population density.
The Hills Shire Council	<ul style="list-style-type: none"> A generally prosperous community with extensive community networks and services. Wisemans Ferry and Sackville are identified as being areas of high vulnerability with an aging and lower income population. The community is complacent and not highly aware of flood risk as generations have not experienced a major flood event. Livelihoods in Wisemans Ferry area are heavily reliant upon river-based activities- note the potential for water ski operators to lose a large proportion of annual income if there were a flood over peak (Christmas/New Year) period.
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. 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 Shire 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. Whilst 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 and the construction impacts such as traffic effects and loss of tourism related income; but very little detail on why there is a need for the Project. Without having an understanding as to why the proposal 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 come to 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 RV park. They want to engage with WaterNSW/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 organise venue.

Stakeholders	Key matters raised in scoping interviews
Blacktown City Council	<ul style="list-style-type: none"> Blacktown Council has experienced transformative growth over the last twenty years and continues to be one of the fastest growing Sydney local government areas. 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 don't 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 highly vulnerable. There is also 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- population projected to be more than 350,000 in 20 years. Regarding the Project, only the north-west portion of the Shire is relevant. These areas include Luddenham, Bringelly, Badgerys Creek, and Greenbank which being peri-urban and rural areas, are very different in character. The Badgerys Creek Airport and the Western 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 will drive growth and development. Friction between state led planning and local governments, 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 Badgerys Creek and associated development.
Hornsby Shire Council	<ul style="list-style-type: none"> Oyster farming is now practically non- existent as 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 huge 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. Very few residential uses along the estuary. Climate change and sea level rise needs to be taken into account by flood modelling as this will 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 become isolated. Vulnerable groups include homeless people who use areas along the river and the elderly, with numerous facilities along the river. Significant infrastructure along the river include the Great River Walk and the Sydney International Regatta Centre which also a function centre and venue for music concerts. Ongoing traffic congestion issues on Mulgoa Road – of relevance if this is a transport route for the Project's construction traffic. Badgerys Creek airport led development (and the western 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.

Stakeholders	Key matters raised in scoping interviews
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 Hawkesbury-Nepean Valley Flood Risk Management Strategy
Turf Australia	<ul style="list-style-type: none"> In the current event of a large flood, they stand to lose 70 % 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 floodplain. Turf Australia and its members are very supportive of the Project, given benefits associated with the Project.
WaterNSW	<ul style="list-style-type: none"> Thirteenth, Twelfth and Nineteenth streets and Weir Road most affected in Warragamba. Local community is very dependent on Dam activities for revenue and economic health. 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. Biggest issue is that people operate on the river as if it is a weir pool – it's not a natural river system as waterflow is managed via the Dam and 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 will 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 will be generating artificially high levels of waterflow and this may produce a risk to public safety. Capacity building required.
National Parks and Wildlife Service	<ul style="list-style-type: none"> If dieback occurs, it will 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 will 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 big 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 will exacerbate vulnerabilities in these isolated areas. Transport infrastructure connections makes evacuation of Penrith an easier task than Windsor/Richmond. The raising of Warragamba Dam 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 and noise/dust. From an emergency management point of view, increased heavy vehicle movement on less than adequate roads brings 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.

Source: SMEC 2018

5.3 SEIA study areas

For the purpose of the socio-economic baseline and impact assessment, SEIA study areas (referred to in the DPE SIA Guideline (DPE 2017c) as ‘areas of influence’) have been identified. The study areas for the SEIA have been defined as locations at which either the construction or operational effects of the Project may have an influence upon existing socio-economic conditions. Definition of the SEIA study areas have been informed by a range of factors, including the Project layout, the nature of the surrounding environment, proximity of sensitive receptors, 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 categorised into the following four areas:

- local communities
- upstream communities
- downstream communities
- estuary communities.

The following describes the Project’s SEIA study areas and relevant areas of influence which are depicted in Figure 5-1 and Figure 5-2.

5.3.1 Local communities study area

The local communities study area is defined as the area within and in close proximity to the Project footprint 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.

A Project footprint has been defined for the construction phase and includes the dam wall and the areas in and around the existing Warragamba Dam as well as the local road network. Figure 3-4 in Section 3.3 shows the construction area which includes the Project’s components and temporary construction facilities, and areas that would be impacted by construction activities.

The Project footprint map (Figure 3-4) shows that the construction area of the Project is positioned to the north-east of Warragamba community. The Project’s construction area consists of:

- Ancillary facilities such as coffer dams, batch plants, material storage and handling areas are located in Warragamba (Wollondilly LGA)
- areas which require clearing of vegetation to allow for construction and access are located in Warragamba (Wollondilly LGA) and the Blue Mountain National Park (Blue Mountains LGA)
- areas that would be used for construction activities but would not be modified by the Project (for example, existing roads, Lake Burragorang) are located in Warragamba and Silverdale (Wollondilly LGA).

The Project construction area (located within the Project footprint) is geographically located in Warragamba and Silverdale in the Wollondilly LGA (including the main dam site, ancillary facilities, and transportation routes) and 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.

5.3.2 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 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 the Wollondilly and Blue Mountains LGAs and bordered by the Oberon and Wingecarribee LGAs. The outcomes of SEIA scoping and stakeholder consultation showed that impacts from upstream inundation would be experienced predominantly in the Wollondilly and Blue Mountains LGAs. The socio-economic changes likely to be experienced in the Oberon and Wingecarribee LGAs 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.

5.3.3 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, 74 suburbs will be affected by a Probable Maximum Flood (PMF), and they collectively constitute the downstream communities study area.

In addition, flood events also generate wider socio-economic changes such as the 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 collectively comprise of five LGAs— Liverpool, Penrith, Hawkesbury, Blacktown, and The Hills. The 74 PMF-affected suburbs are located across the five LGAs. These include 4 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 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
- 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.

5.3.4 Estuary communities study area

The estuary communities study area constitutes the estuarine area of the Lower Hawkesbury River which is defined as downstream of Wisemans Ferry. The estuary communities study area was 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 Hornby LGA, 14 suburbs in the Central Coast LGA and 1 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 Waters, 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.

Figure 5-1. SEIA study areas – local community and upstream LGAs

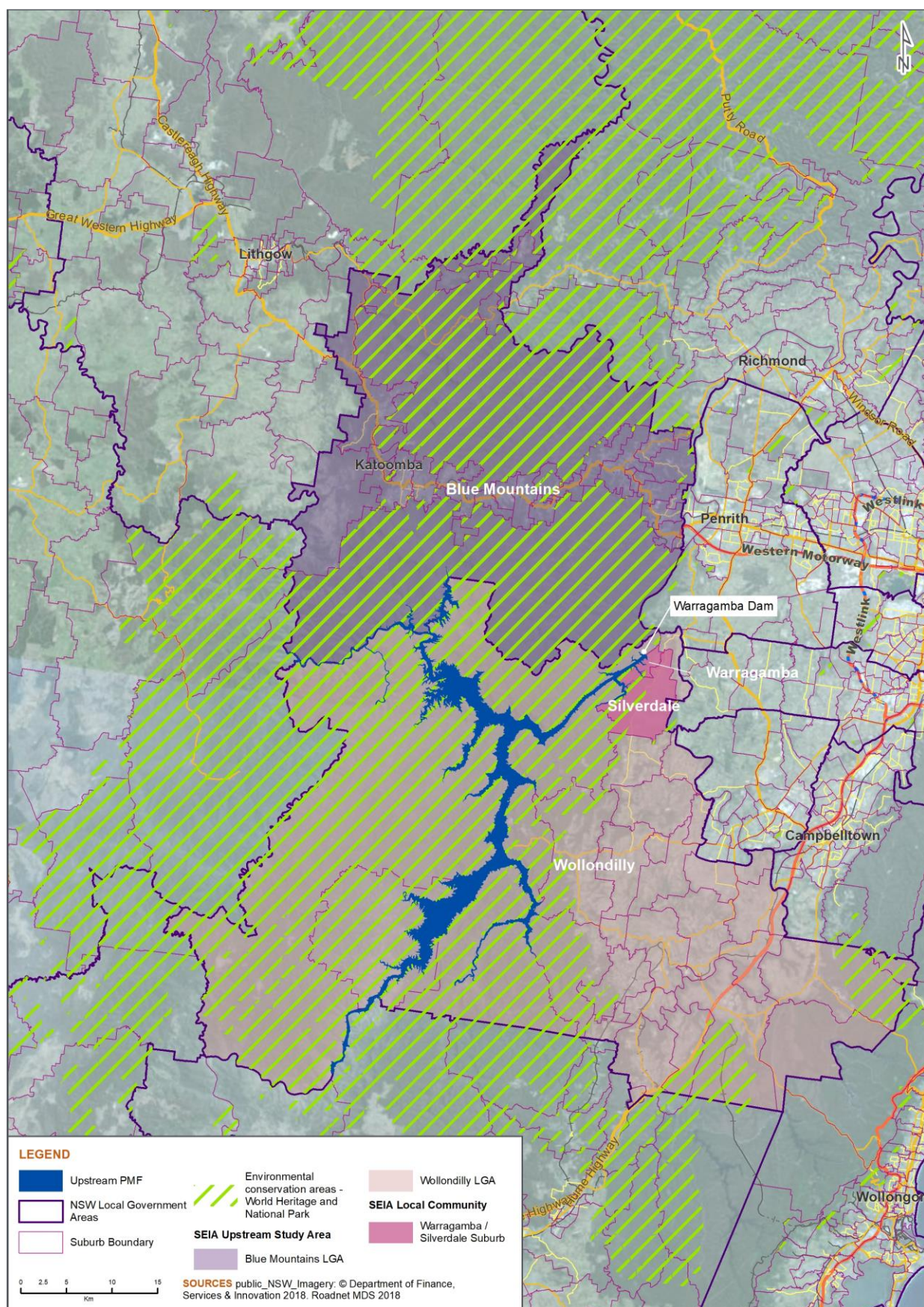
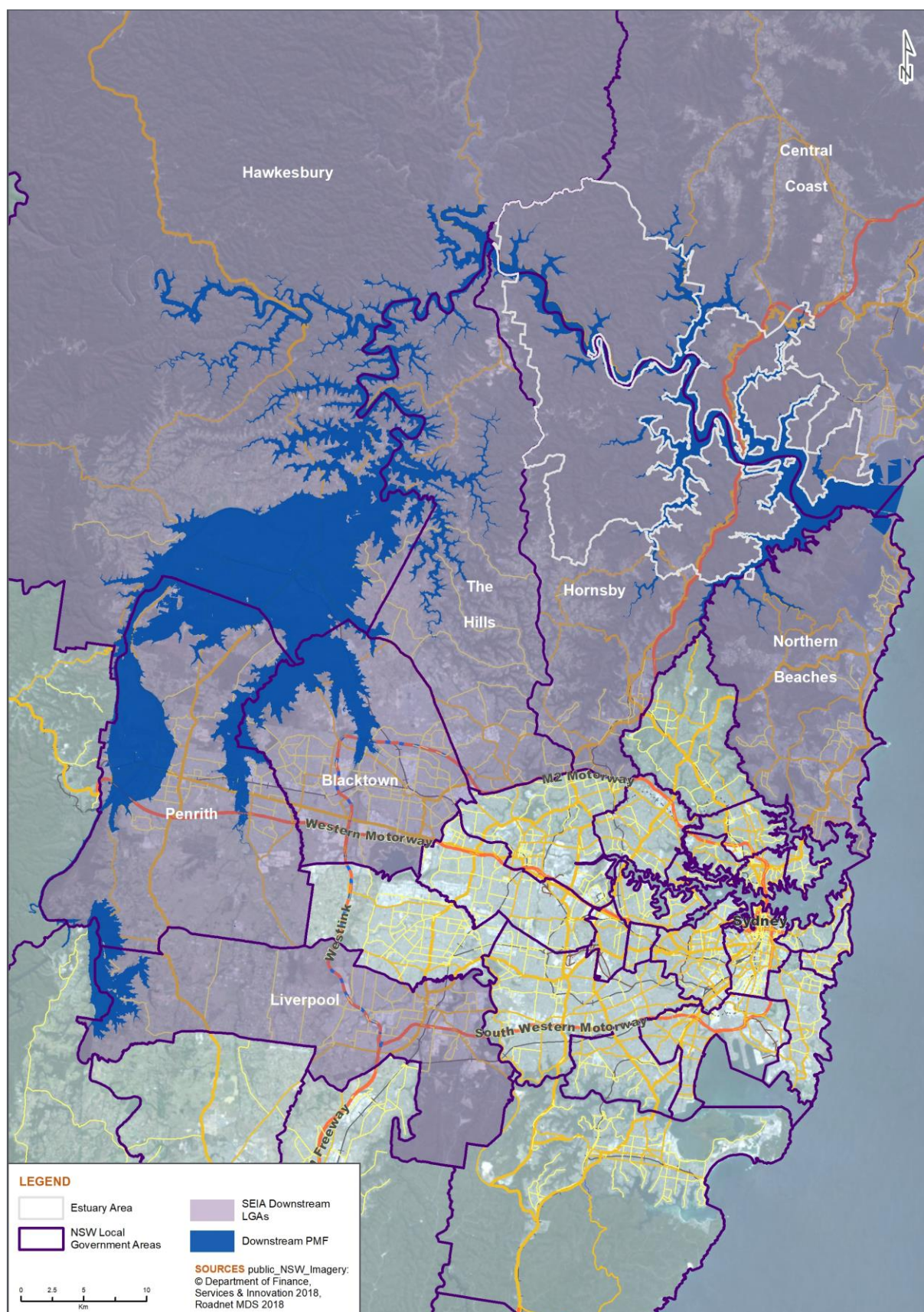


Figure 5-2. SEIA study areas- downstream and estuary LGAs



5.4 Matters checklist

The SIA guideline (DPE 2017c) provides a process for the preliminary identification and assessment of potential socio-economic impacts and benefits. 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 5-2 lists the matters identified as being relevant to an assessment of socio-economic impacts and benefits regarding the Project in each of the key geographic areas affected by the Project's local communities study area as defined by Warragamba/Silverdale and the Wollondilly LGA, upstream communities study area as defined by the Blue Mountains National Park and Blue Mountains LGA, and downstream communities study area which includes the LGAs of Liverpool, Penrith, Blacktown, Hawkesbury, The Hills, Hornsby and Central Coast. As described Section 4.2, 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 5-2. SEIA matters checklist across SEIA study areas

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream communities	Estuary communities
Amenity	Acoustic	Construction activities will result in the generation of noise. In the vicinity of the work site, noise will be generated by operation of the concrete batching plant/s and other machinery. Truck movements to and from the site would also generate noise.	✓			
	Visual	The raising of the Dam wall will alter visual characteristics of the structure itself and surrounding areas.	✓			
		There may be alteration to viewsheds due to temporary inundation during the operation phase.		✓		
	Odour	There may be some localised odour effects following the release of inflows.	✓			
	Microclimate	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 footprint.	✓			
		There would be reduced extent and reduced frequency of flood events affecting property. As a result, access to property and to social infrastructure will be improved. If affected by a major flood, the duration of inhibited access to some property may be more prolonged.			✓	
		Throughout the lower downstream area there will be reduced extent and reduced frequency of flood events affecting property. As a result, access to property and to social infrastructure will be improved. If affected by a major flood, the duration of inhibited access to some property low in the floodplain (such as those reliant on ferry access) may be more prolonged.				✓
	Road and rail network	Project-related traffic may result in altered conditions on local roads. Anticipated truck movements will cause localised congestion throughout the construction period. Along designated truck routes, the condition of roads low in the floodplain (and broader road network) may be affected by the volume of heavy movements.	✓			
		The risk of flood effects on road and rail infrastructure will be reduced as a result of reduced flood extent and frequency. If affected by a major flood, the duration of some roads being cut off may be more prolonged.			✓	
	Offsite parking	Offsite parking could be impacted due to a large workforce.	✓			
	Utilities	The risk of flood effects on utilities will 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 places.				✓
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 Wallacia, Penrith CBD, Riverstone public domains and other public spaces being inundated and damaged will be reduced as a result of reduced flood extent and frequency.			✓	
		The risk of the public domain in areas such as the Wallacia, Penrith CBD, Wisemans Ferry, and other public spaces being inundated will be reduced as a result of reduced flood extent and frequency.				✓

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream communities	Estuary communities
	Public infrastructure	The presence of a large construction workforce in the local area will result in more people utilising public infrastructure.	✓			
		The frequency of some recreational infrastructure such as the Penrith River Walk being inundated will be reduced as a result of reduced flood extent and frequency. If affected by a major flood, the duration of a recreational facility such as the Regatta Centre being off line may be more prolonged.			✓	
		The frequency of recreational infrastructure being inundated will be reduced as a result of reduced flood extent and frequency.				✓
	Other built assets	Potential temporary closure of the Visitor Centre and Haviland Park during the construction.	✓			
		All built assets will be positively affected due to the reduced extent and frequency of flood events.			✓	
		Built assets would be positively affected due to the reduced extent and frequency of flood events.				✓
Heritage	Natural	Whilst the focus of visitors to the Dam is the Dam itself, they also enjoy the surrounding natural environment. 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 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. It is expected that over time natural areas will adapt and there will be minimal long-term effect to the ability of people to enjoy the natural heritage of Liverpool, Penrith and Blacktown.			✓	
		There may be some effects on the natural environment due to alterations to the flood regime. It is expected that over time natural areas will adapt and there will be minimal long-term effect to the ability of people to enjoy the natural heritage of Hawkesbury.				✓
	Cultural	The construction of the Dam is highly culturally significant to the Warragamba community. 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 will be physically altered due to the Project.	✓			
		The risk of flood effects on built heritage will be reduced as a result of reduced flood extent and frequency.			✓	✓

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream communities	Estuary communities
	Cohesion, capital, and resilience	May be some diminished community capital through the polarisation of community sentiment regarding the Project. May also foster community capital as the community unifies against a common cause.		✓		
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 dust, noise and vibration can have a negative localised effect on health.	✓			
		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 will 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.			✓	
		There may be some health effects associated with more prolonged periods of isolation due to prolonged duration of some flood events; however, the Project will improve access to health infrastructure by reducing flood extent and frequency.				✓
	Housing	Due to proximity to Sydney, it is unlikely that the Project would have an effect on the local long-term housing market. There may be higher demand for short-term housing throughout construction which may result in decreased availability.	✓			
		Vulnerable forms of housing such as caravan parks and cabins would be positively affected due to reduced extent and frequency of flood events. For some major flood events the duration of inundation may be more prolonged. The Project will enhance confidence in housing investment by reducing the risk posed by flood events. Any reductions in flood risk at each individual property would be considered by insurers and would typically result in reduced insurance premiums. This may then translate to improved housing affordability in some instances.			✓	✓
	Safety	Project-related traffic movements have the potential to reduce public safety in the local area.	✓			
		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, the Project will have a positive effect on safety in Penrith.			✓	
	Services and facilities	The presence of a large construction workforce in the local area will result more people utilising community services and facilities.	✓			
		By reducing the extent and frequency of flood events the Project will 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. By extending the duration of flood events the closure of services such as Wisemans Ferry Barge will be extended.			✓	✓

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream communities	Estuary communities
	Cohesion	The presence of a large construction workforce may have a negative effect on the cohesion of the Warragamba community; however, a renewed focus on the town may also serve to build community capital and resilience.	✓			
Economic	Natural resource use	There are likely to be some restricted access to natural areas surrounding the Dam throughout construction.	✓			
		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 will 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.			✓	
		Commercial activities such as oyster and prawn farming which rely upon river/estuary use may benefit from the reduction in the frequency of flood events, however, may also be affected by changes to water quality and increased duration of high turbidity levels following some flood events.				✓
	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.	✓			
		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 will 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.			✓	
		The opportunity cost in the Lower Downstream area is 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 flooding.				✓
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.	✓			

Social and environmental matters		Project activities likely to affect receptors	Local communities	Upstream communities	Downstream communities	Estuary communities
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).		✓		
		There may be some effects to the native fauna 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.			✓	
		There may be some effects to the native fauna 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 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.			✓	
		The Project will significantly reduce the extent and frequency of flood events.				✓
Water	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.				✓
	Hydrological flows	Potential community concern associated with alteration of existing riverine flow regime.			✓	✓

6 Socio-economic baseline

6.1 Overview

This Section presents information and findings on socio-economic conditions of SEIA study areas. The socio-economic baseline studies focus on the potential impacts identified through the scoping of the Project's activities and the interaction of the Project with resources and receptors. Where the Project's activities have been scoped, information is only provided regarding baseline conditions if required to inform the impact assessment. The socio-economic baseline of the Project's study areas aims to describe the key socio-economic conditions with an emphasis on the resources and receptors that may be impacted by the Project and to inform judgement where possible about the sensitivity, vulnerability and/or importance of resources and receptors.

The socio-economic baseline studies focus on the SEIA study areas as identified in Section 5.4. The socio-economic baseline covers the following:

- Local communities: The local communities study area includes Warragamba and Silverdale suburbs in the Wollondilly LGA.
- Upstream communities: The upstream communities study area includes communities in the Blue Mountain LGA.
- Downstream communities: The downstream communities study area encompasses 74 state suburbs across five LGAs.
- Estuary communities: The estuary communities study area encompasses 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 study adopts a range of approaches to ensure a robust and accurate socio-economic baseline profile. The approach included the following:

- 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 consultations 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 presented in this section will be used as a baseline to assess the potential impacts of the Project on the socio-economic characteristics.

6.2 Local communities

6.2.1 Overview

As discussed in Section 5.3.1, the socio-economic baseline for the local communities study area only covers Warragamba and Silverdale townships in the Wollondilly LGA since the baseline of the Blue Mountains National Park is addressed under the SEIA upstream communities study area. It is also noted that the Blue Mountain National Park is uninhabited. The local communities study area includes the Project footprint, which encompasses the Project's construction area.

A brief overview of the local communities study area is provided in the following paragraphs.

6.2.1.1 Wollondilly LGA

Wollondilly LGA is located at the south-western edge of Sydney metropolitan region, about 75 kilometres from the Sydney CBD. The LGA forms the gateway to the Southern Highlands, various national parks and the world heritage area. Wollondilly is bordered by Blue Mountains and Penrith LGAs to the north, Liverpool, Camden, Campbelltown and Wollongong LGAs to the east, Wingecarribee LGA to the south, and the Goulburn Mulwaree and Oberon LGAs to the west (Wollondilly Shire Council 2018).

The LGA covers an area of nearly 2,600 square kilometres and is primarily comprised of land used for rural production along with nature reserves and national parks. There are 11 towns and villages in the LGA. The LGA is well-known for

Lake Burratorang and Warragamba Dam, which has been the primary water supply for Sydney since the late 1960s and remains a popular tourism attraction.

6.2.1.2 Warragamba

Warragamba town covers an area of five kilometres and is located in the north-east of Wollondilly LGA. It borders Werombi in the south and Oakdale – Nattai National Park to the west of Wollondilly. The township was initially established as a settlement to provide housing for workers constructing Warragamba Dam in the 1940s and 1950s. Following the completion of Warragamba Dam, the community flourished for a period, with the Dam being a significant tourist attraction. The main residential area of Warragamba town is located to the north of the village centre, characterised by narrow streets and mainly weatherboard and brick houses. A small industrial area is located to the west of the centre with light industrial and rural supply facilities. Warragamba is also the nearest centre for the neighbouring suburb of Silverdale.

6.2.1.3 Silverdale

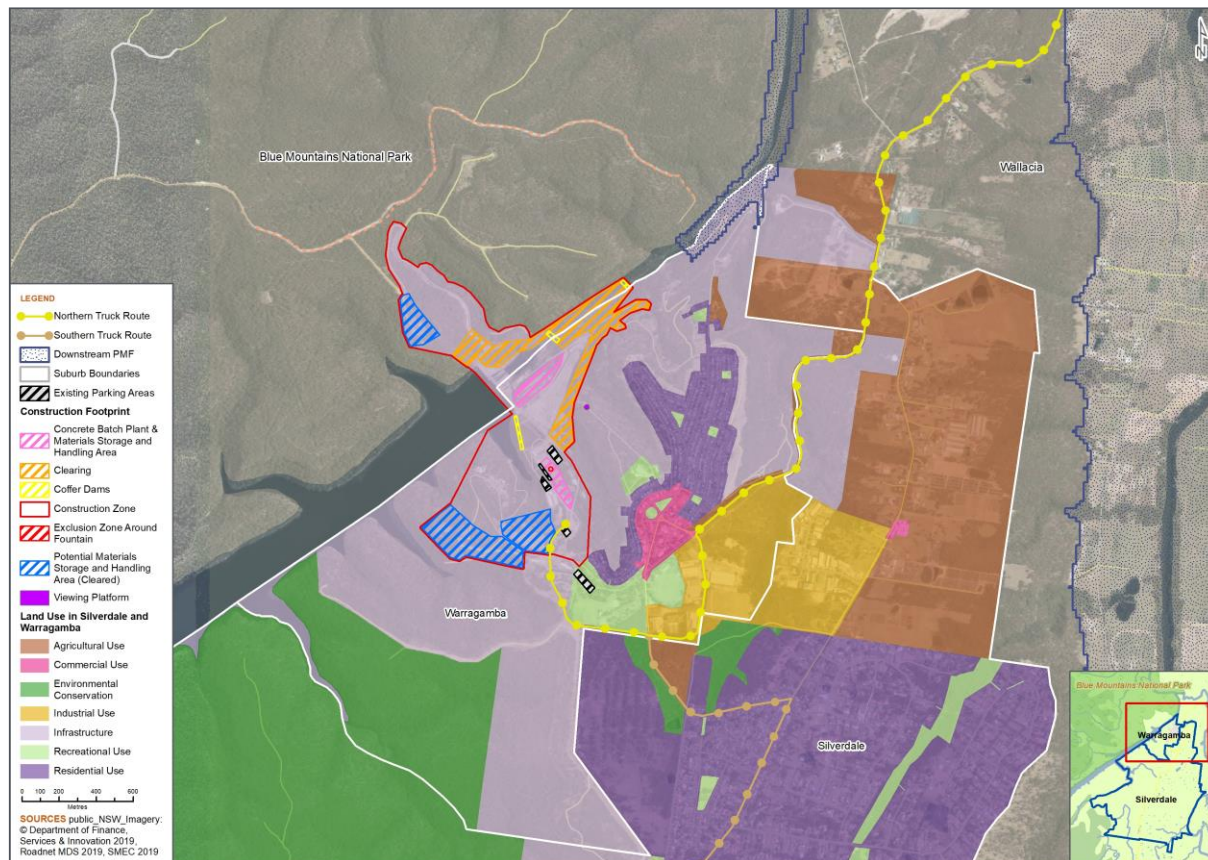
Silverdale has an area of 48 square kilometres and is a small town in Wollondilly LGA. The town borders Warragamba to the north, Werombi to the south, and Wallacia (Penrith LGA) to the east. Silverdale was established around 1928. The construction of the Warragamba Dam in 1940s and 1950s drove the growth of the town. Silverdale is currently characterised as a rural residential in nature.

6.2.2 Land use and planning

6.2.2.1 Land use

Figure 6-1 below provides a map of land use categories near to the Project footprint and local communities of Warragamba and Silverdale townships. The total area of the Project footprint is 105 hectares. Land use within the Project footprint is dictated by an infrastructure zone. Figure 6-1 also shows that an infrastructure land use is dominant surrounding the Project footprint. Other land use categories in proximity to the Project footprint are residential, recreational, and environmental conservation.

Figure 6-1. Map of land use categories within the Project footprint and local communities



Source: SMEC 2019

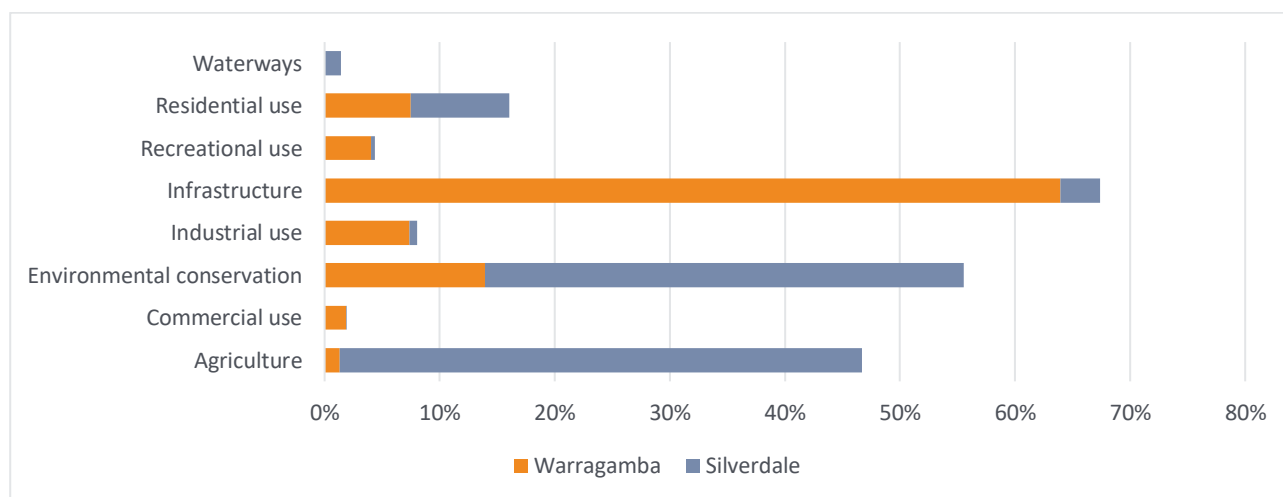
According to the Wollondilly Local environmental plan 2011, in Warragamba, land for infrastructure development was dominant, accounting for 63.9 percent of the total land categories, followed by environmental conservation land uses (14.0 percent). Agricultural land in Warragamba accounted for the lowest proportion with only 1.3 percent of land area. In contrast, Silverdale's land use profile was primarily characterised by agricultural land (45.4 percent) and by environmental conservation use (41.6 percent). Proportions of residential land uses for the two townships were small, accounting for 7.5 percent and 8.6 percent in Warragamba and Silverdale respectively. Other land use activities in the two towns include land for industrial, commercial, and recreational use. The land profiles of the two towns show that there are significant environmental values and agricultural land attributed to the local communities study area. Therefore, the visual character around the Project footprint is predominantly natural forest, woodland, rivers, hills and rural landscape. Table 6-1 below provides a land profile of the two towns. Accordingly, Figure 6-2 illustrates a comparison between land use categories between Warragamba and Silverdale suburbs.

Table 6-1. Land use profile in local communities

Land Use categories	Warragamba (%)	Silverdale (%)	Total land use
Agriculture	1.3	45.4	22.04 km ²
Commercial use	1.8	0.0	0.10 km ²
Environmental conservation	14.0	41.6	20.86 km ²
Industrial use	7.4	0.7	0.72 km ²
Infrastructure	63.9	3.5	4.96 km ²
Recreational use	4.0	0.3	0.36 km ²
Residential use	7.5	8.6	4.54 km ²
Waterways	0.0	1.4	0.01 km ²

Source: Wollondilly Shire Council 2011a

Figure 6-2. Proportions of land use categories in Warragamba and Silverdale



Source: Wollondilly Shire Council 2011a

6.2.2.2 Land use planning

Land use planning for Warragamba and Silverdale suburbs falls within the 2011 Wollondilly Local environmental plan (Wollondilly Shire Council 2011) and the 2016 Development control plan (Wollondilly Shire Council 2015). As per the Growth management strategy 2011, Wollondilly LGA is expecting significant growth over the next 30 years (Wollondilly Shire Council 2015). In 2017, \$166.8 million of development applications around existing towns had been approved (Wollondilly Shire Council 2011b).

A key development is the Wilton Junction Master Plan which aims to deliver 12,000 lots along with commercial and industrial development. Concerns were raised about increased traffic, lack of infrastructure, and loss of the town's rural character. The Council also held concerns surrounding the smaller lot sizes in comparison to other Silverdale properties (Layt 2017).

Under the 2016 Development control plan, Warragamba has seven objectives for development in the area. These include the following:

- to ensure that the development is sympathetic to the heritage character of the Warragamba Heritage Conservation Area and town itself
- to ensure that the design and materials used in new buildings, restoration and renovation of existing building is appropriate in scale and form to the character of the Warragamba Heritage Conservation Area
- to encourage the removal or upgrading of non-contributory elements in the area to enhance the setting of contributory elements
- to encourage the redevelopment of commercial zoned land in Warragamba
- To encourage the simple, post WWII architectural design character features for new buildings within the conservation area
- to maintain the existing view corridor from the conservation area west to the Blue Mountains World Heritage Area
- to ensure new development maintains the historic significance and association of the town with the construction of Warragamba Dam (Wollondilly Shire Council 2016).

According to the 2016 Development control plan, the Warragamba township has three controls for development in the area as follows:

- New building design must be sympathetic to and reflect the simple, post WWII architectural design character of original buildings within the Warragamba village.
- New commercial buildings must maintain significant view lines west to the Blue Mountains World Heritage Area where present.
- Simple designed skillion verandas that extend over the footpath are encouraged when designing new commercial buildings within the precinct (Wollondilly Shire Council 2016).

6.2.3 Demographic profile

6.2.3.1 Population

According to the 2016 ABS Census, the Wollondilly LGA had a total resident population of 48,519 people. The population density of this LGA was 20 persons per square kilometre which was much higher than the NSW average of nine persons per square kilometre. With regards to the affected suburbs, Warragamba township had a total population of 1,241 people, with the density of 241 persons per square kilometre while Silverdale's population was 3,682 people with a 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 of 390 persons per square kilometre.

Between 2011 and 2016, the Wollondilly LGA experienced a 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 (ABS Census 2011 and 2016). Table 6-2 below shows the population change within the LGA and for the two towns from 2011 to 2016.

Table 6-2. Population change in local communities from 2011 to 2016

Area	General population			
	2016	2011	Change in numbers (No.)	Change in percentage (%)
Wollondilly LGA	48,519	43,259	5,260	12.2
Warragamba	1,241	1,236	5	0.4
Silverdale	3,682	3,439	243	7.1

Source: ABS Census of Population and Housing 2016

Indigenous Australian population

Based on the 2016 Census, there were a total of 1,552 Aboriginal and/or Torres Strait Islander residents in the LGA, which accounts for 3.2 percent of the population of Wollondilly. The proportion of the Indigenous Australian population in the LGA was more than double that for the Greater Sydney (1.5 percent of the population). At the local level, the percentages of Indigenous Australians in Warragamba (5.8 percent) was considerably higher than Wollondilly LGA and of Greater Sydney, while Silverdale recorded a lower percentage of Indigenous Australians at 2.7 percent.

Between 2011 and 2016, the proportion of Indigenous Australians significantly increased (by 49.8 percent) in Wollondilly LGA. In line with this trend, the Indigenous Australian population of Warragamba experienced a rapid growth of 84.6 percent while that of Silverdale increased by 33.8 percent. While the general population change from 2011 to 2016 in Warragamba was very small (an increase of five persons), the number of Indigenous Australian residents in Warragamba increased by 33 people within this period.

Table 6-3 shows the Indigenous Australian population change in Wollondilly LGA and Warragamba-Silverdale towns from 2011 to 2016.

Table 6-3. Indigenous Australian population change in local communities from 2011 to 2016

Area	Indigenous Australian population			
	2016	2011	Change in numbers (No.)	Change in percentage (%)
Wollondilly LGA	1,552	1,036	516	49.8
Warragamba	72	39	33	84.6
Silverdale	99	74	25	33.8

Source: ABS Census of Population and Housing 2011 and 2016

6.2.3.2 Gender and age distribution

Table 6-4 below shows the gender distribution in the Wollondilly LGA, Warragamba and Silverdale towns in 2016. The Wollondilly LGA and Warragamba town recorded a similar gender breakdown with slightly more females than males. In contrast, Silverdale township recorded higher percentage of males at 51.8 percent.

Table 6-4. Gender distribution in local communities, 2016

Area	Gender distribution			
	Male (No)	Male (%)	Female (No)	Female (%)
Wollondilly LGA	24,207	49.9	24,314	50.1
Warragamba	606	48.8	633	51.2
Silverdale	1,906	51.8	1,777	48.2

Source: ABS Census of Population and Housing 2016

According to the 2016 ABS Census, Wollondilly LGA had a similar proportion of pre-schoolers and a similar proportion of persons at post retirement age to Greater Sydney. The median age of people in Wollondilly LGA was 37 years old, which was similar to Greater Sydney's median age of 36 years old. Within the Project's study area, Warragamba and Silverdale had the same median age of 36 years old.

Table 6-5 below shows the percentages of selected age groups in 2016, including children aged 14 years old or younger, people aged 15 to 64 years old who are considered the working age population, and people aged 65 years or older. Warragamba and Silverdale townships had a similar percentage of working age population (Warragamba 66.8 percent and Silverdale 68.8 percent) to the LGA's average of 64.7 percent. The proportion of population 65 years and above accounted for 9.2 percent and 13.5 percent in Silverdale and Warragamba respectively.

Table 6-5. Proportions of selected age group in local communities, 2016

Area	14 years and under (%)	15 to 64 years (%)	65 years and above (%)
Wollondilly LGA	22.0	64.7	13.3
Warragamba	19.7	66.8	13.5
Silverdale	22.6	68.2	9.2

Source: ABS Census of Population and Housing 2016

6.2.3.3 Family and household structure

According to the 2016 ABS Census, the total number of families in the Wollondilly LGA was 13,144 while Silverdale and Warragamba had 325 and 997 families respectively. Average household size in Wollondilly was three persons. The average household size in Silverdale (3.3 persons) was higher than that of Warragamba (2.6 persons). Structure of families includes couple family with children, couple family with no children, one parent family, and other family. Couple family with children comprised the dominant family type across the local communities study area. Compared to the Wollondilly LGA and Warragamba, Silverdale town had the highest percentage of couple family with children – 61.0 percent and a lower proportion of couple families with no children – 29.6 percent. Table 6-6 below shows the proportion of different family types in the Wollondilly LGA, Warragamba, and Silverdale.

Table 6-6. Percentages of family types in the Wollondilly LGA, Warragamba, and Silverdale, 2016

Area	Couple family with no children (%)	Couple family with children (%)	One parent family (%)	Other family (%)
Wollondilly LGA	33.7	52.9	12.6	0.8
Warragamba	30.3	43.0	24.8	1.8
Silverdale	29.6	61.0	9.0	0.4

Source: ABS Census of Population and Housing 2016

6.2.4 Employment and industry

6.2.4.1 Labour force profile

Based on the 2016 ABS Census, the labour force participation rate in the Wollondilly LGA was 60.9 percent, which was slightly lower than Greater Sydney at 61.6 percent. In 2016, 25,056 people reported being in the labour force in Wollondilly LGA. Of these, 62.3 percent were employed full time and 28.4 percent were employed part-time. The labour force participation rates in Warragamba and Silverdale towns were 63.8 percent and 71.5 percent respectively. In Warragamba, there were 636 people who reported being in the labour force. Of these, 65.9 percent were employed fulltime and 23.7 percent were employed part-time. In Silverdale, a total of 2,048 people was recorded in the labour force with 65.1 percent of people working fulltime and 27.2 percent of people working part-time. Table 6-7 provides a summary of the labour force in the Wollondilly LGA, Warragamba and Silverdale townships.

Table 6-7. Summary of labour force profile in local communities, 2016

Area	Labour force (No)	Employed fulltime (%)	Employed part-time (%)
Wollondilly LGA	25,056	62.3	28.4
Warragamba	636	65.9	23.7
Silverdale	2,048	65.1	27.2

Source: ABS Census of Population and Housing 2016

In Wollondilly LGA, construction was the largest employer, generating 1,961 local jobs in 2016. An analysis of the jobs held by the resident population in the Wollondilly LGA in 2016 shows that the three most popular industry sectors were: Construction (14.8 percent); Health Care and Social Assistance (9.9 percent); and Retail Trade (9.4 percent). In combination, these three industries employed 34.1 percent of the total employed resident population. In comparison, Greater Sydney employed 8.2 percent in Construction; 11.6 percent in Health Care and Social Assistance; and 9.3 percent in Retail Trade. In Warragamba, the primary industry of employment was similar to the Wollondilly LGA,

including construction, health care and social assistance, and retail trade. Silverdale town has a dependence upon construction, education and training and retail trade. Table 6-8 shows the three highest employing industries of the LGA and the two towns.

Table 6-8. Industry of employment in local communities, 2016

Area	Major industry		Second major industry		Third major industry	
	Name of industry	%	Name of industry	%	Name of industry	%
Wollondilly LGA	Construction	14.8	Health care and social assistance	9.9	Retail trade	9.4
Warragamba	Construction	14.9	Health care and social assistance	10.6	Retail trade	9.7
Silverdale	Construction	18.3	Education and training	9.0	Retail trade	8.9

Source: ABS Census of Population and Housing 2016

An analysis of the occupation profile shows that technicians and trades workers were the most common occupation across the Wollondilly LGA, Warragamba, and Silverdale in 2016. The three most popular jobs in the LGA were: technicians and trades workers (18.3 percent); professionals (14.9 percent); and clerical and administrative workers (14.7 percent). In combination, these three occupations accounted for 47.9 percent of the employed resident population (ABS Census 2016). In Warragamba, the three highest occupations were: technicians and trade workers (16.5 percent); labourers (16.2 percent); and machinery operators and drivers (15.9 percent). In Silverdale, the top three popular jobs were: technicians and trade workers (18.2 percent); clerical and administrative workers (17.3 percent); and managers (13.3 percent). Table 6-9 shows the proportion of occupational groups across the LGA and the two towns.

Table 6-9. Summary of occupation groups in local communities, 2016

Occupation group	Wollondilly LGA (%)	Warragamba (%)	Silverdale (%)
Technicians and trades workers	18.3	16.5	18.2
Professionals	14.9	6.4	13.0
Clerical and administrative workers	14.7	15.7	17.3
Manager	12.7	6.9	13.3
Community and personal service workers	10.2	13.4	8.4
Labourers	9.4	16.2	9.0
Machinery operators and drivers	9.4	15.9	9.2
Sales workers	8.6	6.7	9.1

Source: ABS Census of Population and Housing 2016

The occupation profile in the local communities study area in 2016 indicates that there is potential to provide labour and skills associated with construction industry since the LGA and the two towns had the highest percentage of skilled labour, such as technicians and trades workers. The number of people with vocational and trade qualifications was high in Wollondilly. In addition, Warragamba had other major occupations, which were machinery operators and drivers as well as labourers. Based on the Australian Industry Group Construction Outlook survey conducted in 2018, the top three occupations where construction businesses expect to experience the most skill shortage in 2017 were technicians, trade workers, as well as machinery operators and drivers⁷.

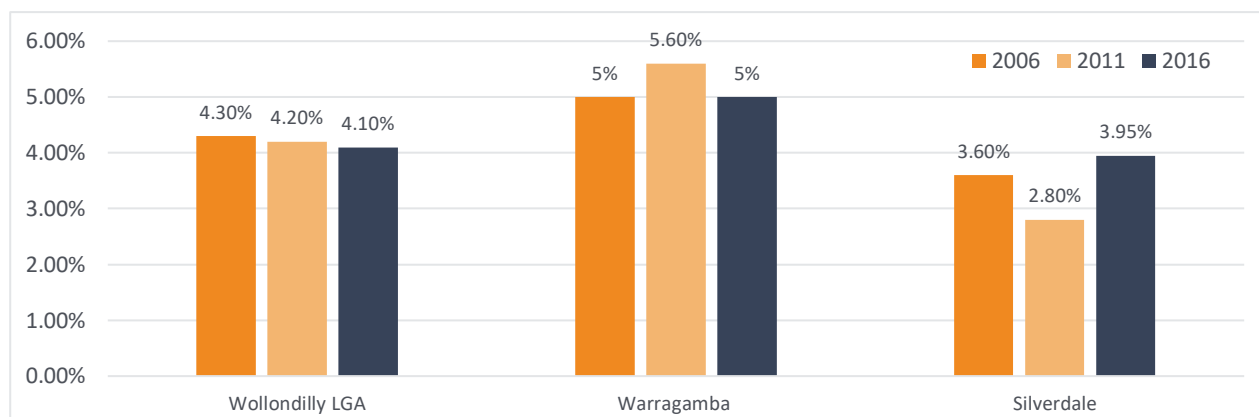
6.2.4.2 Unemployment

In 2016, the unemployment rate in Wollondilly LGA (4.1 percent) was lower than that recorded for Greater Sydney (6.3 percent). With regard to the townships, Warragamba had a higher rate of unemployment (5.0 percent) than Silverdale (4.0 percent). Between 2006 and 2016, the unemployment rate has differed slightly across Warragamba and Silverdale, while Wollondilly LGA's unemployment rate remained relatively consistent over the same time period. Wollondilly LGA's unemployment rate slightly decreased between 2006 and 2016 (from 4.3 percent in 2006 and to 4.1 percent in 2016). Comparatively, the unemployment rate in Silverdale has marginally increased from 3.6 percent in

⁷ Australian Industry Group and Australian Constructors Association 2018

2006 to 4.0 percent in 2016; however, the rate was below the unemployment rate recorded for Wollondilly LGA. In Warragamba, unemployment has remained relatively stable in the same period. In the townships of Warragamba, the unemployment rate increased to 5.6 percent in 2011 from 5.0 percent in 2006. The unemployment rate in Warragamba has remained consistently higher than the rates recorded for Wollondilly LGA as a whole over the ten-year period from 2006 to 2016. Figure 6-3 below shows the unemployment rates for the LGA and the two townships in years 2006, 2011 and 2016.

Figure 6-3. Unemployment rate, 2016



6.2.4.3 Business profile

According to the 2016 ABS Census, the most significant industries of employment in the Wollondilly LGA are construction, and transport, postal and warehousing. There was a total of 4,281 registered businesses in Wollondilly LGA (ABS 2018). Of these, the construction industry had the largest number of total registered businesses in Wollondilly LGA, comprising 31.9 percent of all total registered businesses, compared to 16.0 percent in NSW. Transportation, postal and warehousing industry as well as professional, scientific, and technical services industry were the second and third major registered businesses in the LGA, accounting for 9.3 percent and 8.0 percent respectively. Figure 6-4 below provides the proportion of registered businesses by industry in Wollondilly LGA compared to NSW in 2018.

Figure 6-4. Registered businesses by industry 2018

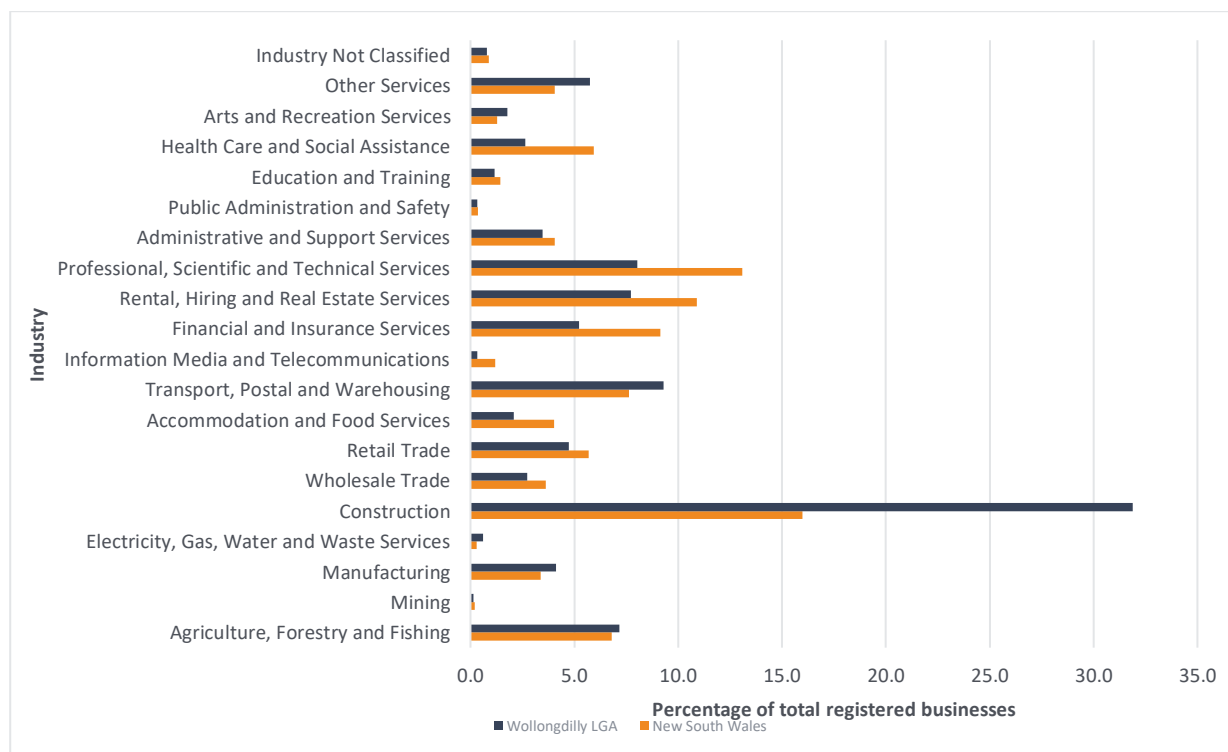


Table 6-10 below provides business counts by industry in the townships of Warragamba and Silverdale. Based on 2018 Australian Bureau of Statistics Business Register (ABSB), in 2018, there was a total of 599 registered businesses in Warragamba and Silverdale. Of these, construction businesses were the most numerous, accounting for 34.0 percent of all businesses. Transportation, postal and warehousing industry (11.1 percent) as well as rental, hiring and real estate services industry (7.2 percent) were the second and third most numerous registered businesses. It is noted that there were 31 retail trade businesses and 14 accommodation and food services in Warragamba and Silverdale. Between 2016 and 2018, the number of registered businesses increased by 43 (8.3 percent). It is noted that the number of businesses in the agriculture, forestry and fishing industry, professional, scientific, and technical services sectors, and health care and social assistance services decreased while other industries increased during this period.

Table 6-10. Registered businesses by industry in Warragamba-Silverdale from 2016 to 2018

Industry	2016		2017		2018		Total change 2016 - 2018	
	No	%	No	%	No	%	No	%
Agriculture, Forestry and Fishing	38	7.4	30	5.8	28	5.0	-10	-26.3
Mining	0	0.0	0	0.0	0	0.0	0	0
Manufacturing	34	6.6	33	6.4	35	6.3	1	2.9
Electricity, Gas, Water and Waste Services	3	0.6	3	0.6	3	0.5	0	0.0
Construction	171	33.1	172	33.2	190	34.0	19	11.1
Wholesale Trade	22	4.3	22	4.2	29	5.2	7	31.8
Retail Trade	24	4.7	29	5.6	31	5.5	7	29.2
Accommodation and Food Services	8	1.6	11	2.1	14	2.5	6	75.0
Transport, Postal and Warehousing	56	10.9	60	11.6	62	11.1	6	10.7
Information Media and Telecommunications	0	0.0	0	0.0	3	0.5	3	0
Financial and Insurance Services	17	3.3	20	3.9	19	3.4	2	11.8
Rental, Hiring and Real Estate Services	34	6.6	37	7.1	40	7.2	6	17.6
Professional, Scientific and Technical Services	32	6.2	31	6.0	29	5.2	-3	-9.4
Administrative and Support Services	13	2.5	11	2.1	19	3.4	6	46.2
Public Administration and Safety	3	0.6	3	0.6	4	0.7	1	33.3
Education and Training	3	0.6	3	0.6	3	0.5	0	0.0
Health Care and Social Assistance	9	1.7	8	1.5	4	0.7	-5	-55.6
Arts and Recreation Services	7	1.4	9	1.7	9	1.6	2	28.6
Other Services	33	6.4	32	6.2	33	5.9	0	0.0
Currently Unknown	9	1.7	4	0.8	4	0.7	-5	-55.6
TOTAL	516	100.0	518	100.0	559	100.0	43	8.3

Source: ABSBR 2018

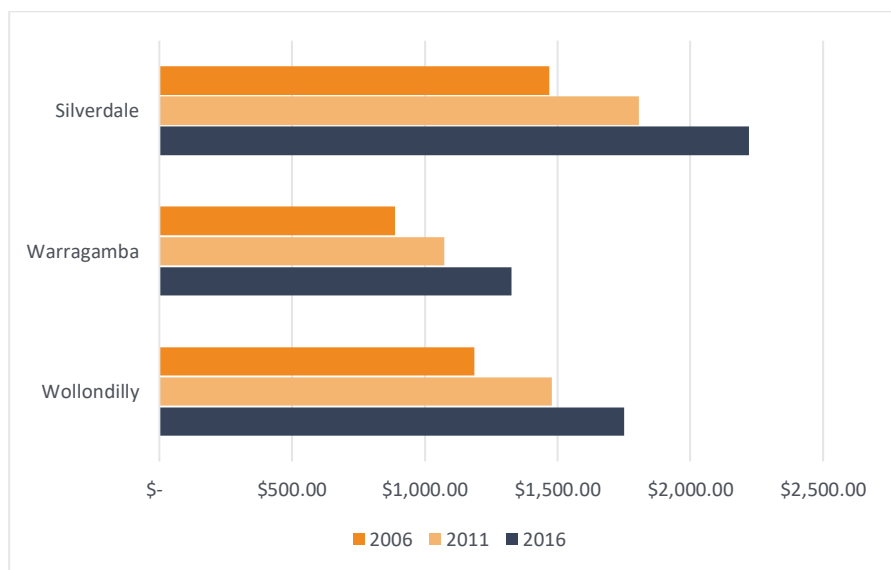
Regarding business capacity to supply the Project, it is considered that over 40 percent of businesses surrounding the Project footprint are in construction and transport, postal and warehousing industries. These businesses are likely to benefit from opportunities to provide goods and services to the Project's construction workforce. There were 190 construction businesses in Warragamba and Silverdale and up to 1,294 construction businesses in the Wollondilly LGA. These businesses may be a major source of labour, services, and equipment for the Project's construction activities.

6.2.5 Income and disadvantage

6.2.5.1 Income levels

Based on the 2016 ABS Census, the median household income in the Wollondilly LGA was \$1,871 per week, which was higher than that recorded for Greater Sydney (\$1,750 per week). Within the two towns, Warragamba had lower median weekly household income than Silverdale at \$1,326 and \$2,220 respectively. The review of income changes over the ten-year period from 2006 to 2016 shows that the population of Wollondilly LGA, Warragamba, and Silverdale have experienced a significant increase in their median household income. Silverdale had the highest median weekly household incomes during this period. Figure 6-5 below shows changes in median weekly household income for the LGA and the two towns in 2006, 2011, and 2016.

Figure 6-5. Median weekly household income in 2006, 2011, and 2016



Source: ABS Census of Population and Housing, 2016

6.2.5.2 Relative socio-economic advantage and disadvantage

To assess the welfare and to determine social and economic wellbeing of Australian communities, the ABS has developed the Social-economic indexes of areas (SEIFA). The indexes are based on information from a five-yearly census of population and housing. The index provides a measure of socio-economic status based on low-income earners, relatively lower education attainment, high unemployment, people's access to material and social resources and their ability to participate in society. Low index values represent areas of most disadvantage and high values represent areas of least disadvantage (ABS 2016).

In 2016, Wollondilly LGA ranked eighth with a score of 1,033. At the local level, Warragamba ranked second with a score of 911. This rank indicates Warragamba being one of the most disadvantaged areas. In contrast, Silverdale's score of 1,056 was higher than the LGA and Warragamba. Silverdale town ranked eighth. Table 6-11 shows SEIFA for the Wollondilly LGA, Warragamba and Silverdale based on ABS 2016 Census.

Table 6-11. Index of relative Socio-economic advantage and disadvantage, 2016

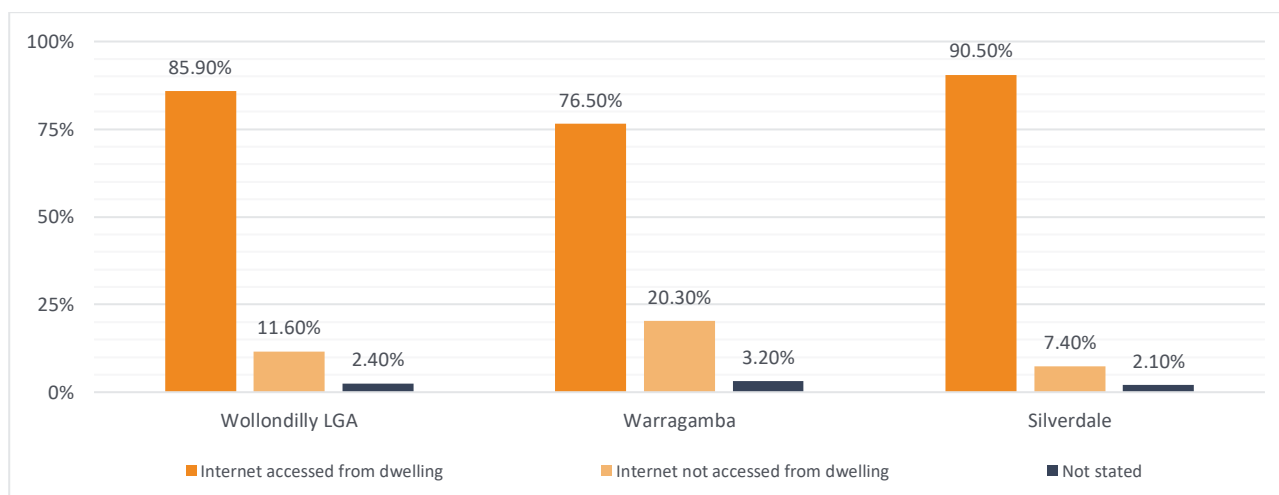
Area	Score	Rank within state/territory
Wollondilly LGA	1,033	8
Warragamba	911	2
Silverdale	1,056	8

Source: ABS Socio-economic indexes for areas 2016

6.2.5.3 Internet access

Based on the 2016 ABS Census, more than 75 percent of households in Wollondilly LGA and the townships of Warragamba and Silverdale were able to access internet from their dwelling. Internet access could have been through a desktop/laptop computer, mobile or smart phone, tablet, music or video player, game console, smart TV, or any other device. Percentage of households having internet access in Wollondilly LGA (85.9 percent) was higher than the NSW average (82.5 percent). Silverdale's internet access rate was high compared to Warragamba. It is recorded that 90.5 percent of households in Silverdale had at least one person with access to the internet from dwelling. Warragamba's internet access rate was lower with 76.7 percent. Given internet access from dwellings is high in the LGA and the two towns, this information is important when considering engagement methods associated with the dissemination of the Project-related information. Figure 6-6 below shows internet access across the Wollondilly LGA, Warragamba and Silverdale townships in 2016.

Figure 6-6. Proportion of internet access in local communities, 2016



Source: ABS Census of Population and Housing 2016

6.2.6 Housing and accommodation

6.2.6.1 Housing type

Data on dwelling structures in 2016 shows that separate houses comprised more than 90 percent of occupied private dwellings within Wollondilly LGA, Warragamba, and Silverdale were separate houses. In Wollondilly LGA, separate houses accounted for 93.9 percent, followed by semi-detached, row or terrace house and townhouses with 4.3 percent. In the LGA, percentages of flat and apartment and other dwellings were very small with 0.7 percent only. Warragamba almost exclusively comprised of separate houses, accounting for 97.8 percent. Only 1.5 percent was semi-detached, row or terrace house, and townhouse. Apart from these two housing types, there were no flat, apartment, and other dwelling types in Warragamba. Silverdale only comprised of separate houses. Regarding the occupancy of private dwellings across the Wollondilly LGA and the townships in 2016, the occupancy rates are similar with 94.1 percent in the LGA, 94.2 percent in Warragamba, and 94.9 percent in Silverdale. Occupancy of private dwellings in these areas was higher than that of NSW (90.1 percent). Table 6-12 below shows a summary of key housing characteristics for the Wollondilly LGA and the two townships.

Table 6-12. Summary of housing characteristics in local communities, 2016

Area	Total private dwellings (no.)	Occupancy rate		Structure of occupied private dwellings			
		Occupied (%)	Unoccupied (%)	Separate house (%)	Semi-detached, row or terrace house, townhouse (%)	Flat or apartment (%)	Other dwelling (%)
Wollondilly LGA	16,048	94.1	5.9	93.9	4.3	0.7	0.7
Warragamba	484	94.2	5.8	97.8	1.5	0.0	0.0
Silverdale	1,100	94.9	5.1	99.7	0.0	0.0	0.0

Source: ABS Census of Population and Housing 2016

6.2.6.2 Housing tenure

Table 6-13 below illustrates the tenure of occupied dwellings in Wollondilly LGA, Warragamba and Silverdale. Over 75 percent of private dwellings were owned outright or with a mortgage across the local communities study area. Percentage of private dwellings owned with a mortgage was higher than owned outright in the three areas. In Wollondilly LGA, the proportion of dwellings being owned accounted for 81.0 percent (50.2 percent being owned with a mortgage and 30.8 percent being owned outright). Silverdale had the highest number of private dwellings with mortgage (59.2 percent). Of occupied private dwellings in Warragamba, 49.3 percent were owned with a mortgage and 28.4 percent were owned outright. Wollondilly LGA, Warragamba, and Silverdale recorded low numbers of private dwellings being rented compared to other tenure types, accounting for 15.2 percent, 18.3 percent, and 7.6 percent respectively. Of rented private dwellings across the three areas of interest, Warragamba had the highest percentage of private dwellings being rented.

Table 6-13. Tenure of occupied private dwellings, 2016

Area	Owned outright (%)	Owned with a mortgage (%)	Rented (%)	Other tenure type (%)	Tenure not stated (%)
Wollondilly LGA	30.8	50.2	15.2	1.2	2.6
Warragamba	28.4	49.3	18.3	0.0	18.0
Silverdale	30.4	59.2	7.6	0.4	2.4

Source: ABS Census of Population and Housing 2016

6.2.6.3 Housing trends

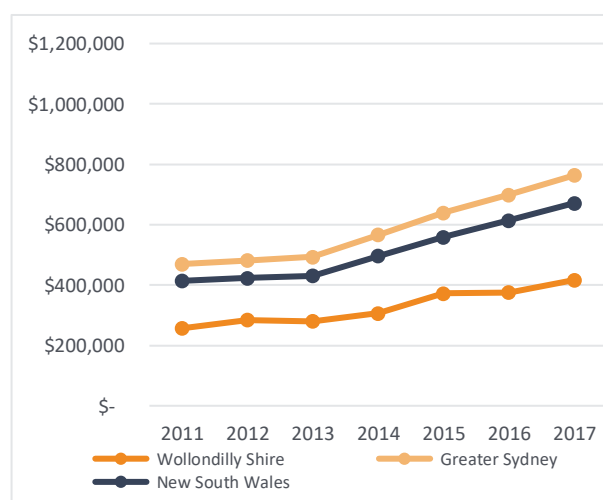
As of 2017, Wollondilly LGA recorded the median house value of \$790,916, which was lower than Greater Sydney (\$1,070,594) and higher than NSW (\$711,006) (Wollondilly Shire Council, 2018). In the same year, the median value of units in this LGA (\$416,683) was also lower than Greater Sydney (\$763,457) and NSW (\$671,543). From 2011 to 2017, the median house and unit prices in Wollondilly LGA have significantly increased. For example, over the last five years, the median prices of houses and units in Wollondilly LGA increased by 43 percent and 38 percent respectively. Figure 6-7 and Figure 6-8 below show changes in median values of houses and units in Wollondilly LGA, compared to Greater Sydney and NSW.

Figure 6-7. Median value of houses in Wollondilly LGA compared to Greater Sydney and NSW from 2011 to 2017



Source: Hometrack 2011- 2017, Housing Valuation System⁸.

Figure 6-8. Median value of units in Wollondilly LGA compared to Greater Sydney and NSW from 2011 to 2017



Source: Hometrack 2011- 2017, Housing Valuation System

⁸ Assessed on 27 November 2018 from <https://economy.id.com.au/wollondilly/housing-prices>

Warragamba and Silverdale townships are typical of a rural residential property market. The two towns have a small property sales market. As of 19 November 2018, the median price of three-bedroom houses in Warragamba was recorded at \$546,000⁹. It should be noted that apart from the median price of three-bedroom houses, there are no information on median values of other housing types. Similarly, as of 19 November, the median price of three and four-bedroom houses was \$840,500 in Silverdale¹⁰. As of 27 November 2018, there were only six properties available for sale in Warragamba and 29 properties listed for sale in Silverdale.

6.2.6.4 Short-term accommodation

In relation to rental cost and availability, in 2017, the median weekly rental 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. Regarding the two townships, as of 19 November 2018, the median weekly rental of houses in Warragamba was \$385/week while Silverdale has a median weekly rental of houses was \$510/week. The review of online property listings on the 27 November 2018 has shown that a low number of rental listings, which is typical of rural localities with a limited stock of dwellings. There were 11 residential properties listed for rent in Silverdale and five properties available for rent in Warragamba.

Online sources indicate that there is no short-term accommodation (such as motels and hotels) in Warragamba and Silverdale townships. In the vicinity of the Project footprint, there is one hotel in Wallacia and 10 motels and hotels located in Penrith area. It is also noted that there are no existing dedicated workers' accommodation camp within the Wollondilly LGA.

6.2.7 Community values

6.2.7.1 Amenity and lifestyle

Wollondilly LGA developed the Community Strategic Plan 2033 in which was incorporated extensive community inputs. The plan reflects shared community values including the following:

- Residents value the rural and community lifestyle as well as town and village atmosphere.
- The LGA appeals to families due to the large-open spaces and family-oriented housing.
- Wealth of heritage is valued and protected because of its cultural significance and its contribution to residents' sense of place and belonging.

The landscape surrounding the Project footprint encompasses natural forest and woodland, rivers, hills, rural roads and small townships within the Hawkesbury-Nepean catchment. The Project footprint is in a close proximity to Greater Blue Mountains World Heritage Area (GBMWA). The general character of Warragamba and Silverdale towns is that of rural broad forest and conservation lands, agricultural areas, interspersed with rural residential homesteads, small commercial services, and open space and recreational areas.

The key feature of Warragamba township is the Warragamba Dam which is heritage-listed. The town centre features a large roundabout, with shops services and community facilities facing onto this and on the streets, which intersect. Warragamba also features a number of sporting and recreational facilities. The Warragamba Dam and Visitor Centre attracts a high number of visitors who also make use of the recreational areas surrounding the Dam. The main residential area of the town located approximately 250 metres away to the east of the Project footprint. The residential area is characterised by narrow streets and mainly weatherboard and brick houses. Warragamba is also the nearest centre for the neighbouring suburb of Silverdale.

Silverdale township is a low-density residential suburb located to the south of Warragamba. While it has no defined town centre, Silverdale residents are close to Warragamba town centre. Silverdale is also close to Warragamba's public swimming pool, sport fields, playground, skate park and tennis/basketball court. Warragamba Public School is the closest primary school for Silverdale residents. Silverdale is accessed via Silverdale Road from the north and south and via Warradale Road from Warragamba to the north.

Residents in Warragamba and Silverdale experience a rural landscape with a mix of broad long-distance vistas, mountain ranges, natural forest and woodlands, rural roads, and small townships. Local people enjoy the rural living and lifestyle, a quiet environment and recreational areas. The community values the identity and characteristics

⁹ Assessed on 27 November 2018 from <https://www.realestate.com.au/neighbourhoods/warragamba-2752-nsw?cid>

¹⁰ Assessed on 27 November 2018 from <https://www.realestate.com.au/neighbourhoods/silverdale-2752-nsw>

associated with the unique lifestyle opportunities of being in a rural setting within close proximity of Sydney. Aspects which support the rural lifestyle in the two towns include a clean and healthy environment, affordable housing, close community connection, access to a range of local facilities, shops and services and strong community network. Figure 6-9, Figure 6-10 and Figure 6-11 below illustrate amenity and lifestyle of residents in the two towns.

Figure 6-9. Amenity and lifestyle in Warragamba town



Source: Wollondilly Shire Council Website 2018¹¹ ; Source: Website¹²

Figure 6-10 Facilities in Warragamba town

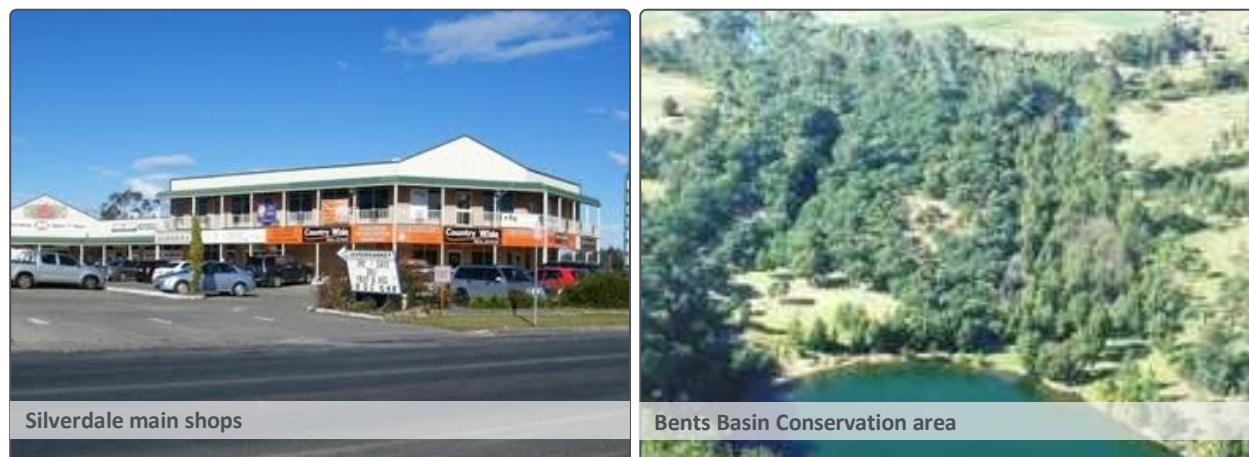


Source: Wollondilly Shire Council Website 2018¹¹ ; Source: Website¹²

¹¹ Assessed on 27 November 2018 from <https://www.wollondilly.nsw.gov.au/lifestyle/community-directory/place/Warragamba-Sportsground>

¹² Assessed on 30 November 2018 from <https://cdn.newsapi.com.au/image/v1/ac828642f0ee3de407d930d32711d3f8?width=650>

Figure 6-11. Amenity and lifestyle in Silverdale town

Source: Website¹³; Source: Website¹⁴

6.2.7.2 Cultural diversity

The Indigenous Australian population in Wollondilly LGA and the townships of Warragamba and Silverdale are described in Section 6.2.3.1. High percentages of population in the three areas were born in Australia including 88.9 percent in Wollondilly LGA, 89.0 percent in Warragamba, and 89.1 percent in Silverdale. Other cultural diversity indicators in these areas is represented by the proportion of residents who were born overseas and households where a primary language other than English (LOTE) was spoken. Table 6-14 below provides a summary of cultural diversity within the local communities study area.

In 2016, Wollondilly LGA, Warragamba, and Silverdale had much lower percentages of residents who were born overseas and of households where LOTE was spoken than the NSW average (26.5 percent). The percentages of people born overseas in Warragamba (11.0 percent) and in Silverdale (10.9 percent) were lower than the Wollondilly LGA average of 11.8 percent. Warragamba and Silverdale had lower percentages of households who do not speak English at home, compared to the rate recorded for Wollondilly LGA as a whole. It is noted that Warragamba had the lowest proportion of households where LOTE was spoken, accounting for only 3.0 percent.

Table 6-14. Summary of cultural diversity, 2016

Area	Born overseas (%)	Non-English speaking households (%)
Wollondilly LGA	11.8	8.9
Warragamba	11.0	3.0
Silverdale	10.9	7.2

Source: ABS 2016 Census of Population and Housing

Within Warragamba and Silverdale, the overseas-born population was predominantly from England. Warragamba had a higher percentage of the population born overseas and in English speaking countries compared to Silverdale. This is in line with the very low percentage of households not speaking English at home in Warragamba (refer to Table 6-14). In Warragamba, the most common countries of birth were England 2.7 percent, New Zealand 2.1 percent, Scotland 0.9 percent, Netherlands 0.9 percent and Tonga 0.5 percent. In Silverdale, the most common countries of birth were England 2.8 percent, Malta 1.0 percent, New Zealand 0.7 percent, Italy 0.6 percent and Scotland 0.5 percent. Table 6-15 below shows the top countries of birth other than Australia for the two towns in 2016.

¹³Assessed on 30 November 2018 from <https://mw2.google.com/mw-panoramio/photos/medium/36548811.jpg>

¹⁴ Assessed on 30 November 2018 from <http://www.attractions.net.au/attractions/nsw/wallacia/bents-basin-state-conservation-area/23102/d>

Table 6-15. Proportion of population born overseas by country of birth, 2016

Country by birth	Warragamba (%)	Silverdale (%)
England	2.7	2.8
New Zealand	2.1	0.7
Scotland	0.9	0.5
Netherlands	0.9	0.3
Tonga	0.5	0.0
Malta	0.3	1.0
Italy	0.0	0.6

Source: ABS Census of Population and Housing 2016

6.2.7.3 Community identity and cohesion

Warragamba and Silverdale residents are closely connected to the natural and rural landscape around the community. Within the area, there are key cultural heritage and recreational areas such as Warragamba Dam, Warragamba River, and Eugenie Byrne and Haviland Parks. In addition, the two towns are in a close proximity to Greater Blue Mountains World Heritage Area. The community values the natural and beautiful landscape as well as the unique rural lifestyle. As such, community identity is strongly linked to sense of place.

Wollondilly LGA, Warragamba, and Silverdale have strong local network, community connections, and support which engender a high degree of community cohesion. In terms of local network and community connection, the Wollondilly LGA runs community events every year, which bring people of diverse backgrounds together. For example, in 2018, the LGA has organised various events, such as Picton Rodeo, Australia Day ceremonies, Breakfast in the Bush, Clean Up Australia day¹⁵. These events provide opportunities for people to meet and interact each other. These informal connections and networks often build a sense of community and belonging. Similarly, Warragamba and Silverdale towns organise several community festivals each year. For example, in 2018, various community events have been organised, such as Food Drive, Youth Week, DamFest (Figure 6-12), Warragamba Family Food Fair and Carols in the Park. Warragamba-Silverdale Neighbourhood Centre, which is a not-for-profit organisation, has been established to be a place to provide services that increase the quality of life and to connect residents of Warragamba, Silverdale, and surrounding areas. This Centre has been providing programs and opportunities for social connection for community members, care for community members, and local development.

Figure 6-12. Warragamba DamFest 2018



Source: Website¹⁶

¹⁵ Assessed on 29 November 2018 from <http://visitwollondilly.com.au/events/2018-09-16/>

¹⁶ Assessed on 29 November 2018 from <https://www.wollondillyadvertiser.com.au/story/371689/warragamba-wall-will-be-open-for-dam-fest/>

Volunteering is another factor to measure community strength. The level of volunteering can indicate the connection of the community and how individuals are able to support each other and contribute to that community. In Wollondilly LGA, 18.5 percent of the population recorded doing voluntary work in 2016, which was higher than that of Greater Sydney (16.7 percent). In Wallacia – Warragamba -Silverdale, the percentage of people doing some form of voluntary work in 2016 was 14.7 percent. Although this percentage was lower than that of Wollondilly LGA and Greater Sydney, it was at above average level compared to other local districts within the Wollondilly LGA. It is also noted that there was an increase in the proportion of people who did volunteer work in Wallacia – Warragamba - Silverdale between 2011 and 2016 with 13.0 percent and 14.7 percent respectively¹⁷.

6.2.8 Infrastructure, facilities, and services

The provision of infrastructure, facilities and services is crucial for social and economic development of communities. In case of its absence, it will have adverse impacts on the region's ability to attract inward migration and to retain a permanent population to contribute to community development and economic growth. This section details the key infrastructure, facilities, and community services in Warragamba and Silverdale around the Project footprint. It should be noted that social infrastructure, facilities, and services in this section are primarily identified based on a radius of 15 kilometres from the Project footprint. It is considered that within this radius, it is likely to experience increased demand for using existing social infrastructure (such as influx of workers) or Project-related impacts associated construction activities (such as noise or traffic).

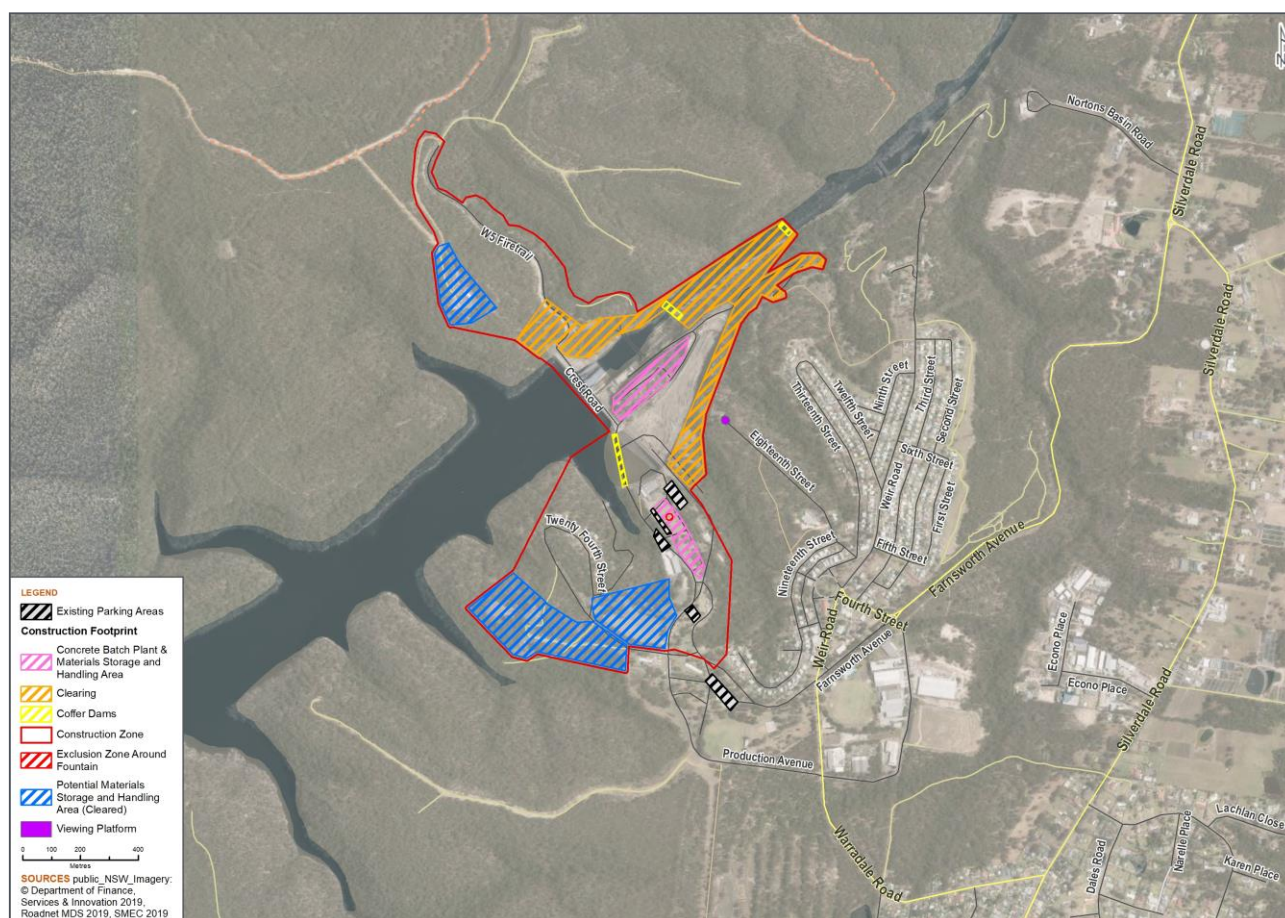
6.2.8.1 Transportation networks

The main transportation network in Warragamba and Silverdale are the local roads and intersections around Warragamba and the region. The major means of transportation in these local communities is private car and bus. There is a network of roads and parking which service the Dam and associated operations and also provide access to recreational areas. Production Avenue and Farnsworth Avenue provide access to the existing Warragamba Dam and Visitor Centre and Haviland Park. Local roads, such as Twenty Third Street and Twenty Fourth Street connect with Production Avenue and Farnsworth Avenue within the Project footprint. However, most of these roads have public access restrictions and are controlled with boom gates and other security measures.

Figure 6-13 below shows major road network and existing parking areas adjacent to the Project footprint. Around the Warragamba Dam, there are a number of designated parking areas located on Production Avenue and Farnsworth Avenue adjacent to Warragamba Dam. The parking located on Farnsworth Avenue is designated for the Warragamba Dam staff only; however, the other parking areas are open to the visitors visiting Warragamba Dam and Haviland Park.

¹⁷ Assessed on 29 November 2018 from <https://profile.id.com.au/wollondilly/volunteering?WebID=100&BMID=20>

Figure 6-13. Major road network and existing parking areas adjacent to the Project footprint



Source: SMEC 2018

The Warragamba local road network can be categorised into three basic types of roads including:

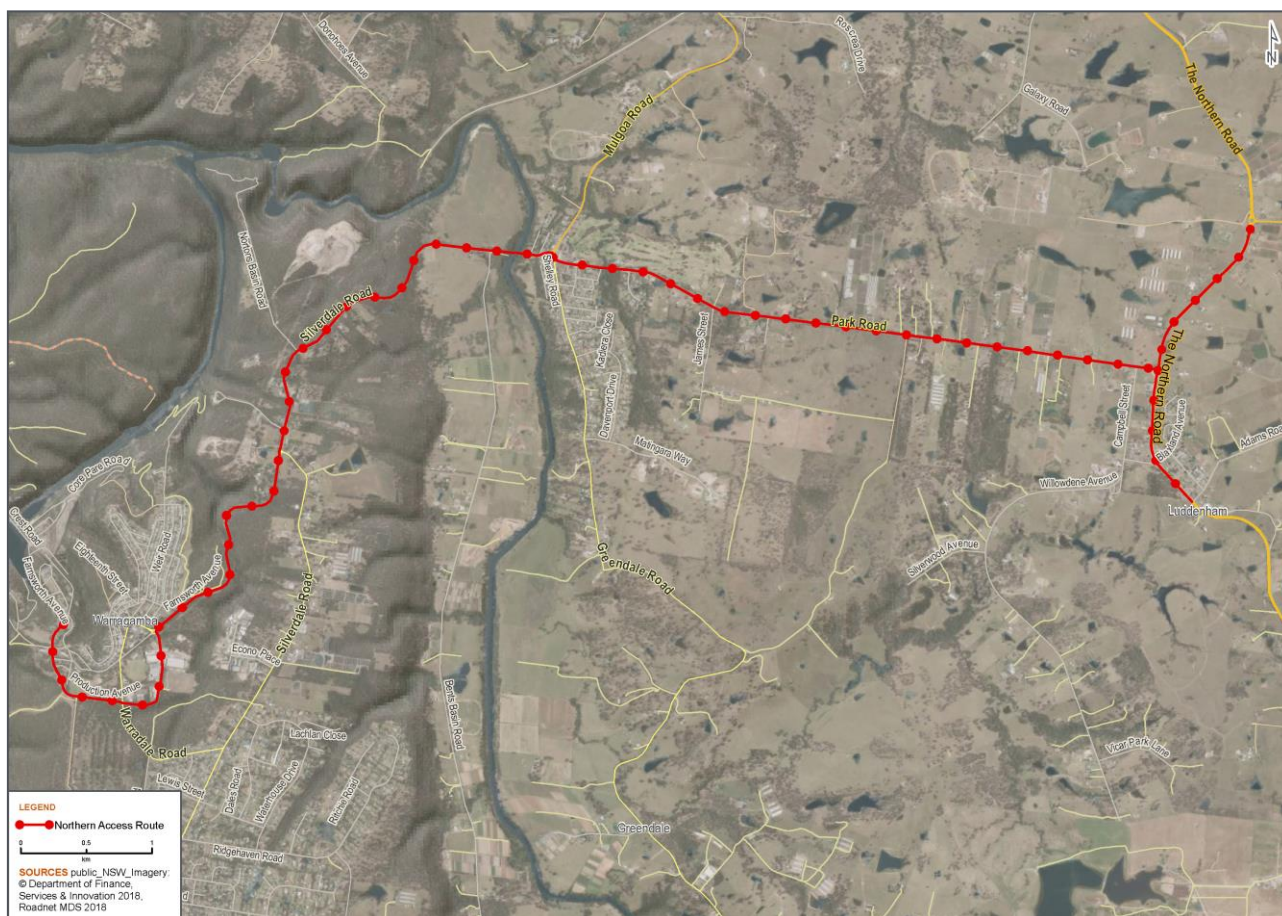
- residential streets make up most of the local roads
- local arterial roads, such as Farnsworth Avenue and Silverdale Road, provide connections to the regional road network
- commercial or industrial roads service light industry, recreational facilities, and commercial facilities in the southern part of Warragamba.

The Blaxland Crossing Bridge is located on the eastern side of Warragamba area and connects the Park Road and Mulgoa Road with Silverdale Road. Currently, heavy trucks from Norton Basin Quarry and Warragamba chlorination plant are using this bridge. Heavy trucks coming from north would use this bridge to access the Project construction area.

Two routes, one from the north (namely the Northern Access Route) and one from the south (namely the Southern Access Route), provide access to the Project footprint. Specifically, regional access to Warragamba Dam construction area for materials and workers would be provided by the M4 Motorway and the Northern Road from the north, and the Hume Motorway from the south.

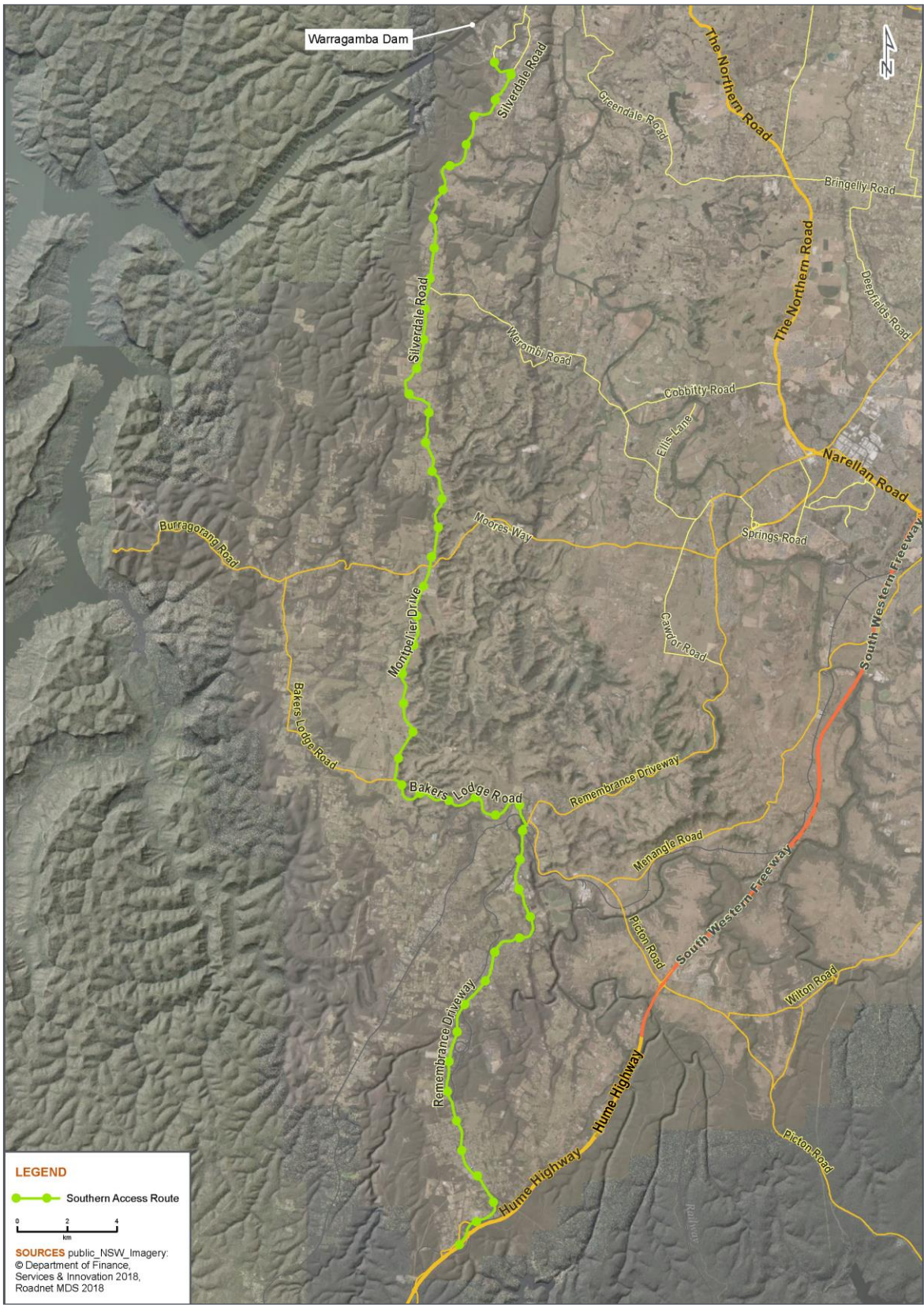
The M4 Motorway, located to the north of Warragamba, connects the Warragamba Dam area to Western Sydney and other parts of Sydney via the Northern Road and Mulgoa Road. The Northern Road and Mulgoa Road are located to the east of Warragamba and connect with Park Road and Silverdale Road respectively. As of November 2018, construction work is being undertaken to upgrade the Northern Road and it is anticipated to be completed before the Project construction works commence. The Northern Road is a key corridor and would be used to transport construction materials to the site from both the north and south. Figure 6-14 shows the Northern Access Route.

Figure 6-14. Northern Access Route



The Hume Motorway, located to the south of the Warragamba, connects to Warragamba via Silverdale Road, Montpelier Drive, Bakers Lodge Road, and Remembrance Driveway. Figure 6-15 shows this transportation route.

Figure 6-15 Southern Access Route



Source: SMEC 2019

Public transportation provided around the Project footprint is limited. The Project is located remote from major transport interchanges or public transport hubs and large population centres. Therefore, it is difficult to increase the potential mode split to active transport. As of November 2018, there were only two bus routes, namely 795 and 32, serving the Warragamba area. It is noted that there was no obvious public transport hub or park-and-ride site for the Project's construction workforce shuttle bus that would generate sufficient patronage to be worthwhile.

6.2.8.2 Education services

The Warragamba Public Primary School and the Silverdale Childcare Centre are the only two education facilities in the local area. Warragamba Public School is located in the town centre and 2.1 kilometres away from the Project footprint. Silverdale Childcare Centre is 4.9 kilometres away from the Project footprint and is located within the main residential area of the suburb. Residents in these two towns travel to Penrith for further education and training.

Table 6-16 below provides a list of community and services available in Warragamba and Silverdale townships. In total, there are eight community and civic services in the local communities (including seven services in Warragamba and one in Silverdale). As mentioned previously, the two towns have same access to Warragamba-Silverdale Neighbourhood Centre.

Table 6-16. List of community and civic services surrounding the Project footprint, 2018

Area	Community and civic services
Silverdale	All Saints' Anglican Church Silverdale
Warragamba	Warradale FC St Paul's Anglican Church Sacred Heart Catholic Church Warragamba Warragamba Silverdale Neighbourhood Centre Warragamba sportsground Warragamba Swimming Pool Warragamba Recreation Reserve

Source: SMEC 2018

6.2.8.3 Police, emergency services, and justice

Key police and emergency services are available in Warragamba and Silverdale townships. In Warragamba, there is one police and one emergency service while there is only one emergency service in Silverdale. It is noted that the police station in Warragamba does not open 24 hours. Table 6-17 lists all police and emergency services available in Warragamba and Silverdale as of November 2018.

Table 6-17. List of community and civic services surrounding the Project footprint, 2018

Area	Police and emergency services
Silverdale	Silverdale Rural Fire Brigade
Warragamba	Fire and Rescue NSW NSW Police

Source: SMEC 2018

6.2.8.4 Open space and recreational areas

There are a wide range of open space and recreational areas located in these two towns that service surrounding communities. The list of open space and recreational areas is detailed in Table 6-18 below.

Table 6-18. Open space and recreational areas in Warragamba and Silverdale, 2018

Area	Open space and recreational areas
Silverdale	Eugenie Byrne Park Burraborang (State Conservation Area) Bents Basin (National Park) Gulguer Nature Reserve
Warragamba	Haviland Park Warragamba Recreation Reserve Warragamba Sportsground Burraborang (State Conservation Area)

Source: SMEC 2018

6.2.9 Community health and safety

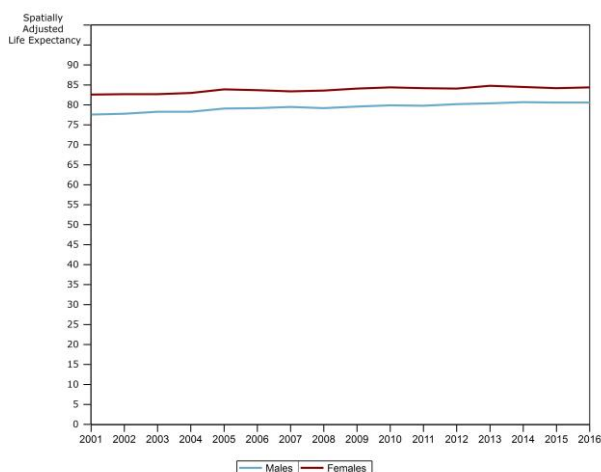
This section provides community health and safety data in the local communities study area. It should be noted that health-related data is only available at LGA level. No official data records are available at the suburb level. Therefore, official health-related data presented in this Section is for the Wollondilly LGA only. Community-related health information for the affected suburbs will be provided where available.

6.2.9.1 Community health

Key health indicator

Morbidity level and the average length of illness are indicators that can describe a community's health status. A lower rate of morbidity means a better handling of health issues in an area. Data from NSW Ministry of Health published in 2018 identified that in 2016, the life expectancy rate in the Wollondilly LGA was 82.9 years. Life expectancy at birth has gradually increased since 2001. Life expectancy rate often indicates the success level of a region's economic and health development. High life expectancy indicates good community health conditions, health knowledge and education levels, as well as good access to health services. When comparing the life expectancy of Wollondilly with the country, the LGA has a slightly higher life expectancy rate than the Australian average rate, at 82.9 years and 82.5 years respectively. Figure 6-16 shows the increase in life expectancy at birth in the Wollondilly LGA from 2001 to 2016.

Figure 6-16. Life expectancy at birth, Wollondilly LGA, 2001 to 2016



Source: NSW Government HealthStats 2018

Figure 6-17. Deaths from all causes, Wollondilly LGA, 2001 to 2016



Source: NSW Government HealthStats 2018

Regarding mortality, from 2015 to 2016, it is recorded that there were average 247.5 deaths from all causes in Wollondilly. The number of deaths from all causes fluctuated from 2001 to 2016. Figure 6-17 shows the change in mortality in the Wollondilly LGA from 2001 to 2016.

General population health

Wollondilly Health Alliance conducted a Wollondilly Health Needs Assessment in 2014 and one of the outcomes of this assessment shows that the health of residents in Wollondilly is equal to or slightly better than the NSW average (Wollondilly Health Alliance, 2014). Based on the website of Wollondilly Health Alliance, as of 2018, residents in the LGA are more likely to rate their health as excellent, very good, or good when compared to the rest of NSW. However, when comparing health issues with the whole of NSW, residents of Wollondilly demonstrate 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.

Table 6-19 below shows the 10 most common reasons for hospital admission in Wollondilly LGA in 2015, compared with NSW. This data is based on the latest report, the Wollondilly Health Profile, conducted in 2016 by South Western Sydney Local Health District. It is noted from the table that digestive system was the common prevalent disease in Wollondilly. In addition, infection-related diseases, such as influenza and pneumonia, were not recorded in the list of the 10 most common reasons for hospital admission in Wollondilly LGA in 2015. Based on HealthStats NSW 2014-2016, the number of influenza and pneumonia hospitalisations in the LGA during this period was only 163 people.

Table 6-19. Ten most common reasons for hospital admissions in 2015, Wollondilly LGA and NSW

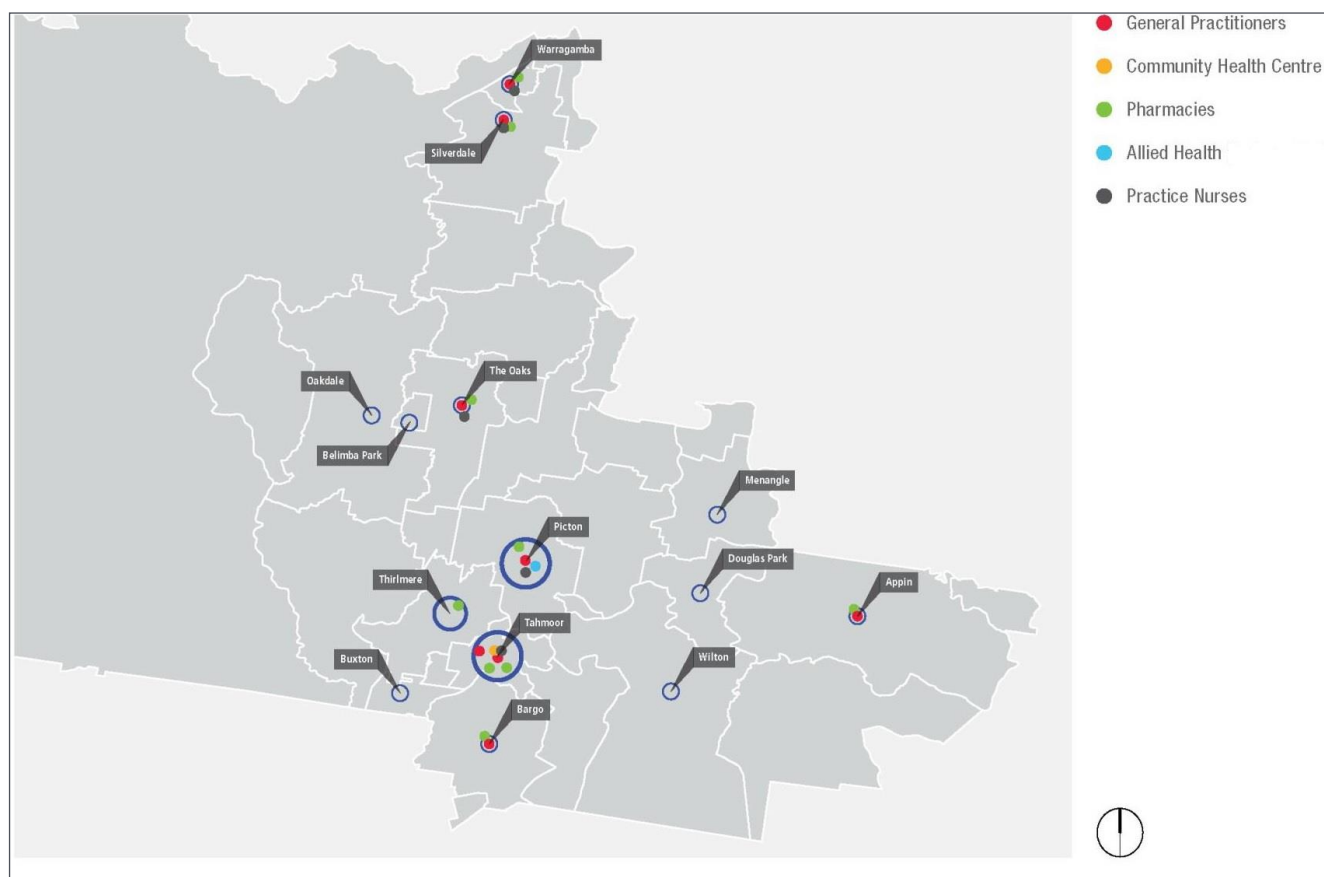
Group	Wollondilly LGA (separation/%)	NSW (separation/%)
Digestive system diseases	1,953 (11.2)	294,950 (9.6)
Dialysis	1,695 (9.7)	376,589 (12.3)
Nervous and sense disorders	1,372 (7.8)	207,110 (6.7)
Symptoms and abnormal findings	1,370 (7.8)	223,780 (7.3)
Injury and poisoning (including external causes)	1,169 (6.7)	199,347 (6.5)
Maternal, neonatal, and congenital causes	1,148 (6.6)	195,501 (6.4)
Musculoskeletal diseases	984 (5.6)	143,603 (4.7)
Genitourinary diseases	970 (5.5)	140,903 (4.6)
Respiratory diseases	812 (4.6)	139,743 (4.6)
Circulatory diseases	745 (4.3)	153,672 (5.0)

Source: Wollondilly Health Alliance 2014

Access to health services

Several types of health services are provided in the Wollondilly LGA. Health services available in the LGA include general practice, community health centres, pharmacies, practice nurse and allied health services. Key health services based in Wollondilly LGA, including Warragamba and Silverdale towns is shown in Figure 6-18 below. It can be seen that health services are scattered across the LGA, with a particular focus in the main population centres of Picton and Tahmoor.

Figure 6-18. Health services in the Wollondilly LGA



Source: Wollondilly Health Alliance 2014

Regarding accessibility to general practice (GP) in the Wollondilly LGA, it is reported under the Health needs assessment for South West Sydney that as of 2013, Wollondilly had a ratio of 1 GP per 2,960 people. This ratio was significantly lower than that of South West Sydney (1 GP: 1,101 people). This report indicated that Wollondilly had the lowest ratio of GPs to population among the LGAs in South West Sydney (Wollondilly Health Alliance, 2014).

Access to community health services is available in the Wollondilly LGA. Community health services in this LGA are provided by the Local Health District. Community health in this LGA provides three main services including:

- Child and family clinical services: These services are provided for children aged 0-12 years and their families. Clinical services provided include centre based, home, school or preschool assessments and interventions.
- Community health nursing: This service is provided to people of all ages across South West Sydney Local Health District. Services operate seven days per week and include post-acute care, general nursing, and palliative care nursing.
- Specialist clinical services: This type of services include a wide range of specialised services designed to meet the unique needs of particular target groups. Specialist services available in the Wollondilly as of 2018 include sexual health services and sexual health information for youth.

Wollondilly LGA is serviced by the Wollondilly Community Health Centre located at Tahmoor. This centre provides a variety of community health services including child and family services, some specialist services, and community nursing.

It is noted that there are no public and private hospitals within Wollondilly LGA. Residents of Wollondilly LGA depend on those in adjoining LGAs such as Bowral and District Hospital, Camden Hospital, and Campbelltown Hospital. As previously mentioned, specialist services are limited in the LGA; therefore, residents in Wollondilly rely on specialist services at Liverpool Hospital and other metropolitan hospitals.

In terms of accessing to healthcare services in Warragamba and Silverdale, GPs are available in these two towns. Each town has one medical centre. Residents of Warragamba and Silverdale have access to nearby Community Health

Centres of other LGAs, such as Penrith Community Health Centre, Narellan Community Health Centre, or Hoxton Park Community Health Centre.

The findings of the Wollondilly Health Needs Assessment undertaken in 2014 show that Wollondilly contains a limited range of health services and largely relies on health services in adjacent LGAs. Key issues associated with health services in Wollondilly are as follows:

- Rates of provision of GPs in Wollondilly are considerably below the national average.
- Very few specialist medical practitioners working in Wollondilly. Number of allied health practitioners are very small.
- No inpatient services are available. Residents rely primarily on Campbelltown Hospital, Camden Hospital and Bowral and District Hospital, as well as private hospitals across Sydney.

6.2.9.2 Community safety and security

Crime and security

Table 6-20 below shows the number of incidents of selected offences recorded in Wollondilly LGA, and Warragamba - Silverdale¹⁸. It can be seen that in 2017, the numbers of offences associated with malicious damage to property were highest in both Wollondilly and Warragamba - Silverdale with 287 and 28 offences respectively. This was followed by the number of crimes relating to intimidation, stalking, and harassment, accounting for 240 incidents in Wollondilly LGA and 14 incidents in Warragamba-Silverdale. It should be noted that crimes such as robbery, theft, or drug and liquor offences are minimal in both Wollondilly and the two affected suburbs. Noticeably, in 2017, there is no incidence of robbery in Warragamba-Silverdale.

Table 6-20. Number of incidents of selected offences recorded in Wollondilly, Warragamba and Silverdale, 2017

Type of criminal incidents	Total number of offences	
	Wollondilly LGA	Warragamba and Silverdale
Malicious damage to property	287	28
Intimidation, stalking, and harassment	240	14
Transport regulatory offences	187	7
Domestic violence related assault	167	13
Non-domestic violence related assault	84	7
Break and enter non-dwelling and dwelling	127	9
Drug offences	79	3
Sexual offences	61	7
Motor vehicle theft	57	5
Liquor offences	15	4
Robbery	4	0

Source: NSW Bureau of Crime Statistics and Research 2018

Violence and fear of violence result in significant social and economic costs to residents. Wollondilly LGA has committed to working with different stakeholder groups, such as residents, police, community organisations, the business community, and State and Federal governments to ensure the LGA is a safe place to live and work. For example, in 2017, Wollondilly Council proposed to re-establish alcohol-free zones (AFZs) across the LGA for a period of four years from 2017 to 2021. The purpose of these zones is to prevent street drinking and improve public safety¹⁹. It

¹⁸ Warragamba and Silverdale have the same post code – 2752. Therefore, crime data recorded for these two towns are merged.

¹⁹ An alcohol-free zone is an area where it is illegal to consume alcohol 24 hours a day, 7 days a week. Any person seen drinking in an alcohol-free zone may have the alcohol in their possession immediately seized and tipped out or otherwise disposed of by Police. Once established each alcohol-free zone is in place for a maximum of four years (Wollondilly Shire Council 2018). Source: Assessed on 10 December 2018 from <https://www.wollondilly.nsw.gov.au/resident-services/community/community-safety/>

is proposed that AFZs will be established in nine suburbs within Wollondilly, including Warragamba²⁰. These zones will greatly reduce the chances of disorderly behaviour and alcohol related crime on the streets.

Transportation and road safety

The local and regional transportation network has been described in Section 6.2.8.1. Based on the traffic and transport assessment, as of November 2018, apart from The Northern Road and Park Road intersection, road and intersection capacity is assessed to be at good level of services and have spare capacity to accommodate additional traffic. Generally, traffic volumes are relatively low in comparison to the capacity of intersections, resulting in good level of performance and minimal delays. However, it is noted that the Northern Road/Park Road intersection's performance is assessed to be low, which is accordingly predicted to deteriorate over the next four years for some traffic movements due to the growth in traffic volumes. It is further noted that as of November 2018, a major upgrade of this section of The Northern Road is planned to facilitate the development and access to the new Western Sydney Airport.

Most existing pavement conditions of the road network are from very good to fair, with high number of roads being very good and good²¹. For instance, roads along the Northern Route (Silverdale Road, Farnsworth Avenue, and Production Avenue) have good pavement condition. However, roads along the Southern Route have poor pavement conditions. As such, additional heavy trucks along this route may have detrimental impacts on the road surface condition.

There are no designated cycle paths within the local communities study area. However, designated pedestrian walkways are available along some of the roads surrounding the Project footprint, such as walkways along Park Road, Silverdale Road, Farnsworth Avenue, Weir Road, Production Avenue, and Warradale Road. However, these walkways are not continuous and concentrated around the main activity centres. Most of these walkways are narrow (1.25 metres), except for the walkways around Farnsworth Avenue and Weir Road (ranges from 2 metres to 2.8 metres).

Table 6-21 below provides a summary of traffic accidents in Wollondilly LGA, compared with the greater regions. Wollondilly LGA lies within the Outer Sydney Area as defined by the NSW Department of Transport. 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 LGA than elsewhere in the Outer Sydney Area. No data on the number of traffic accidents in Warragamba and Silverdale is available.

Table 6-21. Traffic accidents in Wollondilly LGA compared to NSW and outer Sydney, 2016

Area	Total killed and injured	Casualty crashes	
		No. of fatal	% of fatal
NSW	22,593	17,781	78.7
Outer Sydney Area	1,545	1,181	76.4
Wollondilly LGA	132	91	68.9

Source: NSW Department of Transport 2016

6.3 Upstream communities

6.3.1 Overview

As discussed in Section 5.3.2, the socio-economic baseline for upstream communities study area only covers communities in the Blue Mountains LGA as the baseline of Wollondilly LGA has been previously described in the local communities study area. Areas of upstream inundation located in the GBMWhA and associated National Parks. The area of the Blue Mountains LGA directly impacted by the Project is uninhabited. Therefore, the socio-economic baseline of the upstream communities' study area (such as demographic characteristics, economic and employment profile, and housing profile) has been presented at the Blue Mountains LGA level. In the upstream stretch of Lake

²⁰ Suburbs include: Appin, Bargo, Douglas Park, Oakdale, Picton, Tahmoor, The Oaks, Thirlmere, and Warragamba (Assessed on 10 December 2018 from <https://www.wollondilly.nsw.gov.au/home/mediareleases/proposal-to-re-establish-the-alcohol-free-zones/>)

²¹ Refer to Appendix O-Transport and traffic of the Warragamba Dam Raising EIS for further details.

Burraborang, the main impact is the increased water level, the consequent inundation and loss of habitats of the surrounding riparian areas. This potential environmental damage may be against the community values of residents and would cause distress to the population. Therefore, to understand the extent of impacts associated with the upstream inundation, key regional open space and recreational areas within the potential inundation area will be identified. In addition, community values of the Blue Mountains LGA will also be discussed in this section.

6.3.2 Community setting

The Blue Mountains LGA is located on the western fringe of Metropolitan Sydney, covering an area of 1,432 square kilometres. The LGA comprises 27 separate towns and villages each with a distinctive identity and character, reflecting the varied climate, terrain, and heritage of the area (Blue Mountains City Council 2018).

The Blue Mountains were first explored in 1813 and roads were built in 1814 which led to the first building being constructed in 1817 at Springwood. The Blue Mountains National Park (which of the majority is also part of the GBMWH) forms approximately 70 percent of the LGA. The City of Blue Mountains is the biggest urban area in a world heritage listed area. The GBMWH was granted its world heritage status in 2000. This world heritage status is an integral part of the Blue Mountains community and they strive to maintain this status through environmentally based community values.

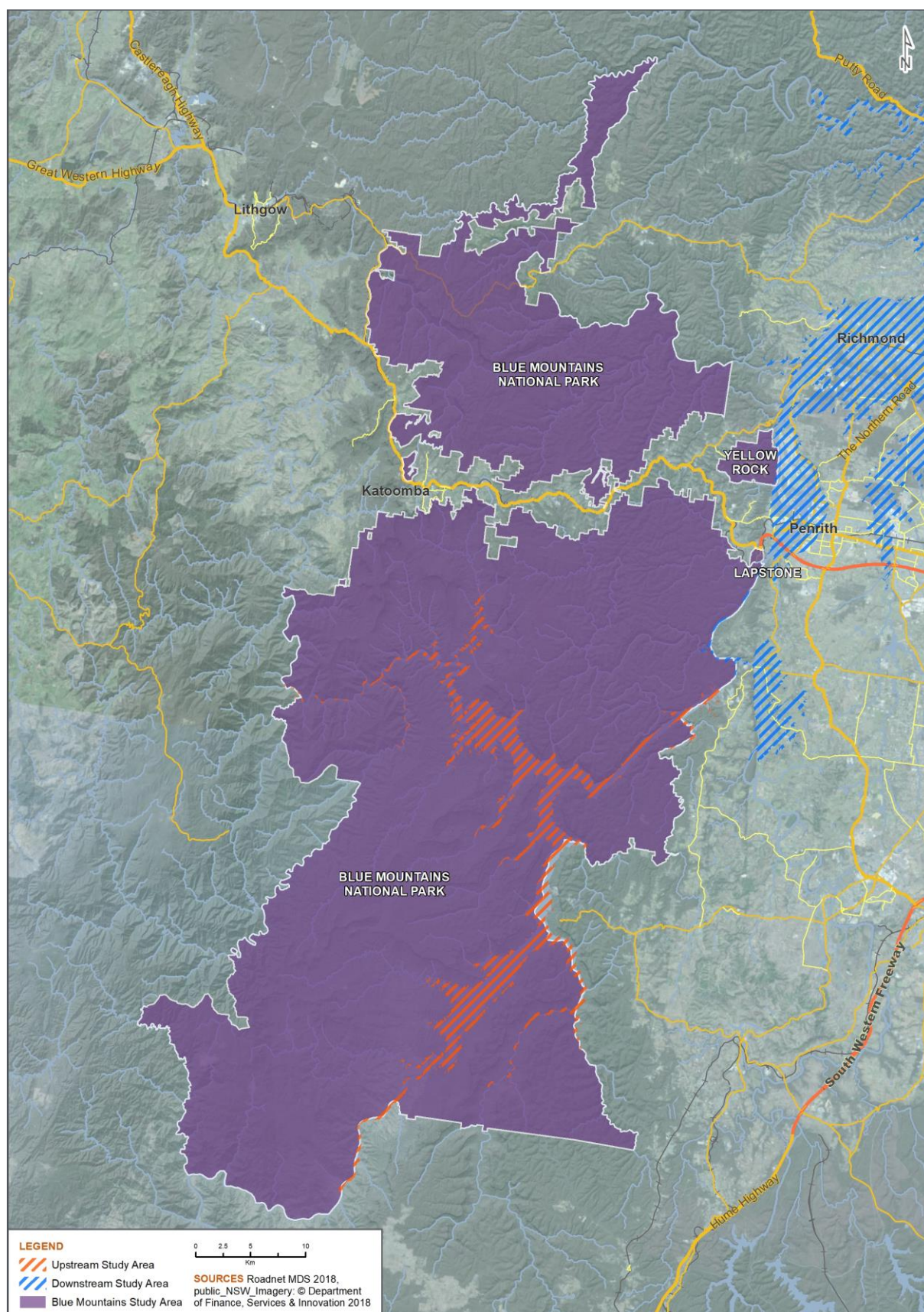
The Great Western Highway and Blue Mountains/Western railway line traverse the LGA transporting goods, services, and commuters between Sydney and the Central West of NSW, and within the LGA itself (Blue Mountains City Council 2018). Tourism is essential in the area and is a key component of the economic profile for the Blue Mountains LGA. Accommodation and food services is the second largest industry and formed 13.6 percent of the Blue Mountains LGA industry composition as of December 2018. There were a total of 2,514 accommodation and food service businesses in the Blue Mountains LGA. Many of these accommodation and food service businesses also provide or link with other businesses to provide eco-tourism through the national parks. Figure 6-19 below provides a map of the upstream communities.

The following sections provide the key socio-economic information for the Blue Mountains LGA with a comparison to Greater Sydney. The information is based on ABS Census data 2016 unless otherwise stated.

6.3.3 Land use

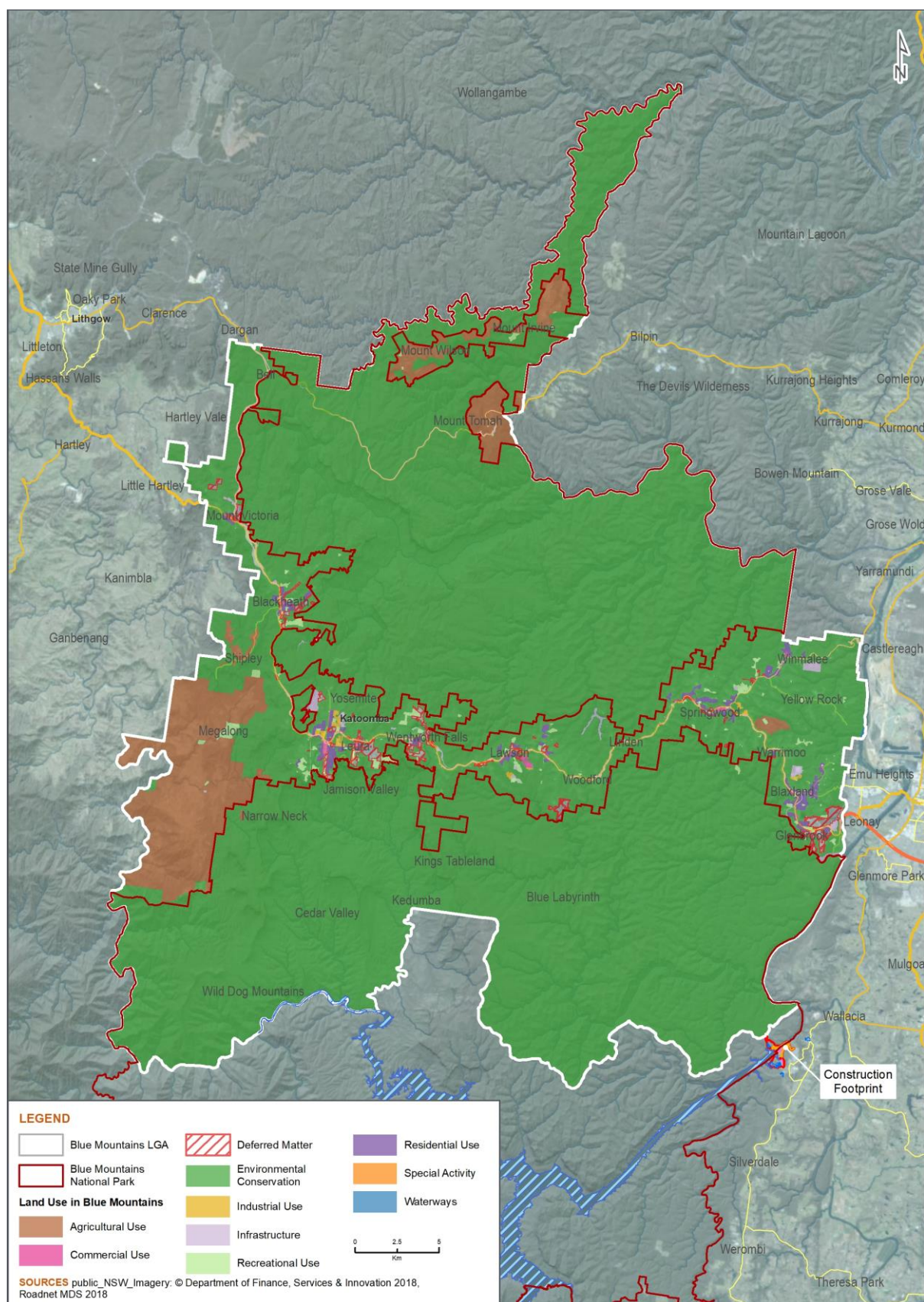
The land use profile of the upstream area is primarily characterised by environmental conservation land. According to Blue Mountains Local Environmental Plan 2015, land for environmental conservation in the Blue Mountains LGA accounted for 91.0 percent of the total LGA. Agricultural land made up 6.0 percent of the total land available in this LGA. Small proportions of other land use categories in the upstream communities included infrastructure, residential, recreational, commercial uses, waterway and deferred matters (NSW Government 2015). Overall, the visual character of the Blue Mountains LGA is predominantly natural forest, woodland, hills, cultural heritage sites and recreational areas. Figure 6-20 below provides a snapshot of land use categories available in the Blue Mountains LGA. Figure 6-21 presents proportions of land use categories in the upstream communities' study area.

Figure 6-19. Map of upstream communities - Blue Mountains LGA and Blue Mountains National Park



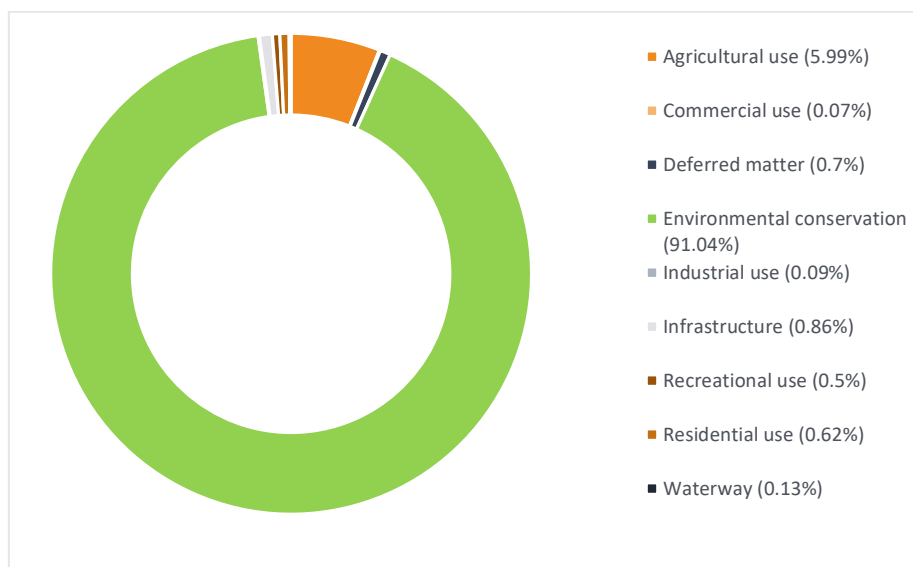
Source: SMEC 2018

Figure 6-20. Map of land use in Blue Mountains LGA



Source: SMEC 2018

Figure 6-21. Proportions of land use categories in the Blue Mountains LGA



Source: NSW Government 2015 (Adapted from Blue Mountains Local Environmental Plan 2015)

6.3.4 Demographic profile

Key demographic indicators were selected to provide a snapshot of the Blue Mountains LGA which is presented in Table 6-22. Based on the ABS Census 2016, the total population of the Blue Mountains LGA was 76,904 people. The population density of this LGA was only 55 persons per square kilometre, which is attributed to the presence of the National Park. The population density in this LGA was much lower than Greater Sydney with 390 person per square kilometre. Between 2011 and 2016, the LGA experienced a population growth of only 1.3 percent which was a slightly lower than the rate of population growth recorded for Greater Sydney overall (1.5 percent).

The Blue Mountains LGA and Greater Sydney recorded a similar gender breakdown with slightly more females than males (including 51.7 percent for females and 48.3 percent for males in the Blue Mountains LGA and 50.7 percent for females and 49.2 percent for males in the Greater Sydney). 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 cultural diversity in the Blue Mountains LGA was less than that in the Greater Sydney. 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 Australia population in this LGA was significantly higher than that of Greater Sydney (1.5 percent of the population). The Indigenous Australian gender distribution in the Blue Mountains LGA was similar to the overall community distribution, with Indigenous female distribution being higher than Indigenous male distribution (50.7 percent females and 49.3 percent males). The percentage of residents who were born overseas in the LGA (21.9 percent) was substantially lower than that in the Greater Sydney (42.9 percent). Accordingly, compared to Greater Sydney, the Blue Mountains LGA had lower proportion of households where a non-English language is spoken at home, accounting for only 6.0 percent in the LGA and 38.2 percent in Greater Sydney. The Blue Mountains LGA had 5.5 percent of its population having a core activity in need of assistance, which was higher than Greater Sydney (4.9 percent).

Table 6-22. Selected demographic indicators of the upstream communities study area, 2016

Demographic indicators	Blue Mountains LGA	Greater Sydney
Area (km ²)	1,432 km ²	12,367 km ²
Total population in 2016 (no.)	76,904 people	4,823,991 people
Population density (persons/km ²)	55 persons/km ²	390 persons/km ²
Population change between 2011 and 2016 (no.)	962 people	70,135 people
Gender distribution (%)	51.7 female 48.3 male	50.7 female 49.3 male
Median age	44 years old	36 years old
Indigenous Australian population (%)	2.4	1.5
Residents born overseas (%)	21.9	42.9
Households where a non-English language is spoken (%)	8.8	38.2

Source: ABS Census of Population and Housing 2016

6.3.5 Economic and employment profile

The economic and employment profile for the Blue Mountains LGA in comparison with the Greater Sydney is shown in Table 6-23. In 2016, the Blue Mountains LGA had 37,644 people in the labour force. The labour force participation rate in the LGA was 59.9 percent, which was slightly lower than Greater Sydney with 61.6 percent. The unemployment rate in the Blue Mountains LGA (4.7 percent) was lower than that in Greater Sydney (6.0 percent).

According to the 2016 ABS Census, there were a total of 5,524 registered businesses in the Blue Mountains LGA. The three top employment industries were: education and training, healthcare and social assistance, and public administration and safety. Education and training was the largest industry of employment in the LGA, comprising 14.8 percent of all total industries. The second and third major employment industries in the LGA were healthcare and social assistance industry and public administration and safety industry, accounting for 14.6 percent and 8.9 percent respectively. Tourism forms a major industry in the Blue Mountains, and it is shown with accommodation and food services being sixth for total employment (7.3 percent). In comparison, the major three employment industries in the Greater Sydney were healthcare and social assistance, professional, scientific and technical services, and retail trade. The median household income in the Blue Mountains LGA was \$1,468/week, which was lower than Greater Sydney (\$1,750 per week). Regarding the SEIFA index, the LGA ranked ninth within Australia with a score of 1,045. This rank shows a relatively high level of advantage in the LGA.

Table 6-23. Selected economic indicators of upstream communities, 2016

LGA	LABOUR FORCE PROFILE			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (No.)	SEIFA	
	No of labour force (no.)	Labour force participation rate (%)	Top three employment industries				Score of advantage & disadvantage	Rank within Australia
Blue Mountains	37,644	59.9	Education and Training Healthcare and Social Assistance Public Administration and safety	4.7	1,468	5,524	1,045	9
Greater Sydney	2,418,902	61.6	Healthcare and Social Assistance Professional, Scientific and Technical Services Retail Trade	6.0	1,750	725,511	10,252	N/A

Source: ABS Census of Population and Housing 2016

6.3.6 Housing profile

The Blue Mountains LGA provides a peri-urban open area for people to live which is still connected to employment hubs within the Greater Sydney region. Table 6-24 below shows the housing characteristics for the Blue Mountains LGA. There was a total of 32,827 private dwellings with 87.5 percent of these being occupied and 7.3 percent being unoccupied. There were 397 State Housing Authority and 197 community/church owned rentals in the Blue Mountains LGA. Social housing in the Blue Mountains formed 2.1 percent of the total dwellings. In this LGA, there was 170 homeless people which formed 0.2 percent of the total population.

Table 6-24. Summary of housing characteristics in Blue Mountains LGA, 2016

Private dwellings			Social housing			Homelessness	
Total private dwellings (no.)	Occupied private dwellings (%)	Unoccupied private dwellings (%)	State housing authorities (no.)	Community/church owned rentals (no.)	Social housing (%)	Total homeless people (no.)	Proportion of total population (%)
32,827	87.2	12.8	397	197	2.1	170	0.2

Source: ABS Census of Population and Housing 2016

6.3.7 Regional open space and recreation areas

The Blue Mountains National Park covers an area of 247,000 hectares, constituting 25 percent of the GBMWA. The GBMWA was listed on the World Heritage register due to its outstanding natural values of the major stages of the Earth's ongoing biological processes and biological diversity. The GBMWA provides habitat for many threatened species of plants and animals, which have survived from the Gondwana period. In addition, the GBMWA is an important recreational resource, providing the setting of a range of nature-based activities. Due to its environmental, cultural, and recreational significance, the GBMWA is a major tourism destination in the Blue Mountains LGA, attracting large numbers of local and overseas visitors²².

The value of the Blue Mountains National Park is significant due to both the natural and cultural features and its geographical setting. Outstanding natural features include cliff lines, narrow canyons, forested ridges, and gorges, along with a range of vegetation communities including rainforest, tall open forest and heathlands. In addition, there are many sites of Aboriginal significance within the Blue Mountains National Park (NSW National Parks and Wildlife Services 2018)²³.

Key regional open space and recreational areas where access may be affected by inundation have been identified and listed in Table 6-25 below. There were 46 recreational features surrounding Lake Burrangorang in the National Park. These recreational features include, for example, national parks, mountain bike trails, walking tracks, and look-out points and campgrounds. It is noted that these features do not give an accurate representation of the open space within the Blue Mountains LGA, which is approximately 70 percent national park. These 46 recreational features, however, are the ones that will potentially be affected by the Project.

Table 6-25. List of key regional open space and recreational areas in the affected upstream area

List of key open space and recreation areas			
1.	McMahon's Point	24.	W4e Trail
2.	Burrangorang - McMahon's walking track	25.	Beloon Pass Trail
3.	Kings Tableland Rd	26.	Murphys Flat Fire Trail
4.	Battleship Tops	27.	Sheepwalk Trail
5.	W5c trail	28.	Roses Trail
6.	W5d Dallawang Ridge Trail	29.	Murphy Link Trail
7.	W5e Bereton Ridge Trail	30.	Colemans Bend Trail
8.	Kedumba Valley Rd	31.	Donohoes Flat Trail
9.	Policeman Point	32.	Tonali Point Trail
10.	W7h Rucksack Ridge Trail	33.	Byrnes Bay Management Trail-w1

²² Assessed on 21 December 2018 from <http://www.environment.gov.au/heritage/places/world/blue-mountains>

²³ Assessed on 21 December 2018 from <https://www.nationalparks.nsw.gov.au/visit-a-park/parks/blue-mountains-national-park>

List of key open space and recreation areas	
11. W7 Ceddarland Ridge Trail	34. Tonalli Point Trail
12. W7d Trail	35. Tonalli Point
13. W7c Kelpie Point Trail	36. W1c Tonalli Cover Trail
14. Kelpie Point	37. Tonalli Ricer Trail
15. W7b White Dog Ridge Trail	38. W1d Jooriland Trail
16. Birrel Lake Bush Camping Area	39. Colemans Bend
17. W2 Scotts Main Ridge Rd	40. Konangaroo Clearing
18. Commodores Trail	41. Catholic Bushwalkers Campsite at New Yards
19. W2a Butchers Creek Trail	42. Dex Creek Bush Camping Area
20. Cedar Road Point	43. Yerranderie Camping Area
21. Fletcher's Lookout	44. Kiaramba Spring Camping Area
22. W4 Trail	45. Birrel Lake Bush Camping Area
23. W4g Trail	46. Dunphys Campground

Source: SMEC 2018

6.3.8 Community values

The Blue Mountains LGA contains areas of the GBMWH which is highly valued by the community for its environmental, cultural, and recreational significance. The community values of the Blue Mountains LGA have been detailed in the 2035 Community Strategic Plan, which was informed by residents in 2017. This plan was designed to engage with the community to understand their values, aspiration goals, and history of the Blue Mountains Region. The vision established in the Blue Mountains Community Strategic Plan is for 'A more sustainable and successful Blue Mountains by 2035, environmentally, socially and economically' (Blue Mountains City Council 2017).

Environmental sustainability is a number one priority for many community members. This is due to the community being surrounded by the world heritage area and national parks. The community strives to minimise their urban footprint on the natural environment and to be a model for sustainable living (Blue Mountains City Council 2017). The Blue Mountains community aspires to maintain its unique feature as the largest urban area within a world heritage area. The key environmental value of the community also ties into the economic profile of this LGA. The environmental values of the community have also been driven by the large tourism industry and its heavy reliance on the scenic environment in the area.

The Blue Mountains LGA is also rich in cultural and built heritage. There are many sites throughout the Blue Mountains that are of both cultural and historical significance to Aboriginal people. Within the Blue Mountains LGA, there are large areas of traditional lands of the Gundungurra and Dharug tribal groups. Aboriginal occupation in the area has been dated to 22,000 years ago. Residents acknowledge the Aboriginal people, their values and knowledge, as well as their contribution to the past, present and future of the area. In addition, the Jooriland Homestead (unlisted potential heritage item) also occurs within the Blue Mountains LGA and holds heritage value. The community aims to improve conservation and recognition of other cultural heritage assets located in natural landscapes.

The areas bushland backdrops underpin the quality of life of residents in the Blue Mountains LGA. Local people have well-defined values and are proud to live in the scenic area. They enjoy the beautiful landscape, a quiet and clean environment, rich cultural and built heritage, and recreational areas in the LGA. The community values this identity and characterises the unique lifestyle opportunities of living in a natural, cultural, recreational, and spiritual area. As such, community identity is strongly linked to the place where values of environment, culture and recreation are significant.

6.4 Downstream communities

6.4.1 Overview

As described previously in Section 5.3.3, the downstream communities study area has been defined as including suburbs which would be affected by a PMF, of which 74 suburbs across five LGAs have been identified. A PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. A PMF is considered to be an extremely rare event. The most acute form of impacts associated with the flood events is direct inundation and the subsequent need to evacuate. Accordingly, the downstream communities study area is defined by the areas affected by a PMF. Suburbs which would be affected by a PMF collectively constitute the downstream communities study area. It should be noted that the flood events also generate wider socio-economic changes, such as loss of utilities and services, community severance and impacts on business and economic activities. Subsequently, it is necessary to collectively understand the five LGAs within the downstream communities study area. Therefore, LGAs which would directly experience effects associated with a PMF event collectively comprise the downstream communities study area.

The downstream communities study area constitutes five LGAs, including Liverpool, Penrith, Hawkesbury, Blacktown, and The Hills. Seventy-four (74) suburbs from these LGAs have been identified to be in the PMF area, and subsequently constitute the downstream communities study area. 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.

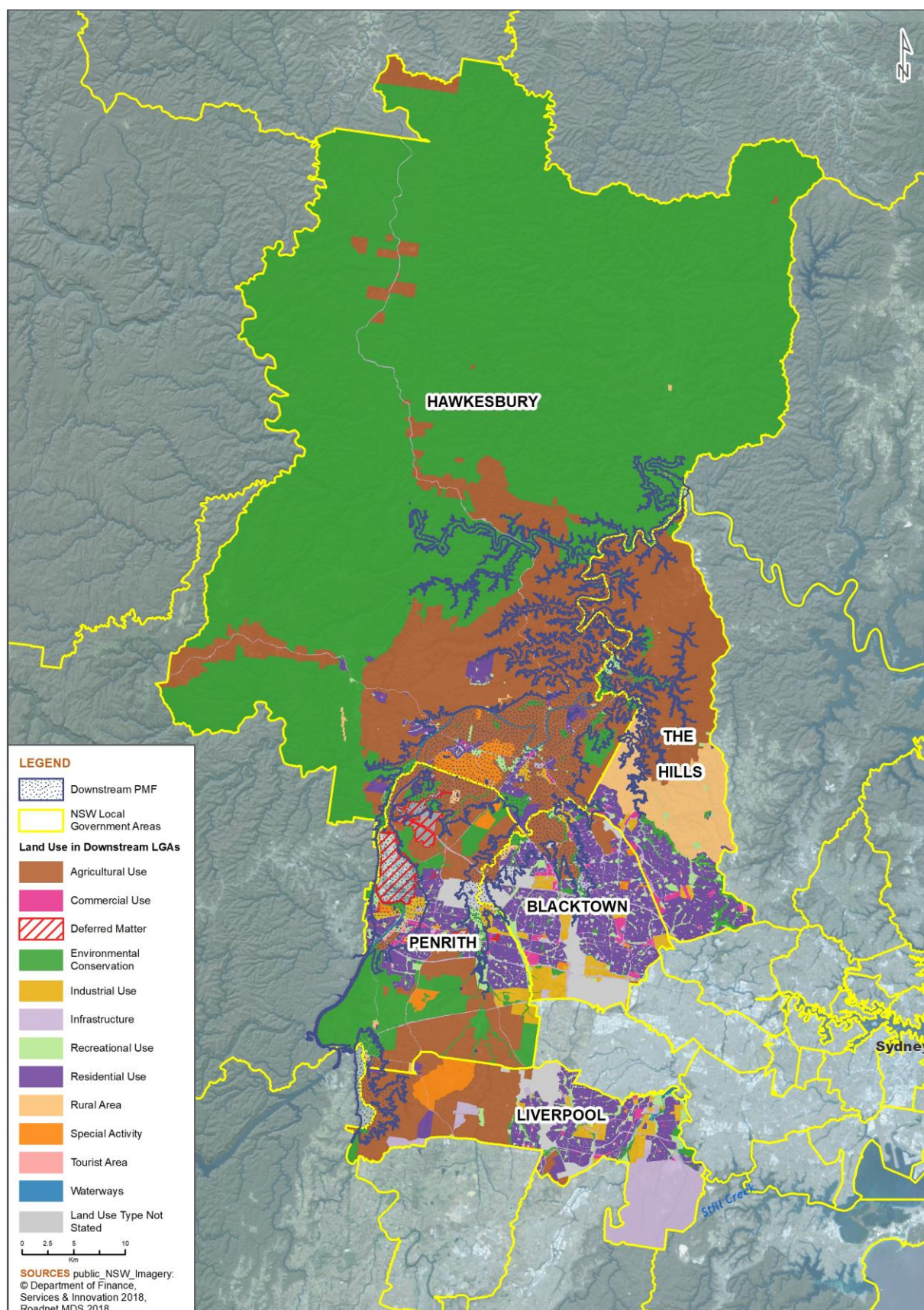
This section provides the key socio-economic indicators for the downstream communities study area, including the 74 PMF-affected suburbs and the five LGAs. The socio-economic baseline analyses the demographic characteristics, economic and employment profile as well as housing profile. This section also highlights the regional open space and recreational areas and key social infrastructure in the downstream communities study area. The socio-economic profile of downstream communities study area is gathered to provide an analysis of existing conditions and future growth of the downstream communities, which will be used to assess potential socio-economic impacts. It should be noted that detailed socio-economic profiles of each of these LGAs can be found in Appendix A of this report. In addition, the downstream communities study area is located in Western Sydney region. Therefore, strategic planning initiatives for Western Sydney region will be provided to understand the potential socio-economic growth of the downstream communities study area.

6.4.2 Land use and planning

6.4.2.1 Land use

The land use profiles of the downstream communities study area show that of the five affected LGAs, Hawkesbury LGA will have the largest proportion of land affected by PMF (at 53 percent of total land area) while Liverpool LGA will have the smallest proportion of land affected by PMF (at 3 percent of total land area). Agricultural land will be predominantly affected by a PMF, followed by environmental conservation land, and subsequently by residential use land. Figure 6-22 and Table 6-26 below provide the land use categories of the LGAs within the downstream communities study area. Maps of land use categories in each LGA have been provided in Appendix B of this report.

Figure 6-22. Map of land use categories in the downstream study areas



Source SMEC 2019

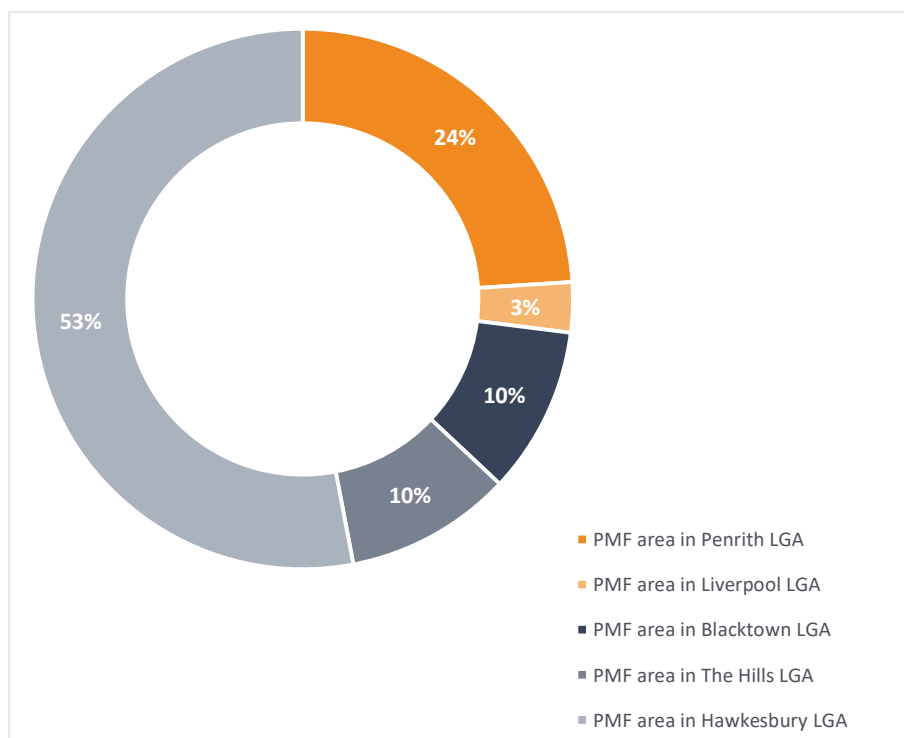
Table 6-26. Land use profile in downstream study areas

Land use categories	Liverpool LGA		Penrith LGA		Hawkesbury LGA		Blacktown LGA		The Hills LGA	
	PMF area %	LGA %	PMF area %	LGA %	PMF area %	LGA %	PMF area %	LGA %	PMF area %	LGA %
Agriculture use	91.4	29.5	30.3	32.7	55.4	55.4	40.6	10.5	56.3	50.0
Commercial use	0.0	1.1	1.5	0.8	0.5	0.4	0.8	3.0	0.7	1.5
Deferred matter	0.0	0.0	22.1	7.9	0.0	0.0	0.0	0.0	0.0	0.0
Environmental conservation	3.5	2.7	14.5	28.1	20.5	20.5	10.5	3.5	15.3	5.3
Industrial use	0.0	3.8	5.8	3.9	1.0	1.0	2.2	9.3	0.2	0.7
Infrastructure	0.0	24.4	2.5	2.9	1.7	1.7	9.9	10.7	0.3	1.4
Recreational use	0.0	5.2	7.0	4.6	2.1	2.1	4.3	6.9	4.4	3.3
Residential use	3.2	20.7	7.0	13.4	6.3	6.3	16.4	39.5	0.5	14.1
Rural use	0.0	0.2	1.3	0.5	0.3	0.3	2.5	0.4	10.6	22.5
Special activity	0.0	5.5	1.1	1.9	8.1	8.1	0.1	0.9	0.0	0.0
Tourist area	0.0	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.1	0.0
Waterways	1.9	1.0	2.1	0.5	4.2	4.2	0.3	0.2	11.6	1.3
TOTAL (km ²)	14.9	306.2	106.1	404.0	232.0	2,775.7	42.5	240.3	43.0	386.4
Total PMF area (km ²)	438.4									

Source: Local Environmental Plans of affected LGAs

The data shows that the total land area affected by a PMF is 438.36 square kilometres. Of this, the PMF area in Hawkesbury LGA is the largest, accounting for 53 percent. This is followed by PMF area in Penrith LGA with 24 percent. The Hills and Blacktown LGAs have the same amount of land areas affected by a PMF, accounting for 10 percent of the total area. Liverpool LGA has the lowest proportion of PMF-affected land, accounting for only three percent. Figure 6-23 below provides the proportions of PMF-affected land areas per each LGA.

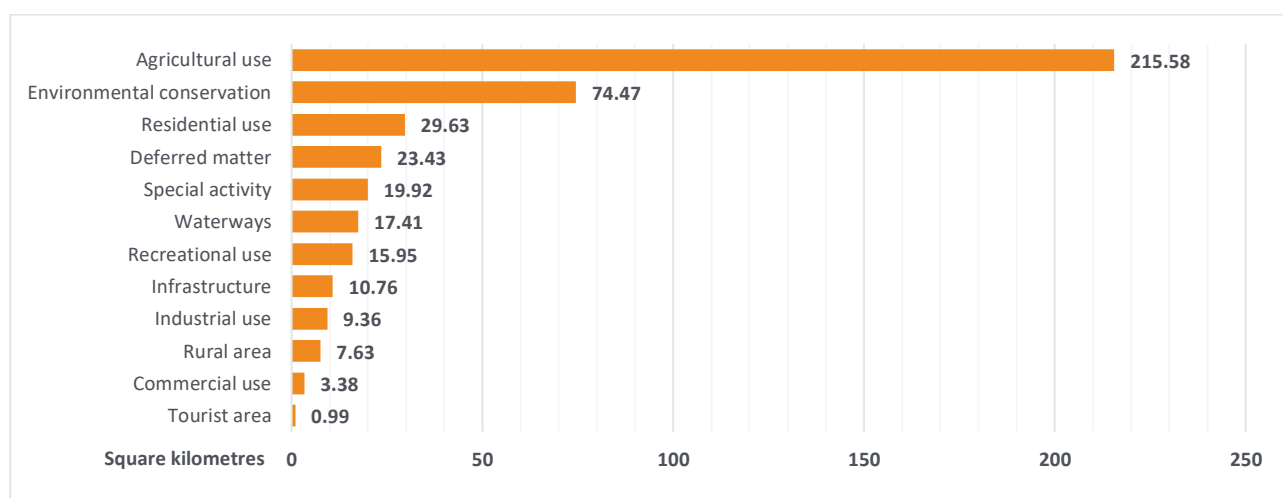
Figure 6-23. Proportions of land areas affected by a PMF across LGAs



Source: Local Environmental Plans of affected LGAs

The top three major land types affected by a PMF are agricultural, environmental conservation and residential use. The total area of affected agricultural land is 215.6 square kilometres accounting for up to 49.2 percent of the entire PMF-affected land area. However, this is attributed to the large amount of affected agricultural land in the Hawkesbury LGA. The agricultural land to be affected by PMF in Hawkesbury consists of 128.4 square kilometres, equivalent to 59.6 percent of the total agricultural land. Regarding environmental conservation land, 74.5 square kilometres of this land type will be affected by a PMF. Of this figure, the total of environmental conservation land in the Hawkesbury LGA is the largest, consisting of 47.5 square kilometres (equivalent to 63.8 percent). This is followed by Penrith LGA (15.4 square kilometres), the Hills LGA (6.6 square kilometres), The Blacktown LGA (4.4 square kilometres) and finally the Liverpool LGA (0.5 square kilometres). In terms of residential land use, the total land area to be affected by a PMF is 29.6 square kilometres. Of this figure, the total area of residential land in Penrith is the largest, accounting for 24.8 percent. This is followed by The Hills, the Blacktown, and finally the Liverpool LGAs. Figure 6-24 below shows the total areas of different land use categories affected by a PMF.

Figure 6-24. Total areas of land use categories affected by a PMF



Source: Local Environmental Plans of affected LGAs.

6.4.2.2 Land planning of broader regional downstream area – the Western Sydney region

Currently, the 1 in 100 chance in a year event is used as a primary measure to determine flood planning levels. However, up until the 1990s development was permitted down to the 1 in 50 chance in a year event in the Hawkesbury LGA. This low-level development is highlighted by the significant scale of inundation around Richmond, Windsor, Bligh Park, Penrith, McGraths Hill, and Marsden Park. Across the floodplain, over 25,000 residents and two million square metres of commercial space are currently subject to flood risk.

Rapid population growth in Sydney has created decreased housing affordability and availability. This has resulted in people seeking affordable housing in the Western Sydney region. Key infrastructure projects in Western Sydney such as the Western Sydney Airport will only increase development in this area. Two key growth areas in the Western Sydney region include Western Sydney (Airport) Priority Growth Area and the North West Priority Growth Area (NSW Government Planning & Environment 2017a, b).

The Western Sydney (Airport) Priority Growth Area is predicted to provide 200,000 jobs as part of an airport city. Key infrastructure will include the Western Sydney Airport in Badgerys Creek. This area will also include the South West Priority Growth Area which is planning to deliver 85,000 homes by 2036 (NSW Government Planning & Environment 2017a).

The North West Priority Growth Area is approximately 30 kilometres from Parramatta and is approximately 10,200 hectares in size (NSW Government Planning & Environment, 2017b). The area has been used for rural purposes historically and is made up by a variety of small parcels (roughly 2-3 hectares) along with larger parcels. A total of 5,900 hectares is suitable for urban development out of the overall 10,200 hectares. As of May 2017, the North West Priority Growth Area had been rezoned to support 53,150 dwellings which would create 43,000 jobs. The North West Priority Growth Area will accommodate approximately 90,000 homes when fully developed. A third of these homes are planned to be delivered by 2026 (NSW Government Planning & Environment 2017b).

The WSIP will invest \$3.6 billion into upgrading the road infrastructure throughout the Western Sydney area (Australian Government & NSW Government 2017). A \$200 million local roads package funded by the Australian Government is also a part of the WSIP. The Northern Road upgrade is a key part of the WSIP and will be completed in six stages (Australian Government and NSW Government 2017).

It is noted that a key development area within the downstream study area is Penrith Lakes. The 2014 Penrith Lakes Parkland Vision Plan details the seven precincts being proposed:

- i. Southern leisure precinct
- ii. Two sports and events precincts
- iii. Chain of ponds precinct
- iv. Urban precinct
- v. Main lakes precinct
- vi. Wildlife lake precinct
- vii. Riverbank precinct (NSW Government 2014).

According to the 2014 Penrith Lakes Parkland Vision Plan, the urban precinct has five objectives for its proposed development. These include the following:

- to develop a vibrant urban community
- to work with Penrith Lakes Development Corporation (PLDC) in preparing a precinct plan
- to integrate the McCarthy's and Poplars sites within the urban landscape
- to ensure a vibrant and active waterfront is developed between the urban and the main lake precincts
- to ensure urban development is built above the 1 in 100 flood level consistent with current legislation (NSW Government 2014).

6.4.3 Demographic profile and community values

6.4.3.1 Population

It is likely that some suburbs within the downstream communities study area will experience impacts and benefits more noticeably than others. These localised impacts and benefits may change the existing character and social amenity of specific localities. To understand the potential impacts and changes, key demographic indicators were selected to provide a population profile and values of the affected suburbs within the downstream communities study area. Table 6-27 presents a summary of demographic profile of the downstream communities study area. The information presented in Table 6-27 is sourced from the 2016 ABS Census.

The review of the demographic profile of the downstream communities study area shows that the population is varying. In detail, data shows that in 2016, there were an estimated 260,511 residents in the identified 74 PMF-affected suburbs, accounting for 69,082 households in total. Of the total populations of the identified 74 PMF-affected suburbs, the 21 affected suburbs in the Penrith LGA had the greatest number of residents of 126,487 people. This is followed by the 10 PMF-affected suburbs in the Blacktown LGA (70,636 residents) and subsequently by 32 affected suburbs in the Hawkesbury LGA (51,419 residents). The average population density across all 74 PMF-affected suburbs was 192.6 persons per square kilometre, which was significantly lower than Greater Sydney (390 persons per square kilometre). It should be noted that the population was unevenly distributed within all PMF-affected suburbs. The population distribution of the 10 PMF-affected suburbs in the Blacktown LGA was the most crowded with the population density average of 719.4 persons per square kilometre. This was followed by the 21 PMF-affected suburbs within the Penrith with 400.4 persons per square kilometre. The seven PMF-affected suburbs in the Hills LGA had the lowest population density, accounting for only 26.3 persons per square kilometre.

In 2016, there were a total of 9,499 Aboriginal and/or Torres Strait Islanders in the PMF-affected suburbs within the downstream communities study area, which accounted for 3.7 percent of the total population of the all affected suburbs. The proportion of Indigenous Australian people across the PMF-affected suburbs was higher than that of the Greater Sydney with 1.5 percent. Of the total number of Indigenous Australians in the PMF-affected suburbs, the affected suburbs in the Penrith LGA made up the greatest number (5,124 people). Cranebrook, in this LGA, was the especially affected suburb, with the highest Indigenous Australian population (812 Indigenous Australians). The PMF-affected suburbs in the Blacktown and Hawkesbury LGA had relatively similar numbers of Indigenous Australians (for example, 2,122 Indigenous Australians in the affected suburbs in the Hawkesbury LGA and 2,058 Indigenous

Australians in the affected suburbs in the Blacktown LGA). The data also shows that the number of Indigenous Australians in The Hills LGA is lowest with 77 Indigenous Australians across the PMF-affected suburbs in total.

Between 2011 and 2016, the population change in the PMF-affected suburbs was varied. Generally, the total population of the seven PMF-affected suburbs within the downstream communities study area increased by 9.1 percent since 2011. This population growth rate of the 74 PMF-affected suburbs was substantially higher than Greater Sydney overall (1.5 percent). While most affected suburbs in the Penrith, Hawkesbury, Blacktown, and the Hills LGAs experienced population growth, there was a decrease in population in the four affected suburbs in the Liverpool LGA. It is further noted that of the downstream communities study areas, there was a significant population growth in the PMF-affected suburbs in Blacktown and Penrith LGAs (for example, the population change in number between 2011 and 2016 is 10,322 and 9,518 people in the Blacktown and Penrith LGAs respectively).

Greater Sydney, and particularly Western Sydney, have experienced significant population growth and development in recent times, with this trend expected to continue over coming decades. The growth of Western Sydney has been supported by many major planning initiatives and transport projects established by the NSW Government, such as priority growth area, urban renewal area, the continued development of new and existing regional centres and major transport projects (for example, Sydney Metro, Western Sydney Infrastructure Plan, South West Rail Link, etc.). The population of Western Sydney is expected to grow significantly. By 2030, the population is expected to grow to 2,734,565 persons (SGS Economics and Planning 2015). It is projected that the population of the five LGAs will increase with a total of 1,637,321 in 2036.

6.4.3.2 Community diversity and networks

Communities of the downstream communities study area in general are diverse and range from densely-populated and highly-urbanised to semi-rural and natural areas. These communities have strong values and are proud of their cultural diversity and values which they live around. Cultural diversity was also prominent across the downstream communities study area. However, residents in the 74 PMF-affected suburbs within the downstream communities study area are more likely to be born in Australia compared to the LGAs within the downstream communities study area and Greater Sydney area as a whole (such as 81.8 percent in the 74 PMF-affected suburbs within the downstream communities study area versus 69.3 percent across the LGAs and 63.3 percent in the Greater Sydney). A lower proportion of households across the 74 PMF-affected suburbs within the downstream communities study area speak a language other than English at home than across the LGAs of the downstream communities study area and the Greater Sydney overall (for example, 13.9 percent across the 74 PMF-affected suburbs within the downstream communities study area versus 34.1 percent across the LGAs and 35.8 percent in the Greater Sydney). Of all affected LGAs, the PMF-affected suburbs in the Blacktown LGA made up the highest percentages of residents who were born overseas. Noticeably, Colebee in the Blacktown LGA had 44.9 percent of its population born overseas. High cultural diversity was also prominent in Glendenning of this LGA, which had 48.8 percent of its population speaking another language. Overall, 3.7 percent of residents across the PMF-affected suburbs within the downstream communities study area require assistance with core activities including self-care, movement, and communication. This proportion was lower than the proportions recorded for the LGAs of the downstream communities study area (6.02 percent) and of the Greater Sydney (4.9 percent) as a whole. Of the PMF-affected suburbs, Richmond in the Hawkesbury LGA had the highest percentage of population having a core activity in need of assistance, accounting for 9.2 percent of its population.

Community cohesion and connectivity varies across the downstream communities study area. In some localities, there are isolated populations which contain fragmented tight-knit communities and groups that do not tend to have many links to others outside of their immediate circles (Newgate Research 2015). For instance, the small townships in the Hawkesbury LGA are considered to be more culturally-homogenous and semi-rural, while the relatively large populations in Penrith LGA and Blacktown LGA are more diverse, suburban, newer, and less well-connected. Research conducted by Newgate Research in 2015 and 2018 shows that residents do link together to help and work with others in times of difficulty situations (Newgate Research 2015 & 2018).

Table 6-27. Selected demographic indicators for suburbs within the downstream communities study area 2016

LGA	2016 state suburb	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Need for assistance (%)	Median age	Gender distribution (%)		Total household (families) (no.)	Population projection by 2036 per LGA (no.)
										Female	Male		
Liverpool	Badgerys Creek	225	8.3	-230	3	26.7	35.1	7.1	37	48.4	49.3	50	
	Greendale	348	10.3	-4	7	20.1	20.1	2.3	35	48.3	51.4	80	
	Luddenham	3,906	41.5	97	49	17.3	16.4	2.9	35	50.6	49.2	452	
	Wallacia	1627	63.7	-73	59	18.3	8.5	3.4	40	48.3	51.6	426	
	4 Suburbs	6,106	49.8	-210	118	20.6	20.03	3.92	37	48.9	51.1	1,008	
	Overall LGA	204,326	668.8	24,183	3,012	40.8	57.2	6.24	33	50.4	49.6	39,725	331,000
Penrith	Agnes Banks	911	58.9	85	35	10.7	7.5	3.1	36	48.3	51.8	228	
	Berkshire Park	2,134	110.8	428	267	19.7	8.6	2.9	34	37.3	62.7	291	
	Castlereagh	1,171	36.4	116	9	14.6	8.7	3.8	40	48.9	51.1	293	
	Claremont Meadows	4,776	1,571.2	625	136	24.6	23.2	3.2	31	50.7	49.4	1,293	
	Cranebrook	15,759	1,054.2	1038	812	15.0	9.0	4.7	32	51.1	48.9	4,325	
	Emu Heights	3,289	959.0	-73	111	12.4	4.6	3.7	35	50.2	49.7	919	
	Emu Plains	8,421	1,020.7	324	306	16.3	6.7	6.6	39	52.8	47.1	2,269	
	Glenmore Park	23,004	2,361.7	2731	559	20.0	14.9	3.5	32	51.5	48.5	6,372	
	Jamisontown	5,500	1,389.6	258	175	19.0	10.7	6.2	36	52.0	48.1	1,413	
	Leonay	1,828	1,019.4	40	85	13.3	7.5	3.7	40	50.8	49.0	724	
	Llandilo	2,518	87.9	89	177	14.0	23.0	4.0	36	49.2	50.7	403	
	Londonderry	1,637	107.8	332	32	13.6	9.6	4.3	38	48.4	51.6	1,001	
	Mulgoa	1,898	35.0	106	38	15.4	11.9	3.7	41	50.0	50.1	497	
	North St Marys	3,921	1,230.7	241	338	22.6	18.6	9.1	35	50.2	49.9	974	
	Orchard Hills	1,877	43.6	-35	22	23.1	24.2	4.6	43	46.8	53.5	505	
	Penrith	13,295	1,089.6	1482	669	23.8	17.0	8.5	37	51.3	48.7	3,218	
	Regentville	809	677.7	191	14	12.6	6.7	3.5	37	48.2	51.3	221	

LGA	2016 state suburb	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Need for assistance (%)	Median age	Gender distribution (%)		Total household (families) (no.)	Population projection by 2036 per LGA (no.)
										Female	Male		
	South Penrith	11,790	2,330.0	150	461	17.6	9.9	5.3	37	51.0	49.0	3,327	
	St Marys	12,195	1,257.8	1234	501	30.9	28.0	7.1	34	50.4	49.6	2,994	
	Werrington	4,031	894.2	182	206	28.7	24.5	5.8	33	51.1	48.8	1,070	
	Werrington County	3,645	1,744.2	-26	171	15.3	7.8	5.1	36	50.1	49.8	1,055	
	21 Suburbs	124,409	400.4	9,518	5,124	18.2	13.4	4.9	36	49.5	50.5	33,392	
	Overall LGA	196,066	484.2	17,599	7,741	21.6	20.7	5.0	34	50.6	49.4	36,268	270,750
Hawkesbury	Blaxlands Ridge	501	12.2	37	23	10.6	2.6	2.6	38	12.6	65.9	129	
	Bligh Park	6,366	3,009.8	-127	325	10.1	3.9	4.3	31	51.6	48.3	1,740	
	Central Macdonald	55	4.3	55	0	7.3	0.0	0.0	51	9.1	63.6	11	
	Clarendon	122	25.9	3	3	18.9	6.6	2.5	40	51.6	46.7	27	
	Cornwallis	53	7.1	N/A	0	32.1	39.6	0.0	37	50.9	43.4	8	
	Cumberland Reach	181	52.8	-16	14	8.8	1.7	1.7	39	12.2	69.1	54	
	East Kurrajong	2195	61.6	86	63	8.8	3.2	3.3	38	11.6	66.7	582	
	Ebenezer (NSW)	993	45.4	25	19	10.2	3.8	3.0	38	12.9	66.0	259	
	Freemans Reach	1,973	80.2	-153	82	11.3	7.8	4.2	36	49.1	51.2	558	
	Glossodia	2,828	182.0	-28	80	8.5	4.6	3.0	33	49.3	50.6	789	
	Grose Wold	635	56.0	3	9	10.9	3.2	4.4	43	49.3	50.9	169	
	Hobartville	2,744	2,514.7	-106	112	14.5	8.2	5.0	35	51.6	48.6	745	
	Lower Macdonald	260	25.5	-1	8	16.5	4.6	3.5	47	18.1	64.6	76	
	Lower Portland	589	9.8	37	22	9.0	1.5	1.9	43	15.1	66.6	149	
	Maraylya	1,244	60.8	72	22	11.5	6.1	3.6	40	49.4	50.3	326	
	McGraths Hill	2,552	825.0	45	94	11.1	6.0	3.1	34	49.5	50.5	716	
	Mulgrave	92	22.9	N/A	0	16.3	26.1	0.0	44	38.0	55.4	16	
	North Richmond	4,977	225.0	376	218	12.3	5.5	6.4	39	52.9	47.1	1,356	

LGA	2016 state suburb	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Need for assistance (%)	Median age	Gender distribution (%)		Total household (families) (no.)	Population projection by 2036 per LGA (no.)
										Female	Male		
	Oakville	1,964	129.7	116	27	15.8	11.9	3.5	41	48.6	51.3	556	
	Pitt Town	3,033	240.8	1,070	49	9.9	4.8	2.4	34	50.0	50.1	852	
	Pitt Town Bottoms	102	17.8	N/A	3	18.6	25.5	0.0	36	36.3	65.7	21	
	Richmond	5,482	204.5	208	206	16.2	8.5	9.1	42	52.4	47.5	1,196	
	Richmond Lowlands	42	5.5	-178	0	9.5	0.0	0.0	35	61.9	50.0	14	
	Sackville	298	58.6	47	13	6.0	1.0	3.0	43	12.8	72.8	73	
	Scheyville	10	1.4	N/A	0	30.0	0.0	0.0	45	90.0	30.0	3	
	South Windsor	5,892	661.6	13	450	11.8	5.6	7.6	34	51.6	48.4	1,526	
	Vineyard	1,166	105.9	-59	27	16.7	13.5	2.3	46	50.3	49.5	262	
	Webbs Creek	44	0.4	44	0	9.1	0.0	0.0	49	22.7	70.5	11	
	Wilberforce	3,007	93.7	128	81	9.4	3.1	2.7	40	49.1	50.7	806	
	Windsor	1,891	457.4	88	106	15.3	8.0	5.6	42	51.6	48.3	483	
	Windsor Downs	1,179	155.6	-111	26	19.5	11.5	2.2	45	47.2	53.0	336	
	Yarramundi	840	26.0	-26	40	9.1	5.1	4.8	36	48.0	51.4	215	
	<i>32 Suburbs</i>	<i>53,310</i>	<i>90.2</i>	<i>1,648</i>	<i>2,122</i>	<i>13.3</i>	<i>7.3</i>	<i>3.0</i>	<i>40</i>	<i>40.9</i>	<i>59.2</i>	<i>14,064</i>	
	Overall LGA	64,592	23.7	2,239	2,393	12.3	9.3	4.7	38	50.5	49.5	11,402	85,050
Blacktown	Colebee	1,931	555.5	1,931	13	44.9	45.4	2.0	32	48.6	51.4	526	
	Dean Park	3,227	2,134.5	125	97	36.6	38.3	7.3	34	51.3	48.6	830	
	Doonside	13,451	2,257.6	364	717	41.4	41.9	7.2	35	50.8	49.2	3,543	
	Glendenning	5,131	1,436.6	105	105	43.9	48.1	3.6	31	50.4	49.5	1,379	
	Marsden Park	1,008	43.2	-42	36	28.0	22.5	6.4	40	45.7	53.9	244	
	Quakers Hill	27,080	2,784.0	914	497	38.4	37.2	4.1	33	50.5	49.5	7,450	
	Riverstone	7,247	322.6	1,056	325	18.1	14.9	4.7	34	50.0	50.0	1,940	
	Ropes Crossing	6,171	1,121.4	4,692	138	43.5	42.3	2.6	30	51.7	48.4	1,670	

LGA	2016 state suburb	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Need for assistance (%)	Median age	Gender distribution (%)		Total household (families) (no.)	Population projection by 2036 per LGA (no.)
										Female	Male		
	Schofields	4,983	359.1	1,170	101	30.0	28.2	3.1	32	49.6	50.4	1,358	
	Shanes Park	407	46.5	7	29	26.0	28.5	4.9	39	48.7	51.6	104	
	10 Suburbs	70,636	719.4	10,322	2,058	35.0	34.7	4.6	34	50.2	49.8	19,044	
	Overall LGA	336,962	1,364.8	35,863	9,526	40.5	45.9	11.0	33	50.3	49.7	66,561	521,450
The Hills	Cattai	790	34.8	100	6	10.0	2.8	3.2	41	16.0	64.4	203	
	Glenorie	3,497	44.0	92	21	19.4	16.9	3.0	41	15.5	64.8	923	
	Leets Vale	57	6.2	-219	0	28.1	5.3	0.0	47	22.8	54.4	14	
	Maroota	617	10.8	326	11	12.5	8.6	6.5	39	14.3	62.2	155	
	Sackville North	312	23.8	50	22	11.2	3.5	1.0	42	14.1	63.5	85	
	South Maroota	557	16.0	50	7	9.2	2.2	2.0	40	13.1	65.4	143	
	Wisemans Ferry	220	16.3	36	10	15.5	8.6	7.7	48	21.4	63.2	51	
	7 Suburbs	6,050	26.3	435	77	15.1	6.8	2.2	43	62.6	37.5	1,574	
	Overall LGA	157,243	407.4	-12,629	813	38.3	37.2	3.2	38	50.7	49.3	31,105	250,971
TOTAL PMF- affected suburbs	74 SUBURBS ACROSS 5 LGAs	260,511	192.6	21,713	9,499	18.2	13.4	3.7	38	53.0	47.0	69,082	315,218
TOTAL LGA	5 LGAs	959,189	232.9	67,255	23,485	30.7	34.1	6.0	35	50.5	49.5	185,061	1,208,250
GREATER SYDNEY		4,823,991	390.1	432,317	70,135	36.7	35.8	4.9	36	50.7	49.3	1,247,047	

Source: ABS Census of Population and Housing 2016

6.4.4 Economic and employment profile

Table 6-28 provides a summary of key economic and employment characteristics of the downstream communities study area. As the PMF-affected suburbs of the downstream communities study area have good connections to the employment hubs of Parramatta and Sydney CBD, many people from these affected suburbs work outside of their local community. In 2016, the total labour force number across all PMF-affected suburbs was 133,293 people, accounting for a total labour force participation rate of 65.1 percent. The proportion of the labour force across the PMF-affected suburbs was slightly higher than the LGAs of the downstream communities study area as a whole (63.1 percent) and Greater Sydney overall (61.6 percent). The Hills LGA recorded the highest labour force participation rate at 68.0 percent (with 84,017 people participating in the labour force), while Liverpool LGA recorded the lowest labour force participation rate at 57.4 percent (with 90,669 people participating in the labour force). The affected suburb with the highest labour force participation rate was Cumberland Reach in the Hawkesbury LGA, at 77.9 percent; however, this could be attributed to the small population (181 people) in the area. Berkshire Park in the Penrith LGA had the lowest labour force participation rate at only 30.3 percent; however, this is likely attributed to a correctional facility located in the suburb, where inmates do not participate in the general labour force.

Of 74 PMF-affected suburbs, 69 suburbs had Construction as one of the top three employment industries in 2016. The unemployment rate across the 74 PMF-affected suburbs within the downstream communities study area was 4.5 percent, which was lower than the LGAs overall (5.9 percent) and Greater Sydney (6.0 percent). The Liverpool LGA had the highest unemployment rate of 7.5 percent compared to other affected LGAs. This is followed by Penrith LGA with 5.2 percent. Unemployment rates of the suburbs in the Hawkesbury and The Hills LGAs made up 3.5 percent and 2.6 percent respectively. It is noted that the averages of unemployment rates of each the 74 PMF-affected communities were lower than that of the five LGAs within the downstream communities study area as a whole.

In 2016, median weekly household income across the PMF-affected suburbs was \$1,746.67, which was slightly lower than the average recorded for LGAs within the downstream communities study area as a whole (at \$1,790/week) and Greater Sydney overall (at \$1,750/week). Median weekly household incomes across the PMF-affected suburbs within the downstream communities study area ranged from \$837 to \$2,787/week. The affected suburbs in the Blacktown LGA had the highest median weekly household income with \$1,993/week. The lowest median weekly household income was the total affected suburbs in The Hills LGA with \$1,694.86/week, which was lower than the entire LGA average (\$2,360/week).

In relation to the SEIFA Index, the 74 PMF-affected suburbs had a combined rank of seventh, which was lower than the combined five LGAs average eighth ranking. This indicates that a higher level of disadvantage across the PMF-affected suburbs within the downstream communities study area compared to the five LGAs as a whole. The affected suburbs in The Hill LGA had the highest ranking (a rank of eighth). This was followed by the affected suburbs in the Hawkesbury LGA with the rank of seventh. The affected suburbs in the Liverpool, Penrith, and Blacktown LGAs had the same rank of sixth. It is noted that of all 74 PMF-affected suburbs, there were a total of 10 affected suburbs which had a rank of 10 which indicates a high level of advantage. St Marys and North St Marys in the Penrith LGA had a rank of one, indicating a high level of disadvantage.

In line with the expected population growth, demand for employment in Western Sydney is projected to increase faster than overall demand of employment in Greater Sydney. By 2025, the total labour force number of Western Sydney is expected to grow to 1,609,401 persons. The total force labour will continuously increase to 1,744,955 persons by 2030 and to 2,664,991 persons by 2065. These figures indicate Western Sydney will experience an increase in labour force requirements by approximately 66 percent between 2025 and 2065. Regarding Greater Sydney, the total labour force is projected to increase to 3,297,664 by 2025, to 3,522,912 persons by 2030, and to 5,016,069 by 2065. Therefore, the increase in labour force in Greater Sydney will be 52 percent over the same period between 2025 and 2065 (SGS Economics and Planning 2015).

As previously mentioned, the major employment, residential, and transport infrastructure projects and initiatives proposed for Western Sydney demonstrate the critical role that the region plays in Sydney future. These projects will be a significant catalyst for economic and employment growth for suburbs in Western Sydney. They will provide a major focus for jobs, housing, transport, and services in Western Sydney communities as the region continue to grow.

Table 6-28. Selected economic indicators for suburbs within the affected downstream communities

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
Liverpool	Badgerys Creek	91	53.8	Agriculture forestry and fishing Construction Wholesale trade.	4.4	1,278	Not available	938	3
	Greendale	158	61.5	Agriculture forestry and fishing Construction Transport postal and warehouse	8.2	1,666		981	5
	Luddenham	980	69.9	Construction Retail trade Manufacturing	3.5	2,153		1,099	9
	Wallacia	835	63.9	Construction Retail trade Manufacturing	4.9	1,888		1,003	7
	4 Suburbs	2,064	65.8	N/A	5.3	1,746.25		1,005	6
	LGA	90,669	57.4	Healthcare and Social Assistance Retail Trade Construction	7.5	1,550	15,335	972	6
Penrith	Agnes Banks	476	74.5	Construction Healthcare and social assistance Education and training	3.6	1,910	N/A	1,049	9
	Berkshire Park	578	30.3	Construction Transport postal and warehouse Retail trade	4.3	1,716		979	5
	Castlereagh	586	62.1	Construction Retail trade Transport postal and warehouse	1.9	1,910		1,043	8
	Claremont Meadows	2,670	74.6	Healthcare and social assistance Construction Retail trade	5.2	2,075		1,027	8

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Cranebrook	8,449	69.7	Construction Retail trade Healthcare and social assistance	5.0	1,874		996	6
	Emu Heights	1,893	72.9	Construction Healthcare and social assistance Retail trade	3.9	2,080		1,038	8
	Emu Plains	4,071	59.7	Healthcare and social assistance Construction Education and training	4.4	1,685		1,015	7
	Glenmore Park	13,152	75.7	Retail trade Construction Public administration and safety	3.9	2,213		1,069	9
	Jamisontown	2,783	63.1	Healthcare and social assistance Retail trade Construction	5.2	1,385		966	4
	Leonay	1,327	66.9	Education and training Construction Health care and social assistance	3.5	1,862		994	10
	Llandilo	804	62.9	Construction Retail trade Transport postal and warehouse	2.4	2,234		1,073	6
	Londonderry	2,031	64.8	Construction Retail trade Transport postal and warehouse	4.0	1,729		1,020	6
	Mulgoa	965	63.9	Construction Healthcare and social assistance Retail trade	4.2	2,217		1,082	10
	North St Marys	1545	50.3	Healthcare and social assistance Retail trade Construction	12.0	1,097		837	1

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Orchard Hills	1045	65.6	Construction Retail trade Education and training	4.5	2,072		1,049	9
	Penrith	6,296	56.7	Healthcare and social assistance Retail trade Construction	8.5	1,142		926	2
	Regentville	442	68.2	Construction Healthcare and social assistance Education and training	3.6	1,804		1,017	7
	South Penrith	5,843	62.8	Construction Healthcare and social assistance Retail trade	5.5	1,573		990	5
	St Marys	5,521	56.8	Healthcare and social assistance Retail trade Construction	9.4	1,190		889	1
	Werrington	1,995	62.5	Healthcare and social assistance Retail trade Construction	9.0	1,228		909	2
	Werrington County	1,968	67.4	Construction Retail trade Healthcare and social assistance	4.1	1,799		986	5
	21 Suburbs	64,440	64.5	N/A	5.2	1,752.14		997	6
	LGA	100,604	65.0	Construction Healthcare and Social Assistance Retail Trade	5.7	1,658	13,557 (24.7% Construction Industry)	988	8
Hawkesbury	Blaxlands Ridge	262	66.5	Construction Education and Training Manufacturing	3.1	2,134	N/A	1069	9
	Bligh Park	3,573	73.8	Construction Healthcare and social assistance Public administration and safety	4.1	1,763		988	5

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Central Macdonald	26	59.1	Construction Accommodation and food services Financial and Insurance	11.5	1,437		1,010	7
	Clarendon	62	65.3	Arts and recreation services Construction Transport postal and warehouse	0.0	1,625		1,036	8
	Cornwallis	26	61.9	Agriculture forestry and fishing Education and training Construction	0.0	2,249		1,054	9
	Cumberland Reach	109	77.9	Construction Public Administration and Safety Professional Scientific and Technical Services	9.2	1,937		988	5
	East Kurrajong	1,155	67.6	Construction Education and Training Retail Trade	2.9	2,187		1,079	10
	Ebenezer (NSW)	536	68.3	Construction Education and Training Retail Trade	3.9	1,886		1,034	8
	Freemans Reach	1,074	68.5	Construction Retail trade Education and training	3.3	1,885		1,022	7
	Glossodia	1,569	73.2	Construction Retail trade Health care and social assistance	3.0	1,910		1,015	7
	Grose Wold	333	63.3	Construction Healthcare and social assistance Education and training	3.0	2,239		1,087	10
	Hobartville	1,389	64.3	Healthcare and social assistance Construction Retail trade	5.3	1,411		965	4

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Lower Macdonald	144	65.2	Construction Health Care and Social Assistance Retail Trade	6.9	1,187		975	5
	Lower Portland	302	62.8	Construction Manufacturing Retail Trade	4.0	1,569		1,031	8
	Maraylya	661	69.4	Construction Education and training Healthcare and social assistance	3.3	2,133		1,074	9
	McGraths Hill	1,452	73.6	Construction Retail trade Healthcare and social assistance	2.7	1,925		1,025	7
	Mulgrave	50	69.4	Agriculture forestry and fishing Construction Manufacturing	0.0	2,062		994	6
	North Richmond	2,393	59.6	Construction Retail trade Healthcare and social assistance	4.6	1,426		990	5
	Oakville	1,046	64.9	Construction Retail trade Manufacturing	3.2	2,095		1,053	9
	Pitt Town	1,664	72.8	Construction Retail trade Healthcare and social assistance	2.2	2,316		1,105	10
	Pitt Town Bottoms	49	56.3	Agriculture forestry and fishing Construction Manufacturing	0.0	1,624		1,069	9
	Richmond	2,598	54.7	Public administration and safety Healthcare and social assistance Retail trade	7.3	1,146		949	3

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Richmond Lowlands	25	67.6	Construction Agriculture forestry and fishing Education and training	0.0	1,625		1,054	9
	Sackville	152	58.0	Construction Healthcare and Social Assistance Administrative and support services	3.3	1786		1,058	9
	Scheyville	4	40.0	Healthcare and social assistance Professionals N/A	0.0	0		n/a	
	South Windsor	2,849	60.8	Construction Healthcare and social assistance Retail trade	6.4	1,283		912	2
	Vineyard	507	52.5	Construction Retail trade Healthcare and social assistance	3.2	1,197		972	4
	Webbs Creek	27	75.0	Accommodation and food services Healthcare and Social Assistance Retail Trade	0.0	900		1,010	7
	Wilberforce	1,649	68.7	Construction Education and training Retail trade	4.2	1,867		1,031	8
	Windsor	937	59.0	Construction Retail trade Healthcare and social assistance	6.7	1,422		965	4
	Windsor Downs	680	67.0	Construction Retail trade Education and training	1.8	2,458		1,093	10
	Yarramundi	464	70.9	Construction Education and training Retail trade	3.0	2,228		1,084	10

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	32 Suburbs	27,767	65.3	N/A	3.50	1,716		1,025	7
	LGA	33,768	65.3	Construction Healthcare and Social Assistance Retail Trade	4.3	1,668	6274	1,014	9
Blacktown	Colebee	1,095	75.6	Healthcare and social assistance Manufacturing Construction	4.3	2,787	N/A	1,178	10
	Dean Park	1,542	61.6	Healthcare and social assistance Retail trade Construction	6.7	1,600		962	4
	Doonside	5,948	55.5	Healthcare and social assistance Retail trade Transport postal and warehouse	9.3	1,340		906	2
	Glendenning	2,662	70.5	Healthcare and social assistance Retail trade Manufacturing	7.2	1,906		1,000	6
	Marsden Park	454	53.4	Construction Transport postal and warehouse Retail trade	4.0	1,161		961	4
	Quakers Hill	14,667	70.4	Healthcare and social assistance Retail trade Construction	6.2	1,993		1,043	8
	Riverstone	3,620	63.4	Construction Retail trade Healthcare and social assistance	6.3	1,667		987	5
	Ropes Crossing	3076	70.4	Healthcare and social assistance Retail trade Transport postal and warehouse	5.1	2,028		1,057	9
	Schofields	2,673	71.1	Construction Retail trade Healthcare and social assistance	5.1	2,051		1,059	9

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	Shanes Park	206	61.1	Construction Agriculture forestry and fishing Transport postal and warehouse	7.8	1,708		968	4
	10 Suburbs	35,943	66.2	N/A	6.2	1,993		1,012	6
	LGA	163,377	62.8	Healthcare and Social Assistance Retail Trade Manufacturing	6.3	1,667	24,900 (18.8% Construction)	993	8
The Hills	Cattai	434	68.8	Construction Manufacturing Retail Trade	3.0	2,013		1,082	10
	Glenorie	1,793	63.8	Construction Retail Trade Professional Scientific and Technical Services	2.8	1,991		1,083	10
	Leets Vale	18	32.7	Accommodation and food services Retail trade Construction	0.0	1,125		989	5
	Maroota	307	63.7	Agriculture forestry and fishing Construction Retail Trade	2.0	1,761		1,017	7
	Sackville North	137	56.1	Construction Manufacturing Healthcare and Social Assistance	3.6	1,968		1,049	9
	South Maroota	282	64.8	Construction Education and Training Healthcare and Social Assistance	2.8	2,052		1,073	9
	Wisemans Ferry	108	56.5	Accommodation and food services Construction Retail Trade	3.7	954		955	3

LGA	2016 suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three industries of employment				Score of advantage and disadvantage	Rank within Australia
	7 Suburbs	3,079	63.5	N/A	2.6	1,694.86		1,035	8
	LGA	84,006	68.0	Hospitals (except Psychiatric) Computer System Design and Related Services Banking	4.6	2,363	20,142	1,133	10
TOTAL	74 PMF-AFFECTED SUBURBS	133,293	65.1	Not applicable	4.5	1,746.67	Not available	1,015	7
TOTAL	5 AFFECTED LGAs	472,424	63.1	Not applicable	5.9	1,790	73,934	1,020	8
Greater Sydney		2,418,902	61.6	Hospitals (except Hospitals) Computer System Design and Related Services Cafes and Restaurants	6.0	1,750	Not available	Not available	Not available

Source: ABS Census of Population and Housing 2016

6.4.5 Housing profile

Table 6-29 provides a summary of housing profile of the downstream communities study area. In 2016, there was a total of 88,822 private dwellings in all 74 PMF-affected suburbs. Of this figure, the total number of private dwellings in the affected suburbs within the Penrith LGA was highest, accounting for 43,823 houses. The proportion of occupied private dwellings across the PMF-affected suburbs within the downstream communities study area was 92.4 percent of the total private dwelling number. The affected suburbs in the Blacktown LGA had a total of 22,612 private dwellings which was the second highest. The affected suburbs in the Liverpool had the lowest total of private dwellings.

The housing profile of the PMF-affected suburbs within the downstream communities study area further shows the total number of homeless people in the suburbs in the Penrith LGA was highest with 1,918 homeless people. This was followed by the total affected suburbs in the Blacktown LGA (1,410 people) and in the Hawkesbury (705 people). Housing trends in the downstream communities study area fluctuate throughout due to the different land use in the area. Predominately, agriculture areas will have a higher median housing value when compared to urban area median house value as usually the value of the land of an agricultural enterprise is linked to the house. For example, the affected suburb with the highest median house price as of 2017 was Oakville in Hawkesbury (\$2,127,500), which is a predominately agricultural area.

Development in Western Sydney is resulting in more peri-urban areas becoming urban hubs. The Western Sydney region has been an option for many families to access more affordable housing close to employment hubs such as Sydney CBD. Based on a recent report by the Property Council of Australia, Sydney will be facing a housing shortage of 190,000 homes by 2024²⁴. The downstream communities study areas and the wider Western Sydney region have housing and land more affordable than other areas of Sydney, leading to increased population growth and high number of young families in this region.

²⁴ <https://www.dailytelegraph.com.au/news/nsw/sydney-housing-crisis-on-the-horizon-190000-homes-needed-over-the-next-decade/news-story/d1f1ea6431c54e5b71feaca170948890>

Table 6-29. Summary of housing characteristics for suburbs within the affected downstream area 2016

LGA	2016 State suburb	Private dwellings			Social housing			Homelessness		House trends		
		Total private dwellings (no.)	Occupied private dwellings (%)	Unoccupied private dwellings (%)	State housing authorities (no.)	Community/ church owned rentals (no.)	Social housing (%)	Total homeless people (no.)	Proportion of total population (%)	Median house price in 2011 (\$)	Median housing price 2017 (\$)	Change in median house prices, 2011 – 2017
Liverpool	Badgerys Creek	73	89.0	11.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	Greendale	95	94.7	5.3	0	0	0.0	0	0.0	Not available	Not available	Not available
	Luddenham	860	95.4	4.7	0	0	0.0	0	0.0	422,500	1,591,000	1,168,500
	Wallacia	557	93.9	6.1	0	0	0.0	0	0.0	Not available	715,000	Not available
	4 Suburbs	1,585	93.3	6.7	0	0	0	0	0	Not available	Not available	Not available
	LGA	65,888	95.2	4.8	4134	352	23.8	1058	0.5	Not available	Not available	Not available
Penrith	Agnes Banks	275	91.3	8.7	0	0	0.0	0	0.0	Not available	965,000	Not available
	Berkshire Park	321	94.1	5.9	0	0	0.0	0	0.0	Not available	Not available	Not available
	Castlereagh	333	97.6	2.4	0	0	0.0	0	0.0	Not available	Not available	Not available
	Claremont Meadows	1,491	96.1	3.9	25	3	9.0	25	0.5	370,000	725,000	355,000
	Cranebrook	5,146	95.9	4.1	376	20	28.9	376	2.4	380,000	675,000	295,000
	Emu Heights	1,105	96.2	3.8	22	0	13.9	22	0.7	420,000	730,500	310,500
	Emu Plains	3,046	95.2	4.8	89	17	15.7	89	1.1	405,000	720,000	315,000
	Glenmore Park	7,270	95.6	4.4	52	13	3.4	52	0.2	440,000	760,000	320,000
	Jamisontown	2,227	93.8	6.2	61	3	7.9	61	1.1	380,000	702,500	322,500
	Leonay	444	94.4	5.6	0	0	0.0	0	0.00	493,750	829,000	335,250
	Llandilo	1,113	95.4	4.6	0	0	0.0	0	0.00	Not available	1,950,000	Not available
	Londonderry	518	90.7	9.3	0	0	0.0	0	0.00	626,750	1,362,500	735,750
	Mulgoa	582	91.8	8.3	0	0	0.0	0	0.00	480,080	1,445,000	964,920
	North St Marys	1,367	93.9	6.1	223	10	35.7	223	5.7	278,750	617,500	338,750
	Orchard Hills	568	93.7	6.3	0	3	0.0	0	0.00	975,000	Not available	Not available
	Penrith	5,864	91.5	8.5	584	93	20.2	584	4.4	335,000	720,000	385,000

LGA	2016 State suburb	Private dwellings			Social housing			Homelessness		House trends		
		Total private dwellings (no.)	Occupied private dwellings (%)	Unoccupied private dwellings (%)	State housing authorities (no.)	Community/ church owned rentals (no.)	Social housing (%)	Total homeless people (no.)	Proportion of total population (%)	Median house price in 2011 (\$)	Median housing price 2017 (\$)	Change in median house prices, 2011 – 2017
	Regentville	273	98.9	1.1	0	0	0.0	0	0.0	Not available	815,750	Not available
	South Penrith	4,272	95.3	4.7	137	13	13.2	137	1.5	376,000	690,000	314,000
	St Marys	4,732	90.7	9.3	288	42	13.2	288	2.4	330,500	670,000	339,500
	Werrington	1,638	93.5	6.5	114	25	15.9	114	2.8	328,750	672,500	343,750
	Werrington County	1,238	96.7	3.3	7	0	3.7	7	0.2	365,000	670,000	305,000
	21 Suburbs	43,823	94.4	5.6	1978	242	8.6	1,978	1.1	Not available	Not available	Not available
	LGA	71,036	94.1	5.9	2601	350	15.4	890	0.5	Not available	Not available	Not available
Hawkesbury	Blaxlands Ridge	136	100.7	-0.7	0	0	0.0	0	0.0	Not available	1,150,000	Not available
	Bligh Park	2,261	95.2	4.8	110	3	14.3	110	1.7	382,000	675,000	293,000
	Central Macdonald	21	76.2	23.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	Clarendon	43	74.4	25.6	0	0	0.0	0	0.0	Not available	Not available	Not available
	Cornwallis	20	55.0	45.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	Cumberland Reach	72	90.3	9.7	0	0	0.0	0	0.0	Not available	Not available	Not available
	East Kurrajong	634	95.4	4.6	0	0	0.0	0	0.0	646,000	1,280,000	634,000
	Ebenezer (NSW)	323	91.0	9.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	Freemans Reach	654	95.3	4.7	0	0	0.0	0	0.0	485,000	755,000	270,000
	Glossodia	925	95.0	5.0	0	0	0.0	0	0.0	373,750	640,000	266,250
	Grose Wold	194	91.2	8.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	Hobartville	1,064	93.7	6.3	30	8	10.2	30	1.1	368,000	652,500	284,500
	Lower Macdonald	131	88.6	11.5	0	0	0.0	0	0.0	Not available	427,500	Not available
	Lower Portland	208	85.6	14.4	4	0	2.3	0	0.0	Not available	Not available	Not available

LGA	2016 State suburb	Private dwellings			Social housing			Homelessness		House trends		
		Total private dwellings (no.)	Occupied private dwellings (%)	Unoccupied private dwellings (%)	State housing authorities (no.)	Community/ church owned rentals (no.)	Social housing (%)	Total homeless people (no.)	Proportion of total population (%)	Median house price in 2011 (\$)	Median housing price 2017 (\$)	Change in median house prices, 2011 – 2017
	Maraylya	387	90.4	9.6	0	0	0.0	0	0.0	Not available	1,830,000	Not available
	McGraths Hill	880	94.9	5.1	0	0	0.0	0	0.0	442,250	780,000	337,750
	Mulgrave	31	77.4	22.6	0	0	0.0	0	0.0	Not available	Not available	Not available
	North Richmond	1,866	93.5	6.5	80	3	15.4	80	1.6	410,000	800,000	390,000
	Oakville	619	93.9	6.1	0	0	0.0	0	0.0	992,500	2,127,500	1,135,000
	Pitt Town	951	95.4	4.6	0	3	0.0	0	0.0	731,500	1,350,000	618,500
	Pitt Town Bottoms	29	79.3	20.7	0	0	0.0	0	0.0	Not available	Not available	Not available
	Richmond	2,246	91.9	8.1	113	18	12.5	113	2.1	370,000	750,500	380,500
	Richmond Lowlands	16	50.0	50.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	Sackville	96	87.5	12.5	0	0	0.0	0	0.0	Not available	Not available	Not available
	Scheyville	3	100.0	0.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	South Windsor	2,320	93.6	6.4	324	51	32.9	324	5.5	347,000	650,000	303,000
	Vineyard	427	94.6	5.4	0	0	0.0	0	0.0	Not available	1,201,000	Not available
	Webbs Creek	19	84.2	15.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	Wilberforce	997	95.9	4.1	0	0	0.0	0	0.0	493,500	887,500	394,000
	Windsor	736	92.9	7.1	48	9	18.0	48	2.5	688,375	850,000	161,625
	Windsor Downs	349	98.0	2.0	0	0	0.0	0	0.0	990,000	1,820,000	830,000
	Yarramundi	236	96.2	3.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	32 Suburbs	18,894	88.7	11.3	709	95	3.3	705	0.5	Not available	Not available	Not available
	LGA	24,064	93.4	6.	703	107	15.7	231	0.4	Not available	Not available	Not available
Blacktown	Colebee	630	84.8	15.2	0	0	0.0	0	0.0	Not available	1,010,000	Not available
	Dean Park	969	97.1	2.9	17	3	7.0	17	0.5	350,000	650,000	300,000
	Doonside	4,396	94.5	5.6	901	23	49.7	901	6.7	350,000	695,000	345,000
	Glendenning	1,476	96.8	3.3	62	6	16.4	62	1.2	365,000	685,000	320,000
	Marsden Park	429	81.6	18.4	0	0	0.0	0	0.0	Not available	840,000	Not available

LGA	2016 State suburb	Private dwellings			Social housing			Homelessness		House trends		
		Total private dwellings (no.)	Occupied private dwellings (%)	Unoccupied private dwellings (%)	State housing authorities (no.)	Community/ church owned rentals (no.)	Social housing (%)	Total homeless people (no.)	Proportion of total population (%)	Median house price in 2011 (\$)	Median housing price 2017 (\$)	Change in median house prices, 2011 – 2017
	Quakers Hill	8,516	96.3	3.7	296	12	12.8	296	1.1	448,000	802,500	354,500
	Riverstone	2,514	91.8	8.2	112	21	15.2	112	1.6	388,750	797,000	408,250
	Ropes Crossing	1,892	97.0	3.0	19	12	4.5	19	0.3	390,000	690,000	300,000
	Schofields	1,670	91.9	8.1	3	0	0.8	3	0.1	445,000	855,000	410,000
	Shanes Park	120	94.2	5.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	10 Suburbs	22,612	92.6	7.4	1,410	77	10.6	1,410	1.2	Not available	Not available	Not available
	LGA	110,800	95.2	4.8	7,650	461	24.9	1,534	0.5	Not available	Not available	Not available
The Hills	Cattai	253	92.5	7.5	0	0	0.0	0	0.0	Not available	1,475,000	Not available
	Glenorie	1,057	94.7	5.3	0	0	0.0	0	0.0	810,000	1,875,000	1,065,000
	Leets Vale	19	100.0	0.0	0	0	0.0	0	0.0	Not available	Not available	Not available
	Maroota	205	89.3	10.7	0	0	0.0	0	0.0	Not available	1,400,000	Not available
	Sackville North	97	94.9	5.2	0	0	0.0	0	0.0	Not available	Not available	Not available
	South Maroota	162	95.7	4.3	0	0	0.0	0	0.0	Not available	Not available	Not available
	Wisemans Ferry	115	85.2	14.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	7 Suburbs	1,908	93.2	6.8	0	0	0.0	0	0.0	Not available	Not available	Not available
	LGA	51,780	87.1	11.3	266		0.5			Not available	Not available	Not available
TOTAL	74 AFFECTED SUBURBS IN 5 LGAs	88,822	92.4	7.6	4097	414	4.5	4,093	0.5	Not available	Not available	Not available

Source: ABS Census of Population and Housing 2016

6.4.6 Regional open space and recreational areas

The downstream communities study area is in the Hawkesbury-Nepean Valley, in which provides a wide range of open space and recreational areas. A list of key regional open space and recreational areas in the downstream communities study area is provided in Appendix C of this report. There were 137 open space and recreation areas across the 74 affected suburbs that are identified in the PMF area which may be impacted by the flood events. Although these are the named areas throughout the downstream communities, there are many agricultural areas which would create more open space throughout. The suburb of Penrith has the most key open spaces and recreation areas with 13 locations in total. The open space and recreational areas provide opportunity for a range of recreational pursuits and contribute to natural, cultural, and heritage values. Significant open space and recreation areas include the following:

- Bents Basin State Recreation Area
- Mountain View Reserve Lookout
- Cable Water Ski Park
- Dharug National Park
- Cattai National Park
- Marramarra National Park
- Maroota Ridge State Conservation Area.

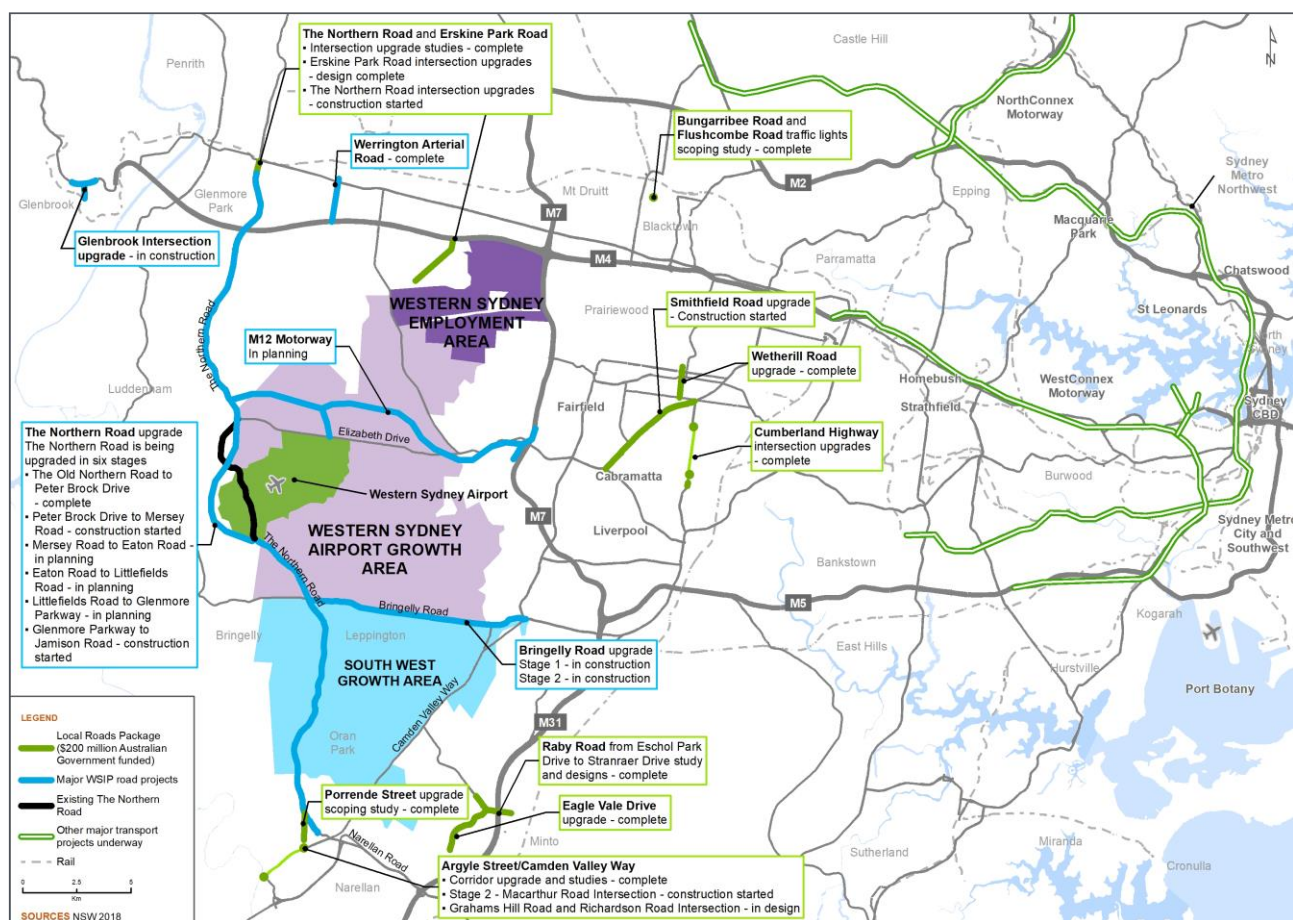
6.4.7 Infrastructure, facilities, and services

Key infrastructure, facilities, and services available in the downstream communities study area are listed in Appendix D of this report. It can be seen that most suburbs in the Liverpool LGA have the most limited infrastructure, facilities, and services compared to other affected LGAs. For instance, as of 2018, Badgerys Creek suburb in the Liverpool LGA has no key infrastructure, facilities, and services in the area; however, this is due to the suburb being predominantly agricultural land and the availability of key infrastructure in surrounding areas. Apart from Wallacia, other suburbs in the Liverpool LGA lack public transportation, community infrastructure, and recreational facilities. Infrastructure, facilities, and services available in suburbs in Penrith are the most substantial, followed by suburbs in the Blacktown LGA. Public transportation including bus routes and railway is available in most of suburbs in these two LGAs. Key community hubs, such as Penrith, Richmond/Windsor and Riverstone are highlighted by the availability of key infrastructure.

Based on the list of infrastructure, facilities, and services in the downstream communities study area provided in Appendix D of this report, there are 62 affected suburbs which have accessibility to public transport in the form of bus routes or trains. Penrith, Windsor and North Richmond are the three affected suburbs which have hospitals servicing the LGAs of the downstream communities study area. Across the downstream communities study area, there were 54 primary schools, 18 high schools and 6 higher education facilities. This downstream communities study area has a total of 25 fire (Fire station and Rural Fire Brigade), six police stations, two State Emergency Stations and eight justice facilities.

Community services have been previously been fragmented but are moving toward greater coordination and collaboration (NewGate Research 2015). The Western Sydney region has been experiencing significant population and economic growth. Since 2017, the Australian and NSW governments has committed to investing \$3.6 billion over ten years in major infrastructure upgrades to accommodate this development through the WSIP. The Plan will involve major road and transport linkages that will capitalise on the economic growth from developing an airport at Badgerys Creek while boosting the local economy and liveability of Western Sydney. This investment will relieve pressure on existing infrastructure and unlock the economy capacity of the region by providing improved road network connections. The plan includes the upgrade of key roads and highways (such as the Northern Road, Bringelly Road, and the Great Western Highway), the construction of new roads (such as a new east-west motorway to the airport between the M7 Motorway and the Northern Road and the Werrington Arterial Road) and a \$200 million package for local roads upgrades. By providing improved road network connections, in the ten -year period, the economy of the Western Sydney region, including the downstream communities study area, will be significantly transformed (Australia Government and NSW Government 2017). Figure 6-25 provides a map on WSIP elements.

Figure 6-25. Western Sydney Infrastructure Plan (WSIP) Overview Map



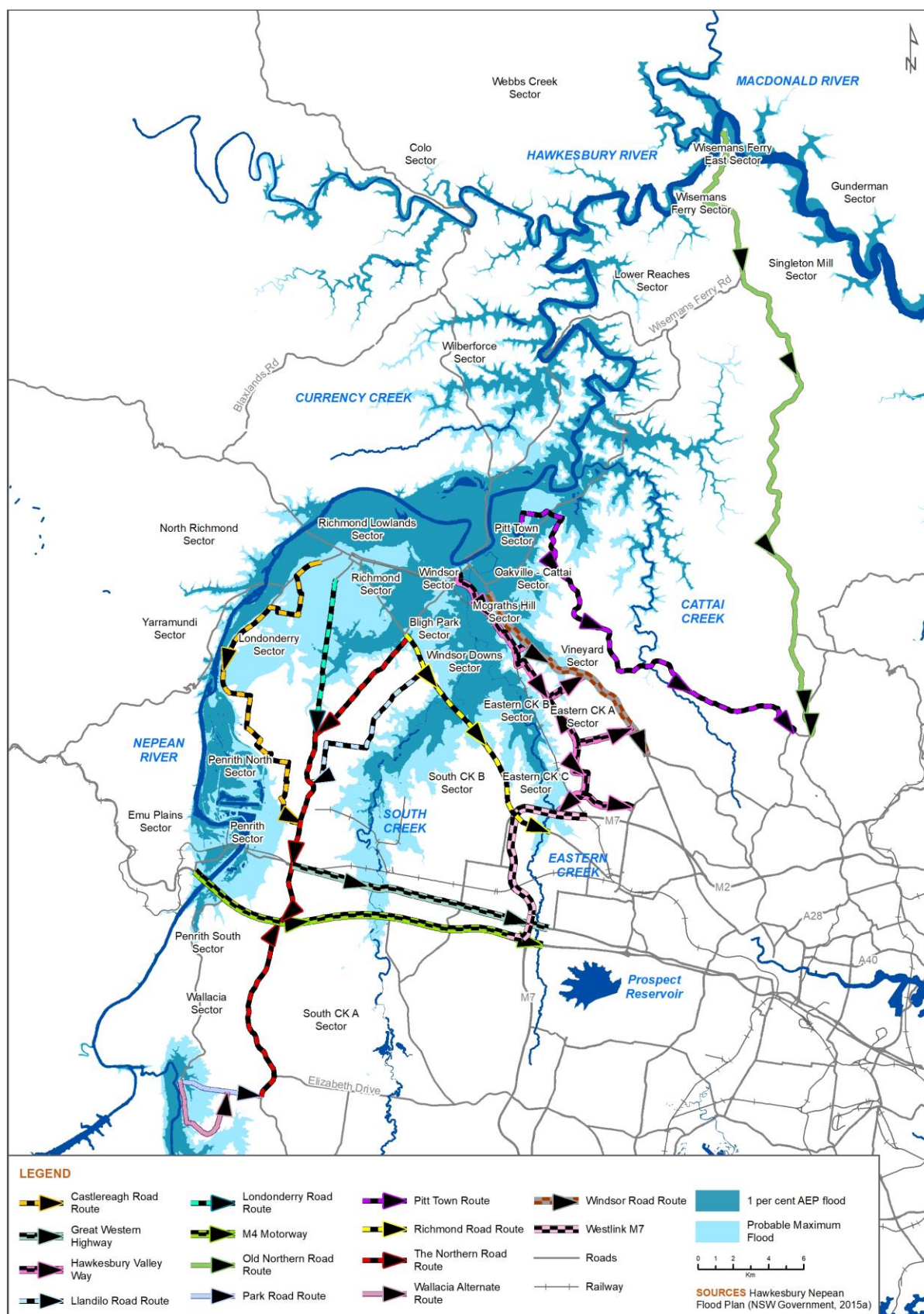
Source: NSW 2018

6.4.8 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)). Based on the plan, the most effective means of evacuation from the Hawkesbury-Nepean Valley is via road, using private vehicles and public transport (such as buses). It should be noted that depending on the extent of flood impacts, some public transport links such as bridges, ferries, and rail will be closed during the flooding event. Under 2015 Hawkesbury-Nepean Flood Plan, road evacuation routes are clearly defined and are further detailed in supporting plans (NSW Government 2015a). Sector evacuation routes are indicative routes within a sector to one or more regional evacuation routes. Sectors evacuation routes are detailed within Local Flood Plans. Thirteen (13) regional evacuation routes and critical points at which they are cut by mainstream river flooding have been identified²⁵. These regional evacuation routes require controlled traffic management arrangement. Figure 6-26 below provides a map of regional evacuation routes in the Hawkesbury-Nepean Valley.

²⁵ These regional evacuation routes include Windsor Road Route, Blacktown- Richmond Road Route, Pitt Town Road Route, Hawkesbury Valley Way Route, Northern Road, Old Northern Road Route, Londonderry Road Route, Castlereagh Road Route, Llandilo Road Route, M4 Western Motorway Route, Great Western Highway, Park Road Route and Wallacia Alternative Route (NSW Government 2015a).

Figure 6-26. Regional evacuation routes within the Hawkesbury-Nepean Valley



Source: Hawkesbury-Nepean Flood Plan (NSW Government 2015a)

The 2015 Hawkesbury-Nepean Flood Plan also identifies critical flooding points on evacuation routes, including mainstream flooding and local flooding. Sector and regional evacuation routes can be cut by mainstream flooding from the Nepean and Hawkesbury Rivers as well as from local flooding. The critical locations at which mainstream flooding from the Hawkesbury River cuts regional evacuation routes are, for instance, Nepean River Crossing – Park Road in Liverpool and Richmond and Windsor Bridges in Hawkesbury (Figure 6-27).

Figure 6-27 Closure of Windsor Bridge during flooding on 9 and 10 February 2020



Source: Image provided by INSW (2021).

Several regional evacuation routes have local flooding points that may cut the route due to localised catchment flooding. Many critical local flooding points are identified in the 2015 Hawkesbury-Nepean Flood Plan. These critical local flooding points, for example, include the Northern Road between Fourth Avenue and Seventh Avenue, Llandilo; the Northern Road between the Richmond Road and Londonderry Road intersection; and Blacktown-Richmond Road between the Northern Road and Llandilo Road.

In the review of the 2015 Hawkesbury-Nepean Flood Plan, Ribbons (2015) comments that the shape of the Hawkesbury-Nepean Valley has an important influence on how floodwaters inundate the landscape and 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. For example, suburbs such as Richmond, Windsor, South Windsor, Pitt Town and McGraths Hill will all become inundated flood islands during large flooding events. Therefore, evacuation is critical issue for the Hawkesbury-Nepean floodplain, in which evacuation by roads is the most effective measure to reduce flood risks from flooding in the Hawkesbury-Nepean floodplain (Ribbons 2015).

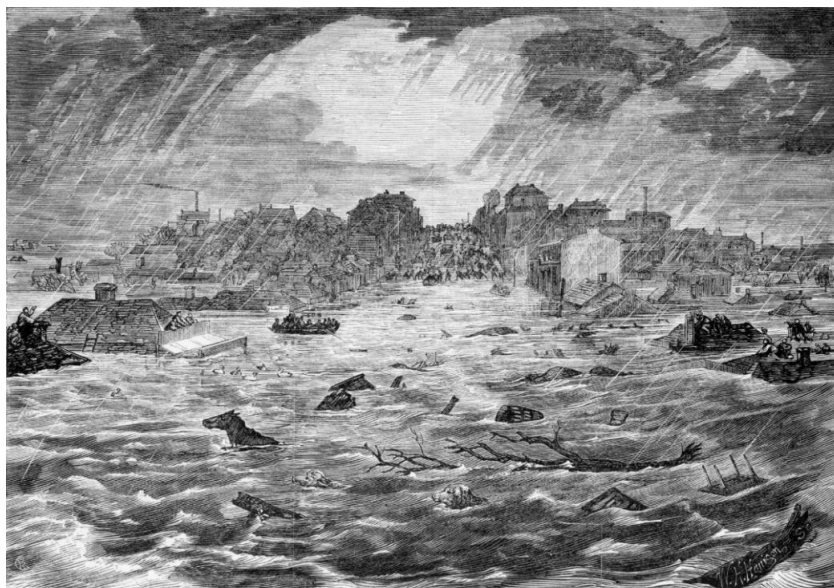
6.4.9 Perceptions and flood risks

Community perceptions of flood risk has been widely recognised as a crucial element in Hawkesbury-Nepean flood risk management. The increasing attention towards the perceptions flood risks is reflected in several recent research papers on perceived flood risks, focusing on areas of Hawkesbury-Nepean floodplain. For instance, Newgate Research conducted social research on flood risks in the Hawkesbury-Nepean Valley in 2014, 2015, and 2018 (Newgate Research 2014a, b, 2015, and 2018). In addition, Bewsher Consulting et al (2002) did research on flood risks in the Hawkesbury-Nepean floodplain. These studies have explicitly explored and evaluated the community awareness, attitudes, and behaviours in relation to potential floods.

The studies have shown that the Hawkesbury-Nepean community has low awareness of flood risks and recommended response measures (Bewsher Consulting et al 2002; Newgate Research 2014a, b, 2015, and 2018). According to Bewsher Consulting et al (2002)'s study, little awareness of flooding and associated risks is because the PMF-affected suburbs within the downstream community study area lacks residents who have had personal experience of severe floods in the area. Threatening flooding is perceived as a remote event which is easily dismissed. Unlike several other coastal NSW floodplains that regularly experience extensive flooding, the floods of the downstream communities study area, which have happened in the last 135 years, have not been severe; and thus, had little meaningful impact

on the community (Bewsher Consulting et al 2002). In the Hawkesbury-Nepean floodplain, the largest flood on record was in 1867 flood, which was estimated to be a 1 in 250-per year flood event at Windsor (Figure 6-28).

Figure 6-28 View of the Windsor 'island' in the 1867 flood



Source: *Illustrated Australian News*, 27 Jul 1867 p. 8; State Library of Victoria. Image provided by INSW.

The communities believed that the 100-year flood event was generally used as the floor planning level and were not well aware of its severe impacts on the community as a whole (Bewsher Consulting et al 2002). It is generally perceived that the largest flood in living memory across the Hawkesbury-Nepean floodplain was the 1961 flood (Figure 6-29).

Figure 6-29 South Windsor during the 1961 flood event



Source: Image provided by INSW (2021).

Newgate Research's 2014 and 2018 studies also revealed that the community's knowledge and awareness of the potential risks of flood was low in the downstream communities study area (Newgate Research 2014 a, b, & 2018). The low perception of flood risks is likely due to limited community exposure to large flood events on the Hawkesbury-Nepean floodplain. The results of Newgate Research's 2018 study further show that respondents ranked flood third in terms of perceived risk, behind severe storms and bushfires. These responses illustrate low levels of knowledge of protection actions and awareness regarding floods, as well as low levels of preparedness.

Due to low flood risk perception, the communities of the Hawkesbury-Nepean floodplain are not well prepared for a flood (Bewsher Consulting et al, 2002; Newgate Research 2014 a, b & 2018). According to Bewsher Consulting et al

(2002), the communities in the Hawkesbury-Nepean floodplain leave themselves very vulnerable to devastating environmental, social, economic, and psychological impacts of a flood as a result of low flood risk perception and a low level of preparedness for a flood. Newgate Research's 2018 study also claims that high levels of unpreparedness are likely due to low risk perception. According to Newgate Research's 2018 study, respondents' characteristics, such as age, gender, previous flood experience and marital status, are shown statistically correlate with responses, as individuals present different perceptions and levels of knowledge and preparedness. While there was minor to moderate flooding in the Hawkesbury-Nepean floodplain in February 2020, communities would likely still be vulnerable to the social, economic and psychological impacts of a major flood.

Overall, the findings of the studies illustrate the need for further education and awareness regarding flood risk and mitigation measures. Increased awareness would not only help elicit an effective response during a flood event, but minimise social disruption and subsequently assist in the recovery process.

6.5 Estuary communities

6.5.1 Overview

Further to the downstream communities study area, the estuarine area of the Lower Hawkesbury River has been identified as potentially impacted from the change to patterns of water release from the Dam due to the Project. Potential impacts which the Project may have on the estuary area along the Lower Hawkesbury River would be:

- potential longer periods of poorer water quality
- reduced flushing of the river.

These changes may promote socio-economic changes in estuary communities along the Lower Hawkesbury River.

The LGAs which form the estuary communities study area are Hornsby, Central Coast, and Northern Beaches. Twenty-six (26) suburbs from these LGAs have been identified and collectively constitute the estuary communities study area. These suburbs include 11 suburbs in the Hornsby LGA, 14 suburbs in the Central Coast LGA, and one suburb in the Northern Beaches LGA. Along with these suburbs, the Pittwater area will be discussed due to the large boating industry located in the waterway.

To help identify the potential socio-economic impacts and to assess the extent of these effects, the socio-economic baseline of the estuary communities on demographic characteristics, economic and industry profile, estuary values needs to be understood. This section provides the key socio-economic indicators for the estuary communities study area.

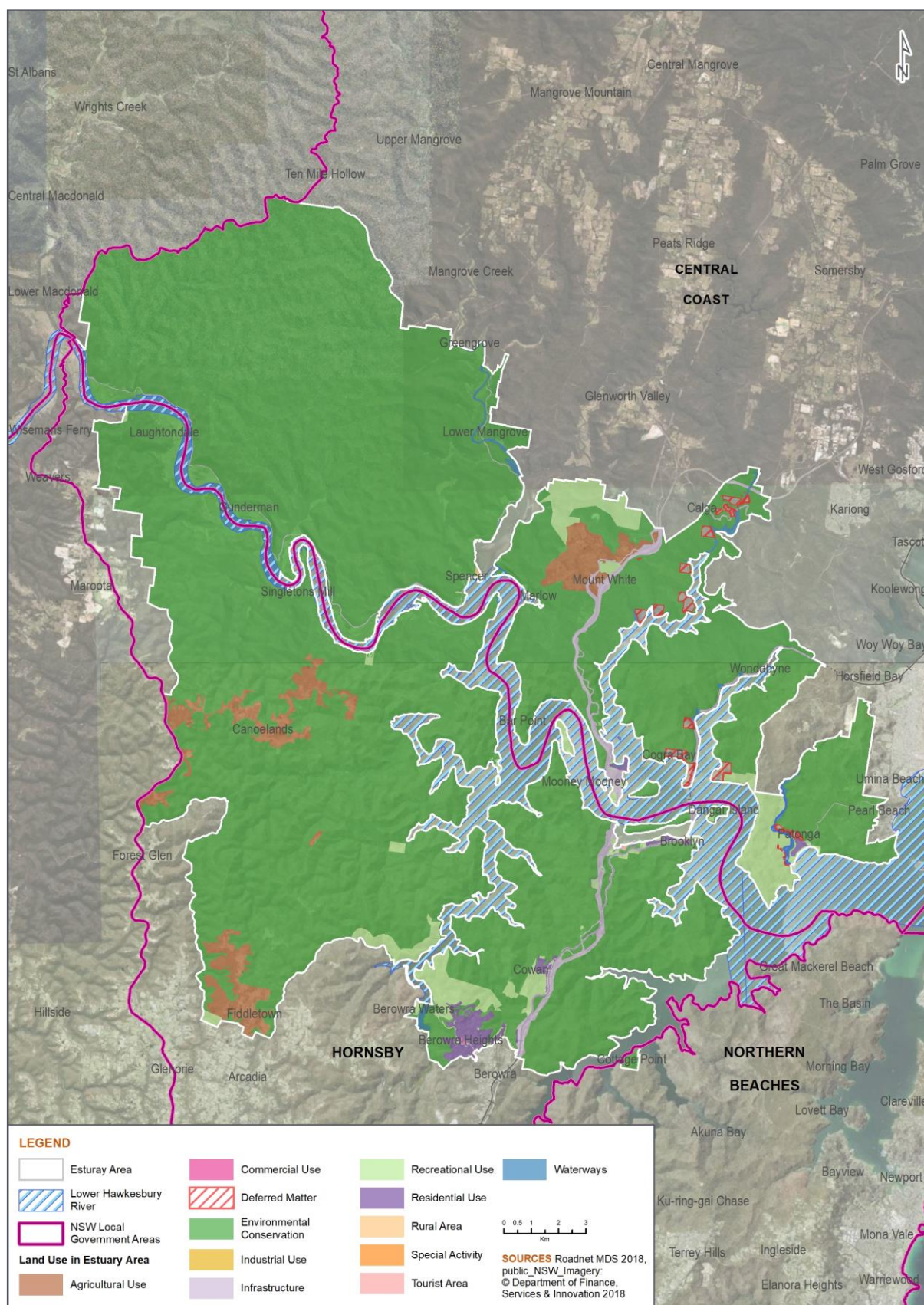
It should be noted that detailed socio-economic profiles of the estuary communities study area, including the three affected LGAs, can be found in Appendix E of this report.

6.5.2 Land use and planning

Figure 6-30 and Table 6-30 provide the land use characteristics of the estuary communities study area. Land use profiles of the estuary communities study area are largely characterised by environmental conservation land. Along the estuarine area of the Lower Hawkesbury River, environment conservation land is dominant. There are small areas of recreational, agricultural, and residential land use within the estuary communities study area. Overall, the visual character of the estuary communities study area is predominantly natural forest, waterways, recreational areas and relatively-limited residential development.

Land use categories and their proportions have been detailed in Table 6-30 below. As shown in Table 6-30, the proportion of environment conservation land is largest across all affected suburbs and affected LGAs. For instance, the proportion of environment conservation land in the estuary communities study area accounts for 88.8 percent. Environmental conservation land makes up 64.2 percent, 49.9 percent, and 40.6 percent in the Hornsby, Northern Beaches, and Central Coast LGAs respectively. Followed the largest proportion of environment conservation land, recreational and agricultural land use in the estuary communities study area accounts for only 3.6 percent and 3.1 percent respectively. Regarding the LGAs within the estuary communities study area, the second and third largest proportions of land use are different across the affected LGAs. In detail, in the Hornsby LGA, agricultural and residential land use accounts for 12.7 percent and 8.8 percent respectively. In Central Coast, the second and third largest proportions of land types are industrial use (19.7 percent) and rural area (13.3 percent). In the Northern Beaches LGA, the proportion of residential land use was the second largest with 18.7 percent, followed by the proportion of waterway. Appendix D of this report provides maps of different types of land use in the three affected LGAs. These maps illustrate the different proportions of land use categories in the affected LGAs.

Figure 6-30. Map of land use categories in the estuary communities study area



Source: SMEC 2018

Table 6-30. Land use profile of estuary communities study area

Land use categories	Suburbs of estuary communities study area (km ²)				LGAs of estuary communities study area		
	Total of local estuary study area (%)	Hornsby LGA – 11 affected suburbs	Central Coast LGA – 14 affected suburbs	Northern Beaches LGA - 1 affected suburb*	Hornsby LGA (%)	Central Coast LGA (%)	Northern Beaches LGA (%)
Environmental conservation	88.8	213.54	219.67	0.33	64.2	40.6	49.9
Recreational use	3.6	7.92	9.80	0	5.0	3.0	8.9
Agriculture use	3.1	10.44	4.53	0	12.7	12.2	5.6
Infrastructure use	1.7	3.16	5.18	0	1.9	9.2	2.4
Residential use	0.7	2.88	0.33	0.07	8.8	6.2	18.7
Waterway	1.6	2.57	5.24	0	6.8	9.2	9.4
Deferred matter	0.5	0	2.43	0	0	4.6	5.1
Commercial use	0.01	1.11	0	0	0.2	0.4	1.1
Rural area	0.01	0	0.04	0	0.01	13.3	0
Tourist area	0.01	0.05	0	0	0.03	0.04	0.05
Industrial use	0.01	0.01	0.01	0	0.35	19.7	0.6
Special activity	0	0	0	0	0	0.2	0.6

*Cottage Point

Source: Local Environmental Plans of relevant LGAs

Development within the Hornsby LGA along the river follows a strict guideline to ensure that settlements will be ecologically sustainable, protect water quality and significant native flora and fauna, and keep the natural topography and the scenic quality of the area. In addition, settlements along the river must restrict their population to a level which will not impact the natural environment (Hornsby Shire Council 2013). The Central Coast LGA also has strict development guidelines which are controlled under the Gosford Development Control Plan 2013 (Central Coast Council 2013). Under the Gosford Development Control Plan 2013, all development in this LGA must be ecologically, socially, and economically sustainable.

6.5.3 Demographic profile

Table 6-31 provides a key demographic profile of the estuary communities study area. The total population across all the 26 affected suburbs along the estuarine area of the Lower Hawkesbury river was 9,368 people, making up 2,596 households. The average population density of the entire estuary communities study area was 144.57 people per square kilometre. This population density was substantially lower than that of each LGA within the estuary communities study area (such as 313.55 people per square kilometre in the Hornsby LGA, 194.95 people per square kilometre in the Central Coast LGA, and 994.80 people per square kilometre in Northern Beaches LGA) and of Greater Sydney (390 people per square kilometre). The data provided in Table 6-31 and the map of the estuary area in Appendix F of this report have shown that there are not many people living along the Lower Hawkesbury river. Along the estuarine area, population was denser in the Hornsby LGA, which is located further south of the Hawkesbury river. The Hornsby Plateau to the south of Berowra Creek is where much of the residential, industrial and commercial development of Hornsby and surrounding suburbs is located. Berowra Heights had the highest population, accounting for 5,264 people. Dangar Island had the highest population density (958.03 persons per square kilometre). Data further shows that the total population of the 11 affected suburbs in the Hornsby LGA was highest with 7,594 people, followed by the affected suburbs in the Central Coast LGA with 1,676 people, and lastly Cottage Point suburb of the Central Coast LGA with only 98 people.

Between 2011 and 2016, overall, there was a slight population increase across the estuary communities study area. This increase is mainly contributed due to the population growth of 68 people in the 11 affected suburbs of the Hornsby LGA. During this five-year period, total population of the affected suburbs in the Central Coast and Northern Beaches LGAs decreased by 44 and 15 people respectively. In comparison with the affected LGAs, the population of the Hornsby and Northern Beaches LGAs decreased significantly between 2011 and 2016. Only the Central Coast LGA

experienced a population growth between 2011 and 2016. This trend is in line with the broader Greater Sydney region.

In 2016, there were a total of 92 Indigenous Australian people in the estuary communities study area, which accounted for only 1.0 percent of the total population the estuary communities study area. It is noted that there were 18 affected suburbs which had no Indigenous Australian people. Of all 26 affected suburbs in the estuary communities study area, Berowra Heights was the affected suburb with the highest Indigenous population (37 Indigenous Australians). The total number of Indigenous people in the 11 affected suburbs within the Hornsby LGA (62 Indigenous Australians) was highest, followed by the total 14 affected suburbs in the Central Coast LGA (30 Indigenous people). Compared among the LGAs within the estuary communities study area, the proportions of Indigenous Australian people in the Hornsby and Northern Beaches LGAs were relatively low, accounting for 0.8 percent and 0.6 percent respectively. The proportions of Indigenous Australian people in these two affected LGAs were lower than that in the Central Coast LGA (3.8 percent) and in Greater Sydney (1.5 percent).

There was generally lower cultural diversity recorded in the suburbs of the estuary communities study area compared to the LGAs of estuary communities study area as a whole and to Greater Sydney. In 2016, the percentage of residents who were born overseas in the estuary communities study area was 14.5 percent. This percentage was lower than the average of the LGAs within the estuary communities study area (30.8 percent) and of the Greater Sydney (36.7 percent). Accordingly, the estuary communities study area had very low proportion of households where LOTE was spoken, accounting for only 3.4 percent, compared to the average of the LGAs within the estuary communities study area (22.5 percent) and the Greater Sydney (35.8 percent). Of all the affected suburbs in the estuary communities study area, Milsons Passage in the Hornsby LGA had highest proportion of population born overseas, accounting for 45 percent. High cultural diversity was also prominent in Berowra Creek in the Hornsby LGA, which had 16.7 percent of its population speaking another language.

Table 6-31. Demographic profile of the estuary study areas

LGA	Suburb	Area (km ²)	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Core activity need for assistance (%)	Median age	Gender distribution (%)		Total households (no.)
											Female	Male	
Hornsby	Berowra Creek	1.31	18	13.77	-195	0	16.7	16.7	0.0	58	44.4	44.4	5
	Berowra Heights	8.00	5,264	657.74	160	37	19.4	8.2	3.0	40	49.3	50.7	1,514
	Berowra Waters	0.38	120	318.52	120	0	16.7	7.5	0.0	56	51.7	50.0	20
	Brooklyn	32.13	722	22.47	-22	7	19.8	9.3	3.5	48	47.5	52.8	196
	Canoelands	63.45	175	2.76	-124	0	19.4	7.4	4.0	41	48.6	54.9	49
	Cowan	31.9	649	20.34	105	11	13.8	10.1	2.9	40	49.3	50.7	208
	Dangar Island	0.32	303	958.03	36	0	31.0	4.3	5.	50	53.8	45.5	80
	Fiddletown	69.4	233	3.36	-10	0	17.5	13.2	3.9	42	47.9	52.1	71
	Laughtondale	27.06	83	3.07	83	7	7.2	0.0	3.6	49	21.7	65.1	24
	Milsons Passage	0.64	20	31.34	-92	0	45.0	0.0	0.0	66	20.0	60.0	7
	Singleton Mill	6.02	7	1.16	7	0	0.0	0.0	0.0	69	42.9	42.9	0
	11 Suburbs	240.61	7,594	184.78	68	62	18.8	7.0	2.4	51	43.5	51.7	2,174
	Overall LGA	455	142,667	313.55	-14,180	663	37	40.5	4.4	40	51.2	48.8	39,339
Central Coast	Bar Point	10.03	64	6.38	-297	0	10.9	6.3	10.9	52	45.3	54.7	21
	Cheero Point	0.18	87	483.54	87	0	13.8	5.8	0.0	45	49.4	52.9	26
	Cogra Bay	0.57	18	31.81	18	0	16.7	0.0	0.0	50	50.0	27.8	0
	Gunderman	102.69	195	1.90	195	8	14.9	1.5	4.6	52	27.2	62.6	39
	Little Wobby	1.49	61	40.98	-157	0	26.2	0.00	6.6	58	39.3	60.7	10
	Lower Mangrove	16.54	65	3.93	65	4	13.9	7.7	4.6	53	41.5	64.6	19
	Marlow	1.18	18	15.29	18	0	16.7	0.0	0.0	58	38.9	66.7	3

LGA	Suburb	Area (km ²)	Total population 2016 (no.)	Population density (persons/km ²)	Population change between 2011 – 2016 (no.)	Indigenous population (no)	Born in overseas country (%)	Households speak non-English language at home (%)	Core activity need for assistance (%)	Median age	Gender distribution (%)		Total households (no.)
											Female	Male	
	Mooney	1.90	310	163.17	-114	4	18.4	2.3	3.9	50	46.8	50.7	91
	Mooney Creek	18.97	25	1.32	25	0	32.0	0.0	0.0	35	52.0	48.0	5
	Mount White	16.68	183	10.97	183	0	18.6	6.6	4.9	53	45.4	51.9	43
	Patonga Beach	18.10	206	11.38	4	0	15.5	5.3	2.9	63	45.6	52.9	51
	Spencer	32.02	306	9.56	-209	14	12.8	2.9	5.6	51	44.8	54.3	57
	Wendoree Park	2.09	134	64.08	134	0	18.7	11.9	2.2	39	44.8	55.2	30
	Wondabyne	24.78	4	0.16	4	0	0.0	0.0	0.0	35	0.0	75.0	3
	14 Suburbs	247.22	1676	6.78	-44	30	16.4%	3.6%	3.3%	50	40.8	55.6	398
	Overall LGA	1,681.1	327,736	194.95	30,023	12,485	21.2%	8.3%	6.4%	42	51.6%	48.4%	87,869
Northern Beaches	Cottage Point	0.4	98	242.14	-15	0	24.5	3.1	0.0	55	50.0	50.0	24
	1 Suburb	0.4	98	242.14	-15	0	24.5	3.1	0.0	55	50.0	50.0	24
	Overall LGA	254.2	252,878	994.80	-15,238	1,394	34.2%	18.9%	6.4%	40	51.2%	48.8%	67,745
	26 Suburbs	488.23	9,368	144.57	9	90	14.5%	3.4%	0.8%	52	44.7	52.4	2,596
Greater Sydney		12,367	4,823,991	390.05	432,317	70,135	36.7	35.8	4.9	36	50.7	49.3	1,247,047

Source: ABS Census of Population and Housing 2016

6.5.4 Economic and industry profile

The communities in the estuary communities study area are diverse and range from densely populated and highly-urbanised areas to semi-rural and natural areas. Continued growth and development in the area has resulted in some communities becoming more urbanised along the estuary. There has been substantial public and private investment within the Hawkesbury Estuary. Table 6-33 below provides a summary of key economic and employment characteristics of the 26 suburbs and three LGAs of the estuary communities study areas.

In 2016, the 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. The labour force participation rate for the suburbs within the estuary communities study area was higher than that of the Greater Sydney (61.6 percent) and of the three affected LGAs in the estuary communities study area (61.2 percent). The suburb of Fiddletown within Hornsby LGA recorded the highest labour force participation rate (72.8 percent), while the suburb of Berowra Waters, also within the same LGA, recorded the lowest labour force participation rate (17.8), which is likely attributed to an older population profile with a recorded median age of 56 years and the presence of retirement villages within the suburb.

Of 26 affected suburbs, a total of 10 suburbs in the estuary communities study area recorded construction as one of the top three industries. Although most suburbs recorded unemployment rates below their corresponding LGAs, there were some suburbs which higher unemployment rates. The relatively small population is likely a contributing factor for variance in unemployment rates. For example, Marlow within the Central Coast LGA had an unemployment rate of 33.3 percent, however the population was only 18 people. Of all the affected suburbs, the unemployment rate was 4.0 percent, which was lower than that of the Greater Sydney (6.0 percent).

Median weekly household incomes in all affected suburbs in the estuary communities study area fluctuate and range from only \$466/week (in Marlow of the Central Coast LGA) to \$2,138/week (in Berowra Heights in the Hornsby LGA). Overall, the affected suburbs in the Central Coast LGA had the lowest median weekly household income (\$1,144.43/week), followed by the affected suburbs in the Hornsby LGA (\$1,293/week) and finally the Cottage Point Suburb in the Northern Beaches LGA (\$2,083/week). Median weekly household income of the estuary communities study area was \$1,243.54/week, which was lower than the two affected Hornsby LGA (\$2,121/week) and Northern Beaches LGA (\$2,178/week) and the Greater Sydney (\$1,750/week).

Regarding SEIFA Index, the data has shown that the affected suburbs in the Hornsby and Northern Beaches LGAs had high level of advantage while the affected suburbs in the Central Coast LGA had very high level of disadvantage. The affected suburbs in the Hornsby and Northern Beaches LGAs had high scores and ranks. The affected suburbs in Hornsby and in Northern Beaches ranked 9th and 10th. In contract, the entire 14 affected suburbs in the Central Coast LGA had a rank of 5th. Overall, the estuary communities study area had a rank of 7th. Industries associated with the Hawkesbury Estuary include oyster aquaculture, commercial fishing, agriculture, recreation, and tourism.

The oyster industry was decimated by the outbreak of QX disease which occurred in 2004. This outbreak caused very high mortality rates of the Sydney Rock Oyster (DPI Fisheries 2006). The oyster industry in the Hawkesbury river recovered through replacing the Sydney Rock Oysters with Pacific Oysters. However, in 2013, the Pacific Oyster Mortality Syndrome (POMS) virus devastated local oyster farms. According to the Department of Primary Industries (DPI), POMS destroyed 10 million oysters and caused major production and economic losses in commercial oyster farms in 2013. Despite the QX disease and POMS virus outbreak, oyster farming in the Lower Hawkesbury Estuary is slowly recovering.

In 2016/2017, the production of oysters in the Hawkesbury River was reported to have a value of \$437,664 in 2016/2017 (NSW DPI 2017c). This value accounted for 0.97 percent of the total value of oyster production in NSW (\$45,323,112). The review of oyster aquaculture production by the Hawkesbury River over the period from 2012 to 2017 shows that the value of oyster production on the Hawkesbury river increased. However, its contribution to the NSW oyster industry has slightly reduced over this period. For example, in the year of 2012/2013, the production value of oyster aquaculture in the Hawkesbury River was \$34,297, accounting for 1.32 percent of the total NSW oyster production (NSW DPI 2017c).

As of January 2019, there were a total of 155 licenced oyster farms. Of these, 38 oyster farms appear to have been decommissioned. However, the precise number of commercially active oyster farms is unknown. Figure 6-31 below shows the phased-out oyster farms in orange. The oyster harvest locations in the estuary communities study area include, for example, the mouth of Mooney Creek, Marramarra Creek, Kimmerikong Bay, Coba Bay, Berowra Creek, Sandbrook Inlet, Parsley Bay, the northern shore of Dangar Island, and Mullet Creek. Good water quality is essential for the economic viability of the local oyster farming industry. The oyster aquaculture industry along the

Hawkesbury River has been assessed to contribute substantially to water quality since oysters are filter feeders, and as such, intake pollutants within the water and can transfer those pollutants into flesh (Hornsby Shire Council 2008).

Figure 6-31. Map showing oyster farms phased out



Note: Phased-out oyster farms are those in orange.

Source: SMEC 2018

Commercial fishing in the Hawkesbury River is the fourth largest fishery in NSW. The Hawkesbury River fishery operates in waters from the confluence of the Hawkesbury River and the South Pacific Ocean and upstream to the vehicular ferry at Lower Portland (DPI 2017c). The prawn trawl fishery is the largest sector of commercial fishing in the Hawkesbury Estuary. This fishery involves the harvesting of prawns, squid, and fish (Kimmerikong 2005). Economically important fish species in the Hawkesbury river and estuaries include mullet, bream, whiting, tailor, flounder, leatherjacket, mullet, and sandy sprats. Economically significant invertebrate species include eastern king prawns, school prawns, greasyback prawns, and king prawns (WRL 2003). Brooklyn is a centre for commercial fishing in the estuary communities study area.

Agricultural land use in the estuary communities study area includes market gardening, orchards, nurseries, poultry production, stud farms, and low intensity grazing. Areas of grazing, orchards and vegetable growing exist in the upper reaches of Mooney Creek (WBM 2007). Popular recreation activities in the estuary communities study area include boating, canoeing, recreational fishing, swimming, picnicking, sightseeing, water-skiing, bird watching, camping and bushwalking (Hornsby Shire Council, 2008). Of these activities, recreational fishing is very popular. In addition to fishing from boats, there are a variety of areas from which fishing is permitted. Tourism, including recreational boating and fishing, is assessed to be growing rapidly. These recreational activities were estimated to total 1.33 million annual visits with an estimated value of \$46.2M (AgEconPlus Consulting 2006).

Brooklyn, particularly Sandbrook Inlet, is the centre for boating, with the largest marina complex in the estuary communities study area. There are 26 marinas located in the Hawkesbury Estuary which provide 1,686 wet berths and an additional 175 dry berths. Along with these marinas there are 93 public wharves across the estuary. There are an estimated 282 commuter berths. The estuary is also serviced by an estimated 2,601 foreshore car parking spots and 905 vehicle/boat trailer parking spots. In the estuary there was 1 boat washing facility and 11 fish cleaning stations. In 2012/2013 the estimated replacement value of fixed foreshore assets was \$274 million in the estuary (Rolyat Services PTY Ltd 2013)

The Hawkesbury Estuary had a total of 4,599 vessels moored and 6,253 vessels berthed across; Berowra Creek, Brooklyn, Cowan Creek, Pittwater, Brisbane Waters (including Patonga) and Wisemans Ferry to Spencer. Both moored and berthed vessels in the estuary is estimated to have a total replacement value of \$1.5 billion. A significant amount

of this replacement value is located on Pittwater at \$1.06 billion (Rolyat Services PTY Ltd 2013). For berthed vessels annual operating and maintenance costs were estimated at 10 percent of its replacement cost whereas moored vessels are between 5 percent and 7.5 percent (Rolyat Services PTY Ltd 2013). The combined annual operation and maintenance costs for all moored and berthed vessels in the Hawkesbury Estuary were estimated at \$135 million.

The berthing fees levied for permanent users in the Brooklyn area (per month) are depicted in Table 6-32.

Table 6-32. Boat fees levied for permanent users in the Brooklyn area (per month)

Boat Size	Cost (\$ per month)
Up to 5 m	390
Between 5 and 10 m	685
Between 10 and 12 m	800
Between 12 and 14 m	920
Over 14 m	1,000

Source: Rolyat Services PTY Ltd 2013

Houseboat hire is also popular from this location. Hence, Brooklyn is the launching point for most of the tourist activity in the area (Hornsby Shire Council 2008). The Brooklyn area had 49 percent of moored houseboats and 69 percent of berthed houseboats on the estuary which was attributed to houseboat hiring businesses such as Luxury Afloat, Holidays Afloat and Ripples Holiday Houseboats (Rolyat Services PTY Ltd 2013).

Table 6-33. Selected economic indicators for suburbs within the affected estuary communities

LGA	Suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three employment industries				Score of advantage and disadvantage	Rank within Australia
Hornsby	Berowra Creek	5	33.3	N/A	0	0	N/A	1,057	9
	Berowra Heights	2,867	71.1	Healthcare and social assistance Education and training Construction	3.3	2,138		1,108	10
	Berowra Waters	19	17.8	Retail trade Education and training Construction	0	749		1,082	10
	Brooklyn	414	65.2	Education and Training Construction Professional scientific and technical support	3.9	1,631		1,063	9
	Canoelands	95	69.3	Construction Healthcare and social assistance Professional scientific and technical support	0	1,937		1,040	8
	Cowan	344	67.4	Hospitals (Except Psychiatric Hospitals) Vegetable Growing (Outdoors) Floriculture Production (Outdoors)	3.8	1,991		1,084	10
	Dangar Island	132	53.9	Healthcare and social assistance Education and Training Professional scientific and technical support	6.8	1,375		1,049	9
	Fiddletown	131	72.8	Hospitals (Except Psychiatric Hospitals) Other Social Assistance Services Cafes and Restaurants	2.3	1,875		1,094	10
	Laughtondale	49	66.2	Mining Agriculture forestry and fishing Accommodation and food services	0	1,406		1,057	9
	Milsons Passage	4	20.0	Not available	0	1,125		1,028	8
	Singleton Mill	0	Not available	Not available	0	0		Not available	Not available
	11 Suburbs	4,060	68.2	Not applicable	1.8	\$1,293	Not available	1,066.2	9
	Overall LGA	74,368	64.8	Health care and social assistance Professional, scientific, and technical services Education and training	4.8	\$2,121	13,799	1,115	10

LGA	Suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three employment industries				Score of advantage and disadvantage	Rank within Australia
Central Coast	Bar Point	28	50.0	Public administration and safety Manufacturing Healthcare and social assistance	10.7	833	N/A	970	4
	Cheero Point	48	64.0	Healthcare and social assistance Construction Accommodation and food services	6.3	1,562		1,070	9
	Cogra Bay	11	84.6	Financial and Insurance	0	900		1,034	8
	Gunderman	72	40.9	Healthcare and social assistance Wholesale trade Manufacturing	5.6	1,194		937	3
	Little Wobby	20	38.5	Healthcare and social assistance Professional scientific and technical support	0	1,375		1034	8
	Lower Mangrove	27	42.2	Agriculture forestry and fishing Professional scientific and technical Construction	0	1,416		937	3
	Marlow	9	56.3	N/A	33.3	466		970	4
	Mooney Mooney	181	68.8	Healthcare and social assistance Construction Retail trade	3.9	2,031		1,070	9
	Mooney Mooney Creek	14	63.6	Wholesale trade Transport postal and warehousing	0	1,625		1,026	7
	Mount White	101	62.0	Healthcare and social assistance Administrative and support services Construction	3	954		970	4
	Patonga Beach	76	39.6	Accommodation and food services Professional scientific and technical support Public administration and safety	5.3	833		969	4
	Spencer	100	36.0	Construction Healthcare and social assistance Manufacturing	5	812		937	3

LGA	Suburb	Labour force profile			Unemployment rate (%)	Median household income (\$/week)	Number of registered businesses (no.)	SEIFA	
		No of labour force (no.)	Labour force participation rate (%)	The top three employment industries				Score of advantage and disadvantage	Rank within Australia
	Wendoree Park	69	71.1	Construction Healthcare and social assistance Retail Trade	0	2,021		970	4
	Wondabyne	Not available	Not available	Not available	0	0		Not available	Not available
	14 Suburbs	761	51.5	Not applicable	5.2	\$1,144.43		921	5
	Overall LGA	140,045	56.0	Construction Retail trade Manufacturing	6.9	1,242	22,480	975	7
Northern Beaches	Cottage Point	36	38.7	Professional scientific and technical services Healthcare and social assistance Accommodation and food services	8.3	2,083	N/A	1,146	10
	Overall LGA	134,324	66.2	Construction Professional scientific and technical services Retail trade	3.5	2,178	31,823	1,120	10
TOTAL	26 Suburbs	4,857	64.6	Not applicable	5.1	1,243.54	Not available	1,066.2	7
Greater Sydney		2,418,902	61.6	Hospitals (except Psychiatric Hospitals) Computer System Design and Related Services Cafes and Restaurants	6.0	1,750	Not available	Not available	Not available

Source: ABS Census of Population and Housing 2016

6.5.5 Regional open space and recreation areas

The Hawkesbury Estuary area provides a multitude of recreational areas and activities for the local community and Greater Sydney Region. The tributary creeks and the river itself provide a space for boating, canoeing, recreational fishing and swimming. The National Parks and nature areas surrounding the estuary provides space 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. The Hawkesbury and Broken Bay region had 43,395 boats in 2009 and is projected to be 69,326 in 2026 (NSW Maritime 2010). In 2009, there were 6,106 registered moorings (NSW Maritime 2010). Many properties in Berowra Creek can only be accessed by boat and this makes the creek system a key mooring area in the estuary.

NSW Fisheries estimates that approximately 150,000 recreational fishing outings occur in the Hawkesbury River per year. This was estimated to comprise of 82 percent on boats and 18 percent on the shore. On shore fishing is allowed in areas such as Cowan Creek. Although Long Island and Spectacle Island are open spaces, access is restricted for scientific, educational and research purposes only. It is estimated that approximately 10 million visits occur to the Hawkesbury River system each year (NSW Environment & Heritage 2005). Table 6-34 below lists a wealth of key open space and recreational areas across the 26 suburbs within the estuary communities study area. In total, there are 95 key open space and recreational areas across the suburbs within the estuary communities study area.

Table 6-34. List of key open space and recreational areas in the estuary communities study area

LGA	Affected suburbs	List of key open space and recreation areas
Hornsby	Berowra Creek	Dust Hole Bay Boat Ramp (Berowra Creek)
	Berowra Heights	Berowra Creek, Cunio Point, Andys Bight, Barnetts Lookout, Naa Badu Lookout, Banggarai Creek, Washtub Gully, Berowra Valley National Park, Franks Gully, Warrina Street Oval, Crossroad Reserve, Great North Walk Log Box
	Berowra Waters	Berowra Creek
	Brooklyn	Kangaroo Point Boat Ramp (Hawkesbury River), Parsley Bay Boat Ramp (Hawkesbury River), Long Island, Muogamarra Nature Reserve, Brooklyn Dam, Sandy Bay, Lookout Bay, McKell Park, Gunyah Beach, Eleonor Beach, Jerusalem Bay, Cowan Creek, Shark Rock Point, Little Shark Rock Point
	Canoelands	Marramarra National Park, Marramarra Creek, Hawkesbury River
	Cowan	Muogamarra Nature Reserve
	Dangar Island	Kiparra Park Reserve Walking Track
	Fiddletown	Marramarra National Park
	Laughtondale	Marramarra National Park, One Tree Reach Wetland
	Milsons Passage	Muogamarra National Park, Prickly Point, Hawkesbury River
	Singletons Mill	Marramarra National Park, Hawkesbury River, Layburys Creek
Central Coast	Bar Point	Hawkesbury River, Popran National Park
	Cheero Point	Hawkesbury River, Popran National Park
	Cogra Bay	Hawkesbury River, Brisbane Water National Park, Mullet Creek, Cogra Point
	Gunderman	Dharug National Park, Hawkesbury River
	Little Wobby	Broken Bay Sport and Recreation Centre, Forest, Croppy Point, Pacific Head, Juno Point
	Lower Mangrove	Dharug National Park, Mangrove Creek, Tarbay Gully
	Marlow	Marlows Gully, Hawkesbury River, Popran National Park
	Mooney	Deerubbun Boat Ramp (Hawkesbury River), Popran National Park, Spectacle Island, Spectacle Island Nature Reserve
	Mooney Mooney Creek	Mooney Mooney Creek, Popran National Park, Brisbane Water National Park

LGA	Affected suburbs	List of key open space and recreation areas
	Mount White	Never Fail Island, Popran National Park, Mangrove Creek, Mount White Bush Reserve
	Patonga Beach	Patonga Boat Ramp, Brisk Bay, Hawkesbury River, Mt Wondabyne park, Warrah Lookout, Dark Corner, Patonga Creek
	Spencer	Dharug National Park, Hawkesbury River, Mangrove Creek, Triangle Island
	Wendoree Park	Greenmans Valley Recreation Park, Mangrove Creek, Hawkesbury River
	Wondabyne	Brisbane Water National Park, Mt Wondabyne, Mullet Creek, Alison Point
Northern Beaches	Cottage Point	Ku-ring-gai Chase National Park, Cowan Creek, Coal and Candle Creek

Source: SMEC 2018

6.5.6 Estuary values

The Lower Hawkesbury Estuary is one of the most valued waterways in NSW, offering significant environmental, recreational, and economic value for visitors and nearby communities.

This estuary catchment is unique since the foreshore areas consist of significant forested areas and relatively-limited foreshore development, with the majority of the foreshore and adjacent lands being National Parks and land for recreational use that can only be accessed by boat (Hornsby Shire Council 2008). 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' (Breen et al 2005).

Estuary values of the Lower Hawkesbury Estuary area have been identified in the 2008 Lower Hawkesbury Estuary Management Plan (Hornsby Shire Council 2008). Through community and stakeholder consultation undertaken to inform development of the Lower Hawkesbury Estuary Management Plan, the following values of the Lower Hawkesbury Estuary were identified:

- **High scenic amenity:** The estuary area is a "unique and beautiful estuary of national significance and value" (Hornsby Shire Council 2008, p 73). The topography of the estuary catchment has served as a barrier to developing and exploiting the land surrounding the waterway, and to the urban sprawl of Sydney. The estuary area covers largely undeveloped surrounding land. Therefore, its high scenic amenity has been preserved in proximity to a major metropolitan centre.
- **Functional and sustainable ecosystems:** Functional and sustainable ecosystems and biodiversity is one of the key assets covering the entire Lower Hawkesbury and its estuary catchment. These ecosystems support environmental values and industries, such as oyster aquaculture, commercial fishing, and agriculture, which accordingly provide wellbeing and incomes to estuary communities.
- **Recreational opportunities:** The Lower Hawkesbury Estuary holds significant recreational value, offered by the estuary's vast area of natural vegetation, and deep waterways with open channels and secluded harbours, coupled with, high quality of terrestrial and aquatic habitats. There are a range of land and water based recreational activities in the estuarine area. These include, for example, boating, fishing, water-skiing, swimming, bushwalking, picnicking, bird-watching, scenic appreciation, and relaxation. The Lower Hawkesbury estuary's close proximity to metropolitan centres such as Sydney contributes to the recreational value of the estuary due to its accessibility for recreational users and tourists.
- **Sustainable economic industries:** Sustainable economic industries are recognised as an asset of the estuary. There are number of economic activities undertaken in the waterway. These industries include, for instance, fish, prawn, and oyster industries, tourism and recreation providers, and agriculture. Such sustainable economic industries have supported the estuary communities.
- **Culture and heritage:** The Lower Hawkesbury Estuary has both Aboriginal and non-Aboriginal cultural areas. There are many significant Aboriginal sites, particularly situated in the national parks as well as sites symbolic to European settlement area. Heritage sites are of local, regional, and national significance in the Lower Hawkesbury Estuary (Hornsby Shire Council 2008).
- **Water quality to support user demands:** The water quality has supported an abundant and diverse estuarine ecosystem, which in turn greatly support sustainable economic industries, such as commercial fishing, oyster aquaculture, tourism, and recreation. Improving the water quality of the estuarine area will sustain current

future uses and users (Hornsby Shire Council 2008). Figure 6-32 below provides an illustration of the Lower Hawkesbury river.

Figure 6-32. Views of Lower Hawkesbury River



Source: Google image 2018

A list of risks potentially affecting the estuary assets has also developed under the 2008 Lower Hawkesbury Estuary Management Plan. These risks have been determined through consultation and a detailed review of existing background information. For example, the key risks identified in the Lower Hawkesbury Estuary Management Plan as potentially affecting the estuarine area are:

- 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 user 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 (Hornsby Shire Council 2008, p. 75-76).

Assessing the impacts or benefits of the Project on the Lower Hawkesbury Estuary is complicated since most natural or anthropogenic processes in the estuary are highly interactive and dynamic. As such, the specific role of a single process may change over time and location and is consequently often difficult to assess. This section has provided a baseline of the estuary communities study area which will be considered to identify effects or pathways through which the Project may impact the estuary communities.

7 SEIA stakeholder engagement

7.1 Overview

Central to the SEIA methodology is the incorporation of the views, concerns, and opinions of potentially affected communities. Information generated through the engagement of Project stakeholders is used to verify baseline characteristics, identify potential socio-economic impacts and benefits associated with the Project and development of mitigation measures. The SEIA has been informed by both engagement activities specifically undertaken as part of the SEIA along with the community engagement program associated with the EIS. The SEIA is further supported by engagement activities undertaken by INSW to inform the Hawkesbury-Nepean Valley Flood Risk Management Strategy. This Section presents outcomes of SEIA stakeholder engagement undertaken to date.

7.2 Aim and objectives

The overarching aim of the SEIA stakeholder engagement was to ensure that potentially affected people, groups, organisations, and communities had an opportunity to provide informed input to the social baseline, impact assessment and mitigation measures. To achieve this aim, the objectives of the SEIA Stakeholder Engagement (SE) were to:

- undertake engagement that allows for the informed participation of all stakeholders in the early stages of risk and impact identification and assessment
- leverage the established inclusive and continuous process to attain and collate direct input from various stakeholders that can influence both Project design and SEIA development
- ensure that stakeholders' inputs to inform each stage of the SEIA including the scoping, baseline, and impact assessment, and mitigation measures.

7.3 EIS engagement

7.3.1 Overview

Community and stakeholder consultation undertaken as part of the EIS has sought to inform, consult and involve stakeholders regarding the impacts and benefits of the Project whilst also increasing community knowledge, awareness and understanding of flood management issues; improving the community's skills, capacity and capability to appropriately prepare for and respond to floods; and fostering a shared responsibility for planning, preparing, responding to and recovering from a flood.

A range of tools and activities were used in informing, consulting with and involving stakeholders regarding the impacts and benefits of the Project, including:

- **Meetings and briefings:** The project team provided briefings and held meetings with relevant councils across the study areas, as well as local 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. These occurred at Warragamba Dam Visitor Centre, Penrith Plaza, Windsor Riverview Shopping Centre, North Richmond Community Centre, Wisemans Ferry Shops, the Hawkesbury Show, DamFest, and the Yandhai Nepean River Crossing opening ceremony

Thirteen information displays were established at council chambers, libraries, and other facilities, including community updates on both the Project and the Hawkesbury-Nepean Valley Flood Risk Management Strategy. These displays on the Project are located at Hornsby and Berowra libraries, The Hills Shire Council, Camden Council, Blacktown City Council, Hawkesbury City Council, Liverpool Library, Penrith City Council, Warragamba Dam Visitor Centre, Warragamba-Silverdale Community Centre, Wollondilly Shire Council, Wingecarribee Shire Council and Springwood Community Hub

A dedicated project website (www.waternsw.com.au/wdr), project email address (wdr@waternsw.com.au) and information line (1800 932 066) were established for communities and stakeholders wanting further information

- **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. The updates contained information about the

risks and effects of flooding in the Hawkesbury-Nepean Valley, justifications for the Project, and ‘myth-busting’ statements in response to misconceptions that were discovered to be held by stakeholders through either direct consultation or through observation of claims against the Project made by opposition groups that were deemed to be false by technical specialists.

- **Consultation with Aboriginal stakeholders:** In accordance with Aboriginal cultural heritage consultation requirements for proponents 2010 (ACHCRs) (DECCW 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’s 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:** Engagement with a broad range of stakeholders was conducted, including interviews with councils and other stakeholder groups, council briefings, meetings with relevant government agencies, and briefings provided and meetings held with three special interest groups. In relation to the Project as a whole, there were 552 subscribers registered to receive updates and over 1,500 phone calls and emails received via the free call 1800 number and Project email address. Consultations with landowners upstream of the Warragamba Dam who would possibly be affected by temporary upstream inundation as a result of the Project were 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.

All consultation that occurred on the Project was registered and captured in a Consultation Manager database. To monitor issues as they arose, reports were regularly run in order to provide insights into stakeholder interests and concerns, to ensure adequate response to the issues. The EIS Stakeholder Register includes more than 2,403 entities. The types of stakeholders consulted are categorised as per the following groups:

- residents
- organisations interacting with vulnerable groups
- registered Aboriginal parties and other Aboriginal people
- local government
- interest groups
- state government
- special interest groups
- media
- community groups
- local business
- interest in construction work
- federal government
- service/infrastructure providers
- properties directly affected

7.3.2 Summary of issues raised during EIS engagement consultation

A broad range of issues has been raised by stakeholders across the variety of EIS engagement activities. Using Consultation Manager software, a summary of issues raised during the EIS consultation from 1 July 2017 to 15 September 2019 has been prepared as presented in Table 7-1. Records of media, social media and parliamentary documents relating to the Project were also maintained and reviewed by the project team during the consultation period to inform the development of engagement activities. However, these records have not been incorporated into the table below. It should be noted that the summary of issues raised during the EIS consultation will be further updated as consultation continues through ongoing use of the Consultation Manager software. As such, this should be considered as a preliminary listing of issues and will be further refined.

Issues raised by participants during EIS consultation informed the identification and assessment of both perceived and felt impacts to understand the level of concern stakeholders had in relation to these potential impacts. It also served

to confirm matters raised by stakeholders during the scoping phase, including in the development of the matters checklist.

Table 7-1. 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 GBMWH
Water hydrology	Changes to tributaries and rivers	Changes to the catchment's tributaries, including wild rivers, and waterflows downstream of the Dam
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	Perception that 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/would not reduce the risk to life from floods
Project development	Project approvals	Queries as to how the Project would gain planning approval

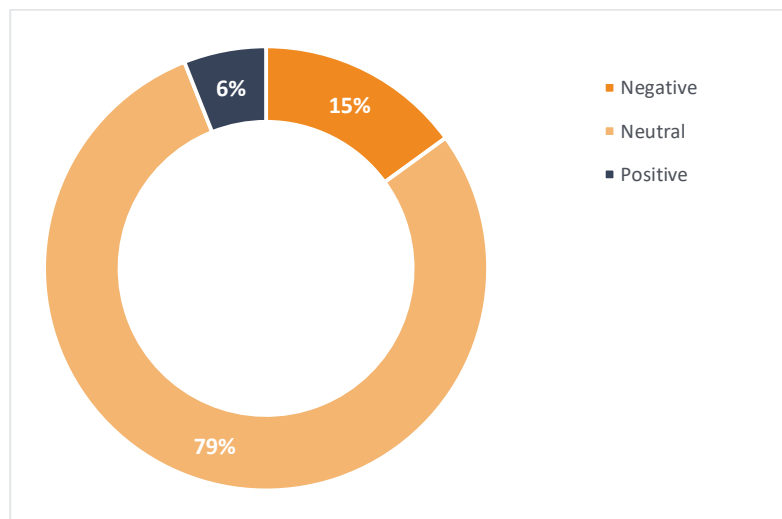
Category	Sub-issue category	Issue raised
Project development	Cost of Project	There are better ways to use the government funding allocated to the Project
Traffic and transport	Evacuation routes	The need for improved evacuation routes in the floodplain
Health and safety	Safety of the raised dam	The ability 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
Water quality	Negative effect on water quality	Water quality in the catchment would be impacted by construction and the retention of 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 might have on insurance provisions for properties on the floodplain
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	Flood management needs to consider sustainability principles

7.3.3 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, as well as community and stakeholder meetings. To help inform the EIS development the database captured one sentiment, 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 7-1 shows the sentiments expressed as percentages of the total. Whilst the majority of sentiment captured were neutral (79 percent), negative sentiment (15 percent) was higher than positive sentiment (6 percent).

Figure 7-1. Sentiment of events from 1 July 2017- 15 September 2019



7.4 SEIA stakeholder engagement

7.4.1 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's upstream, downstream and specifically the communities of Warragamba and Silverdale.

Direct forms of engagement which were specifically undertaken to inform the SEIA included the following:

- scoping interviews with local government authorities and other key stakeholders to document key social trends in local areas and build an understanding of the stakeholders potentially affected by the Project
- a phone-based survey which captured the level of appreciation of flood risk and perceptions regarding the proposal to raise the dam wall
- a web-based survey which allowed stakeholders to provide more detailed feedback on local level perceptions of risks and benefits of the Project
- a business survey which recorded the sensitivities and dependencies of businesses in potentially affected areas and how Project-related activities and outcomes might affect business operations
- two stakeholder workshops which provided an opportunity for residents and organisations that serve the Warragamba, Wallacia, and Silverdale communities to review the information about the Project and findings from relevant specialist studies.

All data collected through SEIA stakeholder engagement was in accordance with ethical social research practices and standards. All participants fully understood why the information was being sought and how it was to be used.

7.4.2 Scoping interviews

As described in Section 5.2, scoping of the SEIA was informed by direct engagement with key stakeholders. The scoping interview structure (provided as Appendix G of this report) focused on fostering an understanding of the socio-economic context including social features, trends, and values. Perceptions and concerns regarding how the Project may affect different stakeholders were elicited through semi-structured interview questions on topics including environmental conditions, health and wellbeing, community cohesion, and character and sense of place. The means of delivery was via phone-based and face-to-face interviews. This allowed the structuring and tailoring of open ended questions so that they focused on the key interests of the respective participants.

7.4.3 Phone-based survey

The SEIA phone-based survey sought to capture the level of appreciation of flood risk and perceptions regarding the Project to raise the dam wall. Underpinning the surveys was the methodologically driven selection of stakeholders. As defined by the SEARs, 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.

Parameters of social vulnerability and applicable indicators were defined, and data assembled to determine comparative levels of social vulnerability at the LGA level. Stakeholder organisations which represent the interests of identified vulnerable sectors of respective LGAs were targeted for engagement. A total of 352 specific organisations were identified through this process- as provided as Appendix G of this report.

Stakeholders were further identified through the preliminary identification of impacts and benefits informed through the scoping interviews, review of a broad range of background material, and the initial findings of other EIS technical studies. As described in Section 5, the *Social Impact Assessment Guideline Scoping Tool* (DPE 2017c) was completed to define location specific impacts and the stakeholder groups potentially affected. From an initial listing of over 500 stakeholder organisations, a process of refinement through the analysis of linkages to potential Project-related effects was applied to define a listing of 310 stakeholder organisations (see Appendix G of this report) that were invited to participate in the SEIA surveys.

The key objectives of the phone-based survey were to capture attitudinal, quantitative data (towards flood risk perception and the proposed dam wall raising) and promote participation in the web-based survey which provided an opportunity to provide more detailed feedback of location specific impacts and benefits. The phone-based survey was designed to be a duration of 5 to 7 minutes and was delivered by experienced communications professionals from the SMEC (Sydney) Communications Team between 12 November 2018 and 26 November 2018.

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 as outlined in Table 7-2.

Table 7-2 SEIA Phone survey- breakdown of responses

Location	Number of organisations contacted	Number of completed surveys
Warragamba/Silverdale/Wallacia/Wollondilly	48	10
Blue Mountains	38	10
Penrith	53	8
Liverpool	15	3
Blacktown	46	8
Hawkesbury	60	16
The Hills	13	4
Hornsby	15	5
Estuary- Central Coast/Northern Beaches	22	5

The key reasons recorded for organisations which were contacted not participating in the survey were:

- not interested as did not appreciate flood risk and therefore how the Project related to their organisation (21 percent of those contacted)
- too busy to participate (19 percent of those contacted)
- person contacted did not feel comfortable participating on behalf of the organisation and alternative person not available (16 percent of those contacted)
- not wanting to get involved due to politicised nature of the Project (8 percent of those contacted).

7.4.3.1 Overview of outcomes of SEIA phone survey

As provided in Appendix G of this report, the SEIA phone-based survey included questions designed to gather information on the geographic and numerical extent of stakeholders which they represented, awareness of flood vulnerability and the proposal to alleviate flood risk through the raising of Warragamba Dam. Participants were directly asked whether they supported or opposed the raising of the dam wall.

Participants from community organisations estimated the total number of members or the number of stakeholders the organisation provided services to, with the following results:

- Warragamba/Wollondilly: 35,423 people
- upstream: 95,098 people
- downstream: 427,492 people.

An overview of the feedback generated through the SEIA phone- based survey is provided in Table 7-3,

Table 7-4 and

Table 7-5 below. Around 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:

- Warragamba/Wollondilly: 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).

Seventy percent of participants had previously heard about plans to raise the Warragamba Dam in order to reduce the frequency and severity of flooding; however, participants from the upstream area (60 percent) 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).

Participants were read a number of key predicted effects associated with the Project relating to predicted effects in different localities and subsequently asked to indicate to what extent they supported or opposed the raising Warragamba Dam, with the following results:

- Warragamba/Wollondilly: strongly oppose (10 percent), oppose (20 percent), neutral (40 percent), support (10 percent), strongly support (20 percent)
- upstream: strongly oppose (60 percent), oppose (0 percent), neutral (10 percent), support (20 percent), strongly support (10 percent)
- downstream: strongly oppose (20 percent), oppose (13 percent), neutral (24 percent), support (27 percent), strongly support (16 percent).

A total of 43 percent of respondents from the downstream area supported the raising of Warragamba Dam whilst 60 percent of respondents from the upstream area opposed the Project. The most prevalent response in Warragamba/Wollondilly was neutral (40 percent). Respondents were asked to provide reasons for their position with a majority of respondents from both the upstream (80 percent) and downstream (60.87 percent) citing concerns with the Project, in particular environmental and cultural damage. In Warragamba/Wollondilly, more than half of respondents (60 percent) raised concerns surrounding the increased traffic from the Project.

7.4.3.2 Overview of results

An overview of results of the SEIA phone survey is provided in Table 7-3, Table 7-4, and Table 7-5 below. Note that comments received from stakeholders through the phone survey are presented verbatim.

Table 7-3. Phone survey responses for Warragamba/Wollondilly

	Locality	Warragamba/Wollondilly
Q1a	Can you provide an estimation as the total number of members of your organisation or the number of stakeholders your organisation provides services to	35,423 people
Q3	Do you believe there is further action required to reduce the severity and impact of flooding in the Hawkesbury-Nepean Valley?	<ul style="list-style-type: none"> ■ 30% Unsure ■ 40% Yes ■ 30% No
Q4	Can you briefly explain why you gave this answer (Key Points)	<ul style="list-style-type: none"> ■ We are in a drought so not sure about flooding ■ Don't know all the facts regarding the Project ■ The wall has already been raised ■ No severe flood in a number of years ■ Need more information to make an opinion ■ Flooding restricts movement which interrupts workers

	Locality	Warragamba/Wollondilly
		<ul style="list-style-type: none"> Warragamba system is not the only system that contributes to flooding No rain so flooding doesn't affect us at the moment No floods for 12 years- but always a risk
Q5	I am concerned about future flood events [Score: (5 Strongly Agree, 3 unsure, 1 Strongly Disagree) (Averages)]	Average score: 3.2 (Unsure)
	The existing dam wall needs to be raised to reduce flood risk in the Hawkesbury-Nepean Valley	Average score: 3.1 (Unsure)
	There are other options to reduce flood risk in the Hawkesbury-Nepean Valley	Average score: 3.3 (Unsure)
Q6	Prior to this survey, had you heard about plans to raise the Warragamba Dam in order to reduce the frequency and severity of future flooding events in the Hawkesbury-Nepean Valley? - Yes, No, Unsure	<ul style="list-style-type: none"> 0% Unsure 70% Yes 30% No
Q7	(If yes) And what had you heard about it?	<ul style="list-style-type: none"> Water overflow Dam being raised WaterNSW presentation ill informed That there have been protests For water capture rather than flooding
Q9	Based on this description, to what extent do you support or oppose raising Warragamba Dam as we have just described? - Strongly oppose, Oppose, Neutral or unsure, Support, Strongly support	<ul style="list-style-type: none"> 10% Strongly Oppose 20% Oppose 40% Neutral 10% Support 20% Strongly Support
Q10	(Unless neutral to Q9) Can you briefly explain why you support/oppose (in Q9) raising the Dam?	<ul style="list-style-type: none"> Environmental Issues Heavy Vehicle Traffic and accidents Damage to World Heritage Lack of Information Low Chance of a flood Unnecessary with correct control methods Potential Jobs For the 'Greater Good' Safety
Q11	Do you see any particular benefits to the planned Dam raising? (Multiple response)	<ul style="list-style-type: none"> No Benefit for Wollondilly Extra water capture Potential to adjust bridges instead Increased Water Storage Less need for evacuation Less risk of flooding
Q12	And do you have any concerns about this Proposal? (Multiple response)	<ul style="list-style-type: none"> Environment damage Increased traffic in construction Dust and noise Impacts upon businesses due to loss of tourists during construction Cost of building it

Table 7-4. Phone survey results for the upstream communities study area

	Locality	Upstream
Q1a	Can you provide an estimation as the total number of members of your organisation or the number of stakeholders your organisation provides services to	95,098
Q3	Do you believe there is further action required to reduce the severity and impact of flooding in the Hawkesbury-Nepean Valley?	<ul style="list-style-type: none"> 10% Unsure 50% Yes 40% No
Q4	Can you briefly explain why you gave this answer (Key Points)	<ul style="list-style-type: none"> Sensible option is to do something Flooding isolates areas- risk to human life Already seems well managed Believe it is only being built to allow further development downstream
Q5	I am concerned about future flood events [Score (5 Strongly Agree, 3 unsure, 1 Strongly Disagree) (Averages)]	Average score: 3.1 (Unsure)
	The existing dam wall needs to be raised to reduce flood risk in the Hawkesbury-Nepean Valley	Average score: 2 (Disagree)
	There are other options to reduce flood risk in the Hawkesbury-Nepean Valley	Average score: 4 (Agree)
Q6	Prior to this survey, had you heard about plans to raise the Warragamba Dam in order to reduce the frequency and severity of future flooding events in the Hawkesbury-Nepean Valley? - Yes, No, Unsure	<ul style="list-style-type: none"> 0% Unsure 87.5% Yes 12.5% No
Q7	(If yes) And what had you heard about it?	<ul style="list-style-type: none"> Threatening world heritage status Local residents are very concerned Is just to enable further downstream development Environmental damage Cultural Heritage damage
Q9	Based on this description, to what extent do you support or oppose raising Warragamba Dam as we have just described? - Strongly oppose, Oppose, Neutral or unsure, Support, Strongly support	<ul style="list-style-type: none"> 60% Strongly Oppose 0% Oppose 10% Neutral 20% Support 10% Strongly Support
Q10	(Unless neutral to Q9) Can you briefly explain why you support/oppose (in Q9) raising the Dam?	<ul style="list-style-type: none"> Environmental Issues Heritage destruction Dam raise won't improve flooding Only for development Will cause impacts to views Cost- waste of money Need more information Good flood mitigation Flooding a big issue- something should be done

	Locality	Upstream
Q11	Do you see any particular benefits to the planned Dam raising? (Multiple response)	<ul style="list-style-type: none"> Potential increased water storage None- it is a bad idea Short-term employment Potential to improve Sydney's housing problem Improved water security Increased water storage Less flooding Mitigation of future flooding
Q12	And do you have any concerns about this Proposal? (Multiple response)	<ul style="list-style-type: none"> Highly concerned about effects on World Heritage Negative effects on threatened species Highly concerned about effects on Aboriginal cultural heritage

Table 7-5. Phone survey results for the downstream study area

	Locality	Downstream
Q1a	Can you provide an estimation as the total number of members of your organisation or the number of stakeholders your organisation provides services to	427,492
Q3	Do you believe there is further action required to reduce the severity and impact of flooding in the Hawkesbury-Nepean Valley?	<ul style="list-style-type: none"> 29.79% Unsure 57.45% Yes 12.77% No
Q4	Can you briefly explain why you gave this answer (Key Points)	<ul style="list-style-type: none"> There is a lack of information about the Project Haven't had a flood in a long time Bridge flooding and sewage a concern Flood water effect on the oyster and prawning industry Potential flooding and risk to people's lives and property The Project will only enable more development- which means more concreted areas which actually makes flooding worse Dam levels low but good to plan for floods Improved evacuation routes need to be created Floods cut access to work and social infrastructure Other options are needed- raising the Dam won't stop floods Isolation and people displacement Need to plan around flooding- not try to control it Good drought proofing Negative impacts on national park areas Other options need to be used (rather than raising the Dam) Flooding doesn't happen often enough to warrant the Project Floods through the river are important- should be retained
Q5	I am concerned about future flood events [Score (5 Strongly Agree, 3 unsure, 1 Strongly Disagree) (Averages)]	Average Score: 3.6 (Unsure)
	The existing dam wall needs to be raised to reduce flood risk in the Hawkesbury-Nepean Valley	Average Score: 3.0 (Unsure)
	There are other options to reduce flood risk in the Hawkesbury-Nepean Valley	Average Score: 3.5 (Unsure)
Q6	Prior to this survey, had you heard about plans to raise the Warragamba Dam in order to	<ul style="list-style-type: none"> 2.08% Unsure 72.92% Yes

	Locality	Downstream
	reduce the frequency and severity of future flooding events in the Hawkesbury-Nepean Valley? - Yes, No, Unsure	<ul style="list-style-type: none"> 25% No
Q7	(If yes) And what had you heard about it?	<ul style="list-style-type: none"> Dam wall being raised Damage to national parks Comparison to Hoover dam and it being a positive investment To reduce frequency and severity of floods Retaining flood water and releasing it slowly The effects upstream will be permanent. Aboriginal communities will lose cultural sites Is only being done to advance further development on the floodplain Structural issue of current (old dam) which need to be fixed Accessed WaterNSW supplied information That it is all about drought proofing That will allow further development in Emu Plains and Penrith There is a low flood risk so why build the Project
Q9	Based on this description, to what extent do you support or oppose raising Warragamba Dam as we have just described? - Strongly oppose, Oppose, Neutral or unsure, Support, Strongly support	<ul style="list-style-type: none"> 20% Strongly Oppose 13.33% Oppose 24.44% Neutral 26.67% Support 15.56% Strongly Support
Q10	(Unless neutral to Q9) Can you briefly explain why you (Q9) raising the Dam?	<ul style="list-style-type: none"> Environmental Impacts World heritage impacts Waterway flow disruption Hydro impacts not assessed properly Harm to Farmers Area before Colo a huge contributor to flood not Warragamba Don't think it will change flood patterns Will create more damage Only to allow for more development Limited information provided (e.g. Aboriginal Heritage) Not convinced that other options have been looked at Environmental impacts Waste of money No recent flood Unsure of affect personally Not enough information Tiny chance of floods Reduction in houses affected by floods Will save lives Reduces evacuation number Time advantage for evacuation Flood Severity Reduction Reduction of bathtub effect Risk management been undertaken and stakeholders consulted Reduced isolation time Improved safety

	Locality	Downstream
Q11	Do you see any particular benefits to the planned Dam raising? (Multiple response)	<ul style="list-style-type: none"> ■ Potential employment generation ■ Increased water storage ■ Slower flooding and therefore improved safety ■ Less disruption caused by floods ■ Less area affected ■ Reduction of inundation ■ Increased evacuation time ■ Good for the economy with local trade use ■ Less people impacted by floods ■ Reduction in business damage from floods
Q12	And do you have any concerns about this Proposal? (Multiple response)	<ul style="list-style-type: none"> ■ World heritage impacts ■ Don't think it will change flood patterns and make a real difference ■ Will create more damage rather than stop floods ■ Only to allow for more development ■ Not convinced that other options have been fully looked into ■ Environmental impacts ■ Waste of money

7.4.4 Web-based survey

The key objective of the web-based survey was to allow participants to provide more detailed information regarding perceived Project-related effects in specific localities. As provided in Appendix G of this report (Web-based survey and supporting material), the SEIA phone-based survey included the provision of a visual representation and supporting information (in text boxes) explaining the predicted effects if a 1 in 100 chance in a year event were to occur.

This information was provided for Warragamba, Silverdale and Wallacia, along with upstream and downstream localities. Respondents were asked to digest this information and provide details as to how such effects might translate to benefits and impacts, who would be most affected and how impacts might be mitigated, and benefits realised.

Using a 'Survey Monkey' based platform, an invitation to participate in the survey was sent to 197 stakeholder organisations. A total of 61 surveys were completed. Of these, 4.9 percent were from organisations located in the upstream, 29.5 percent in the downstream and 67.2 percent in the Warragamba/Wollondilly area.

7.4.4.1 Overview of outcomes of SEIA web-based survey

Outcomes of the SEIA web-based survey are summarised as follows:

- In the local communities area, feedback from the web-based survey are 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, feedback from the web-based survey are as follows:
 - Potential negative effects associated with the Project were identified from participants including:
 - i. restricted access to some bushwalking tracks
 - ii. loss of vegetation potentially impacting threatened flora and fauna species
 - iii. 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:
 - i. 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.
 - ii. 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.
 - iii. Flood mitigation is only an issue if unchecked inappropriate development continues. Loss of rare remaining Cumberland Plains woodland is irreversible.
 - iv. 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.
 - v. Other alternatives are required to be more rigorously investigated.
 - vi. The Project would cause irreparable damage to important habitat for threatened flora and fauna.
 - vii. The Project would cause permanent loss of Aboriginal heritage.
 - viii. Declared wilderness areas should be protected and not threatened by development.
 - ix. Lack of confidence that the dam wall raising 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.
- Respondent across the downstream communities study 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 of alternative is to influence on current development plans around the area that is going to 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.
 - Other suggestions include improving warnings, and not allowing 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.

An overview of the feedback generated through the SEIA web-based survey is provided in Table 7-6 to Table 7-10 below.

Table 7-6. Wollondilly/Warragamba key online survey responses

Topic	Responses						
Construction Traffic effects? (2 Responses)	How might it affect your stakeholders? (Agree, Disagree, unsure)					How do you think the impact could be reduced or benefit maximised? (2 responses)	Who do you think might be most affected? (2 responses)
	Higher levels of congestion causing time delays (2 responses)	Disruption to property access (2 responses)	Deterioration of amenity due to increased noise and air emissions? (2 responses)	Reduced economic activity generated by visitors? (2 responses)	Increased economic activity due to construction workforce spend? (2 responses)		
<div><div>100.00% Yes</div><div>00.00% No</div></div>	100.00% Agree	100.00% Agree	100.00% Agree	100.00% Agree	100.00% Agree	<div><div>Communication with communities with dates and times</div><div>Provide financial incentives or compensation</div></div>	<div><div>Business</div><div>Residents</div></div>
Dust, noise, and vibration effects? (2 responses)	How might it affect your stakeholders? (agree, disagree, unsure)					How do you think the impact could be reduced or benefit maximised? (2 responses)	Who do you think might be most affected? (2 responses)
	Reduced amenity? (2 responses)		Reduced economic activity? (2 responses)		Temporary effect on property prices and rental demand? (2 responses)		
<div><div>100.00% Yes</div><div>0.00% No</div></div>	100.00% Agree		100.00% Agree		100.00% Agree	Not Sure	<div><div>Community</div><div>Business</div></div>
Increased workforce effect? (2 responses)	How might it affect your stakeholders? (agree, disagree, unsure)					How do you think the impact could be reduced or benefit maximised? (2 responses)	Who do you think might be most affected? (2 responses)
	Provide job opportunities for local people? (2 responses)	Provide opportunities for local business? (2 responses)	Provide increase in rental demand? (2 responses)	Heighten community tension due to increased use of local infrastructure and services? (2 responses)			
<div><div>100.00% Yes</div><div>0.00% No</div></div>	100.00% Agree	50.00% Agree	50.00% Agree	100.00% Agree		<div><div>Unsure- hopefully help the unemployed</div><div>Loss of tourism could be offset if workforce supports local business</div></div>	<div><div>Community</div><div>Business</div></div>
	0.00% Disagree	0.00% Disagree	0.00% Disagree	0.00% Disagree			
	0.00% Not Sure	50.00% Not Sure	50.00% Not Sure	0.00% Not Sure			

Topic	Responses				
Economic investment effect? (2 responses)	How might it affect your stakeholders? (agree, disagree, unsure)			How do you think the impact could be reduced or benefit maximised? (2 responses)	Who do you think might be most affected? (2 responses)
	Stimulate economic activity? (2 responses)	Generate employment opportunities? (2 responses)	Divert funding from other forms of essential community infrastructure? (2 responses)		
	100.00% Yes	50.00% Agree	100.00% Agree		
	0.00% No	0.00% Disagree	0.00% Disagree		
	50.00% Not Sure	0.00% Not Sure	50.00% Not Sure	<ul style="list-style-type: none"> Not Sure Local services should be offered a say in financial opportunities 	<ul style="list-style-type: none"> Community Businesses Residents

Table 7-7. Upstream online survey section with most responses (Blue Mountains Locality)

Topic	Responses					
The project would increase the area inundated temporarily by major flood events. Would this potentially affect your stakeholders? (18 responses)	How might it affect your stakeholders? (Agree, Disagree, unsure)			Other Comments (Summary key points) (10 responses)	How do you think the impact could be reduced or benefit maximised? (18 responses)	Who do you think might be most affected? (18 responses)
	Restrict access to some bushwalking tracks? (18 responses)	Loss of vegetation potentially impacting threatened species? (18 responses)	Impact on aboriginal and non-aboriginal heritage sites? (18 responses)			
<ul style="list-style-type: none"> 100.00% Yes 00.00% No 	94.44% Agree	100.00% Agree	100.00% Agree	<ul style="list-style-type: none"> Impacts to road management Impacts on water quality for long periods Damage to non-Aboriginal heritage Habitat and bird species likely to be destroyed Biodiversity and threatened species impacts Erosion issues and increased sedimentation Impact on the World heritage listing and potential to lose it Potential to impact some Karst areas Potential increase for weed invasion Current exclusion zone for bushwalkers could be moved. 	<ul style="list-style-type: none"> Funding evacuation routes and a better road system Not going ahead with the Project Find other mitigation measures Stop development on the floodplain Invest money on high speed rail to areas outside the Sydney Basin to absorb the housing pressure Implementation of other policies No potential benefit to the World Heritage Area Reduce inundation period Adequate education for communities 	<ul style="list-style-type: none"> The Gundungurra Community Sydney Water Customers Villages on eastern side of lake People needing access through Burragorang Valley Current residents along Wollondilly River Bushwalkers Young people and future generations Everyone concerned about world heritage/environmental loss Everyone People who enjoy the outdoors Traditional Owners Blue Mountains economy
	0.00% Disagree	0.00% Disagree	0.00% Disagree			
	5.56% Not Sure	0.00% Not Sure	0.00% Not Sure			

Table 7-8. Downstream key online survey responses (Flood Extent)

Topic	Response					
The project would reduce the extent of flooding in Penrith LGA by approximately 45%, in Blacktown LGA by 26% and in Hawkesbury LGA by 17%. Would this potentially affect your stakeholders? (41 Responses)	How might it affect your stakeholders? (Agree, Disagree, Unsure)			Other Comments (Summary key points) (10 responses)	How do you think the impact could be reduced or benefit maximised? (summary key points) (27 responses)	Who do you think might be most affected? (summary key points) (27 responses)
	Reduce risk of damage to and loss of property? (28 responses)	Lower the risk of damage to or loss of property? (21 responses)	Reduce damage to infrastructure? (27 responses)			
<ul style="list-style-type: none"> 82.50% Yes 17.50% No 	62.86% Agree	61.90% Agree	69.23% Agree	<ul style="list-style-type: none"> Impacts on management of oyster harvest areas. Agriculture benefits Dam raise should not allow more development in revised flood zone Loss of biodiversity and threatened species should not be tolerated Increased siltation Reduced emergency callouts Concerns about biased survey Improved opportunities for green industry and renewable energy. Ecological damage 	<ul style="list-style-type: none"> Not allowed development initially and reduce future development Better development planning Early warnings Cannot stop flooding with the dam raise due to population growth Installing pipes to reroute water Unsure Need to release regular large water flow Longer lead time for water release Not raising the dam wall Increase dam wall height Review Nepean flood plan regularly Remapping 1 in 100 per year flood event and rezoning implications. 	<ul style="list-style-type: none"> Residents and businesses on the floodplain Private housing close to foreshore Western Sydney residents Commercial farmers on the Richmond Lowlands Boat owners who require access to areas near mud banks Future residents of Sydney Developers Emergency services Local Gov NGOs Insurers Agriculture and tourism industries.
	22.22% Disagree	23.81% Disagree	19.23% Disagree			
	14.81% Not Sure	14.29% Not Sure	11.54% Not Sure			

Table 7-9. Downstream key online survey results (Evacuation routes)

Topic	Response					
The Project would result in evacuation routes remaining open for a longer time, ALLOWING people to evacuate from flood affected areas. Would this potentially affect stakeholders? (34 responses)	How might it affect your stakeholders? (Agree, Disagree, unsure)			How might it affect your stakeholders? (Agree, Disagree, unsure) Other Comments (Summary key points) (5 responses) Other Comments (Summary key points) (5 responses)	How do you think the impact could be reduced or benefit maximised? (21 responses)	Who do you think might be most affected? (21 responses)
	Lower the risk of injuries or fatalities? (21 responses)	Reduce flood related anxiety for residents? (21 responses)	Reduced costs for emergency services? (21 responses)			
	66.68% Agree	57.14% Agree	61.90% Agree			
	23.81% Disagree	23.81% Disagree	23.81% Disagree			
<ul style="list-style-type: none"> 64.71% Yes 35.29% No 	9.50% Not Sure	19.05% Not Sure	14.29% Not Sure	<ul style="list-style-type: none"> Environmental damage and species loss. Aboriginal cultural damage. Reduce congestion on flood evacuation routes Increased evacuation routes Halt floodplain development Concerns about biased survey Increasing urban development may be pressure on evacuation routes. Reduced flood risk can enhance non-urban development 	<ul style="list-style-type: none"> Ensuring residents have evacuation plans Long-term thinking and different approaches to flood mitigation Increased warning and evacuation time Redirecting water flow No further development Unsure Raise dam wall Contact support number Third crossing for Hawkesbury above 1 in 100 flood line Conduct a 'proper survey' Ensure Nepean Flood Plan is regularly reviewed Increased regional management of evacuation routes to emerging urban development areas, use agri-industry as a buffer 	<ul style="list-style-type: none"> Everyone on floodplains Residents Businesses Lower Hawkesbury Future generations Commercial farmers No idea Riverside property owners with no road access Emergency services Local Gov Residents moving into newly developed area.

Table 7-10. Downstream key online survey results (Increased Inundation Time)

Topic	Response			Other Comments (Summary key points) (7 responses)	How do you think the impact could be reduced or benefit maximised? (16 responses)	Who do you think might be most affected? (16 responses)
Low lying areas across the floodplain may be inundated for several days longer following a major flood event. Would this potentially affect your stakeholders? (31 responses)	How might it affect your stakeholders? (Agree, Disagree, unsure) Longer periods of flooding may adversely impact river use and access? (16 responses)	Longer periods when people may be isolated due to flood islands? (16 responses)	Longer periods when river and river bank uses are affected? (16 responses)			
<ul style="list-style-type: none"> 51.61% Yes 48.39% No 	75.00% Agree 6.25% Disagree 18.75% Not Sure	75.00% Agree 6.25% Disagree 18.75% Not Sure	56.25% Agree 12.50% Disagree 31.25% Not Sure	<ul style="list-style-type: none"> Flood debris flowing downstream and effects on emergency response times Reduced salinity impacting oyster harvest areas Commercial farm production impacted for longer Windsor area impacted due to flooding and road closure Access to and from Lower Macdonald River will be much longer with ferry closure Increased clean-up cost Increased damage, risk of death and disease due to longer inundation Concern surrounding survey Changes to the Environmental flow 	<ul style="list-style-type: none"> Restrict building close to foreshore Use the desalination plant Better flood mitigation below the Dam Better management of dam water levels Hold flood waters and release much slower for a longer period of time Rerouting water supply with pipes Maximise outflow to reduce inundation time Give sufficient warning Don't raise the dam wall Keep river banks free of loose debris Reduce wash effects on river banks Third crossing in Hawkesbury above 1 in 100 floodplain Stop development on floodplain 	<ul style="list-style-type: none"> Residents Flood island Commuters Businesses Commercial industries (trawlers and oyster growers) Commercial farmers People of Sydney and NSW Elderly residents with water only access properties Survey participants Emergency services Local Gov People moving into emerging urban development areas

Topic	Response					
				will have ecological impacts	<ul style="list-style-type: none"> ▪ Unlikely effect could be reduced ▪ Create viable evacuation routes ▪ Design a valid survey ▪ Regular reviews of the Nepean flood plan ▪ Conduct table top exercises in conjunction with LEMC and REMC ▪ Careful development planning 	

7.4.5 Business survey

In addition to the engagement completed as part of SEIA phone and web surveys, a business survey was conducted by a specialist economic analysis firm - HillPDA.

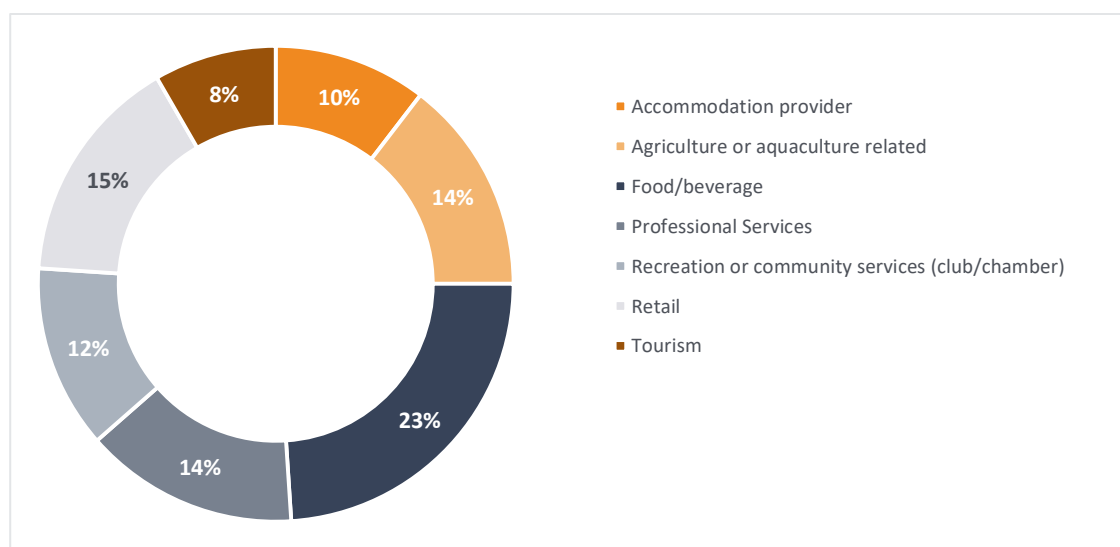
The SEIA business survey aimed to engage businesses across the study areas to understand the perception of potential impacts in relation to:

- construction of the Project (specific to Warragamba, Silverdale and Wallacia communities)
- operation of the Project on upstream and downstream communities.

Survey responses were gathered between 13 November and 19 December 2018. The survey is attached in Appendix G of this report. A total of 170 businesses were invited to participate in the business survey with a total of 50 business surveys completed.

The results were collated using the online survey tool, Survey Monkey, with the data later consolidated and analysed. Provided in Figure 7-2 is a breakdown of the types of businesses who participated in the business survey.

Figure 7-2. Percentages of business within study area by industry



Suburbs where businesses participated in the surveys included:

- | | | |
|-------------------|------------------|---------------------|
| ▪ Richmond | ▪ Riverstone | ▪ Richmond Lowlands |
| ▪ Norway | ▪ Luddenham | ▪ Agnes Banks |
| ▪ Katoomba | ▪ Rossmore | ▪ Londonderry |
| ▪ Sackville North | ▪ Mortdale | ▪ Silverdale |
| ▪ Blackheath | ▪ Wisemans Ferry | ▪ Warragamba |
| ▪ Jamisontown | ▪ Hornsby | ▪ Wallacia |
| ▪ Emu Plains | ▪ South Maroota | ▪ Windsor |
| ▪ Marsden Park | ▪ Sackville | ▪ Penrith |

7.4.5.1 Business characteristics

Information was gathered on the key characteristics and dependencies of the businesses surveyed. Forty percent of respondents indicated that they primarily served persons or entities from the local area with 32 percent relying on a primary business catchment from the broader region and 8 percent primarily catering to customers or clients from outside the region. A total of 14 percent of respondents were reliant on visitors and tourists as their primary customer base.

Eighty-six percent of business respondents indicated that employees opted to travel to and from work using a private vehicle. It was reported that within the study area there were limited public transport options available to encourage

alternate travel methods. Of the participants who stated 'other' for mode of transport, 80 percent reported they lived on site.

More than half of the respondents had been operating their business for more than five years with numerous having been established for more than 20 years. In terms of business sensitivities, water, air quality, vibration and noise were raised as key elements which effect business within the study region as provided in Table 7-11.

Table 7-11. Business Sensitivities

Sensitivity	% Extreme sensitivity	Business type
Noise	18%	Tourism; accommodation providers; professional services; recreation and community service; agriculture (horse stables)
Vibration	16%	Tourism; accommodation providers; professional services; recreation and community service
Air Quality	16%	Accommodation providers; professional services; food and beverage; recreation and community service; agriculture (horse stables)
Unpleasant Odour	14%	Accommodation providers; professional services; recreation and community service; food and beverage
Congestion	14%	Accommodation providers; professional services; recreation and community service; food and beverage; agriculture (eggs); retail
Travel time delays	12%	Accommodation providers; professional services; recreation and community service; agriculture (eggs)
Water Quality	37%	Agriculture or aquaculture related; Tourism (ski park, trail rides, river tours; Recreational or community services (club/chamber); Accommodation provider; Professional services; Agriculture or aquaculture related (horse stables, mushrooms, produce); Food and beverage

7.4.5.2 Businesses in the local communities study area (Warragamba/Silverdale) - Overview of feedback

Businesses in the Warragamba and Silverdale communities were asked a series of questions specifically relating to the perceived effects of Project construction activities on their business. Of the 20 business respondents, 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 the potential temporary 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, 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.

7.4.5.3 Businesses in the upstream communities study area (Blue Mountains) - Overview of feedback

Businesses within the upstream communities study area were asked a specific question regarding how the Project may affect their business operations. 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 on customer and employee access. Businesses stated that trail maintenance was already poor and believed that flooding would cause further degradation of the trails and would increase safety concerns.

7.4.5.4 Businesses in the downstream study area - Overview of feedback

Forty-eight percent of businesses who participated in the business survey were located downstream of Warragamba Dam. Of these, 65 percent indicated that their business had not been affected by a previous flood event whilst 35 percent had experienced a flood event. Seventy-three percent of participants indicated that they would return to the same location after a flood event occurring.

Of the businesses affected by flooding, more than 75 percent indicated that their flood experience was a consequence of the Hawkesbury-Nepean River flooding. Only two respondents indicated that it was from localised heavy rainfall. One business reported having been fully inundated, during which utilities were still operational; however, there was extensive damage to property and stock.

A total of 25 percent businesses reported as having experienced partial inundation with most of these having to temporarily close their business and experienced a subsequent a loss in sales. There was damage to property and stock and half were unable to receive deliveries and employees and customers were unable to access the business. Two businesses did not experience partial or full inundation from a flood event; however, they were affected due to employees and customers being unable to access the business.

In most cases, businesses were able to continue operating during the flood event. The longest reported closure period was between 14 and 28 days, which was over 10 years ago. In the event of a flood, respondents discussed community evacuation flood management as a key factor that delayed the business operating at normal capacity. After a flood event, over 90 percent of businesses were operational within seven days. Only 40 percent of businesses surveyed reported that they had a formal emergency evacuation strategy linked to flooding events. As there have been few events in recent years, there is a perception that flood risk is minimal, and some businesses have not updated plans when moving business location or when undergoing renovations/upgrades to the business.

In previous flood events, a total of 20 percent of business survey participants indicated that there was no loss to earnings; 5 percent indicated that the estimated cost to business was between \$5,000 and \$9,999 and 15 percent indicated that loss was between \$10,000 and \$19,999. One of the respondents, who suffered revenue losses between \$10,000 and \$19,999, stated that the loss was incurred due to a significant reduction in weekend trade, in peak season, because of bridge closures for safety reasons during a flood event.

Overall, the perception of the Project's potential impacts on business operations recorded predominantly neutral responses from downstream businesses. There was an even split of 43 percent of respondents stating there would be no impacts or minor impacts. Positive perceptions reported included improved employee and customer safety; customer and employee access; business revenue and sales; and distribution and supplier access. It was perceived by respondents that the increased evacuation time would be positive for their business, particularly in regard to employee safety. Delays to recovery time was has the highest recorded negative feedback with 22 percent of respondents reacting negatively to the increased duration of flood effects as a result of the Project.

Forty-eight of the downstream respondents perceived that the Project would have no notable impact on business activity and were therefore indifferent/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.

7.4.5.5 Business survey - Overview of outcomes conclusions

Overall, the survey generally reflected that businesses were indifferent or not interested in the Project. Whilst there was some polarisation of opinion (such as negative sentiment towards the Project in the upstream areas and positive sentiment in the downstream areas), the results displayed an inherent trend towards neutral/no perceived effect on businesses. Key themes which came through in interviews with businesses were as follows:

1. As there has been limited flood activity in recent years, business owners were unaware/uninterested in the Project.
2. Road networks and utilities have previously been affected by flooding and have had a more notable effect on businesses, whereas direct damages/costs to business have been less prolific.
3. Flood risk varies in downstream communities with some businesses, even if located in a flood prone area, not perceiving themselves to be at risk.
4. Businesses in upstream communities study area held greater concerns regarding the Project and potential effects on environmental and heritage values.

7.4.6 Stakeholder workshop

7.4.6.1 Purpose

The two Stakeholder workshops were held on 11 April 2019 at Warragamba Town Hall and provided 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 provide insights into local issues and concerns.

7.4.6.2 Selection of participants

Key stakeholder groups likely to experience impacts and benefits associated with the Project include residents located nearer to the work site and primary transport routes, local businesses, service providers and the broader community of the Warragamba, Silverdale and Wallacia areas. Taking into consideration the types of impacts and associated stakeholders along with advice provided via SEIA surveys and other forms of consultation, a breakdown of the stakeholder groups positioned to make a valued contribution in the workshop was identified, including: (i) Elected local representatives (ii) Officers from local governments (iii) Emergency services (iv) Community service providers (v) Community groups (vi) Local businesses (vii) Members of the community.

A maximum of 18 stakeholders for each of the two sessions (36 total) from the Warragamba/Silverdale/Wallacia area were invited and pre-registered – including local council members, business, schools, churches, police, emergency, community services and local community leaders/members. A recommended list of 38 participants was developed and drawn from those 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 and 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 was 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

Participants who accepted the invitation were provided publicly available material, such as the Hawkesbury-Nepean Valley Flood Risk Management Strategy and recent Community Updates as pre-workshop familiarisation reading.

7.4.6.3 Workshop themes and methodology

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.

Matters which related to the broader study areas, including the downstream communities study area and the estuary communities study area, were specifically excluded as the purpose of the workshops was to engage with the communities on localised construction impacts and potential benefits.

The methodology for the workshops involved a widely-used round-robin collaborative participation model, commonly referred to as 'World Café consultation'. The workshops were divided into three sessions which focused on the three themes. 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 inclusive, collaborative participation with round tables equipped with relevant materials to assist discussion (for example, maps, post-it pads or butcher's paper for recording views, post-it notes for recording/determining priority of issues etc). An independent facilitator hosted the workshops, introduced the technical experts, outlined the session process, set the context, and motivated table discussions. As participants carried key ideas or themes to new tables, they exchanged perspectives, enriching the possibility for new insights

After the consultation, participants were provided exit survey forms to assess the quality of the workshops. A total 27 exit survey forms were completed, and all were positive. Feedback from the participants was that the workshops were equitable in representation, transparent in the information provided and genuine in its aims.

7.4.6.4 Summary of stakeholder feedback

Table 7-12 below summarises 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 7-12. Summary of 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	<p>Tourism is a big part of Warragamba. The Dam has always been the main attraction of the town.</p> <ul style="list-style-type: none"> Attraction of and access to the Dam has been impacted by past experiences such as the closure of the Lion Park, the 2001 bushfires, the spillway construction works, and 9/11 attack which denied access to parts of the Dam for security reasons. Tourism to Warragamba has been already reduced due to construction works for nearby residential developments and the spillway construction works in the past. Tourism to Warragamba is just starting to increase. However, the Project may disrupt this progress. 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. The closure of the Dam during the construction of the spillway from 1998 to 2002 impacted tourism to Warragamba. The tourism industry in Warragamba basically collapsed. Events in the past have demonstrated that once impacted, tourism to Warragamba will take a long time to recover. For example, shops were closed due to the 2001 bushfires and have taken a long time to reopen or have not even reopened. <p>Tourism infrastructure is needed to improve to attract and maintain a tourism to the Dam and Warragamba town.</p> <ul style="list-style-type: none"> The town's facilities and businesses need to be built up to attract and keep tourists. There are a lot of features that are existing or can be installed to encourage more participation and interest in the Dam. Council has already done signage aimed at redirecting traffic towards the town centre. However, there are already so many signs that people do not take notice and another sign will not be eye-catching.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> ▪ Applications for a zip line/flying fox across the Dam have previously been submitted to NSW Government. ▪ During the 2001 bushfires, key tourism infrastructure such as the suspension bridge and walkways, was lost and was never replaced. This infrastructure provides an opportunity for visitors to physically connect to the space. ▪ Council has been pushing for a walking track network that will connect Warragamba with the Blue Mountains. ▪ The Blue Mountains has a huge tourism industry that Warragamba could capitalise on, including the eco-tourism potential. ▪ It is proposed that dam tours guided by Sydney Water/WaterNSW staff could be organised. The tours would also stop by local eateries for people to purchase food and other items. This would encourage tourism to the Dam and increase local spend. ▪ Tourism infrastructure should be enhanced. For example, the viewing platform on Eighteenth Street should be opened. A zip line/flying fox across the Dam should be installed. It is suggested to construct a second viewing platform with an access route, such as via Core Pare Road, that will divert people through the town. It is suggested upgrading viewing platform and the amenity of the viewing platform. ▪ A fleet of houseboats that are self-contained and solar powered could be established permanently on the Dam. This would generate employment, business and tourism as the houseboats become short or long-term accommodation, and services and facilities are built nearby to support the fleet. Dam regulations would have to be taken into consideration in this plan. ▪ Fourteenth Street (the main street) should be improved to attract tourism. ▪ Cable cars can be installed like the one at Scenic World in Katoomba. <p>There needs to be greater opportunities for tourists and non-locals to spend money in Warragamba.</p> <ul style="list-style-type: none"> ▪ Visitors are not staying in Warragamba. They are passing through and sometimes not stopping to purchase anything from the shops. ▪ Visitors are mostly not spending money in town as they have everything they need. The most they might buy is milk and bread. ▪ Due to WaterNSW regulations, local businesses cannot advertise their business at the Dam. This means visitors are unaware of the town and other attractions in the area. ▪ There is not a lot of information about Warragamba on the internet. Greater promotion of the Dam and town is needed. ▪ Working with the Chamber of Commerce will help to identify and create opportunities to increase local spend. <p>Warragamba town is largely supported by tourism and business from non-locals.</p> <ul style="list-style-type: none"> ▪ During works for the construction of the spillway, shops were seeing increased business, especially during lunchtimes when workers came to get food. ▪ A significant number of shops in the town rely on external business. ▪ The Workers Club is more likely to benefit from an external workforce coming in as workers will stop by after work.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<p>Local recreational and sport facilities need to be improved to benefits locals and to attract and maintain visitors.</p> <ul style="list-style-type: none"> Overcrowding at the Recreational Vehicle (RV) site, which contains eight sites for self-contained RVs and the recreation reserve, is putting pressure on Council's facilities and resources, for example, rubbish removal and public toilet maintenance. Overcrowding of the site spills onto the area behind the soccer fields and the access road. Upgrading recreational facilities will help attract visitors and will also benefit local businesses. (for example, upgrade facilities at the recreational park; support the local recreation by upgrading or improving the existing facilities such as BBQ areas). <p>The sports masterplan is supporting the planning and development of Warragamba.</p> <ul style="list-style-type: none"> The public school and community sports groups are working together towards a masterplan that will help with the development of Warragamba. The plan is aiming to integrate with other facilities and developments planned for the area to create a holistic approach to sport and recreational development. The plan will upgrade sports facilities that have not been upgraded in since the 1970s/80s. The plan will accommodate existing groups including both sport and community groups and accommodate for potential future growth and potential other users. For example, increasing school enrolments will mean a greater number of users of facilities. The plan will connect with other recreational facilities such as BBQ and picnic areas. For example, the walking trails can be used for cross country competitions. It will create a sports facility that can host visitors. For example, football teams playing at Penrith can fly into Badgerys Creek then use Warragamba's facilities. The masterplan should be considered in the Project's program (for example. timing and construction of both proposals).
	Influx of workers and local economic opportunities	<p>An external workforce coming to Warragamba will impact on the existing infrastructure and facilities.</p> <ul style="list-style-type: none"> An incoming workforce will put pressure on the roads further back of Warragamba. People are deterred from travelling to Warragamba due to the number of vehicles, such as construction vehicles, using the roads. There will be more workers around and more cars on the road. Silverdale Road is in bad condition and current and future truck movements are only going to worsen the road condition. Trucks and truck movements for housing developments on Marsh Road are already an issue and have been directly affecting residents living on that road. There is already an undersupply of health services in Warragamba. Construction workers might put added pressure on local health services <p>Local employment can be utilised during the construction phase.</p> <ul style="list-style-type: none"> Maximising local employment will help reduce the number of workers coming from outside of Warragamba. The construction phase could harness local resources and skills. Construction contractors could be given an incentive or encouraged to hire locally and provide apprenticeships. It is suggested promoting the apprenticeships and opportunity for employment locally to the community and creating a community liaison

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<p>group that is ongoing throughout the project to maintain a connection between the contractors and the local community.</p> <ul style="list-style-type: none"> It is suggested opening an employment office in town and offering training and apprenticeship opportunities. <p>There might be local supply opportunities during the construction phase.</p> <ul style="list-style-type: none"> The incoming workforce may potentially rent locally for accommodation. The locals, townspeople and local businesses need to come together to organise and plan for how to manage and support an incoming workforce.
	Public access to Warragamba Dam, infrastructure, services, and facilities during construction	<p>Changes to how visitors can access and experience the Dam and the surrounding areas.</p> <ul style="list-style-type: none"> In the past, there were fewer restrictions around public access to the Dam. People were able to walk on the Dam and drive down to the bottom. Changes to local road access during the spillway construction meant drivers were diverted through town which had a positive impact by increasing tourism. Access to the viewing platform on Eighteenth Street is currently restricted due to the presence of asbestos. It is suggested keeping the viewing platform open on Eighteenth Street as it will allow tourists and locals to see the construction progress of the Dam. There are existing walking tracks in the vicinity, including the Jack Evan Track to Glenbrook and the Warragamba Watershed Track from McMahon's Point to Wentworth Falls. However, access is restricted because parts of the tracks are on Schedule 1 land. It would be good if the Dam could be opened during the construction like in the past. The walking track could bypass the construction zone. Signage at the corner needs to be improved to direct drivers to the town centre and workers club. Access to the town should be improving through realignment of Farnsworth Avenue. Guided tours to the Dam could operate. <p>Potential temporary closure of the Visitor Centre and Haviland Park during the construction phase will have negative consequences on the community and tourism to Warragamba.</p> <ul style="list-style-type: none"> The Visitor Centre and Haviland Park are tourist attractions in Warragamba. Haviland Park is a popular socialising and recreational sport for locals. Its potential closure would reduce the options and space for locals to gather outside of the town centre. Both these sites are crucial to Warragamba and there will be significant impacts from their closure. The potential temporary closure of these sites will overall reduce tourism which will impact local businesses and the Workers Club. The potential temporary closure of the Visitor Centre and Haviland Park will change tourist behaviour and habits to the extent that tourists will avoid Warragamba or pass through without stopping. It is suggested improving the recreational park to compensate for the closure of Haviland Park during the construction phase. <p>Access for emergency services</p> <ul style="list-style-type: none"> Warragamba Fire Station was established to prevent isolation during emergencies.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> Rural Fire Service and other emergency responders will require access across the Dam during the construction phase. Emergency responders are delayed/would come from further away such as from Camden or Penrith if these routes were cut. There exists a single access point to Warragamba. There should be an alternative access across the dam wall for emergency services. Bushfire responders would need road access over the Dam Emergency responders would be delayed by the proposed temporary traffic lights. Helipads could be located at the sports fields and other cleared areas. It is suggested re-opening the Silverdale Hill Climb track to use as an access route. <p>Community and local facilities</p> <ul style="list-style-type: none"> Construction work on Saturdays would conflict with the users of the football fields and RV camping area. Construction activity would conflict with school traffic. The program and timing of Dam Fest and other community events should be considered when developing the construction program. It is suggested creating an opportunity for a walking circuit around the construction zone or throughout town as a tourism attraction.
Environmental management of the local communities study area during construction	Noise and vibration	<ul style="list-style-type: none"> Construction activities would have noise and vibration impacts on the community. Vibration impacts on the existing chlorine plant is a concern for the community. Experience of noise is influenced by location within Warragamba and the geography of the area. Noise is carried across the gully very easily. Noise levels are also influenced by wind direction and speed. Noise would impact the primary school. Actual noise impacts are unknown until construction starts. Noise propagation across the gully was very noticeable during construction of the spillway. Twelfth Street, Thirteenth Street, Weir Road, and the Scout Camp all experienced increased noise levels during spillway construction. During the spillway construction, some houses experienced noise and vibration impacts that were not picked up in the dilapidation assessment because the houses were not identified as at risk. Noise and vibration particularly impacted the elderly and families with small children. During spillway construction, noise and vibration impacts were particularly noticeable at Twelfth, Eleventh and Fourteenth Streets. The batch plant could be relocated to reduce potential exposure to noise, such as closer to the Dam away from the town. Health impacts related to noise and vibration including asthma, allergies and psychological impacts. Truck configuration and driver behaviour are expected to be factors that would impact how much noise is generated during construction. Noise impacts, particularly on the aged community can be managed through communication of planned works and alternative hours of construction. Hours of operation need to be clearly communicated to the community.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> Vehicle type and configuration should conform to the appropriate standards. The construction methodology for the Project needs to be communicated to Warragamba residents so that they can understand what should be expected in terms of noise, vibration and dust at different stages. The construction schedule should take into consideration community events such as Dam Fest (including parking and venue amenity) and the event for the sixtieth anniversary of the dam opening, which will be a big event in the town. 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 will 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 airport construction. The dust from the quarry is already quite significant, even without the additional dam construction works. Communication about expected dust levels both daily and at different stages of construction should occur between the contractors and the wider community. Mitigation and management of dust and construction activities can include covering vehicles and curtaining/confining concrete batching facilities. Water carting may be used as a dust suppressant. Dust and air quality modelling and management is necessary. Dust impacts can be controlled by limiting exposure, managing generation and materials handling. Ample supplies of respiratory medication could be made available similar to the preparation for bushfire season. For example, PPE/face masks can be made available on days where there are excess dust emissions.
	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. Construction work run-off is a concern. There may be asbestos in potential clearing areas.
	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. During spillway construction, there was a general feeling within the community of being unappreciated and of frustration at the process. Construction of the wall can be accompanied by a “thank you” gift to Warragamba, such as replacement and reinstatement of community facilities. For example, the playground in the middle of town has still not been fully constructed and it is unsightly and dangerous. In addition, there could be a donation to local services/facilities, such as the Community Sports Clubs Master Plan.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
	Vulnerable community members	<ul style="list-style-type: none"> Construction activities might have greater impacts on vulnerable community members. Warragamba is largely made up of an aging community who are particularly vulnerable to poor air quality. This was experienced during the bushfire season. 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"> Children wait on the footpath for buses to pick them up or they ride their bicycles to the school through Production Avenue. School students also cross Farnsworth Avenue to access the sport grounds. There would be a safety risk for children travelling to/from school during the construction phase. The roads need to be made safer for the children from the public school and there is a need to ensure that increased traffic noise levels do not impact the school. Danger of trucks travelling up the hill at Blaxland Crossing Bridge. There is only one route out of Warragamba for fire evacuation. Silverdale Road is not in good condition and dangerous. There is wildlife on Silverdale Road. Blaxland Creek Bridge is not weight limited. 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.
	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. Accidents could occur heading south on Silverdale Road. There is a 45-minute to 1-hour detour on The Northern Road during accidents. Emergency services receive a high volume of call-outs for accidents on Silverdale Road and Baines Hill from oil spillages. At least, a couple of times, there was road blockage. Emergency response to accidents would be impacted by additional construction traffic using the road network. There would be potential accidents at the roundabout at Silverdale Road and Farnsworth Avenue. An accident would stop work and leave children stranded.
	Congestion	<ul style="list-style-type: none"> The development of Silverdale shopping centre was not approved because of traffic issues – therefore the approvals for the Project's construction should be consistent regarding traffic. 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. Routes are over capacity.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> Peak traffic occurs around school pickup/drop-off time. New residential development would mean more residential traffic on the roads particularly Marsh Road. 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. Warragamba Public School staff travel to work on the Northern Route. Teachers would have to wait later with students after school if bus routes/parents were delayed by construction traffic. Suggested mitigation measures for avoiding/minimising congestion include: introducing overtaking lanes; installing traffic lights at the Park Road/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 the damage created by construction trucks; creating extra access to local roads; and staggering shift times for workers to avoid peak times
	Cumulative impacts	<ul style="list-style-type: none"> Cumulative impacts from the airport construction at Badgerys Creek would occur. There would be conflicts with planned road upgrades especially Silverdale Road. Construction of new developments at Silverdale will have cumulative impacts. There are increased residents in new developments at Lion Park and Silverdale. An additional intersection on Southern Route from Joiner Road will be built to support these developments and would result in additional residential traffic on Production Avenue. Western Sydney Airport construction currently uses the Southern Route. Road repairs during construction will further disruption. 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. High school students travelling to Penrith would be using the roads along the Northern route. Many workers in the town travel to Penrith using the Northern route. Poor condition of roads/bridges along the routes would deteriorate. Trucks would destroy the road surfaces. The state needs to be responsible for maintaining these roads, Silverdale Rd especially should be a state road. Blaxland Creek Bridge is susceptible to flooding during heavy rainfall, which could make the Northern Route unusable at times. Communities and residents live along the proposed routes. Roads are in poor condition and need upgrades. For example, Blaxland Crossing Bridge needs to be upgraded. Another bridge is needed. The cost of road improvements on top of the cost of the dam raising would be significant.

Workshop theme	Key discussion topics	Matters raised during stakeholder workshops
		<ul style="list-style-type: none"> Recommendations were proposed including: Testing/investigating Megarritys Creek road culvert as it is currently untested; upgrading Baines Hill; constructing a flood resilient bridge at Blaxland Creek, upgrading bridge and road duplication; and upgrading Blaxland Crossing Bridge.
	Community amenity	<ul style="list-style-type: none"> The Southern transport route would pass the Oaks public school and town facilities. There would be Potential dilapidation of properties along the routes. An incoming workforce of approximately 500 workers at peak construction period will 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. Noise from construction will impact sporting activities. Sport is played on Saturday morning at the fields along Production Avenue. When there is evening training, there can be more than 200 players using the facilities on one evening. Consultations with the Oaks community should be implemented. Mitigation measures were proposed, including: dilapidation surveys needed; time of day that truck movements required; 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; and investments in infrastructure for future tourism.

Source: SMEC 2019

7.5 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 *Social Research on Floods in the Hawkesbury-Nepean Valley* was completed in 2014, the *Social Network Analysis report* was completed in 2015 and the final report on *Flood Evacuation Social Research for the Hawkesbury-Nepean Flood Risk Management Directorate* was completed in 2018.

Informing the 2014 Research report was a telephone survey conducted between 2 to 15 September 2014 and was roughly 21 minutes long. This survey randomly sampled 400 residents in the Hawkesbury-Nepean Valley with a core target group of residents within the extent of the area inundated in the last major flood in 1867.

For the 2015 network analysis report, stakeholder engagement included an online survey, interviews, and workshops. The online survey was open to all residents and workers in the area with 241 total respondents. A total of 20 interviews were conducted with key community stakeholders. The workshops (two hours) which had a total of 36 participants (23 of whom had completed the online survey) was conducted with State Emergency Service (SES) volunteers.

The Flood Evacuation Social Research (2018) was informed by a 17-minute telephone survey with 386 Hawkesbury-Nepean Valley Flood Plain residents from 17 April to 1 May 2018. The 2018 survey followed a similar design to the 2014 survey; however, it utilised a different sampling method which sought to target decision makers and community representatives.

Since the research was undertaken in 2014, 2015 and 2018, there has been minor to moderate flooding in the Hawkesbury-Nepean Valley, including in February 2020. While the flood in February 2020 was a relatively small event in the history of flooding in the valley (with a likelihood of around a 1 in 5 chance per year), it was the largest flood since the early 1990s and caused disruption across the floodplain, including the closure of roads and bridges (Figure 7-3).

Figure 7-3 Looking east from Windsor to McGraths Hill during the February 2020 flood event



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

WaterNSW has been conducting engagement activities for Hawkesbury-Nepean Valley Flood Risk Management Strategy. Appendix H of this report provides a summary of engagement activities undertaken from 2017 to 2019.

7.5.1 Outcomes of the 2014 research survey

Respondents on average had lived at their current properties for 20 years with respondents reporting they had strong connections within the local community. The survey determined that 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 residing in the zone within the 1 in 100 chance in a year event were significantly more likely to perceive a flood risk. Fifty-two percent of participants had experienced flooding and 21 percent at their current property. A concern associated with flood risk on a scale of 1 to 10 (where 10 meant 'extremely concerned') was a fairly low level with an average of 4.6. The respondents recorded perceived preparedness for flooding. Sixty-seven 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-nine (49) percent of respondents stated they would need a fair amount of help to prepare for a flood and 44 percent thought they would need assistance evacuating. The lack of knowledge surrounding flooding in the Hawkesbury-Nepean 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 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. Respondents gave an average time of 62 minutes for evacuation with 58 percent thinking they would be able to leave within an hour. A total of 3 percent of respondents stated they would refuse to leave regardless of who gave the evacuation order and 22 percent reported having someone who has a disability which would affect their ability to evacuate quickly. Thirteen percent of respondents admitted they were not aware of what the procedures were following an evacuation order. Only 29 percent of respondents stated that they would go wherever they were directed. On average, two cars would be taken to evacuate. Sixty-three percent of respondents stated they would not try to return home if told access was cut off.

Twenty-six percent of respondents recalled seeing, hearing, or reading about flood related information. The main preference for receipt of 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 councils. The respondents stated they would have a strong reliance on the 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. Participants in the qualitative survey concluded that they would like information packs with brochures and preparedness checklists being sent to households along with a corresponding public relations campaign. Residents expect that communication would be similar to the 2013 bushfires where information was clearly relayed using a variety of services.

7.5.2 Outcomes of the 2015 research survey

The key outcome sought by this research was to utilise the ‘core of the core’ network of well-connected individuals to determine the connectivity of the community. 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 do band together to help and work through situations. The social networks which were identified were more interconnected and healthier than expected for the small sample size. The stakeholders interviewed tended to cite people within their own sector but all cited links to other sectors also. This highlighted individuals who could build the community’s flood resilience. Stakeholders who both worked and lived in the area or lived in the area the longest usually had stronger local networks. The 10 most integrated individuals were found to be from the SES (7), Hawkesbury police (1), Rural Fire Service (1) and Penrith Press (1). The two most disconnected stakeholders identified were remote dwellers, elderly people and those with disabilities.

The survey also determined that word of mouth was the most popular channel for disseminating local information. This was followed by social media and the local newspapers. Concerns were raised about misinformation being spread through the community particularly via social media. The survey further found that some people disagree with authorities about flood-related issues. 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 preparing was emphasised by participants.

7.5.3 Outcomes of the 2018 research survey

The key outcome sought by the 2018 survey was to guide the implementation of the Hawkesbury-Nepean Valley Flood Risk Management Strategy. The survey had a particular focus on supporting the introduction of new flood evacuation signage. Community cohesion is strong in the Hawkesbury-Nepean Valley Floodplain with 74 percent of participants claiming they often do things to help others. The 2018 survey determined that floods were still considered to be the lowest risk when compared to bushfires and severe storms. Only 18 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. The survey determined that in general, the community is not prepared for a flood with 36 percent rating themselves as not prepared at all and only 11 percent rating themselves as totally prepared. Seventy-nine percent had done nothing in preparing for a flood. Sixty-four percent of participants agreed that with ‘there isn’t 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. Awareness of flood evacuation procedures was quite low with only 32 percent of participants being 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. The 2018 survey further confirmed the finding of the 2014 survey with people still perceiving flooding as being low risk and were underprepared if a flood event was to occur.

8 Impact assessment

8.1 Summary of impact assessment methodology

Predicted impacts were identified based on the nature of Project construction and operational effects, feedback generated through community and stakeholder engagement and the social conditions in the study areas at the time when the SEIA was undertaken. It is recognised that the predicted social impacts and their assessments may change with any alternations to the socio-economic and political context or as stakeholder perceptions change over time as more information about the Project becomes available.

Positive and negative impacts identified were evaluated to determine their impact significance using a method in accordance with the NSW Social Impact Assessment Guideline:

- 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 is determined from the perspective of those expected to be affected by the positive or negative impact.
- The likelihood of the potential social impact, that is, 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 (that is 1 in 5 chance in a year event, 1 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 (that is, it is assumed that the flood event will occur).

As outlined in Section 4.4, community and stakeholder sentiment attained through both EIS and SIA specific 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 (such as noise, traffic, air quality etc.). The likelihood of social impacts and benefits was assessed with reference to the socio-economic baseline, inputs of stakeholders and other relevant technical findings as outlined in Table 8-1 below.

Table 8-1. 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.

Consequence has been assessed based on how social impacts are experienced by the stakeholders as outlined in Table 8-2 below.

Table 8-2. 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 ²⁶ . 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.
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. Figure 8-1 below presents the impact significance matrix for negative impacts.

²⁶ 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.

Figure 8-1. 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

Figure 8-2 below presents the impact significance matrix for positive impacts.

Figure 8-2 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

8.2 Local communities

8.2.1 Property and land use

8.2.1.1 Changes to property and land use

Changes to property and land use can lead to socio-economic impacts for residents in the local communities study area. This section describes the changes to property and land use and the likely socio-economic impacts within the local communities study area.

As outlined in Section 6.2.2, the construction footprint has an area of 105.3 hectares, covering the main dam site and temporary construction facilities, such as material storage areas and concrete batching facilities. The land ownership status within the Project's footprint has been checked and provided in Table 8-3 below, which indicates that land areas affected by the Project construction footprint are owned by WaterNSW. There are no privately-owned properties identified to be traversed, leased or acquired by the Project during both construction and operation phases. As such, there would be no socio-economic impact to communities within the local communities study area in relation to property.

Table 8-3. Ownership status of land areas within the Project footprint

Lot ID and Description	Construction Purpose	Address	Ownership
1124/DP1159978: Warragamba Dam and Auxiliary Spillway; Haviland Park; Visitor Centre; bushland	Main construction activities including site office, batch plants, material storage and clearing areas	Weir Road, Warragamba	WaterNSW
4/DP209076: Bushland	Areas to be cleared to enable dam raising construction to proceed	Weir Road, Warragamba	WaterNSW
B/DP417126: Bushland	Potential material storage area	Production Avenue, Warragamba	WaterNSW
1/DP87998: Warragamba Dam, storage facility; bushland	Areas to be cleared to enable dam raising construction to proceed and potential material storage area	Farnsworth Avenue, Warragamba	WaterNSW
4 and 5/DP248989: Eighteenth Street Lookout	Areas to be cleared to enable dam raising construction to proceed.	25-39 Eighteenth Street, Warragamba	WaterNSW
74/DP751294: Bushland	Potential material storage area	Farnsworth Avenue, Warragamba	WaterNSW

Source: SMEC 2018

There are no changes on land use types required within the Project footprint during construction and operation phases. The land use within the Project construction footprint is an infrastructure zone (see Section 3.4.1). However, as the Warragamba Dam Visitor Centre and Haviland Park are situated within the Project construction footprint, there may be a temporary disruption of tourism and recreation uses due to the potential closure of the Warragamba Dam Visitor Centre and Haviland Park during the construction phase. For example, Haviland Park will be used for temporary construction facilities such as a concrete batching plant. This may have a flow on effect to local businesses and the overall economic vitality of the town. This impact will be discussed in Section 8.2.5.3.

Changes to property and land use may influence the character and the enjoyment of social infrastructure in the surrounding community. In particular, the Project construction may temporarily disrupt tourism and recreation uses due to the potential closure of the Warragamba Dam Visitor Centre and Haviland Park.

8.2.1.2 Access to properties

Changes to access to properties as a result of Project activities during construction can generate socio-economic changes. These changes may include delayed travel time in access properties due to construction traffic, including both light and heavy vehicle traffic, on local roads within the local communities study area.

Existing accesses to properties in Warragamba, Wallacia and Silverdale areas were assessed in the Project's Traffic and Transport Assessment report (refer to Chapter 24 and Appendix O of the EIS). Qualitative assessment was carried out to investigate the potential future impacts of the Project's traffic on the existing properties' access locations. Based on the Project's Traffic and Transport Assessment report, on the Northern Route, some properties have direct access from Silverdale Road, Park Road and Mulgoa Road in the Silverdale and Wallacia area. It is anticipated that additional Project traffic, especially heavy vehicles, may have indirect impacts on these accesses. Indirect impacts would potentially include increased time to enter and exit properties due to increased traffic on impacted roads. However, there would be no direct impacts such as temporary or permanent closure of accesses. The Southern Route also passes through the main activity centres (such as commercial areas and schools) of Tahmoor, Picton and the Oaks. There are schools and commercial centres located along the Southern Route in these areas. Additional heavy vehicle movements in these areas may indirectly impact access and result in a reduction in pedestrian safety. Besides the above-mentioned properties, many rural properties have direct access from Park Road, Silverdale Road, Montpelier Drive and Remembrance Drive along the Northern and Southern routes which may be indirectly impacted by the additional Project traffic. Figure 8-3 below shows the property access locations from the Northern and Southern Routes.

It is anticipated that the Project's construction works will generate heavy and light vehicle traffic movements. The truck movements would be generated by the delivery of materials for concrete production. There would also be the delivery of other materials such as steel, plant and equipment, precast elements and new components for the Dam. Table 8-4 provides the estimated numbers and types of vehicles accessing the Project footprint during the different construction stages based on the Traffic and Transport Assessment report. In addition, it is estimated that 500 workers would travel to site during the peak construction period.

Table 8-4. Construction vehicle movements

Material	Approximate number of vehicles per day travelling to Project site
Site establishment	Light vehicles – 100 Heavy vehicles – 50
Main works	Light vehicles – 250 Heavy vehicles – 104
Demobilisation	Light vehicles – 50 Heavy vehicles – 25

Source: SMEC 2019

Impacts of the construction stage of the Project on the accessibility to properties have been assessed. It is assessed that the increased construction traffic would not result in any loss of access or any substantial delays in accessing roads from properties. It is anticipated that some delays would occur due to additional Project heavy vehicle traffic, especially at the construction peak time. Many properties have direct road access in the Silverdale and Wallacia area. Property access locations along Silverdale Road, Warradale Road, Mulgoa Road and Park Road would occur some travel delays due to heavy vehicle movements. For instance, Park Road, Silverdale Road and Farnsworth Avenue are single lane dual carriageways. Heavy trucks loaded with construction materials may drive at lower speeds which may result in reducing the average travel speed of these roads.

During the construction phase, there would be some road network modifications. For example, access of Production Avenue (northern part near the construction area) and Twenty Third Street/Twenty Fourth Street would be restricted for construction vehicles only. Part of Farnsworth Avenue (northern part near the construction area) would be closed for all vehicles during the construction phase. However, these road network modifications would not impact on access from properties as there are no private properties in these areas. In addition, queuing of heavy vehicles would be permitted only within the site perimeter and all construction traffic would use Production Avenue only to access the site. This would avoid impacts on access roads from the properties in proximity to the Project footprint.

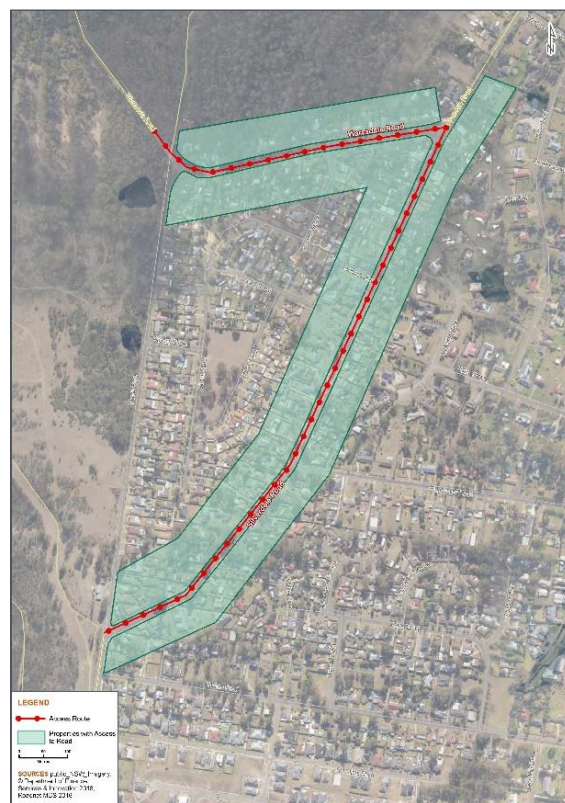
The operation of the Project would not generate any additional deliveries, workers or other traffic generating activities. As such, after construction is completed, traffic flows in the surrounding road network would return to their existing levels. There would be no additional traffic impact on the road network surrounding Warragamba Dam from the operation of the Project. Therefore, there would be no impact on access to properties during the Project operation phase.

Figure 8-3. Property access locations from Northern and Southern Routes

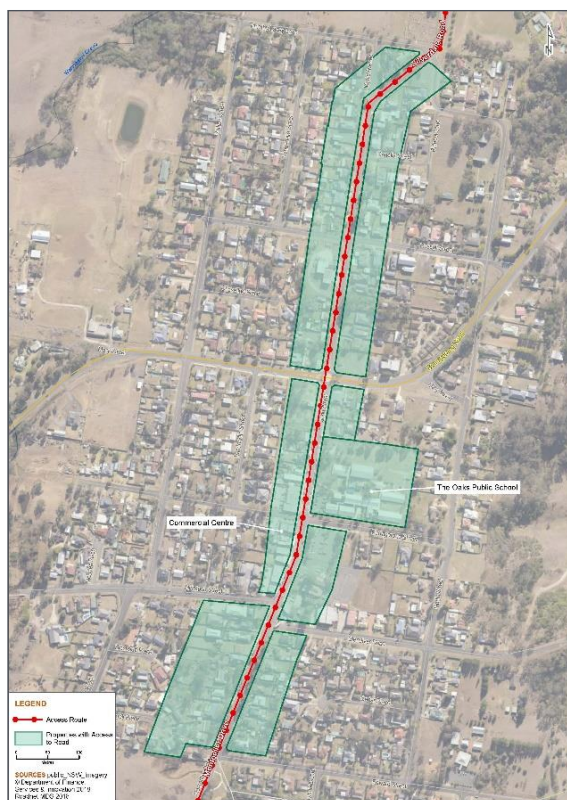
Property access locations from Park Road (Northern route)



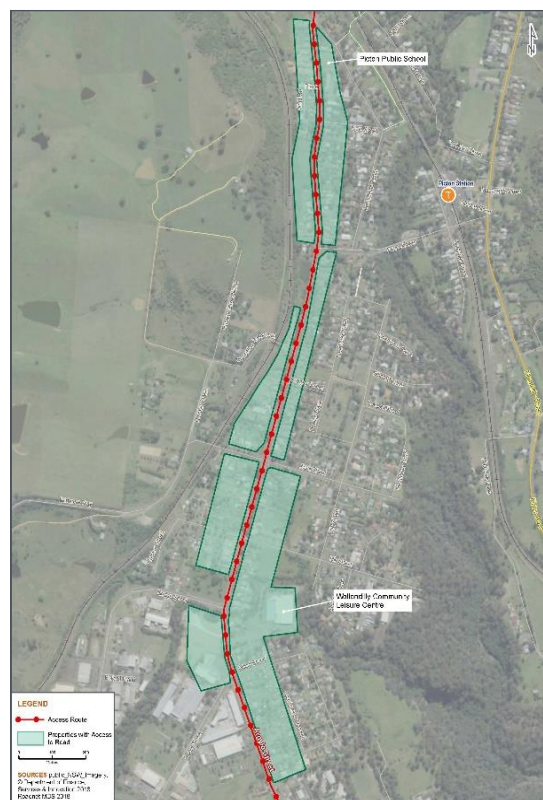
Property access locations from Silverdale Road and Warragamba Road (Southern route)



Property access locations from Montpelier Drive (Southern route)



Property access location from Argyle Street (Southern route)



Project footprint and surrounds. The visual impact assessment comprised of physically assessing the viewpoints as well as utilising digital 3D modelling to visualise the completed Project.

In terms of landscape character impacts in the SEIA local communities study area, Character Zone 2 – dam wall was identified. This zone covers the dam wall and the areas in and around the existing Warragamba Dam, including auxiliary access roads and site buildings and public open space areas. Three viewpoints were selected in CZ 2 – dam wall. These viewpoints are representative of views that will be experienced by tourists and visitors who have deliberately visited the area as well as dam operations staff who are based on site. The identified viewpoints assessed were:

- The viewing platform at the Warragamba Dam Visitor Centre:
 - This viewpoint is located on the edge of an escarpment next to Lake Burragorang and offers excellent views of the upstream area of Lake Burragorang and its surrounding vegetation, the dam spillway bridge, and the western face of the Dam
- Valve House Road, Warragamba Dam:
 - This viewpoint is located on the lower terrace on Valve House Road approximately 150 metres below the dam wall. This viewpoint provides a view of the eastern face of the Dam and auxiliary spillway and the associated buildings and machinery
- The Eighteenth Street Lookout, Warragamba:
 - This view point is located approximately 300 metres north-east of the Warragamba Dam Visitor Centre. It provides a panoramic view across the auxiliary spillway and a distant view of Warragamba dam wall

The following describes the key findings of impacts associated with landscape character and visual amenity at the dam wall.

Landscape character impacts at dam wall (LZ 2)

The new and modified infrastructure will be provided as part of the Project and include various modified and new structures (see Section 3.3 for full description). It is assessed that the Project would result in a higher visually-prominent structure of the dam wall and more extensive downstream infrastructure. However, the dam elements would essentially be the same and be similar in visual appearance to the existing dam albeit more 'contemporary' in appearance.

The increase in height and scale of the dam wall would keep the existing built form and nature of the existing altered landscape. The wall is enveloped by the large-scale of the surrounding natural environment which will continue to frame the significantly altered landscape of the dam wall. The Project was assessed as having a moderate impact on the landscape character. The sensitivity of the landscape character is assessed to be moderate by the evaluation criteria in the Landscape Character and Visual Assessment as it reflects the highly modified landscape of the dam wall and the visual links to the wider natural landscape. Hence, the sensitivity is primarily a reflection of the built form, yet is influenced by the sensitivity of the natural environment that forms the wider context in which the landscape character zone sits. The magnitude of the landscape character impact at the dam wall is also assessed to be moderate. This is because the size and scale of the built infrastructure will increase; however, this increase does not have an adverse effect on the wider natural landscape.

Visual amenity at dam wall (LZ 2)

Visual impacts at the dam wall area during construction have been assessed. Within the vicinity of the Project construction area, it is anticipated that some roads and bridges may require upgrading or strengthening. Some of the existing Warragamba Dam elements and infrastructure would require demolition or removal to enable the Project to be built. The stages of the construction works in and around the dam wall area would include enabling works, flood and dewatering works, abutment works, central spillway works, auxiliary spillway works, environmental flow infrastructure and other works. The construction works are expected to be completed in about four – five years from commencement. It was assessed that the dam wall area and the surrounds would visually be impacted during the construction phase due the construction works and the visual impacts are assessed to be moderate depending on viewpoints. However, the visual impacts during the construction phase would only be temporary. Once the Project is fully operational, the visual impacts in and around the dam wall construction area would reduce significantly as construction machinery is removed and batch plant and material storage areas are remediated. At the three viewpoints selected for visual impact assessment, during the construction phase, the viewing platform at the Dam Visitor Centre located within the construction zone and the viewpoint on Valve House Road used for a potential batching plant will temporally be closed to the general public. However, the viewpoint at Eighteenth Street Lookout

will likely remain open to the general public, providing excellent views of the wall raising and general construction works within the designated construction zone.

During the operation phase of the Project, it is assessed that overall, the Project would result in a higher visually-prominent structure of the dam wall and more extensive downstream infrastructure, especially within and downstream of the auxiliary spillway. However, the dam elements would essentially be the same and be similar in visual appearance to the existing dam albeit more 'contemporary' in appearance.

Visual impacts at the three selected viewpoints are slightly different as follows:

Viewpoint at Warragamba Visitor Centre

The views from this location would be dominated by the new bridge access road and raised auxiliary spillway bridge which will run directly through the location of the existing viewing platform. Foreground views of the upstream dam environment, with a bright exposed rock shoreline, are also prominent while longer range views of associated dam infrastructure encompassed by the surrounding densely vegetated mountains and valleys are also distinguishable.

The visual prominence of the new bridge access road and raised auxiliary spillway infrastructure would significantly increase as a result of the raising works. Although the existing viewing platform and cliff-top walkway would be demolished as part of the associated dam raising works, both would be reinstated with a similar relationship to the auxiliary spillway crest and bridge so that these features are maintained as distinct built forms within the view but with an increase in their scale and size. While the Dam and associated infrastructure contrasts strongly with the natural bushland surroundings of the locality, it is viewed as a landmark of regional significance and demonstrates a significant built/engineering achievement. The sections of the exposed shoreline around the lake are visible and may increase by infrequent and temporary increase in upstream water levels. Impacts may be discernible when compared to the existing sections of exposed shoreline. The change in extent of exposed shoreline would depend upon the frequency and size of rainfall events and the period between events which may allow for vegetation to recolonise exposed areas. However, future fluctuations in exposed shoreline areas would be of a similar visual nature and such changes and fluctuations are expected when viewing an operational dam. Figure 8-4 illustrates the viewpoint at the Warragamba Visitor Centre through the existing and photomontage views.

Figure 8-4. Viewing platform at Warragamba Dam Visitor Centre



Viewpoint from Valve House Road

The view from this location is dominated by the dam wall and a bitumen access road, park seating and pedestrian fences and some native trees in the immediate foreground. From this location, colour striation of the dam wall face is obvious as result of both discolouration and various development upgrades. Parts of the dam wall including the spillway bridge, spillway piers, dam crest and lift towers will all be raised as part of the Project but will aim to mimic the style and materials of the existing wall.

It is assessed that the visual prominence of the raised dam wall and associated infrastructure will increase at this location; but it should be noted that the Dam is considered to be a landmark in itself with regional significance

demonstrating a significant built/engineering achievement. As a result of the dam wall raising, it is likely that the engineering significance of the wall will continue and/or be increased. Figure 8-5 below provides the viewpoint from Valve House Road through the existing and photomontage views.

Figure 8-5. Viewpoint from Valve House Road, Warragamba Dam

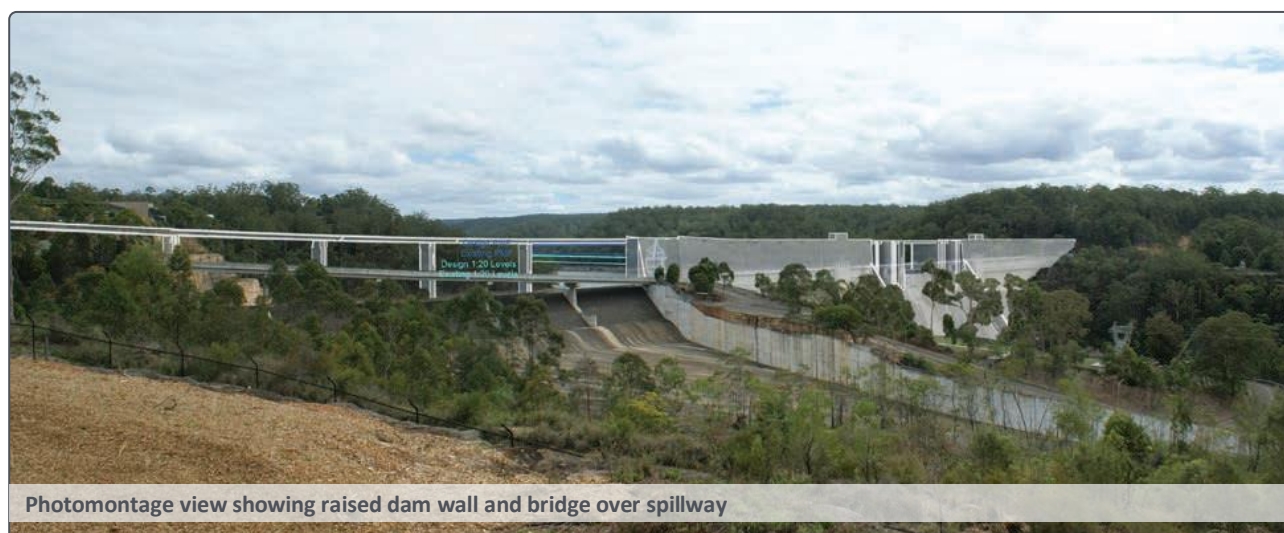


Viewpoint at the Eighteenth Street Lookout

The view from this location is dominated by the existing auxiliary spillway, auxiliary spillway bridge and distant view of the Warragamba dam wall and associated infrastructure. Native bushland vegetation and a newly mulched area close lookout are secondary but located in the immediate foreground. From this location, colour striation of the dam wall face is obvious as result of both discolouration and various development upgrades. Parts of the dam wall including the spillway bridge, spillway piers, dam crest and lift towers will all be raised as part of the Project but will aim to mimic the style and materials of the existing wall and associated infrastructure.

Similar to the viewpoint from Valve House Road, Warragamba dam, it is assessed that the visual prominence of the raised dam wall and associated infrastructure will increase from this location. The Dam is considered to be a landmark in itself with regional significance demonstrating a significant built/engineering achievement and as a result of the raising it is likely that the engineering significance of the wall will continue and/or be increased. Figure 8-6 illustrates the viewpoint at the Eighteenth Street Lookout through the existing and photomontage views.

Figure 8-6. Viewpoint at the Eighteenth Street Lookout



Overview

Changes to landscape character and visual amenity during the construction phase are likely to result in diminished enjoyment of viewsheds for tourists and members of the local communities study area. This may result in reduced tourism and subsequent reduced commercial opportunities for local businesses.

In summary, the Project has the potential to result in both negative and positive impacts on visual amenity and landscape character. During the construction phase, some of the existing Warragamba Dam elements and infrastructure would require demolition or removal to enable the Project to be built. As a 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. Following the application of mitigation and management measures as outlined in Section 9, changes to visual amenity as experienced by stakeholders such as tourists, local residents and dam operation staff working at the site is assessed as being of a moderate level of significance.

During the post-construction phase, the Project has the potential to have a positive impact on visual amenity due to the establishment of new infrastructure at the dam wall which is assessed as being of an extreme level of significance.

8.2.2.2 Noise impacts on community lifestyle and amenity

Changes to noise levels can generate effects on social amenity and alter existing lifestyles for local communities, particularly for residents in close proximity to noise sources. The existing environment within the local communities study area is described as semi-rural with a relatively quiet and relaxed character. An increase in undesirable noise

levels can generate effects for enjoyment and liveability values, especially for those residents who enjoy the rural lifestyle of the area.

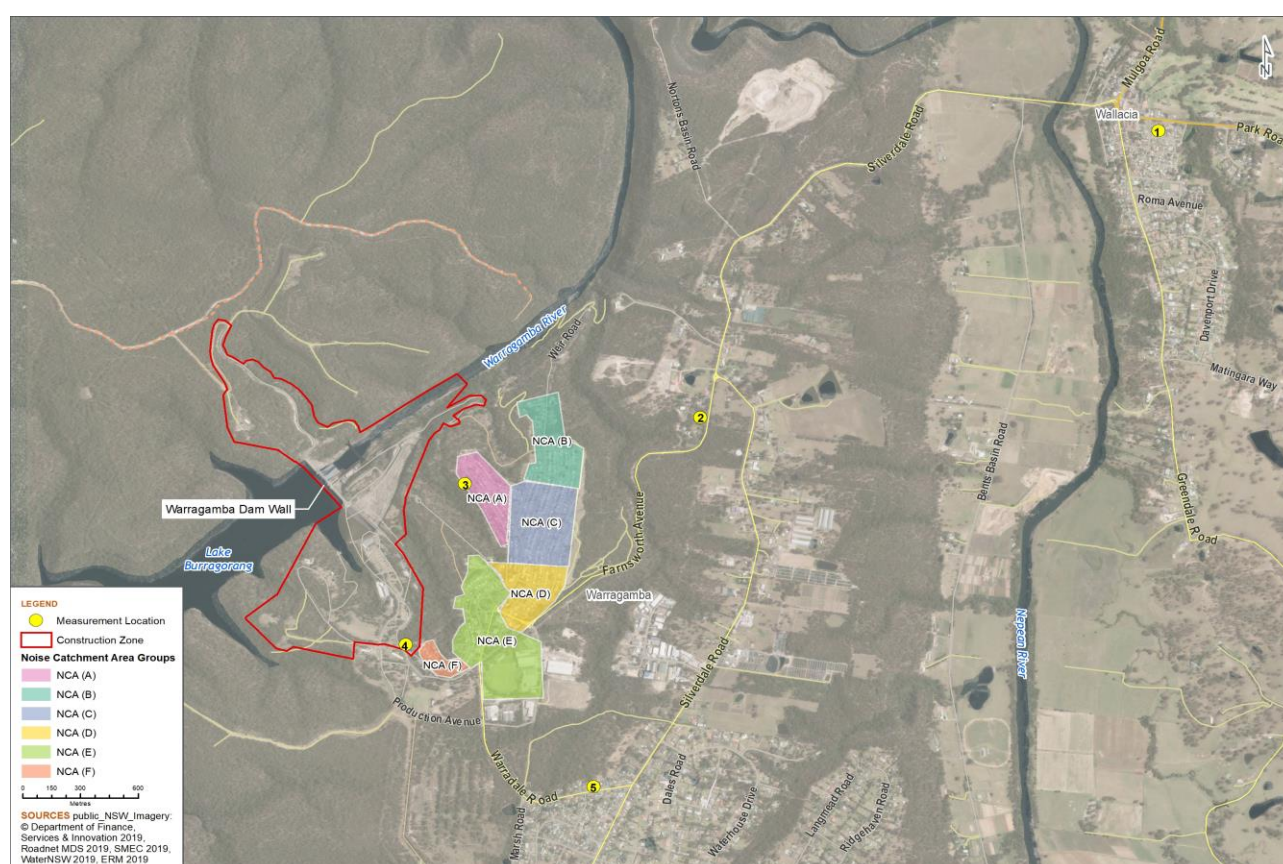
A noise and vibration assessment was been conducted for the Project (refer to Chapter 19 and Appendix L of the EIS). This assessment has considered potential noise and vibration impacts of the Project during the construction and operational phases. Noise and vibration impacts considered include:

- construction noise created by construction activities
- construction vibration
- construction road traffic
- construction blasting
- operational noise.

Background noise monitoring was undertaken in the suburbs of Wallacia, Warragamba and Silverdale as part of the Noise and Vibration Assessment. The primary influence on ambient noise profiles included local community activity, fauna (birds and insects) and discontinuous traffic on Farnsworth Road and Silverdale Road. No industrial noise sources or dam operations were audible. Background levels were typically between 31 to 37dB(A) in daytime periods, 31 to 35 dB(A) during the evening periods, and 26 to 32 dB(A) during the night-time period. These levels are consistent with a quiet suburban or rural residential area with low levels of transportation noise.

The noise baseline shows that in terms of noise sensitive land uses, the nearest residential sensitive receivers are located to the east of the Project. Two noise catchment areas (NCA) were assigned representing impacts from the majority of works surrounding the dam wall (NCA 1) and the laydown area to the north-east of the dam wall (NCA 2). The closest residence is located approximately 600 metres north-east of the dam wall in NCA 1 and adjacent the laydown area in NCA 2. The nearest potentially impacted receivers are presented in Figure 8-7.

Figure 8-7. Noise catchment areas and noise monitoring locations



Construction noise

Noise created from construction activities may generate effects on the quiet rural amenity of the surrounding area.

Construction activities would occur over a period of four-to-five years. The construction was assessed for two stages, including site establishment and early works, and the main construction works. Criteria for construction noise is based on the *Interim Construction Noise Guideline* (ICNG) (DECCW 2009). In general, these criteria state that the construction noise should not exceed the background noise level by more than 10 decibels during standard hours, and by more than 5 decibels outside of standard hours. The highly noise affected level represents above 75 decibels which there may be strong community reaction to noise. Standard hours working hours include Monday to Friday from 7 am to 6 pm, Saturday from 8 am to 1 pm, and no works on Sundays or Public Holidays. Times not covered in the standard hours are considered outside standard hours.

The majority of construction works would generally be limited to standard hours in accordance with the ICNG. Residential receptors are the nearest potentially impacted receivers to construction activities. There are also several noise sensitive commercial receptors located in the Project footprint, including commercial activities, a sporting centre, a community centre, and several restaurants. The noise assessment predicted that noise levels would intermittently exceed criteria at the nearest sensitive receivers. However, noise levels are not predicted to exceed the high noise level of 75 decibels at any receptor.

Although most of construction works would be limited to standard hours, some concrete pouring during warmer periods may occur into the night-time period. Activities occurring outside standard hours will potentially result in noise exceedances of criteria. Potential sleep disturbance impacts were also identified at receivers closest to night-time construction. As a result, specific out of hours works management and mitigation measures would be required.

Construction vibration and blasting

Blasting and other activities associated with construction causing vibration has the potential to disrupt nearby residents, indirectly impacting amenity and lifestyle values. However, batch plants used during construction activities are generally located a significant distance from the nearest receivers and therefore unlikely to cause any vibration impacts at the nearest sensitive receiver.

Blasting would be required in some areas such as at the toe of the dam spillway and left abutment. Given the proximity of these areas to the Dam, blasting would be controlled to minimise any risk of structural damage to the Dam. Blasting overpressure and ground vibration was assessed using the ANZEC guidelines (ANZEC 1990) which set limits for overpressure and ground vibration levels. The result of construction blasting assessment shows that a maximum instantaneous charge of 100 kilograms would not exceed criteria levels at the nearest residential and community receivers in Warragamba. Blasting would also be limited to guideline recommended times which are between 9 am to 5 pm Monday to Saturday.

Construction road traffic

Additional traffic associated with the Project's construction may also generate effects on the quiet rural amenity of nearby receivers.

An assessment of road noise impact was completed at the nearest receivers to the Project's transport routes (see Figure 6-14 in Section 6.2.8.1 for transportation routes). Criteria for road noise is based on the 'NSW Road Noise Policy' (RNP) (DECCW 2011). The assessment showed that existing traffic noise levels are potentially above traffic noise criteria for the nearest receivers to Park Road, Wallacia during the day-time and night-time periods. Existing traffic noise levels were below the criteria for the nearest receivers to Farnsworth Road and Silverdale Road. The additional Project traffic did not result in a noise level increase of greater than 2 decibels, and therefore would not result in a noticeable increase in traffic noise. The greatest noise increase is expected for Warradale Road sensitive receivers where traffic noise levels will increase by 1.8 decibels from additional passenger vehicle traffic. As per the RNP (DECCW 2011) *"an increase of up to 2 decibels represents a minor impact that is considered barely perceptible to the average person."* As such, construction traffic associated with the Project is unlikely to generate socio-economic changes for members of the local communities study area.

Operation

The noise and vibration assessment concluded that noise and vibration impacts from the operation of the Project are expected to be consistent with the existing dam operations – which does not generate significant noise. Results from the noise monitoring found the operation of the existing dam were not audible at the nearest residential areas. Given the current operation of Warragamba Dam does not generate significant noise or vibration impacts on the community and are not expected to change following completion of the Project, noise impacts on social amenity and lifestyle of communities during the operational phase are not likely to occur.

Impacts on social amenity and lifestyle

During the construction phase, the Project would lead to a reduction in social amenity and impact on existing lifestyles for local communities, especially residents in proximity to the Project construction area. As discussed in the socio-economic baseline of the local communities study area (refer to Section 6.2), the existing environment in the local communities study area is described as a semi-rural and relatively quiet nature of these areas. Local people value the rural living and lifestyle, a tranquil environment and recreational areas. 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. Following the application of mitigation and management measures as outlined in Section 9, changes to social amenity and lifestyle experienced by Warragamba residents living in proximity to the Project construction area as a result of construction noise is assessed as being of a high level of significance.

8.2.2.3 Air quality impacts on community lifestyle and amenity

Changes to air quality can also generate effects on community lifestyle and social amenity. As a semi-rural area, residents in the local communities study area are likely to value the clean and fresh air afforded by the location compared to more urbanised areas.

An Air Quality Assessment has been undertaken for the Project which includes an assessment of potential dust impacts from the site establishment and major construction activities (refer to Chapter 7 and Appendix E of the EIS). The dust generating activities would occur during site clearing and construction and not to any significant extent during the operational phase. Dust emissions would occur during the initial site establishment works and general construction works. The outcome of the air quality assessment shows that there are anticipated to be minor increases in both 24-hour and annual average concentrations of particulate matter due to emissions from site establishment work activities. However, the magnitude of these increases is low and unlikely to result in any measurable differences in air quality or exceedances of the Environmental Protection Authority's air quality assessment criteria at the nearest receptors.

There are no expected changes in air quality due to the operation of the Project and subsequently, no socio-economic effect will result.

Impacts on social amenity and lifestyle

Based on the outcome of the air quality study, predicted increases for all pollutants would be small and would be well below their respective air quality assessment criteria. Therefore, it is unlikely that air quality impacts will affect the lifestyle of the local communities as air emissions from the construction activities would not exceed relevant criteria. However, Warragamba is largely made up of an aging community and as a semi-rural area, communities are likely to value the clean and fresh air afforded by the location compared to more urbanised areas. Therefore, there might be changes in air quality which can affect the lifestyle of the residents, especially the closest receivers located approximately 600 metres north-west of the dam wall. Participants in the stakeholder workshops raised a concern about the impacts of dust on health (such as asthma, allergies and psychological impacts) and cumulative impact with dust coming from the airport construction. Following the application of mitigation and management measures as outlined in Section 9, changes to air quality as experienced by Warragamba and Silverdale residents living in the proximity to the Project construction area is assessed as being of a low level of significance.

8.2.2.4 Transport connectivity and access impacts on community lifestyle and amenity

Changes to transport connectivity and access can generate effects on community lifestyle and social amenity for road users within the local communities study area, leading to a temporary disruption to the enjoyment of natural surroundings. This section describes how the potential changes to connectivity and access on transport networks may result in impacts to social amenity and lifestyle for residents of, and visitors to, the local communities study area.

Transport and traffic have been assessed for the Project during the construction and operation phases (refer to Chapter 24 and Appendix O of the EIS). The transport and traffic assessment found that during the construction phase, the Project would potentially impact local roads and traffic in the local communities study area due to the increased number of construction vehicles using the local road network to access the construction area.

Two potential routes for accessing the Project footprint were identified – Northern and Southern Routes. These routes would be used for the delivery of construction materials, the removal of waste and for workers to access the construction area. It is estimated that the Project would generate an estimated 104 heavy vehicle movements and 250 light vehicle movements per day along these routes over the four to five-year construction period. The study assumed that majority of workers (75 percent) would travel to and from the site from Greater Western Sydney region (Penrith,

Liverpool, and Campbelltown, etc) using Mulgoa Road and The Northern Road, whereas five percent of worker journeys were assumed from the adjacent local Wallacia area. Although the number of workers required would vary over the Project construction period²⁷, it was assumed that 250 cars would travel to the Project footprint during the morning peak hour and would leave the construction area during the evening peak.

The study concluded that the local road network and intersections would have adequate capacity to accommodate additional construction traffic volumes. Low traffic volumes were observed on Park Road, Farnsworth Avenue and Silverdale Road during the traffic count survey. Moreover, the generated construction traffic would also be very low (250 vehicles/hour) and would be distributed on these roads. As such, the existing road networks have enough spare capacity to accommodate additional construction traffic during the construction period. Therefore, it is anticipated that there would be negligible impacts from the Project on the road capacity in the local communities study area.

The increased construction traffic would not result in any loss of access or any substantial delays in accessing roads from properties, businesses, or other facilities. However, at peak times, minor travel and access delays may be experienced especially on Park Road, Silverdale Road and Farnsworth Avenue which are single lane dual carriageways. Heavy vehicles loaded with construction materials may travel at lower speeds which may result in a minor reduction in average travel speed of these roads. In addition, public access around the Project footprint would be restricted to allow for construction of the Project. For instance, a section of Production Avenue and Twenty Third Street/Twenty Fourth Street would only be used for construction vehicles during the construction phase.

The impacts of the Project's traffic on the existing pedestrian and cyclist movements were assessed to identify any potential locations that would be potentially impacted by construction. There is no designated cycle path to the Dam. The proposed heavy vehicle routes for the Project would avoid possible pedestrian and cyclist activity areas within the local Warragamba area. Therefore, there would be negligible impacts from the Project on the existing pedestrian and cyclist movements during the construction phase.

Public transportation in Warragamba area would not be directly affected by the additional construction traffic as there is sufficient capacity on the existing local roads. However, due to the additional heavy truck movements in the Warragamba area, the bus travel time between the stops may increase. However, the bus routes (Bus No. 795 and Bus No. 32) serving the Warragamba area have very low frequencies. Considering the low heavy truck movements (18 truck movements/hour), it is anticipated that such impacts on the overall bus travel time will be very low.

Impacts on local public parking around the Project footprint were assessed. The study shows that all Project vehicles including worker/staff cars would be parked inside the construction area. As such, no additional external or on-street parking spaces will be required. The Warragamba Dam Visitor Centre's parking area, parking around Haviland Park and the parking area near the corner of Farnsworth Avenue and Production Avenue would be closed during the construction period. Warragamba Dam Visitor Centre may remain open during the construction period; however, this would only be for bus tours and there would be no car or pedestrian access to the Visitor Centre. The existing parking area located on Farnsworth Avenue as shown in

Figure 8-8 would be available for parking and access to the adjacent recreational area, subject to agreement with Council. The potential impacts on the local parking is anticipated to be moderate as there would be a loss of parking and access to recreational areas. A detailed parking study would be prepared as part of the Construction Traffic Management Plan to understand and cater for potential impacts during the construction period.

The operation of the Project would not generate any additional deliveries, workers, or other traffic generating activities. As such, after construction is completed, traffic flows in the surrounding road network would return to their existing levels and there would be no additional traffic impacts on the road network surrounding Warragamba Dam from the operation of the Project. Parking and the dam road network would be returned to their pre-construction configuration.

Impacts on social amenity and lifestyle

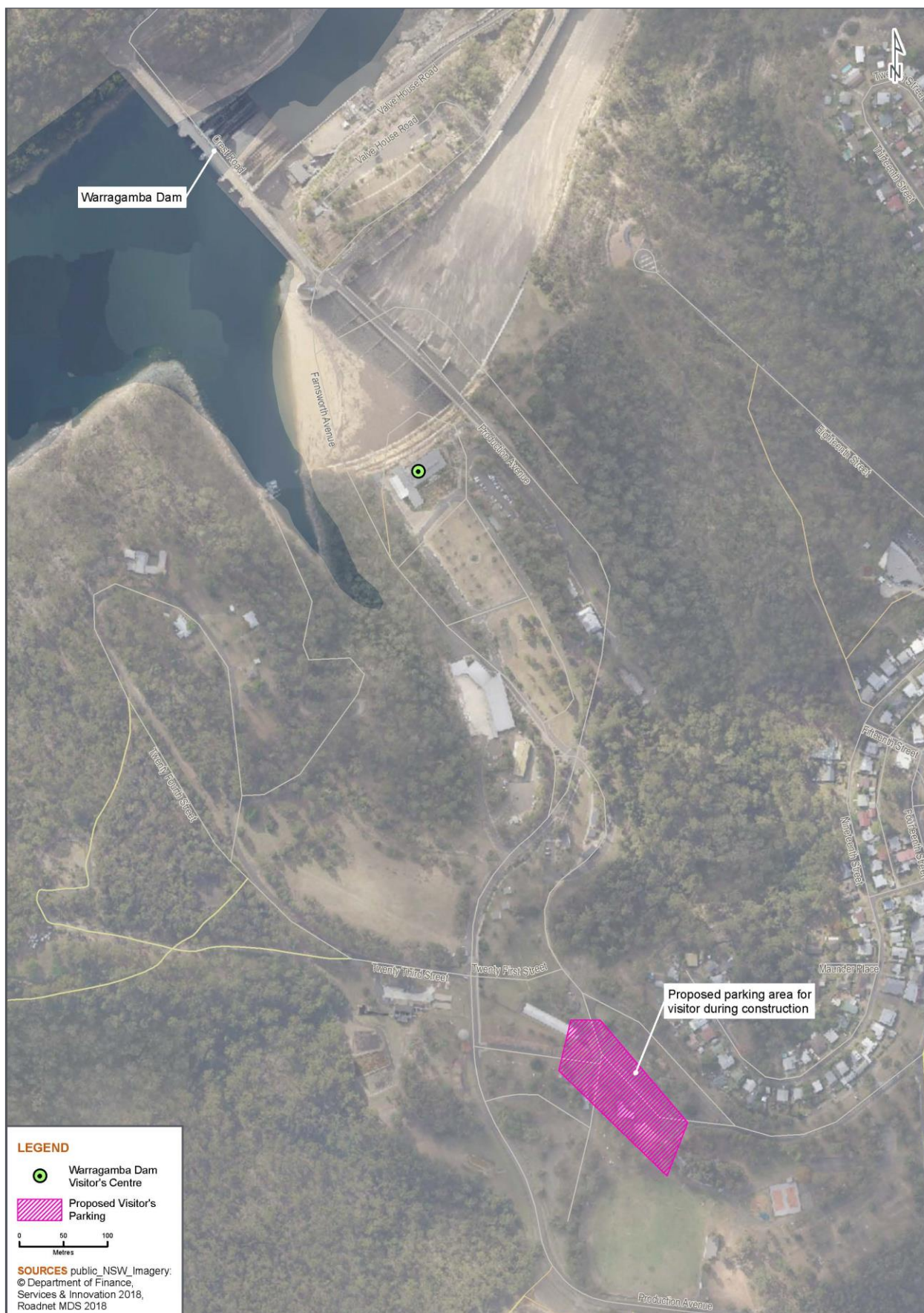
Based on the outcomes of the transport and traffic assessment outlined above, the Project would lead to an increase in traffic on roads in the local communities study area, including Warragamba and Silverdale. This would be expected

²⁷ 300 workers would be on site establishing the site offices, compound, concrete batch plants and in beginning early and enabling works. Once these tasks are completed, the number of workers on site would stabilise at approximately 500 workers throughout the remainder of the main construction works.

to have a moderate impact on the social amenity and lifestyle of these semi-rural areas, particularly those living in the proximity to the Project footprint. There is a network of roads and parking which service the Dam and associated operations and also 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. In addition, public access to the Visitor Centre and Haviland Park would be unavailable during the construction phase. The Visitor Centre may only be open for bus tours and there would be no car or pedestrian access to the Visitor Centre. 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 area. 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. Figure 8-8 depicts the proposed parking area for visitors during the construction of the Project.

Following the application of mitigation and management measures as outlined in Section 9, the temporary disruption to the enjoyment of natural surroundings due to changes to transport and connectivity and access as experienced by stakeholders such as tourists and residents is assessed as being of a moderate level of significance.

Figure 8-8. Proposed parking area for visitors during the construction of the Project



8.2.3 Community health and wellbeing

8.2.3.1 Community safety

The Project may generate effects on community safety for residents and visitors within the local communities study area, such as through increased traffic movements during construction generating temporary risks to road safety and generating temporary anxiety relating to community safety.

As discussed in Section 8.2.2.4, the Project would lead to increased traffic on the local road network. The Southern and Northern access routes travel through the communities of Warragamba, Silverdale and Wallacia. It is estimated that the additional 180 heavy and 250 light vehicles would use these routes during the four-year construction period. The 250 light vehicles would travel to the Project footprint during the morning peak and would leave the construction area during the evening peak. While the existing road networks and intersections have been assessed to have enough spare capacity to accommodate this increased construction traffic movement, the additional construction traffic movements may pose an increased level of safety risk for road users and pedestrian in sensitive localities.

The most significant effect associated with increased traffic is the increased risk of traffic accidents, especially as the Northern Route will pass Warragamba Public School and the Southern route will pass The Oaks Public School, Picton Public School, Picton High School, Tahmoor Public School, and the commercial centres of The Oaks, Picton and Tahmoor. There may be heightened safety risks for children travelling to/from schools during the construction phase. For example, during school time, children wait on the footpath for buses to pick them up or they ride their bicycles to the school through Production Avenue. School students also cross Farnsworth Avenue to access the sport grounds. Road safety remains a concern for the children from the public school given the traffic will increase during the construction phase. In addition, while there would be no direct impact on pedestrian or cyclist movements or paths, there may be an increased safety risk due to the increase in heavy vehicle movements. This is particularly the case where the heavy vehicle routes pass by schools or commercial areas, where existing heavy vehicle movements are low.

At peak times, the number of heavy vehicles needing to use local roads to access the construction area may have a negative impact on the 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 operational phase would not generate any additional deliveries, workers and other traffic generating activities. Therefore, traffic flows in Warragamba, Silverdale and Wallacia would return to their existing level after construction. There would be no additional traffic impacts on the road network surrounding Warragamba Dam from the operation of the Project. Risk to community safety due to the Project's traffic movements is unlikely to occur.

In summary, the Project's construction traffic would pose an increased level of risk for road users and pedestrians in sensitive localities. There is also 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. Following the application of mitigation and management measures as outlined in Section 9, changes to road safety risk as experienced by communities living along the construction traffic route is assessed as being of a high level of significance.

In addition, the Project's construction phase has the potential to generate temporary anxiety for communities living along the construction traffic movements relating to community safety. As discussed in this section, the Project's construction phase may result in an increased risk of traffic accidents, especially as the Southern route will 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 needed to use local roads to access the construction area may have a negative impact on current levels of accessibility. Feeling unsafe can influence levels of anxiety and can be a barrier to community participation and accessing services. Following the application of mitigation measures as outlined in Section 9, changes to levels of anxiety as experienced by communities living along the construction traffic route is assessed as being of a low level of significance.

8.2.3.2 Impacts on social infrastructure and services

Social infrastructure, facilities, and services play an important role in supporting the health and wellbeing of communities. Impacts on social infrastructure and services in local communities study areas have been considered. Social infrastructure, facilities and services include, for example, health and emergency services, education, childcare,

police and community services. An external workforce coming to Warragamba and Silverdale may impact on existing social infrastructure, facilities, and services during the construction period.

During the construction phase, the influx of construction workforce may impose additional demand on medical and emergency services in Warragamba and Silverdale. At peak construction period, there could be about 500 construction workers on site. The majority of the Project's construction workforce (around 75 percent) would be sourced from outside the local area and drive-in-and-drive out on a daily basis. It is possible that workers may use medical and emergency services and may generate an increase in demand for health services in the Project's local communities study area. For instance, workers might go to local general practitioners and health centres in Warragamba and Silverdale for minor injuries and illness during working hours. Patients requiring more complex treatment would be sent to hospitals close by, such as Bowral and District Hospital, Camden Hospital, and Nepean Hospital. Based on the data on health services in Warragamba and Silverdale, access to health services in these towns is relatively limited. GPs are available in the areas and each town has one medical centre. Due to the limited access to healthcare in Warragamba and Silverdale towns, residents also access nearby community health centres in other local government areas, such as the Penrith Community Health Centre, Narellan Community Health Centre, and Hoxton Park Community Health Centre. The presence of construction workforce of up to 500 personnel would result in increased demand on the limited medical and emergency services available in the towns of Warragamba and Silverdale. Hence, there would be a pressure on existing medical and emergency services due to the influx of construction workforce.

There is potential for accessibility for emergency services, such as fire and police to be impeded during the Project's construction phase. The social baseline shows that there are one police station and a fire station servicing Warragamba and Silverdale. It is noted that the police station located in Warragamba does not operate 24 hours. A need for increased police presence in Warragamba throughout the construction period was identified during the stakeholder workshops. During the construction period, accessibility and response times for emergency services may be impacted due to increased traffic.

In terms of education and childcare services, during the Project construction phase, increased demands on existing education and childcare services are not expected due to the assumption that the majority of the Project's construction workforce (around 75 per cent) would only commute between the Project and their homes. In addition, it is not anticipated that the presence of the construction workforce on site could place additional pressure on other services and facilities in Warragamba commercial areas (such as retail trade, food services and other community services) in such a way that may affect their availability for residents in the local areas. Workers will be likely to access social infrastructure facilities and services at their area of residence.

The additional operational workforce would be minimal. No increase is anticipated in demand for social infrastructure, facilities and services during the operation of the Project.

In summary, the Project's construction phase has the potential to generate temporary pressure on existing medical and emergency services due to the influx of the construction workforce. Following the application of mitigation measures as outlined in Section 9, this impact as experienced by Warragamba and Silverdale communities and existing medical and emergency services is assessed as being of a low level of significance.

8.2.4 Cultural heritage

8.2.4.1 Non-Aboriginal heritage

Changes to non-Aboriginal heritage values within the local communities study area can result in a loss of cultural values, indirectly impacting on the character of rural and scenic landscapes. A Non-Aboriginal Heritage Impact Assessment for the Project has been undertaken (refer to Chapter 17 and Appendix I of the EIS). The outcome of the study shows that within and adjacent to the construction area, there are three listed non-Aboriginal heritage items including:

- Warragamba Dam – Haviland Park (SHR No.01375)
- Warragamba Dam Emergency Scheme (SHR No.01376)
- Warragamba Supply Scheme (WaterNSW s170 No. 4580161).

During the construction phase, the Project would result in a range of physical and visual impacts, especially a high impact on Haviland Park and the Warragamba Supply Scheme. This is due to both of these heritage items being within the construction area, not to mention, in the case of the Warragamba Supply Scheme, being the focus of the Project. The following describes the physical and visual impacts on the listed non-Aboriginal heritage items due to the Project.

Warragamba Dam – Haviland Park (SHR No. 01375)

The Project would result in an overall high direct physical impacts to the State listed Haviland Park. The Project would involve the construction of a new bridge over the Auxiliary Spillway and realignment of a section of Production Avenue within the heritage curtilage of Haviland Park. The proposed realignment would impact the section of Haviland Park recently modified by landscaping works carried out in 2007. While this portion of Haviland Park does not contain any significant elements, the realignment works would result in modifications and reduction of the item's heritage curtilage in this locality. In addition, the proposed temporary use of a large portion of land within Haviland Park as a laydown area/batching plant during construction works would result in a range of physical impacts, both temporary and permanent. This would include removal of vegetation and ground excavations across the site. While the vegetation within Haviland Park is largely not original and was replanted following the December 2001 bushfire and major storm event in 2018, the existing vegetation contributes to the cultural landscape character and setting of the park since its establishment during the 1960s beautification works that occurred following completion of the dam. The remnant concrete base of the original fountain, the centrepiece in the design of the park that is identified in the CMP 2010 as being a component of primary significance to the Warragamba Supply Scheme, would be retained and protected for the duration of the Project.

The Project would also have moderate indirect visual impacts to Haviland Park. The Project also would result in visual impacts to Haviland Park for the duration of the Project. Establishment of a laydown area/batching plant, which would remove all trees and vegetation within the item's heritage curtilage and require excavations across the site, would diminish the landscape quality and setting of the park. Revegetation and landscaping works following completion of the Project would mitigate this associated visual impact to the cultural landscape of the park. The establishment of a batching plant and introduction of large machinery in Haviland Park during the Project's construction phase would also obscure significant views from the approaches towards the Dam along Farnsworth Avenue, although this visual impact would be temporary in nature.

Warragamba Emergency Scheme (SHR No.01376)

The Warragamba Emergency Scheme is identified as a 'primary' element of significance in the Warragamba Supply Scheme CMP 2010. Based on the outcome of the non-Aboriginal heritage assessment, the project would not involve any direct physical impacts to key components within the emergency scheme comprising the weir and later diversion tunnel, pumping station, Megarritys Creek Bridge, former construction platform, balance reservoir, or early dam model. Indirect physical impacts are associated with flood events, which are not considered to result in any additional impact to the current flood conditions as the volume of water discharged into Warragamba River by the dam would not change. For most events, there would be a reduction in the peak flow discharged by the dam which would lessen any risk of damage to the heritage item. Therefore, the project would result in a negligible physical impact to the SHR listed Warragamba Emergency Scheme heritage item.

With regard to visual impact to the SHR listed Warragamba Emergency Scheme, the Project would involve clearing and removal of vegetation in proximity to the heritage curtilage of the Warragamba Emergency Scheme, including a proposed laydown area. This would result in minor alteration to the current landscape setting of the item. The landscape setting has been identified as playing an important role in defining the character and setting of the Warragamba Emergency Scheme. It is noted that revegetation and landscaping works following completion of the Project would mitigate associated visual impacts. Moreover, it is noted that surrounding areas of bushland have been cleared and modified over time. The outcome of the non-Aboriginal heritage assessment shows that the Project would result in an overall negligible visual impact to the SHR listed Warragamba Emergency Scheme heritage item.

Warragamba Supply Scheme (WaterNSW s170 No. 4580161)

Based on non-Aboriginal heritage assessment, the Project would result in a high physical impact to the Warragamba Supply Scheme heritage item. Individual components within the overall heritage item of the Warragamba Supply Scheme would be subjected to varying degrees of impact. The main heritage impacts are expected to be focused around the dam wall and its associated features including the crest crane, equipment and commemorative plaques and memorials, the Valve House, landscaped areas of Haviland Park (discussed previously) and the Terraced Garden to the east, and the 18-tonne upper tail tower located on the western bank of the Dam.

The Project would result in permanent physical changes to the dam wall and its current configuration and features which would directly impact the original fabric of the dam wall itself. In addition, the drum and radial gates, associated mechanical and electrical infrastructure, and portions of the piers within the main spillway would be removed and

replaced. The lift towers on both abutments would be raised by around 17 metres, and a 12 to 15 metre wide pathway would be built along the top of the abutments to connect with the approaches.

In addition, the Project would result in impacts to significant features on the crest road including the crest crane and associated equipment and several commemorative plaques/memorials as follows:

- Removal of the crest crane, which is one of the original and practical features of the crest road. The blue-painted and track mounted structure has been retained historically for maintenance works along the crest and gates and emergency operations. Removal of the crest crane would represent a direct physical impact to the heritage significance and intactness of the Warragamba Supply Scheme complex.
- Relocation of plaques and memorials on the crest roadway, including the rectangular polished terrazzo/concrete memorial with brass plaques commemorating the works and the significant persons involved. The memorial, which was unveiled at the opening ceremony of the dam in October 1960, was previously relocated during the construction of the auxiliary spillway. The relocation of memorials and plaques to new locations on the raised dam would not result in any additional impacts to the heritage significance of the Warragamba Supply Scheme complex.
- Eighteen-tonne upper tail tower remaining on the western bank of the Dam due to modifications to the left abutment access. The 18-tonne upper tail tower demonstrates the original construction and operations processes of the dam. The Project has been developed to allow for the relocation of the 18-tonne upper tail tower to a proposed new position along the crane rails on the terrace around 30 metres upstream which would represent a positive heritage outcome.
- Site of the adjacent terraced gardens, which constituted part of Haviland Park prior to the construction of the auxiliary spillway, resulting from minor encroachments. This component, featuring ornamental gardens that reflect an ongoing evolution in garden design since the dam's construction, would be impacted by the proposed establishment of a laydown area/batch plant in this location which could result in the removal of vegetation and significant landscape elements, along with ground excavations, and direct impacts to significant fabric within the Warragamba Supply Scheme.

With regard to visual impact to the s170 Warragamba Supply Scheme, the Project would result in an overall moderate visual impact to this heritage item. The increase in height and width of the dam wall would result in visual changes to the dam's profile and modifications to aspects that are evocative of the original design of the dam wall. It is noted the relative dimensions would be proportionately retained and the design would adopt a smooth profile, and that the dam wall has been previously raised and subject to change over time to maintain the item's ongoing role and significant use.

The demolition of the original crest crane would result in a visual change to the Warragamba Supply Scheme. However, dependant on the final design option selected, a new fit for purpose crane would be installed. The overall loss of the crest crane would diminish the visual qualities and intactness of the dam site.

Further, the Project would involve clearing of bushland and vegetation adjacent to the Dam which the CMP (2010) identified as playing an important role in defining the landscape character and setting of the Warragamba Supply Scheme. Clearing of vegetation, as such, would result in visual changes that would diminish the landscape setting of the dam, although it is noted that revegetation and landscaping works following completion of the Project would mitigate associated visual impacts.

Changes to non-Aboriginal cultural heritage values within the local communities study area may diminish cultural connection for some stakeholders and communities. This has the potential to cause anxiety or distress for those stakeholders who highly value the non-Aboriginal cultural heritage sites.

In summary, the Project's construction phase has the potential to generate temporary and permanent disturbance of non-Aboriginal heritage items. Within and adjacent to the construction area, there are several listed non-Aboriginal heritage items, including Warragamba Dam – Haviland Park (SHR No. 01375), Warragamba Emergency Supply Scheme (SHR no. 01376) and Warragamba Supply Scheme (WaterNSW s170 No. 4580161). The Project would result in a range of physical and visual impacts to these heritage items, especially a high impact on Haviland Park and the Warragamba Supply Scheme. Following the application of mitigation measures as outlined in Section 9, changes to non-Aboriginal heritage values as experienced by tourists and locals is assessed as being of a high level of significance.

8.2.4.2 Natural heritage including parkland and native bushland flora and fauna

The construction phase of the Project could result in impacts to native vegetation and fauna habitat, subsequently impacting on biodiversity values.

As part of the Warragamba EIS, impacts on biodiversity values within the construction area of the Project have been assessed (refer to Chapter 10 and Appendix F3 of the EIS with regard to the construction area biodiversity assessment). The Construction Area Biodiversity Assessment shows that the construction area layout has been refined through consideration of alternatives, which have reduced the potential for adverse impacts to the environment, including specific impacts on threatened ecological communities. The construction area shown in Figure 3-4 covers approximately 105 hectares. Of this total area, native vegetation covers approximately 52 percent of the Project construction area (55.23 hectares). The outcome of the assessment indicates that Project construction activities can cause both direct and indirect impacts to biodiversity values which include the composition, structure, and function of ecosystems, and comprise (but is not limited to) threatened species, populations and ecological communities, and their habitats. 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.

Direct impacts on biodiversity values, for example, include loss of fragmentation of native vegetation; loss of threatened ecological communities; loss of threatened flora and fauna species and their habitats; and fauna mortality. The Construction area biodiversity assessment (Chapter 10 and Appendix F3 of this EIS) has provided a detailed assessment of each impact on biodiversity values. Of note, a total of 22.5 hectares of native vegetation will be directly cleared. Indirect impacts may result in further loss of native vegetation. The combined direct and indirect impact areas will lead to fragmentation through the creation of discontinuities of the extent of vegetation communities.

The assessment further indicates that one threatened flora species (listed as Vulnerable under both the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)), which was recorded within the Project footprint, may be affected by clearing. In addition, potential suitable habitat for 37 threatened flora species (defined as having a moderate or higher likelihood of occurrence) was also identified within the Project footprint and may also be affected by clearing.

One threatened fauna species, the Red-crowned Toadlet (*Pseudophryne australis*), listed as Vulnerable under the BC Act was recorded within the Project footprint. Approximately 8.3 hectares of suitable habitat for this species would be cleared. In total, around 22.5 hectares of suitable habitat for threatened fauna species would be removed. The impacts on biodiversity values within the Project footprint during the construction are assessed as being high. The construction area biodiversity assessment also specifies impacts of the Project that fall into the threshold of impacts require offsetting (refer to Chapter 10 and Appendix F3 of this EIS). During operation, the Project may result in increased inundation effects to the upstream communities study area, which has been assessed in Section 8.3.

Overall, the ability to enjoy native flora and fauna for some stakeholders may be affected by the loss or displacement of valued species due to alternation of habitat. In particular, the construction phase of the Project could result in direct and indirect impacts to biodiversity values within the construction area. As detailed above, the Project may result in loss and fragmentation of native vegetation, loss or degradation of ecologically important habitat, loss of threatened flora and fauna species, fauna mortality, changes to natural fire regimes, and weed and feral animal invasion. The loss of ecological habitat and threatened species due to the clearance of native vegetation create an extreme impact because of the local degradation of sensitive habitat. However, following the application of mitigation measures as outlined in Section 9, the impact to natural heritage values as experienced by stakeholders such as locals, tourists and local environmental advocacy groups is assessed as being of a high level of significance.

8.2.5 Way of life

8.2.5.1 Employment opportunities

During the construction phase, there would be a requirement to source construction labour. The Project would require up to 300 workers for site establishment works and approximately 500 workers throughout the remainder of construction works. The construction workforce for the Project would generally be provided by contractors and subcontractors working on the Project construction, and any opportunities for local employment is likely to be through these contractors and subcontractors.

Potential jobs required during the construction phase could include both construction and related support services. The potential jobs, for example, could be as follows:

- engineering and construction
- transport and fuel
- materials handling
- maintenance
- administration and information technology
- food and beverages
- ancillary services
- medical/emergency facilities.

A proportion of the construction workforce is expected to be drawn from local communities in Warragamba, Silverdale, and Wallacia (5 percent). Construction workers would also be drawn from the surrounding regions hence employment benefits would extend to construction industry workers across the broader region. It is evident from the social baseline conditions of the study areas that construction is the largest industry in local communities study area. The proportion of technicians and trades workers across the Wollondilly LGA, Warragamba and Silverdale are highest. The availability of construction personnel in the local communities study areas would not make difficult for the Project to access adequate labour for construction locally and regionally. Therefore, the construction phase would generate employment opportunities for people in local communities of Warragamba, Silverdale and Wallacia and for people across the broader region.

Once operational, there would be no additional direct employees as a result of the Project. However, there is anticipated to be an increase in tourism, which would indirectly benefit the businesses of Warragamba. This is described in Section 8.2.5.3.

The generation of employment opportunities by the Project has the potential to enhance individual and community socio-economic wellbeing within the local communities study area. In summary, the Project is likely to generate a high positive impact for jobseekers in the local communities study area during the construction phase. In addition to creating local employment opportunities, the Project may lead to increased spending in the local communities study area due to the Project stimulating additional (flow on) indirect employment opportunities.

8.2.5.2 Local supply opportunities

The construction phase is anticipated to create economic opportunities for the local communities through the provision of goods and services in both regional and local and regional study areas. During the construction phase, the Project would involve the procurement of construction supplies and the use of construction-related services. Relevant construction services could be transport, logistics and utilities services. The socio-economic baseline showed that construction is the largest industry and there are numerous construction-related supplies in Wollondilly LGA. In addition, retail trade is the third major industry in the local communities study area. Therefore, there is potential to utilise local companies which would assist in revitalising the local economy. The increased demand in procuring construction supplies and providing relevant services for the Project would provide a stimulus to business growth and development and would generate a positive impact on relevant industry sectors, such as construction, utilities, trade, transport and logistic services, and retail.

During construction, there would also be a demand for food and other worker consumables in the local communities study area. On-site observation identified that there are at least 20 retail trade, food and beverage services located near to the Project footprint within the township of Warragamba. These businesses would be likely to benefit from the trade generated by the construction workforce. The addition of approximately 500 workers would have a significant and positive impacts on the existing retail, food and beverage service providers. The increased spending in

the local area due to the Project would also stimulate additional (flow-on) indirect employment opportunities in the local communities. Some participants in the stakeholder workshops expressed a view that many businesses in Warragamba town are largely supported by tourism and business from non-locals. During construction of the spillway from 1998 to 2002, shops did experience increased business, especially during lunchtimes when workers came to get food. They further articulated that businesses, such as the Workers Club, are likely to benefit from an external workforce coming as workers stop by after work.

Hospitality services associated with providing short-term accommodation for members of workforce who do not reside locally would be potentially required during the construction phase. No dedicated worker accommodation facilities would be constructed for the Project since the majority of construction workforce (up to 75 percent) would commute daily to the Project footprint to work. However, there is the likelihood of some benefits to short-term accommodation services as workers may sometime use this service while they are working or travelling to work. Based on the socio-economic baseline, there is no short-term accommodation (such as motels and hotels) in Warragamba and Silverdale. Nevertheless, in the vicinity of the Project footprint, there is one hotel in Wallacia and 10 motels and hotels located in Penrith area. Therefore, short-term accommodation services are likely to be spread across the broader region and would obtain some benefits from non-resident construction workforce.

Once operational, there would be no potential for direct benefits for local businesses through local supply opportunities associated with the Project. However, there is anticipated to be an increase in tourism, which would indirectly benefit the businesses of Warragamba. Effects on tourism are discussed in the following section.

The generation of local supply opportunities by the Project's construction has the potential to enhance economic prosperity for businesses located in the local communities study area. 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 and Wallacia and the broader local communities study area. This has the potential to generate a high positive impact for business and industry within the local communities study area.

8.2.5.3 Effect on tourism

Local stakeholders advised that tourism continues to make an important contribution to the local economy in Warragamba. Feedback provided at the stakeholder workshops and other stakeholder engagement activities undertaken in Warragamba indicated that the town has suffered financially due to a downturn in tourism numbers. This has been a result of a number of factors over the last 20 years. For example, there were the closure of the Bullen's Lion Park in 1991, damage to the town incurred by bushfires in 2001, spillway construction works from 1998 to 2002, and restrictions placed on access to areas on and around the Dam introduced in 2002. These factors, along with the changing nature of domestic visitation to the Dam, have resulted in a decline in the number of tourists visiting the Dam and spending money in the local area.

During the construction phase, the potential temporary closure of the Warragamba Dam Visitor Centre and the closure of Haviland Park along with increased heavy vehicle movements and construction related activities may further deter some tourists from visiting the Dam. The Visitor Centre and Haviland Park are tourist attractions in the town. Haviland Park is a popular socialising and recreational area for both locals and visitors. Reduced tourist numbers may also have a flow-on effect to local businesses and the overall economic vitality of the town. However, the Project may also have a positive effect on tourism during the construction phase 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 view of the construction activities on the Dam itself, possibly leading to increased tourists to Warragamba.

Once the construction of the Project is completed, there would be a higher visually-prominent structure of the dam wall and more extensive downstream infrastructure, especially within and downstream of the Auxiliary Spillway. The dam elements would essentially be the same and be similar in visual appearance to the existing dam albeit more contemporary in appearance. It is likely that the 'engineering significance' of the Dam would increase because of the Project and therefore may attract additional tourists following completion of construction. The Visitor Centre would be reopened when construction work is finished, and the surrounding area is restored. Therefore, there is a potential for increased visitation numbers to Warragamba Dam and accordingly a benefit to local economy of Warragamba.

In summary, the potential temporary closure of the Warragamba Dam Visitor Centre and the closure of Haviland Park during the construction phase along with increased heavy vehicle movements and construction related activities may deter some tourists from visiting the area, subsequently generating temporary negative effects on the tourism industry. A reduction of tourist numbers in the local communities study area would have a flow on effect on local

businesses and the overall economic vitality of the area. Following the application of mitigation measures as outlined in Section 9, effects on tourism as experienced by stakeholders such as tourists, local residents and businesses which benefit from tourism is assessed as being of a high level of significance. At the completion of the construction phase, the Project is likely to result in an increase in visitation numbers to the dam, resulting in a moderate positive impact for tourists, locals, tourism bodies and tourism businesses within the local communities study area.

8.2.5.4 Community cohesion

The presence of a large construction workforce (approximately 500 construction workers at peak times) may impact on community sentiment and cohesion. Most of the construction workforce would be sourced from outside the local area and drive-in-drive-out daily. As non-resident workers would be present only while on roster, there are 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 might occur. However, there are also benefits on having non-resident workers visiting the towns, particularly in relation to expenditure at local businesses. Following the application of mitigation measures as outlined in Section 9, changes to community cohesion as experienced by the communities of Warragamba, Silverdale and Wallacia is assessed as being of a moderate level of significance.

8.2.6 Impact assessment summary - Local communities

Table 8-5 summarises the socio-economic impacts discussed in Section 8.2 and assesses their significance rating as per the impact assessment methodology outlined in Section 4.5 for the local communities study area.

Table 8-5. Summary of socio-economic impacts and their significance rating for the local communities study area

No.	Impact	Positive/ negative	Description	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	The Warragamba Dam Visitor Centre and Haviland Park are situated within the Project construction footprint and would be affected 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.	Tourists and locals	Almost certain	Moderate	A3 - Extreme
2	Construction-Delayed travel time in accessing properties due to increased construction traffic	Negative	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.	Communities living along the construction traffic movements	Almost certain	Minor	A2 - High
Environment							
3	Construction – Temporary negative visual impacts	Negative	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.	Tourists, locals, and dam operation staff working on site	Likely	Moderate	B3 - High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
4	Post construction - Positive landscape character	Positive	New infrastructure will be delivered as part of the Project including various modified and new structures. This will result in a higher 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 a slightly more contemporary in appearance.	Tourists, locals, and tourism bodies	Likely	Moderate	B3 - High
5	Construction – Temporary noise impacts on social amenity	Negative	Project related noise would lead to a reduction in social amenity and impact on existing lifestyles for local communities, especially residents close to the Project construction area. The existing environment in 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.	Warragamba communities living in the proximity to the Project construction area	Likely	Moderate	B3 - High
6	Construction – Temporary air quality impacts	Negative	Based on the outcome of the air quality assessment study, predicted increases for all pollutants would be low and well below their respective air quality assessment criteria. Therefore, it is unlikely that air quality impacts will affect the lifestyle of the local communities as air emissions from the construction activities would be within the permissible levels. However, as a semi-rural area, Warragamba communities are likely to value the clean and fresh air afforded by the location compared to more urbanised areas. Therefore, there might be changes in air quality which can affect the lifestyle of the residents, especially the closest receivers located within a one km radius and mainly to the east of the Project construction areas. Many receptors are located downwind of the dominant west southwest winds.	Warragamba and Silverdale communities living in the proximity to the Project construction area	Possible	Minor	C2 - Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
7	Construction – Temporary disruption to the enjoyment of natural surroundings	Negative	There is a network of roads and parking areas which service the dam and associated operations and also 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 may 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 area. 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 will be reduced for the duration of the construction phase.	Tourists and locals	Likely	Moderate	B3 - High
Community Health and wellbeing							
8	Construction – Temporary risks to road safety due to construction traffic movements	Negative	Project transport routes travel through the communities of Warragamba, Silverdale, and Wallacia. The Project would generate an estimate of 180 heavy vehicle movements and 250 light vehicle movements per day along these routes over the four-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.	Communities living along the construction traffic routes	Possible	Catastrophic	C5 - Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
9	Construction – Temporary anxiety relating to community safety due to additional construction traffic movements	Negative	A potential impact associated with increased traffic is the increased risk of traffic accidents, especially as the Southern route will 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 area 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.	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	The presence of a large construction workforce (approximately 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.	Warragamba and Silverdale communities and existing medical and emergency services	Possible	Minor	C2 - Moderate

No.	Impact	Positive/ negative	Description	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	Within and adjacent to the construction area, there are several listed non-Aboriginal heritage items, including Warragamba Dam – Haviland Park (SHR No.01375), Warragamba Emergency Supply Scheme (SHR No.01376) and Warragamba Supply Scheme (WaterNSW s170 No.4580161). The Project would result in a range of physical and visual impacts to Haviland Park due to construction of a new bridge over the Auxiliary spillway and realignment of a section of Production Avenue. In addition, the use of 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. During the construction phase, the Project would result in a range of physical and visual impacts, especially a high impact on Haviland Park and the Warragamba Supply Scheme.	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	The construction phase of the Project could result in direct and indirect impacts to biodiversity values within the construction area. Based on the Construction Area Biodiversity Assessment, the Project may result in loss and fragmentation of native vegetation, loss or degradation of ecologically important habitat, loss of threatened flora and fauna species, fauna mortality, changes to natural fire regimes, and weed and feral animal invasion. These impacts may translate into social impacts for locals, tourists, and local environmental advocacy groups. The ability to enjoy native flora and fauna may be affected by the loss or displacement of value species due to alternation of habitat.	Tourists, locals, environmental advocacy groups	Almost certain	Moderate	A3 - Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
Way of life							
13	Construction – Temporary generation of employment opportunities	Positive	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 approximately 500 workers at the peak of construction. The construction workforce for the Project would generally be provided by contractors and subcontractors. The Project requires a large workforce for the duration of the construction period. This can create local employment opportunities for communities in Western Sydney. Increased spending in the local area due to the Project would also stimulate additional (flow on) indirect employment opportunities in local communities.	Project region jobseekers	Likely	Minor	B2- High
14	Construction – Temporary Generation of commercial opportunities for businesses	Positive	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 and Wallacia and the broader region.	Project region business and industries	Likely	Minor	B2- High
15	Construction – Perceived temporary negative effects on Tourism industry	Negative	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.	Tourists, locals, tourism bodies, and tourism businesses	Likely	Moderate	B3 - High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
16	Post construction – Increase in visitation numbers to the Dam	Positive	<p>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.</p> <p>Once operational, it is likely that the ‘engineering significance’ of the Dam will increase and therefore may attract additional tourists. The Visitor Centre would be reopened when construction work is finished, and the surrounding area restored.</p>	Tourists, locals, tourism bodies, and tourism businesses	Possible	Minor	C2 - Moderate
17	Construction – Temporary impacts on community sentiment, cohesion, and resentment	Negative	<p>The presence of a large construction workforce (approximately 500 construction workers) may impact on community sentiment and cohesion. Most of the construction workforce would be sourced from outside the local area and drive-in-drive-out daily. 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.</p>	Warragamba, Silverdale, and Wallacia communities	Possible	Moderate	C3 – High

8.3 Upstream communities

8.3.1 Property and land use

The upstream communities study area comprises features of significant environmental value, which are highly regarded by communities and visitors. Changes to property and land use has the potential to generate effects to these environmental values.

When the Warragamba Dam was originally constructed, an area of about 153 square kilometres, which included all properties to be submerged and those lying within 3 kilometres of the Dam, was compulsorily acquired by the NSW Government. This land was declared Special and Controlled Areas under legislation at the time to protect the catchment and water quality in Lake Burragorang. For the Warragamba Dam, this includes:

- Special area: Schedule 1 – includes lands immediately surrounding the Lake Burragorang, extending for three kilometres from the top of the full supply level. The public is not permitted to access to this area.
- Special area: Schedule 2 – is a secondary protection area surrounding the Schedule 1 areas. Entry to this area is permitted on foot – and there are other restrictions in relation to disturbing or damaging the plants and soils as well as a prohibition on lighting fires in certain circumstances.
- Controlled areas – are areas outside the direct catchment of a water storage but may contain other infrastructure that is related to water supply such as pipelines or canals. Controlled areas can also be Schedule 1 or Schedule 2 lands.

Lake Burragorang is surrounded by the GBMWhA, national parks (Blue Mountains, Kanangra-Boyd, Nattai, Grose, Wollemi, Dharug, Marramarra, Cattai and Scheyville), state conservation areas and karst conservation areas.

Potential impacts from the operation of the Project relate to the increased area of temporary inundation of protected areas. As part of the EIS (refer to Chapter 20- Protected and Sensitive Lands of the EIS), spatial analysis was undertaken to determine the potential change in inundation between various size floods, noting that there would only be a change in the temporary storage of flood waters above the existing full supply level (FSL).

Changes in potential inundation areas within the study area for the PMF are provided in Table 8-6. For the existing conditions, the inundation of the various protected lands would be greater than the areas presented below, as existing inundation outside the study was not assessed.

Table 8-6. Potential areas of increased inundation of protected and sensitive lands within the study area based on changes in the probable maximum flood

Protected area	Inundation area ha (percent of total area)		Change in area ha (percent of total area)
	Existing	With Project	
Greater Blue Mountains World Heritage Area	1,085 (0.1%)	1,675 (0.2%)	590 (0.1%)
Blue Mountains National Park	1,519 (0.6%)	2,729 (1.0%)	1,210 (0.5%)
Nattai National Park	867 (1.7%)	1,319 (2.6%)	453 (0.9%)
Kanangra-Boyd National Park	7 (<0.1%)	7 (<0.1%)	0
Burragorang State Conservation Area	404 (2.3%)	664 (3.8%)	261 (1.5%)
Nattai State Conservation Area	107 (3.3%)	190 (5.8%)	83 (2.5%)
Yerranderie State Conservation Area	665 (5.4%)	1,123 (9.0%)	458 (3.7%)

Upstream communities have raised a high level of concern that the Project would affect the conservation and protected status of surrounding lands. In particular, there is opposition to the inundation of the GBMWhA. Whilst the additional total area that would be temporarily inundated for the PMF would be relatively small (590 hectares which accounts for 0.1 percent of the total area), community and stakeholder interest groups have expressed opposition to any impacts to the GBMWhA and other protected lands as it erodes the value which such a status provides.

The increase in the area of inundation of the protected areas in Table 8-6 (excluding the GBMWhA) is estimated to be 2,465 hectares for the PMF which equates to approximately 0.6 percent of the total area. The largest increase in potential inundation would occur in the Yerranderie State Conservation Area (3.7 percent), which borders Lake Burragorang. There are community concerns that the changes to the physical condition of lands which are

(temporarily) inundated would negatively affect the environmental conservation and protection values which these lands provide.

Whilst most of the lands upstream potentially affected by the Project are designated for environmental conservation and water catchment protection, there are a small number of private properties which may be temporarily inundated in some flood events. Specifically, there are two privately owned lots (same owner) which would experience increased inundation during a major flood event due to the Project. There are some additional properties which are impacted by existing flooding but would experience no change in flooding due to the Project. In addition, eastern access routes through to the Yerranderie Private Town via the fire trails which are not public access routes, would be affected in some flood events as a result of the Project. The main access route to Yerranderie via the Oberon-Colong Stock Route would not be affected by the Project.

In summary, the Project's operation has the potential to generate negative impacts for communities within the upstream communities study area. The upstream community has voiced a high level of concern as to the effects of the Project on the World Heritage listed area. While the additional total area estimated to be temporarily inundation is relatively small, there are community concerns that the loss of any World Heritage listed areas erodes the value which such a status provides. Further, the upstream community has voiced concern regarding the effects on environmental conservation and protection values of National Parks around Lake Burragorang. Following the application of mitigation measures as outlined in Section 9, changes to property and land use in the upstream communities study area is assessed as being of a moderate level of significance.

The Project's operation may also result in direct effects on two private properties. The two privately owned lots (same owner) would be temporarily affected by partial inundation of the land in the event of withholding inflows associated with a major flood event. Following the application of mitigation measures as outlined in Section 9, this impact is assessed as being of a high level of significance for affected property owners, due to temporary loss of property in the event of a major flood event. In addition, the temporary storage of flood waters would result in impacts in access to Yerranderie Private Town from the east. However, this is not a public access route. Therefore, and following the application of mitigation measures outlined in Section 9, this impact is assessed as being of a low level of significance.

8.3.2 Environment

8.3.2.1 Landscape character and visual amenity

Changes to landscape character and visual amenity has the potential to generate adverse effects on social and economic values within the upstream communities study area through potential upstream inundation associated with the Project. As described in Section 6.3.8, the upstream communities study area contains areas of the GBMWhA, which is highly valued by the community for its environment, cultural, and recreational significance.

The landscape character and visual assessment completed as part of the EIS defined the upstream landscape character zone including Lake Burragorang (that is, the reservoir formed by Warragamba Dam) and its tributaries and areas of the Blue Mountains National Park, Burragorang State Conservation Area, Nattai National Park, Nattai State Conservation Area, and Yerranderie State Conservation Area (refer to Chapter 25 and Appendix P of the EIS). Most of the Blue Mountains National Park is also in the GBMWhA and some areas of the GBMWhA would be impacted by increased temporary inundation. The upstream operational study area of the landscape character and visual assessment includes the areas upstream of Warragamba dam that could be affected by the future operation of the Project and environmental flow releases. The upstream landscape character zone was assessed as having a high level of sensitivity due to its rare diversity of natural features and world heritage listed National Park which is highly valued by local residents and tourists. The magnitude of impact on the upstream landscape character zone due to the Project was assessed as being low in the Landscape Character and Visual Assessment. This is due to the relatively small extent of the shoreline of both Lake Burragorang and tributaries which would likely be affected. The significance of the impact on the landscape character of the upstream area was assessed as being moderate.

The Blue Mountains area is synonymous with iconic viewsheds, including Echo Point, and the views over the Three Sisters and surrounding Blue Mountains wilderness areas. The enjoyment of such views is a central reason why people visit the Blue Mountains and is subsequently a vital component of the local economy. There have been concerns raised by businesses and other stakeholders in the Blue Mountains that due to the temporary inundation of areas around Lake Burragorang and its tributaries, there would be loss of vegetation which would detract from the visual amenity enjoyed by residents and visitors to the area. The landscape character and visual assessment identified two viewpoints which would have potential visual impacts resulting from the Project: Echo Point Lookout, Katoomba and Burragorang Lookout, Nattai. These viewpoints are considered to have long and medium range views of the upstream operational area when above the full supply level.

In relation to the Echo Point lookout, the Landscape Character and Visual Assessment found that the closest visible waterway to Echo Point potentially impacted by the Project is the Kedumba River. At its closest, the area potentially impacted by the Project on the Kedumba River is about 12 kilometres from the Echo Point viewpoint. While some low-lying zones adjacent to the existing watercourse may be impacted by increased temporary inundation, it is unlikely that such impacts would be visible from this location due to their scale and distance from Echo Point. Inundation zones adjacent to the Kedumba River are surrounded by densely-vegetated valley environments, populated with eucalypt forest and occasional pockets of semi-rainforest environments in gullies where water is prevalent. Together with steep topography, much of the river from Echo Point is screened and unlikely to be visible. This viewpoint has panoramic views out across the GBMWA. The Assessment assigned a low level of magnitude since there would be small, if at all discernible, change to existing vegetation within the temporary inundation zones in the upstream environment 12 kilometres away. The subsequent visual impact on this viewpoint was assessed as moderate.

The Nattai Lookout, almost 300 metres above the full supply level of Lake Burragorang, is perched high above Warragamba Dam. The viewpoint provides spectacular panoramic views across Lake Burragorang, the Nattai National Park, and Yerranderie State Conservation Area. Views from the Nattai Scenic Lookout in the elevated Blue Mountains escarpment look down a steep vegetated valley and reveal Lake Burragorang as a dominant feature in the visual catchment. The lake with a shoreline of bright exposed rock contributes to the high scenic amenity at the Nattai Scenic Lookout. Sections of the exposed rock on the Lake Burragorang shoreline, which includes areas of the Nattai National Park and Yerranderie State Conservation Area, are visible and are caused by variation in the existing dam permanent water levels. A greater area of exposed rock along the lakes shoreline may be visible and as a result of the Project. At its closest point, the shoreline is still almost 2 kilometres from the Nattai Scenic Lookout and stretches as far as 16 kilometres into the distance; therefore, impacts are not likely to be highly apparent as distinct from the existing exposed shoreline which fluctuates in scale depending on rainfall and drought conditions. This viewpoint was rated as having a high level of sensitivity. The magnitude of the visual impact on this viewpoint was rated as low in the landscape character and visual assessment due to moderately discernible change to existing vegetation along the visible shorelines of Lake Burragorang that sit within the temporary inundation zones. The visual impact on this viewpoint was assessed as being moderate.

In addition to the more elevated areas of the Blue Mountains LGA, there are numerous popular lookouts and views from walking trails in both the Blue Mountains and Wollondilly LGAs which may be affected by changes to landscape surrounding Burragorang Lake as a result of the Project. The Project would see infrequent raising of the water levels in the upstream environment which included Lake Burragorang and its tributaries and areas of the Blue Mountains National Park, Burragorang State Conservation Area, Nattai National Park, Nattai State Conservation Area, and Yerranderie State Conservation Area. Depending on the size of the flood event, these areas could be inundated up to about 143 metres AHD. During the temporary storage of flood water before their release, Lake Burragorang and its tributaries would appear fuller and any visual impacts would be negligible.

Changes to landscape character and visual amenity within the upstream communities study area is likely to result in diminished enjoyment of viewsheds for tourists and residents. This in turn may result in reduced tourism and commercial opportunities for local businesses (refer to Chapter 25 and Appendix P of the EIS for the latest Landscape Character and Visual Amenity Impact Assessment).

In summary, the Project's operation has the potential generate negative social impacts in the upstream communities study area in relation to changes to landscape character and visual amenity. Concerns were raised by community stakeholders that views from lookouts such as Echo Point and Burragorang may be negatively affected and that views of Lake Burragorang from helicopter tours and other air borne travel may be negatively affected. Following the application of mitigation measures as outlined in Section 9, changes to visual amenity as experienced by tourists and local residents within the upstream communities study area is assessed as being of a moderate level of significance.

8.3.2.2 Enjoyment of native flora and fauna

The Upstream Biodiversity Assessment found that the Project's operational impact would result in increased temporary inundation effects (refer to Chapter 8 and Appendix F1 of the EIS for the latest version of the Biodiversity Impact Assessment). These impacts would involve changes to current temporary inundation extents, depths and durations, and rates of rising and receding flows resulting in potential impacts on biodiversity values in the upstream communities study area. Impacts on biodiversity values are caused by loss of vegetation with related potential impacts on species habitat, populations or ecological communities. Potential 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. Other potential impacts on biodiversity values include loss or fragmentation of native vegetation; degradation and changes to terrestrial habitats and associated fauna mortality.

The upstream biodiversity assessment (Chapter 8 and Appendix F1 of this EIS) provide a detailed assessment of each impact on biodiversity values. The upstream biodiversity study area comprises of approximately 5,280 hectares, broadly equating to the area between the existing dam FSL and the Project PMF flood level. An estimated 5,205 hectares of native vegetation within this study area would be subject to impacts of vegetation loss from ongoing direct changes to inundation; within the 1 in 100 chance in a year flood extent, about 2,860 hectares would potentially be affected. This may lead to fragmentation through the creation of discontinuities of the extent of vegetation communities. The Upstream Biodiversity Assessment found that within the 1 in 100 chance in a year flood extent, about 237 hectares of River Flat Eucalypt Forest (listed as an endangered ecological community (EEC) under the BC Act) and about 855 hectares of Box-Gum Woodland (listed as an EEC under both BC Act and EPBC Act) could be impacted. Loss of flora and fauna species and their habitats may occur in the upstream study area. Up to 5,280 hectares of suitable habitat for both threatened and non-threatened flora and fauna species could be impacted in the study area. The loss of native vegetation may lead to fragmentation and further reduced extent. Some resulting fauna mortality including both vertebrates and invertebrates would be expected. Direct fauna mortality would occur due to a major flood event, particularly if it occurred during breeding periods where juveniles may have limited ability to flee flood water and are sensitive to disturbance. The impacts on biodiversity values in the upstream communities study area are assessed as being significant.

As outlined in the SEIA baseline and engagement sections, the residents of the Blue Mountains highly value the opportunity to enjoy natural areas and the native flora and fauna. Many people choose to live in the Blue Mountains LGA for the opportunity to enjoy the natural environment and accordingly, all the respondents to the SEIA phone and web-based surveys from the LGA registered opposition or indifference to the Project due to perceived effects on native fauna and flora. There is a very large and active group of volunteers in the Blue Mountains who devote time and money to management of the environment. A key theme across responses to the SEIA surveys was concern as to the potential effect of the Project on species such as the regent honeyeater. As a result of the temporary inundation of habitat which supports endangered species, such as the regent honeyeater and subsequent changes to habitat, may result in further pressure being placed on vulnerable species. In terms of flora, the potential effect of the Project on the Camden white gum has been registered as a key concern by community and environmental advocacy groups. The ability to enjoy native flora and fauna may be affected by the loss or displacement of valued species due to alteration of habitat. Further displacement of native species may result from the increased proliferation of pest species such as pigs and lantana in areas affected by inundation.

In summary, the Project's operation has the potential to disrupt the enjoyment of native flora and fauna within the upstream communities study area due to increased temporary inundation effects. These impacts would involve changes to current temporary inundation extents, depths and durations, and rates of rising and receding flows, which could subsequently impact on biodiversity values. The residents of the Blue Mountains LGA highly value the opportunity to enjoy natural areas and the native flora and fauna, and following application of mitigation measures as outlined in Section 9, disruption to enjoyment of native flora and fauna as experienced by local residents and tourists is assessed as being of a moderate level of significance.

8.3.3 Community health and wellbeing

8.3.3.1 Health effects associated with heightened anxiety

The Project may generate health effects for members of the upstream communities study area. Members of the upstream communities study area have demonstrated deep opposition to the Project. For instance, respondents from the upstream communities study area to the SEIA surveys almost universally reported opposition to the Project on the basis that it would cause irreparable damage to important habitat for threatened flora and fauna and Aboriginal heritage.

Opposition to major projects, particularly when there would be environmental change and when people feel that events are occurring beyond their control, can cause stress and anxiety. Anxiety is the most common mental health condition in Australia and can have a pronounced effect on quality of life and day to functioning. It can manifest in mental health issues such as depression and be a trigger for substance abuse and family violence.

Members of the upstream communities have indicated that they feel highly concerned by the potential loss of World Heritage and environmental values. Members of the Aboriginal community feel threatened and anxious by the potential loss of cultural heritage. This may trigger further deeper feelings of disempowerment for Aboriginal peoples, associated with loss of access to and ability to manage their country. Prolonged anxiety regarding the potential effects of the Project could manifest in negative health outcomes. Following the application of mitigation measures as

outlined in Section 9, the potential effects associated with heightened anxiety as experienced by members of the upstream communities study area is assessed as being of a low level of significance.

8.3.4 Culture and heritage

8.3.4.1 Aboriginal heritage

A key concern raised by community and stakeholder interest groups is the impact which the Project would have upon Aboriginal cultural heritage. Aboriginal cultural heritage sites may hold important tangible and intangible values for members of the upstream communities study area.

The Project would lead to the temporary inundation of areas which have social, aesthetic, historical and archaeological significance. Upstream operational impacts would occur in the Lake Burragorang catchment and its tributaries, which include areas of national park, state conservation areas and the GBMWhA. The flooding impact zone has been defined as the extent of temporary inundation up to the PMF with the Project operating for flood mitigation. The water level of a PMF event would vary across the flooding impact zone depending on topography, hydrology and any effects of water backing up along tributaries. A PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Given the size of the upstream catchment, the likelihood of a PMF actually occurring is highly unlikely.

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

Aboriginal cultural heritage sites potentially impacted by the Project are defined as any site that falls within the PMF zone and experiences increased temporary inundation lasting from hours to around two weeks. A total of 207 sites were identified between the full supply level and Project PMF. Of these, 34 sites were identified between the existing and Project PMF. Submersion of a site can result in varying impacts depending on site type, for example:

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

Members of the Aboriginal community within the upstream communities study area may feel threatened and anxious by the potential loss of cultural heritage. This may trigger further deeper feelings of disempowerment for Aboriginal peoples associated with loss of access to and ability to manage their country.

In summary, the Project's operation would lead to the temporary inundation of areas which have social, aesthetic, historical and archaeological significance. Some 207 known sites would be affected by the Project, of which 173 sites are within the current PMF but may experience further inundation because of the Project. An additional 34 sites would also be affected between the existing and Project PMF. Following the application of mitigation measures as outlined in Section 9, changes to Aboriginal heritage values is assessed as being of a moderate level of significance for Aboriginal people and members of the broader community who value Aboriginal heritage.

8.3.4.2 Natural heritage

Changes to natural heritage values within the upstream communities study area has the potential to generate adverse effects on amenity and community values. As part of the EIS, a Non-Aboriginal cultural heritage assessment was completed by Artefact Heritage (refer to Chapter 17 of the EIS). With regard to the potential effects of the Project on heritage in the upstream communities study area, all non-Aboriginal heritage was either relocated or destroyed prior to the completion of Warragamba and the inundation of Lake Burragorang. Subsequently, heritage is limited to natural heritage.

The National Heritage List (NHL) was established under the EPBC Act and provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places. There are

two places within the upstream area on the NHL. This includes one listed place and one nominated place on the NHL. 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 or not has been made.

These items have been summarised in Table 8-7 below.

Table 8-7. National heritage places within the upstream study area

Name	Place ID	Class	Status	Address
The Greater Blue Mountains Area	105999	Natural	Listed Place	Greater Western Hwy, Katoomba NSW
The Greater Blue Mountains Area - Additional Values	105696	Natural	Nominated Place	Katoomba, NSW

The Convention Concerning the Protection of World Cultural and Natural Heritage 1972 (the Convention), also referred to as the World Heritage Convention, provides State Parties (that is, Countries) with guidance on how to identify potential sites for inscription on the World Heritage List, and what is required of each State Party in the protection and preservation of such sites. Signatories of the convention pledge to conserve world heritage sites situated on their territory, and to take active measures to protect their national heritage. The Convention aims to promote international cooperation to protect heritage that is of such outstanding universal value that its conservation is important for current and future generations. The Convention also sets out the criteria that a site must meet to be inscribed on the World Heritage List (WHL).

The convention sets out the criteria that a site must meet to be inscribed on the WHL and the role of State Parties in the protection and preservation of world and their own national heritage. Places on the WHL are protected in Australia through the EPBC Act.

The upstream communities study area is located within the curtilage of one place listed in the WHL as summarised in Table 8-8 below.

Table 8-8. World heritage places within the upstream study area

Name	Place ID	Status	Natural criteria	Cultural criteria	Address
The Greater Blue Mountains Area	105127	Declared property	ii, iv	-	Great Western Highway, Katoomba NSW

The GBMWhA covers approximately 1,030,000 hectares and is comprised of eight adjacent conservation protected areas – Blue Mountains, Nattai, Gardens of Stone, Thirlmere Lakes, Wollemi, Kanangra-Boyd, and Yengo National Parks, and the Jenolan Karst Conservation Reserve. It contains the largest integrated system of protected areas in NSW, providing outstanding opportunities for the conservation of natural communities and processes. The area was inscribed onto the World Heritage List in 2000. The value of the GBMWhA includes:

- outstanding examples of ongoing ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt dominated ecosystems
- significant natural habitats for the in-situ conservation of biological diversity, including the eucalypts and eucalypt dominated communities, taxa with Gondwanan affinities, and taxa of conservation significance.

As part of the EIS, a world heritage assessment for the Project has been undertaken (refer to Appendix J of the EIS). The outcome of world heritage assessment shows that the Greater Blue Mountains Area (WHL Place ID 105127 and NHL Place ID 105999) would be impacted in areas upstream of the dam wall that are within the potential inundation levels. These within the item's curtilage would be directly impacted by the retention of flood waters at an increased level in areas over an extended period. A larger portion of The Greater Blue Mountains Area - Additional Values (NHL Place ID 105696) listing would also be impacted by the raised dam levels. This is due to the curtilage extending down to the current FSL around Lake Burragorang.

Changes to natural heritage values within the upstream communities study area may diminish enjoyment of the surrounding environment for some stakeholders. Following the application of mitigation measures as outlined in Section 9, changes to natural heritage values as experienced by members of the upstream communities study area is assessed as being of a moderate level of significance.

8.3.5 Way of life

8.3.5.1 Community cohesion

The residents of the Blue Mountains highly value the environmental and cultural attributes of the area in which they live. There has been considerable opposition registered against the Project on the basis of potential environmental and cultural effects. The most prominent concerns raised related to potential impacts on environmental values and subsequent impacts on endangered and valued flora and fauna (19 percent of all issues registered) and Aboriginal cultural heritage (18 percent of all issues raised).

A key factor influencing community satisfaction with development outcomes is whether they feel they are able to participate in decision-making processes. If the Project were to proceed, those who hold strong environmental and cultural values may feel powerless, disenfranchised, and lacking capacity to influence decisions that affect them. People may feel as though their ability to enjoy their (environmental and cultural) 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 both 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. There was almost universal opposition to the Project (which can also have a positive effect on community capacity and involvement) in the Blue Mountains LGA, while in other study areas, such as in the downstream communities study area, many stakeholders were undecided regarding whether they supported or opposed to the Project. Fracturing of public opinion can have a negative effect on community relationships and networks and resultant erosion of community cohesion.

8.3.6 Impact assessment summary – upstream communities

Table 8-9 summarises the socio-economic impacts discussed in Section 8.3 and assesses their significance rating as per the impact assessment methodology outlined in Section 4.5 for the Project's upstream communities study area.

Table 8-9. Summary of socio-economic impacts and their significance rating for the Project's upstream community study areas

No.	Impact	Positive/ negative	Description	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	The upstream community has voiced a high level of concern as to the effects of the Project on World Heritage listed area. Whilst the additional total area estimated to be temporarily inundated is relatively small (an increase of 0.06% of the total area), there are concerns that the loss of any World Heritage listed areas erodes the value which such a status provides.	Upstream communities, broader community, and environmental advocacy groups	Likely	Moderate	B3- High
2	Operation -Community concern regarding effects on National Parks	Negative	The upstream community has voiced concern regarding the effects on environmental conservation and protection values caused by temporary inundation of areas of National Parks around Lake Burragorang.	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	Whilst 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 (same owner) which would be temporarily affected by inundation in the event of with-holding 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.	Affected property owners	Almost Certain	Minor	A2-High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
4	Operation - Changed access to properties at Yerranderie	Negative	The temporary storage of flood waters 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.	Yerranderie residents living along access routes	Unlikely	Minor	D2-Low
Environment							
5	Operation -Alteration to upstream iconic viewsheds	Negative	Concerns were raised by community stakeholders that views from lookouts such as Echo Point and Burragorang may be negatively affected. Views of Lake Burragorang from helicopter tours and other air borne travel may also be negatively affected.	Tourists and locals	Unlikely	Major	D4- High
6	Operation -Alterations to viewpoints from walking, mountain bike and 4WD trails	Negative	There are popular walking, mountain bike and 4WD trails throughout the area surrounding Lake Burragorang with some passing close to areas which would be temporarily inundated. Viewpoints from such trails may be affected.	Tourists, locals, pedestrians, and cyclists	Rare	Minor	E2 - Low

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
7	Operation -Disruption to enjoyment of native flora and fauna	Negative	The Project's operational impact would result in increased temporary inundation effects. 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 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 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 and changes to terrestrial habitats and associated fauna mortality. The residents of the Blue Mountains LGA 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.	Upstream communities, tourists, and environmental conservation community groups	Likely	Moderate	B3-High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
Community health and wellbeing							
8	Operation - Health effects associated with heightened anxiety	Negative	Members of the upstream community have demonstrated deep 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 threatened and anxious by the loss of World Heritage and environmental values. In particular, members of the Aboriginal community feel threatened and anxious 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 country.	Upstream communities and members of environmental advocacy groups	Unlikely	Moderate	D3- Moderate
Culture and heritage							
9	Operation – Effects on Aboriginal cultural heritage	Negative	The Project’s operation would lead to the temporary inundation of areas which have social, aesthetic, historical and archaeological significance. The Project would generate effects on Aboriginal cultural heritage and as such, lead to a high negative impact for Aboriginal people and members of the broader community who value Aboriginal heritage through potential loss of cultural heritage.	Aboriginal people and members of the broader community who value Aboriginal heritage	Likely	Moderate	B3- High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
10	Operation – Effects on natural heritage	Negative	The National Heritage List was established under the EPBC Act 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. This includes one listed place and one nominated place on the NHL. 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.	Upstream communities and environmental advocacy groups	Possible	Moderate	C3- High
Way of life							
11	Operation- Reduced tourism visitation due to perceived environmental impacts	Negative	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 tourists' numbers would affect a broad array of tourism related businesses with potential flow effects to other businesses.	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 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.	Nature-based recreation businesses	Unlikely	Moderate	D3- Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
13	Operation- Diminished enjoyment of community values	Negative	The residents of the Blue Mountains LGA 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.	Members of environmental advocacy groups and locals	Possible	Moderate	C3- High
14	Operation- Polarisation of community sentiment resulting in reduced community cohesion	Negative	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. It 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. In the Blue Mountains area there was almost universal opposition to the Project (which can also have a positive effect on community capacity and involvement). Fracturing of public opinion can have a negative effect on community relationships and networks and resultant erosion of community cohesion.	The Blue Mountains communities	Possible	Moderate	C3- High

8.4 Downstream communities

8.4.1 Property and land use

8.4.1.1 Property affected by flooding

The Project would indirectly affect property and land use downstream of Warragamba Dam by reducing flood extents, durations and depths, potentially reducing the number of properties inundated by flooding and subsequently reduce the risk of damage and loss of life. Outlined below is a summary of predicted land use vulnerability to floods in different locations across the downstream communities study area. This analysis is based on the best information available at the time of preparing the SEIA.

Modelling of flood affected property and land use completed by INSW as part of the *Hawkesbury- Nepean Valley Flood Risk Management Strategy 2016-2036 (Infrastructure NSW 2017)* and the *Hawkesbury-Nepean Valley Regional Flood Study* (WMAwater 2019) has informed inundation effects for various flood scenarios ranging from 1 in 5 chance in a year event to PMF. Note that investigation of flooding characteristics upstream and downstream of Warragamba Dam is ongoing and may result in minor changes to the specific number of properties affected under various flooding scenarios. Flooding effects have been predicted for the following key land uses:

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

Flood effects were modelled as per current state and compared against the 'with Project' scenario. Outlined below is a summary of predicted effects across each of the LGAs of the downstream study area.

Liverpool LGA

Most of the land area affected by flood events in the Liverpool LGA is zoned for rural activities. The only suburb in which residential lots would be affected is in Wallacia. In a 1 in 100 chance in a year event, flooding at Wallacia would be generally confined to a 7.5-kilometre section of the Nepean River, typically either side of the river channel with minor backwater flooding of tributaries to the east of the river. Generally, the Wallacia town centre would not be affected by flooding; however, all connecting roads would be flooded. The whole township of Wallacia would be inundated under a PMF event and there would be considerable flood damage. Modelling indicates that the area around Wallacia flooded in a PMF would be approximately double that flooded in the 1 in 100 chance in a year event.

In the Liverpool LGA there are currently no residential properties affected by smaller flood events (1 in 50 chance in a year and smaller) and less 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 percent.

With regard to the extent of land supporting rural activities in the Liverpool LGA which is vulnerable to flooding, it is predicted that for a 1 in 100 chance in a year event there would be 310 hectares 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. There are less than 20 commercial and industrial properties predicted to be affected by flooding in a PMF event. 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.

Penrith LGA

Areas within the Penrith LGA which are potentially threatened by flooding include the suburbs of 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. The combined (2016) population of these suburbs was 124,409 people, with Glenmore Park being the most populous (23,004 people), followed by Cranebrook (15,759 people and Penrith (13,295 people).

A summary of residential property vulnerability to flooding in the Penrith LGA- current state and with the Project is provided in Table 8-10.

Table 8-10. Residential property (approximate numbers) affected by flooding in Penrith LGA - existing and with Project

Flood size	Existing risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total*	Residential property	Manufactured homes	Total*	Numerical change	Percentage change (%)
1 in 5	0	0	0	0	0	0	0	—
1 in 10	10	0	10	<10	0	<10	Approx. <10	Approx. 100
1 in 20	70	<10	100	<10	<10	<10	Approx. 70	Approx. 90
1 in 50	240	30	300	10	30	50	250	83
1 in 100	1,700	40	1,750	40	30	70	1,650	95
1 in 200	2,500	70	2,600	110	30	150	2,450	94
1 in 500	5,600	80	5,700	390	40	400	5,300	93
1 in 1,000	7,200	150	7,350	2,500	70	2,600	4,750	65
1 in 2,000	8,800	170	9,000	5,900	80	6,000	3,000	33
1 in 5,000	10,100	170	10,250	7,900	170	8,100	2,150	21
PMF	14,000	170	14,200	12,500	170	12,700	1,500	11

* Note that these numbers have been rounded reflecting that they are approximate estimates only

In the 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 less 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 40 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.

With regard to commercial and industrial properties vulnerable to flooding in the Penrith LGA, for a 1 in 100 chance in a year event it is estimated that 70 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

During significant rainfall events, flows in the Hawkesbury-Nepean River results in back water flooding along South Creek into areas within the Blacktown LGA (Figure 8-9).

Figure 8-9 Inundation at South Creek backwater during February 2020 flooding event



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

The areas within the Blacktown LGA which are potentially threatened by flooding are the suburbs of Colebee, Dean Park, Doonside, Glendenning, Marsden Park, Quakers Hill, Riverstone, Ropes Crossing, Schofields and Shanes Park. The combined (2016) population of these suburbs was 70,636 people, with Quakers Hill being the most populous (27,080 people), followed by Doonside (13,451 people). Modelling indicates that the suburbs of Marsden Park, Riverstone, and Schofields are the most vulnerable to flooding of residential areas.

A summary of residential property vulnerability to flooding in the Blacktown LGA- current state and with the Project is provided in Table 8-11.

Table 8-11. Residential property (approximate numbers) affected by flooding in Blacktown LGA - existing and with Project

Flood Size	Existing Risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total*	Residential property	Manufactured homes	Total*	Numerical change	Percentage change (%)
1 in 5	<10	0	<10	<10	0	<10	<10	Approx. 100
1 in 10	<10	0	<10	<10	0	<10	<10	Approx. 90
1 in 20	40	0	50	<10	0	<10	<40	Approx. 90
1 in 50	260	0	250	<10	0	<10	<260	Approx. 100
1 in 100	370	0	400	30	0	50	350	88
1 in 200	520	0	500	90	0	100	400	80
1 in 500	760	0	750	320	0	300	450	60
1 in 1,000	1,400	0	1,050	470	0	450	600	57
1 in 2,000	1,298	0	1,300	700	0	700	600	46
1 in 5,000	1,600	0	1,600	1,010	0	1,000	600	36
PMF	4,700	0	4,700	3,100	0	3,100	1,600	34

* Note that these numbers have been rounded reflecting that they are approximate estimates only

In the 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 500 chance in a year event, a large number of residential properties (760) 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 60 percent to 300 properties in total.

In terms of land supporting rural activities, an estimated 790 hectares 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. With regard to commercial and industrial properties, it is estimated that for a 1 in 100 chance in a year event there would currently be 50 properties affected. Under a 'with Project' scenario, this number would reduce to less than 10 properties.

Hawkesbury LGA

The areas within the Hawkesbury LGA which are potentially threatened by flooding include the suburbs of Blaxland 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. During significant rainfall events, flows from the Warragamba catchment can cause the Hawkesbury River to break its banks, causing major flooding throughout the Hawkesbury LGA. Key suburbs in the Hawkesbury LGA which are most vulnerable to the effects of flooding are McGraths Hill, North Richmond, Pitt Town, Richmond, South Windsor, Wilberforce, Windsor, and Windsor Downs. The combined (2016) population of these suburbs was 53,310 people, with Bligh Park being the most populous (6,366 people), followed by South Windsor (5,892 people).

A summary of residential property vulnerability to flooding in the Hawkesbury LGA- current state and with the Project is provided in Table 8-12.

Table 8-12. Residential property (approximate numbers) affected by flooding in Hawkesbury LGA - existing and with Project

Flood Size	Existing Risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total*	Residential property	Manufactured homes	Total*	Numerical change	Percentage change (%)
1 in 5	70	160	250	30	10	50	200	80
1 in 10	220	430	650	70	120	200	450	70
1 in 20	740	520	1,300	150	390	550	720	58
1 in 50	2,400	580	3,000	280	480	750	2,200	75
1 in 100	3,500	610	4,200	530	540	1,100	3,100	74
1 in 200	4,800	610	5,400	1,400	580	2,000	3,400	63
1 in 500	6,900	610	7,500	3,200	590	3,800	3,700	49
1 in 1,000	9,000	610	9,600	4,400	610	5,000	4,600	48
1 in 2,000	11,000	610	11,600	6,300	610	6,900	4,700	41
1 in 5,000	12,100	610	12,700	8,800	610	9,400	3,300	26
PMF	15,200	620	15,800	14,500	610	15,100	700	4

** Note that these numbers have been rounded reflecting that they are approximate estimates only*

Data on flood affected property and land use in the Hawkesbury LGA indicates that there are residential areas in the Hawkesbury LGA which are highly vulnerable to flooding. For a 1 in 10 chance in a year event there are currently an estimated 220 residential properties and 430 manufactured homes affected by flooding. Under the 'with Project' scenario there would be an estimated 70 percent reduction in the number of properties affected with the number of manufactured homes affected reducing to 120 in total.

In a 1 in 100 chance in a year event, apart from a very small area, all of Wilberforce, Windsor and McGraths Hill would be flooded. The main town centre of Richmond and North Richmond would remain flood free; however, the fringe areas of both towns may experience some flooding. North Richmond is likely to be isolated as The Bells Line of Road to the north of town would be inundated and the Richmond Bridge over the Hawkesbury River and Kurrajong Road completely submerged. 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.

The Hawkesbury LGA is a key rural production area. Outlined in Table 8-13 is a summary of rural activity lands vulnerability to flooding in the Hawkesbury LGA- current state and with the Project

Of property in the Hawkesbury LGA supporting rural activities, it is predicted that 3,810 hectares 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 total 2,080 hectares. The effect of the Project in terms of 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, whilst for a PMF the effect of the Project is only a 2 percent reduction.

With regard to commercial and industrial property in the Hawkesbury LGA, it is estimated that currently 820 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.

Table 8-13. Rural activity property (hectares) affected by flooding in Hawkesbury LGA - existing and 'with Project'

Flood Size	Existing Risk (2018)	With Project	Change between 'existing' and 'with Project'	
	Area of 'rural activities' affected by flooding (ha)	Area of 'rural activities' affected by flooding (ha)	Area of 'rural activities' affected by flooding	
			Area change (ha)	Percentage change (%)
1 in 5	3,810	2,080	1,770	46
1 in 10	4,900	3,200	1,700	35
1 in 20	5,450	4,080	1,370	25
1 in 50	6,020	4,890	1,130	19
1 in 100	6,280	5,310	970	15
1 in 200	6,500	5,690	810	12
1 in 500	6,690	6,180	510	8
1 in 1,000	6,830	6,500	330	5
1 in 2,000	7,040	6,650	390	6
1 in 5,000	7,250	6,820	430	6
PMF	7,810	7,620	190	2

The Hills LGA

The areas within the Hills LGA which are potentially threatened by flooding are in the suburbs of Cattai, Glenorie, Leets Vale, Maroota, Sackville North, South Maroota and Wisemans Ferry. These suburbs are relatively sparsely populated and predominately comprise land zoned for agricultural and environmental conservation uses. During significant rainfall events, flooding impacts are most significant in Cattai, South Maroota and Wisemans Ferry. Cattai and South Maroota experience flooding due to the constriction of flood flows at the Sackville Gorge and Wiseman Ferry experiences flooding due to the opening of the gorge and sharp bend in the river.

A summary of residential property vulnerability to flooding in The Hills y LGA- current state and with the Project is provided in Table 8-14.

Table 8-14. Residential property (approximate numbers) affected by flooding in The Hills LGA - existing and 'with Project

Flood Size	Existing risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total*	Residential property	Manufactured homes	Total*	Numerical change	Percentage change (%)
1 in 5	<10	270	250	<10	120	100	150	60
1 in 10	30	670	700	10	380	400	300	43
1 in 20	50	850	900	20	650	700	200	22
1 in 50	90	910	1,000	50	870	900	100	10
1 in 100	100	920	1,050	60	900	1,000	50	5
1 in 200	120	920	1,050	80	910	1,000	50	5
1 in 500	150	930	1,100	110	920	1,050	50	4
1 in 1,000	170	930	1,100	130	930	1,050	50	5
1 in 2,000	190	940	1,150	150	930	1,100	50	4
1 in 5,000	210	940	1,150	170	930	1,100	50	4
PMF	390	940	1,350	260	940	1,200	150	11

* Note that these numbers have been rounded reflecting that they are approximate estimates only

In 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. In terms of land for rural activities, it is predicted that 144 hectares of land affected by a 1 in 5 chance in a year event and 172 hectares 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.

Overview of Hawkesbury-Nepean Floodplain

Overall, the Project would result in a reduction in the impacts of flooding within the downstream communities study area. Table 8-15 presents the modelled flood effects on residential properties as per current state and compared against the 'with Project' scenario.

Table 8-15 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 8-16 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 8-16 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 per cent to 1,700 manufactured homes.

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.

Flood related land use controls

A complex system of land use planning controls set and administer land use, with flood risk being a key consideration in determining permissible land use and development (refer to Table 6-26 in Section 6.4.2.1). Control over local development outcomes is generally administered by local government authorities (NSW Government 2005). This is through the LGA's Local Environment Plan (LEP) with further detailed controls implemented through Development Control Plans (DCPs). The overarching policy context for floodplain development is provided by the NSW Government through the NSW Flood Prone Land Policy contained in the Floodplain Development Manual. In combination, the Policy and Manual set the framework within which each local government establishes and administers flood planning controls.

Local councils have primary responsibility for flood risk management in NSW. With eight LGAs covering the Hawkesbury-Nepean Valley, achieving a coordinated and strategic management of flood risk holistically across the region is difficult. Summarised in Table 8-17 are current approaches to flood risk management in the various LEPs.

Table 8-17. Flood provisions in LEPs relevant to the study area

LEP	Flood planning clause	Land to which flood planning clause applies	Additional clause*	Flood map with LEP
Blacktown LEP 2015	✓	At or below 1:100 ARI + 0.5m freeboard OR highest historical flood event (1867)	x	x
Gosford LEP 2014	✓	At or below FPL as defined by FDM	✓	x
Hawkesbury LEP 2012	✓	At or below 1:100 ARI	x	x
Hornsby LEP 2013	✓	At or below 1:100 ARI + 0.5m freeboard OR identified as 'flood planning area' on flood planning map	x	✓
Liverpool LEP 2008	✓	At or below FPL as defined by FDM	✓	x
Penrith LEP 2010	✓	At or below 1:100 ARI + 0.5m freeboard OR identified as 'flood planning land' on clause application map	x	✓
The Hills LEP 2012	✓	At or below 1:100 ARI + 0.5m freeboard	x	x
Wollondilly LEP 2011	✓	At or below 1:100 ARI + 0.5m freeboard	x	x

* Additional clause for land between flood planning level and PMF.

Despite Standard Instrument LEP Provisions and model clauses, the identified differences from this brief comparison of LEP clauses highlights the need for a more coordinated approach to the management of flood risk in land use planning in the Hawkesbury-Nepean Valley. This has been recognised in numerous reports:

- Hawkesbury-Nepean Valley Flood Management Strategy – Land Use Planning and Development Control Measures (Don Fox Planning and Bewsher Consulting 1997)
- Designing Safer Subdivisions – Guidance on Subdivision Design in Flood Prone Areas (Hawkesbury-Nepean Floodplain Management Strategy Steering Committee 2006)
- Hawkesbury Floodplain Risk Management Study and Plan (Bewsher Consulting 2012).

Although the need has been long identified, policies to manage growth in the floodplain have had limited effectiveness to date, with an increase in the number of dwellings within the PMF floodplain from 16,000 in 1997 to 29,000 in 2016.

The Hawkesbury-Nepean Valley Flood Management Review (2014) identified poor integration between state-level policies for land use planning, road planning, and emergency and recovery planning in relation to flooding. This resulted in inconsistent approaches to the way flood risks were incorporated into land use planning between various jurisdictions. The 2007 'Guideline on development controls on low risk flood areas – Floodplain Development Manual' (NSW Department of Planning 2007) was identified as an issue, since it made it more difficult for councils to apply development controls for residential development on land above the 1 in 100 chance in a year event (plus freeboard).

In response to the identified issues, the 2014 Review recommended the improved land use planning policies and practices for flood prone land. The 2014 Review also recommended improved land use planning tools for managing flood prone land. Such a tool – Flood Information to Support Land-use Planning – has since been prepared under the auspices of the Australian Institute for Disaster Resilience. The 2014 Review also recommended a regional approach to development to manage the cumulative effect of evacuation constraints and planning.

Under the current land use planning system, the 1 in 100 chance in a year event is the default planning level for local councils to set flood planning controls for residential development, unless they apply for and receive approval to impose more stringent flood controls under 'exceptional circumstances'.

If Warragamba Dam wall were to be raised as described by the Project description, the downstream flood water level corresponding to the 1 in 100 chance in a year event would change. For instance, the Project would result in the probability of a flood at Windsor reaching 17.3 metres, changing from 1 in 100 chance in a year event to around 1 in 600 chance in a year event. This would mean that more land currently subject to flood planning controls could be free of flood planning controls, under current policy. This would, however, undermine the flood mitigation benefits of the dam raising: all the risk to life and economic damage assessment is predicated on the current 1 in 100 chance in a year event continuing to control residential development after the Dam is raised. However, the NSW government has categorically stated that the proposed dam raising would not lead to any further development beyond what is already permitted.

The Hawkesbury-Nepean Valley Flood Risk Management Strategy recommended that a suitable planning instrument such as State Environmental Planning Policy (SEPP) be prepared to ensure that flood-related controls continue to apply over the same area to which they currently apply. The SEPP would directly amend the relevant local council Local Environmental Plans to include maps showing the flood planning area that is to be maintained. This may be supported by a direction under s9.1 of the *Environmental Planning & Assessment Act 1979* to prohibit councils subsequently amending the flood planning area.

The NSW Government has clearly stated that the proposed dam raising would not lead to any further development beyond what is already permitted. Ultimately, the effectiveness of the flood planning system will be reliant upon collaboration and coordination between State driven policy and local government implementation. Whilst Hawkesbury-Nepean Valley Flood Management Taskforce and Hawkesbury-Nepean Valley Flood Risk Management Strategy has done much to initiate the basis for a strategic and coordinated flood planning system, there remain many elements which need to come together. Furthermore, history has shown that the longevity and effectiveness of such strategic and integrated planning initiatives are heavily reliant upon the allocation of resourcing in accordance with the priorities of the government of the day.

Inhibited access to property

Whilst the Project would reduce the frequency, extent and severity of flood events, the release of water from the FMZ would lead to more prolonged (lower level) flood conditions. As a result, access to property may be inhibited for a longer period. For example, in the 1 in 100 chance in a year 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.

The constant rate of discharge of about 100 GL/day would result in higher downstream water levels in the river to Wisemans Ferry. Downstream of Wisemans Ferry, the impact of the FMZ discharge on water levels decreases substantially as the river widens and tidal processes become more dominant. Generally, the flows would be confined 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 FMZs. River crossings that would be affected the most include Yarramundi Bridge, Cattai Road bridge over Cattai Creek and the Sackville car ferry.

In summary, the Project's operation has the potential to positively impact on property owners through reduction in the effects of flooding, including reduction in the number of properties inundated by flood events. Properties in

Liverpool LGA may experience a high positive impact while properties in the LGAs of Penrith, Blacktown, Hawkesbury, and The Hills may experience an extreme positive impact.

On the other hand, the Project's operation may increase duration of inhibited access to (and from) property due to longer flood duration associated with discharge of the FMZ across the downstream communities study area, potentially affecting access to some properties for a longer period. Following the application of mitigation measures as outlined in Section 9, changes to property access for affected property owners is assessed as being of a moderate level of significance.

8.4.2 Environment

8.4.2.1 Landscape character and visual amenity

The Project may generate changes to landscape character and visual amenity for communities located within the downstream communities study area through a reduction in flood events. The landscape character and visual assessment as part of the EIS identified the downstream landscape character zone of the Warragamba Dam (refer to Chapter 25 and Appendix P of the EIS). This included the freshwater and estuarine reaches of the Hawkesbury-Nepean valley river system and its tributaries between Warragamba Dam where it joins the Nepean River near Wallacia (not including the reach of Nepean River upstream of Wallacia) and Wisemans Ferry as well as the abutting riparian zone, floodplain and wetland/lagoon waterbodies. The downstream areas are likely to experience a reduction in flood extents (and flows) and reduced flood related damages and consequently, the Project could be interpreted as having positive visual impact.

Three viewpoints were selected and assessed in the downstream landscape character zone – Penrith Weir, Richmond Bridge and Windsor Bridge. These viewpoints were identified as having close range views of the downstream operational area when in flood and thus experience potential visual impacts resulting from the Project.

Penrith Weir is located approximately 22 kilometres downstream of Warragamba Dam on the banks of the Nepean River. This viewpoint has expansive views dominated by the pooled water of the Nepean River and the weir structure in the foreground with an impressive metal bridge. At this location, it is expected that during a flood event, the extent of inundation would be reduced; but it is still likely that recreational areas and the floodplains of Penrith, Emu Plains, Richmond, and Windsor would continue to see some inundation. During the reduced flood events, it is still expected that there would be vegetation losses and surface scouring within the flood zones which over time might be recolonised with other vegetation and it is expected that damages would substantially increase during major events. Therefore, it is observed that after the dam wall raising, there would be a reduction in the possible visual impact of flood levels. This viewpoint 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. The landscape character and visual assessment assigned a moderate and low levels of magnitude as a result of PMF and 1 in 20 chance in a year event respectively. The subsequent impact on visual amenity was assessed as moderate in 1 in 20 chance event and high-moderate in PMF event.

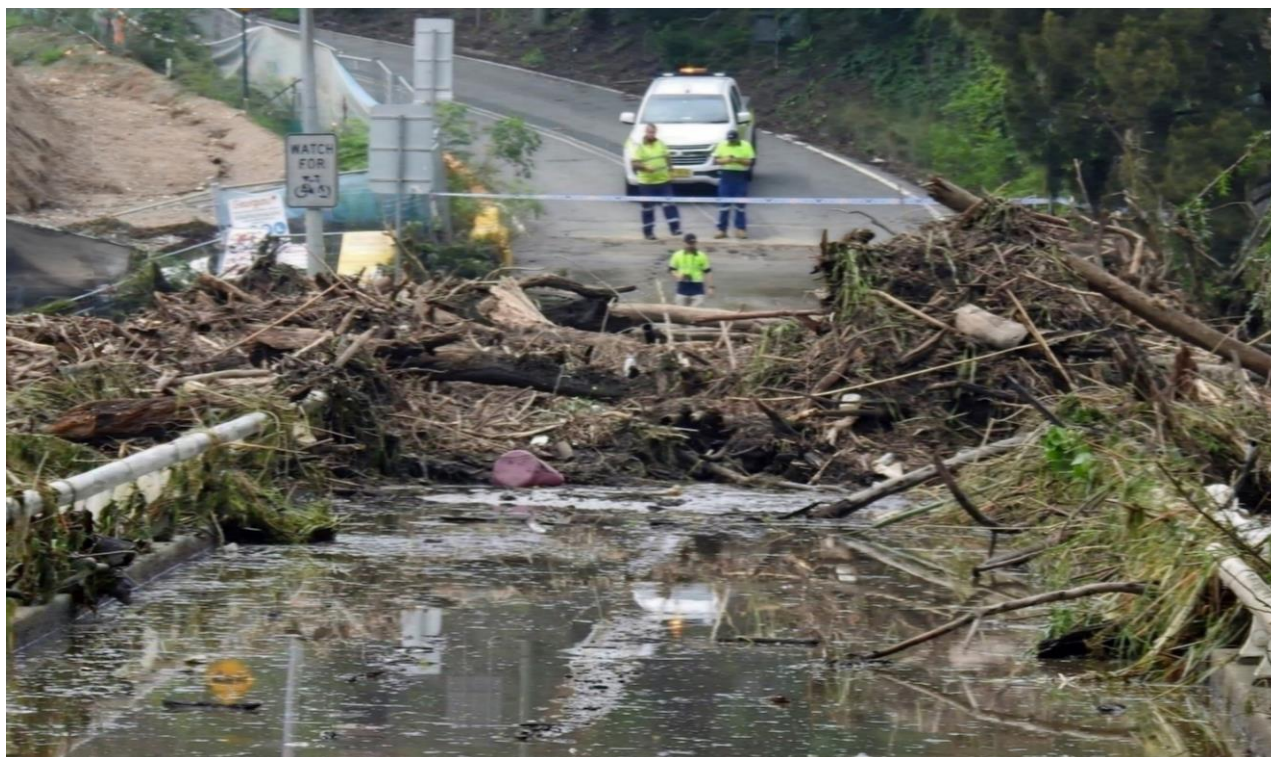
Richmond Bridge is located approximately 44 kilometres downstream of the Warragamba Dam Visitor Centre. The viewpoint has expansive views through simple pedestrian safety fences out across the Hawkesbury River to the densely vegetated woodland and forested banks. At this location, it is expected that during a flood event, the extent of inundation would be reduced; but it is still likely that recreational areas and the floodplains between the eastern bank of the Hawkesbury River at Richmond Bridge and the township of Richmond would continue to see some inundation. During the reduced flood events, it is still expected that there would be vegetation losses and surface scouring within the flood zones which over time might be recolonised with other vegetation and it is expected that damages would substantially increase during major events. Hydraulic modelling has indicated that after the Dam wall raising, there would be a reduction in the possible visual impact of flood levels. This view point 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. The landscape character and visual assessment assigned a low level of magnitude of impact as a result of 1 in 20 chance in a year event and moderate level of magnitude of impact in PMF event. In the landscape and visual assessment, the visual impact was assessed as moderate in 1 in 20 chance in a year event and as high-moderate in a PMF event.

Windsor Bridge is located approximately 60 kilometres downstream of the Warragamba Dam Visitor Centre. The viewpoint comprises views across simple pedestrian safety fences out towards steep river banks. Although the area is characterised by a wide flat floodplains of mostly pasture grasses, at this location, the township of Windsor sits above a ridge on the southern river bank. Trees associated with parks and open spaces mostly screen views of the town. At

this location, minor flood events (1 in 5 chance in a year flood) would have an impact on the recreational areas directly abutting the waterway. However, during major flood events (PMF), there would be a substantially higher degree of flooding out across the floodplain and even into the township of Windsor, inundating large floodplains between the eastern bank of the Hawkesbury River at Windsor Bridge and the township of Windsor. During minor flood events, there would be vegetation losses and surface scouring within the flood zones which over time might be re-colonised with other vegetation and it is expected that such damage would substantially increase during major events. It should be observed that after the dam wall raising, there would be a reduction in the possible visual impact of current flood levels. This view point was rated as having high sensitivity and again, the Landscape Character and Visual Assessment assigned a moderate level of magnitude of impact. The visual impact at this view point was assessed as moderate in 1 in 20 chance in a year event and as high-moderate in PMF event.

These three sites are representative of the potential impact on visual amenity along the Hawkesbury-Nepean River. Whilst 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 will temporarily disturb viewsheds. As a result of the Project, there would be reduced frequency in which 'flood events' are experienced in downstream areas. By withholding peak flood waters, 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 (Figure 8-10). Reducing flood flow and extent would reduce the flood damage and consequently the Project would reduce visual impacts.

Figure 8-10 Debris on bridge due to February 2020 flood event



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

Changes to landscape character and visual amenity is likely to result in diminished enjoyment of viewsheds for tourists and members of the downstream communities study area. This may result in reduced tourism and commercial opportunities for local businesses.

In summary, the Project's operation has the potential to lead to alterations in visual amenity associated with release of the FMZ within the downstream communities study area. Penrith Weir, Richmond Bridge and Windsor Bridge are considered to have high levels of sensitivity due to locals and tourists regularly visiting the viewpoints. While the Project is not expected to impact access to these sites, changes to the viewshed from an extended duration of elevated flood waters may temporarily disturb views and therefore temporarily impact visual amenity for tourists and

members of the downstream communities study area. Following the application of mitigation measures as outlined in Section 9, changes to landscape character and visual amenity for these stakeholder groups is assessed as being of a moderate level of significance.

On the other hand, the Project has the potential to generate a high positive impact for tourists and members of the downstream communities study area through a reduced frequency in which 'flood events' are experienced in the downstream communities study area. The reduced frequency of flood events has the potential to positively affect visual amenity as areas that would currently be flooded, would avoid being flooded with the Project.

8.4.2.2 Enjoyment of natural surroundings

Across the Hawkesbury-Nepean 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.

As the Project would result in minor changes to the rates of flow and flood regime, some stakeholders have raised concerns that there may be subsequent effects on flora and fauna downstream- particularly in natural areas located adjacent to or close to the Hawkesbury-Nepean River. As part of the Warragamba EIS, impacts on biodiversity values within the downstream operational area of the Project have been assessed (refer to Chapter 9 and Appendix F2 of the EIS in regard to Downstream Biodiversity Assessment). Based on this assessment, the Project would have four different effects on the downstream hydrological regimes:

- A reduction in peak flood extents and durations and a reduction in peak flood flow.
- An increase in low level flooding and flows during the discharge of the FMZ.
- An increase in dry weather flows and variability due to environmental flow releases.
- Improved environmental flows that would mimic the natural variability of flows.

The alternation of natural flow regimes of rivers, streams and their associated floodplains is documented in the Downstream Biodiversity Assessment as a key factor contributing to the loss of biological diversity and ecological function in the aquatic and terrestrial ecosystem. The Assessment notes that within the downstream communities study area, the Project would result in a decrease in the extent, frequency and variability of downstream flooding. Further, some floodplain areas would be affected by the discharge of the FMZ and would be inundated for longer. This may negatively impact on biodiversity values in the downstream area. The Assessment shows that there would be impacts on plant community types (PCTs), impacts on threatened flora and fauna species and other potential impacts (such as potential loss of fringe wetlands due to reduced flooding, increase in weeds, feral animals and overabundant native species, effect on groundwater dependent ecosystems, minor impacts on flooding changes to national parks, with Scheyville and Cattai National Parks being the most affected.

With regard to impacts on the PCTs, the outcomes of the downstream biodiversity assessment are as follows:

- 1,042 hectares of PCTs would no longer be flooded during the 1 in 10 chance in a year event. However, most of this area would continue to be flooded during the 1 in 20 chance in a year event.
- 1,883 hectares of PCTs would experience minor increased inundation due to the discharge of FMZ.
- 90 percent of the area of PCTs that would experience increased inundation are flood-tolerant and include:
 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion or Forest Red Gum
 - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain Sydney Basin Bioregion.

Regarding impacts on threatened flora and fauna species, there would be potential impacts on 56 threatened flora species, populations, and their habitats, and 54 threatened fauna species due to: erosion, deposition, inundation, changes to fire regime, spread of pathogen, spread of weeds and exotic species, and changing access to groundwater.

There are thirteen national park estates within the downstream communities study area including Mulgoa Nature Reserve, Yellomundee Regional Park, Windsor Downs Nature Reserve, Scheyville National Park, and Cattai National Park. For most national park areas, the change in flooding extents is very minor. Scheyville National Park and Cattai National Park would experience the greatest reductions in flooding extents. The reduction of flood frequency and inundation area could be beneficial for the conservation of key natural heritage areas; both these National Parks would experience longer duration of low-level flooding due to the discharge of water from the FMZ.

Throughout the Hawkesbury floodplain, there are numerous popular swimming spots including Yarramundi Reserve, Upper Colo Reserve and Navua Reserve. The discharge of temporarily stored inflows from the FMZ following a large

flood event would result in such locations experiencing a flood condition for a more prolonged period. This would prevent their use for swimming and recreational activities for a more prolonged period following a flood event.

In summary, the Project's operation has the potential to disrupt enjoyment of natural areas and the flora and fauna for members and tourists of the downstream communities study area. For example, following some major flood events, access to some popular natural park destinations, such as Bents Basin and Wianamatta Regional Park, is likely to be restricted due to the release of temporarily stored waters from the FMZ. Reduced access to these areas has the potential to impact on recreational and environmental values held by those who enjoy the natural surroundings of the area, including by undertaking nature-based activities such as fishing and birdwatching. Following the application of mitigation measures as outlined in Section 9, changes to enjoyment of natural surroundings as experienced by members and tourists of the downstream communities study area is assessed as being of a low level of significance.

8.4.3 Community health and wellbeing

8.4.3.1 Community safety

Flood risk

Flood events present a significant risk to community safety on the Hawkesbury-Nepean Valley, with both historical and geological evidence of rapid widespread flooding across the Hawkesbury-Nepean Valley. The Insurance Council of Australia considers that the Hawkesbury-Nepean Valley presents the highest single flood exposure in NSW, if not Australia (Hawkesbury-Nepean Valley Flood Risk Management Strategy 2017).

Exacerbating the risk to human life posed by flooding is the unique topography of the floodplain which combines a large upstream catchment with narrow downstream sandstone gorges. As a result, inflows back up and rise rapidly, causing significant flooding both in terms of areas and depth. This is unusual as most coastal river valleys tend to widen as they approach the coast. As a result, the depth of flooding associated with a 1 in 100 chance in a year event and a PMF may be substantially different- in some localities the difference between a 1 in 100 chance in a year event and a PMF may be up to 9 metres in depth (at Windsor). This means that residential and commercial development may be submerged even if located above the 1 in 100 chance in a year event inundation area. Given the large differences in flood depths between a 1 in 100 chance in a year event and the PMF in the Hawkesbury-Nepean Valley, the focus on the area below the 1 in 100 chance in a year event may not sufficiently address flood risk on the Hawkesbury-Nepean floodplain.

The risk to community safety is well recognised. 'Resilient Valley, Resilient Communities - the Hawkesbury-Nepean Valley Flood Risk Management Strategy' concluded that the significant risks to life and property from flooding in the Hawkesbury-Nepean Valley warranted a comprehensive and coordinated response to reducing impacts and risks. In addition to the proposed raising of Warragamba Dam, the NSW Government is overseeing and coordinating the delivery of the range of measures as part of the of the Hawkesbury-Nepean Valley Flood Risk Management Strategy. These include:

- community awareness and education
- improved weather predictions and flood forecasting
- new flood evacuation road signage
- regional land use and road planning framework
- detailed planning for local road upgrades
- better flood maps and information for the community
- flood emergency response and recovery exercises
- coordinated flood risk management.

Development in flood prone areas

The most direct way in which to avoid flood related risk is to minimise the exposure of people to areas where floods have the potential to threaten human life and wellbeing. Land use planning controls administered by State and local government authorities seek to ensure that residential development does not occur in areas highly vulnerable to flood events. As outlined above, there has been limited effectiveness in achieving this outcome.

All councils across the Hawkesbury-Nepean floodplain administer a restriction on any residential development in areas inundated by a 1 in 100 chance in a year event (and below). However, this has not always been the case and up until the 1990s, residential development was approved in some areas which would be inundated in a 1 in 100 chance in a

year event. As a result, there are an estimated 5,000 residential properties which would be affected in a 1 in 100 chance in a year event (Infrastructure NSW 2017).

Since the mid-1990s, councils have worked to administer appropriate planning controls on development within the 1 in 100 chance in a year event threshold, generally adopting the 1 in 100 chance in a year event with 0.5 metres of freeboard as the applicable flood level for new development. Considering the substantial growth which has been experienced and is predicted to continue, administering flood development controls is a complex and difficult undertaking. Sydney is an ever-growing global city with the population increasing by 1,148,575 in the Greater Sydney since 1996. The western side of the city offers potential for new residential and commercial developments to absorb sustained growth. It is predicted that across Western Sydney, the population will grow by up to an additional 134,000 new residents over the next 30 years (Infrastructure NSW 2017). Initiatives such as the Western Sydney (Nancy- Bird Walton) International Airport and the Western Sydney Infrastructure Plan will further facilitate growth and development, which is supported by the release of residential, commercial and industrial land through the North West Growth Area and the South West Growth Area.

A concern which was raised by community and special interest groups regarding the Project is that it would facilitate further development on the Hawkesbury-Nepean floodplain and thereby directly lead to more people being placed in harm way. It is questionable whether this perception is valid due to two factors. As outlined above, there has been a clear commitment made by all members of the Hawkesbury-Nepean Flood Management Taskforce that the flood planning levels which are based on the existing 1 in 100 chance in a year event would not change even though the Project would result in a reduction in the 1 in 100 chance in a year event extents and height.

Whether the Project would promote additional population growth in flood vulnerable areas is not able to be predicted with any confidence. It is clear that development on the floodplain has progressed at a rapid rate regardless of the risk of flooding. Between 2006 and 2016, there has been substantial population growth in suburbs on the floodplain which are susceptible to flooding. Furthermore, large-scale residential and commercial development have already been planned for and approved. Whilst technically above the 1 in 100 chance in a year event, major developments which are in areas that are susceptible to flooding such as Marsden Park North and Vineyard, are either approved or going through approval processes.

Such developments along with many others throughout Western Sydney are advancing whether the Project occurs or not. Against a current state of rapid development, it is difficult to conclude whether the Project would further accelerate or add to the extent of development activity on the floodplain and thereby lead to more people being placed at risk. It is evident that development activity has already occurred and is in the process of occurring on the Hawkesbury-Nepean floodplain in areas which would be highly vulnerable in the event of a major flood (such as above a 1 in 100 chance in a year event).

A direct outcome of the Project would be the improved safety of people who live on the floodplain through reducing the extent of flood inundation associated with most flood events. A summary of predicted effects of the Project include:

- in Wallacia, there would be reductions of more than 2 metres for floods rarer than the 1 in 20 chance in a year event (more frequent floods are created by backwater flooding from the Fairlight Gorge before they are impacted by backwater from the Warragamba River flows)
- in Penrith, there would be reductions of more than 2 metres (up to 4.8 metres) for floods up to and including the 1 in 200 chance in a year event
- in North Richmond and Windsor, there would be reductions of more than 2 metres (up to 4.1 metres) for events up to and including the 1 in 5,000 chance in a year event
- in Wisemans Ferry, there would be modest reductions of about 0.5 metres to 1 metres for all representative floods.

The Project would also change the frequency of flooding of specific locations. For instance, the current 1 in 100 chance in a year event extent at Windsor would only occur in a 1 in 580 chance in a year event. The level of flooding experienced in the 1867 flood (currently a 1 in 370 chance in a year event) would only occur in a 1 in 1,500 chance in a year event at Windsor.

Of the 5,000 houses currently located in areas which would be inundated in a 1 in 100 chance in a year event, with the Project, this number would be reduced to around 1,000 (Infrastructure NSW, 2017). This equates to approximately 10,000 people whose personal safety is currently threatened by a 1 in 100 chance in a year event, no longer being directly at risk due to their homes being inundated.

Reduced risk to people living in highly vulnerable forms of housing

Across the downstream communities study area, there are numerous semi-permanent styles of housing such as cabins and caravans – these are referred to as ‘manufactured homes’ in the assessment of effects on residential property as outlined in Section 8.4.1. There is a caravan park in Wallacia, two in Penrith and numerous along the lower reaches of the Hawkesbury River between Windsor and Wisemans Ferry, including major water ski parks, tourist style cabin developments, and caravan parks.

Caravan parks are typically located on the banks of the river, taking advantage of high scenic amenity and ready access to recreational opportunities and lower land values. 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 and other short-stay occupants tend to lack awareness of the local flood risk. Numbers of tourists may also swell dramatically during holiday periods, adding to the logistical challenge if evacuation is required. Longer-term residents are often the elderly, those with a form of disability or those who are employed in low-paying jobs. In addition, there are residents who are unemployed. These characteristics may make emergency evacuation difficult and there would be 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 in the valley. The reduction of flood flow and extent 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, an estimated 5 percent of whom live in caravan parks and improvised forms of housing such as tents. Whilst the estimated number of homeless persons in specific localities in the downstream communities study area was able to be ascertained, there has been a substantial increase in the recorded number of homeless persons between 2011 and 2016 in Penrith (45 percent increase), Hawkesbury (166 percent increase) and Dural- Wisemans Ferry (77 percent increase) (Lawton 2018). By reducing the frequency of smaller flood events (such as 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

Due to the potential depth, extent, and duration of floods in the Hawkesbury-Nepean Valley, evacuation is critical to avoid the risk to life in flood events. Further, because of the limited capacity and flood prone evacuation routes from developed areas of the floodplain, there is a risk of the loss of human life when significant flood events occur. As presented in Table 8-18, under the existing risk scenario, it is currently estimated that 43,100 residents within the downstream communities study area would need to consider evacuation in the event of a 1 in 100 chance in a year event and an estimated 61,200 residents needing to consider evacuation in a 1 in 500 chance in a year event. Under the future risk scenario to 2041, the estimated number of total residents (including residents in future development and infill areas) considered in evacuation planning increases to 44,100 residents in a 1 in 100 chance in a year event and an estimated 97,300 residents in a 1 in 500 chance in a year event.

Under the future risk scenario (2041), it is estimated that 18,500 employees who live outside the downstream communities study area would need to be considered in evacuation planning in a 1 in 100 chance in a year event and an estimated 38,100 employees in an 1 in 500 chance in a year event. The estimated number of people (including residents and employees) needing to consider evacuation would increase significantly by 2041, with an estimated 135,000 people in a 1 in 500 chance in a year event.

Table 8-18 Estimate of people considered in evacuation planning by 2041

Flood size	Residents (2041)			Employees (2041)	Total people considered in evacuation planning (2041)
	Existing risk (2018)	Future risk (2019-2041)	Estimated total of residents considered in evacuation planning by 2041	Total employees considered in evacuation planning who live outside floodplain	
	Total residents considered in evacuation planning	Estimate of total future residents considered in evacuation planning (2019-2041)			
1 in 100	43,100	900	44,100	18,500	63,000
1 in 500	61,200	36,100	97,300	38,100	135,000
PMF	104,000	85,400	189,000	69,600	259,000

As outlined in Section 6.4.8, there are established evacuation routes across the Hawkesbury-Nepean Valley. The SES, NSW Police Service, RMS and INSW along with other agencies and local councils have completed detailed evacuation planning and are continually working to improve evacuation measures. This includes the development of a Regional Evacuation Road Master Plan and road upgrades to enhance access to and resilience of the existing flood evacuation routes and the rollout of flood evacuation road signage system. The SES is also working with communities to raise awareness of flood risks and to ensure that the most vulnerable sectors of the community have plans for evacuation in the event of floods. Analysis of evacuation data and previous experience served to identify the most vulnerable groups with regard to evacuation include:

- Child care centres – pose a particular problem as there a large number of individual centres (estimated 180 child care centres on the floodplain) and parents will commonly ignore evacuation directions to retrieve their children which could lead to further risks.
- Hospitals – there are four hospitals on the floodplain providing several thousand beds resulting in a considerable logistical evacuation challenge, particularly as many people are incapacitated and require specialised equipment to move.
- Aged care facilities – there are more than 45 aged care homes located on the floodplain with many residents having special needs in order to move.
- Livestock owners – much of the lands most threatened by flood waters are used for agricultural purposes. Owners of livestock (particularly horses) are very reluctant to leave without their stock, creating considerable evacuation challenges.

A summary of key evacuation routes for communities on the floodplain is as follows:

- Wallacia and westerns districts of Liverpool LGA – residents would predominantly rely upon Park Road route to connect through to The Northern Road and then on to the M4 Motorway.
- Penrith – the M4 Motorway provides the primary evacuation route along with the Great Western Highway and Castlereagh Road. Emu Plains is a major evacuation area relying upon the M4 Motorway bridges and Victoria Bridge.
- Blacktown – residents in the flood prone north-western suburbs of Blacktown LGA would rely upon Richmond Road or Hawkesbury Valley Way.
- Hawkesbury – key evacuation routes vary across the LGA with residents of Richmond and surrounds relying upon either the Castlereagh Road Route or the Londonderry Road evacuation routes which both connect with The Northern Road and onto the M4 Motorway. Residents of Bligh Park and surrounding areas would rely upon The Northern Road and Llandilo Road routes which then connect with the M4 Motorway or alternatively use the Richmond Road. Windsor and surrounds rely on Hawkesbury Valley Way whilst in McGraths Hill, residents would use either Windsor Road or Hawkesbury Valley Way. Residents of Pitt Town would evacuate using the Pitt Town route.

A key challenge to evacuation occurs in the formation of flood islands, in which communities get cut off from infrastructure and support services and are connected to flood-free land via relatively low-level roads. Key locations in the Hawkesbury-Nepean Valley which become flood islands and their corresponding (2016) population include:

- McGrath's Hill: population 2,552
- Pitt Town: population 3,033
- Windsor: population 1,891
- Bligh Park: population 6,366
- Richmond: population 5,482.

To minimise the risk to life, it is essential that populations on flood islands are evacuated prior to the inundation of roads that form the evacuation routes. Successful self-evacuation using the road network is the primary method of reducing risk to life from flooding in the Hawkesbury-Nepean Valley due to limited and flood prone public transport options.

Indicative evacuation timings for key flood islands are shown in Table 8-19. Significant evacuations are triggered when floods are predicted to inundate the McGraths Hill regional flood evacuation route, which is flooded at 13.5 metres Australian Height Datum (AHD). After that, the Windsor regional flood evacuation route (Jim Anderson Bridge at 17.3 metres AHD) is a key evacuation route for Windsor and South Windsor. The Richmond regional flood evacuation route is flooded at 20.2 metres AHD, which corresponds to between a 1 in 500 and 1 in 1,000 chance in a year event. Considering the risk to life on the flood islands, the critical range of floods is taken to include the 1 in 1,000 chance in a year event. Extreme but rare floods greater than 20.2 metres AHD in the Richmond/Windsor area increase the area needing to be evacuated but no significant additional flood islands are created. Hence, most of the risk to life is created if the evacuation is not successful before floods reach 20.2 metres AHD. Most additional people requiring evacuation when floods exceed 20.2 metres AHD have a rising evacuation route. In Penrith, there are no real flood islands; but evacuation is impacted by the high Penrith population and evacuation traffic from the Richmond/Windsor area causing local traffic congestion.

Table 8-19. Indicative evacuation timings for key flood islands

Sector	Estimated number of vehicles requiring evacuation	Estimated time required for community to evacuate (hours)	Level at which evacuation route is cut (metres AHD)
McGraths Hill	2,756	8.1	13.5
Pitt Town	1,071	4.8	16.0
Windsor	8,494	19.2	17.3
Bligh Park	5,611	13.9	18.5
Richmond	9,088	20.7	20.2

Source: Hawkesbury-Nepean Flood Plan (NSW SES, 2015), Volume 3 Chapter 2 Table 5.

The Project would increase the time available for evacuation for all downstream residents which would significantly reduce risks to human safety. Currently, the time to evacuate some areas of the Hawkesbury-Nepean Valley exceeds the flood forecast target time (8 to 15 hours), forcing the SES to order evacuations based on uncertain flood level predictions. This uncertainty is due to the rapid flooding characteristic of the Hawkesbury-Nepean Valley which requires the use of forecast rainfall rather than fallen rain or observed river level rises. By delaying the time at which evacuation roads are cut, the Project provides more certainty about the timing, making it possible to safely evacuate more people from the floodplain.

A key objective of the Project is to delay peak flooding to provide additional time for the evacuation of flood-affected areas. Road river crossings are a part of many key evacuation routes. Table 8-20 details the number of hours a crossing remains open after the beginning of a flood event. Only the major road crossings have been discussed in Table 8-20 as the railway is not a major evacuation means and the ferry crossings have extremely low capacities. A change in time of closure of one hour or more – or a crossing remaining open with the Project when it was previously closed was considered significant and the results in Table 8-20 have been colour-coded to reflect this. The 10th and 90th percentiles times to closure have also been included in Table 8-20 to demonstrate the potential range in time to closure for each event and crossing. These percentile times were included due to the varying spatial and temporal patterns of rainfall during individual flood events. Only a single event was modelled for PMF and therefore, there is no range.

There would be no change or an increase in the time available for evacuation for all flood events with the Project except for a PMF for the Cattai Creek bridge at Cattai. The scale of benefit ranges from an increase of one hour to river crossings no longer being closed and remaining open for evacuation throughout the flood event. Increased open times are critical for evacuation with a single lane with traffic travelling 40 kilometres per hour having the capacity to evacuate 1,500-1,750 vehicles per hour. If it is assumed two people per vehicle, an extra hour for evacuation could allow about 3,000 to 3,500 extra evacuees.

Table 8-20 Number of hours before a river crossing is closed for different flood events for the existing conditions and with the Project

Crossing	Hours before a river crossing is closed for different flood events									
	Red shading = increase in time to closure					Green shading = decrease in time to closure				
	1 in 5 chance in a year (hours to closure)		1 in 10 chance in a year (hours to closure)		1 in 20 chance in a year (hours to closure)		1 in 100 chance in a year (hours to closure)		PMF (hours to closure)	
	Existing	Project	Existing	Project	Existing	Project	Existing	Project	Existing	Project
Cattai Creek Road Bridge	8 (3-22)	10 (4-23)	8 (2-14)	8 (3-19)	6 (2-13)	7 (3-17)	5 (2-11)	6 (3-14)	6	3
Yarramundi Road Bridge	3 (1-17)	6 (3-21)	3 (1-9)	5 (3-17)	2 (1-5)	4 (2-14)	2 (1-4)	4 (2-10)	1	3
Windsor Road Bridge (New)	Not closed	Not closed	Not closed	Not closed	30 (21-45)	Not closed	21 (15-34)	39 (29-54)	8	14
North Richmond Road Bridge	4 (3-17)	17 (6-27)	5 (3-19)	11 (5-22)	3 (2-12)	9 (4-20)	3 (2-10)	6 (4-19)	2	5
Richmond - Blacktown Road Bridge	Not closed	Not closed	Not closed	Not closed	46 (35-64)	Not closed	38 (26-55)	59 (43-75)	20	28
Jim Anderson Bridge	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	29 (21-41)	Not closed	18	24
Victoria Road Bridge	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	53	64
M4 Motorway Bridge - Nepean River (west)	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed
M4 Motorway Bridge - Nepean River (east)	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	81	110
M4 Motorway - South Creek	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	69	93
Great Western Highway - South Creek	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	Not closed	7	8
Blaxland Crossing Road Bridge (Wallacia)	15 (11-29)	15 (12-29)	12 (8-26)	13 (9-26)	10 (5-19)	11 (8-20)	8 (3-15)	10 (7-18)	7	8

Note: Range is 10th to 90th percentile. Hours to closure indicated in brackets

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.

Following a major flood event, the water temporarily stored in the FMZ would need to be discharged. This would result in an extension to the duration of flood events. Discharges from the FMZ would generally be released at a constant rate of 100 gigalitres day for up to 12 days. This may result in some river crossing being closed longer compared to the existing conditions. Analysis undertaken as part of the EIS (refer to Chapter 24 and Appendix O of the EIS in regard to Traffic and Transport Assessment) found the following:

- Cattai Creek Bridge at Cattai – This is the lowest level bridge considered in the assessment (about 2 metres AHD) and is prone to flooding and closure during all modelled flood events. The number of hours that this bridge would be closed would approximately be double for all events except the PMF due to the Project. This is because the low-level flooding caused by the emptying of the FMZ would result in a longer closure time of the

bridge. Although the bridge would be closed for longer there are nearby alternative routes that would remain open.

- Yarramundi Bridge – This is the second lowest level bridge considered in the assessment (about 5.61 metres AHD) and is prone to flooding and closure during all modelled flood events. The number of hours that this bridge would be closed would increase by about two to three times for all events except the 1 in 5 chance in a year flood event and PMF due to the Project. There would still be an increase in closure time for these two events, however, the increase would not be as large as for other events. Increased closure times are due to the low-level flooding caused by the emptying of the FMZ. Although the bridge would be closed for longer there are alternative routes.
- Windsor Bridge (New) – The number of hours that this bridge would be closed would increase by about two to three times for all events except for the PMF due to the Project. There would still be an increase in closure time for the PMF, however, the increase would not be as large as for other events. Increased closure times are due to the low-level flooding caused by the emptying of the FMZ.
- North Richmond Bridge – The North Richmond Bridge is closed during all flood events under existing conditions. With the Project, the North Richmond Bridge would remain open during the 1 in 5 chance in a year event and would be closed for shorter periods during the 1 in 10 chance in a year flood event and the 1 in 20 chance in a year flood event. For the other events there would be a minor increase in the number of hours closed due to the Project.
- Jim Anderson Bridge – Under existing conditions, the Jim Anderson Bridge is closed during flood events greater than the 1 in 100 chance in a year event. With the Project, the bridge would only be closed during events greater than the 1 in 500 chance in a year flood event and would be closed for shorter periods of time.
- Victoria Bridge, M4 Motorway Bridges (Nepean River), M4 Motorway Bridge (Ropes Creek) and Great Western Highway Bridge would remain open and operational during all flood events apart from the PMF under existing conditions and with the Project. All these bridges would be closed during a PMF event, however there would be a small reduction in the time that they are closed with the Project.
- Blaxland Crossing Bridge – Apart from the 1 in 5 chance in a year flood event the bridge would be closed during all flood events both under existing conditions and with the Project. However, there would be a small reduction in the time that the bridge was closed due to the Project.
- Sackville Ferry crossing – This ferry crossing is closed during all flood events and the period of closure would increase by about 50 percent due to the Project for all flood events apart from the 1 in 5 chance in a year flood event where it would decrease slightly.
- Portland Ferry crossing – This ferry crossing is closed during all flood events and the period of closure would increase by about 25 percent due to the Project for most flood events apart from the 1 in 5, 1 in 10 and 1 in 20 chance in a year flood events, where closure times would decrease slightly.
- The Webb Creek and Wisemans Ferry have identical closure patterns as they are adjacent to each other and results for both assessment criteria are relatively similar. The ferries remain open for the 1 in 5 chance in a year flood event and close for the remainder of events under existing conditions. With the Project, the ferries would also remain open for the 1 in 10 chance in a year flood event and there would be a decrease in the time the ferries are closed for all other flood events apart from the PMF. There would be a small increase in the number of the hours the ferries are closed during the PMF event due to the Project.
- The Penrith and South Creek rail crossings would remain open during all flood events under existing conditions and with the Project, except for the PMF event. There would be a small reduction in the number of hours the Penrith and South Creek rail crossings are closed with the Project during the PMF
- Windsor Richmond rail crossing would be closed under existing conditions during the 1 in 10 chance in a year flood event and all larger flood events. With the Project the Windsor Richmond rail line would remain open during the 1 in 10 chance in a year flood event – and there would a reduction in closure time during the 1 in 20 chance in a year. For all other flood events there would be an increase in closure times due to the Project
- Generally, the Project would result in a reduction or no change in closure times apart from low level crossings such as Yarramundi Bridge, the Cattai Creek bridge at Cattai, Windsor Bridge and some ferry crossings. The low-level crossings would experience an increase in closure times due to the emptying of the FMZ. Some crossings would experience a reduction in closure times for smaller events and an increase in closure time for larger events.

Perceived flood risk

Community perception surrounding flood impacts and flood potential are both key factors for community safety. The communities within the downstream area perceive flooding as a low risk and are more concerned with severe storms and bushfires. This perception means that large parts of the community have done no or little flood preparation. The downstream communities also lack knowledge of correct evacuation procedures and routes which could reduce the effectiveness of evacuation planning. The delivery of key evacuation information is essential for the community to understand the correct procedures. Information about flood evacuation should be paired with flood risk information and facts. Current information delivery methods can be seen as inadequate with community responses between the 2014 and 2018 surveys around flood perception showing a lack of knowledge about evacuation and risk.

Social research undertaken for the Hawkesbury-Nepean Valley Flood Risk Management Strategy showed that three percent of the population in Hawkesbury-Nepean Valley would not evacuate when told to evacuate and 27 percent would use their own judgement. In a 1 in 100 chance in a year event, even if only three percent do not evacuate, around 2,000 of the 64,000 that currently need to evacuate would be risking their lives. One other key finding from the study was that 44 percent of people within the downstream communities study area require assistance to evacuate, including the elderly and those with a disability.

There is a risk that the Project may further engender a false sense of security that the community is now 'protected' from floods. This may have an effect on human behaviours which is problematic, providing a further disincentive for residents to evacuate.

Reduced adverse effects on mental health due to reduced experience of severe flood events

A primary reason why there is a general lack of awareness of flood risk is that there are members of the community have not experienced a major flood 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.

Reduced economic costs related to mental health issues associated with flooding

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.

Access to infrastructure

Access to infrastructure during flooding periods is essential for the health and wellbeing of affected communities. There are a broad range of services and facilities across the floodplain (refer to Appendix D of this report). 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 a year event, both the McGraths Hill Sewerage Works and the Richmond Sewerage Treatment Plant would currently be affected. 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 major health facilities such as the Nepean Hospital is 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. There is a complex network for providing emergency services. The SES has led multi-agencies planning and scenario testing to optimise the availability of essential services in the event of major floods.

As a result of the gradual release of the temporarily water discharged 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 a very large flood events such as 1 in 500 chance in a year event to the PMF, flood islands such

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, key access points were assessed in terms of effects associated with the discharge 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 from 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 137.5 hours in a 1 in 100 chance in a year event, compared to 350 hours with the Project (refer to Chapter 24 Traffic and Transport Assessment of the EIS).

Additional health risks

There is a risk that the heightened consistent elevated flows associated with discharge of the FMZ may induce ‘thrill seeking’ behaviour presenting a subsequent risk of personal injury. Discharge of the FMZ would generally occur at a relatively consistent rate for periods up to 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 would likely place participants at risk of personal injury or death. However, on the other hand, the Project would reduce the risk of water-borne, vector-borne and soil-borne disease from flooding through reducing the frequency of flood events.

Overview

In summary, the Project has the potential to generate both negative and positive social impacts to the health and wellbeing of members of the downstream communities study area. The Project’s operation is likely to generate extreme positive impacts for the downstream community through enhanced safety of residential areas due to reduced extent and frequency of floods, enhanced safety due to improved ability to evacuate communities, and reduced risk to people living in highly vulnerable forms of housing. Further, the Project is likely to generate a high positive impact for members of the downstream communities study area through improving access to key services and health facilities, and an extreme positive impact through reducing the effects on mental health due to reduced experience of severe flood events.

On the other hand, reduced levels of flood risk awareness and flood disaster planning, compounded by increased complacency, has the potential to generate a negative impact for members of the downstream communities study area. Following the application of mitigation measures as outlined in Section 9, this impact is assessed as being of a low level of significance. In addition, there may be an increase in health risk relating to temporary reduction in water quality, however, following the application of mitigation measures outlined in Section 9, this is assessed as being of a low level of significance for members of the downstream communities study area.

8.4.4 Culture and heritage

8.4.4.1 Aboriginal cultural heritage

Aboriginal cultural heritage sites may hold important tangible and intangible values for members of the downstream communities study area. However, modelling assessment undertaken as part of the ACHA demonstrates that raising the Dam will not increase regional inundation levels downstream. Therefore, the Project would not result in any negative effect on already recorded Aboriginal sites which will have been subject to inundation from past flood events. The ACHA further found that the Project would not result in any negative impacts to Aboriginal cultural heritage sites downstream of Warragamba Dam. However, the downstream area is included in the data synthesis for an understanding of Aboriginal Objects and sites associated with Hawkesbury-Nepean River catchment. A total of 887 sites were recorded with a full listing provided in the ACHA report (refer to Chapter 18 Aboriginal cultural heritage of the EIS).

However, Aboriginal people and people who value Aboriginal heritage may perceive the Project to impact on intangible Aboriginal cultural heritage values. Following the application of mitigation measures outlined in Section 9, this impact is assessed as being of a low level of significance for Aboriginal people and people who value Aboriginal heritage.

8.4.4.2 Non-Aboriginal cultural heritage

The Hawkesbury-Nepean Valley can experience extensive flooding and many heritage items located within, or near the Hawkesbury-Nepean River or its tributaries may experience impacts from flooding. Flooding may cause direct or indirect impacts to heritage items depending on the depth of flooding, length of flooding and velocity of flood waters.

Within the operational downstream areas, the assessment of non-Aboriginal heritage impacts (refer to Chapter 17 of the EIS) focused specifically on listed heritage items located within the downstream FMZ discharge area. In this zone,

heritage items may experience flood events for an extended period of time. For listed heritage items outside the zone of impact of the FMZ discharge area, heritage items would likely be positively affected by the Project due to the reduced extent, frequency and severity of flooding.

Table 8-21 provides a summary of listed heritage items affected by flood events in the downstream and estuary as per current situation.

Table 8-21. Summary of listed heritage items affected by flood events in the downstream and estuary as per current situation

Heritage List	1 in 5 Chance in a year event	1 in 10 Chance in a year event	1 in 20 Chance in a year event	1 in 100 Chance in a year event	Probable maximum flood
World heritage list	2	2	2	3	3
National heritage list	4	4	4	4	5
Commonwealth	0	0	0	2	3
State heritage register	24	27	30	40	67
Local environmental plan	222	239	266	395	813

Table 8-22 below provides a summary of listed heritage items affected by flood events in the downstream and estuary with the Project.

Table 8-22. Summary of listed heritage items affected by flood events in the downstream and estuary with the Project

Heritage List	1 in 5 Chance in a year event	1 in 10 Chance in a year event	1 in 20 Chance in a year event	1 in 100 Chance in a year event	Probable maximum flood
World heritage list	2	2	2	3	3
National heritage list	4	4	4	4	5
Commonwealth	0	0	0	0	3
State heritage register	16	19	23	29	67
Local environmental plan	192	207	228	270	793

Table 8-23 below provides a summary of the number of listed heritage items that would be affected by the nominated flooding events following implementation of the Project.

Table 8-23. Comparison between heritage items affected by existing condition and the Project

Heritage List	1 in 5 Chance in a year event		1 in 10 Chance in a year event		1 in 20 Chance in a year event		1 in 100 Chance in a year event		Probable Maximum flood	
	Existing	Project	Existing	Project	Existing	Project	Existing	Project	Existing	Project
World heritage list	2	2	2	2	2	2	3	3	3	3
National heritage list	4	4	4	4	4	4	4	4	5	5
Commonwealth	0	0	0	0	0	0	2	0	3	3
State heritage register	24	16	27	19	30	23	40	29	67	67
Local environmental plan	222	192	239	207	266	228	395	270	813	793

Table 8-23 demonstrates a reduction in the number of Commonwealth, state and local heritage items that would experience flooding with the Project for all events apart from the PMF. The reduction in the number of heritage items affected by flooding ranged between about 10 and 30 percent of the total number of heritage items depending upon the type of heritage item and size of event. The largest decrease was for the 1 in 100 chance in a year (1 percent AEP) flood event. In addition, a reduction in the number of heritage items directly impacted by flooding, generally heritage items that would continue to be impacted by flooding would experience:

- a shorter duration of flooding
- a reduction in the depth of flooding
- the same or lower flood water velocities.

There would only a minor reduction in flooding impacts on heritage items during a PMF as the Project would only have a minor impact on flood extents and other aspects of flood behaviour. Overall, the Project would result in a reduction of impact to downstream heritage items due to a reduction in peak flooding impacts for most events.

In summary, the Project has the potential to enhance protection of non-Aboriginal heritage due to the reduced extent, frequency and severity of PMF events. This is likely to generate an extreme positive impact for members of the downstream communities study area and environmental conservation groups. In addition, the Project has the potential to negatively effect on listed cultural heritage due to release of the FMZ. Following the application of mitigation measures outlined in Section 9, changes to non-Aboriginal heritage values as experienced by stakeholders such as members of the downstream communities study area and for environmental conservation groups is assessed as being of a low level of significance.

8.4.5 Way of life

8.4.5.1 Economic benefits

The Project would generate direct and indirect positive economic effects by reducing flood related damage to property. By reducing the extent, severity and frequency of flood events, the Project would avoid damage to property. As shown in Table 8-24 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 this cost significantly with a 1 in 100 chance in a year event only causing \$0.26 billion of costs and PMF resulting \$14.7 billion of costs.

Table 8-24 Estimated damages in billions dollars for current (2015) and future (2041) development in the Hawkesbury-Nepean floodplain

Scenario	Flood damages (in billions \$AUS) for 1 in x chance in a year flood										
	5	10	20	50	100	200	500	1,000	2,000	5,000	PMF
EXISTING Current development	0.023	0.071	0.19	0.99	2.1	3	5	6.6	12.2	24.6	29.2
EXISTING 2041 development	0.024	0.072	0.19	1.1	2.2	3.8	6.8	9.5	17.1	35.8	44.9
PROJECT Current development	0.006	0.022	0.043	0.14	0.26	0.59	1.8	3	5.2	7.6	14.7
PROJECT 2041 development	0.007	0.023	0.045	0.16	0.3	0.64	1.9	3.8	7.2	11.1	23.7

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. Project savings are shown in Table 8-25.

Table 8-25. Estimated reduction in damage with Project in billion dollars for current (2015) and future (2041) development in the floodplain

Development scenario	1 in x chance in a year flood										
	5	10	20	50	100	200	500	1,000	2,000	5,000	PMF
Current development	0.017	0.049	0.147	0.85	1.84	2.41	3.2	3.6	7	17	14.5
	74%	69%	77%	86%	88%	80%	64%	55%	57%	69%	50%
2041 development	0.017	0.049	0.145	0.94	1.9	3.16	4.9	5.7	9.9	24.7	21.2
	71%	68%	76%	85%	86%	83%	72%	60%	58%	69%	47%

The loss of utilities due to flood events incurs both direct and indirect costs to communities as businesses which rely upon the power, water and communications they provide are also impacted. Utilities would be afforded additional protection as a result of the Project. For instance, electricity outages occur at 24m AHD in Penrith which would occur during a 1 in 100 chance in a year event under current circumstances. With the Project, the flood level will only reach 22.01m AHD which means there would be no electrical outages. In a 1 in 100 chance in a year event, the sewage treatment plant in Penrith would be damaged at 31m AHD but would no longer be affected with the Project. Electrical outages in Hawkesbury currently occur in a 1 in 10 chance in a year event, while with the Project electrical outages would only occur in a 1 in 50 chance in a year event.

In summary, the Project has the potential to generate positive effects due to reduced flood related damage to property. This is likely to result in extreme positive impacts for NSW Government, and members and businesses of the downstream communities study area.

8.4.5.2 Local economy- Housing

It is likely that the Project would have a positive effect in terms of confidence in the local housing market. While a key finding of social surveys undertaken by INSW (2017) (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 home owners. A related benefit is the potential for a reduction in flood insurance premiums. Any reductions in flood risk at each individual property would be considered by insurers and would typically result in reduced insurance premiums. This may then translate to improved housing affordability in some instances. 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 (NSW Department of Primary Industries 2014).

In summary, the Project has the potential to reduce risk of people permanently and temporarily losing access to housing and accommodation. This would likely result in an extreme positive impact for members and LGAs of the downstream communities study area. Further, the Project has the potential to result in an extreme positive impact for properties owners, investors and house-related businesses within the downstream communities study area due to improved confidence in housing market and potential reduction in insurance premiums.

8.4.5.3 Agricultural and industrial businesses

The Hawkesbury floodplain is a highly fertile and productive area supporting a wide range of agriculture and agriculturally 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 (NSW Department of Planning and Environment 2017a). In addition, they provide key goods and services to the Greater Sydney region. The Hawkesbury River has traditionally also 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 (such as 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.

The Project may result in occasional and additional economic losses for agricultural businesses. As a result of the release of the water stored in the FMZ following a major flood event, low lying areas would be inundated for a longer period than the existing situation. 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. There are a complex range of factors which influence how individual businesses would be affected in any particular flood event.

In summary, the Project has the potential to generate an extreme positive impact for agricultural and industrial businesses located within the downstream communities study area through reduction in flood related economic losses for agricultural and industrial businesses. However, and with the application of mitigation measures as outlined in Section 9, changes to agricultural and industrial businesses due to occasionally additional economic losses as a result of the discharge of the water in FMZ following a major flood event is assessed as being of a moderate level of significance.

8.4.5.4 Tourism and recreation related businesses

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 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 events), 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 gradual release of the water stored 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 generate a significant proportion of their 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.

In summary, the Project has the potential to generate a high positive impact for tourism and recreation-related businesses located within the downstream communities study area as a result of a reduction in flood-related economic losses. On the other hand, and with application mitigation measures as outlined in Section 9, the Project has the potential to generate a negative impact through occasional additional economic losses for tourism and recreation related businesses which is assessed as being of a low level of significance.

8.4.5.5 Community cohesion

The Project would have a positive effect on community cohesion by reducing the risk of people permanently and temporarily losing access to housing and accommodation. In the event of a major flood, a large number of people would need to be evacuated and would be dislocated from their homes. It is estimated that 64,000 people would need to evacuate from their homes if a 1 in 100 chance in a year event was to occur. Some of these people may be homeless for a prolonged period due to access roads being cut, loss of utilities, water and sewerage, and damage to houses caused by flood inundation. Some people's homes may be completely destroyed. It is estimated that 5,000 homes would currently be inundated 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 51 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 2,500. There would also be less damage to road infrastructure and utilities, which allow people to return to their homes sooner.

The Project may also have a positive effect on community cohesion due to improved ability to control flood related risk and plan communities accordingly. 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 would 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.

The Project has the potential to generate a high positive impact for members and LGAs of the downstream communities study area due to improved community cohesion as a result of improved ability to control flood related risk. This would in turn serve to reduce community concerns and anxiety relating to floods.

8.4.6 Impact assessment summary- downstream communities

Table 8-26 summarises the socio-economic impacts discussed in Section 8.4 and assesses their significance rating as per the impact assessment methodology outlined in Section 4.5 for the Project's downstream communities study area.

Table 8-26. Summary of socio-economic impacts and their significance rating for the Project's downstream community study areas

No.	Impact	Positive/ negative	Description	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	Areas in the Liverpool LGA vulnerable to flooding from the Warragamba Dam catchment are primarily limited to the suburb of Wallacia. The lots affected in Luddenham, Greendale and Badgerys Creek are primarily confined to agricultural uses. In a 1 in 2,000 chance in a year flood an estimated 30 residential properties would be affected in Wallacia. 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 percent.	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	In the 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 less 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 40 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	Property owners inundated by flooding in the LGA of Penrith	Almost certain ²⁸	Major	A4- Extreme

²⁸ 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 year level at Windsor.

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			reducing from 150 to 70 homes. The largest number of lots affected by flooding in Penrith LGA occur in the suburbs of Emu Plains, Penrith CBD and Emu Heights.				
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	In the Blacktown LGA a 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 370 residential properties would currently be affected. With the Project, there would be an estimated 92% reduction in the number of residential properties affected. For as 1 in 500 chance in a year event, a large number of residential properties (760) 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 58% to 320 properties in total. The largest number of lots affected by flooding in Blacktown LGA occur in the suburbs of Marsden Park, Riverstone and Schofields.	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	In terms of total number of lots inundated, Hawkesbury is the most acutely affected LGA. Data indicates that there are residential areas in the which are highly vulnerable to flooding. For a 1 in 10 chance in a year event there are currently an estimated 220 residential properties and 430 manufactured homes affected by flooding. Under the 'with Project' scenario there would be an estimated 71 percent reduction in the number of properties affected with the number of	Property owners inundated by flooding in the LGA of Hawkesbury	Almost Certain ²⁹	Major	A4- Extreme

²⁹ 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 year level at Windsor.

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			<p>manufactured homes affected reducing to 120 in total.</p> <p>In a 1 in 100 chance in a year event, apart from a very small area, all of Wilberforce, Windsor and McGraths Hill would be flooded. 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.</p> <p>Of property in the Hawkesbury LGA supporting rural activities, it is predicted that 3,810 ha 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 total 2,080 ha.</p>				
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	<p>Areas in The Hills LGA vulnerable to flooding are primarily limited to the suburbs of Cattai, South Maroota and Wisemans Ferry. In 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.</p> <p>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</p>	Property owners inundated by flooding in the LGA of The Hills	Almost Certain	Moderate	A3- Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			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.				
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	<p>Whilst the Project would reduce the frequency, extent and severity of flood events, the release of water will lead to more prolonged (lower level) flood conditions. As a result, access to some properties may be affected for a longer period.</p> <p>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.</p> <p>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.</p>	Affected property owners	Possible	Moderate	C3- High
Environment							
7	Alteration of visual amenity associated with release of the FMZ	Negative	The Landscape Character and Visual Assessment examined potential Project related effects at three key sites- Penrith Weir, Richmond Bridge, and Windsor Bridge. 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. The subsequent impact on	Downstream communities and tourists	Possible	Minor	C2- Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			visual amenity was assessed as moderate in 1 in 20 chance in a year event and high-moderate in PMF event. 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. The visual impact was assessed as moderate in 1 in 20 chance in a year event and as high-moderate in PMF event. 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 Project. The visual impact at this view point was assessed as moderate in 1 in 20 chance in a year event and as high-moderate in PMF event. These three sites are representative of the potential impact on visual amenity along the Hawkesbury-Nepean River. Whilst 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 will temporarily disturb views.				

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
8	Avoidance of altered visual amenity due to reduction in the extent of flood inundation associated with most flood events	Positive	As a result of the Project there would be reduced frequency in which 'flood events' are experienced in downstream areas. By with-holding peak flood waters, 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 visual assessment report recognised that due to viewers having no context to compare to, the reduced flooding extent in the downstream 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.	Downstream communities and tourists	Likely	Minor	B2- High
9	Operation – Disruption to the enjoyment of natural areas and the flora and fauna	Negative	Across the Hawkesbury 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, following some major flood events, access to some popular natural destinations, such as Bents Basin and Wianamatta Regional Park, is likely to be restricted due to the release of temporarily stored waters from the FMZ. Additionally, 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.	Downstream communities and tourists	Unlikely	Minor	D2 - Low

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
Community Health and wellbeing							
10	Enhanced safety of residential areas due to reduced extent and frequency of floods, including reduced risk to disease	Positive	<p>Flood events present a significant risk to community safety on the Hawkesbury-Nepean Valley, which is considered the highest single flood exposure in NSW. Population growth pressures along with historically deficient planning controls has 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. Of the 5,000 houses currently located in areas which would be inundated in a 1 in 100 chance in a year event, with the Project this number is reduced to 1000. 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.</p> <p>In addition, by reducing the frequency of smaller flood events (that is, 1 in 5, 1 in 10 and 1 in 20 chance in a year event), 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.</p>	Downstream communities	Almost certain	Major	A4- Extreme
11	Enhanced safety due to improved ability to evacuate communities	Positive	<p>Evacuation is critical to avoid risks to human life in flood events. It is currently estimated that 63,000 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 135,000 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</p>	Downstream communities	Almost certain	Major	A4- Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			longer. This would substantially reduce the risk of loss of life in a major flood event.				
12	Reduced risk to people living in highly vulnerable forms of housing.	Positive	<p>Across the downstream 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 high 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 suffering from a form of disability. Those in the workforce tend to be employed in low-paying jobs, with some unemployed people.</p> <p>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).</p> <p>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 in Penrith (45% increase), Hawkesbury (166% increase) and Dural- Wisemans Ferry (77% increase).</p> <p>By reducing the frequency of smaller flood events (that is, 1 in 5, 1 in 10 and 1 in 20 chance in a year event), 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.</p>	Downstream communities	Almost certain	Major	A4- Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
13	Reduced risk to vulnerable people living in social housing at risk of flooding	Positive	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 in the valley. The reduction of flood flow and extent by the Project would reduce the risk to vulnerable people living in social housing.	Downstream communities	Likely	Major	B4 - Extreme
14	Operation- Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency	Negative	Research conducted by SMEC (SEIA surveys and EIS consultations) and Newgate Research (Hawkesbury-Nepean Valley Flood Risk Management Strategy) confirmed that levels of flood risk consciousness held by the broader public is 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 as members of the community (falsely) interpret that the Project would deliver flood immunity.	Downstream communities	Possible	Minor	C2 - Moderate
15	Operation - Improved access to key services, and health facilities	Positive	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; whilst 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. Whilst health facilities, such as the Nepean Hospital,	Downstream communities	Possible	Moderate	C3- High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			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.				
16	Operation – Occasional reduced access to services and health facilities during discharge of water from the FMZ	Negative	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 will remain closed for a longer duration. For a very large flood events such as a 1 in 500 chance in a year event to 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 term 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.	Downstream communities	Possible	Minor	C2- Moderate
17	Health risk relating to temporary reduction in water quality	Negative	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 water quality assessment (refer to Chapter 27 of the EIS) indicates no significant, long-term and adverse impacts on	Downstream communities	Unlikely	Minor	D2- Low

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			water quality in the downstream study area are predicted due to releases from the FMZ.				
18	Reduced adverse effects on mental health due to reduced experience of severe flood events	Positive	A primary reason why there is a general lack of awareness of flood risk is that there are members of the community that has not experienced a major flood 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.	Downstream communities	Likely	Major	B4 - Extreme
19	Reduced economic costs related to mental health issues associated with flooding	Positive	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 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.	NSW Government, downstream communities and downstream local government areas	Likely	Major	B4 - Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
21	Reduced health risk to water borne disease	Positive	A reduction in flood frequency and severity in the downstream communities would decrease exposure to water borne pathogens and potential disease.	Downstream communities	Likely	Major	B4 - Extreme
Culture and heritage							
21	Aboriginal cultural heritage	Negative	Modelling assessment undertaken as part of the ACHA indicates that the Project would not result in any negative impacts to sites of Aboriginal cultural heritage downstream of Warragamba Dam. However, the downstream area is included in the data synthesis for an understanding of Aboriginal Objects and sites associated with Hawkesbury-Nepean River catchment. A total of 887 sites were recorded with a full listing provided in the ACHA report (refer to Chapter 18 of the EIS).	Aboriginal people and members of broader community who value Aboriginal heritage	Unlikely	Minimal	D1-Low
22	Enhanced protection of non-Aboriginal cultural heritage	Positive	Within the operational downstream areas, the assessment of non-Aboriginal heritage impacts (refer to Chapter 17 of the EIS) focused specifically on listed heritage items located within the downstream FMZ discharge area. In this zone, heritage items may experience flood events for an extended period of time. For listed heritage items outside the zone of impact of the FMZ discharge area, heritage items would likely be positively affected by the Project due to the reduced extent, frequency and severity of flooding.	Downstream communities and environmental conservation groups	Possible	Moderate	C3- High
23	Potential effects on listed cultural heritage due to release of the FMZ	Negative	The Hawkesbury-Nepean Valley can experience extensive flooding and many heritage items located within, or near the Hawkesbury-Nepean River or its tributaries may experience impacts from flooding. Flooding may cause direct or indirect impacts to heritage items depending on the depth of flooding, length of flooding and velocity of flood waters. Outcomes of the Non-Aboriginal Cultural Heritage Assessment demonstrates a reduction in the number of Commonwealth, State and Local heritage	Downstream communities and environmental conservation groups	Unlikely	Moderate	D3- Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			items that would experience flooding with the Project for all events, apart from PMF. The reduction in the number of heritage items affected by flooding ranged between about 10 and 30 percent of the total number of heritage items depending upon the type of heritage item and size of event. The largest decrease was for the 1 in 100 chance in a year (1 percent AEP) flood event. In addition, a reduction in the number of heritage items directly impacted by flooding, generally heritage items that would continue to be impacted by flooding would experience: (i) a shorter duration of flooding (ii) a reduction in the depth of flooding (iii) the same or lower flood water velocities. There would only a minor reduction in flooding impacts on heritage items during a PMF as the Project would only have a minor impact on flood extents and other aspects of flood behaviour. Overall, the Project would result in a reduction of impact to downstream heritage items due to a reduction in peak flooding impacts for most events.				
Way of life							
24	Positive economic effects due to reduced flood related damage to property	Positive	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 this cost significantly with a 1 in 100 chance in a year event only costing \$0.26 billion and a PMF costing \$14.7 billion. Overall, 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	NSW Government, downstream communities, and businesses	Almost Certain	Major	A4- Extreme

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			potentially has broader positive economic implications, such as the ability to fund further flood risk management solutions and investment in social and community infrastructure.				
25	Reduced risk of people permanently and temporarily losing access to housing and accommodation	Positive	In the event of a major flood a large number of people would need to be evacuated and would be dislocated from their homes. It is estimated that 64,000 people would need to evacuate from their homes if a 1 in 100 chance in a year event was to occur. Some of these people 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 5,000 homes would currently be inundated in a 1 in 100 chance in a year event. The Project would reduce the extent, frequency and severity of major floods- note that the Project would have little effect on a PMF. The number of houses predicted to be inundated in a 1 in 100 per year event falls to 1,000. There would also be less damage to road infrastructure and utilities, which allow people to return to their homes sooner.	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	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 home owners.	Downstream property owners, investors, and house-related businesses	Possible	Moderate	C3- High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
27	Reduction in flood related economic losses for agricultural and industrial businesses	Positive	<p>The Hawkesbury floodplain is a highly fertile and productive area supporting a wide range of agriculture and agriculturally 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. 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.</p> <p>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 (that is, 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.</p>	Downstream agricultural and industrial businesses	Almost Certain	Moderate	A3- Extreme
28	Occasional additional economic losses for agricultural and industrial businesses	Negative	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	Downstream agricultural and industrial businesses	Possible	Moderate	C3- High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			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.				
29	Reduction in flood-related economic losses for tourism and recreation related businesses	Positive	<p>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.</p> <p>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 (that is, 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 equipment and other assets out of harm way, which would further reduce flood related economic losses.</p>	Downstream tourism and recreation-related businesses	Almost Certain	Minor	A2- High
30	Occasional additional economic losses for tourism and recreation related businesses	Negative	As a result of the discharge of the water stored 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-	Downstream tourism and recreation-related businesses	Possible	Minor	C2- Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			based activities; however, the magnitude of effect will differ between respective businesses. For instance, water ski parks are very popular over the summer holiday period and during such time, they make a significant proportion of their 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.				
31	Improved community cohesion due to improved ability to control flood related risk and plan communities accordingly	Positive	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 would 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.	Downstream communities and LGAs	Possible	Moderate	C3- High

8.5 Estuary communities

8.5.1 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 Water Quality Assessment (Chapter 27 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 a 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. Modelling of flood affected property and land use completed by INSW as part of the Hawkesbury-Nepean Valley Flood Risk Management Strategy has defined inundation effects for various flood scenarios ranging from 1 in 5 chance in a year event to PMF. Flood effects were modelled as per current state and compared against the 'with Project' scenario. Outlined below is a summary of predicted effects for the LGAs Hornsby and Central Coast.

Hornsby LGA

The areas within the Hornsby LGA which are potentially affected by estuary flooding are confined the suburbs of Berowra Creek, Berowra Heights, Berowra Waters, Brooklyn, Canoelands, Cowan, Dangar Island, Fiddletown, Laughtondale, Milsons Passage and Singletons Mill. These suburbs stretch along the southern side of the Hawkesbury Estuary. The area is generally sparsely populated with much of the land designated as 'environmental conservation'.

A summary of residential property vulnerability to flooding in the Hornsby LGA- current state and with the Project is provided in Table 8-27.

Table 8-27. Residential property (numbers) affected by flooding in Hornsby LGA - existing and 'with Project'

Flood size	Existing risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total	Residential property	Manufactured homes	Total	Numerical change	Percentage change (%)
1 in 5	30	0	30	30	0	30	<10	<10
1 in 10	40	0	40	40	0	40	<10	<10
1 in 20	40	0	40	40	0	40	<10	<10
1 in 50	50	0	50	40	0	40	10	20
1 in 100	60	0	60	60	0	60	<10	<10
1 in 200	70	0	70	60	0	60	<10	<10
1 in 500	90	0	90	70	0	70	20	22
1 in 1,000	100	0	100	80	0	80	20	20
1 in 2,000	120	0	120	100	0	100	20	17
1 in 5,000	150	0	150	130	0	130	20	13
PMF	190	0	190	150	0	150	40	21

The dynamics of the floodplain whereby flood waters are constricted by narrow gorges prior to reaching the broader estuary also influences the effect of the Project on reducing the flood inundation in the estuary communities study area. 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 which represents 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.

With regard to commercial and industrial properties, there are very few in 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.

Central Coast LGA

The areas within the Central Coast LGA which are potentially affected by estuary flooding include the suburbs of Bar Point, Cheero Point, Cogra Bay, Gunderman, Little Wobby, Lower Mangrove, Marlow, Mooney Mooney, Mooney Mooney Creek, Mount White, Patonga, Spencer, Wendoree Park and Wondabyne. These suburbs are generally sparsely populated and stretch along the north side Hawkesbury Estuary surrounded by environmental conservation land. The most acutely flood affected suburbs in the Central Coast LGA are Mooney Mooney, Patonga, and Wondabyne.

A summary of residential property vulnerability to flooding in the Central Coast LGA- current state and with the Project is provided in Table 8-28.

Table 8-28. Residential property (numbers) affected by flooding in Central Coast LGA - existing and 'with Project'

Flood size	Existing risk (2018)			With Project			Change between 'existing' and 'with Project'	
	Residential properties affected by flooding			Residential properties affected by flooding			Residential properties affected by flooding	
	Residential property	Manufactured homes	Total	Residential property	Manufactured homes	Total	Numerical change	Percentage change (%)
1 in 5	50	140	190	40	130	180	10	5
1 in 10	60	160	220	50	150	210	10	5
1 in 20	70	170	240	60	160	220	20	8
1 in 50	90	170	260	80	170	250	10	4
1 in 100	110	180	290	100	170	270	20	7
1 in 200	130	180	310	110	180	290	20	6
1 in 500	150	180	330	130	180	310	20	6
1 in 1,000	160	190	350	140	180	330	20	6
1 in 2,000	190	190	370	160	190	350	20	5
1 in 5,000	220	190	410	190	190	380	30	7
PMF	260	190	450	220	190	410	40	9

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 flood 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 flood 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 flood.

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 5 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 Flooding and Hydrology Assessment of the EIS). 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.

8.5.2 Environment

8.5.2.1 Visual amenity

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. Changes to visual amenity may adversely affect these viewpoints, indirectly impacting people's enjoyment of the environment.

The landscape character and visual assessment completed as part of the EIS did not specifically assess any locations in the estuary communities study area. For those locations assessed in the downstream communities study area, a key determinant of impact was the effect which the Project would have in prolonging flood effects. This would also apply to the estuary communities study area, albeit to a lesser degree.

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. Whilst 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 may prolong disturbance of views. Following the application of mitigation measures as outlined in Section 9, the Project has the potential to generate a negative impact of moderate significance for members and tourists of the estuary communities study area through alteration of visual amenity associated with release of the FMZ.

8.5.2.2 Enjoyment of natural areas and native flora and fauna

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. However, following the application of mitigation measures as outlined in Section 9, this impact is assessed as being of a low level of significance for members and tourists of the estuary communities study area through disruption to the enjoyment of natural areas.

8.5.3 Community health and wellbeing

There are numerous semi-permanent styles of housing such as cabins and caravan parks across the estuary communities study area. Caravan parks are typically located on the banks of the river, taking advantage of high scenic amenity and ready access to recreational opportunities. As such, they are in a highly hazardous location in terms of floods.

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.

A key activity throughout the Hawkesbury Estuary is swimming and aquatic recreation. Discharge of water from the FMZ following a large flood event may result in such popular swimming and recreational locations experiencing higher water levels for a more prolonged period. However, the quality of water released from the FMZ would be high and therefore, no water quality impacts are expected in the estuary area. The outcome of the water quality assessment (Chapter 27 of the EIS) indicates there is no significant, long-term and adverse impacts on water quality are 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.

In summary, the Project has the potential to generate an extreme positive impact for residents living in vulnerable housing within the estuary communities study area. Further, the Project has the potential to generate a moderate negative impact for members of the estuary communities study area through occasional reduced access to services and health facilities. A low negative impact for recreation users within the estuary communities study area may also

be generated due to the health risk relating to a temporary reduction in water quality. Following the application of mitigation measures as outlined in Section 9, changes to community health and wellbeing is assessed as being of a low level of significance.

8.5.4 Culture and heritage

The Non-Aboriginal heritage assessment (Chapter 17 of the EIS) found that the anticipated impacts of the Project would generally result in a reduction of the number of heritage items that would be flooded during the nominated flooding events, or otherwise a reduction in the depth and duration of flooding for other heritage items. 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 flood water; 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, Wisemans Ferry to Bucketty (NHL Place ID 106318) and Ku-ring-gai Chase National Park, Lion, Long and Spectacle Island Nature Reserves (NHL Place ID 105817). The visual and physical assessment for Great North Road heritage site determined that the Project would not result in any significant impact or benefit to this site, both the existing and proposed PMF only encroaching upon a very minor portion of the southern and eastern boundary of the item's curtilage. These negligible areas of impact are located a considerable distance from significant elements within the Great North Road. Further, the Project would not result in no direct physical and visual impacts to the Ku-ring-gai Chase National Park heritage site. These areas are located a considerable distance downstream from the dam and in an area where marine influences and local catchment inflows dominate. Therefore, no or negligible changes in flood levels or regimes are anticipated.

In summary, the Project has the potential to generate a high positive impact for members and tourists of the estuary communities study area through enhancing protection of non-Aboriginal cultural heritage.

8.5.5 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. In 2012, the estimated cost to replace both berthed and moored vessels was valued at more than \$1.7 billion (Rolyat Services PTY Ltd 2013). Pittwater is the largest mooring and berthing area in the Hawkesbury Estuary with an estimated \$1.06 billion replacement value. Brooklyn's cost to replacement all vessels was \$100.8 million and Cowan Creek's cost to replacement all vessels was \$124.6 million (Rolyat Services PTY Ltd 2013). Brooklyn had 559 vessels moored and the Brooklyn area had 49 percent of moored houseboats on the estuary which was attributed to houseboat hiring businesses, such as Luxury Afloat, Holidays Afloat and Ripples Holiday Houseboats. The estimated annual operation and maintenance cost for all vessels across all of the sub-catchment was \$135.7 million for 2012-2013 (Rolyat Services PTY Ltd 2013). 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 2016/2017 (NSW DPI 2016). This has increased significantly from 2012/2013 where oyster aquaculture in the Hawkesbury River was valued at \$34,297. It is noted that the outbreak of QX disease occurred in 2004. This outbreak caused high mortality rates in Sydney Rock Oyster (DPI Fisheries 2006). The oyster industry in the Hawkesbury river recovered through replacing the Sydney Rock Oysters with Pacific Oysters. However, in 2013, the Pacific Oyster Mortality Syndrome (POMS) virus devastated local oyster farms. 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 will be detrimental to oyster aquaculture (NSW Government Department of Primary Industries 2017). With the Project, retaining flood water 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 of the Water Quality Assessment (Chapter 27 of the EIS) indicates that there is no significant, long-term and adverse impacts on water quality are 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.

In summary, the Project has the potential to generate a high positive impact for tourism and recreation-related businesses, relevant industries, recreational users and LGAs within the estuary communities study area through positive economic effects as a result of reduced flood related damage to property. However, there may be a negative impact on fishing and aqua-culture related industries and businesses within the estuary communities study area due

to occasionally, potential and additional economic losses. Following the application of mitigation measures as outlined in Section 9, this impact is assessed as being of a low level of significance.

8.5.6 Impact assessment summary - estuary communities

Table 8-29 summarises the socio-economic impacts discussed in Section 8.5 and assesses their significance rating as per the impact assessment methodology outlined in Section 4.5 for the Project's estuary communities study area.

Table 8-29. Summary of socio-economic impacts and their significance rating for the Project's estuary communities study area

No.	Impact	Positive/ negative	Description	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	<p>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 which represents 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.</p> <p>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.</p>	Estuary property owners inundated by flooding in a 1 in 100 chance in a year event	Possible	Minor	C2- Moderate

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
2	Increased duration of inhibited access to (and from) property due to release of the FMZ	Negative	A unique feature of the Hawkesbury Estuary are small riverside pocket communities which are only accessible by boat- such as the communities of Berowra Creek and Dangar Island. More prolonged flood conditions due to the release of the FMZ may result in inhibited access for areas in the Hawkesbury Estuary which are only accessible by boat. Turbidity and in stream floating objects associated with FMZ induced flood conditions may reduce the safety of marine transport, thereby preventing access to (or from) property.	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	A feature throughout the estuary 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 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 will be changed for a more prolonged period than currently occurs. Whilst 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 will prolong disturbance of views.	Estuary communities and tourists	Possible	Minor	C2- Moderate
4	Disruption to the enjoyment of natural areas	Negative	Throughout the estuary 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. However, following some major flood events, access to some popular natural destinations, such as Ku-ring-gai Chase National Park, Brisbane Water	Estuary communities and tourists	Unlikely	Minor	D2 - Low

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			<p>National Park and Dharug National Park may be restricted due to the release of the FMZ.</p> <p>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.</p>				
Community health and wellbeing							
5	Reduced risk to people living in highly vulnerable forms of housing	Positive	<p>Across the estuary 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.</p> <p>By reducing the frequency of smaller flood events (that is, 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.</p>	Estuary communities living in highly forms of housing	Likely	Major	B4 - Extreme
6	Occasional reduced access to services and health facilities	Negative	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.	Estuary communities	Unlikely	Moderate	D3- Moderate
7	Health risk relating to temporary reduction in water quality	Negative	A key activity throughout the Hawkesbury Estuary is swimming and aquatic recreation. Discharge of water from the FMZ following a large flood event may result in such popular swimming and recreational locations experiencing higher water levels for a more prolonged period. However, the quality of water released from the FMZ would be high and therefore, no water	Recreation users	Unlikely	Minor	D2- Low

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			quality impacts are expected in the estuary area. The outcome of Water Quality Assessment (Chapter 27 of the EIS) indicates there is no significant, long-term and adverse impacts on water quality are predicted in the estuary study area due to the release of water from the FMZ. Therefore, the Project would have no effect upon fish and prawns.				
Culture and heritage							
8	Enhanced protection of non-Aboriginal cultural heritage	Positive	The Non-Aboriginal Heritage Assessment (Chapter 17 of the EIS) found that the anticipated impacts of the Project would generally result in a reduction of the number of heritage items that would be flooded during the nominated flooding events, or otherwise a reduction in the depth and duration of flooding for other heritage items.	Estuary communities and tourists	Possible	Moderate	C3- High
Way of life							
9	Positive economic effects due to reduced flood related damage to property for fishing, recreation and aquaculture-related businesses	Positive	<p>The Hawkesbury Estuary is integral to the local economy and any change to conditions of the estuary would have economic implications.</p> <p>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.</p> <p>Fishing and marine aquaculture also make a key contribution to the local economy. Oyster aquaculture was reported to be worth \$437,664 for 2016/2017 (NSW DPI 2016). This has increased significantly from 2012/2013 where oyster aquaculture in the Hawkesbury River was valued at \$34,297. It is noted that the outbreak of QX disease occurred in 2004. This outbreak caused high mortality rates in Sydney Rock Oyster (DPI Fisheries 2006). The oyster industry in the Hawkesbury river recovered through replacing the</p>	Tourism and recreation-related businesses, relevant industries, recreational users, and estuary LGAs	Possible	Moderate	C3- High

No.	Impact	Positive/ negative	Description	Affected stakeholders	Impact assessment before mitigation/enhancement		Significance rating
					Likelihood	Consequence	
			<p>Sydney Rock Oysters with Pacific Oysters. However, in 2013, the POMs virus devastated local oyster farms. 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 will be detrimental to oyster aquaculture (NSW Government Department of Primary Industries 2017). With the Project, retaining flood water 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.</p> <p>In the Hawkesbury Estuary, Brooklyn is a centre for commercial fishing and prawn industries. The outcome of Water Quality Assessment (refer to Chapter 27 of the EIS) indicates that there is no significant, long-term and adverse impacts on water quality are predicted in the estuary study area due to the release of water from the FMZ. Therefore, the Project would have no effect upon fish and prawns.</p>				
10	Occasional, potential and additional economic losses for fishing and aquaculture-related businesses	Negative	The Hawkesbury Estuary is integral to the local economy and any change to conditions of the estuary would have economic implications. As a result of the discharge of the water stored in the FMZ following a major flood event, there would be occasional additional economic losses for fishing and aquaculture-related businesses. The outcome of Water Quality Assessment (refer to Chapter 27 of the EIS) indicates that there is no impact on water quality in the estuary study areas due to the release of water from the FMZ.	Fishing and aquaculture-related businesses and industries	Unlikely	Moderate	D3 - Moderate

9 Impact mitigation/enhancement and residual assessment

The social impact management strategies outlined in this SEIA seek to both enhance the benefits for the stakeholders and communities as well as mitigate negative impacts from the Project development. 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. The recommended management strategies were developed using adaptive management principles, recognising that impacts may change over time, and that ongoing monitoring of impacts would provide the flexibility to accommodate such changes.

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

- change 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. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed effective implementation of the proposed mitigation and enhancement measures.

The following tables (Table 9-1 for the local communities study area, Table 9-2 for the upstream communities study area, Table 9-3 for the downstream communities study area, and Table 9-4 for the estuary communities study area) provide impact mitigation and residual assessment in each SEIA study area. Positive impacts are indicated in blue.

Table 9-1. 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	<ul style="list-style-type: none">Establish a new walking trail for the public.Local communities and visitors will be notified about construction activities, the temporary closure of recreation venues, changes in the traffic arrangements and heavy vehicle routes during the construction period.Assess options to continue functions of the Visitor Centre at alternative location/s to ensure public safety during construction.Ongoing consultations with relevant State agencies and local government to identify and implement appropriate solutions to reduce disruption of areas surrounding the Project footprint.Consult with the local community to select a legacy project to be delivered upon construction completion:<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 Wollondilly LGA to offset the temporary closure of facilities within the construction area.	Almost Certain	Minor	A2 - High

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	
					<ul style="list-style-type: none"> Provide support to Wollondilly Council to assist with project-related administration and enquiries. 			
2	Construction – Delayed travel time in accessing properties due to increased construction traffic	Almost Certain	Minor	A2 - High	<ul style="list-style-type: none"> Implement the Construction Traffic Management Plan developed as part of the Traffic and Transport Assessment (Chapter 24 and Appendix O of the EIS. Installation of temporary traffic control measures and signage for safe movement of vehicles, pedestrians and cyclists accessing local community facilities, shopping centres and schools. Local communities will 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. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 	Possible	Minimal	C1 – Low
Environment								
3	Construction – Temporary negative visual impacts	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> Implement impact mitigation measures as outlined in the 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. 	Possible	Minor	C2 – Moderate

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	
4	Post construction – Positive landscape character	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> 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. 	Almost certain	Moderate	A3 – Extreme
5	Construction – Temporary noise impacts on social amenity	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> 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. Notify the community of construction activities in advance. 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. 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. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 	Likely	Minor	B2 – High
6	Construction – Temporary air quality impacts	Possible	Minor	C2 - Moderate	<ul style="list-style-type: none"> Develop and implement a Dust Management Plan which would include detailed mitigation 	Possible	Minimal	C1 - Low

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	
					measures such as enclosing dust generating activities, dust suppression and monitoring. <ul style="list-style-type: none"> 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. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 			
7	Construction – Temporary disruption to the enjoyment of natural surroundings	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> Clearing areas will be minimised during detailed design and construction. Rehabilitation and landscaping of the cleared and disturbed areas. Provide support to Wollondilly Council to assist with project-related administration and enquiries. Ongoing consultations with relevant state agencies and local governments to identify and implement appropriate solutions to reduce the disruption to the enjoyment of natural surroundings. 	Possible	Minor	C2 – Moderate
Community health and wellbeing								
8	Construction – Temporary risks to road safety due to construction traffic movements	Possible	Catastrophic	C5 - Extreme	<ul style="list-style-type: none"> 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. Implement road safety initiatives during construction. 	Possible	Moderate	C3 - High

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	
					<ul style="list-style-type: none"> Delivery of driver and community education and awareness initiatives regarding traffic safety. Improve traffic signage at key impacted localities to increase community and visitor awareness. Notify the community of construction activities in advance. Provide support to Wollondilly Council to assist with project-related administration and enquiries. Ongoing consultations with relevant state agencies such as Emergency Services, RMS and local governments. 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. 			
9	Construction – Temporary anxiety relating to community safety due to additional construction traffic movements	Possible	Minor	C2 - Moderate	<ul style="list-style-type: none"> 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. Delivery of driver and community education and awareness initiatives regarding traffic safety. Improve traffic signage at key impacted localities to increase community and visitor awareness. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 	Possible	Minimal	C1 - Low

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	
					<ul style="list-style-type: none"> Ongoing consultations with relevant state agencies such as Emergency Services, RMS and local governments. 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. 			
10	Construction – Temporary pressure on existing medical and emergency services due to influx of construction workforce	Possible	Minor	C2 - Moderate	<ul style="list-style-type: none"> 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. 	Unlikely	Minimal	D1 - Low
Culture and heritage								
12	Construction – Temporary and permanent disturbance of non-Aboriginal heritage items	Almost certain	Moderate	A3 - Extreme	<ul style="list-style-type: none"> Incorporation of heritage into the design such as through completion of a Heritage Interpretation Strategy. Photographic archival recording heritage items that may be damaged or destroyed by construction activities. Where feasible, retain and display significant heritage items as movable heritage. Development and implementation of a moveable heritage item strategy for items such as the Warragamba Supply scheme, including machinery, equipment, plaques, and memorials. 	Almost certain	Minor	A2 – High

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	
					<ul style="list-style-type: none"> Application of site remediation measures for the construction area including Haviland Park. Preparation of an archaeological research design to identify the need for archaeological testing and monitoring. Documentation of the condition of existing heritage items prior to disturbance, removal or change. 			
11	Construction – Temporary impacts on natural heritage (such as local parkland and native bushland flora and fauna)	Almost certain	Moderate	A3 - Extreme	<ul style="list-style-type: none"> Ensure that environmental impacts are offset, where possible, through implementation of the Biodiversity Offset Strategy. Clearing of vegetation will be minimised during detailed design and construction. Rehabilitation and landscaping of the cleared and disturbed areas. 	Almost certain	Minor	A2 - High
Way of life								
13	Construction – Temporary generation of employment opportunities	Likely	Minor	B2- High	<ul style="list-style-type: none"> Provide a clear and efficient process for people to access information about employment and provide an opportunity to register interest in the Project. Liaise with local job network providers to provide information on employment opportunities to local job seekers. 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. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 	Likely	Moderate	B3 - High

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	
14	Construction – Temporary generation of commercial opportunities for businesses	Likely	Minor	B2- High	<ul style="list-style-type: none"> Develop a local procurement policy to encourage the Project's contactors, where possible, source their workforce and their suppliers for goods and services locally. Provide a process for local businesses to register interest in project-related supplier and service provider opportunities. Work with the local networks and local businesses to organise and plan for how to benefit from the incoming workforce. Work with government stakeholders to build businesses' capacity through business development and mentoring. Work with the local networks and local businesses to organise and plan for how to benefit from the Project. Liaise with local job network providers to provide information on employment opportunities to local job seekers. Provide support to Wollondilly Council to assist with project-related administration and enquiries. 	Likely	Moderate	B3 - High
15	Construction – Perceived temporary negative effects on Tourism industry	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> 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. Assess options to continue functions of the Visitor Centre at alternative location/s whilst ensuring public safety during construction. Ongoing consultations with relevant State agencies and local government to identify and implement appropriate solutions to reduce 	Likely	Minor	B2 - High

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	
					disruption of areas surrounding the Project footprint. <ul style="list-style-type: none"> Work with the local networks and local businesses to organise and plan for how to benefit from the Project. Consult 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 Wollondilly LGA to offset the potential temporary closure of facilities within the construction area. 			
16	Post construction – Increase in visitation numbers to the Dam	Possible	Minor	C2 - Moderate	<ul style="list-style-type: none"> Consult with the local community to select a legacy project to be delivered upon construction completion. Establish a new walking trail for the public. Provide information regarding the Project to tourism related agencies to assist them promote the area as a tourism attraction. After construction, add project information to the Visitor Centre display. 	Likely	Minor	B2 - High
17	Construction – Temporary impacts on community sentiment, cohesion, and resentment	Possible	Moderate	C3 – High	<ul style="list-style-type: none"> Work with the DamFest committee to support its ongoing success during the four-year construction phase. 	Possible	Minor	C2 - Moderate

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	
					<ul style="list-style-type: none"> Workforce fundraising to contribute to local Warragamba initiative/s as voted by the community. Development and implementation of a Code of Conduct for the workforce. Actively engage with local communities to understand concerns and expectations and identify mitigation measures. Provision of regular Project construction updates to the community. 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. 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. On-site parking for all construction vehicles. 			

Table 9-2. Upstream 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	<ul style="list-style-type: none">Regular engagement with local communities (as through 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.	Possible	Minor	C2 – Moderate
2	Operation -Community concern regarding effects on National Parks	Likely	Minor	B2- High	<ul style="list-style-type: none">Regular engagement with local communities (as through 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.	Possible	Minor	C2 – Moderate

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	
					<ul style="list-style-type: none"> Implementation of EMP measures which also aid in maintaining the environmental condition of the National Parks. 			
3	Operation - Direct effects on two private properties due to temporary and partial inundation of land	Almost Certain	Minor	A2-High	<ul style="list-style-type: none"> Regular engagement with the two impacted property owners (through a Community and Stakeholder Engagement Plan.) to explain actual impacts/benefits, understand concerns and identify mitigation measures. 	Almost Certain	Minimal	A1-High
4	Operation -Changed access to properties at Yerranderie	Unlikely	Minor	D2-Low	<ul style="list-style-type: none"> Regular engagement with local communities (as through 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. 	Unlikely	Minimal	D1 – Low
Environment								
5	Operation -Alteration to upstream iconic viewsheds	Unlikely	Major	D4- High	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Regular engagement with local communities (as per a Community and Stakeholder Engagement Plan) to explain actual impacts/benefits, understand concerns and identify mitigation measures. 	Possible	Minor	C2 - Moderate

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	
					<ul style="list-style-type: none"> 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. 			
Community health and wellbeing								
8	Operation - Health effects associated with heightened anxiety	Unlikely	Moderate	D3 - Moderate	<ul style="list-style-type: none"> Regular engagement with local communities (as through a Community and Stakeholder Engagement Plan.) to explain actual impacts/benefits, understand concerns and identify mitigation measures. 	Unlikely	Minor	-D2 - Low
Culture and heritage								
9	Operation- Negative effects on Aboriginal cultural heritage	Likely	Moderate	B3 - High	<ul style="list-style-type: none"> Provide opportunities for the Aboriginal community to be involved in the management of cultural sites and the landscape. 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. Conduct heritage awareness training which can be incorporated into the site inductions for both employees and sub-contractors involved 	Possible	Minor	C2 - Moderate

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	
					in the operation of the Dam and activities in the catchment of Lake Burragorang. <ul style="list-style-type: none"> Ensure ongoing active engagement with traditional custodians, including through the Gundungurra Indigenous Land Use Agreement and other key stakeholder groups. 			
10	Operation – Negative effects on natural heritage	Possible	Moderate	C3 - High	<ul style="list-style-type: none"> Ensure that environmental impacts are offset, where possible, with a biodiversity offset strategy. Create a dedicated offset fund to specifically address any impacts from the Project. 	Possible	Minor	C2- Moderate
Way of life								
121 1	Operation- Reduced tourism visitation due to perceived environmental impacts	Possible	Minor	C2- Moderate	<ul style="list-style-type: none"> Implementation of EMP measures which also aid in maintaining the environmental condition of the catchment. 	Possible	Minimal	C1 - Low
12	Operation-Reduction in revenue for nature-based recreation businesses due to perceived environmental impacts	Unlikely	Moderate	D3- Moderate	<ul style="list-style-type: none"> Regular engagement with local communities, tourism businesses and groups (as through 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	<ul style="list-style-type: none"> Regular engagement with local communities (as through a Community and Stakeholder Engagement Plan.) to explain actual impacts/benefits, understand concerns and identify mitigation measures. 	Possible	Minor	C2 - Moderate

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	
					<ul style="list-style-type: none"> 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. 			
14	Operation- Polarisation of community sentiment resulting in reduced community cohesion	Possible	Moderate	C3- High	<ul style="list-style-type: none"> 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 might be impacted by the Project as per the Project's Community and Stakeholder Engagement Plan.. 	Possible	Minor	C2 - Moderate

Table 9-3. Downstream 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	<ul style="list-style-type: none">During floods, WaterNSW will implement operating protocols to minimise downstream impacts.Work with relevant State agencies and local governments to build community awareness on flood risks and specifically the effect which the Project has upon flood risk.	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	
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	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant State agencies and local governments 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	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant State agencies and local governments 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 and improved evacuation) in the LGA of Hawkesbury	Almost certain	Major	A4- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant State agencies and local governments to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. 	Almost certain	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)	Almost certain	Moderate	A3- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant State agencies and local governments 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	Possible	Moderate	C3- High	<ul style="list-style-type: none"> Work with relevant agencies to develop and implement updated Emergency Evacuation Plans. 	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	
	property due to longer duration of the FMZ discharge				<ul style="list-style-type: none"> Inform stakeholders on the duration of inhibited access to (and from) properties due to release of the FMZ. 			
Environment								
7	Alteration of visual amenity associated with release of the FMZ	Possible	Minor	C2- Moderate	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Not applicable 	Likely	Minor	B2- High
9	Operation – Disruption to the enjoyment of natural areas and the flora and fauna they support	Unlikely	Minor	D2 - Low	<ul style="list-style-type: none"> Ensure that environmental impacts are offset, where possible, with a Biodiversity Offset Strategy. Ongoing consultations with relevant state agencies and local governments 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	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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. 	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	
					<ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
11	Enhanced safety due to improved ability to evacuate communities	Almost certain	Major	A4- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Almost certain	Major	A4- Extreme
12	Reduced risk to people living in highly vulnerable forms of housing	Almost certain	Major	A4- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	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	
					the Hawkesbury-Nepean Valley Flood Risk Management Strategy.			
13	Reduced risk to vulnerable people living in social housing at risk of flooding	Likely	Major	B4 – Extreme	<ul style="list-style-type: none"> 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. Project's Community and Stakeholder Engagement Plan to include inclusive and participatory engagement modes, including consideration of different languages. WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Likely	Major	B4 - Extreme
14	Operation – Reduced levels of flood risk awareness, reduced (individual) flood disaster planning and increased complacency	Possible	Minor	C2- Moderate	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	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	
					<ul style="list-style-type: none"> Work with relevant agencies to develop and implement updated Emergency Evacuation Plans. 			
15	Operation – Improved access to key services, and health facilities	Possible	Moderate	C3- High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	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	<ul style="list-style-type: none"> Implement the impact mitigation measures as per Transport and Traffic Assessment Report. Work with relevant agencies to develop and implement updated Emergency Evacuation Plans. During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. WaterNSW will continue to work with the relevant NSW Government agencies to support 	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	
					the Hawkesbury-Nepean Valley Flood Risk Management Strategy.			
17	Health risk relating to temporary reduction in water quality	Unlikely	Minor	D2 - Low	<ul style="list-style-type: none"> Regular monitoring of water quality and application of corrective measures as required. Work with relevant state agencies and local governments to build community awareness on flood risks and specifically the effect which the Project has upon flood risk. 	Unlikely	Minimal	D1 - Low
18	Reduced adverse effects on mental health due to reduced experience of severe flood events	Likely	Major	B4 - Extreme	<ul style="list-style-type: none"> Provision of mental health support to those affected by flood events 	Likely	Major	B4 - Extreme
19	Reduced economic costs related to mental health issues associated with flooding	Likely	Major	B4 - Extreme	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. 	Possible	Major	C4- 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	
					<ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
23	Potential effects on listed cultural heritage due to release of the FMZ	Unlikely	Moderate	D3- Moderate	<ul style="list-style-type: none"> 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Unlikely	Minor	D2 - Low
Way of life								
24	Positive economic effects due to reduced flood related damage to property	Almost certain	Major	A4- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	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	
					Project's Community and Stakeholder Engagement Plan. <ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
25	Reduced risk of people permanently and temporarily losing access to housing and accommodation	Almost certain	Major	A4- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Almost certain	Major	A4- Extreme
26	Improved confidence in housing market and potential reduction in insurance premiums at individual properties	Possible	Moderate	C3- High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	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	
					Project's Community and Stakeholder Engagement Plan. <ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
27	Potential reduction in insurance premiums at individual properties	Possible	Moderate	C3 - High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Almost certain	Moderate	A3- Extreme
28	Reduction in flood related economic losses for agricultural and industrial businesses	Almost certain	Moderate	A3- Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	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	
					Project's Community and Stakeholder Engagement Plan. <ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
29	Occasional additional economic losses for agricultural and industrial businesses	Possible	Moderate	C3- High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Possible	Minor	C2 - Moderate
30	Reduction in flood related economic losses for tourism and recreation related businesses	Almost certain	Minor	A2- High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	Almost certain	Minor	A2 - 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	
					Project's Community and Stakeholder Engagement Plan. <ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
31	Occasional additional economic losses for tourism and recreation related businesses	Possible	Minor	C2- Moderate	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Possible	Minimal	C1 - Low
32	Improved community cohesion due to improved ability to control flood related risk and plan communities accordingly	Possible	Moderate	C3- High	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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 	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	
					Project's Community and Stakeholder Engagement Plan. <ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			

Table 9-4 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		Residual 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	<ul style="list-style-type: none">During floods, WaterNSW will implement operating protocols to minimise downstream impacts.Work with relevant state agencies and local governments 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy.	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		Residual significance rating
		Likelihood	Consequence			Likelihood	Consequence	
2	Increased duration of inhibited access to (and from) property due to release of the FMZ	Possible	Moderate	C3- High	<ul style="list-style-type: none"> 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Possible	Minor	C2- Moderate
Environment								
3	Alteration of visual amenity associated with release of the FMZ	Possible	Minor	C2- Moderate	<ul style="list-style-type: none"> Not applicable 	Possible	Minor	C2 - Moderate
4	Disruption to the enjoyment of natural areas	Unlikely	Minor	D2 - Low	<ul style="list-style-type: none"> Not applicable 	Unlikely	Minor	D2 - Low
Community health and wellbeing								
5	Reduced risk to people living in highly vulnerable forms of housing	Likely	Major	B4 - Extreme	<ul style="list-style-type: none"> During floods, WaterNSW will implement operating protocols to minimise downstream impacts. Work with relevant state agencies and local governments 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. 	Likely	Major	B4 - Extreme

No.	ESTUARY 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	
					<ul style="list-style-type: none"> WaterNSW will continue to work with the relevant NSW Government agencies to support the Hawkesbury-Nepean Valley Flood Risk Management Strategy. 			
6	Occasional reduced access to services and health facilities	Unlikely	Moderate	D3 – Moderate	<ul style="list-style-type: none"> 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	Unlikely	Minimal	D1 - Low
7	Health risk relating to temporary reduction in water quality	Unlikely	Minor	D2- Low	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 Hawkesbury-Nepean Valley Flood Risk Management Strategy. 	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		Residual 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	<ul style="list-style-type: none">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 Hawkesbury-Nepean Valley Flood Risk Management Strategy.Work with relevant state agencies and local governments 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	<ul style="list-style-type: none">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 Hawkesbury-Nepean Valley Flood Risk Management Strategy.	Unlikely	Minor	D2 - Low

10 Conclusions

The key conclusion of this SEIA is that 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. However, avoiding the loss of human life is the most critical socio-economic benefit associated with the Project and one which outweighs all other considerations. A summary of the anticipated socio-economic impacts and benefits associated with the Project in each of the SEIA study areas is provided below.

10.1 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 Wollondilly LGA which are socially 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 changes 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 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 Wollondilly LGA 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 socio-economic impacts predicted to occur in the local communities study area is provided in Table 10-1.

Table 10-1. Summary of impacts – local communities study area

Impact description	Impact nature	Residual significance rating
Local communities		
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

10.2 Upstream communities

Upstream communities are confined to those 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 build 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 the GBM WHA. The community values the world heritage listing and has 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 social effects are limited to two privately owned lots which would be temporarily affected by inundation following a major flood event. In addition, whilst not a public access route, the temporary storage of flood waters would 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 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 opinion which can have a negative effect on community relationships and networks and resultant erosion of community cohesion.

WaterNSW has recognised the potential socio-economic changes 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 GBMWhA Advisory Committee and state/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 GBMWhA
- 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 10-2.

Table 10-2. Summary of impacts –upstream study area

Impact description	Impact nature	Residual significance rating
Upstream communities		
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
Operation – Health effects associated with heightened anxiety	Negative	Low
Operation – Changed access to properties at Yerranderie	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

10.3 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. In a 1 in 100 chance in a year event it is estimated that 64,000 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 State agencies and local governments to build community awareness on flood risks and specifically the effect which the Project has upon 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 owners 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 10-3.

Table 10-3. Summary of impacts – downstream study area

Impact description	Impact nature	Residual significance rating
Downstream communities		
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	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

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 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 (primarily limited to Wisemans Ferry)	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
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

10.4 Estuary communities

The estuary communities study area encompasses the area from Wisemans Ferry down 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 live in areas adjacent to the estuary itself due to the high levels of restriction on residential development enforced by state agencies and Councils. 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 per year.

The overall effect of the Project on socio-economic conditions in the estuary communities study area are 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 fish, oyster and prawn industries.

To maximise the benefits which the Project would deliver and mitigate potential socio-economic impacts, WaterNSW has made numerous 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 10-4.

Table 10-4. Summary of impacts – the estuary study area

Impact description	Impact nature	Residual significance rating
Estuary communities		
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 aqua-culture businesses	Negative	Low

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Appendix A SEIA regional downstream study area - Profile of Hawkesbury Shire Council

Hawkesbury LGA socio-demographic profile**Community Overview³⁰³¹**

- The Hawkesbury Local Government Area is located towards the outer north west of the Sydney metropolitan area. It is located about 50 kms and approximately one hour's drive from the central business district.
- European settlement dates from 1794 when 22 farms were established at the settlement on the Hawkesbury River. By 1810 Governor Lachlan Macquarie named four of the five Macquarie Towns in the area: Pitt Town, Richmond, Wilberforce and Windsor (originally The Green Hills). Gradual growth took place from the early 1800s. More substantial growth took place from the 1860s into the early 1900s with improved transport and industry. Significant development occurred in the post-war period, particularly during the 1970s and 1980s. The population increased from nearly 29,000 in 1976 to about 38,000 in 1981, and then to about 50,000 in 1989. The population continued to increase during the 1990s, although at a slower rate, rising from about 51,000 in 1991 to about 61,000 in 2001. The population was relatively stable between 2001 and 2006, and then rose slightly between 2006 and 2011. As of 2011, the finalised estimated resident population (ERP) figure for Hawkesbury City was 64,234 (ABS, Cat. No. 3218.0 - Regional Population Growth, Australia, 2013).
- Hawkesbury City is predominantly comprised of national and state parks, with some residential, commercial, industrial and military land use. The City encompasses a total land area of about 2,800 square kilometres, of which more than 70 percent is National Park. The Hawkesbury is divided by 5 river systems; the Nepean, Hawkesbury, Grose, Colo and MacDonald rivers. The main population centres are Windsor and Richmond, with urban areas also in many small townships and localities. Most of the population live in the south-eastern section of the City.
- Hawkesbury City is served by Bells Line of Road, Singleton Road, Wollombi Road, Richmond-Blacktown Road, and the Western railway line.
- Major features of Hawkesbury City include Blue Mountains National Park, Cattai National Park (Mitchell Park), Scheyville National Park, Wollemi National Park, Yengo National Park, RAAF Base Richmond, Western Sydney University (Hawkesbury Campus), TAFE NSW Western Sydney Institute (Richmond College), the Windsor and Richmond CBDs (including various shopping centres and malls), Parr State Conservation Area, Windsor Downs Nature Reserve, Yellomundee Regional Park, Crago Observatory, Pitt Town Lagoon, Hawkesbury Race Club, Hawkesbury Showgrounds, various business and industrial districts, numerous accommodation places, Hawkesbury District Health Service, the Hawkesbury/Nepean River and various ferries.

Demographic profile**Population³²**

- The usual resident population of the Hawkesbury City at June 30, 2016 was 64 592 persons.
- In 2016, the residents of Hawkesbury LGA occupied 24 099 dwellings, with an average household size of 2.79 people, similar to Greater Sydney (³³2.72 persons per dwelling).
- The Hawkesbury has a population density of the Hawkesbury LGA is 0.24 person per hectare, which is substantially lower than 4.15 persons per hectare in Greater Sydney³⁴
- From 2011 to 2016, Hawkesbury City's population increased by 2,239 people (3.6%). This represents an average annual population change of 0.71% per year over the period.³⁵

³⁰ <https://profile.id.com.au/hawkesbury/about> 0806

³¹ Verbatim from <https://www.hawkesbury.nsw.gov.au/council/about-council/the-hawkesbury-area>

³² Accessed 4 June 2018, <https://profile.id.com.au/hawkesbury>

³³ <https://profile.id.com.au/australia/population?WebID=250> 1406

³⁴ <https://profile.id.com.au/australia/about?WebID=250> 1406

³⁵ <https://profile.id.com.au/hawkesbury/population?WebID=10> 1806

Hawkesbury LGA socio-demographic profile
<ul style="list-style-type: none"> In 2016, the Aboriginal and Torres-Strait Islander population of the Hawkesbury LGA (3.7%) was more than double that in Greater Sydney (1.5%)³⁶ In 2016, 12% of the population of the Hawkesbury were born overseas, about a third of that of Greater Sydney at 37%. For the same period, only 6% of Hawkesbury residents spoke a language other than English at home, compared to 36% of people in Greater Sydney³⁷.
<p>Population Projections³⁸</p> <p>The population of Hawkesbury LGA is expected to increase to 2036³⁹. Comparatively, the population of Greater Sydney is anticipated to increase to 6 599 601 people between by 2036⁴⁰.</p>
<p>Age profile</p> <ul style="list-style-type: none"> The median age of residents of the Hawkesbury in 2016 was 38 years old, about the same of Greater Sydney (36 years old)⁴¹. Hawkesbury City had a similar proportion of pre-schoolers and a higher proportion of persons at post retirement age than Greater Sydney in 2016. Overall, 24.2% of the population was aged between 0 and 17, and 19.7% were aged 60 years and over, compared with 22.2% and 19.0% respectively for Greater Sydney. The largest portion of people in the Hawkesbury LGA were Parents and homebuilder (35-49 years old), who made up 20.1% of the resident population. Similarly, this was also the largest age bracket in Greater Sydney, making up a similar proportion of total residents at 21.1% in 2016. The major differences between the age structure of Hawkesbury City and Greater Sydney were: A larger percentage of 'Older workers and pre-retirees (50 to 59)' (13.9% compared to 12.2%) A larger percentage of 'Secondary schoolers (12 to 17)' (8.3% compared to 6.9%) A smaller percentage of 'Young workforce (25 to 34)' (12.4% compared to 16.1%), A smaller percentage of 'Parents and homebuilders (35 to 49)' (20.1% compared to 21.1%) Between 2011 and 2016, the Young workforce has increased in the Hawkesbury LGA, as have older workers, retirees, seniors and the elderly. while the portion of families was reduced. The largest changes in the age structure in this area were in the age groups: Seniors (70 to 84) (+1.5%) Older workers and pre-retirees (50 to 59) (+0.8%) Empty nesters and retirees (60 to 69) (+0.9%) Young workforce (25 to 34) (+0.6%) ⁴²The major differences between the age structure of Hawkesbury City and Greater Sydney were: A larger percentage of persons aged 15 to 19 (7.1% compared to 6.0%), A smaller percentage of persons aged 30 to 34 (5.9% compared to 8.1%), A smaller percentage of persons aged 35 to 39 (5.8% compared to 7.4%), A smaller percentage of persons aged 25 to 29 (6.6% compared to 7.9%)
<p>Gender profiles</p> <ul style="list-style-type: none"> In 2016, the Hawkesbury population was 50.5% female and 49.5% male. The male to female to male population is in keeping with Greater Sydney, at 50.7% female, 49.3% male (2016⁴³).

³⁶ <https://profile.id.com.au/hawkesbury/highlights-2016> 0406

³⁷ <https://profile.id.com.au/hawkesbury/highlights-2016> 0806

³⁸ <http://www.planning.nsw.gov.au/research-and-demography/demography/population-Projections> 1406

³⁹ NSW population Projections

⁴⁰ <http://infrastructureaustralia.gov.au/policy-publications/publications/files/Background-paper-on-demographic-Projections.pdf> 1406

⁴¹ <https://profile.id.com.au/hawkesbury/service-age-groups?WebID=10> 0706

⁴² <https://profile.id.com.au/hawkesbury/five-year-age-groups> 04062018

⁴³ <https://profile.id.com.au/hawkesbury/population> 0706

Hawkesbury LGA socio-demographic profile
<p>Household structure and family composition⁴⁴</p> <ul style="list-style-type: none"> There were approximately 24 099 households in the Hawkesbury in 2016. The average household size was 2.79 persons per dwelling. In 2016, 36.6% of households were made up of couples with children, about the same as Greater Sydney at 35.3%. 19.5% were lone person households and 2.3% were group householders. The same household types made up 20.4% and 4.5% of Greater Sydney respectively. One parent families made up 11.8% of households in the Hawkesbury, compared to 10.4% of those in Greater Sydney. The number of households in Hawkesbury City increased by 798 between 2011 and 2016. The largest changes in family/household types in Hawkesbury City between 2011 and 2016 were: Couples without children (+233 households) Couples with children (+139 households) Lone person (+127 households) One parent families (-66 households)
<p>Education level</p> <ul style="list-style-type: none"> Analysis of the qualifications of the population in Hawkesbury City in 2016 compared to Greater Sydney shows that there was a lower proportion of people holding formal qualifications (Bachelor or higher degree; Advanced Diploma or Diploma; or Vocational qualifications), and a higher proportion of people with no formal qualifications. In 2016, substantially less people in the Hawkesbury LGA (39.5%) had a Year 12 qualification or equivalent than Greater Sydney (60.0%)⁴⁵ In 2016, 13.1% of people aged over 15 in Hawkesbury held Bachelor degree or higher, less than Greater Sydney average 28.1%. Both have increased from 2011 (11.5% and 24.1% respectively)⁴⁶. More people in the Hawkesbury LGA had no qualification (41.3%) than Greater Sydney (37.7%) The major differences between qualifications held by the population of Hawkesbury City and Greater Sydney were: A larger percentage of persons with Vocationals (27.0% compared to 15.1%) A larger percentage of persons with No qualifications (41.3% compared to 37.7%), and smaller percentage of persons with Bachelor or Higher degrees (13.1% compared to 28.3%) In the Hawkesbury, nearly half (45.9%) of residents left school in Year 10 or below, compared to 27.3% in Greater Sydney⁴⁷.
<p>Housing tenure</p> <ul style="list-style-type: none"> The total number of households in the Hawkesbury increased by 794 between 2011 and 2016 In the Hawkesbury LGA (2016), there were 24 094 private dwellings, 6.3% were unoccupied compared to 7.3% unoccupied private dwellings for Greater Sydney. In the Hawkesbury LGA, the average household size (2.79) was slightly larger than Greater Sydney (2.72) 84.8% of private dwellings in Hawkesbury were separate houses, compared to 55% in Greater Sydney In Hawkesbury City, 69% of households were purchasing or fully owned their home, 19.0% were renting privately, and 3.6% were in social housing in 2016.4.6% of Greater Sydney live in social housing.⁴⁸
<p>Economic profile</p>
<p>Total employment</p> <ul style="list-style-type: none"> In 2016, 32 329 Hawkesbury residents were employed. This equates to 95.7% of the labour force attending regular work, of which 65% worked full-time and 33% part-time. The employment rate of Greater Sydney was about the same at 94%.

⁴⁴ <https://profile.id.com.au/hawkesbury/households> 0706

⁴⁵ <https://profile.id.com.au/hawkesbury/schooling?WebID=10> 1806

⁴⁶ <https://profile.id.com.au/hawkesbury/qualifications> 0706

⁴⁷ <https://profile.id.com.au/hawkesbury/qualifications?WebID=10> 0706

⁴⁸ <https://profile.id.com.au/hawkesbury/tenure> 0806

Hawkesbury LGA socio-demographic profile
<ul style="list-style-type: none"> The number of employed people in Hawkesbury City increased by 1,157 between 2011 and 2016.⁴⁹
Unemployment rate <ul style="list-style-type: none"> Total unemployment Hawkesbury LGA in 2016 (4.3%) was lower than Greater Sydney (6.0%)⁵⁰
Total labour force <ul style="list-style-type: none"> Total labour force participation in the Hawkesbury LGA (65.3%) was slightly higher than for Greater Sydney (61.6%) in 2016. Between 2011 and 2016, the number of people employed in the Hawkesbury LGA showed an increase of 1,154, and the number unemployed showed a decrease of 68. In the same period, the number of people in the labour force showed an increase of 1,086 or 3.3%. In 2017, there were 28 050 local jobs in the Hawkesbury LGA.⁵¹
Occupations <ul style="list-style-type: none"> There were more technicians and trades workers in Hawkesbury City in 2016 than any other occupation. The three most common occupations in the Hawkesbury in 2016 were: Technicians and Trades Workers (18.6%) Clerical and Administrative Workers (15.1%) Professionals (14.8%). In combination these three occupations accounted for 48.5% of the employed resident population. In comparison, Greater Sydney employed 11.7% in Technicians and Trades Workers; 14.6% in Clerical and Administrative Workers; and 26.3% in Professionals.⁵² The major differences between the jobs held by the population of Hawkesbury City and Greater Sydney were: A larger percentage of persons employed as Technicians and Trades Workers (18.6% compared to 11.7%) A larger percentage of persons employed as Machinery Operators and Drivers (8.3% compared to 5.6%) A larger percentage of persons employed as Labourers (9.6% compared to 7.5%) A smaller percentage of persons employed as Professionals (14.8% compared to 26.3%)⁵³ Changes in occupation between 2011 and 2016 were small in the Hawkesbury LGA. The largest changes were: Community and Personal Service Workers (+276 persons), Managers (+233 persons), Labourers (+183 persons) Technicians and Trades Workers (+155 persons)⁵⁴
Industries of employment <ul style="list-style-type: none"> More Hawkesbury City residents worked in construction (15.2%) than any other industry in 2016. The three next largest industries were healthcare and assistance, retail trade, and education and training.⁵⁵ The major differences between the jobs held by the population of Hawkesbury City and Greater Sydney were: almost double the population working in construction (15.2% compared to 8.2%) more than seven times more people working in agriculture, forestry and fishing (2.9% compared to 0.4%), half of the proportion of people working in professional, scientific and technical services (4.6% compared to 9.8%) and less than half of the number of persons employed in financial and insurance services (2.3% compared to 6.4%).⁵⁶

⁴⁹ <https://profile.id.com.au/hawkesbury/travel-to-work?WebID=10> 0706

⁵⁰ <https://profile.id.com.au/hawkesbury/highlights-2016?WebID=10> 1806

⁵¹ <https://economy.id.com.au/hawkesbury> 0806

⁵² <https://profile.id.com.au/hawkesbury/occupations> 04062018

⁵³ <https://profile.id.com.au/hawkesbury/occupations?WebID=10> 0706

⁵⁴ <https://profile.id.com.au/hawkesbury/occupations?WebID=10> 1806

⁵⁵ <https://profile.id.com.au/hawkesbury/industries> 04062018

⁵⁶ <https://profile.id.com.au/hawkesbury/industries?WebID=10> 0706

Hawkesbury LGA socio-demographic profile
<p>Travel to work⁵⁷</p> <ul style="list-style-type: none"> In 2016, 44.2% of Hawkesbury LGA residents lived and worked in the area, and 49.3% travelled outside for work. 6.4% of workers had no fixed place of work, which is characteristic of the construction industry which is a leading industry in the Hawkesbury LGA. A lower portion of Hawkesbury residents utilised public transport to travel to work than Greater Sydney. 69.4% of workers in the Hawkesbury drove themselves to work in 2016, 4.9% travelled by train, and 0.5% by bus. Comparatively, 52.7% of people in Greater Sydney drove themselves to work, 16.2% travelled by train, and 6.1% by bus.
<p>Average income</p> <ul style="list-style-type: none"> The median weekly individual income of persons in the Hawkesbury (2016) was \$728, which is slightly higher than Greater Sydney (\$719/week) The median weekly household income of the Hawkesbury LGA (\$1668) was lower than Greater Sydney (\$1750/week)⁵⁸ In Hawkesbury City, 24.8% of households earned an income of \$2,500 or more per week in 2016⁵⁹. In 2016, 15.9% of households in the Hawkesbury had an income of less than \$650 and 18.5% of households had a weekly income of more than \$3000. Assuming all households were the same size, the 'medium highest' (\$892-\$1464/week) quartile was the largest income group in Hawkesbury LGA (30.6%) in 2016, which was larger than Greater Sydney (25.5%)⁶⁰
<p>Housing values</p> <ul style="list-style-type: none"> In 2016, 23% of households in the Hawkesbury were renting, paying a median of \$369 weekly rent. 40% of households had a mortgage, and median weekly mortgage payments were \$479⁶¹. For the quarter ending September 2017, median house sales in the Hawkesbury were \$720 000⁶²
<p>Need for assistance</p> <ul style="list-style-type: none"> In 2016, 3,046 people or 4.7% of the population in the Hawkesbury, reported needing help in their day-to-day lives due to disability⁶³.
<p>SEIFA rating</p> <ul style="list-style-type: none"> The 2016 SEIFA disadvantage rating for the Hawkesbury was 1028. The Greater Sydney SEIFA rating is 1020; Ku-ring-gai was the highest at 1121 and Brewarrina the lowest with a SEIFA score of 757⁶⁴. In 2016, 79.9% homes in Hawkesbury City had an internet connection, which was less than Greater Sydney (81.4%)⁶⁵ In 2016 there were estimated to be 231 homeless people in the Hawkesbury LGA⁶⁶
<p>Key opportunities and challenges</p> <p><i>Opportunities</i></p>

⁵⁷ <https://profile.id.com.au/hawkesbury/travel-to-work?WebID=10> 0706

⁵⁸ http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/1GSYD?opendocument 1406

⁵⁹ <https://profile.id.com.au/hawkesbury/household-income?WebID=10> 1806

⁶⁰ <https://profile.id.com.au/hawkesbury/equivalised-household-income-quartiles?WebID=10> 0806

⁶¹ <https://profile.id.com.au/hawkesbury/highlights-2016> 0706

⁶² <https://public.tableau.com/profile/facs.statistics#!/vizhome/RentandSales/Rent> 0706

⁶³ <https://profile.id.com.au/hawkesbury/assistance?WebID=10> 0706

⁶⁴ <https://profile.id.com.au/cws/seifa-disadvantage-small-area> accessed 04062018

⁶⁵ <https://profile.id.com.au/hawkesbury/internet-connection> 1406

⁶⁶ <https://profile.id.com.au/hawkesbury/highlights-2016> accessed 22062018

Hawkesbury LGA socio-demographic profile

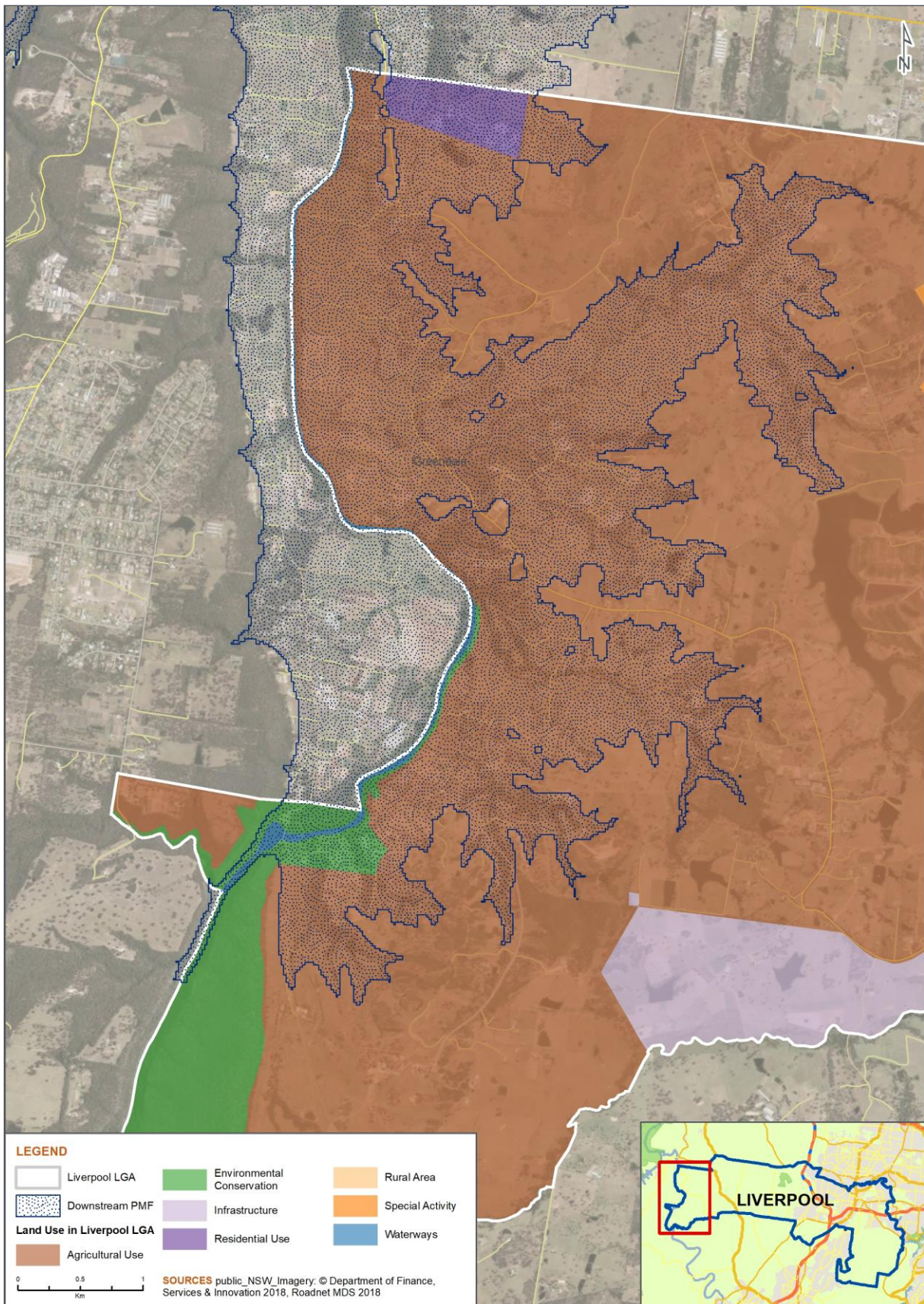
- A favourable region for retirees and the older population generally equates to lower crime and stable housing values
- The community is small and SEIFA disadvantage score could infer a reasonably high quality of life
- Residential development

Challenges

- Population growth and aging population requires adequate infrastructure and services
- Public transportation
- Balancing growth with traffic congestion
- Replenishing the workforce as the population ages
- Local jobs
- Managing the economic dependence on primary industries and construction

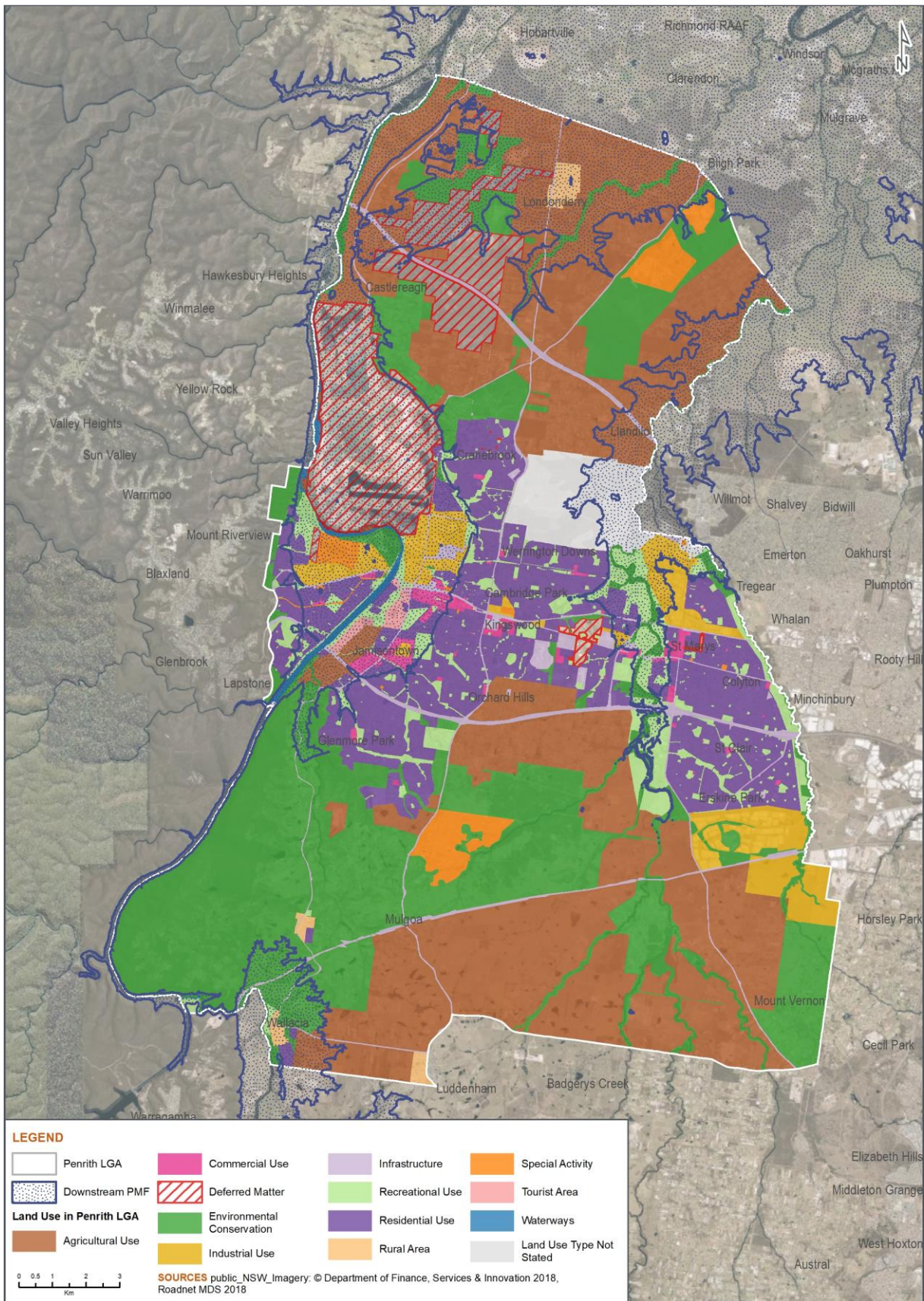
Appendix B Map of land use categories in each regional and local downstream study area

Map of land use categories in Liverpool

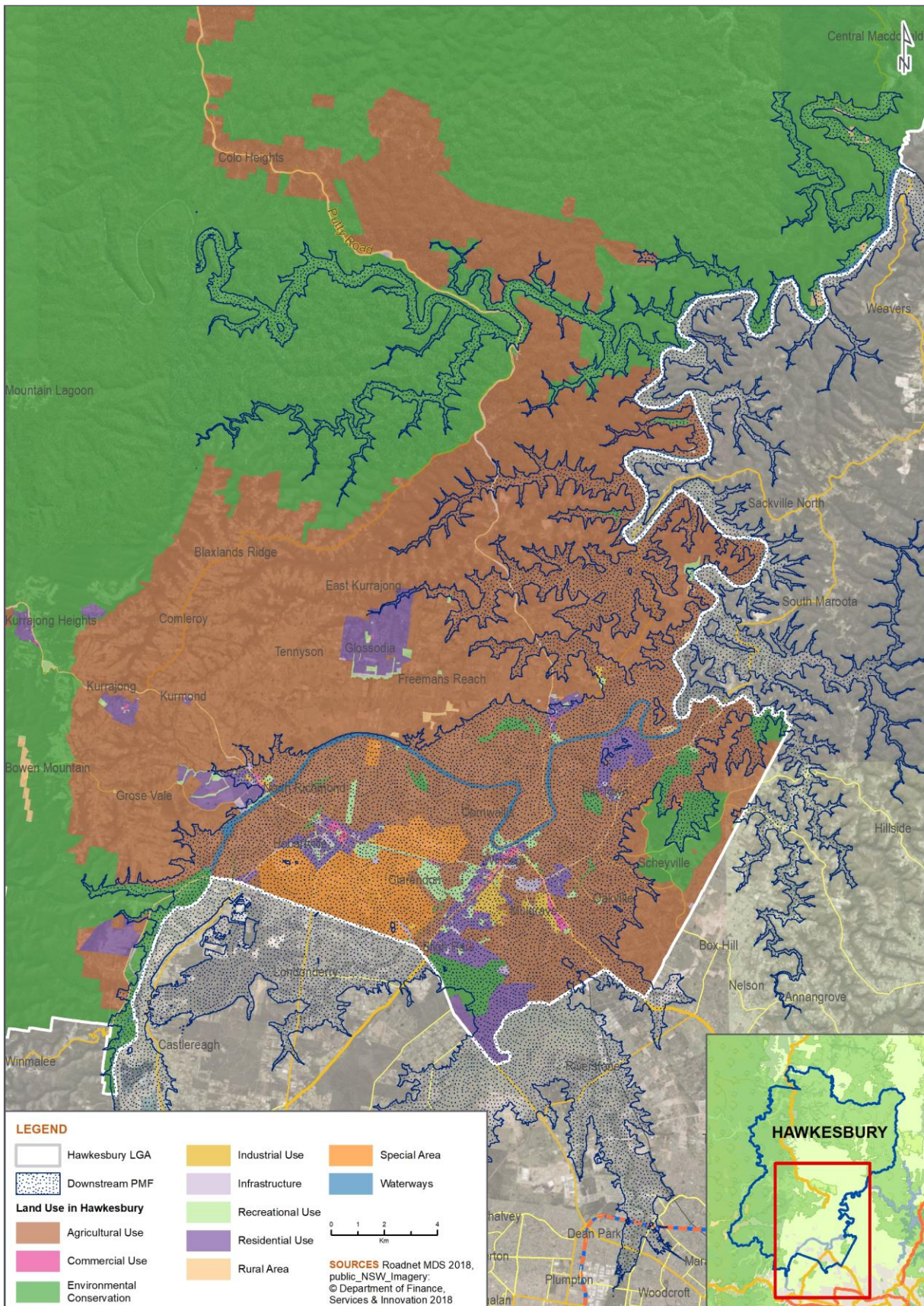


Source: SMEC 2019

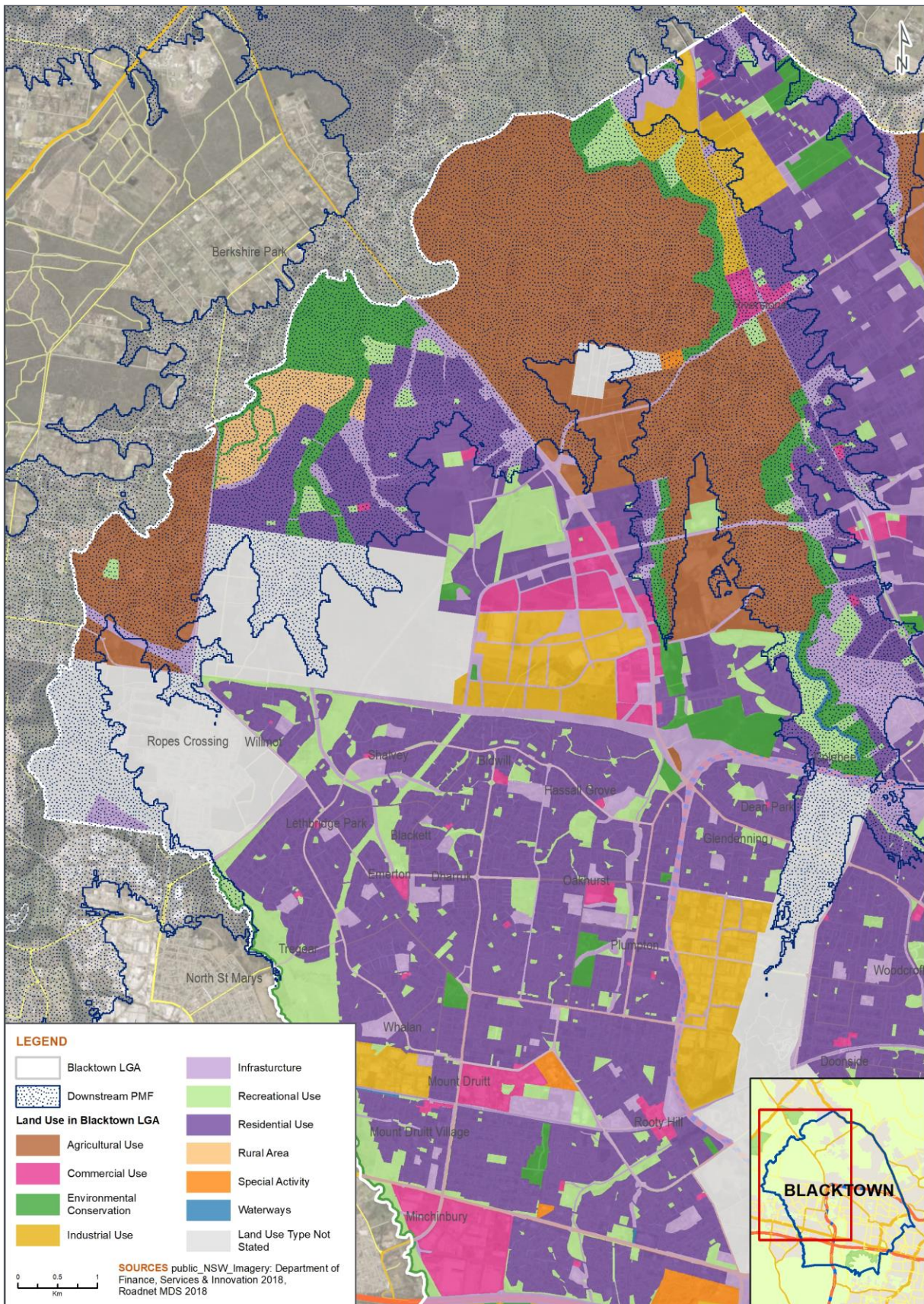
Map of land use categories in Penrith



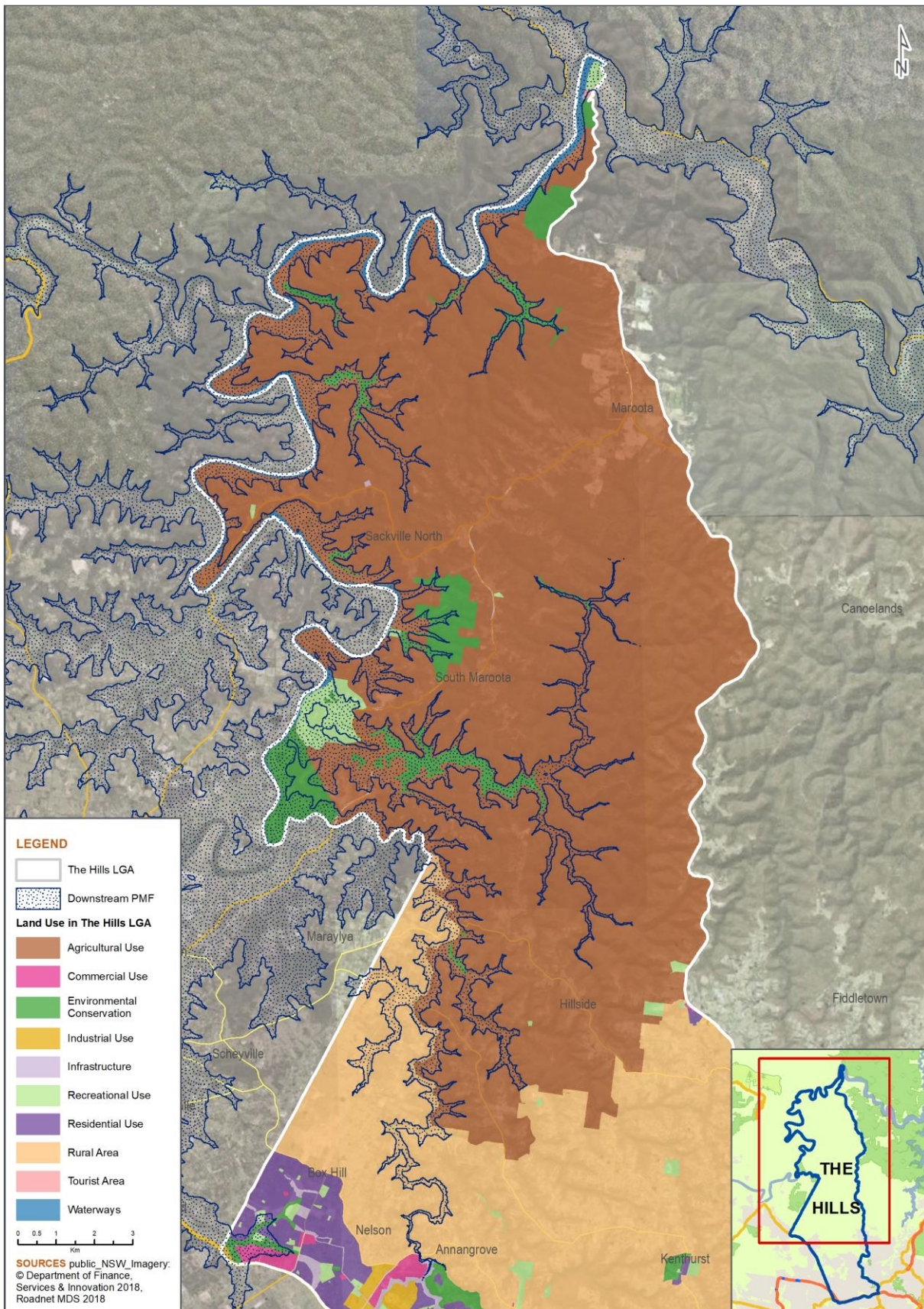
Map of land use categories in Hawkesbury



Map of land use categories in Blacktown



Map of land use categories in The Hills



Appendix C List of key regional open space and recreational areas in the downstream study area

Key regional open space and recreational areas in the downstream study area

LGA	Affected suburbs	List of key open space and recreation areas
Liverpool	Badgerys Creek	Agriculture land
	Greendale	Bents Basin State Recreation Area
	Luddenham	Agriculture land
	Wallacia	Blaxland Crossing Reserve Fowler Reserve
Penrith	Agnes Banks	Forest Agriculture land
	Berkshire Park	Berkshire Park Recreation Ground
	Castlereagh	Penrith Lakes Regional Park
	Claremont Meadows	Samuel Marsden Reserve Myrtle Road Reserve
	Cranebrook	Mountain View Reserve Lookout Cranebrook Park
	Emu Heights	Clissold Reserve
	Emu Plains	Dewdney Road Reserve Lions Park River Road Reserve Bunyarra Drive Reserve Regatta park Lions Park
	Glenmore Park	The Carriageway Reserve Apple Gum Reserve Richardson Place Reserve
	Jamisontown	Robinson Park Tench Reserve Cable Water Ski Park
	Leonay	Pamela Parade Reserve
	Llandilo	Wilson Park
	Londonderry	Londonderry Park
	Mulgoa	Agriculture land
	North St Marys	Boronia Park Robin Wiles Park
	Orchard Hills	Agriculture land
	Penrith	Burcher Park Brown Street Reserve Penrith Park Judges Park Soper Place Ladbury Avenue Reserve Woodriff Gardens Norman Peek Park Thornton Playground

LGA	Affected suburbs	List of key open space and recreation areas
		Bel-Air Road Reserve Weir Reserve Caloola Park Hickeys Park
	Regentville	Agriculture land Mulgoa Creek
	South Penrith	Barnett Street Reserve Mary Mackillop Park Jamison Park Smith Park
	St Marys	Cook Park Lang Park Kokoda Park Coachmans Park South Creek Park Jack Jewry Reserve
	Werrington	Armstein Crescent Reserve Parkes Avenue Reserve Werrington Creek Park Werrington Lakes Reserve John Batman Avenue Reserve
	Werrington County	Ellison reserve
Hawkesbury	Blaxlands Ridge	National Park
	Bligh Park	Colonial Reserve Bounty Reserve Bligh Park
	Central Macdonald	Dharug National Park Forest
	Clarendon	Rickaby Park Friendship Park
	Cornwallis	Agriculture Land
	Cumberland Reach	Forest
	East Kurrajong	Forest
	Ebenezer (NSW)	Forest
	Freemans Reach	Freemans Reach Reserve
	Glossodia	Agriculture land
	Grose Wold	Grose Wold Park Woods reserve
	Hobartville	Atkins Crescent Park
	Lower Macdonald	Forest
	Lower Portland	National Park
	Maraylya	Lions Park Maraylya Park

LGA	Affected suburbs	List of key open space and recreation areas
		Mitchell Park
	McGraths Hill	Colbee Park Kallawatta Park Picnic Area
	Mulgrave	Agriculture land
	North Richmond	Hawkesbury Park Hanna Park North Richmond Park Peel Park Terrace Park
	Oakville	Oakville Park Oakville Reserve
	Pitt Town	Pitt Town Nature Reserve
	Pitt Town Bottoms	Pitt Town Nature Reserve
	Richmond	Ham Common Park Richmond Park Icely Park Smith Park
	Richmond Lowlands	Bensons Lane Reserve
	Sackville	Forest
	Scheyville	Scheyville National Park
	South Windsor	South Windsor Park Mcleod Park Mason Park
	Vineyard	Vineyard Park
	Webbs Creek	Forest
	Wilberforce	Wilberforce Park Woodlands Park
	Windsor	Paine Park McQuade Park Howe Park Thompson Square Governor Phillip Park
	Windsor Downs	Windsor Downs Nature Reserve
	Yarramundi	Nepean Park Yarramundi Reserve
Blacktown	Colebee	Sunningdale Reserve Medallist Reserve
	Dean Park	Frank Flores Park
	Doonside	Nurragingy Reserve Gollan Park
	Glendenning	Hillview Park Joe McAleer Park Durawi Park

LGA	Affected suburbs	List of key open space and recreation areas
	Marsden Park	Marsden Park
	Quakers Hill	Melrose Park Greenhalgh Reserve Sherwood Park Quakers Hill Park Oppy Reserve Douglas Siding Reserve
	Riverstone	Knudsen reserve Riverstone Park Mill Street Reserve Ridgeview Park
	Ropes Crossing	Wianamatta Regional Park
	Schofields	Grange Avenue reserve Schofields Park Brinsley Park Boundary Road Reserve
	Shanes Park	Shanes Park
The Hills	Cattai	Cattai National Park
	Glenorie	Forest
	Leets Vale	Forest
	Maroota	Marramarra National Park
	Sackville North	Forest
	South Maroota	Maroota Ridge State Conservation Area South Marrota Reserve
	Wisemans Ferry	Wisemans Ferry Park

Source: SMEC 2018

Appendix D List of key infrastructure, facilities, and services in the local downstream study area

List of key infrastructure, facilities, and services in the local downstream study area

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
Liverpool	Badgerys Creek	No bus routes Key road network: Elizabeth Drive	Shares Education Services with Luddenham and other suburbs.	Shares Hospital with Penrith.	Shares police and emergency services with other suburbs	Shares Services with other suburbs
	Greendale	No bus routes Key road network: Mulgoa Road	The University of Sydney (Camden-John B Pye, Wolverson and Coates Park Farms) Shares Education Services with Wallacia and other suburbs.	Shares Hospital with Penrith.	Shares police and other emergency services with Warragamba.	Shares Services with other suburbs
	Luddenham	No bus routes Key road network: Northern Road	Luddenham Public School	Shares Hospital with Penrith.	Shares police and other emergency services with Warragamba.	Luddenham Uniting Church Catholic Church Workers Hubertus Country Club
	Wallacia	Bus Route Available Key road network: Mulgoa Road	Wallacia Public School	Shares Hospital with Penrith.	Shares police and other emergency services with Warragamba.	Wallacia Bowling and Recreation Club Wallacia Panthers Golf and Country Club Wallacia Progress Association Regal Oaks Village
Penrith	Agnes Banks	Bus route Available	Shares Services with Richmond and Penrith	Shares Services with Richmond and Penrith	Shares Services with Richmond and Penrith	Shares Services with Richmond and Penrith
	Berkshire Park	Bus route Available	Shares Services with surrounding suburbs	Shares Services with Richmond and Penrith	Berkshire Park Rural Fire Brigade John Morony Correctional Complex Dillwynia Womens Correctional Centre	Berkshire Park Hall
	Castlereagh	Bus route Available	Castlereagh Public School The Lakes Christian College	Shares Services with Richmond and Penrith	Castlereagh-Penrith Rural Fire Brigade	Christ Church, Castlereagh Castlereagh Hall
	Claremont Meadows	Bus route Available	Putland School	Shares Services with Penrith	Penrith SES	Windsor Samoan Assembly of God
	Cranebrook	Bus route Available	Braddock Public School Samuel Terry Public School	Shares Services with Penrith	Cranebrook Fire Station	Penrith Whitewater Stadium Greygums Oval Sydney International Regatta Centre St Thomas Anglican Church

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
	Emu Heights	Key road network: Old Bathurst Road Bus Route Available	Emu Heights Public School	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	Emu Heights Neighbourhood Centre
	Emu Plains	Emu Plains Railway Station Bus Route Available Key road network: Western Motorway; Great Western Highway	Nepean Creative and Performing Arts High School McCarthy Catholic College Emu Plains Emu Plains Public School Our lady of the way Primary School	Shares Services with Penrith	Emu Plains Correctional Centre Emu Plains Juvenile Justice Centre	Hunter Fields Darcy Smith Oval Dukes Oval Emu Plains Correctional Pool Lennox Shopping Centre Emu Plains Anglican Church Uniting Church in Australia Emu Plains Emu Plains Sporting and recreation Club Emu Plains Community Centre Melrose Hall Emu Plains Library The Arms of Australia Inn Edinglassie Village
	Glenmore Park	Key road network: Western Motorway Bus Route Available	Shares Education Services with other suburbs	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	Glenmore Heritage Valley Gold Club Floribunda Retreat Conference Centre
	Jamisontown	Key road network: Western Motorway Bus Route Available	Jamisontown Public School	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	Elevation Church Extended Hand Church
	Leonay	Key road network: Western Motorway Bus Route Available	Leonay Public School	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	Leonay Oval Leonay Centre
	Llandilo	Bus Route Available	Llandilo Public School	Shares Services with Penrith	Llandilo Rural Fire Service	St Davids Church St Mary and St Marina Coptic Orthodox Church Llandilo Community Centre
	Londonderry	Bus Route Available	Londonderry Public School	Shares Services with Penrith	Londonderry Rural Fire Brigade	Evangelical Presbyterian Church

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
						Londonderry Neighbourhood Centre Richmond Greyhound Racing Club
	Mulgoa	Bus Route Available	Mulgoa Public School Mulgoa Preschool Nepean Christian School	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	St Mary's Catholic Church Anglican Parish of Mulgoa Winbourne Retrea Conference Centre
	North St Marys	Bus Route Available	Chifley College Dunheved Campus	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	The Word Christian Mission Boronia House
	Orchard Hills	Key road network: Western Motorway Bus Route Available	Penrith Anglican College	Shares Services with Penrith	Orchard Hills Rural Fire Brigade	Imagine Nations Church Kingdom Hall of Jehovah's Witnesses
	Penrith	Penrith Railway Station Bus Route Available Key road network: Great Western Highway Great Western Highway Bridge	St Nicholas of Myra Primary School Nepean Tafe College Penrith Campus	NSW Penrith Ambulance Nepean Private Hospital Nepean Hospital Penrith Community Health Centre	Penrith Fire Station Penrith Court House Penrith Police Station	Howell Oval Penrith Stadium Andres Road Baseball Complex Penrith War Memorial Swimming Pool Nepean Square Penrith Plaza Church of Christ Penrith Uniting Church C3 Church Penrith Campus Sacred Church of the Holy Spirit Penrith Bowling and Rec Club Penrith RSL Club Nepean Rowing Club Penrith Rugby League Club Club Paceway Joan Sutherland Performing Arts Centre Lemongrove Lodge Nepean District Tennis Association North Penrith Community Centre

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
						Summitcare Penrith Mountainview Nursing Home Mountainview Retreat Retirement Village Penrith City Library Museum of Fire
	Regentville	Key road network: Western Motorway (M4); M4 Motorway Bridge Bus Route Available	Regentville Public School	Shares Services with Penrith	Regentville Fire Station Regentville Rural Fire Brigade	Regentville Hall
	South Penrith	Key road network: Western Motorway Bus Route Available	Shares Education Services with other suburbs	Shares Education Services with other suburbs	Shares police and emergency services with surrounding suburbs	
	St Marys	St Marys Railway Station Bus Route Available Key road network: Great Western Highway	St Marys Senior High School St Marys Public School Preschool St Marys Public School Our Lady of the Rosary Primary School Penrith Valley Learning Centre St Marys Flexible Learning Centre	Shares Services with Penrith	St. Marys Fire Station St Marys Police Station	Ripples Leisure Centre Blair Oval New Horizons Community Church Our Lady of the Rosary Church St Demetrios Greek Orthodox Church St Marys Uniting Church St Marys Corps St Marys RSL and Ex-Servicemens Club St Marys Band Club St Marys Rugby League Club Dunheved Golf Club St Marys Memorial Hall St Marys Senior Citizens Centre St Marys Community Centre St Marys Tennis Club Summitcare St Marys St Marys Library
	Werrington	Werrington Railway Station Bus Route Available	Montgrove College Werrington Campus	Shares Services with Penrith	Cobham Juvenile Justice Centre	Arthur Neave Memorial Tennis Centre

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
		Great Western Highway	Werrington Public School Kurrambee School Western Sydney University (Werrington) Wollemi College			Rance Oval Troy Adams Archery Field Hillsong Church Sydney Werrington Community Cottage Arthur Neave Memorial Hall
	Werrington County	Bus Route Available	Werrington County Public School	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	Namatjira Neighbourhood Centre
Hawkesbury	Blaxlands Ridge	Key road network: Putty Road	Shares Education Services with other suburbs	Shares Services with Richmond	Shares Services with Surrounding Suburbs	
	Bligh Park	Key road network: The Northern Road Bus Route Available	Bligh Park Public School	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Windsor District Baptist Church
	Central Macdonald	Key road network: St Albans Rd	Macdonald Valley Public School	Shares Services with Richmond/Wisemans Ferry	Shares Services with Surrounding Suburbs	
	Clarendon	Key road network: Hawkesbury Valley Way Bus Route Available	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Hawkesbury Riding Club
	Cornwallis	Bus Route Available	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	
	Cumberland Reach	Key road network: Putty Road Bus Route Available	Shares Education Services with other suburbs	Shares Services with Richmond	Shares Services with Surrounding Suburbs	
	East Kurrajong	Key road network: Sackville Road Bus Route Available	Shares Education Services with other suburbs	Shares Services with Richmond	Shares Services with Surrounding Suburbs	
	Ebenezer (NSW)	Key road network: Sackville Road Bus Route Available	Ebenezer Public School	Shares Services with Richmond	Ebenezer RFB	Ebenezer Church
	Freemans Reach	Bus Route Available	Hawkesbury High School Freemans Reach Public School	Shares Services with Windsor or Windsor	Freemans Reach Rural Fire Brigade	The Breakaway Ovals
	Glossodia	Bus Route Available	Shares Education Services with other suburbs	Shares Services with North Richmond	Shares police and emergency services with surrounding suburbs	
	Grose Wold	Bus Route Available	Shares Education Services with other suburbs	Shares Services with North Richmond	Shares police and emergency services with surrounding suburbs	

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
	Hobartville	Bus Route Available	Hobartville Public School Hobartville Day Care Pre-School	Shares Services with North Richmond	Shares police and emergency services with surrounding suburbs	Hobartville Shopping Centre P22. Muslim Prayer Room
	Lower Macdonald	Key road network: St Albans Road	Shares Education Services with other suburbs	Shares Services with Wisemans Ferry	Lower MacDonald Rural Fire Brigade	
	Lower Portland	Key road network: W Portland Road Ferry Crossing	Shares Education Services with other suburbs	Shares Services with Richmond	Lower Portland- Hawkesbury RFB	
	Maraylya	Bus Route Available	Marayla Public School	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Marayla Community Hall
	McGraths Hill	Key road network: Windsor Road Bus Route Available	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	McGraths Hill Shopping Centre Kingdom Hall of Jehovah's Witnesses McGraths Hill Community Centre
	Mulgrave	Mulgrave Railway Station Key road network: Windsor Road Bus Route Available	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	
	North Richmond	Key road network: Bells Line Road Bus Route Available	Colo High School Richmond North Public School	St John of God Richmond Hospital	Shares police and emergency services with surrounding suburbs	Turnbull Oval One R Church Hawkesbury Valley Baptist Church Richmond Kingdom Hall of Jehovah's Witnesses Panthers North Richmond North Richmond Community Centre Kingsford-Smith Village
	Oakville	Bus Route Available	Oakville Public School Arndell Anglican College	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	
	Pitt Town	Key road network: Pitt Town Road and Cattai Road Bus Route Available	Pitt Town Public School	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Pitt Town Shopping Centre Pitt Town Anglican Church Lynwood Country Club The Pitt Town and District Sports Club

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
	Pitt Town Bottoms	Key road network: Pitt Town Road	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	
	Richmond	Richmond Railway Station East Richmond Railway Station Key road network: Hawkesbury Valley Way Richmond Bridge Bus Route Available	Richmond Highschool Richmond Public School Aspect Western Sydney School Richmond Tafe College Western Sydney University (Richmond)	NSW Ambulance Shares Services with North Richmond	Richmond Court House	Richmond Indoor Cricket Richmond Club Sporting Complex Richmond Marketplace Richmond Mall Richmond LDS Chapel St Andrew's Uniting Church Richmond Anglican Church Hawkesbury Christian Reformed Church St Monicas Catholic Church Richmond Golf Club Richmond Club Richmond School of Arts Hawkesbury City Soccer Club Chesalo Care Richmond Richmond Community and RSL Nursing Home Richmond Branch Library Hawkesbury village
	Richmond Lowlands	Key road network: Cornwallis Road	Shares Education Services with other suburbs	Shares Services with North Richmond	Shares police and emergency services with surrounding suburbs	RAAF Richmond
	Sackville	Key road network: Sackville Road Ferry Crossing Bus Route Available	Shares Education Services with other suburbs	Shares Services with Richmond	Shares Services with Surrounding Suburbs	St Thomas Cemetery
	Scheyville	Key road network: Scheyville Road	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Phoenix Pistol Club
	South Windsor	Key road network: Northern Road Bus Route Available	Bede Polding College Chisholm Catholic Primary School Windsor South Public School	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Hawkesbury Indoor Stadium
	Vineyard	Vineyard Railway Station Bus Route Available	Vineyard Public School	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	Vineyard Church

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
		Windsor Road				
	Webbs Creek	Key road network: Bicentenary Road	Shares Education Services with other suburbs	Shares Services with Richmond/Wisemans Ferry	Shares Services with Surrounding Suburbs	
	Wilberforce	Wilberforce Road Bus Route Available	Wilberforce Public School	Shares Services with Windsor	Wilberforce Rural Fire Brigade Hawkesbury SES	Wilberforce Shopping Centre Saint Johns Church Woodlands Park Pony Club
	Windsor	Windsor Railway Station Bus Route Available Hawkesbury Valley Way Windsor Bridge	Windsor Highschool Windsor Park Public School Windsor Public School St Mathew's Primary School	Hawkesbury District Health Service Hawkesbury Community Health Centre Hawkesbury Community Mental Health Centre	Windsor Fire Station Windsor Local Court Windsor Police Station	McQuade Oval St Mathew's Anglican Church Windsor Strong Nation Church Windsor Seventh-day Advent Church Windsor Uniting Church Jar Bar (Place of Worship) Windsor Leagues Club Windsor RSL Club Windsor Country Golf Club Windsor Bowls Club Windsor Function Centre Upper Hawkesbury Power Boat Club Windsor Polo Club Fitzgerald Memorial Aged Care Facility Limited Windsor Library Windsor Country Village
	Windsor Downs	Key road network: Richmond Road Bus Route Available	Shares Education Services with other suburbs	Shares Services with Windsor	Shares police and emergency services with surrounding suburbs	
	Yarramundi	Key road network: Springwood Road	Shares Education Services with other suburbs	Shares Services with North Richmond	Yarramundi Rural Fire Brigade	YMCA Camp Yarramundi
Blacktown	Colebee	Bus Route Available	Shares Education Services with other suburbs	Shares Services with other suburbs	Shares police and emergency services with surrounding suburbs	Stonecutters Ridge Golf Club Stonecutters Ridge Neighbourhood Centre

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
	Dean Park	Key road network: Westlink M7 and Richmond Road Bus Route Available	William Dean Public School	Shares Services with other suburbs	Shares police and emergency services with surrounding suburbs	Dean Park Neighbourhood Centre St Elizabeth Home
	Doonside	Doonside Railway Station Bus Route Available	Doonside Public School Mountain View Adventist College Crawford Public School Doonside Technology High School St John Vianney's Primary School Kids' Early Learning Doonside North	Shares Services with other suburbs	Shares police and emergency services with surrounding suburbs	St John's Anglican Church Westview Baptist Church Mountain View Adventist Church
	Glendenning	Bus Route Available	Shares Education Services with other suburbs	Shares Services with other suburbs	Shares police and emergency services with surrounding suburbs	Saint Nirankari Satsang Bhawan
	Marsden Park	Key road network: Richmond Road Bus Route Available	Marsden Park Public School Australian Christian College Marsden Park	Shares Services with Penrith	Marsden Park Rural Fire Brigade	Baitul Huda Mosque
	Quakers Hill	Key road network: Westlink M7; Quakers Hill Pkwy Bus Route Available	Quakers Hill Public School Nirimba Tafe College Western Sydney University (Nirimba)	Shares Services with other suburbs	Quakers Hill Police Station	Life Anglican Church Catholic Church Quakers Hill Uniting Church The Church of Jesus Christ Of Latter Day Saints Quakers Hill Masjid Quakers Hill Community Hall
	Riverstone	Riverstone Railway Station Key road network: Riverstone Parade Railway Terrace Bus Route Available	Riverstone Public School St John's Primary School Casuarine School Riverstone Public School Preschool	NSW Ambulance	Riverstone Fire Station Riverstone Police Station	Riverstone Indoor Sports Centre Riverstone Swimming Centre Riverstone Baptist Church Riverstone Community Church of Christian Brethren St Andrew's Uniting Church Kingdom Hall of Jehovah's Witnesses Riverstone Schofields Memorial Club Riverston District Bowling and Recreation Club

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
						Riverstone Neighbourhood Centre & Community Aid Service Corporation Riverstone Library Blacktown City Bicentennial Museum
	Ropes Crossing	Ropes Crossing Blvd Palmyra Avenue Bus Route Available	Ropes Crossing Public School	Shares Services with Penrith	Ropes Crossing Fire Station	Rochford Place
	Schofields	Schofields Railway Station Railway terrace Schofields Road Bus Route Available	Wyndham College Schofields Public School	Shares Services with other suburbs	Schofields Rural Fire Brigade	Centro Sociale Italiano Club Schofields Community Centre
	Shanes Park	Bus Route Available	Shares Education Services with other suburbs	Shares Services with Penrith	Shares police and emergency services with surrounding suburbs	
The Hills	Cattai	Cattai/Wisemans Ferry Road Bus Route Available	Cattai Public School	Shares Services with Richmond	Shares Services with Surrounding Suburbs	
	Glenorie	Key road network: Old Northern Road Bus Route Available	Glenorie Public School Hillside Public School Glenorie Pre School	Glenorie District Medical Centre	Glenorie Volunteer Rural Fire Brigade	Glenorie Community Church (ACC) Glenorie Mission Church
	Leets Vale	Key road network: River Road	Shares Education Services with other suburbs	Shares Services with Richmond/Wisemans Ferry	Shares Services with Surrounding Suburbs	
	Maroota	Key road network: Old Northern Road Bus Route	Maroota Public School	Shares Services with Wisemans Ferry	Shares Services with Surrounding Suburbs	
	Sackville North	Key road network: Sackville Ferry Road	Brewongle Environmental Education Centre	Shares Services with Richmond	Sackville North RFB	
	South Maroota	Key road network: Wisemans Ferry Rd Bus Route Available	Shares Education Services with other suburbs	Shares Services with Richmond/Wisemans Ferry	South Maroota RFS	
	Wisemans Ferry	Key road network: Old Northern Road Ferry Crossing	Wisemans Ferry Public School	Wisemans Ferry Community Health Centre Shares Services with Richmond	Wisemans Ferry RFB Wisemans Ferry Police Station	Shopping Centre Wisemans Ferry Bowling Club Wisemans Ferry Golf Club

Appendix D List of key infrastructure, facilities, and services in the local downstream study area

LGA	Affected suburbs	Key transportation networks	Education services	Hospital and health services	Police, emergency services and justice	Other community and civic services
		Bus Route Available				Black Diamond Wakeboarding School Wisemans Ferry Community Centre

Appendix E Estuary communities study area – Profiles of LGAs

Hornsby LGA socio-demographic profile
<p>Community Overview⁶⁷</p> <p>Hornsby Shire is in Sydney's northern suburbs - about 25 kilometres from the Sydney CBD. Hornsby Shire is bounded by the Central Coast Council area and the Hawkesbury River in the north and north-east, Cowan Creek in the east, the Ku-ring-gai Council area, the City of Ryde and the City of Parramatta in the south, and The Hills Shire in the west.</p> <p>European settlement dates from 1794 when the first land grants were made along the Hawkesbury River, with land used mainly for farming. Development was slow, due to limited access. Some growth took place in the 1820s and the 1830s, following the opening of the Great North Road and other tracks. Early industries included citrus and stone fruit farming, salt production, flour mills and boat building. Growth continued in the 1880s and 1890s, especially in the south-eastern section, spurred by the opening of the Newcastle and North Shore railway lines. Hornsby CBD developed as a railway town, becoming the major centre of the Shire. In the 1920s poultry and egg production replaced citrus and stone fruits as the main industry. The most significant development took place from the post-war years, with the most rapid growth during the 1950s and 1960s. From the 1970s population growth began to slow down. The population gradually increased from the 1990s, rising from about 110,000 in 1991 to about 141,000 in 2016. Much of the growth during the 1990s was in the south-western suburbs of Castle Hill, Cherrybrook and Dural, with urban consolidation in and around the Hornsby CBD. Since 2001 there has been considerable medium and high-density development (apartments) in the Hornsby CBD and the neighbouring suburb of Waitara.</p> <p>Hornsby Shire is a predominantly rural and residential area, with some commercial and industrial land use. The Shire encompasses a total land area of about 460 square kilometres, of which two-thirds is National Park and reserves. Most of the land in the northern section is rural. The Shire has two major centres, with a major centre at Hornsby and a secondary centre at Pennant Hills. There are also many suburbs, villages, islands and river communities. Most residential areas are established suburbs, except for Castle Hill, Cherrybrook and Dural, which have developed in more recent decades.</p> <p>Hornsby Shire is served by the Pacific Highway, the Sydney-Newcastle Freeway, the Hills (M2) Motorway, Pennant Hills Road and the North Shore, Northern and Central Coast & Newcastle railway lines.</p> <p>Major features of the Shire include Ku-ring-gai Chase National Park, Marramarra National Park, Berowra Valley Regional Park, Dural Nature Reserve, Long Island Nature Reserve, Muogamarra Nature Reserve, Dangar Island, Milson Island, Asquith Golf Club, Pennant Hills Golf Club, Westfield Hornsby Shopping Centre, Hornsby Mall, TAFE NSW Northern Sydney Institute (Hornsby College), Hornsby Ku-ring-gai Hospital, Koala Park Sanctuary, Crosslands Reserve, Fagan Park, Thornleigh Brickpit Sports Stadium, Hornsby Aquatic and Leisure Centre, Galston Aquatic and Leisure Centre, the Hawkesbury River and the Great North Walk.</p>
<p>Demographic profile</p> <p>Population⁶⁸</p> <ul style="list-style-type: none"> ▪ The 2017 Estimated Resident Population for the Hornsby Shire is 149,242, with a population density of 3.28 persons per hectare, which is a ▪ The number of persons per household in the Hornsby LGA (2.86 persons per dwelling) was slightly higher than Greater Sydney (2.72 persons per dwelling) ▪ The population density of the Hornsby LGA (3.28 persons per hectare) was lower than Greater Sydney in 2016 (4.15 persons per hectare) ▪ Less people in the Hornsby LGA identified as Aboriginal or Torres Strait Islander (0.5%), than in Greater Sydney (1.5%) ▪ The same proportion of Hornsby residents were born overseas as Greater Sydney (37%), and a slightly lower proportion speak a language other than English at home (31% compared to 36%)⁶⁹.
<p>Population Projections</p>

⁶⁷ <https://profile.id.com.au/hornsby/about?WebID=10> accessed 070618

⁶⁸ <https://profile.id.com.au/hornsby/household-size?WebID=10> accessed 180618

⁶⁹ <https://profile.id.com.au/hornsby/highlights-2016?WebID=10> accessed 080618

Hornsby LGA socio-demographic profile
<ul style="list-style-type: none"> From 2011 to 2016, Hornsby Shire's population increased by 5,416 people (3.9%). This represents an average annual population change of 0.78% per year over the period.⁷⁰ The population of Hornsby LGA is Projected to reach 178,100 persons by 2036, growing at a rate of about 0.8% each year for the next two decades.⁷¹
<p>Age profile⁷²</p> <ul style="list-style-type: none"> The median age of Hornsby LGA residents (40 years old) is slightly higher than Greater Sydney (36 years old). Analysis of the service age groups of the Hornsby LGA in 2016 compared to Greater Sydney shows that there was a higher proportion of people in the younger age groups (0 to 17 years) as well as a higher proportion of people in the older age groups (60+ years). Overall, 23.7% of the population was aged between 0 and 17, and 21.7% were aged 60 years and over, compared with 22.2% and 19.0% respectively for Greater Sydney. The Hornsby LGA had a lower proportion of pre-schoolers and a higher proportion of persons at post retirement age than Greater Sydney in 2016. Overall, 23.7% of the population was aged between 0 and 17, and 21.7% were aged 60 years and over, compared with 22.2% and 19.0% respectively for Greater Sydney. The major differences between the age structure of the Hornsby Shire and Greater Sydney were: A larger percentage of 'Older workers and pre-retirees (50 to 59)' (13.8% compared to 12.2%) A larger percentage of 'Secondary schoolers (12 to 17)' (8.2% compared to 6.9%) A larger percentage of 'Seniors (70 to 84)' (8.6% compared to 7.5%) A smaller percentage of 'Young workforce (25 to 34)' (10.3% compared to 16.1%) The Hornsby LGA is an aging population. The largest changes in the age structure in Hornsby LGA between 2011 and 2016 were in the age groups: Seniors (70 to 84) (+1,609 people), Empty nesters and retirees (60 to 69) (+1,373 people) Primary schoolers (5 to 11) (+1,113 people) Older workers and pre-retirees (50 to 59) (+765 people)
<p>Gender profiles⁷³</p> <ul style="list-style-type: none"> In 2016, 51.2% of the Hornsby population were female, and 48.8% male
<p>Household structure and family composition⁷⁴</p> <ul style="list-style-type: none"> The number of households in Hornsby LGA increased by 1,267 between 2011 and 2016. In the Hornsby LGA, 45.4% of households were made up of couples with children in 2016, compared with 35.3% in Greater Sydney. Analysis of the household/family types in the Hornsby LGA in 2016 compared to Greater Sydney shows that there was a higher proportion of couple families with child(ren) as well as a lower proportion of one-parent families. Overall, 45.4% of total families were couple families with child(ren), and 8.8% were one-parent families, compared with 35.3% and 10.4% respectively for Greater Sydney. The major differences in the household size for the Hornsby LGA and Greater Sydney were: A larger percentage of households with 4 persons usually resident (22.8% compared to 18.1%) A larger percentage of households with 5 persons usually resident (9.1% compared to 8.0%) A smaller percentage of households with 1 person usually resident (17.4% compared to 21.6%) A smaller percentage of households with 2 persons usually resident (28.2% compared to 29.9%) In the Hornsby LGA there were a lower proportion of lone person households and a higher proportion of couples without children in 2016. Overall, the proportion of lone person households was 16.9%

⁷⁰ <https://profile.id.com.au/hornsby/service-age-groups?WebID=10> accessed 070618

⁷¹ Hornsby Population Projection

⁷² <https://profile.id.com.au/hornsby/service-age-groups?WebID=10> accessed 160618

⁷³ <https://profile.id.com.au/hornsby/population?WebID=10> accessed 160618

⁷⁴ <https://profile.id.com.au/hornsby/households?WebID=10> accessed 160618

Hornsby LGA socio-demographic profile
<p>compared to 20.4% in Greater Sydney while the proportion of couples without children was 23.1% compared to 22.4% in Greater Sydney.</p> <ul style="list-style-type: none"> The largest changes in family/household types in the Hornsby LGA between 2011 and 2016 were: Couples with children (+1,073 households) Group household (+55 households) One parent families (-50 households)
<p>Education level⁷⁵</p> <ul style="list-style-type: none"> In the Hornsby LGA, 68.7% of people aged over 15 years had completed Year 12 schooling (or equivalent) in 2016, compared to 60% of Greater Sydney. Overall, 62.3% of the population aged 15 and over held educational qualifications, and 30.4% had no qualifications, compared with 52.7% and 37.7% respectively for Greater Sydney. Analysis of the qualifications of the population in the Hornsby Shire in 2016 compared to Greater Sydney shows that there was a higher proportion of people holding formal qualifications (Bachelor or higher degree; Advanced Diploma or Diploma; or Vocational qualifications), and a lower proportion of people with no formal qualifications. The major differences between qualifications held by the population of the Hornsby Shire and Greater Sydney were: A larger percentage of persons with Bachelor or Higher degrees (38.4% compared to 28.3%) A larger percentage of persons with Advanced Diploma or Diplomas (10.6% compared to 9.3%) A smaller percentage of persons with No qualifications (30.4% compared to 37.7%) A smaller percentage of persons with Vocationals (13.4% compared to 15.1%)⁷⁶ The number of people with a higher education is increasing faster than any other sector in the Hornsby LGA. Between 2011 and 2016 the major changes in educated people were Bachelor or Higher degrees (+5,771 persons) No qualifications (-1,742 persons) Vocationals (+269 persons) Advanced Diploma or Diplomas (-183 persons)
<p>Housing tenure⁷⁷</p> <ul style="list-style-type: none"> In the Hornsby Shire, 73% of households were purchasing or fully owned their home, 18.3% were renting privately, and 2.2% were in social housing in 2016. Overall, 34.6% of the population owned their dwelling; 38.5% were purchasing, and 20.8% were renting, compared with 27.7%, 31.5% and 32.6% respectively for Greater Sydney. In 2016, there was a lower portion of people living in social housing in the Hornsby LGA (2.2%) than Greater Sydney (4.6%)⁷⁸
Economic profile
<p>Total employment⁷⁹</p> <ul style="list-style-type: none"> Total employment in the Hornsby LGA (95.2%) was slightly higher than Greater Sydney (94%) 70,797 people living in the Hornsby Shire in 2016 were employed, of which 63% worked full-time and 35% part-time The number of employed people in Hornsby Shire increased by 1,689 between 2011 and 2016.⁸⁰
<p>Unemployment rate⁸¹</p>

⁷⁵ <https://profile.id.com.au/hornsby/schooling> accessed 160618

⁷⁶ <https://profile.id.com.au/hornsby/qualifications> accessed 070618

⁷⁷ <https://profile.id.com.au/hornsby/tenure> accessed 160618

⁷⁸ <https://profile.id.com.au/hornsby/tenure?WebID=10> accessed 160618

⁷⁹ <https://profile.id.com.au/hornsby/highlights-2016> accessed 160618

⁸⁰ <https://profile.id.com.au/hornsby/industries> accessed 070618

⁸¹ <https://profile.id.com.au/hornsby/highlights-2016> accessed 160618

Hornsby LGA socio-demographic profile
<ul style="list-style-type: none"> The unemployment rate of Hornsby LGA in 2016 (4.8%) was slightly lower than Greater Sydney (6%). Between 2011 and 2016, the number of unemployed people increased by 456 people
<p>Total labour force⁸²</p> <ul style="list-style-type: none"> Labour force participation was higher in the Hornsby LGA (65%) than Greater Sydney (61.6%) The size of the Hornsby Shire's labour force in 2016 was 74,371, of which 24,901 were employed part-time and 44,918 were full time workers. From 2011 to 2016, the number of people in the Hornsby LGA labour force showed an increase of 1,725 or 2.4%. In 2017, there were estimated to be 49 262 local jobs in the Hornsby LGA⁸³
<p>Occupations⁸⁴</p> <ul style="list-style-type: none"> In 2016, there were more professionals in the Hornsby LGA than any other occupation. An analysis of the jobs held by the resident population in Hornsby Shire in 2016 shows the three most popular occupations were: Professionals (33.7%) Managers (15.6%) Clerical and Administrative Workers (14.6%). In combination these three occupations accounted for 63.9% of the employed resident population. The major differences between the jobs held by the population of the Hornsby LGA and Greater Sydney were: A larger percentage of persons employed as Professionals (33.7% compared to 26.3%) A smaller percentage of persons employed as Machinery Operators and Drivers (2.5% compared to 5.6%) A smaller percentage of persons employed as Labourers (5.3% compared to 7.5%) A smaller percentage of persons employed as Technicians and Trades Workers (9.8% compared to 11.7%) The largest changes in the occupations of residents between 2011 and 2016 in the Hornsby LGA were for those employed as: Professionals (+1,436 persons) Clerical and Administrative Workers (-722 persons), Community and Personal Service Workers (+660 persons) Managers (+408 persons)
<p>Industries of employment⁸⁵</p> <ul style="list-style-type: none"> More Hornsby LGA residents worked in health care and social assistance than any other industry in 2016. An analysis of the jobs held by the resident population in Hornsby Shire in 2016 shows the three most popular industry sectors were: Health Care and Social Assistance (13.5%) Professional, Scientific and Technical Services (12.8%) Education and Training (10.7%). In combination, these three industries employed 37.0% of the total employed resident population. In comparison, Greater Sydney employed 11.6% in Health Care and Social Assistance; 9.8% in Professional, Scientific and Technical Services; and 8.0% in Education and Training. The major differences between the jobs held by the population of the Hornsby Shire and Greater Sydney were: A larger percentage of persons employed in professional, scientific and technical services (12.8% compared to 9.8%) A larger percentage of persons employed in education and training (10.7% compared to 8.0%) A larger percentage of persons employed in health care and social assistance (13.5% compared to 11.6%) A smaller percentage of persons employed in transport, postal and warehousing (2.7% compared to 5.0%) Between 2011 and 2016, the industries experiencing the greatest reduction in the Hornsby LGA were manufacturing (-1179) and wholesale trading (-1107)

⁸² <https://profile.id.com.au/hornsby/highlights-2016> accessed 160618

⁸³ <https://economy.id.com.au/hornsby> accessed 160618

⁸⁴ <https://profile.id.com.au/hornsby/occupations> accessed 070618

⁸⁵ <https://profile.id.com.au/hornsby/industries> accessed 070618

Hornsby LGA socio-demographic profile
<p>Travel to work⁸⁶</p> <ul style="list-style-type: none"> 47,984, or 67.8% of the Hornsby LGA's working residents travel outside of the area to work, 28.4% live and work in the area; 17.8% residents travelled to Sydney City for work, Less people drove themselves to work in the Hornsby LGA (49.6%) than in Greater Sydney (52.7%) in 2016 Analysis of the method of travel to work of the residents in the Hornsby LGA in 2016, compared to Greater Sydney, shows that 27.2% used public transport, while 53.8% used a private vehicle, compared with 22.7% and 58.1% respectively in Greater Sydney.⁸⁷ The major differences in persons between the method of travel to work of the Hornsby Shire and Greater Sydney were: A larger percentage of persons who travelled by train (23.3% compared to 16.2%) A larger percentage of persons who worked at home (5.8% compared to 4.4%) A smaller percentage of persons who travelled by car (as driver) (49.6% compared to 52.7%) A smaller percentage of persons who travelled by bus (3.9% compared to 6.1%) The largest changes in the method of travel to work by resident population in the Hornsby Shire between 2011 and 2016 were for those nominated: Train (+2,576 persons), Did not go to work (-587 persons) Car - as driver (-459 persons) Bus (+414 persons)
<p>Average income</p> <ul style="list-style-type: none"> In 2016, the median weekly household income in the Hornsby LGA (\$2,121/week) was higher than Greater Sydney (\$1750/week) The median personal income of Hornsby LGA residents (\$793/week) was higher than Greater Sydney in 2016 (\$719/week)⁸⁸ Assuming all households were the same size, the 'highest' quartile (\$1,465 or more/week) was the largest income group in the Hornsby LGA in 2016 (36.6% compared to 30.3% in Greater Sydney)⁸⁹. The most significant change in Hornsby Shire between 2011 and 2016 was in the medium lowest quartile which showed an increase of 460 households.
<p>Housing values</p> <ul style="list-style-type: none"> Fewer households rented in Hornsby LGA (21%) than Greater Sydney (33%). The median weekly rent in Hornsby LGA (\$501/week) was higher than Greater Sydney (\$447/week). There were a larger portion of households with a mortgage in the Hornsby LGA (39%) compared to Greater Sydney (32%). Median mortgage \$550/week compared to \$495/week, payments were also higher⁹⁰ For the quarter ending September 2017, the median house price in the Hornsby LGA was \$1,138,000⁹¹
<p>Need for assistance</p> <ul style="list-style-type: none"> 4.3% of the population in the Hornsby Shire in 2016, reported needing help in their day-to-day lives, which was about the same as Greater Sydney (4.6%)
<p>SEIFA rating⁹²</p>

⁸⁶ <https://profile.id.com.au/hornsby/residents?WebID=10> accessed 080618

⁸⁷ <https://profile.id.com.au/hornsby/travel-to-work?WebID=10> accessed 180618

⁸⁸ http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA14000?opendocument accessed 160618

⁸⁹ <https://profile.id.com.au/hornsby/equivalised-household-income-quartiles?SeifaKey=40002> accessed 070618

⁹⁰ <https://profile.id.com.au/hornsby/highlights-2016> accessed 160618

⁹¹ <https://public.tableau.com/profile/facs.statistics#!/vizhome/RentandSales/Rent> accessed 070618

⁹² <https://profile.id.com.au/hornsby/highlights-2016?WebID=10> accessed 070618

Hornsby LGA socio-demographic profile

- The 2016 SEIFA disadvantage score for Hornsby LGA was 1,091, which was higher than Greater Sydney (1,020). For context Ku-ring-gai was the highest at 1,121 and Brewarrina the lowest with a SEIFA score of 757.
- In 2016, there was estimated to be 248 homeless persons in the Hornsby LGA
- More people had an internet connection in the Hornsby LGA (88.6%) than Greater Sydney (81.4%) in 2016⁹³

Key opportunities and challenges⁹⁴*Opportunity*

- Large and growing population
- Low levels of socio-economic disadvantage
- high level of socio-economic advantage

Challenges

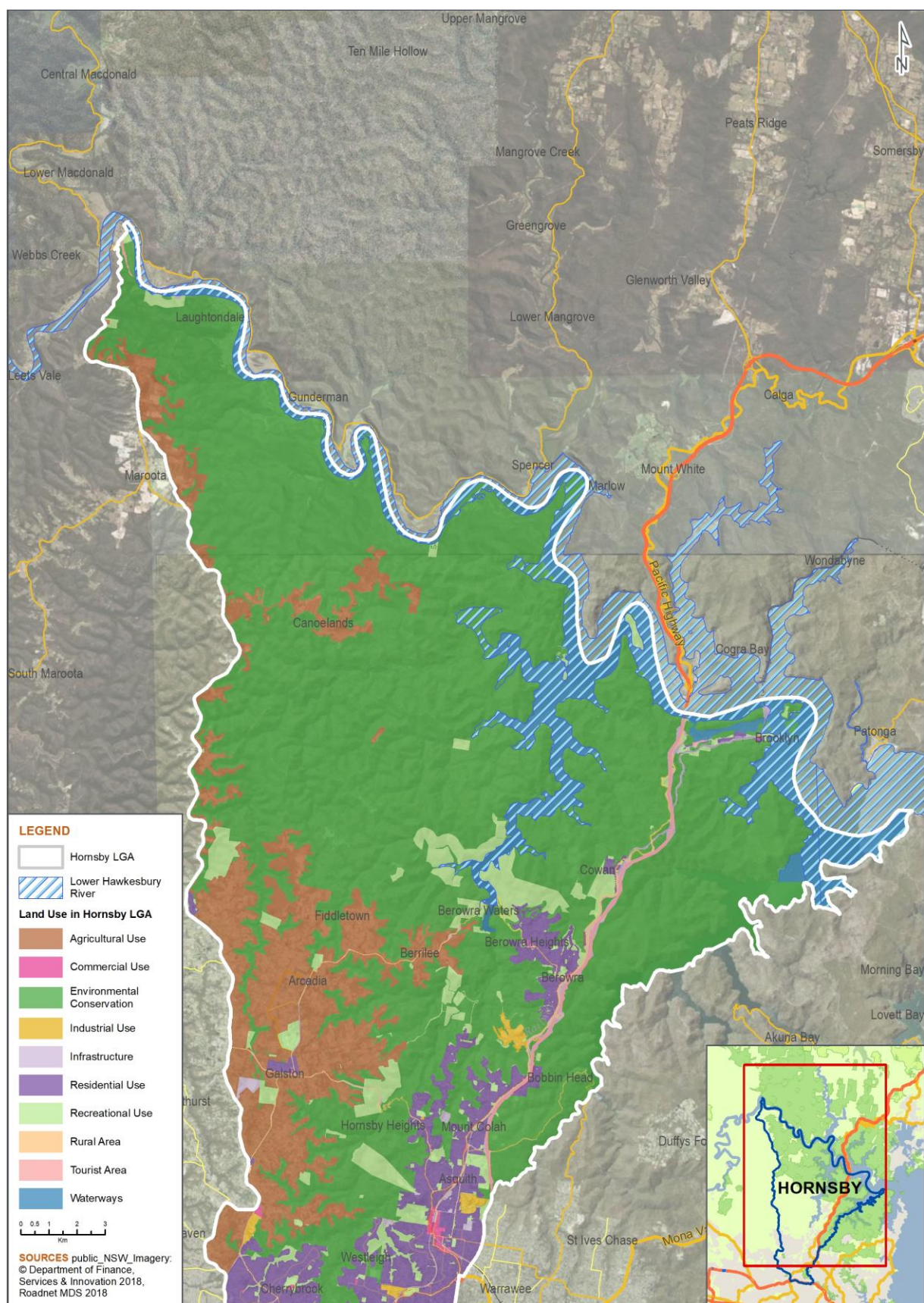
- The Hawkesbury Estuary is the recreational hub of Northern Sydney, so the overall effect could be quite substantial. If people cannot access boat ramps (for trailer boats etc.), then that whole activity is not possible.
- Climate change and sea level rise is worth considering. Flood modelling has not factored in sea level rise. If there was a as predicted sea level rise of 90cm, then residents on the banks of the estuary would be potentially affected. If there is added flood regime alterations such as longer duration flood events, then this may result in far more area being inundated than what flood modelling shows.

⁹³ <https://profile.id.com.au/hornsby/additional-areas?SeifaKey=40002> accessed 070618

⁹⁴ SEIA Scoping (SMEC Internal 15062018)

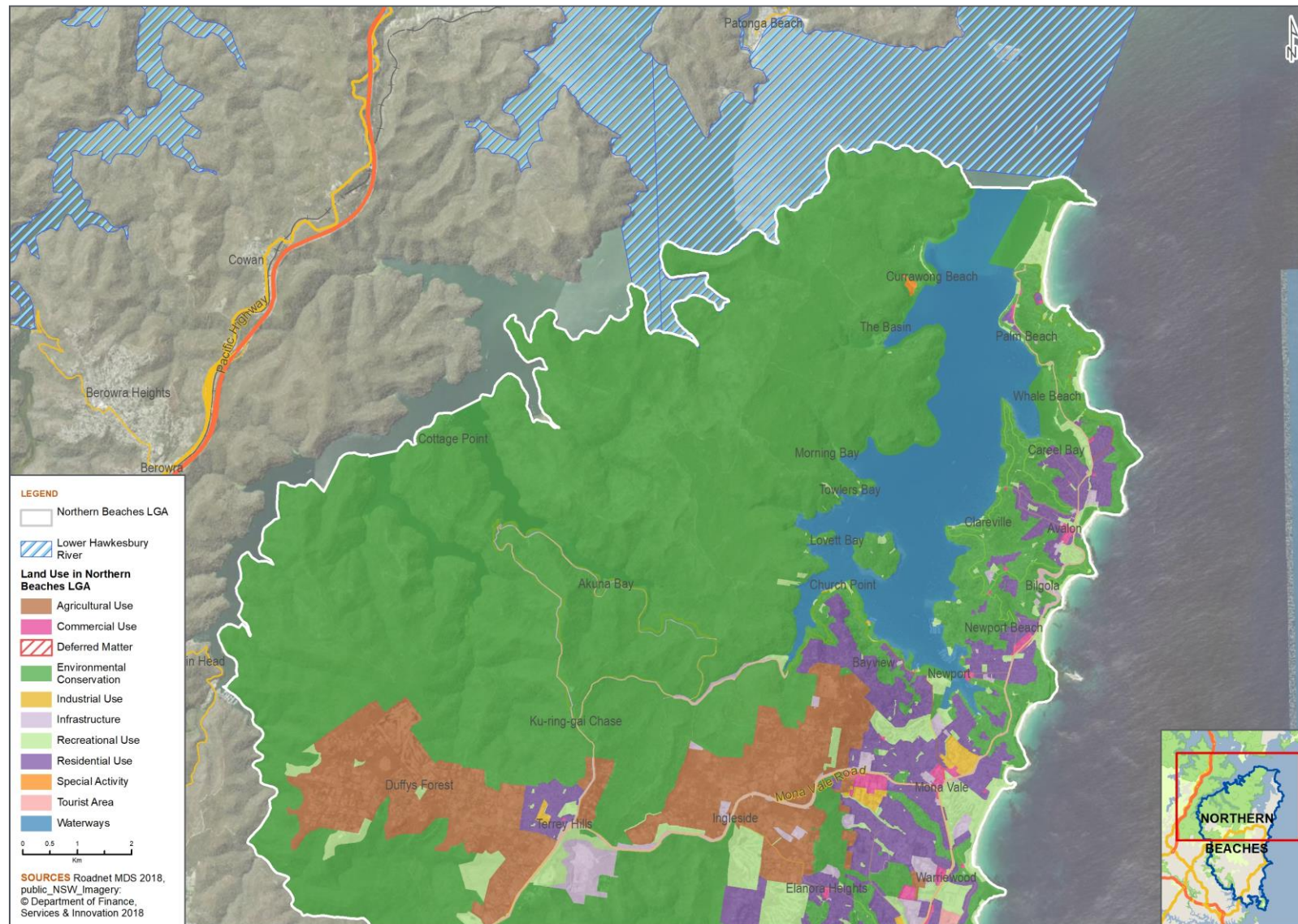
Appendix F Maps of land use categories in estuary communities study area

Map of land use categories in the Hornsby LGA



Source: SMEC 2019

Map of land use categories in the Northern Beaches LGA



Source: SMEC 2019

Appendix G Interview and Survey Protocol

SEIA Scoping: semi-structured interview guideline

Contextual overview

The purpose of this interview is to inform scoping of the Socio-economic Impact Assessment (SEIA) being completed as part of the Environmental Impact Statement (EIS) for the Warragamba Dam Raising proposal (the proposal).

In May 2017, the NSW Government released Resilient Valley, Resilient Communities - the Hawkesbury-Nepean Valley Flood Risk Management Strategy (Flood Strategy), which found raising Warragamba Dam by around 14 metres the preferred infrastructure option to reduce flood risk from inflows from the Warragamba Catchment. The Flood Strategy also includes a range of other infrastructure and non-infrastructure outcomes that must also be part of the solution for managing ongoing flood risk.

WaterNSW, as the owner and operator of Warragamba Dam, is leading the Warragamba Dam Raising proposal. A comprehensive EIS is being prepared under NSW environmental planning and assessment regulation. The proposal is also being assessed under Australian Government environmental legislation.

A component of the EIS is to undertake a SEIA study to assess impacts and benefits of the proposal to communities in the Hawkesbury-Nepean region. We welcome your input to this study.

Objectives of the scoping phase of the SEIA include:

- Build an understanding of potential socio-economic benefits and impacts, who might be affected, their relevant interests, values and aspirations and how they may be best engaged to inform the SEIA
- Identify any potentially affected built or natural features which have social value or importance including key social infrastructure
- Identify any relevant social trends or social change processes being experienced by potentially affected communities.

To inform scoping of potential socio-economic changes associated with the proposal, we are keen to gather your insights into your perceptions of the Warragamba Dam Raising and how it may influence socio-economic conditions experienced in your local area/local government area.

The discussion should take approximately 30 minutes. A summarised record of your responses will be taken and used to inform the SEIA. This record will be provided to you for review and approval prior to its use.

Your insights and involvement in this process are greatly appreciated.

Interview Guide

1. Understanding your community

- 1.1. What areas in the local area/local government area do you think may be affected (positively or negatively) by the Warragamba Dam Raising proposal?
- 1.2. What kind of place would you say this area is to live?
 - (a) How would you describe population density, forms of housing, types of people, how long they have lived there, what people value and desire?
 - (b) Tell us what it's like to live here? What do people like and don't like?
 - (c) Do you think there is a sense of community? Do people identify as part of the local community and get together to work towards a common goal?
 - (d) How do people usually find out what's happening in the area? Who usually knows what's going on?
 - (e) What are the main community and business groups and what is the best way to engage with such groups?
 - (f) Who are the community leaders that people look up to or seek guidance from?
- 1.3. Are there any built or natural features which have social value or importance (including key social infrastructure) which you think could be potentially affected by the proposal?
- 1.4. Are you aware of any social trends or social change processes being experienced in the local area/local government area, particularly in those areas potentially affected by the proposal?

- 1.5. A particular focus of the SEIA is understanding vulnerable groups and how they may be affected by the proposal either positively or negatively. Who do you feel are the more vulnerable groups in your local area/local government area?
- 1.6. Do you have or know of established disability or other vulnerable group networks that we can reach out to for participation in the social survey?

2. Scoping of socio-economic effects

- 2.1 How do you think the proposal could potentially impact on **property rights**?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.2 How do you think the proposal could potentially affect **economic livelihoods** or **the enjoyment of civil liberties**?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.3 How do you think the proposal could potentially impact on **environmental conditions** (including amenity, aesthetics, access and the enjoyment of ecosystem services)?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.4 How do you think the proposal could potentially impact on people's **way of life** (such as how people live, work, play, and interact)?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.5 How do you think the proposal could potentially impact on **culture** (including values, heritage, and customs)?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.6 How do you think the proposal could potentially impact on **wellbeing, health** (physical and mental) and **safety** of the community?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.7 How do you think the proposal could potentially impact on the **settlement pattern, community cohesion, character or sense of place**?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.8 How do you think the proposal could potentially impact on access to social infrastructure such as health and education facilities?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)
 - People or groups most acutely affected and their capacity to influence decisions?
- 2.9 Are there any other ways in which you think the proposal can affect **socio-economic conditions including any fears or aspirations** held by people who live in the local area/local government area?
 - Positive effects? (construction/operation)
 - Negative effects? (construction/operation)

- People or groups most acutely affected and their capacity to influence decisions?

2.10 In finishing, what do you see as the top two or three priorities to be considered in the SEIA for the Warragamba Dam Raising proposal?

THANK YOU FOR YOUR INSIGHTS AND INVOLVEMENT

SEIA Phone survey

Introduction/Preamble:

Good morning/afternoon, my name is (name) and I'm calling on behalf of WaterNSW. We are conducting a short survey of stakeholders in relation to the Proposal to raise Warragamba Dam by around 14 metres to allow people more time to evacuate and reduce flood severity. WaterNSW is leading the environmental assessment for the Warragamba Dam Raising proposal. This includes looking at the proposal's possible social and economic benefits and impacts. As an organisation who provides services to people who may be positively or negatively affected by the Proposal, we would greatly appreciate your feedback.

This particular survey will only take a few minutes, and all answers are confidential. Would you be willing to assist WaterNSW by taking part in a short survey this morning/afternoon? (If not, try to arrange convenient callback - or determine the correct person to speak with.)

Script and questions

Q#	Question	Responses	Prompted/ Unprompted
Q1	Thanks so much (name). To kick things off, can I just confirm you are involved with XXXXXXX (type of stakeholder).	Confirm and record name of participant and stakeholder organisation	Prompted
Q1a	Can you provide an estimation as the total number of members of your organisation or the number of stakeholders your organisation provides services to		Prompted
Q2	Do your organisations stakeholders primarily live upstream or downstream of Warragamba Dam?	Upstream Downstream Neither	Prompted
Q3	Do you believe there is further action required to reduce the severity and impact of flooding in the Hawkesbury-Nepean Valley?	Yes No Unsure	Unprompted
Q4	Can you briefly explain why you gave this answer?	Open answer	
Q5	And to what extent do you agree or disagree with the following statements? We'll use a sliding 1-5 scale, where 1 is strongly disagree, 3 is neutral and 5 is strongly agree: <ul style="list-style-type: none"> I am concerned about future flood events The existing dam wall needs to be raised to reduce flood risk in the Hawkesbury-Nepean Valley There are other options to reduce flood risk in the Hawkesbury-Nepean Valley 	1 – Strongly disagree 2 3 – Neutral or unsure 4 5 – Strongly agree	Prompted
Q6	Prior to this survey, had you heard about plans to raise the Warragamba Dam in order	Yes No	Unprompted

Q#	Question	Responses	Prompted/ Unprompted
	to reduce the frequency and severity of future flooding events in the Hawkesbury-Nepean Valley?	Unsure	
Q7	(If yes) And what had you heard about it?	Open answer	
Q8	+/- 200 words on what is being proposed- <i>refer to Key messages script below</i>		
Q9	Based on this description, to what extent do you support or oppose raising Warragamba Dam as we have just described?	Strongly oppose Oppose Neutral or unsure Support Strongly support	Prompted
Q10	(Unless neutral to Q9) Can you briefly explain why you (Q9) raising the Dam?	Open comment	
Q11	Do you see any particular benefits to the planned Dam raising? (Multiple response)	Open comment	Unprompted
Q12	And do you have any concerns about this Proposal? (Multiple response)	Open comment	Unprompted
Q13	Thanks so much (name), that's all the information we require at this stage. WaterNSW are building a database with organisations that have an active role with communities upstream and downstream of Warragamba Dam such as yourself. Would you be comfortable providing an email address, so we can keep you up to date with the proposal and reach you for possible future surveys and notifications?	Yes No	Unprompted
Q14	(If yes to Q13) Gather or confirm email address		
Q15	Thanks so much (name), that is the end of the survey. We greatly appreciate your time and feedback. Did you have any final comments or questions?		

Key Messages Script

Preliminary investigations indicate that the Proposal would:

- Reduce the extent of flooding in Local Government Areas such as Penrith, Liverpool, Hawkesbury, Blacktown and The Hills: For example, the number of properties inundated by a 1 in 100 year flood would likely reduce by between 50%- 80% in locations such as the Penrith CBD, Riverstone and Windsor.
- Enhance capacity to evacuate flood prone areas in Local Government Areas such as Penrith, Liverpool, Hawkesbury, Blacktown and The Hills: For example, currently, in Windsor, it is predicted that up to 65,000 people in the area would need to be evacuated for a 1 in 100 year event. Under the 'with Proposal' scenario, the number of people needing to be evacuated is predicted to be reduced to 10,000 people. People would also have substantially more time to evacuate.
- Result in less frequent yet longer duration of some flood events in Local Government Areas such as Penrith, Liverpool, Hawkesbury and The Hills. For example, preliminary modelling indicates that for a 1 in 100 year

event Windsor Bridge would currently be cut for 5 days whilst under the 'with Proposal' scenario, it is predicted to be cut for 7 days.

- Increase the area inundated temporarily by major flood events around the periphery of Lake Burragorang and tributaries. For example, preliminary modelling indicates that for a 1 in 100 event an additional 0.6% of land which has a World Heritage Area listing would be temporarily inundated
- Result in construction related impacts in the Warragamba/Silverdale/Wallacia area. For example, construction could involve on average 18 heavy vehicle movements per hour travelling along Silverdale Road.

SEIA Web based survey

Introduction

The proposal to raise Warragamba Dam by around 14 metres is one of nine key actions outlined in the NSW Government's *Hawkesbury-Nepean Valley Flood Risk Management Strategy*. The proposed dam raising would provide flood mitigation by temporarily storing inflows and releasing them downstream in a controlled way. WaterNSW is leading the concept design and the environmental assessment for the Warragamba Dam Raising proposal. The assessment includes looking at the proposal's possible social and economic benefits and impacts.

To help inform this assessment, WaterNSW is conducting an online survey with organisations that have an active role with communities upstream and downstream of the Warragamba Dam.

The survey is completely confidential and will take around 10 minutes to complete. You have until 21 December to respond.

Survey Context

The proposal to raise Warragamba Dam by around 14m may affect communities in both positive and negative ways. We are seeking your input to identify impacts and benefits in particular locations, the people who might be affected and what might be done to realise benefits and mitigate impacts.

Firstly, in which of the following local government areas does the organisation which you represent primarily operate (select as many as are relevant).

Downstream of Warragamba Dam

Penrith City Council	(check box)
Liverpool City Council	(check box)
Blacktown City Council	(check box)
Hawkesbury City Council	(check box)
The Hills Shire Council	(check box)
Hornsby Shire Council	(check box)
Northern Beaches Council	(check box)
Central Coast Council	(check box)

Upstream of Warragamba Dam

Blue Mountains City Council	(check box)
Wollondilly Shire	(check box)

Near Warragamba Dam

Communities of Warragamba/Silverdale and Wallacia (check box)

To inform your understanding of the Proposal, you are provided with a visual representation and supporting information (in text boxes) explaining the predicted effects if a 1 in 100 chance in a year event were to occur.

Please take your time to review the information provided before proceeding with the survey.

For those questions that are relevant to you and your stakeholders, please provide details as to how such effects might translate to benefits and impacts, who would be most affected (with particular reference to more vulnerable sectors of the community) and how you think impacts might be mitigated and benefits realised.

Press here to proceed (check box)

Vulnerability: A person (or household) is vulnerable to future loss of wellbeing below some socially accepted norms if he or she lacks (or is strongly disadvantaged in the distribution of) assets which are crucial for resilience to risks. (Morrone, Scrivens, Smith, and Balestra)

PART 1: Downstream

1. If a major flood event (such as a 1 in 100 year) was to occur there would be extensive areas inundated and many properties affected. It is predicted that the raising of Warragamba Dam would reduce the extent of flooding in Penrith LGA by approximately 45%, in Blacktown LGA by approximately 26% and in Hawkesbury LGA by approximately 17%.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Reduce risk of damage to and loss of property	Agree/Disagree/Not sure
• Reduce insurance costs	Agree/Disagree/Not sure
• Reduce damage to infrastructure (roads, utilities, hospitals etc.)	Agree/Disagree/Not sure
• Other (please specify)	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

2. For a major flood such as a 1 in 100 year event, it is estimated that up to 70,000 people would need to be evacuated. It is predicted that the raising of Warragamba Dam would result in evacuation routes remaining open for a longer time, allowing extra time for people to evacuate from flood affected areas.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Lower the risk of injuries or fatalities	Agree/Disagree/Not sure
• Lower the risk of damage to or loss of property	Agree/Disagree/Not sure
• Reduce flood related anxiety for residents	Agree/Disagree/Not sure
• Reduced costs for emergency services	Agree/Disagree/Not sure
• Other (please specify)	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

3. The raising of Warragamba Dam would reduce the severity and frequency of flood inundation downstream; however the controlled release of floodwaters for major flood events may increase the number of flood affected days experienced in some localities (i.e., lower flood levels but a longer duration of some flood events). Low lying areas across the floodplain may be inundated for several days longer following a major flood event.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Longer periods of flooding may adversely impact river use and access (e.g. boat ramps, pontoons, jetties)	Agree/Disagree/Not sure
• Longer periods when people may be isolated due to flood islands	Agree/Disagree/Not sure
• Longer periods when river and river bank uses are affected	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

PART 2: Upstream

1. The raising of Warragamba Dam would result in an increase in the area being inundated temporarily by major flood events around the periphery of Lake Burragarang and the rivers which flow into the Lake Burragarang.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Restrict access to some bushwalking tracks	Agree/Disagree/Not sure
• Loss of vegetation potentially impacting threatened flora and fauna species	Agree/Disagree/Not sure
• Impact on Aboriginal and Non-Aboriginal heritage sites	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

2. The raising of Warragamba Dam would result in key infrastructure such as the Blue Mountains Rail Line being affected by floods less frequently; however in certain circumstances the duration of effect may be prolonged.

Would this potentially affect your stakeholders?

Yes/No

If yes, do you think your stakeholders would be:

• Highly impacted	Agree/Disagree/Not sure
• Mildly inconvenienced in the broader context of a region in the midst of a flood	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

PART 3: Construction of the flood mitigation capacity at Warragamba Dam

1. Throughout the four year construction period, there would be no public access to existing dam facilities such as the Warragamba Dam Visitor Centre, the Dam itself, some viewing locations, and reserves and picnic areas adjacent to the Dam.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Fewer visitors /tourists to the region	Agree/Disagree/Not sure
• Reduced recreational opportunities	Agree/Disagree/Not sure
• Reduced economic activity	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

2. Over the four year construction period, the raising of the Dam would generate considerable construction traffic

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Higher levels of congestion causing time delays	Agree/Disagree/Not sure
• Disruption to property access	Agree/Disagree/Not sure
• Deterioration of amenity due to increased noise and air emissions	Agree/Disagree/Not sure
• Reduced economic activity generated by visitors	Agree/Disagree/Not sure
• Increased economic activity due to construction workforce spend	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

3. Throughout the four year construction period, construction activities may generate noise, dust and vibration effects in the vicinity of the construction site.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Reduced amenity	Agree/Disagree/Not sure
• Reduced economic activity	Agree/Disagree/Not sure
• Temporary effect on property prices and rental demand	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

4. The proposal would lead to an estimated peak construction workforce of approximately 1,000 over the four year construction period.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Provide job opportunities for local people	Agree/Disagree/Not sure
• Provide opportunities for local business	Agree/Disagree/Not sure
• Provide increase in rental demand	Agree/Disagree/Not sure
• Heighten community tension due to increased use of local infrastructure and services	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

5. The proposal would involve a significant economic investment which would generate employment and require the procurement of goods and services.

Would this potentially affect your stakeholders?

Yes/No

If yes, how might it affect your stakeholders? Listed are some potential ways:

• Stimulate economic activity such as through the provision of commercial opportunities for businesses	Agree/Disagree/Not sure
• Generate employment opportunities	Agree/Disagree/Not sure
• Divert funding from other forms of essential community infrastructure	Agree/Disagree/Not sure
• Other (please specify).....	

Who do you think might be most affected?

How do you think the impact could be reduced or benefit maximised?

<<NOTE: Applies to all geographies>>

6. Are there any further comments or concerns you would like to raise including anything you think WaterNSW should consider in order to maximise the proposal's benefits or minimise impacts?

If yes, please add:

Thank you for your assistance

HillPDA SEIA Business impact survey

Preamble

The proposal to raise Warragamba Dam is one of nine key actions outlined in the NSW Government's Hawkesbury-Nepean Valley Flood Risk Management Strategy.

Raising Warragamba Dam by around 14 metres will provide flood mitigation by creating 'airspace' behind the raised wall. This would reduce flood risk by temporarily holding back and releasing floodwaters coming from the large Warragamba Catchment. The raising of Warragamba Dam would significantly reduce the flood risk to life and property, including the worst floods on record, and increase the certainty of time for evacuation.

WaterNSW is leading the concept design and the environmental assessment for the Warragamba Dam Raising proposal. The assessment includes looking at the proposal's possible social and economic benefits and impacts. To help inform this assessment, WaterNSW is conducting a survey with businesses which operate upstream and downstream of the Warragamba Dam. The survey is completely confidential, and your responses would be analysed alongside other stakeholder representatives, with no one being identified personally.

1.0 Business details

1. Are you an owner occupier or tenant? <<note that the respondent must have a reasonable level of seniority>>
 - ☐ Owner occupier
 - ☐ Tenant
2. What are typical trading times?
 - a. Monday- Friday: 8am- 5 pm or other.....
 - b. Saturday: 8am- 5 pm or other.....
 - c. Sunday: 8am- 5 pm or other.....
3. Who are your primary business customers? (Please tick one).
 - ☐ Persons/entities from the local area
 - ☐ Persons/entities from the broader region
 - ☐ Persons/entities from outside the region
 - ☐ Visitors/tourists

- ☐ Others- specify.....
4. How many full time employees work for the business? (Please tick one).
- ☐ 0-10
- ☐ 11-20
- ☐ 21-50
- ☐ 50+
5. How many part time employees work for the business? (Please tick one).
- ☐ 0-10
- ☐ 11-20
- ☐ 21-50
- ☐ 50+
6. How do most employees usually travel to your business? (Please tick one).
- ☐ Private vehicle
- ☐ Walk/cycle
- ☐ Public transport
- ☐ Other (please specify).....
7. How do your clients/customers/suppliers usually travel to your business? (Please tick one).
- ☐ Private vehicle
- ☐ Walk/cycle
- ☐ Public transport
- ☐ Other (please specify)
8. Where do the majority of your customers travel from? (Please tick one).
- ☐ Suburb
- ☐ LGA
- ☐ District
- ☐ Greater Sydney
- ☐ State or wider
9. Where do you distribute to? (Please tick one).
- ☐ Suburb
- ☐ LGA
- ☐ District
- ☐ Greater Sydney
- ☐ State or wider
10. How long have you been operating your business in this location? (Please tick one).
- ☐ Less than one year
- ☐ 1-3 years
- ☐ 3-5 years
- ☐ More than 5 years

11. Does the business have a flooding strategy or evacuation strategy in place (e.g. to help react to a flood warning/the relocation of stock/return to normal operation sooner)? (Please tick one)

☐ Yes

☐ No

2.0 Sensitivities and dependencies

12. Is your business sensitive to any of the following? If so please state how sensitive on a scale of 1-5 (1 being not sensitive at all and 5 being extremely sensitive).

SENSITIVITY	1	2	3	4	5
Noise					
Vibration					
Air quality (including dust)					
Unpleasant odours					
Congestion					
Travel time delays					
Growth and development					
Water quality					

13. Is your business dependent on any of the following? If so please state, how dependent, on a scale of 1-5 (1 being not dependent at all and 5 being extremely dependent).

DEPENDENT	1	2	3	4	5
Other businesses in the area					
Recreation and community facilities in the area					
Passing trade (motor vehicle)					
Passing trade (Pedestrian and cyclist)					
Pleasant visual amenity					
Convenient customer parking					
Business exposure (visibility)					
Identity and character of the area					
On-street parking					
Loading zones					
Road network (for distribution and deliveries)					
Environmental setting or attributes					
Access to water					
Tourism /visitor numbers					
Access to sewerage					
Power					

3.0 Past experience

[Note: Questions in this section are not relevant for businesses located in the Upstream and Construction geographies]

14. Has this business previously been affected by a flood event, as described? (Please tick one).

- ☐ Yes Do you recall what year/years it occurred (Yes/No Year XXXX)?
- ☐ No

[Answer the following questions if yes, if no – move to Question 23 (a)]

15. If yes, do you know if it was specifically caused by the flooding of the Hawkesbury-Nepean River?

- ☐ Yes- it was due to flooding of Hawkesbury-Nepean River
- ☐ No- it was due to localised heavy rainfall (stormwater/local waterway overflow)
- ☐ Not sure

16. For the most recent flood event described above which of the following impacts did the business experience?

Direct

- a. Full inundation Yes /No
- b. Partial inundation Yes /No
- c. Loss of utilities such as power, sewerage and water Yes /No
- d. Business closure/loss of sales Yes /No
- e. Damage to assets (e.g. stock/property/crops etc.) Yes /No
- f. Loss of access due to road and bridge closures Yes /No

Indirect

- a. Suppliers affected Yes /No
- b. Employees unable to get to work Yes /No
- c. Customers affected Yes /No

17. Did the business experience any other impacts not mentioned already?

18. How many days was your business unable to operate? (Please tick one).

- ☐ Less than 7 days
- ☐ 7-14 days
- ☐ 14-28 days
- ☐ More than 28 days
- ☐ Business did not return to operation

19. How long after the flood event did your business return to full (normal) operation? (Please tick one).

- ☐ Less than 7 days
- ☐ 7-14 days
- ☐ 14-28 days
- ☐ More than 28 days
- ☐ Business did not return to operation

20. If a flood event occurred again, would you re-establish your business in the same area after the flood event? (Please tick one)

- ☐ Yes
- ☐ No

For Questions 21 and 22, please only answer if you feel comfortable doing so.

21 What was the estimated cost of physical damage to property? (Please tick one).

- ☐ Less than \$5,000
- ☐ \$5-25,000
- ☐ \$25-50,000
- ☐ \$50,000+

22. What was the estimated loss in earnings? (Please tick one).

- ☐ \$1 - \$4,999
- ☐ \$5,000 - \$9,999
- ☐ \$10,000 - \$19,999
- ☐ \$20,000 - \$49,999
- ☐ \$50,000 - \$99,999
- ☐ \$100,000 - \$499,999
- ☐ \$500,000+

4.0 Comparison of Scenarios

4.1 Downstream (Operations Phase)

23a. Scenario 1: [Drafting note: Scenario materials and script to be provided for a number of key localities.]

As per the 1 in 100 flood event- 'Current' Scenario, what aspects of your business would be affected? [Please state how dependent, on a scale of 1-5 (1 being extremely negative and 5 being extremely positive).]

	1	2	3	4	5
Employee and customer safety					
Business revenue/sales					
Recovery time					
Power supply					
Building and fit-out damage					
Office records/equipment					
Customer/employee access					
Distribution/Supplier access					
Communication links					
Stock/produce /products					
Other: <i>please identify</i>					

23b. Scenario 2: Scenario 1: [Drafting note: Scenario materials and script to be provided for a number of key localities.]

As per the 1 in 100 flood event- 'with Proposal' Scenario, what aspects of your business would be affected? [Please state how dependent, on a scale of 1-5 (1 being extremely negative and 5 being extremely positive).]

	1	2	3	4	5
Employee and customer safety					
Business revenue/sales					
Recovery time					
Power supply					
Building and fit-out damage					
Office records/equipment					
Customer/employee access					
Distribution/Supplier access					
Communication links					
Stock/produce /products					
Other: <i>please identify</i>					

5.2 Upstream (Operations Phase)

24a. Scenario 1: [Drafting note: Scenario materials and script to be provided for Upstream.]

As per the 1 in 100 flood event- 'Current' Scenario, what aspects of your business would be affected? [Please state how dependent, on a scale of 1-5 (1 being extremely negative and 5 being extremely positive).]

	1	2	3	4	5
Employee and customer safety					
Water/sewerage system					
Recovery time					
Customer/employee access					
Distribution/Supplier access					
Communication links					
Stock/produce /products					
Business revenue due to tourism					
Business revenue due to recreational activity					
Other: <i>please identify</i>					

24b. Scenario 2: [Drafting note: Scenario materials and script to be provided for Upstream.]

As per the 1 in 100 flood event- 'with Proposal' Scenario, what aspects of your business would be affected? [Please state how dependent, on a scale of 1-5 (1 being extremely negative and 5 being extremely positive).]

	1	2	3	4	5
Employee and customer safety					
Water/sewerage system					
Recovery time					
Customer/employee access					
Distribution/Supplier access					
Communication links					
Stock/produce /products					
Business revenue due to tourism					
Business revenue due to recreational activity					
Other: <i>please identify</i>					

5.3 Warragamba/Silverdale/Wallacia (Construction Phase)

25. Throughout the four-to-five year construction period, construction activities have the capacity to generate noise, dust, vibration and increased construction vehicle movements. The Project would also require the potential temporary closure of existing dam facilities (including the visitor centre and picnic areas) for the duration of construction. There would be an estimated 500-person construction workforce present in the local area throughout the construction period. [Drafting note: Script will be provided on how to describe Project effects.]

What effect do you think this might have on the following?

	Positive/ Negative	Not at all	Slightly	Moderately	Majorly
Noise					
Vibration					
Dust					
Construction vehicles					
Visitor numbers					
Supplier opportunities					
Job opportunities					
Servicing the workforce					

26. What affect do you think the proposal will have on insuring your business?
27. In the event of a flood, how do you think the changes mentioned (reduced flood extent and severity, longer flood duration and flood evacuation period) would impact on the short-term viability of the business?
- ☐ No impact (operate as normal)
- ☐ Minor impact
- ☐ Moderate impact

- ☐ Major impact
- ☐ Critical impact (permanent closure) Why do you feel this way?
28. In the event of a flood, how do you think the changes mentioned (reduced flood extent and severity, longer flood duration and flood evacuation period) would impact on the long-term viability of the business?
- ☐ No impact (operate as normal)
- ☐ Minor impact
- ☐ Moderate impact
- ☐ Major impact
- ☐ Critical impact (permanent closure) Why do you feel this way?
29. Do you think the proposal will change the way your business operates? If yes, how?

Thank you for your participation in this survey. If you would like more information, please go to (SMEC to provide information).

Status of Interviewee: (circle which best applies) Owner/Owner- Manager/Non-owner Manager/Full time Employee/Part time Employee

Length of time involved with the business.....

Contact details (phone number/e mail address).....

Business details

[Note: can be filled out by survey representative]

Trading name of business..... Business type

- ☐ Retail
- ☐ Food/beverage
- ☐ Recreational services/tourism
- ☐ Professional services/finance
- ☐ Construction
- ☐ Health care
- ☐ Education
- ☐ Wholesale
- ☐ Other (Please specify)

Address: (where trades).....

Appendix H Hawkesbury-Nepean Valley Flood Risk Management Engagement Summary undertaken by WaterNSW

Hawkesbury-Nepean Valley Flood Risk Management Engagement Summary

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
COMPLETED and ONGOING communication & engagement activities – November 2017 to March-2019				
Event/Activity	Date/s & Venues	Stakeholders/ Audience	Materials	Matters covered and/or issues raised
Liaison with education providers	November to December 2017	NSW Department of Education, peak school organisations	Presentation	INSW liaison with relevant government and non-government education representatives to support development of Education and Engagement Program for Young People as key element under Outcome 5 of Flood Strategy.
Hawkesbury City Council's Floodplain Risk Management Advisory Committee meeting	7 December Windsor 2017	Floodplain Risk Management Advisory Committee members	Presentation	INSW presented an update on implementation of the Flood Strategy.
Briefing for officers of Ministers Harwin and Blair	19 January 2018	Policy and media officers from the Ministers' offices	Presentation	Flood Strategy implementation and the role of and status of the Warragamba Dam Raising project
Responses to letters on the proposed Warragamba Dam Raising	Ongoing	Letter writers – majority opposed the dam raising proposal	Draft responses	Majority of letters based on 'guide' letters from the Colong Foundation opposing the dam raising for environmental and heritage reasons and suggesting alternative options to provide flood mitigation
Greater Blue Mountains World Heritage Area Advisory Committee meeting	2 February 2018	Advisory Committee members	Presentation	WaterNSW further presented on the Warragamba Dam Raising EIS process – issues raised relate to the upstream impacts of temporary inundation.
Warragamba Dam Raising project EIS				
Newsletter #1	February 2018	Warragamba Dam Raising Newsletter subscribers	Newsletter – online and hard copy	Newsletter to announce the project within the context of the Flood Strategy and explain EIS process
Pop-up sessions and Static displays to raise awareness of the proposal and upcoming EIA process	February- April 2018 Warragamba Dam Visitor Centre, shopping centres, council offices, libraries, Hawkesbury Show	Floodplain communities, other areas of interest (dam neighbours, broader community)	Displays - fact sheets, maps	Flood Strategy background and context, Warragamba Dam Raising proposal and EIS process, issues how people can find out more
Biodiversity and heritage surveys	Jan-March 2018	Downstream properties (300+)		

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
Key Stakeholder interviews	March-April 2018	Stakeholders across the study area – councils, NSW SES, peak groups	Letters followed by site visits	Surveys support EIA process.
Aboriginal engagement	Ongoing	Registered Aboriginal Parties Gundungurra ILUA Committee	Interview guide Presentations	Insights and issues to inform next steps in social impact assessment INSW and WaterNSW on Flood Strategy and Warragamba Dam Raising proposal – ACHA values, methodology, survey effort
Field visit to the Kedumba Valley in the Warragamba Special Area	5 February 2018	Colong Foundation, Gundungurra reps, local MPs, community representatives	Field trip guided by WaterNSW Catchment Officer	WaterNSW and INSW joined trip to inspect the Camden White Gums and other ecological and heritage features. Concerns raised related to effects of temporary inundation, and access to the areas for Gundungurra
Meetings with council communication officers	9 February 2018	Penrith City Council, Hawkesbury City Council	Flood Strategy	Regular communication and engagement catch up with council communication managers. Both councils keen to work with INSW on communication engagement in 2018, including on events for Youth Week and the Hawkesbury Show in April 2018.
Liaison with local schools, councils and youth groups	February to March 2018	HN school principals, teachers, council youth officers and youth groups	Presentation	INSW liaison with local schools and youth program providers to support development of Education and Engagement Program for Young People as a key element under Outcome 5 of Flood Strategy
Liaison with education providers	April 2018 and ongoing	NSW Department of Education, peak school organisations, Western Sydney University	Presentation	Curriculum support development – Yr 9 Geography School emergency planning
Hawkesbury City Council and Penrith City Council	Regular quarterly meetings (March/April 2018)	Floodplain Risk Management Advisory Committee members	Presentation	INSW presented an update on implementation of the Flood Strategy.

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
Floodplain Risk Management Advisory Committee meetings				
Field visit to Warragamba Dam and floodplain	27 April 2018	Government MPs and staff	Site visit and presentations	INSW and WaterNSW briefing on the implementation of the Flood Strategy and the Warragamba Dam Raising project
Briefings for Ministers Ayres and officers	Early May 2018	Minister, Policy and media officers from the Ministers' offices	Presentation	Flood Strategy implementation Proposed legislative amendment Status and budget Warragamba Dam Raising project
Briefings for regional Councils		Elected Councillors and senior council officers	Presentations	INSW on Flood Strategy – refresh and update WaterNSW on Warragamba Dam Raising project – status and issues (see report)
Hawkesbury City	2 April 2018			
Blacktown City	2 May 2018			
Wollondilly Shire	8 May 2018			
Youth Week events Hawkesbury and Penrith	13 April 2018 and 19 April 2018	Young people and their families, youth groups and networks	Display, maps, catchment model, collateral	Asked question of young people and families 'Do you live in a floodplain?' Establishing contact with youth groups/associations
Media event re Evacuation Signage Strategy with Ministers Ayres and Davies	Penrith 20 April 2018	Floodplain communities	Display, signs, media release	With RMS and NSW SES – update on signage strategy with focus on user testing
Hawkesbury Show	20-22 April 2018	Visitors to the show	Display, maps, collateral,	Asked the question of Show visitors "Do you live in a floodplain?" Broad range of issues raised and discussed.
Flood Evacuation Signage	March/April 2018	Community participants drawn from floodplain area	Phone survey User testing Technical field testing	Concept designs for the RMS flood evacuation signage project were tested with the community technical field testing user testing in simulated driving environment 400-person quantitative phone survey
Testing of draft designs and sign system for new	Sydney Uni			
Briefings for officers of Ministers Upton and Blair	Early May 2018	Policy officers from the Ministers' offices	Presentation	Flood Strategy implementation Proposed legislative amendment Status Warragamba Dam Raising project
Responses to letters on the proposed Warragamba Dam Raising	Ongoing	Letter writers – vast majority opposed to the dam raising proposal	Draft responses	Hundreds of emailed letters based on 'guide' letters from the Colong Foundation opposing the dam raising

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
Greater Blue Mountains World Heritage Area Advisory Committee meeting and Blue Mountains Regional Advisory Committee	Combined meeting 12 May 2018	Members of both Committees	Presentation	INSW - refresher and update on Flood Strategy WaterNSW – update on Warragamba Dam Raising EIS process – issues raised largely relate to the upstream impacts of temporary inundation and downstream development.
Blue Mountains City Council briefing Liverpool City Council briefing The Hills Shire Council	22 May 2018 24 May 2018 5 June 2018	Councillors and senior Council officers	PowerPoint Presentation followed by Q&A session	INSW and WaterNSW brief Councils on Flood Strategy and the EIS for the Warragamba Dam Raising Project. Issues raised consistent with previous council briefings – upstream impacts, floodplain development, dam safety, etc. The Hills Shire Council very supportive of dam raising proposal.
Local Government Advisory Group meeting	13 June 2018	Local councils, DP&E, INSW, OEH, RMS, NSW SES, FMA, GSC, WSROC	Presentations	Third meeting of the Local Government Advisory Group, chaired by DP&E and supported by INSW. Detailed presentations to Council officers on: Emergency management for the Hawkesbury-Nepean (NSW SES and Police) Flood Evacuation Signage Strategy (RMS)
Hawkesbury City Council Floodplain Committee	26 June 2018	Councillors and community representatives	Powerpoint presentation	Update on Flood Strategy and Warragamba Dam Raising EIS process to be presented by Alison White, INSW.
Council briefings – Flood Strategy and Warragamba Dam Raising Proposal Liverpool City Council Penrith City Council	July/August 2018 Council offices	Liverpool City – council officers Penrith City –Councillors, senior staff	PowerPoint presentations followed by Q&A sessions	Upstream impacts Local impacts and benefits Impacts on floodplain development (Penrith) Construction impacts of the Project Concerns re adequacy of evacuation capacity and planning (Penrith) Future use of the Project for water supply Adequacy of evacuation roads
Briefing to Greater Blue Mountains World Heritage Advisory Committee	10 August 2018 Penrith	Chair and committee members	Powerpoint presentations and Q&A session by INSW, DP&E, & NSW SES	Update on the Flood Strategy Impacts on floodplain development

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
				Emergency planning and response Integration of Flood Strategy outcomes Project Upstream impacts
Media briefings	July/August 2018	Selected print and broadcast media	Powerpoint presentation Q&A session	INSW Exec Director, Communications Director and Coordinating Minister's Media Officer Flood Strategy context, drivers, research and investigations, key outcomes, status Project rationale, proposal, assessment, status
Flood Strategy Update	September 2018	Floodplain communities, other stakeholders	Printed and online versions	Around 75,000 copies of the first Flood Strategy community update was distributed in the week beginning 24 September 2018 via The Western Weekender, Hawkesbury Gazette, Hawkesbury Courier, and Wollondilly. Copies were also distributed via information stalls held in Windsor and Penrith in the same week and the update has been made available online.
Warragamba Dam Raising - Community Update #2	September 2018	WaterNSW website and emailed to stakeholder database		WaterNSW update on what they have heard from the community during consultation to date and clarifying misinformation.
Media responses	Sept/Oct 2018	Floodplain communities, other stakeholders	Responses provided to media as required	There was significant media coverage about the proposal to raise Warragamba Dam in Sept/Oct 2018, particularly in relation to the amendment to the WaterNSW Act and the potential impact of the proposal on Aboriginal Cultural Heritage.
Attendance at community events – Windsor Markets, Nepean Village Shopping Centre, Dam Fest	Sept/Oct 2018	Floodplain communities, other stakeholders	Pullup banners FAQs Updates	INSW and WaterNSW – provided the opportunity for members of the community to learn more about the Flood Strategy and the Warragamba Dam Raising Proposal.
Council engagement on the regional flood study	Sept/Oct 2018	Floodplain Councils		Initial Council engagement on the regional flood study has been completed and feedback has been reviewed and considered. The communication and

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
				engagement plan for the public release for flood study is being finalised in consultation with Councils.
Communities of concern workshops (round one)	October 2018	Service providers in Penrith and Hawkesbury		The first series of Communities of Concern workshops was delivered in conjunction with the University of Sydney and NSW SES. These workshops focused on building flood awareness and emergency preparedness for the clients of the service providers. Around 40 service providers attended.
Briefings with Floodplain Councils - Flood Evacuation Signage Strategy Implementation (RMS and INSW)	Oct/Nov 2018	Relevant council officers – roads and comms staff Relevant council Floodplain Committees	Presentation, and maps Discussions	RMS (with INSW as appropriate) – provided updates on signage strategy, discussions with council officers and floodplain committees on implementation process and operational and maintenance issues re signage on local roads. Signage roll out began 5 December 2018. Media event with Minister 12 December.
Hornsby Shire Council	1 November 2018	Councillors and senior council officers	PowerPoint presentation Q&A session	WaterNSW provided briefing on Flood Strategy and the EIS for the Warragamba Dam Raising Project.
Camden Shire Council	21 November 2018	Councillors and senior council officers	PowerPoint presentation Q&A session	WaterNSW provided briefing on Flood Strategy and the EIS for the Warragamba Dam Raising Project.
Workshops with Government agencies and floodplain Councils regarding proposed regional land use planning framework	October – November 2018	Relevant agency and Councils' staff	Presentation and maps Discussion	Department of Planning and Environment (with INSW as appropriate) workshops including presentation, maps and discussion on proposed regional land use management framework. Further steps to follow during 2019.
High School geography resource contract awarded	December 2018	Floodplain schools and communities		Western Sydney University has been appointed as the successful tenderer for the development of a High School Geography curriculum-based resource.

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
Briefings with Floodplain Councils – Regional Land Use Planning Framework	Late 2018	Relevant council officers	Large map	DP&E - Context and future framework for land use planning in the floodplain
Person Centred Emergency Preparedness workshops (round two)	December 2018	Disability and aged care workers who support people in their own home	Presentation, discussion and University of Sydney's Person Centred Emergency Toolkit	Delivered in conjunction with the University of Sydney, NSW SES, Office for Emergency Management and local councils, these workshops delivered flood awareness and emergency preparedness training. Over 60 people from 25 services attended the workshops in Penrith and Richmond and were provided advice about how to help their clients be more resilient to flood and other natural disasters. Following on from the success of these events, more workshops are being planned for 2019.
Warragamba Dam Raising - next phase social impact assessment	December 2018	300 Stakeholders	Phone & online surveys some I/Vs	SMEC on behalf of WaterNSW has surveyed representatives from identified stakeholder groups to inform social impact assessment. This phase of engagement was completed in April 2019.
New flood signage complete	December 2018	Floodplain communities, other stakeholders		As part of the Flood Strategy, more than 150 new signs have been installed across the Hawkesbury-Nepean Valley to help guide people out of the floodplain in a flood event.
High School geography resource	December 2018	Floodplain schools and communities		Western Sydney University was appointed as the successful tenderer for this project and work is progressing towards a launch of the Stage 4 Geography 'Water in the World' curriculum support resource in October/November 2019.
Warragamba Dam Raising - Community Update #3	January 2019	WaterNSW website and emailed to stakeholder database	Printed and online versions	WaterNSW update on what has been heard from the community during consultation to date and providing some information about the current operation of Warragamba Dam and the potential upstream

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
				and downstream impacts of the proposal to raise Warragamba Dam.
Media/social media responses	Ongoing	Floodplain communities, other stakeholders	Responses provided to media as required	Media and social media coverage about the proposal to raise Warragamba Dam has continued.
Nepean River Floodplain Risk Management Study and Plan Technical Working Group	1 February 2019	Penrith City Council	Discussion	Nepean River floodplain risk management
South Creek Floodplain Risk Management Study and Plan Technical Working Group	1 February 2019	Penrith City Council	Discussion	South Creek floodplain risk management
Hawkesbury Floodplain Risk Management Advisory Committee	14 February 2019 and ongoing	Hawkesbury City Council	Discussion	Regular attendance and updates to the Hawkesbury Floodplain risk management committee on all Flood Strategy outcomes comprising Council and community representatives
Greater Blue Mountains World Heritage Advisory Committee Meeting combined with Blue Mountains Region Advisory Committee	16 February 2019	Members of both Committees	Presentation and discussion and Q and A session	Flood Strategy implementation (INSW) Warragamba Dam Raising proposal – update on status of EIS and associated studies (WaterNSW)
Red Cross Beyond the Assembly Point emergency preparedness workshop	6 March 2019	Early childcare providers in the Hawkesbury	Presentation and discussion	Infrastructure NSW and NSW SES have partnered with the Red Cross to deliver Beyond Assembly workshops for childcare providers in conjunction with the Red Cross. The first workshop is in the Hawkesbury, with other workshops being planned in other parts of the floodplain.
High school Geography curriculum resource expert briefing School Emergency planning briefing	22 March 2019	Writing team for the geography curriculum resource Stakeholders in school emergency planning	Presentation and discussion	An information sharing day was delivered to upskill the writing team for the Geography school resource and brief key stakeholders in the school emergency planning project.
Western Sydney Uni Hawkesbury Campus – Peri-urban Greenhouse and Masterplan Project	25 March 2019	Hawkesbury City Council		Preliminary discussion of flood risk with Hawkesbury City Council
NSW Health Residential Aged Care Flood Awareness and	26 March 2019	Residential aged care providers in the floodplain	Presentation and discussion	Infrastructure NSW, NSW SES and NSW Health are delivered facilitated

Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy				
Emergency Preparedness training				workshop to build flood awareness and emergency preparedness for residential aged care facilities in the floodplain.
Media/social media responses	Ongoing	Floodplain communities, other stakeholders	Responses provided to media as required	Media and social media coverage about the Flood Strategy and, in particular, the proposal to raise Warragamba Dam has been ongoing throughout the period.

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