

# Preliminary Environmental Assessment and Project Plan

## Raising of Timor Dam



March 2019



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**19-004: TIMOR DAM RAISING  
PRELIMINARY ENVIRONMENTAL ASSESSMENT AND PROJECT PLAN**

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## 1. INTRODUCTION

Timor Dam on the upper reaches of the Castlereagh River is the surface water storage for Coonabarabran town water supply in Warrumbungle Shire. Council is investigating the raising of Timor Dam in response to frequent water supply restrictions imposed due to falling dam levels. Investigations completed to date include a feasibility study, concept design and dam break study. To progress the project, this report provides a preliminary assessment of the environmental impacts of the proposed dam raising, approval requirements, project budget and timing.

### 1.1 Existing Timor Dam

Timor dam is located on the Castlereagh River 12 km west of Coonabarabran (Figure 1). The dam is accessible by an unsealed road off Timor Road. Timor dam was designed and constructed by Public Works and completed in 1962.

Timor dam is a concrete arch structure with an overfall spillway. The structure has a maximum height of 19.5m, a crest length of 68m, a crest width of 1.4m and an arch radius of 33m. The storage capacity of the reservoir at Full Supply Level (FSL) is 1,140 ML. The main arch wall spillway crest level is RL 611.21m AHD, and the saddle dam crest level is RL 616.09m AHD. The height difference is 4.88m. Water is drawn from the dam storage through a 250mm diameter floating trunnion attached to an operating platform on a 450mm square concrete column. The outlet works are located north-west of the main wall towards the storage area, upstream of the saddle dam (Public Works Advisory, 2018).

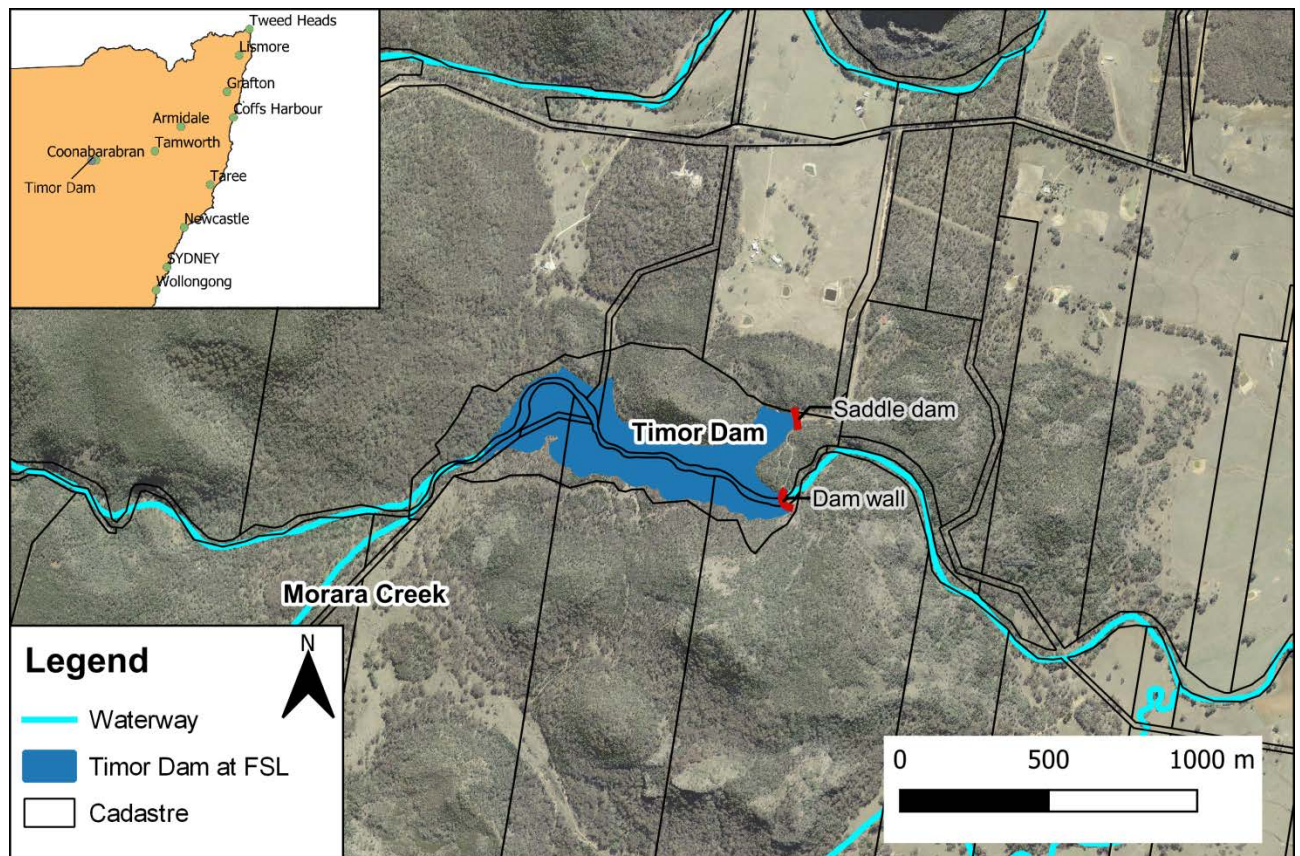


Figure 1: Timor Dam study area

## 1.2 Available Documentation

Investigations into the raising of Timor Dam commenced with a recommendation in the 2013 draft Warrumbungle Shire Council Drought Management Plan. Table 1 provides a list of existing documentation relevant to this project.

**Table 1: Available documentation**

<b>Title</b>	<b>Author</b>	<b>Date</b>	<b>Scope</b>	<b>Outcomes/findings</b>
<i>Drought Management Plan (draft)</i>	Warrumbungle Shire Council	November 2013	Drought restriction policy and operating rules for town water supplies. Superseded by 2018 draft plan.	Raising the wall of Timor Dam to augment Coonabarabran's water supply was considered "worthy of investigation".
<i>Restart NSW Application for Funding RNSW 728 Coonabarabran - Raising Timor Dam Wall</i>	Warrumbungle Shire Council	2014	Application for funding under Water Security for Regions program.	Background and justification for project, business case and economic appraisal, risk assessment and procurement plan. Council received funding for the feasibility study for the raising of the dam wall.
<i>Timor Dam Hydrology Study</i>	GHD	2016	Hydrological study of the Timor Dam and Pound Yard Weir catchments.	A RORB* model of the catchment and Timor Dam flood hydrographs including calculations of a Probable Maximum Flood.
<i>Coonabarabran Water Supply Yield Study Report</i>	NSW Urban Water Services	2017	Secure yield estimates for Coonabarabran's water supply headworks system estimated in accordance with DPI Water/NSW Office of Water guidelines.	The results suggest the benefits in yield from the proposed raising of the Dam may be offset by changed release requirements.



Title	Author	Date	Scope	Outcomes/findings
<i>Timor Dam Dambreak and Consequence Assessment</i>	Entura	November 2017	Dambreak modelling and consequence assessments on the existing dam.	The flood consequence category of Timor Dam is High A. Based on a High A consequence category the existing dam may not meet the required acceptable flood capacity.  It was recommended that prior to commencing the dambreak and consequence assessment of the preferred Timor Dam upgrade option that the hydrological modelling is updated. The consequence category for the preferred saddle dam upgrade option should also be determined.
<i>Timor Dam Raising Feasibility Study</i>	Public Works Advisory	March 2018	A feasibility study of options for raising of Timor Dam. The report presents options based on a review of available data.	Proposes raising the dam spillway by 3 m to RL 614.210 m AHD. The most feasible option for raising the dam structure involves providing an additional 3 m deep arch on top of the current structure. Two options were considered for the saddle dam.  Concludes that raising of Timor Dam to this level is feasible and estimates the cost to be \$7.0 – 8.0 million.
<i>Timor Dam Raising Concept Design Report</i>	Public Works Advisory	July 2018	Presents a detailed concept design for the raising of Timor Dam including drawings, cost estimates, project risks and constructability.	Provides a structural concept design for the raising of Timor Dam by 3 m to increase storage capacity from 1,140 mL to 1,810 ML. Estimates total cost to be approximately \$7.5 million.
<i>Peer Review of Public Works Advisory (PWA) Concept Design Report for the Raising of Timor Dam</i>	Norm Himsley	August 2018	Peer review of dam safety aspects of PWA concept design.	Provides further recommendations for the detailed design phase including that an updated dambreak study and Consequence Category assessment be the first part of detailed design of the upgraded dam to set appropriate parameters for design and dam safety management.
<i>Coonabarabran Yield Study Report: Additional Cases Progress Reports</i>	NSW Urban Water Services	2018	Review and update of secure yield estimates for Coonabarabran's water supply headworks system estimated in accordance with DPI Water/NSW Office of Water guidelines.	Secure yield estimates were updated with revised input data including reduced groundwater availability, flow releases and operational philosophy. Modelling considered generic environmental flow release requirements. Actual flow release requirements are to be developed in consultation with NSW Department of Industry.

Title	Author	Date	Scope	Outcomes/findings
<i>Warrumbungle Shire Integrated Water Cycle Management Strategy Issues Paper (draft)</i>	Hydrosphere Consulting	2018	Identifies the IWCM issues facing WSC and its customers and is the first component of the IWCM Strategy development.	Security of Coonabarabran's water supply is a high priority issue to be addressed in the IWCM Strategy. The IWCM Strategy will compare the raising of Timor Dam with other augmentation options using a triple bottom line approach.
<i>Drought Management Plan (draft)</i>	Warrumbungle Shire Council	2018	Drought restriction policy and operating rules for town water supplies.	2018 draft Drought Management Plan has been placed on public exhibition. Council will adopt the revised Plan with minor amendments. The plan recommends that the costs/benefits of the raising of the dam wall are examined.

\*RORB is a general runoff and stream flow routing program used to calculate flood hydrographs from rainfall and other channel inputs. It subtracts losses from rainfall to produce rainfall-excess and routes this through catchment storage to produce runoff hydrographs at any location. (GHD, 2016)

## 2. PROPOSED RAISING OF TIMOR DAM

### 2.1 Concept Design

PWA (2018) prepared a concept design report for the raising of Timor Dam. The concept design is informed by assessments of several key considerations including:

- Hydrology and flood;
- Dam break;
- Geotechnical considerations;
- Seismic hazards; and
- Work health and safety, security and access.

The raising of Timor Dam seeks to increase the current Full Supply Level (FSL) by 3 metres from RL 611.21 m AHD to RL 614.21 m AHD increasing the storage capacity by 59% from 1,140 ML to 1,810 ML. The existing main arch dam structure is considered to be in good condition and capable of withstanding additional loading imposed by raising the FSL by 3 metres. The preferred option for raising involves providing an additional 3 m deep arch on top of the current structure.

The current earth fill saddle dam would be raised from the existing level of RL 616.09 m AHD to RL 619.15 m AHD. The preferred option involves raising by placement of additional earthfill using mainly locally sourced materials with the upstream face protected by rip rap while the downstream slope would be topsoiled and grassed. Realignment of access roads to both sides of the crest of the saddle dam is also required. In conjunction with the main construction works a new seepage weir would also be installed with significant upgrade of the inlet and outlet works and security and access arrangements.

Timor Dam has been assigned a HIGH A Flood Consequence Category (FCC), which requires safe passage of the Probable Maximum Flood (PMF) and a SIGNIFICANT Sunny Day Consequence Category (SDCC), which requires it to withstand a 0.2% AEP (500 year) earthquake. Himsley (2018) suggest that the method used in the concept design is incorrect and recommends that an updated dambreak study and Consequence Category assessment be the first part of detailed design of the upgraded dam to set appropriate parameters for design and dam safety management.

Preliminary identification of ecological issues to be considered in the environmental assessment phase were outlined in the Safety in Design Risk checklist.

### 2.2 Inundation Area and Land Acquisition

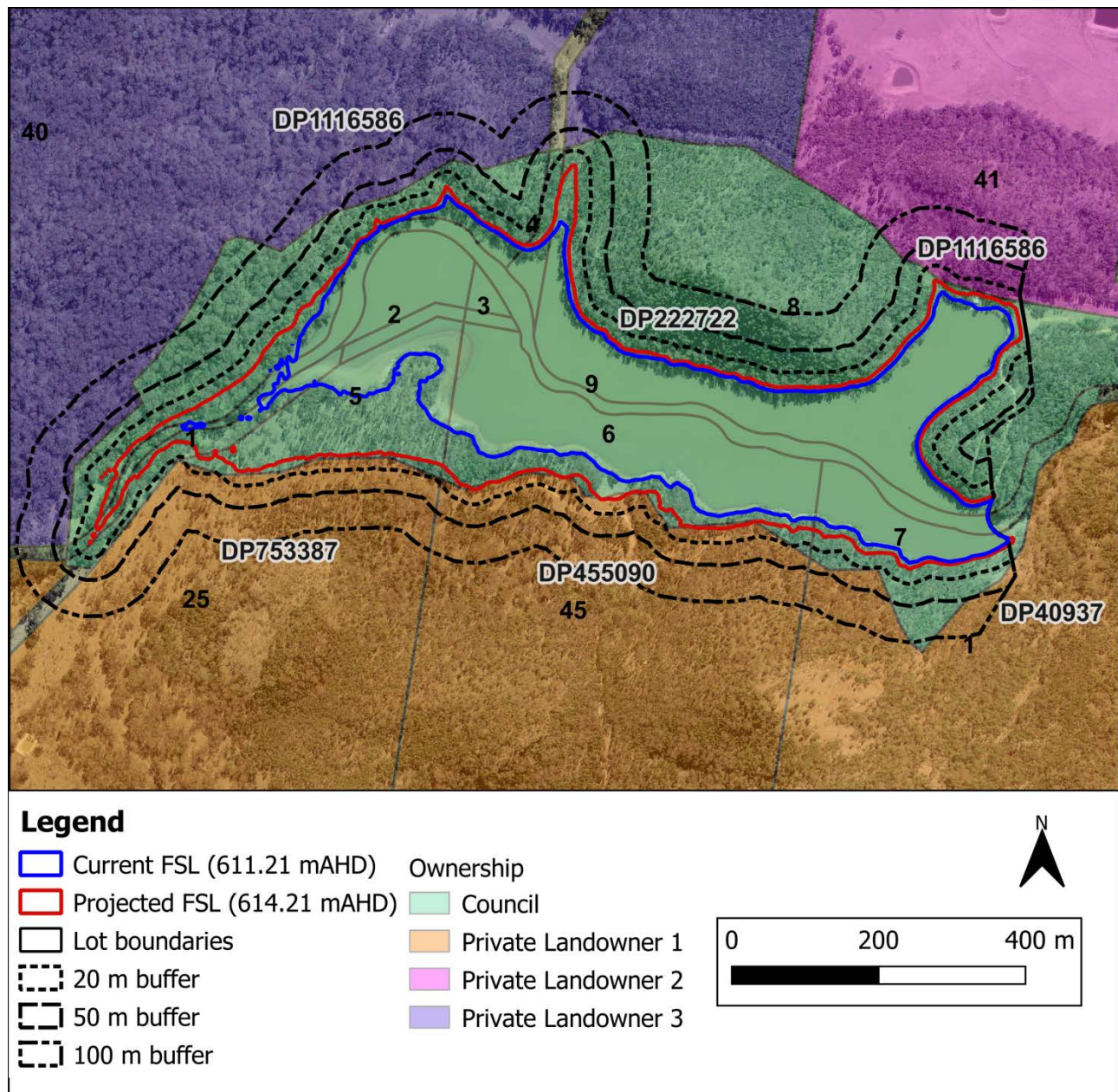
The projected estimated inundation extent of the dam raising to 614.21 m AHD FSL was calculated using existing LiDAR data and is presented in Figure 2 including ownership of land within the inundation area. The projected inundation extent at the new FSL does not include flood surcharge inundation and is an approximation only. The surface area of the storage is approximately 20 ha at the current FSL and is projected to expand to 27 ha with the projected 614.21 m AHD FSL. As illustrated in Figure 2 the majority of the increase in inundation area will occur on Council owned land (Lots 1-9 DP222722) with a small area (approx. 600 m<sup>2</sup>) of inundation likely to occur on private land (Lot 45 DP455090).

Buffer zone requirements are discussed in Section 2.3. If buffer zones are incorporated into the management of the dam, additional land area and land parcels will be impacted. Figure 2 illustrates the extent of indicative 20, 50 and 100 m buffer zones if applied to the projected FSL. A 20 m buffer would impact Lot 1 DP 40937 and Lot 40 DP1116586 with 50 m and 100 m buffers impacting all previous lots as well as an additional lot. The required indicative areas of land acquisition associated with each buffer zone are provided in Table 2.

**Table 2: Estimated areas of land acquisition based on indicative buffer zones**

Buffer Zone	Estimated land acquisition required (ha)
None	0.06
20 m	1.5
50 m	6.8
100 m	20.7

Negotiations with relevant landowner/s will be required regarding acquisition of land for inundation and for buffer zones. Survey of the property boundary will be required as part of this process.



**Figure 2: Current and projected FSL inundation areas, buffer zones (indicative) and land ownership**

## 2.3 Buffer Zone

The water quality and safety of public drinking water supply systems are managed under a multi-barrier approach. This approach generally includes management of the drinking water source catchment which may include the provision and management of a vegetated buffer zone around the water supply reservoir. The establishment of vegetated buffers around water supply reservoirs is a recognised management strategy for the protection of water quality and reduction of risks to water supply.

Buffer zones are applied to water storages to:

- Exclude incompatible land use (e.g. stock access);
- Provide “filtering” capability to remove contaminants and reduce turbidity of runoff;
- Offset the effects of remote contaminant sources;
- Reduce erosion and sedimentation (hence improve storage longevity);
- Improve storage water quality through reduced ‘dead’ storage, environmental incidents and operational requirements.
- Allow long-term land management planning (revegetation, bush fire access, provision for future dam raising inundation areas);
- Create additional environmental value (e.g. biodiversity, habitat offset, fauna movement corridors); and
- May provide other social benefits through multiple-use (day trip bushwalking, family facilities, aesthetic appreciation, local tourism, etc.).

There is no common industry standard for buffer zone widths with water storage buffers ranging from less than 20 m in width to several kilometres and/or covering 100% of the catchment. Site-specific issues such as catchment land use, land tenure, slope, vegetation type and cover and project-specific issues such as costs, operational requirements and land acquisition arrangements are considerations when determining catchment and storage management requirements for a specific water supply reservoir.

Determination of buffer zone extents needs to:

- Identify the key risk areas and factors within the catchment;
- Evaluate the cumulative risk represented by these factors;
- Evaluate the other potential additional benefits; and
- Identify natural break-points that would serve as scientifically logical, cost-effective and administratively simple boundaries for the extent of the buffer zone.

At this stage, the need for or extent of a buffer zone for the proposed raised extent of Timor Dam has not been assessed. The need for, extent and type of buffer zone around the storage will need to be evaluated and determined during the planning phase of the project. The determination of a buffer zone is critical in determining the project footprint, land acquisition requirements, management and operational requirements and consequently project costs. Other assessments and agency requirements will need to be considered in the buffer zone planning and as such will need to be undertaken and obtained prior to the determination of a buffer zone.

The following additional considerations are required to inform the buffer zone evaluation:

- Drinking water quality results and requirements;
- Biodiversity assessment;

- Catchment land use, slope, erosion risk; and
- Property survey and land acquisition negotiations.

### **3. LEGISLATION AND APPROVALS**

#### **3.1 Environmental Planning and Assessment Act 1979**

The Environmental Planning and Assessment Act, 1979 (EP&A Act) and the EP&A Regulation, 2000 provide a framework for environmental planning in NSW. An assessment of the likely impacts of a proposal which may have an impact on the environment is required under the Act prior to a decision to proceed with the proposal.

The Act imposes requirements for controlling development under two parts:

- Part 4 of the Act controls development that requires consent or is prohibited under an environmental planning instrument; and
- Part 5 of the Act imposes requirements for assessing the impact of development that does not require consent under an environmental planning instrument.

The relevant environmental planning instruments that regulate use and development under this legislation are discussed below.

The proposed works do not require consent (Section 3.11.2), are not considered to be prohibited under an environmental planning instrument and are not considered to be state significant development or state significant infrastructure (Section 3.11.3) and therefore require assessment under Part 5 of the Act. WSC is the proponent and determining authority responsible for deciding whether to approve or proceed with the activity. An environmental assessment in the form of a Review of Environmental Factors (REF) is required in accordance with Part 5 of the EP&A Act and Section 111 of the Act, which requires that the proponent (WSC) take into account to the fullest extent possible all matters affecting or likely to affect the environment due to the proposed activity.

#### **3.2 Water Management Act 2000**

The Water Management Act 2000 (WM Act) provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.

Section 90 of the Act requires an approval to undertake water supply work. The definition of water supply work includes work (such as a tank or dam) for the purpose of capturing or storing water or any work that has, or could have, the effect of impounding water in a water source.

Approval would be required from Department of Industry - Water for the raised weir, either in the form of a new works approval/licence or an amendment to the existing works approval/licence (refer Section 3.12.1).

#### **3.3 Fisheries Management Act 1994**

The objectives of the Fisheries Management Act 1994 (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. To meet the primary objectives, Part 7 of the FM Act deals with the protection of aquatic habitats and Part 7A deals with threatened species conservation.

All proposals for the construction of, or modification to, dams, weirs or similar structures are required to be referred to DPI - Fisheries for assessment. For the construction or the major modification or alteration of dams, weirs and regulators the construction of a fishway will generally be required. Under Section 218 of the

Act, a public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway (or to approve of any such construction, alteration or modification) must notify the Minister of the proposal, and must, if the Minister so requests, include as part of the works for the dam, weir or reservoir, or for its alteration or modification, a suitable fishway or fish by-pass. All fishway proposals require the approval of DPI - Fisheries. The appropriateness of a particular fishway and its design specifications are usually dealt with on a 'case-by-case' basis. In cases where the nature of the structure or other factors mean that it is not cost-effective or practical to install a fish passage structure or restore fish passage and greater ecological outcomes can be achieved elsewhere, fish passage trade-offs may be considered. A trade-off involves ensuring equal or more cost-effective fish passage outcomes through transferral of fish passage works from the proposed works site to an alternative site or sites. Generally, trade-off sites must (NSW DPI, 2013):

- Occur within the same catchment as the compliance site;
- Be identified by NSW DPI as a high priority for rehabilitation of a fish passage barrier;
- Not be a site where planned upgrade works are proposed in the next 10 years that would trigger s218 of the FM Act; and
- Derive equal to or greater ecological benefit than providing fish passage at the original compliance site; and
- Be discussed and agreed upon by DPI - Fisheries.

A permit to obstruct free passage of fish must be obtained under Section 219 of the Act.

The existing Timor Dam structure does not include a fishway or fish passage and the current proposed dam raising concept design (Public Works Advisory, 2018) does not include a fishway or other fish passage structure. Fish passage requirements were not discussed in the dam raising concept design. The requirement for a fishway, fish passage offset or permit to obstruct free passage of fish would need to be negotiated with DPI - Fisheries.

Under Section 200 of the Act a local government authority must not carry out dredging work or reclamation work except under the authority of a permit. The definition of dredging work includes any work that involves excavating water land, or any work that involves moving material on water land or removing material from water land. The definition of reclamation work includes any work that involves:

- Using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land; or
- Depositing any such material on water land for the purpose of constructing anything over water land.

Water land means land submerged by water either permanently or intermittently. The proposed works are considered to constitute dredging and reclamation work and therefore require a dredging and reclamation permit issued under Section 200 of the Act.

The FM Act contains schedules of species, populations and ecological communities that have been listed as 'threatened'. Where a proposed development is in the potential range of a listed threatened species, population or ecological community under the FM Act and/or the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the area has not been declared a critical habitat, then the preparation of the 'test of significance' on the subject species, population or community is required. The 'test of significance' is used to determine whether the proposed development is likely to significantly affect threatened species, population or ecological communities. If the determining/consent authority determines that the project will not have a significant impact after considering the test of significance, then the proposal may be accepted. If the determining/consent authority determines that the proposed project will have a significant impact via the 'test of significance', then a Species Impact Statement (SIS) is required to be prepared, or the proposal may require modification where possible.

### **3.4 National Parks and Wildlife Act 1974**

The National Parks and Wildlife Act 1974 (NPW Act) provides for the statutory protection of protected flora and fauna and Aboriginal cultural heritage places, objects and features. It is an offence under the NPW Act to cause harm or desecration to any Aboriginal heritage items, objects or places discovered during operations.

A search of the Aboriginal Heritage Information Management System (AHIMS) database revealed no Aboriginal sites within the vicinity of Timor Dam (Section 4.6). Due diligence should be exercised to determine whether the proposed activity will harm an Aboriginal object or site in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (OEH, 2010). Initial consideration of the code and landscape features indicates that Aboriginal objects are considered likely to occur within and/or near the dam and the proposed works may potentially impact such objects. As such an Aboriginal Cultural Heritage Due Diligence Assessment will need to be undertaken to satisfy due diligence requirements and allow an informed assessment of the impacts of the proposal on Aboriginal cultural heritage values. If the assessment determines that Aboriginal objects are present or likely to be present and an activity will harm those objects, then an Aboriginal Heritage Impact Permit and associated application will be required.

### **3.5 Biodiversity Conservation Act 2016**

The NSW Biodiversity Conservation Act 2016 (BC Act) came into effect in August 2017 replacing the repealed Threatened Species Conservation Act 1995, Native Vegetation Act 2003 and National Parks and Wildlife Act 1974 (animal and plant provisions only). The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The Act provides provisions for the protection of threatened or protected animal and plant species, threatened ecological communities and areas of outstanding biodiversity value.

The Act sets out the assessment framework for threatened species and ecological communities, which are now listed under this Act, for activities and approvals under Part 5 of the Environmental Planning and Assessment Act 1979. To determine whether the proposed activity is likely to significantly affect threatened species or ecological communities or their habitats, a test of significance must be applied. If it is found that the proposed activity is likely to significantly affect threatened species or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS). If the proposed activity will not have a significant impact on threatened species or areas of outstanding biodiversity value it will continue to be assessed under s.111 of the Environmental Planning and Assessment Act 1979.

### **3.6 Protection of the Environment Operations Act 1997**

The POEO Act regulates air, noise, land and water pollution. Under the Act it is an offence to cause pollution. The Act enables the issue of environment protection licences (EPL) for scheduled and non-scheduled development work or activities. The proposed works are considered unlikely to consist of a scheduled activity and therefore do not require an EPL as a scheduled activity. A non-scheduled activity EPL may be granted to regulate water pollution from an activity. The licence provides a defence against a pollution of waters offence for those pollutants specifically regulated under the licence as long as the pollutants discharged to waters are within the limits specified in the licence. In general the EPA will not issue a non-scheduled activity licence where there is a low likelihood of impact on waters and where pollution should not occur if the activity is carried out in a competent manner. The need for an EPL is subject to final design and construction methodology.



### **3.7 Local Government Act 1993**

The Local Government Act 1993 provides the legal framework for local government in NSW and sets out the responsibilities and processes by which it operates.

Under Section 60 of the Local Government Act 1993 a Council must seek approval of the Minister for Primary Industries to construct or extend a dam for the impounding or diversion of water for public use or any associated work.

### **3.8 NSW Heritage Act 1977**

All non-Aboriginal archaeological relics across NSW (including NPWS estate) over 50 years old are managed under the Heritage Act 1977. Any works or activities that may disturb non-Aboriginal archaeological relics must have an Excavation Permit, which is a separate approval under the Heritage Act 1977. From searches of relevant registers and lists no known heritage sites or archaeological relics have been identified within the proposed works site (Section 4.5) and therefore impacts on non-Aboriginal heritage are not expected as a result of the works.

### **3.9 Dam Safety Act 2015**

The Objectives of the Dam Safety Act are to ensure that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community, as well as regulating the management and risks associated with dam safety. Changes in the operation and maintenance of Timor Dam will require consultation with the NSW Dams Safety Committee.

### **3.10 Environmental Protection Biodiversity Conservation Act 1999 (Commonwealth)**

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the EPBC Act as matters of national environmental significance. The Act lists threatened species or ecological communities that are recognised as a matter of national environmental significance. Under the EPBC Act an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. In order to determine whether an action is likely to have a significant impact, an assessment of significance on relevant matters is required

Under the Act a referral is required to the Commonwealth Minister administering the Act for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land.' The Minister will decide if the proposed action triggers the matters protected by the EPBC Act and requires a formal assessment and approval. If the Minister deems that the proposal is not likely to be significant, approval is not required if undertaken in accordance with the referral or in a 'particular manner'. If the Minister decides that the proposal is likely to be significant, it is considered a 'controlled action' and approval under the Act will be required. The proposal will be subject to a formal assessment and approval process (to be decided by the Minister).

Actions can be assessed using one of the following assessment approaches:

- Accredited assessment (e.g. bilateral agreements);
- Assessment on referral information (assessment undertaken solely on the information provided in the referral form);
- Assessment on preliminary documentation (referral form and any other relevant material identified by the Minister as being necessary to adequately assess a proposed action);

- Assessment by Environmental Impact Statement (EIS) or Public Environment Report (PER); or
- Assessment by public inquiry.

Following the assessment the Minister will decide whether to:

- Approve the proposal;
- Approve the proposal subject to constraints (e.g. will place conditions on the action); or
- Not approve the proposal.

When deciding if a proposed action should be approved, and what conditions to impose, the Minister will consider the impacts of the proposed action on matters protected by the EPBC Act and other economic and social matters. The Minister must take into account:

- The principles of ecologically sustainable development;
- The outcomes of the assessment of the impacts of the proposed action;
- Referral documentation;
- Community and stakeholder comment;
- Any other relevant information available on the impacts of the proposed action; and
- Relevant comments from other Australian Government and state and territory government ministers

### 3.11 Relevant Environmental Planning Instruments

Environmental Planning Instruments (or EPI) refer to Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). EPIs detail the range of land use zones and planning controls and where and how they apply to development or activities.

#### 3.11.1 Warrumbungle Local Environmental Plan 2013

Land within the vicinity of Timor Dam is zoned as RU1 – Primary Production. Water supply systems are permitted with consent in areas zoned RU1. SEPP – Infrastructure prevails over this plan and the proposed works are permissible without consent (refer Section 3.11.2).

#### 3.11.2 SEPP – Infrastructure (2007)

The State Environmental Planning Policy (Infrastructure) 2007 (known as the Infrastructure SEPP) assists in providing infrastructure by modifying planning provisions to improve efficiency and service delivery.

Under Part 3, Division 24, Clause 125 (2) "*Development for the purpose of water storage facilities may be carried out without consent if it is carried out by or on behalf of... any public authority on land in Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone SP1 Special Activities, Zone SP2 Infrastructure or an equivalent land use zone*".

Water storage facility means "*a dam, weir or reservoir for the collection and storage of water, and includes associated monitoring or gauging equipment*".

The proposed works are considered to be development for the purpose of a water storage facility, will be carried out by a public authority (WSC) and will be undertaken on land zoned RU1 and therefore are permitted without consent under Part 3, Division 24, Clause 125 (2) SEPP – Infrastructure.

### 3.11.3 SEPP - State and Regional Development (2011)

The aim of this policy is to identify state significant development and state significant infrastructure.

Under Schedule 3 of the Policy development for the purpose of water storage or water treatment facilities (not including desalination plants) carried out by or on behalf of a public authority that has a capital investment value of more than \$30 million is considered to be state significant infrastructure. The value of the proposed Timor Dam raising is expected to be approximately \$7.5 million and therefore is not expected to be considered as state significant infrastructure. However, if the project was projected to exceed the \$30 million threshold then the project would be considered as state significant infrastructure and require the preparation of an Environmental Impact Statement.

### 3.11.4 SEPP 44 – Koala Habitat Protection

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP requires a plan of management for areas of more than one hectare that contain koala habitat and for which a development application has been lodged under Part 4 of the EP & A Act. The proposed works will be assessed under Part 5 of the EP & A Act and therefore SEPP 44 does not apply. If koala habitat was found to be impacted by the proposed works it would be assessed accordingly under the requirements of the Biodiversity and Conservation Act 2016 and Environment Protection Biodiversity Conservation Act 1999.

## 3.12 Other Considerations

### 3.12.1 Warrumbungle Integrated Water Cycle Management Strategy

An IWCM Strategy is a local water utility's (LWU's) 30-year strategy for the provision of appropriate, affordable, cost-effective and sustainable urban water services that meet community needs and protect public health and the environment.

The Warrumbungle Shire Council (WSC) IWCM Strategy will:

- Identify the urban water services issues;
- Assess the options;
- Develop and evaluate IWCM scenarios; and
- Adopt a sound IWCM Strategy and Financial Plan to address the identified issues.

The IWCM Issues Paper (Hydrosphere Consulting, 2018) identifies the IWCM issues facing WSC and its customers and is the first component of the IWCM Strategy development. An IWCM issue is defined as an unacceptable risk of failure to meet statutory requirements or the adopted Levels of Service now or within the 30-year planning horizon. The IWCM Issues Paper identifies the security of Coonabarabran's water supply as a high priority issue and discusses Council's current response to this issue as follows:

- Review of the secure yield assessment;
- Emergency groundwater bores have been constructed. A concept for a dedicated groundwater supply system is being developed. A grant application has been submitted for design and construction of the pipeline (NSW Government Safe and Secure Water Program);
- A groundwater resource analysis is being undertaken to confirm sustainability of groundwater extraction; and

- Council is investigating the feasibility of raising Timor Dam. A draft concept design has been prepared. A preliminary environmental assessment and project plan is being prepared (this document).

The IWCM Issues Paper also identifies the need to assess the options for water supply security including demand management and water loss management. The IWCM Strategy is expected to be completed in early 2019.

### 3.12.2 Water Sharing Plan

All WSC town water sources are subject to licences under the Water Management Act 2000. The Water Sharing Plan for the Castlereagh River Unregulated and Alluvial Water Sources 2011 specifies requirements for sharing of water to protect the water source and its dependent ecosystems as well as basic landholder rights.

Under the Act, extractions for town water supply are afforded a higher priority than extractions for commercial purposes such as irrigation. Water sharing plans recognise this priority by ensuring that a full share of water is allocated for annual town water supplies except where exceptional drought conditions prevent this. Local water utilities such as local councils are issued with local water utility access licences.

Council has an approval and Local Water Utility Water Access Licence for Timor Dam under the Water Sharing Plan for the Castlereagh River Unregulated and Alluvial Water Sources 2011. The licence extraction entitlement is 800 ML/a.

Any development of new water storages in the Water Sharing Plan area must be undertaken within the bounds of the plan. The plan sets a framework within which development of future water supplies can occur in a sustainable manner. At a minimum, a local water utility will need to meet conditions specified in the plan to ensure enough water is flowing to protect the environment in accordance with the plan. The practical implementation of the conditions will be determined in consultation with NSW Department of Industry.

### 3.12.3 NSW Weirs Policy

The goal of the State Weirs Policy is to halt and, where possible, reduce and remediate the environmental impact of weirs. Within the policy, a weir is defined as a structure (including a dam, lock, regulator, barrage or causeway) across a defined watercourse that will pond water, restrict flow or hinder the movement of fish along natural flow paths, in normal flow conditions.

The Policy outlines a number of management principles to be adopted to achieve the goal of the policy as follows:

1. The construction of new weirs, or enlargement of existing weirs, shall be discouraged.
2. Weirs that are no longer providing significant benefits to the owner or user shall be removed, taking into consideration the environmental impact of removal.
3. Where retained, owners shall be encouraged to undertake structural changes to weirs to reduce their environmental impact on the environment.
4. Where retained, owners of weirs with regulatory works shall prepare and adhere to operational plans to reduce the environmental impact of those weirs.
5. Where retained, gates, offtake structures and fishways on all weirs shall be maintained in good working order.
6. Wetlands and riparian vegetation adjacent to weirs should be protected from permanent inundation.

7. Areas of environmental degradation caused by the impacts of weirs upstream and downstream of weir pools, should where possible be rehabilitated.
8. A respect for the environmental impact of weirs should be encouraged in all agencies and individuals who own, manage or derive benefits from weirs.

With respect to the expansion of an existing or construction of a new weir, the Policy states that a proposal to build a new weir or enlarge an existing weir should not be approved unless it can be demonstrated that the primary component of the proposal is necessary to maintaining the essential social and economic needs of the affected community.

In determining the need for a new or expanded weir under the Policy, the following general principles apply:

- Provision for fish passage cannot be used as a sole justification to approve a proposal to enlarge an existing weir.
- An increase in town water supply for the purposes of meeting projected population demand cannot be used as a justification to approve a proposal to build a new, or expand an existing weir, if environmentally friendlier alternatives to meeting that demand exist, which are also economically feasible.
- Provision for future industrial expansion (such as, but not limited to, tourism) cannot be used as a justification to build a new, or expand an existing weir.
- Subject to the usual EIA process, a proposal for the construction of new, or expansion of an existing weir that will result in a net environmental benefit may be approved.

The IWCM Strategy (under preparation) will assess the potential options to achieve town water supply security for Coonabarabran. Further consultation and assessment will be required to determine if the proposal for the raising of Timor Dam is consistent with the NSW Weirs Policy.

### 3.12.4 Petroleum Exploration Licences

Timor Dam and its catchment lie within a petroleum title, Petroleum Exploration Licence (PEL) 450 held by Santos QNT Pty Ltd (NSW Resources and Energy, 2016). A PEL gives the holder the exclusive right to explore for petroleum (including conventional and coal seam gas) within the exploration licence area, during the term of the licence. The PEL expired in 2012 however renewal is being sought by Santos.

Works undertaken under the PEL may potentially pose a risk to Timor Dam and its drinking water catchment. Risks to the drinking water catchment have not been assessed as a part of this preliminary environmental assessment and would require review once the PEL status is confirmed.

### 3.13 Approvals Pathway

An environmental assessment in the form of a REF is required in accordance with Part 5 of the EP&A Act and Section 111 of the Act, which requires that the proponent (WSC) take into account to the fullest extent possible all matters affecting or likely to affect the environment due to the proposed activity. WSC is the proponent and determining authority responsible for deciding whether to approve or proceed with the activity.

In addition to the REF the following negotiations and approvals/licences/permits are expected to be required:

- NSW Department of Industry - Water approval under the WM Act in the form of a new or amended works approval/licence;
- The requirement for a fishway, fish passage offset and permit to obstruct free passage of fish would need to be negotiated with NSW DPI – Fisheries;
- A dredge and reclamation permit issued by NSW DPI – Fisheries under the FM Act; and

- The requirements for environmental flow releases will need to be determined in consultation with Department of Industry – Water.

Depending on the results of detailed environmental assessments, other environmental approvals may be required as discussed in the following sections.

## 4. PRELIMINARY ENVIRONMENTAL ASSESSMENT

### 4.1 Soils and geology

Public Works Advisory (2018) provides a summary of site geology. The regional geology of the Timor Dam area is described as a volcanic and intrusive shield comprising trachyte and basalt of Tertiary age. These igneous rocks intrude and overlie the Pilliga Sandstone that comprises sandstone, conglomerate and shale of Jurassic age. Other smaller deposits of basalt of Tertiary age (Tb) cap the higher areas, especially to the south of Coonabarabran.

At the dam wall site itself, the existing concrete arch dam is founded on massive trachyte. The trachyte is underlain at depth by sandstone. At the dam wall the trachyte has been estimated to be in the order of 12 m thick under the valley base. The storage area and saddle embankment (to the north) are also underlain by trachyte. Laboratory tests (SMEC, 2016) have indicated very strong rock substance strength.

The saddle embankment is also founded on trachyte with sandstone occurring at some depth beneath the foundation. A typical weathering profile comprises topsoil overlying red-brown gravelly clayey sandy silt with boulders. Extremely weathered/highly weathered trachyte, with moderately weathered boulders, underlies the soil at a variable depth up to approximately 1m.

Soils across the majority of the catchment are dominated by Rudosols and Tenosols with small areas of Ferrosols and Kandosols in the upper catchment.

#### 4.1.1 Preliminary assessment

Establishment of access roads, haul roads, construction pads, stockpile, auxiliary and laydown areas will require excavation and importation of rock fill material. The construction of the extended saddle dam will also require excavation and importation of fill material. All of these aspects pose a potential erosion risk and will be required to be managed through the development and implementation of a site soil and water management plan. The soil and water management plan should be developed in accordance with the Blue Book (*Urban Stormwater: Soils and Construction Volume 1*, Landcom 2004).

During the operation phase of the dam raising (i.e. post-construction) bank erosion is likely to occur along shorelines from fluctuations in water levels. There is also a risk of bank erosion occurring downstream from the dam wall during releases and flood conditions. Bank erosion both within the storage and downstream should be considered in the REF.

Soil contamination is a potential issue for the proposed inundation area from cattle dip sites, agricultural sheds and associated agricultural activities, septic systems or illegal waste sites. A search of the NSW EPA contaminated lands records of notices revealed no recorded contaminated sites within the project area and the proposal is unlikely to impact contaminated land. However, given the agricultural history of the area, the potential for contamination within the proposed inundation and construction footprint should be considered in the environmental assessment phase of the project.

The proposal has the potential to result in contamination of soil and water as a result of chemical (most likely hydrocarbon) spills and leaks from construction equipment. Standard measures would be implemented during the construction phase to minimise the likelihood of any spills.

#### 4.1.2 Recommendations

- Development of soil and water management plan developed in accordance with the Blue Book (*Urban Stormwater: Soils and Construction Volume 1*, Landcom 2004).

- REF to consider bank erosion within storage and downstream.
- REF to consider contaminated land and potential for contamination as a result of the works.

## 4.2 Terrestrial Flora and Fauna

Vegetation surrounding the water storage and dominating the majority of the catchment is mapped as Dry Sclerophyll Forest (shrubby subformation) with small areas of other vegetation formations (OEH, 2015). Vegetation directly surrounding the water storage consists of numerous plant community types as illustrated in Figure 3. The majority of the vegetation directly surrounding the dam is Red Stringybark – Rough-barked Apple +/- Nortons Box open forest. An area of Blakelys Red Gum – Yellow Box grassy tall woodland is present directly upstream of the dam extent and a little further upstream along the river, derived speargrass – wallaby grass–wire frass mixed forb grassland is mapped. At the upstream extent of the dam a small area of Whitebox grassy woodland is mapped, however this appears to be an error as the aerial photograph (2011) shows the water storage. The potential conservation status/significance of the vegetation types are briefly outlined below:

- Red Stringybark – Rough-barked Apple +/- Nortons Box open forest – no conservation status;
- Blakelys Red Gum – Yellow Box grassy tall woodland – may potentially have features characteristic of White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands which is a Threatened Ecological Community listed as Critically Endangered under the EPBC Act. This vegetation may also be classified as White Box Yellow Box Blakely's Red Gum Woodland (equivalent of above) which is listed as an Endangered Ecological community under the BC Act; and
- Derived speargrass – wallaby grass–wire grass mixed forb grassland – undetermined conservation status.



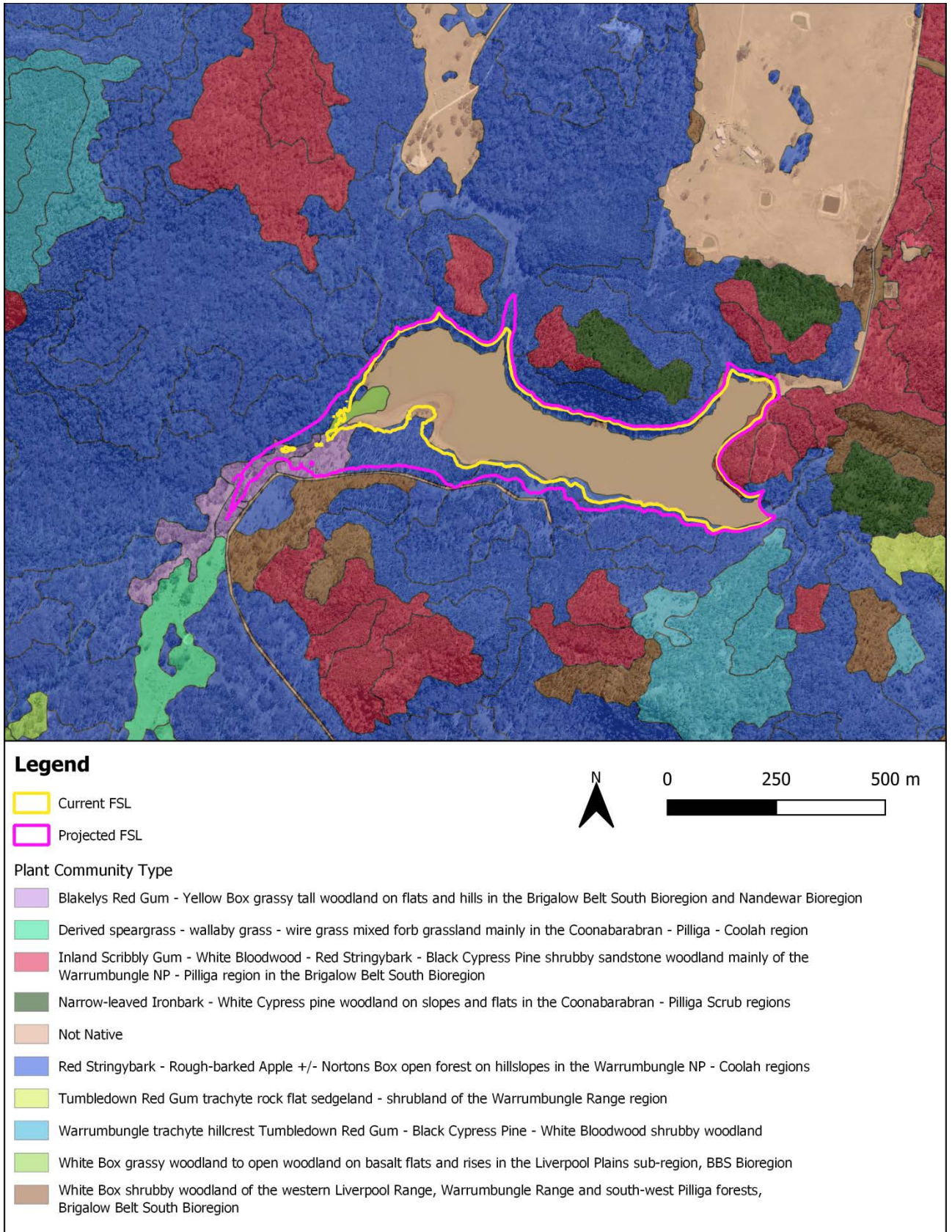


Figure 3: Plant community types within the vicinity of Timor Dam

Searches of the following databases were conducted to assist in evaluating the potential for threatened species to be present within the works area:

- Protected Matters Search Tool (EPBC Act); and
- BioNet.

A search of the Bionet database revealed records of a number of fauna species within approximately 5 km of Timor Dam as follows:

- Little Lorikeet (*Glossopsitta pusilla*) – Vulnerable (BC Act);
- Turquoise Parrot (*Neophema pulchella*) – Vulnerable (BC Act);
- Barking Owl (*Ninox connivens*) – Vulnerable (BC Act);
- Brown Treecreeper (*Climacteris picumnus victoriae*) – Vulnerable (BC Act);
- Regent Honeyeater (*Anthochaera Phrygia*) – Endangered (BC Act);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) – Vulnerable (BC Act);
- Diamond Firetail (*Stagonopleura guttata*) – Vulnerable (BC Act); and
- Koala (*Phascolarctos cinereus*) – Vulnerable (BC Act; EPBC Act).

Results from the Protected Matters Search Tool indicated that three species listed under the EPBC Act were known or had habitat known to occur within 1 km of Timor Dam including:

- Regent Honeyeater (*Anthochaera phrygia*) – Endangered (EPBC Act);
- Painted Honeyeater (*Grantiella picta*) – Vulnerable (BC Act; EPBC Act); and
- Koala (*Phascolarctos cinereus*) – Vulnerable (BC Act; EPBC Act)

Numerous other species or species habitat were listed as likely to or may occur within the study area (Appendix 1). Threatened ecological communities listed under the EPBC Act recorded as likely to occur within the study area include:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia – Endangered (EPBC Act); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered (EPBC Act), Endangered (BC Act).

Several other communities were recorded as 'may occur' within the study area (Appendix 1).

#### 4.2.1 Preliminary assessment

The raising of the dam is projected to result in the inundation and permanent loss of approximately 7 ha of vegetation and potential habitat. Some areas of vegetation to be inundated may contain threatened and or endangered ecological communities. A relatively large proportion of the inundation area at the upstream extent of the dam is mapped as a potential TEC/EEC.

The significance of any impacts on habitat and vegetation is difficult to assess without further information on habitat and vegetation type, extent, value and significance of that present at the site. However, it is reasonable to expect that the increase in inundation area will have negative impacts on inundated vegetation and habitat. It is expected that impacts would be restricted to directly within and in the immediate vicinity of the inundation area and construction works footprint (i.e. establishment of access tracks, site compounds etc.). Impacts to vegetation and terrestrial habitat upstream or downstream of the storage area are not expected.

## 4.2.2 Recommendations

The impacts of the proposal on terrestrial flora and fauna habitat need to be fully considered and assessed in the REF process. To enable the assessment of impacts on flora and fauna the following will be required:

- Detailed terrestrial flora and fauna assessment to be undertaken by an appropriately qualified ecologist of any areas potentially impacted by the proposed works including projected inundation areas, potential buffer areas, construction area, construction access, site storage, site compound areas etc. The assessment is required to:
  - Identify flora and fauna species (including threatened species and ecological communities) and habitat features within study area;
  - Assess extent, value, quality and significance of habitat within study area;
  - Assess impacts on flora and fauna values;
  - Provide measures to minimise impacts on flora and fauna values.
- If there is potential for the proposal to impact threatened species or ecological communities listed under the BC Act, a test of significance must be applied to determine whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats;
- If it is found that the proposed activity is likely to significantly affect threatened species or will be carried out in a declared area of outstanding biodiversity value, the Biodiversity Offsets Scheme must be applied or a species impact statement (SIS) must be prepared. The Biodiversity Offsets Scheme would likely include acquisition and management of suitable offset areas;
- If there is potential for the proposal to impact threatened species or ecological communities (matter of national environmental significance) listed under the EPBC Act, an assessment of significance on the relevant matters is required;
- If the assessment of significance indicates that the proposal will have, or is likely to have a significant impact on a matter of national environmental significance, the proposal will require referral to the Minister; and
- If the Minister deems the proposal requires approval under the EPBC Act it is likely that an EIS will be required.

## 4.3 Aquatic Habitat

Site specific information on aquatic habitat within Timor Dam, upstream and downstream of the dam is not available and the type, value and condition of aquatic habitat within the Castlereagh River within the vicinity of the proposal are currently unknown.

Davies *et al.* (2012) undertook a condition and ecosystem health assessment for the valleys in the Murray Darling Basin during 2008 – 2010. The study reported that overall the Castlereagh River system's fish, benthic macroinvertebrate and riverine vegetation communities were in Very Poor, Moderate and Good condition respectively, while Hydrology and Physical Form were both in Good condition and the overall river ecosystem health was poor.

Table 3 presents the fish species Davies *et al.*, (2012) predicted to occur or recorded within the Upland section of the Castlereagh River and are considered representative of what species may occur within the vicinity of the proposal site.

**Table 3: Fish species predicted to occur and recorded by Davies *et al.*, (2012) in the upland section of the Castlereagh River**

Common Name	Occurrence
Australian Smelt	Recorded
Bony Herring	Recorded
Freshwater Catfish	Recorded
Golden Perch	Recorded
Gudgeon (spp)	Recorded
Mountain Galaxias	Predicted
Murray Cod	Predicted
Murray-Darling Rainbowfish	Predicted
Olive Perchlet	Predicted
River Blackfish	Predicted
Silver Perch	Predicted
Southern Purple-spotted Gudgeon	Predicted
Spangled Perch	Predicted
Unspecked Hardyhead	Predicted
Common Carp	Recorded
Gambusia	Recorded
Goldfish	Recorded

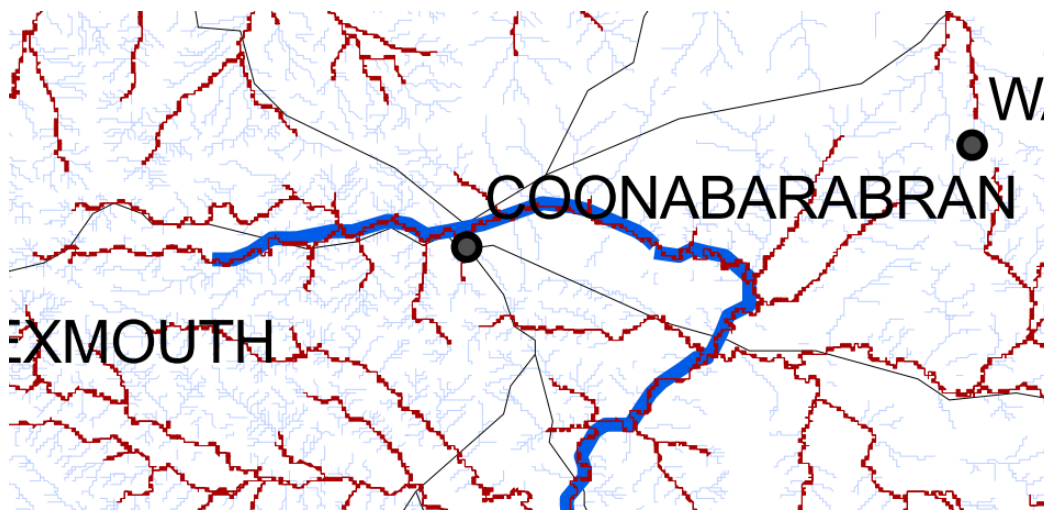
### 4.3.1 Key fish habitat

Key fish habitats are those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. Key fish habitat includes:

- Oceanic, bay, inlet and estuarine habitats up to the level defined by High High Water Solstice Spring tides (so called 'King tides' or Highest Astronomical Tide);
- Intermittently Closing and Opening Lakes and Lagoons (ICOLLs) up to the level at which they would naturally break out to the sea (which may be 2 or 3 metres above mean sea level);
- Permanently flowing rivers and creeks including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified;
- Intermittently flowing rivers and creeks that retain water in a series of disconnected pools after flow ceases including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified;
- Billabongs, lakes, lagoons, wetlands associated with other permanent fish habitats (e.g. permanent rivers and creeks, estuaries etc.);

- Weir pools and dams up to full supply level, where the weir/dam is across a natural stream channel or waterway;
- Flood channels or flood runners that may normally be dry but would be used by fish to move/migrate across or along floodplains between habitats during high flow events;
- Mound springs; and
- Any waterbody, regardless of whether or not it may be listed under the heading 'What is not included?' below, if it is known to support or could be confidently expected (based on predictive modelling) to support threatened species, threatened populations or threatened communities listed under the provisions of Part 7A of the *Fisheries Management Act 1994*.

Based on the above definition and WSC key fish habitat mapping (Figure 4), Timor Dam and the main arm of the Castlereagh River upstream and downstream of the dam is considered to be key fish habitat.



**Figure 4: Excerpt from Warrumbungle LGA key fish habitat mapping**

Source: NSW DPI (undated). Maroon – key fish habitat, blue – Castlereagh River.

### 4.3.2 Threatened Species

NSW DPI mapping data (Figure 5) indicates Timor Dam and the Castlereagh River, both upstream and downstream of the dam, is within what is considered to be within indicative distributions of the Southern Purple Spotted Gudgeon (*Mogurnda adspersa*), listed as an Endangered species under the FM Act. Approximately 10 km downstream is the upstream extent of what is considered to be the indicative distribution of the Murray Darling Basin population of Eel-tailed Catfish (*Tandanus tandanus*), listed as an endangered population under the FM Act.

There are minimal fish survey data however Davies *et al.*, (2012) undertook fish surveys in the upland areas of the Castlereagh River. Although no survey sites were within the vicinity of Timor Dam (closest site near Coonabarabran) no *M. adspersa* were recorded anywhere throughout the Castlereagh River.

*M. adspersa* are usually found in slow flowing sections of rivers, creeks and billabongs with good instream structure over a variety of substrates. They have a particular affinity for small, relatively shallow, small slow flowing pools with aquatic macrophytes and overhanging vegetation (Miles, 2013) being generally found in smaller tributaries rather than larger rivers. The spawning season of *M. adspersa* in south-east Queensland spans from spring to late summer, favouring temperatures over 18°C, although appears to be concentrated between November and February (Pusey *et al.*, 2004). There is no discerned migration associated with

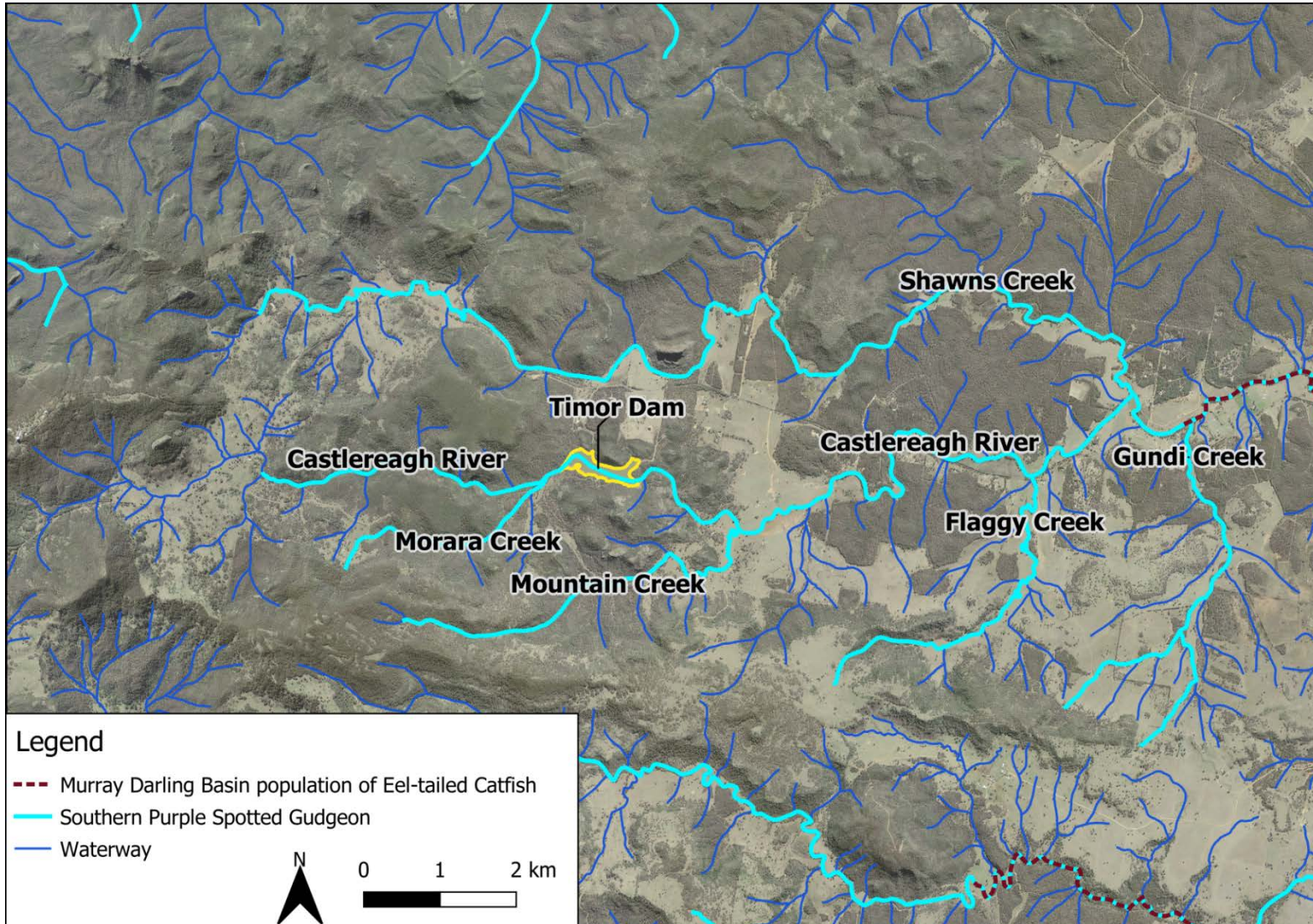
spawning although adults may seek suitable spawning habitat and juveniles may undergo a mass dispersal phase. Eggs are generally laid on rocks, woody debris, plant matter and other relatively hard substrates.

*M. adspersa* is susceptible to a range of threats including (NSW DPI, 2013b):

- Predation by introduced fish such as Eastern Gambusia (*Gambusia holbrooki*);
- Habitat degradation, particularly the loss of aquatic plants; and
- Fluctuations in water levels as a result of river regulation, resulting in deleterious effects on reproduction and recruitment.

*T. tandanus* is a relatively large and generally robust freshwater fish with a wide range of environmental tolerances. They occur in a wide range of habitats from very small coastal streams and drainages to large inland freshwater rivers. They are generally a benthic dwelling species preferring slow flowing locations with gravel/sand/mud substrates and fringing riparian vegetation. The spawning season for *T. tandanus* is Spring-Summer. The species has no discerned spawning or dispersal migration patterns with the species considered to be generally sedentary with a small home range (Pusey *et al.*, 2004).

The Background Document for the Water Sharing Plan (Rabbidge, 2016) lists the threatened Macquarie Perch (*Macquaria australasica*) as expected to occur within this reach of the Castlereagh River but is not included on NSW DPI Fisheries mapping.



**Figure 5: Indicative distribution of threatened fish species**

Source data: NSW DPI – Fisheries

### 4.3.3 Fish passage

Physical barriers such as dams, weirs, levees, culverts, causeways, barrages and road crossings can stop the natural movement and migration patterns of native fish species stopping those species from completing key components of their life cycle. In its current state Timor Dam is a barrier to upstream migration under all flow conditions. The dam also acts as a barrier to downstream fish migration during low flows when the dam is not spilling. During high flow when the dam is spilling, fish could potentially migrate downstream, however significant injury or mortality of fish could be expected for fish moving over the spillway under some spill conditions. It is considered that the existing dam is a barrier to upstream and a significant impediment to downstream migrations under all flow conditions.

Timor Dam is not unique in that there are thousands of fish barriers are present throughout the Murray Darling Basin. The closest known barrier downstream of Timor Dam is Poundyard Weir at Coonabarabran. Neither Timor Dam nor Poundyard Weir are considered to be priority fish passage barriers (NSW DPI, 2012). Upstream of Timor Dam there is approximately 8 km of stream length of the Castlereagh River and 3.5 km of Morara Creek. There are no known fish passage barriers along the upstream sections.

The current proposed design of the raised wall has not incorporated consideration of fish passage. As discussed in Section 3.3, DPI - Fisheries may require fish passage, in the form of a fishway, or a fish passage trade-off may to be incorporated into the proposal.

### 4.3.4 Preliminary assessment

The Castlereagh River including upstream and downstream of Timor Dam and Timor Dam itself provides potential habitat for the threatened fish *M. adspersa*. Downstream of Timor Dam also contains potential habitat for the threatened Murray Darling Basin population of *T. tandanus*. The proposal has the potential to impact both species (and potentially other species) by altering flows, potentially altering habitats and acting as a further fish passage barrier. Impacts on the species will need to be fully considered and assessed.

### 4.3.5 Recommendations

Potential impacts of the proposal on aquatic habitats, threatened fish species and fish passage need to be assessed and the following is recommended:

- Aquatic habitat assessment of Timor Dam, Castlereagh River upstream (to top of catchment) and downstream (approximately 10 km). The assessment should include:
  - Aquatic flora and fauna assessment;
  - Aquatic habitat assessment including type and condition;
  - Identification of upstream fish passage barriers; and
  - Threatened fish species survey including key habitat indicators.
- Preparation of assessments of significance for threatened species where/if required and further assessments (e.g. SIS) if required;
- Consultation and negotiation with DPI – Fisheries regarding fish passage and environmental flow requirements, threatened species impacts and permit requirements; and
- If required and depending on outcomes from negotiations with DPI - Fisheries, identification and assessment of fish passage structure options or potential fish passage offset options.

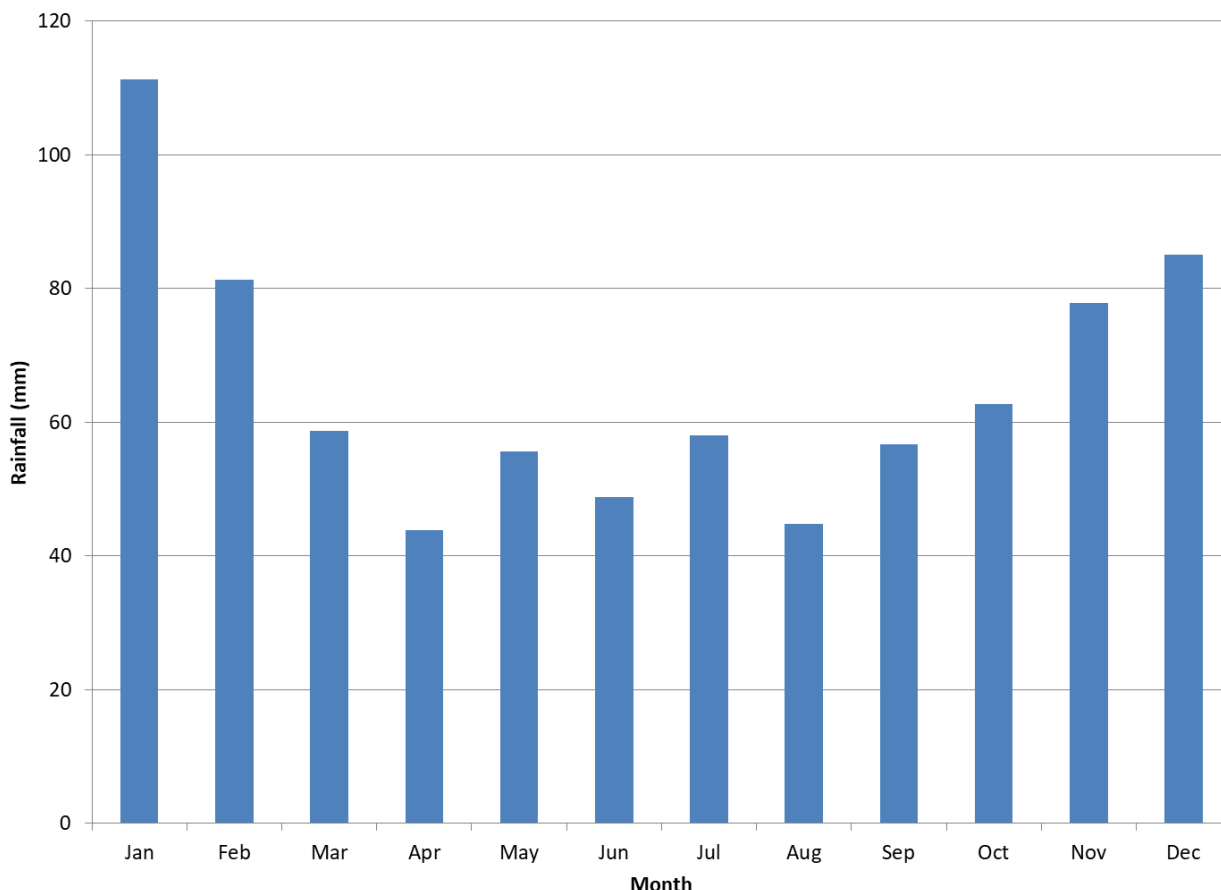


## 4.4 Hydrology, Environmental Flows and Water Quality

### 4.4.1 Hydrology

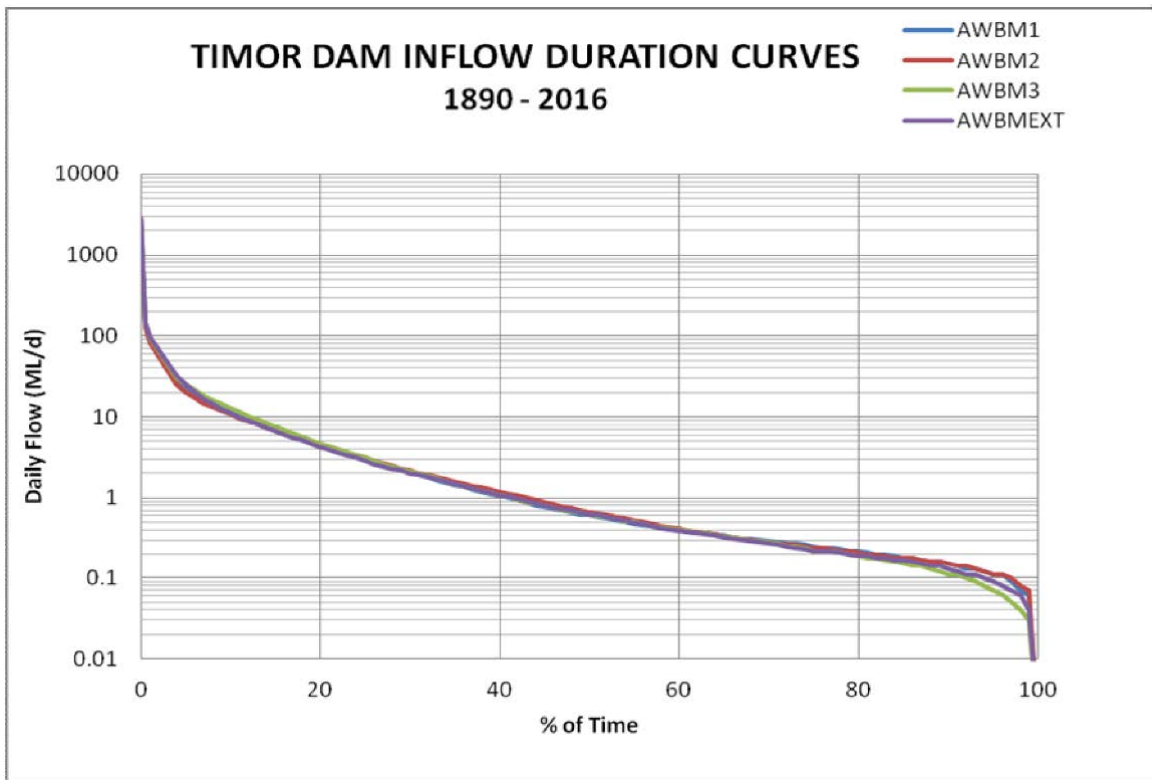
Timor Dam is located on the upper Castlereagh River, a third order stream, approximately 11 km west of Coonabarabran. The storage covers an area of approximately 20 ha and stores approximately 1,140 ML at FSL. The upstream dam catchment is approximately 20 km<sup>2</sup> (GHD, 2016). Morara Creek flows into the Castlereagh River just above Timor Dam along with several other small tributaries (Figure 5, Section 4.3.2).

Rainfall and evaporation are highest in the summer months, with the highest average monthly rainfall occurring in January (Figure 6). April and August are on average the driest months. The total average annual rainfall since 1970 was 792 mm.



**Figure 6: Average monthly rainfall at Coonabarabran**

No flow gauges exist upstream of Timor dam therefore actual inflows to the dam are unknown. Two gauges (420002 and 420013) are located downstream just downstream of Pound Yard weir and just upstream of the weir, respectively. Although these gauges do not provide inflow data, gauge 420002 was operational between 1951 and 1969 and therefore provides data indicating the stream-flows during the period before the dam was built. Figure 7 provides modelled Timor Dam daily inflow duration curves (NUWS, 2017).



**Figure 7: Modelled Timor Dam inflows**

Source: NUWS (2017)

A flood model was developed by GHD (2016) for Timor Dam design rainfall and rainfall loss estimates in accordance with the Australian Rainfall and Runoff. The RORB model was simulated for a range of durations ranging up to 12 hours. Table 4 provides the design flood peaks for Timor Dam.

**Table 4: Timor Dam Design Flood Peaks**

Flood event AEP	Timor Dam Flood Peak m3/s	Critical Duration (hr)	Coonabarabran Peak m3/s	Critical Duration (hr)
50%	57	6	313	6
20%	90	6	495	6
10%	111	6	626	6
5%	141	6	806	6
1%	213	4.5	1261	6
0.1%	326	4	1803	5
0.01%	493	3	2681	5
0.001%	703	3	3712	5
0.0001%	969	3	4793	4
PMPDF/PMF (see Section 3.2.4)	1256	2.5	5917	4

Source: GHD (2016)

#### 4.4.2 Environmental flows

Current operating requirements regarding environmental flows for Timor Dam as stated in the Water Access Licence (6424) are as follows:

*“When dam inflows are less than 15 L/s, the discharge rate into the Castlereagh River downstream must be equal to the inflow rate.*

*When dam inflows are greater than 15 L/second, the discharge rate into the Castlereagh River downstream must be equal to or greater than 15 L/s.”*

The dam is currently operated with no releases for environmental flows, irrigation or riparian requirements as required by the licence as there is currently no inflow monitoring gauge (to trigger a release) and access to the release valve is unsafe and therefore the release valve cannot currently be operated.

Requirements for environmental flow releases were not considered in the concept design apart from allowing for a separate facility for releases as part of the new outlet system. The requirements for environmental flow releases will need to be determined in consultation with Department of Industry – Water. While the dam raising can address the existing licence requirements, it is likely that more stringent release requirements will be required as part of the dam raising. As part of the 2017 Secure Yield Study (NUWS, 2017), generic environmental flow requirements were agreed with Department of Industry – Water representatives for modelling purposes. The generic environmental flow requirements were:

*Cease to pump (CTP) at 90%ile flow for the months of January to July inclusive and 80%ile flow for the months of August to December inclusive. Share of daily flow (above the CTP) that could be extracted by all extractive users is 30% (of the flow above the CTP) (ie, Town Water Supply (TWS) & Upstream of TWS users).*

*The above CTP rule relaxed to 95%ile flow for the months of January to July inclusive and also 90%ile flow for the months of August to December inclusive when the town water storage levels were at/below 65% full\*. No change to share of daily flow rule.*

*\* proxy for when town on restrictions determined from 5/10/10 rules and may be modified.*

#### 4.4.3 Water quality

There are limited data on water quality in the Castlereagh River, in particular the upper Castlereagh River. Welsh *et al.* (2014) provides a basic summary of water quality of the lower Castlereagh River concluding that turbidity and pH were good and nutrient levels and salinity were poor to very poor. Water quality data recorded at the Coonabarabran water treatment plant are provided in Table 5. These are considered to be reflective of the water quality conditions in Timor Dam.

**Table 5: Timor Dam raw water quality recorded at Coonabarabran Water Treatment Plant**

Parameter	Minimum	Average	Maximum
Turbidity (NTU)	0.2	3.42	24.6
Colour (HU)	-	18	80
pH	4.9	7.2	7.98

Source: Hydrosphere Consulting (2018)

The Castlereagh River Water Quality and River Flow Objectives provide guidance on the desired water quality outcomes for the Castlereagh River. The environmental assessment will need to consider these objectives in addition to assessing construction and operational impacts on water quality.

#### 4.4.4 Preliminary assessment

##### Hydrology and environmental flows

Catchment flood flows have been modelled for Timor Dam however the impact of the proposal on localised flooding is unknown. Raising the dam wall is expected to have flooding impacts (increase in storage inundation) at the upstream extent of the storage during flood flows. The proposal also has the potential to alter flood behaviour downstream of the dam however, the extent of flooding impacts is unknown at this stage and needs to be assessed.

Currently Timor Dam is operated without the release of environmental flows. Environmental flows are likely to be required following the raising of the dam which could have a significant influence on storage behaviour and secure yield during dry periods. Development of an environmental flow regime would need to be prepared in consultation with relevant agencies. In addition to any intended benefits, such as increased connectivity to other habitats and improved water quality of downstream pools, the impact of environmental flows on downstream habitats needs to be assessed including impacts on bank stabilisation and erosion..

##### Water Quality

The construction phase of the proposal has the potential to negatively impact downstream water quality through turbid runoff from access roads, work pads, stockpiles etc. and contaminant/chemical spills. However, these impacts are likely to be minimal and managed through standard control measures.

Temporary impacts on in-storage water quality may occur during the first inundation after raising through decomposing vegetation and mobilisation of sediments.

Long-term downstream water quality will need to be considered and assessed in the development of the environmental flow regime.

#### 4.4.5 Recommendations

- Flood study to determine the impact of the proposal on upstream and downstream flow conditions;
- Development of an environmental flow regime in negotiation with DPI – Fisheries and NSW Department of Industry - Water. Impacts on downstream aquatic habitat and water quality need to be assessed in the development of the regime; and
- Construction and operational phase associated water quality impacts to be assessed in the REF.

#### 4.5 European Heritage

A search of the following registers was conducted:

- Warrumbungle Local Environmental Plan 2013 - No listed heritage sites within or near the proposal site.
- State Heritage Register - No state listed heritage sites within or near the proposal site.
- The National Heritage List – no national heritage listed sites within or near the proposal site. Warrumbungle National Park a national heritage listed site is located 1.2 km to the north of the proposal site.
- Commonwealth Heritage List – No Commonwealth heritage listed items within or near the proposal site.
- Register of the National Estate – Warrumbungle National Park is listed on the Register of the National Estate

The project site is not expected to include any items of European heritage significance.

#### 4.5.1 Preliminary assessment

No items of European heritage significance are expected to be impacted by the proposal.

#### 4.5.2 Recommendations

Standard assessment of potential impacts on European heritage should be assessed through the REF process.

### 4.6 Aboriginal Cultural Heritage

The proposal site lies within the Coonabarabran Local Aboriginal Land Council area.

The dam site lies close to the border of the traditional lands of the Wailwan (also Weilwan or Walywan) nation and Wiradjuri nation to the south. The Wailwan nation stretches from around Coonabarabran and Gilgandra in the east and south to Walgett and Brewarrina in the north. The Wailwan were river people based around the Castlereagh and Macquarie Rivers (Central West and Central Tablelands Local Land Services, 2014). As such the landscape, flora and fauna within and near the proposal site are likely to be of high cultural significance.

The proposal site is situated within the area subject to Native Title Claim (NC2011/006 – Active, accepted for registration) by the Gomeroi People. However, the area covered by the claim application excludes any land and waters covered by past or present freehold title. The current proposed inundation area lies within freehold land and therefore is considered not be subject to a Native Title Claim, however this should be confirmed during the REF process.

A search of the AHIMS showed that no aboriginal sites or Aboriginal places have been recorded or declared in or near the proposal site (refer Appendix 1).

#### 4.6.1 Preliminary assessment

The Castlereagh River and surrounding landscape holds cultural significance for the local Aboriginal people and has been used by various nations for thousands of years. The AHIMS search revealed no recorded Aboriginal sites or places within the proposal site however the presence of such places, sites and archaeological artefacts, particularly within the proposed inundation area, cannot be discounted. Aboriginal objects are often associated with particular landscape features as a result of Aboriginal people's use of those features in their everyday lives and for traditional cultural activities. Examples of such landscape features are rock shelters, sand dunes, waterways, waterholes and wetlands (DECCW, 2010). The proposal has the potential to negatively impact aboriginal cultural heritage values/artefacts of the site and as such requires further assessment.

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010) provides guidance on the process of exercising due diligence when carrying out activities that may harm Aboriginal objects and to determine whether they should apply for consent in the form of an Aboriginal Heritage Impact Permit (AHIP). The code provides a series of steps/questions to be considered when determining the extent of due diligence assessment required for a proposal. Consideration of this process in the context of this proposal (Table 6) indicates that Aboriginal objects are considered likely to occur within and/or near the proposal site and the proposed works may potentially impact such objects. As such an Aboriginal Cultural Heritage Due Diligence Assessment will need to be undertaken to satisfy due diligence requirements and allow an informed assessment of the impacts of the proposal on Aboriginal cultural heritage values. If the assessment determines that Aboriginal objects are present or likely to be present and an activity will harm those objects, then an AHIP and associated application will be required.

Table 6: Consideration of Aboriginal cultural heritage due diligence process as outlined in DECCW (2010)

No.	Step	Description	Project context
1.	Will the activity disturb the ground surface?	If an activity will disturb the ground surface there is a higher likelihood that Aboriginal objects will be harmed.	Yes. Ground disturbance will be required for construction site access, work pads, storage/laydown areas etc.
2a.	Search the AHIMS database and use any other sources of information of which you are already aware.	Identify whether Aboriginal objects have been recorded in the area or are likely to be present in the area.	Search has been conducted. No sites or places recorded near or within proposal site.
2b.	Activities in areas where landscape features indicate the presence of Aboriginal objects.	<p>Regardless of whether your AHIMS search indicates known Aboriginal objects, you still need to consider whether Aboriginal objects are likely to be in the area of the proposed activity having regard to the following landscape features:</p> <ul style="list-style-type: none"> <li>• within 200m of waters, or</li> <li>• located within a sand dune system, or</li> <li>• located on a ridge top, ridge line or headland, or</li> <li>• located within 200m below or above a cliff face, or</li> <li>• within 20m of or in a cave, rock shelter, or a cave mouth.</li> </ul> <p>If the site contains one of the above landscape features and occurs on land that is not disturbed land then Step 3 must be applied.</p>	The proposal site is within 200 m of waters and the inundation area is considered not to be disturbed land. Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.
3.	Can you avoid harm to the object or disturbance of the landscape feature?	<p>If it is likely that there are Aboriginal objects present in the area of the proposed activity, you need to decide whether you can avoid the harm to those objects.</p> <p>If you can't avoid harm to the object or disturbance of the landscape feature(s) you must go to step 4.</p>	It is unlikely that harm to any Aboriginal objects and/or landscape feature within the inundation can be avoided.
4 and 5	Desktop assessment and visual inspection, further investigations impact assessment.	This step involves review of available information, on-ground survey and assessment and impact assessment. This will need to be done by a person with expertise in Aboriginal cultural heritage management.	An Aboriginal Cultural Heritage Due Diligence Assessment on the proposal site will need to be undertaken.

#### 4.6.2 Recommendations

- An Aboriginal Cultural Heritage Due Diligence Assessment for the proposal will need to be prepared in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (OEH2010); and
- The Native Title status of the project land should be confirmed and any implications for the project identified.

#### 4.7 Noise and Vibration

The proposal site is situated in a remote rural setting adjacent to rural land primarily used for grazing. As such the background noise levels at the site are likely to be low and characterised by background wildlife noise, primary production related noises such as stock noise and occasional vehicle and machinery noise and noise associated with operation of the dam.

Sensitive receivers for noise and vibration from the proposal site include several residences within 1 km of the construction site. The closest residence is located approximately 650 m to the north east of the construction site at the dam wall.

##### 4.7.1 Preliminary assessment

The *Interim Construction Noise Guideline* (DECC, 2009) provides guidance on the assessment of construction noise impacts in NSW. Under the guidelines, if works are not likely to affect an individual or sensitive land use for more than three weeks in total a qualitative assessment may be used. If the works are likely to affect an individual or sensitive land use for more than three weeks then a quantitative assessment must be undertaken.

Potential noise and vibration sources likely to be associated with the construction of the raised wall include, excavation, blasting, rock placements, heavy vehicles and increased construction traffic into the site. Noise associated with the operation of the raised dam post-construction would be the same as current existing noise.

##### 4.7.2 Recommendations

- Impacts of noise and vibration on sensitive receivers are to be considered in the REF.

## 5. CONSULTATION

During the REF process consultation will be required with the following approval agencies:

- NSW DPI – Fisheries;
- NSW Office of Environment and Heritage; and
- NSW Department of Industry – Water and the Natural Resources Access Regulator.

It is recommended that agency consultation is conducted as follows:

- Preliminary workshop/meeting to outline the proposal and define the scope of studies and additional considerations;
- Second workshop to discuss outcomes of studies and potential management requirements;
- Further workshops maybe required to resolve particular issues; and
- Consultation with agencies would be maintained throughout the project

Consultation with Aboriginal representatives (including NTSCorp, Coonabarabran Local Aboriginal Land Council and other interested parties) will be undertaken as part of the Aboriginal Cultural Heritage Due Diligence Assessment.

In addition consultation with the surrounding landowners and occupiers that are likely to be impacted by the proposal is required to address land acquisition, buffer zone management and impacts of the proposal.



## 6. PROJECT PLAN

A preliminary project plan is attached in Appendix 1. The following timeframes are expected to be required for each phase of the project. The following timeframes exclude filling of the dam which will depend on rainfall/streamflows, extraction and losses.

**Table 7: Estimated timeframes**

<b>Project Phase</b>	<b>Duration (months)</b>
Funding application – environmental assessment/approvals	4
Environmental studies/REF preparation and concurrent agency consultation	10
Funding application – design and construction	4
Design and construction	10
<b>Total duration</b>	<b>28</b>

## 7. COST ESTIMATES

Based on the review of background documentation and the preliminary environmental assessment a number of items have been identified that need to be completed to facilitate the planning, assessment and approvals of the proposed project. The total direct cost for the environmental studies, consultation, assessment and approvals component of the project is at \$270,000 with a further \$81,000 for project management and contingencies.

Projected inundation areas and dam buffer zones (if required) will encroach onto privately owned land (Section 2.2) and acquisition of land that will be required. Costs associated with land acquisition have been estimated.

As discussed in Section 1.2 the current dam raising design and cost estimates do not include the design the construction of a fish passage structure. The need for and scope of a fish passage structure will need to be considered in the environmental assessment phase including discussions and negotiations with NSW DPI – Fisheries. Cost estimates have been based on inclusion of a fish passage structure, either within the design of the raised dam or at an alternative offset location.

Cost estimates for the main components of the Timor Dam raising project are detailed in Appendix 3 and summarised in Table 8.

**Table 8: Summary of project cost estimates**

Item	Total cost estimate (excluding GST)
Environmental studies, assessment and approvals <sup>1</sup>	\$455,000
Land acquisition	\$43,000
Fishway design and construction <sup>2</sup>	\$6,760,000
Dam wall raising – construction <sup>3</sup>	\$7,746,000
<b>Total cost</b>	<b>\$15,004,000</b>

1. Flora and fauna assessment cost estimates are based on traditional industry best practice methods. This project may provide an opportunity for Council to consider exploring emerging biodiversity assessment technologies/techniques such as eDNA (use of DNA sequencing to determine what organisms are present).

2. Fish passage costs are unknown. Walgett Shire Council has received funding of \$4.67 million for the construction of a vertical slot fishway for Walgett Weir in association with a 1m raising of the weir with a total cost of \$8.25 million. A vertical slot fishway is unlikely to be suitable for Timor Dam. A higher cost alternative fish passage structure such as a fish lift is likely to be required. Ongoing maintenance, monitoring and reporting of any type of fish passage structure would be required, however, costs associated with fish lifts may be higher than other types.

3. Dam wall raising construction costs were detailed in PWA (2018).

Ongoing maintenance and monitoring costs associated with the fish passage structure and buffer zone would be required in addition to the costs of ongoing operation and maintenance of the dam and water supply.

## 8. POTENTIAL FUNDING

The NSW Government has established the Safe and Secure Water Program to improve economic growth and productivity in NSW. The program will fund eligible projects that will deliver public health, environmental and/or social benefits to regional communities. Funding is available for three project phases - scoping study (needs assessment, feasibility study, and/or options assessment), business case and construction. The NSW Department of Industry is responsible for assessing funding submissions and providing technical advice.

A discussion of current eligibility and funding requirements for a funding application is provided below. The application process was reviewed and amended in November 2018 with full details unavailable for this report.

**Table 9: Information required in a Safe and Secure funding application**

Project phase	Information required	WSC eligibility
Project Scoping Studies	<ul style="list-style-type: none"> <li>Clearly defined problem / project justification; and</li> <li>Statement of eligibility in accordance with the guidelines.</li> </ul>	<ul style="list-style-type: none"> <li>Concept design is completed.</li> <li>WSC may apply for funding for the environmental studies, assessment and approvals as documented in this report.</li> <li>Liaison with NSW Department of Industry representatives is required to confirm eligibility.</li> </ul>
Business Case Development	<ul style="list-style-type: none"> <li>Project scoping documentation such as needs assessment, feasibility study, and/or options assessment; and</li> <li>Demonstrated alignment with sound strategic planning, such as an Integrated Water Cycle Management (IWCM) strategy.</li> </ul>	<ul style="list-style-type: none"> <li>To be eligible, the IWCM Strategy will need to identify the raising of Timor Dam as a key component of the Coonabarabran water security strategy. However, yield studies indicate that the yield benefit in raising the dam may be offset by requirements for environmental flow releases (generic environmental flow releases were assumed and are to be confirmed through agency consultation) and the IWCM Strategy may identify that other augmentation options are preferred.</li> </ul>
Design and Construction	<ul style="list-style-type: none"> <li>Detailed Business Case that compares options. Also would include items such as the following, where applicable - concept design for recommended option, environmental assessment, implementation timeframes, risk management and procurement approach, statutory approvals etc.</li> </ul>	<ul style="list-style-type: none"> <li>To be determined after business case is developed.</li> </ul>

Two stages of funding are proposed for this project. The first application would address the environmental assessment and approval requirements with the second stage covering the design and construction phase.

WSC is expected to be eligible for 75% funding under the program. The remainder would be funded through the WSC water fund. The IWCM Strategy will include a financial plan which will assess the affordability of the project and any required increases in customer bills and loans in addition to external grant funding.

## 9. RISK ASSESSMENT

A number of project risks were considered for the key project components identified in this assessment. Risks considered were as follows:

- Timing – risk to increasing the timeline of the project;
- Cost – risk to increasing the estimated cost of the project;
- Yield – risk to decreasing the expected yield (useable water storage) from raising the dam; and
- Viability – risk to overall viability of raising the dam.

Table 10 provides a discussion of the key project risks associated with relevant project components.

Table 10: Discussion of risks associated with key project components

Component	Discussion	Risk Type	Potential project risk
Flora and fauna	<p>If the flora and fauna assessment indicates that the project will have a significant impact on a threatened species or community then further assessment will be required (e.g. Species Impact Statement). Further assessment would likely include further surveys which may need to be undertaken seasonally and/or repeated, adding significantly to project timeline.</p> <p>Significant impacts may also trigger the need for species/community offsets which would require further assessment, negotiation, land acquisition management arrangements etc. Further assessment or offset arrangement would increase the project cost and add significantly to the project timeline.</p> <p>If any significant impacts are deemed to be unacceptable then the project may become unviable.</p>	Timing, Cost, Viability	Significant impact on threatened species or community.
Aboriginal Cultural Heritage	<p>If the initial Aboriginal cultural heritage due diligence assessment indicates the project may impact Aboriginal cultural heritage values then further assessments and negotiations would be required. Further assessment would include the preparation of an Aboriginal cultural Heritage Assessment and may include detailed consultation and archaeological surveys/diggings.</p>	Timing, Cost, Viability	Significant impact on Aboriginal cultural heritage values, object, site or place.
Engineering feasibility	<p>The studies undertaken to date suggest the design is feasible and will satisfy engineering and dam safety requirements.</p>	-	None identified.
Buffer zone	<p>The buffer zone strategic plan may identify the requirement of a larger buffer area or catchment management arrangements. This may require further negotiations and/or land acquisitions adding to the project timeline and cost.</p>	Timing, Cost	None identified.
Environmental flow study	<p>The main risk is that recommended/required environmental flow requirements outweigh or significantly reduce the yield increases provided by the dam raising. Environmental flow requirements may therefore reduce the viability of the project.</p>	Yield, Viability	Environmental flow requirements significantly reduce yield such that other augmentation options are preferred.

Component	Discussion	Risk Type	Potential project risk
Alternative water supply options	Alternative water supply augmentation options are currently being investigated as part of the IWCM Strategy.	Cost, Viability	The IWCM Strategy identifies that other augmentation options are preferred and does not support the raising of Timor Dam. Funding under the Safe and Secure program may not be provided.
Land acquisition	Land acquisition costs and timing have been estimated, however there is the potential that planning, negotiations and costs increase.	Timing, Cost	Landholder agreement is not obtained.
Fishway	The provision of a fishway or fish passage offset works is likely to be required as discussed in this report. A preliminary cost estimate is provided although detailed investigations and consultation are required to confirm this.	Timing, Cost	Significant increase in cost that may not be externally funded or affordable.
External funding	Two stages of funding approval have been assumed – scoping studies and design/construction.	Cost	Funding under the Safe and Secure program may not be provided. Council's Water Fund is unlikely to sustain 100% investment in this project.
Costs	Costs in this report are budget estimates only. Tendered costs may vary.	Cost	Additional funding may be required.
Time	Increases in time may be required due to seasonal considerations or delays due to inclement weather.	Timing	Additional time to completion may be required.
State Government Policy	The current proposal for raising Timor Dam may potentially be inconsistent with the NSW Weirs Policy. Under the policy a proposal to enlarge an existing weir should not be approved unless it can be demonstrated that the primary component of the proposal is necessary to maintaining the essential social and economic needs of the affected community. The proposal would also have to demonstrate that other alternatives have been explored and that other economically feasible and environmentally friendlier alternatives do not exist. The proposal would also need to demonstrate that the proposal results in a net environmental benefit.	Viability	The project is not approved.

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## Appendix 1. ENVIRONMENTAL REGISTER SEARCH RESULTS

Table 11: NSW Bionet search results recorded within 1 km of Timor Dam

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC Act
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Marine Bird	Usually coastal areas including beaches, normally seen perched high in a tree, or soaring over waterways and adjacent land.	-	-	Migratory Species
Little Lorikeet	<i>Glossopsitta pusilla</i>	Bird	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	-	Vulnerable	-
Turquoise Parrot	<i>Neophema pulchella</i>	Bird	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December.	-	Vulnerable	-
Barking Owl	<i>Ninox connivens</i>	Bird	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats.	-	Vulnerable	-

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC Act
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	Bird	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringy barks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum ( <i>Eucalyptus camaldulensis</i> ) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	-	Vulnerable	-
Regent Honeyeater	<i>Anthochaera phrygia</i>	Bird	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species.	-	-	Endangered
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	Bird	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.	-	Vulnerable	-
Diamond Firetail	<i>Stagonopleura guttata</i>	bird	Endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum ( <i>Eucalyptus pauciflora</i> ) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	-	Vulnerable	-
Koala	<i>Phascolarctos cinereus</i>	Mammal	Inhabit eucalypt woodlands and forests	-	Vulnerable	Vulnerable

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
<b>Species or species habitat <u>known</u> to occur within area</b>						
Regent Honeyeater	<i>Anthochaera phrygia</i>	Bird	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species.	-	-	Endangered
Painted Honeyeater	<i>Grantiella picta</i>	Bird	Inhabits Boree/ Weeping Myall ( <i>Acacia pendula</i> ), Brigalow ( <i>A. harpophylla</i> ) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	-	Vulnerable	Vulnerable
Koala	<i>Phascolarctos cinereus</i>	Mammal	Inhabit eucalypt woodlands and forests	-	Vulnerable	Vulnerable
<b>Species or species habitat <u>likely</u> to occur within area</b>						
Malleefowl	<i>Leipoa ocellata</i>	Bird	Limited to areas of inland semi-arid scrub. They prefer a dry environment with low-growing eucalypt trees and shrubs, referred to as mallee country. The stronghold for this species in NSW is the mallee in the south west centred on Mallee Cliffs NP and extending east to near Balranald and scattered records as far north as Mungo NP. West of the Darling River a population also occurs in the Scotia mallee including Tarawi NR and Scotia Sanctuary, and is part of a larger population north of the Murray River in South Australia.	-	Endangered	Vulnerable
Large-eared Pied Bat, Large Pied Bat	<i>Chalinolobus dwyeri</i>	Mammal	Most common in dry sclerophyll forests and woodlands, but also occur in sub-alpine woodland, edges of rainforest and in wet sclerophyll forest. Insectivorous, foraging up to mid-canopy level. Roost in caves and mines, in colonies <37, clustered in indentations on ceiling, usually in dim light not far from the entrance. Males often hibernate alone in abandoned mines. Mainly in areas with extensive cliffs and caves.	-	Vulnerable	Vulnerable

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Corben's Long-eared Bat, South-eastern Long-eared Bat	<i>Nyctophilus corbeni</i>	Mammal	Inhabits a variety of vegetation types, including mallee, bullocke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Distribution coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.	-	Vulnerable	Vulnerable
Bluegrass	<i>Dichanthium setosum</i>	Plant	<i>Dichanthium setosum</i> is associated with heavy basaltic black soils and red-brown loams with clay subsoil (NSW OEH 2013a). Associated species include White Box ( <i>Eucalyptus albens</i> ), Silver-leaved Ironbark ( <i>Eucalyptus melanophloia</i> ), Yellow Box ( <i>Eucalyptus melliodora</i> ), Manna Gum ( <i>Eucalyptus viminalis</i> ), Amulla ( <i>Myoporum debile</i> ), Purple Wire-grass ( <i>Aristida ramosa</i> ), Kangaroo Grass ( <i>Themeda triandra</i> ), Fine-leaved Tussock-grass ( <i>Poa sieberiana</i> ), Red-leg Grass ( <i>Bothriochloa ambigua</i> ), Pitted Blue-grass ( <i>Bothriochloa decipiens</i> ), <i>Macrozamia stenomera</i> , Small Woolly Burr-medic ( <i>Medicago minima</i> ), Scaly Buttons ( <i>Leptorhynchos squamatus</i> ), Lomandra aff. longifolia, Australian Bugle ( <i>Ajuga australis</i> ), Bogan-flea ( <i>Calotis hispidula</i> ) and <i>Austrodanthonia spp.</i> , <i>Dichopogon spp.</i> , <i>Brachyscome spp.</i> , <i>Vittadinia spp.</i> , <i>Wahlenbergia spp.</i> and <i>Psoralea spp.</i> <i>Dichanthium setosum</i> is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. It is often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched. The species may tolerate or benefit from disturbance, otherwise, disturbance is indicative of threatening processes in its habitat	-	-	Vulnerable
Fork-tailed Swift	<i>Apus pacificus</i>	Bird	Breeds in the northern hemisphere before migrating to Australia during the southern summer	-	-	-
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Bird	Migratory terrestrial bird species found in tall forests, preferring wetter habitats such as heavily forested gullies.	-	-	Migratory Species

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Great Egret	<i>Ardea alba</i>	Waterbird	Migratory wetland bird species that inhabits inland and coastal wetlands and frequents river margins, lakes shores, marshes and flood-plains.	-	-	Marine, Migratory
Black-eared Cuckoo	<i>Chrysococcyx osculans</i>	Bird	Is found in drier country where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds.	-	-	Marine
<b>Species or species habitat <u>may</u> occur within area</b>						
Curlew Sandpiper	<i>Calidris ferruginea</i>	Shorebird	This species occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Curlew Sandpipers forage on mudflats and nearby shallow water. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds. Breeds in Siberia, migrating to Australia between August and November for the summer before leaving again between March and mid-April. Occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin.	-	Endangered	Critically Endangered Migratory Species
Swift Parrot	<i>Lathamus discolor</i>		Forages in woodlands and in riparian vegetation, increasingly reliant on small remnant patches of mature eucalypts in agricultural areas. Preferred food on coast is nectar of winter-flowering eucalypts such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ) and Red Bloodwood ( <i>C. gummifera</i> ).	-	Endangered	Critically Endangered
Superb Parrot	<i>Polytelis swainsonii</i>	Bird	Found throughout eastern inland NSW. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	-	Vulnerable	Vulnerable

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Australian Painted Snipe	<i>Rostratula australis</i>	Bird	Freshwater marshes and swamps with temporary water regimes and a combination of shallow water, exposed wet mud and dense low fringing vegetation, especially tussocky grasses . Can use a wider range of habitat in non-breeding periods but avoids areas of tall dense reeds. Well-vegetated shallows and margins of wetlands, dams, sewage ponds, wet pastures, marshes, irrigation areas, lignum; tea-tree scrub, open timber. Inhabits the fringes of swamps, dams and marshy areas that provide a cover of grasses, lignum, low scrub or open timber.	-	Endangered	Endangered
Spotted-tail Quoll	<i>Dasyurus maculatus</i>	Mammal	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals.	-	Vulnerable	Endangered
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	Marsupial	In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. They occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.	-	Endangered	Vulnerable
Pilliga Mouse	<i>Pseudomys pilligaensis</i>	Mammal	Restricted to the Pilliga region of New South Wales. However, a Pilliga Mouse was reportedly trapped in the Warrumbungles after a major wildfire in January 2013. Within the Pilliga region this species is largely restricted to low-nutrient deep sand soils which are recognised as supporting a distinctive vegetation type referred to as the Pilliga Scrub.	-	Vulnerable	Vulnerable

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Mammal	Occur in rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas. Forage on fruits and blossoms of more than 80 species of plants. Prefer eucalypt blossom with native figs being the most popular fruit. Chew leaves and appear to eat the salt glands from mangroves. Congregate in large camps of up to 200,000 individuals from early until late summer usually in gullies close to water.	-	Vulnerable	Vulnerable
a leek-orchid	<i>Prasophyllum sp. Wybong</i>	Plant	A perennial orchid, appearing as a single leaf over winter and spring. Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Known to occur in open eucalypt woodland and grassland	-	-	Critically Endangered
Austral Toadflax	<i>Thesium australe</i>	Native Plant	Is semi-parasitic on roots of a range of grass species, commonly Kangaroo Grass. Occurs in subtropical, temperate and subalpine climates along the coastal and tablelands of NSW, QLD, VIC and the ACT. Commonly observed in the New England Tablelands and NSW North Coast.	-	Vulnerable	Vulnerable
Striped Legless Lizard	<i>Delma impar</i>	Reptile	Occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma, Muswellbrook and Tumut areas. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass <i>Themeda australis</i> , spear-grasses <i>Austrostipa spp.</i> and poa tussocks <i>Poa spp.</i> , and occasionally wallaby grasses <i>Austrodanthonia spp.</i>	-	Vulnerable	Vulnerable
White-throated Needletail	<i>Hirundapus caudacutus</i>	Bird	Migratory terrestrial aerial bird that roosts in trees.	-	-	Migratory Species

Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Yellow Wagtail	<i>Motacilla flava</i>	Bird	Preference for damp or wet habitats with low vegetation including pastures, meadows, hay fields, marshes and grassy tundra. Observed throughout Australia during the non-breeding seasons.	-	-	Migratory Species
Rufous Fantail	<i>Rhipidura rufifrons</i>	Bird	Occurs in coastal and near coastal areas. Prefers areas of rainforest and sclerophyll forests. Also occur in paperbark and mangrove swamps.	-	-	Marine, Migratory
Common Sandpiper	<i>Actitis hypoleucos</i>	Shorebird	In Australia, the Common Sandpiper is found in coastal or inland wetlands, both saline or fresh. It is found mainly on muddy edges or rocky shores. They are migratory, generally breeding in Eurasia during the Australian winter. Eats small molluscs, aquatic and terrestrial insects	-	-	Migratory Species
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Shorebird	Prefers the grassy edges of shallow inland freshwater wetlands. It is also found around flooded fields, mudflats, mangroves, rocky shores and beaches. A summer migrant from Arctic Siberia, being found on wetlands throughout Australia.	-	-	Migratory Species
Pectoral Sandpiper	<i>Calidris melanotos</i>	Shorebird	Breeds in the northern hemisphere, northern Russia and North America, before migrating to Australia for the southern summer. Prefers shallow fresh to saline wetlands that have open fringing mudflats and low, emergent or fringing vegetation,. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	-	-	Marine, Migratory
Latham's Snipe, Japanese Snipe	<i>Gallinago hardwickii</i>	Shorebird	They usually inhabit open, freshwater wetlands with low, dense vegetation but can also occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers. Omnivorous species forages mudflats and shallow water feeding on seeds and plant material as well as invertebrates including insects, earthworms and spiders.	-	-	Marine, Migratory
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Marine Bird	Usually coastal areas including beaches, normally seen perched high in a tree, or soaring over waterways and adjacent land.	-	-	Migratory Species



Common Name	Species	Type	Habitat & Ecology	Conservation Status		
				FM Act	BC Act	EPBC
Rainbow Bee-eater	<i>Merops ornatus</i>	Bird	Distributed across the entire continent. Diverse habitat from beach hind dunes, open forests, woodlands, open pastures and cleared areas, mangroves to inland dune systems. Feeds mainly on insects, in particular, bees and wasps.	-	-	Migratory
Painted Snipe	<i>Rostratula australis</i>	Bird	Freshwater marshes and swamps with temporary water regimes and a combination of shallow water, exposed wet mud and dense low fringing vegetation, especially tussocky grasses . Can use a wider range of habitat in non-breeding periods but avoids areas of tall dense reeds. Well-vegetated shallows and margins of wetlands, dams, sewage ponds, wet pastures, marshes, irrigation areas, lignum; tea-tree scrub, open timber. Inhabits the fringes of swamps, dams and marshy areas that provide a cover of grasses, lignum, low scrub or open timber. Distribution includes Eastern Australia and the NT where better watered areas occur. Generally rare. Recorded in wetlands of all states of Australia. Most common in Eastern Australia where it has been recorded in scattered locations throughout Queensland, NSW and Victoria.	-	Endangered	Endangered

Hydrosphere Consulting

Date: 17 October 2018

P O Box 7059  
Ballina New South Wales 2478

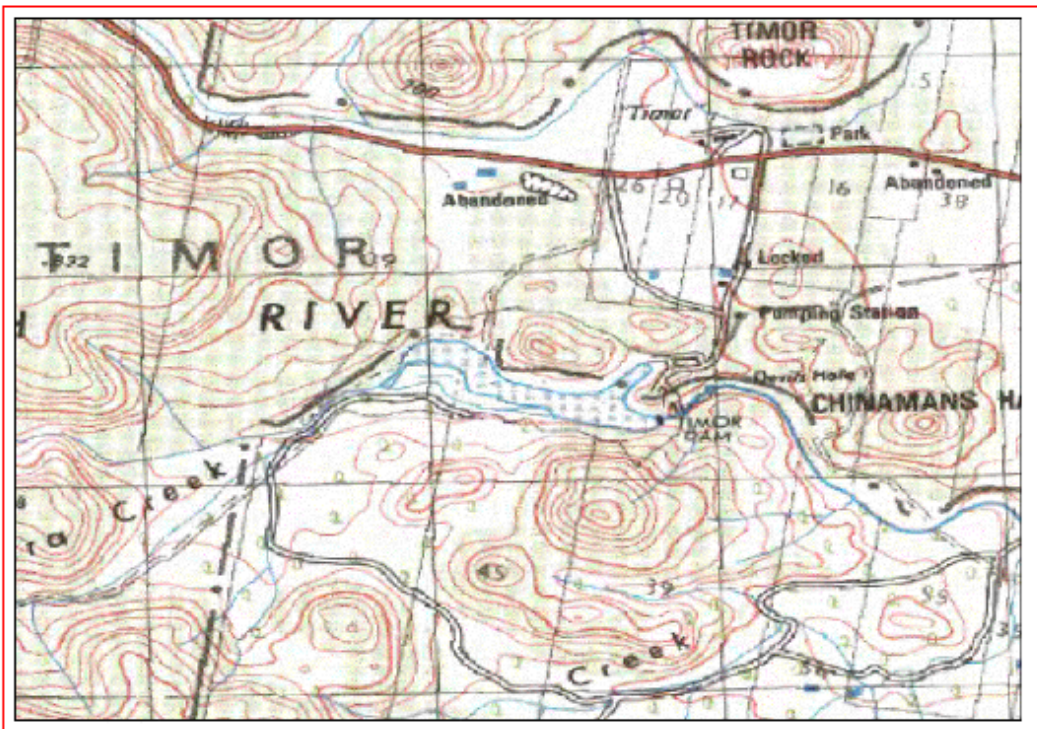
Attention: Uriah Makings

Email: [uriah.makings@hydrosphere.com.au](mailto:uriah.makings@hydrosphere.com.au)

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 8, DP:DP222722 with a Buffer of 1000 meters, conducted by Uriah Makings on 17 October 2018.**

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *



## Search Aboriginal Places & State Heritage Register

The combined map search below is for Aboriginal Places and State Heritage Register items only. It does not include Interim Heritage Orders, State Agency Heritage Registers and Local Environmental Plans.

The location of Aboriginal Places and State Heritage Register items are marked on the map as a single approximation point for general identification and research purposes only.

Location information for some Aboriginal Places (e.g. burial grounds and sacred sites) have been generalised because of their cultural sensitivity. Location information for restricted Aboriginal Places is not shown at all. If an activity or development is proposed that may potentially impact on or harm (i.e., damage, deface or destroy) an Aboriginal Place, then proponents must undertake a search for the exact boundaries of Aboriginal Places through **AHIMS Web Services**.

Downloading of State Heritage Register spatial datasets and associated metadata into a Geographical Information System (GIS) software package is available through **Data NSW**.

Listing Type:  All  Aboriginal Places  State Heritage Register

Local government area:

Item name/Database ID:

SHR number:

Location:

Local Aboriginal Land Council (LALC):

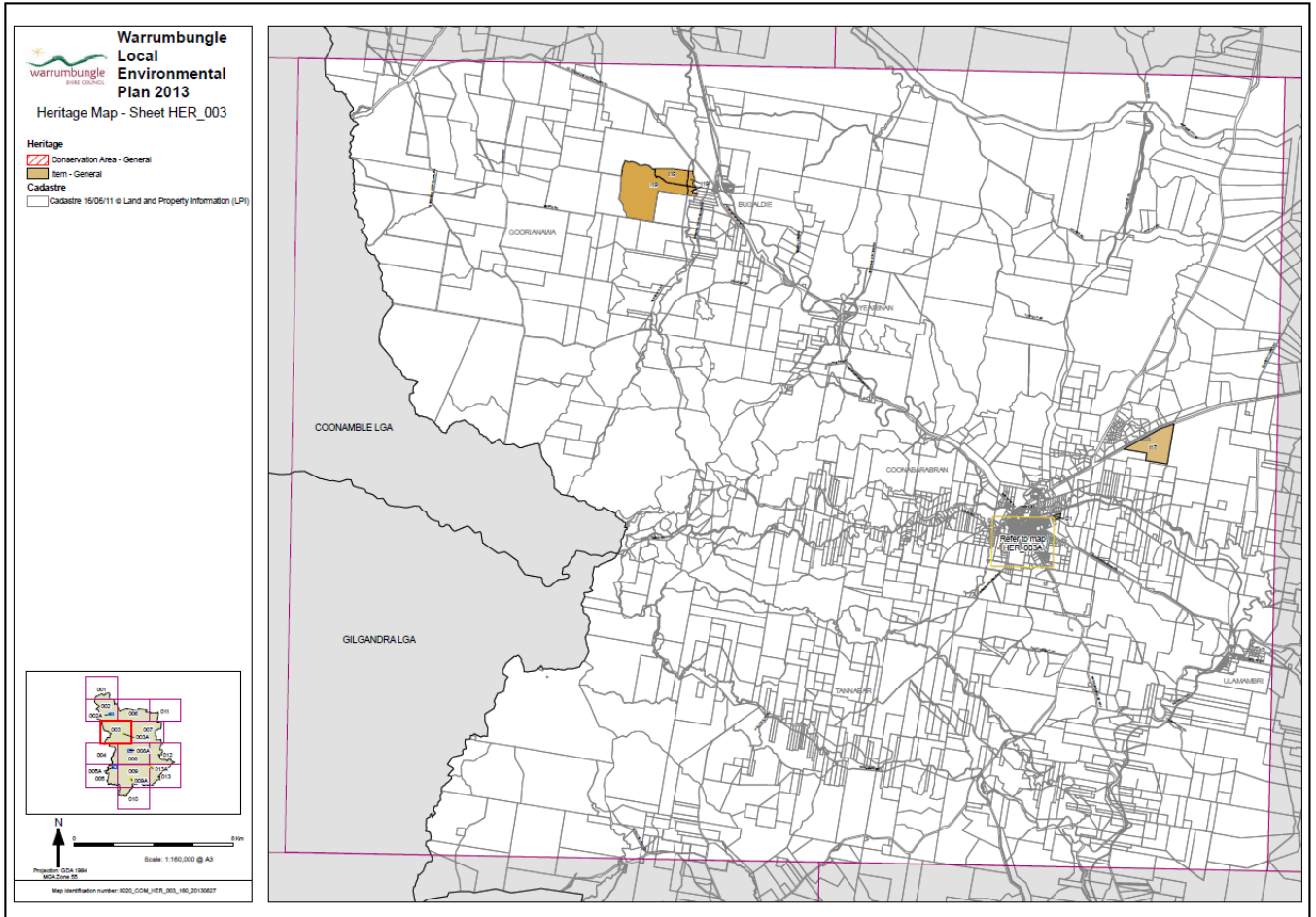
State theme:

Item type:

Item Group:

Item category:





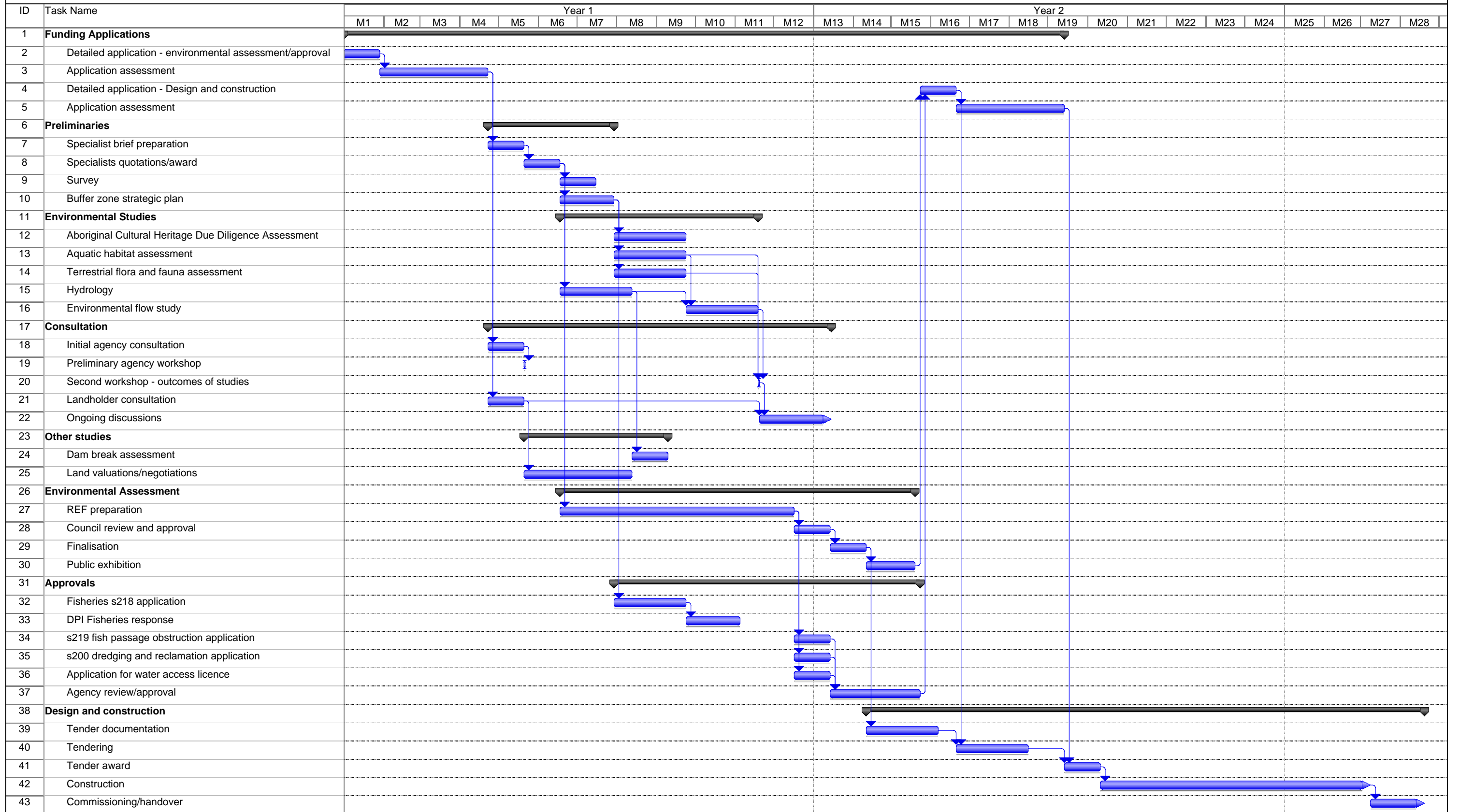


**Appendix 2. PRELIMINARY PROJECT PLAN**





## Raising of Timor Dam - Preliminary Project Plan



### Appendix 3. PROJECT COST ESTIMATES

**Table 12: Cost estimates for the environmental studies, consultation and assessment and approvals components**

Item	Cost Estimate (ex GST)
<i>Environmental studies</i>	
Survey (cadastral and inundation extent)	\$20,000
Terrestrial flora and fauna assessment	\$100,000
Aquatic habitat assessment	\$40,000
Aboriginal cultural Heritage Due Diligence Assessment	\$10,000
Flood study	\$20,000
Updated Dam Break Assessment	\$20,000
Buffer zone strategic plan	\$10,000
Environmental flow study	\$30,000
<i>Consultation</i>	
Agency	\$30,000
Landowner	\$15,000
<i>Assessment and approvals</i>	
REF Assessment and documentation	\$50,000
Approvals	\$5,000
<b>Total Direct Costs</b>	<b>\$350,000</b>
Project Management (10%)	\$35,000
Contingency (30%)	\$70,000
<b>Total</b>	<b>\$455,000</b>

**Table 13: Land acquisition cost estimates**

Item	Cost Estimate (ex GST)
Land valuations	\$10,000
Land acquisition <sup>1</sup>	\$23,100
<b>Total Direct Costs</b>	<b>\$33,100</b>
Project Management (10%)	\$3,310
Contingency (30%)	\$6,620
<b>Total</b>	<b>\$43,030</b>

1. Based on NSW Valuer General's valuations for properties within the vicinity of Timor Dam. The land value is the freehold value of the land excluding any structural improvements. Valuer General valuations may significantly differ from market value.

**Table 14: Fishway cost estimates**

Item	Cost Estimate (ex GST)
Fishway design	\$200,000
Construction <sup>1</sup>	\$5,000,000
<b>Total Direct Costs</b>	<b>\$5,200,000</b>
Project Management (10%)	\$520,000
Contingency (30%)	\$1,040,000
<b>Total</b>	<b>\$6,760,000</b>

1. Fish passage costs are unknown. Walgett Shire Council has received funding of \$4.67 million for the construction of a vertical slot fishway for Walgett Weir in association with a 1m raising of the weir with a total cost of \$8.25 million. A vertical slot fishway is unlikely to be suitable for Timor Dam. A higher cost alternative fish passage structure such as a fish lift is likely to be required.

**Table 15: Construction cost estimates**

Item	Cost Estimate (ex GST)
Construction - Total Direct Costs	\$5,164,000
Preconstruction (10%)	\$516,400
Supervision (10%)	\$516,400
Contingencies (30%)	\$1,549,200
<b>Total</b>	<b>\$7,746,000</b>

Source: PWA (2018)