# Balickera Tunnel Remediation Works Review of Environmental Factors

# **Hunter Water Corporation**



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# Abbreviations

Abbreviation	Description
ASS	Acid Sulphate Soils
BC Act	NSW Biodiversity Conservation Act 2016
CAA	Controlled Activity Approval
CEMP	Construction Environmental Management Plan
CER	Chief Executives Requirements
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPIE	NSW Department of Planning, Industry and Environment
ELA	Eco Logical Australia Pty Ltd
EPA	NSW Environment Protection Authority
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ISEPP	State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)
FM Act	NSW Fisheries Management Act 1994
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPW Act	NSW National Parks and Wildlife Act 1974
NRAR	Natural Resources Access Regulator
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (now DPIE)
POEO Act	NSW Protection of the Environment Operations Act 1997
РСТ	Plant Community Type
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TEC	Threatened Ecological Community
WM Act	NSW Water Management Act 2000

# **Executive Summary**

Hunter Water are proposing to carry out restoration works to rehabilitate the structural condition of the Balickera Tunnel. The Balickera Canal was built in 1962 and requires structural improvements to ensure its long-term viability to transfer water from the Williams River to Grahamstown Dam.

The Balickera Tunnel (the tunnel) forms part of the Balickera Canal that transfers water from the Williams River to Grahamstown Dam which holds over 65% of the total water storage for the Lower Hunter region. The Balickera Canal provides approximately 50% of water yield for the Grahamstown Dam.

The proposal includes:

- construction of a coffer dam at the downstream end of the tunnel to facilitate dewatering
- internal remediation works replacement of existing bolts, spot bolting as required with dental concrete at isolated locations, and the application of fibre-reinforced shotcrete extending from the roof to the base of the tunnel walls
- establishment of equipment laydowns
- upgrades to existing roads to provide access for construction and maintenance vehicles.

## STATUTORY PLANNING FRAMEWORK

Clause 125 of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) permits development on any land for the purpose of a water reticulation system to be out by or on behalf of a public authority without consent.

The proposal meets the definition of a water reticulation system under clause 124 of the ISEPP and are proposed to be undertaken by Hunter Water. Therefore the proposal is permissible without consent and is to be assessed under Part 5, Division 5.1 of the EP&A Act with Hunter Water as the determining authority. This REF has assessed all environmental factors listed in clause 228 of the *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation); and outlined impact mitigation measures to be undertaken, in line with relevant policies and procedures.

## ENVIRONMENTAL IMPACT ASSESSMENT

This REF assesses potential impacts of the proposal in accordance with clause 228 of the EP&A Regulation. The impact assessment process is summarised below.

## **Biodiversity**

The proposal will involve temporary exclusion of microbats from the tunnel, direct impacts to tunnel roosting habitat and removal of 0.05 ha of native vegetation. The proposal is likely to have a significant impact on three threatened microbat species within the tunnel. These species, listed as Vulnerable under the *NSW Biodiversity Conservation Act 2016* (BC Act) are:

- Eastern Bent-winged Bat (Miniopterus orianae oceanensis)
- Little Bent-winged Bat (Miniopterus australis)
- Southern Myotis (Myotis macropus).

Therefore a Species Impact Statement (SIS) has been prepared to assess and address these impacts in detail.

#### **Geology and Soils**

The proposal will have a positive impact on landform, geology and soils within the study area as the tunnel is being reinforced. No impacts below the ground surface will occur during infrequent maintenance activities. The risk of soil erosion during the works will be low provided the recommended mitigation measures are implemented and maintained.

### **Contaminated Land and Acid Sulphate Soils**

Excavation is not proposed to a depth which may potentially disturb Acid Sulphate Soils (ASS) and fill will be used on constructed access tracks which will minimise the potential for exposure. Within the tunnel, there is no risk of the disturbance of ASS as the works will only require the reinforcement and restoration of existing infrastructure.

If contaminated sediments are suspected such as through visual assessment, odorous smells or evidence of seepage within the study area, further surveys should be undertaken to assess the risk. All exported material must be tested and classified prior to disposal in accordance with Environmental Protection Authority Waste Classification Guidelines EPA (2014). Potential impacts from accidental chemical spills and general wastes will be minimised through the establishment of a dry works area to ensure that no wastes from construction can enter the water supply.

### Waterways and Aquatic Habitat

Erosion and sediment controls must be in place within the immediate works area and downstream, prior to instream works commencing to prevent sediment and waste material entering the water column and achieve no visible turbid plumes. This would ensure that no significant impact to water quality within the site and downstream occurs as a result of the proposal.

Fish passage will be temporarily blocked through the site during dewatering and operation of the coffer dam. Fish passage is considered to be limited by the current pumping station that poses a significant barrier to fish migration from the Williams River. It is considered unlikely that the endangered Southern Purple Spotted Gudgeon (*Mogurnda adspersa*) would be found in the study area due to the highly disturbed nature of the aquatic habitat in the Balickera Canal and Tunnel and the lack of instream features that would provide quality habitat. There are no records of this species within 10 km of the works area. The proposal is not likely to have a significant impact on the aquatic habitat and water quality of Balickera Canal within the study area and downstream if mitigation measures outlined are implemented and maintained.

### **Aboriginal Heritage**

The study area does not contain any previously recorded Aboriginal heritage sites recorded on the Aboriginal Heritage Information System (AHIMS). The study area was inspected for the presence of Aboriginal objects, none were identified. Furthermore, the level of disturbance observed within the study area makes it highly unlikely that intact Aboriginal archaeological sites are present. Therefore, construction is not likely to have a significant impact on the aboriginal cultural heritage of the study area.

### **Historic Heritage**

Two heritage items, 'Grahamstown - Balickera Pumping Station' and the associated 'Grahamstown Canal', listed under Section 170 of the *Heritage Act* 1977, occur within the study area. The significance

of the items and any potential impacts resulting from the proposal were assessed, which found that no impact as a result of the proposed works are likely.

The Balickera House is a locally listed heritage item on the Port Stephens Local Environmental Plan 2013 and is located approximately 500 metres to the west of the study area. Vibration impacts are not likely greater than 25m from the vibration origin, therefore it is considered that there are no potential impacts likely on the heritage item from the proposal. There will not be visual impacts on the heritage item as works are confined to maintenance works to existing infrastructure and will not change the amenity of the location.

### **Noise and Vibration**

During construction, there is potential for some sensitive receivers near the study area where noise management levels (NMLs) are predicted to be exceeded. For these receivers, the maximum noise events are predicted to be below the maximum screening criteria of 52 dB at all assessment locations with the exception of R3, where maximum noise events are predicted to be up to 61 dB.

Measures have been developed to mitigate and manage potential noise impacts during construction. Consultation will be carried out with potentially affected residents before noisy construction activities begin.

### **Air Quality**

During construction, temporary reductions in air quality are likely to occur due to elevated particulate matter from dust generating activities and exhaust emissions from diesel-powered construction equipment. Significant impacts on sensitive receivers from elevated particulate matter and dust deposition are not anticipated given the location of the study area which is generally located away from residences.

### Traffic

There is potential for construction to impact traffic on Italia Road. Any traffic impacts will be temporary and short term and mitigation measures will ensure ongoing road safety. It is recommended that notification be given to individual landowners existing in close proximity to the works area to ensure that any potential disruptions to local road users are minimised, particularly with regard to the Ringwood Park Motor Complex and Boral Quarry.

### **Visual Impacts**

Visual impacts will occur during the construction phase of the project. This includes temporary fencing, site compounds and laydown areas. These impacts are temporary and public are to be excluded therefore minimising impacts of these activities. The proposal is considered to have a minor, temporary impact on visual amenity.

### Socio-Economic

As the tunnel is essential for providing a significant proportion of the water supply of the Lower Hunter region, its structural condition and operating performance has direct economic and social implications. Once operational, the improvement of the tunnel will therefore have a positive socio-economic impact for the Lower Hunter region by ensuring the long-term viability of an existing critical asset.

#### CONCLUSION

The proposal is likely to have a significant impact on the biodiversity; therefore an SIS has been prepared for the proposal and will be submitted to the Department of Planning, Industry and Environment for concurrence. However, no other significant impacts on the environment are likely to occur and as such it is not necessary for an Environmental Impact Statement (EIS) to be prepared and approval sought from the NSW Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Hunter Water is the determining authority for this proposal. Consent from Port Stephens Council is not required.

The proposal is unlikely to have a significant impact on Matters of National Environment Significance (MNES) or Commonwealth land within the meaning of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A referral to the Australian Government Minister for the Environment is not recommended.

# 1. Introduction

The potential impacts of the proposal to restore the Balickera Tunnel have been assessed in accordance with the environmental impact assessment requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Hunter Water Corporation (Hunter Water) is the determining authority of the proposal in accordance with Division 5.1 of the EP&A Act. Additionally, Hunter Water has elected to prepare a Species Impact Statement (SIS) to assess likely impacts on threatened species in accordance with the Chief Executives' Requirements (CERs) from the then NSW Office of Environment and Heritage (OEH), now Department of Planning, Industry and Environment (DPIE).

# 1.1. Proposal Identification

Eco Logical Australia Pty Ltd (ELA) was engaged by Hunter Water to prepare a Review of Environmental Factors (REF) for the proposed restoration works to be undertaken within the Balickera Tunnel, Balickera. Balickera Tunnel is located in the Balickera Canal off Italia Road in Balickera, approximately 50 km north of Newcastle. Balickera Tunnel is a rock tunnel constructed in 1962 and is the only means to transfer water from the Williams River to Grahamstown Dam. Grahamstown Dam is the main water supply for the Lower Hunter region. The long-term viability of the tunnel is therefore critical for maintaining the water supply of the region. The location of the proposal is shown in Figure 1 and a detailed description of the proposal is provided in Section 3.

Geological investigations commissioned by Hunter Water, in 2007, identified severely corroded rock bolts and substantial over-break in some sections of the tunnel. It further identified potential for rock falls. The proponent is therefore seeking to carry out restoration works to rectify these structural issues. These works will include construction of a coffer dam at the downstream end of the tunnel to facilitate dewatering. Internal remediation works will include the replacement of existing bolts, spot bolting as required with dental concrete at isolated locations, and the application of fibre-reinforced shotcrete extending from the roof to the base of the tunnel walls. The works will also require the implementation of equipment laydowns, and upgrades to existing roads to provide access for construction and maintenance vehicles.

The following definitions are use throughout this report:

- Proposal refers to all activities and ancillary sites associated with the proposed Balickera Tunnel restoration works
- Proposal area refers to the areas that would be directly impacted by the proposal. It includes the total proposal footprint, ancillary facilities, and any other areas that would be temporarily disturbed.
- Study area refers to the proposal area and the wider area that may be indirectly impacted by the proposal.

The study area is located in the suburb of Balickera, within the Port Stephens Council Local Government Area (LGA). The proposal area will be contained within the following lots on land owned by Hunter Water:

- Lot 11 (DP849064)
- Lot 1 (DP230094)
- Lot 1 (DP206272).



Figure 1: Location of the study area

## 1.2. Purpose of the Report

This REF has been prepared by ELA on behalf of Hunter Water. For the purposes of these works, Hunter Water is the determining authority under Division 5.1 of the EP&A Act.

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposal and assessment of associated environmental impacts has been carried out in the context of clause 228 (refer to Appendix D) of the NSW *Environmental Planning and Assessment Regulation 2000*, the NSW *Biodiversity Conservation Act 2016* (BC Act), the NSW *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured.

# 2. Proposal Need and Justification

# 2.1. Objectives of the Proposal

To ensure ongoing, reliable transfer of water from the Williams River to Grahamstown Dam through long term structural stability of the tunnel. This reduces the following risks:

- Failure of Balickera tunnel could result in a reduction of 50% in yield for Grahamstown dam
- Expensive unplanned emergency repair/replacement works in the event of a catastrophic failure of the Balickera Tunnel
- Customer impacts and damage to Hunter Water's reputation.

Balickera Tunnel provides roosting habitat for a number of threatened microbat species and any remedial works must be undertaken in a manner to minimise impact on bat colonies.

# 2.2. Existing Water Infrastructure

The Balickera Tunnel was constructed between 1958 and 1960 from both ends using drill and blast methods. Due to the ground conditions and construction methods, the 1217.5 m long tunnel includes both concrete lined sections (379.3 m) and unlined (natural rock) sections (838.2 m). The diameter of the tunnel is approximately 4.5 m.

# 2.3. Options considered

## 2.3.1. Option 1: Construction of a new tunnel

Construction of a new tunnel was considered. Due to the long timeframe required for this method, as well as the significant costs that would result, this method was not the preferred option.

# 2.3.2. Option 2: A combination of shotcrete and rock bolting

A mixture of shotcrete and rock bolting would allow for the reinforcement of both the lined and unlined sections of the tunnel, with minimal loss of potential habitat features within unlined sections of the tunnel. Inspection by a geotechnical engineer would allow for installation of appropriate supports with minimal disturbance.

## 2.3.3. Option 3: Shotcrete the entire tunnel

Shotcreting of the entire tunnel for reinforcement. Due to likely impacts to threatened species present and roosting within the tunnel, this method was not the preferred option.

## 2.3.4. Option 4: Do-nothing

No change to the Balickera Tunnel. The structural condition of the tunnel would continue to deteriorate and lead to potential collapse. The tunnel collapsing would have major impacts to the Lower Hunter region's water supply. Because it does not meet proposal objectives to stabilise the tunnel, this was not the preferred option.

# 2.4. Preferred Option

The preferred option is Option 2 - a combination of shotcrete and rock bolting. This option is considered to have the least impact on the bat population within the tunnel while also achieving the required structural stability of the tunnel.

As such, certain zones of exposed rock within unlined sections of the tunnel will be maintained to ensure no loss of habitat for threatened microbats within the tunnel.

# 3. Description of the Proposal

# 3.1. Scope of Works

The proposal includes the following (Figure 2 to Figure 4):

- Construction of a coffer dam at the downstream end of the tunnel to facilitate dewatering
- Internal tunnel remediation works replacement of existing bolts, spot bolting as required with dental concrete at isolated locations, and the application of fibre-reinforced shotcrete extending from the roof to the base of the tunnel walls
- Establishment of equipment laydowns
- Upgrades to existing roads to provide access for construction and maintenance vehicles.

# 3.2. Construction Activities

## 3.2.1. Pre-construction and Site Set Up

A Construction Environmental Management Plan (CEMP) will be prepared prior to on-ground works. This will specify the location of proposed site compounds and stockpiling areas for materials and equipment, and 'no go' zones around environmentally sensitive areas. The CEMP will also prescribe erosion and sediment controls during the construction period and include further mitigation and safeguards in accordance with Section 7.

The following will occur as pre-construction and as part of the site set up:

- A Dial Before You Dig Assessment (DBYD) will be undertaken prior to any excavation or construction works to locate any service infrastructure present on site
- Transport of machinery, equipment and materials to the site and establishment of site storage and parking areas
- Installation of sediment and erosion protection measures in accordance with the 'Blue Book' Soils and Construction, Managing Urban Stormwater (Landcom, 2004) with reference to Chapter 5 'Erosion Control: Management of Water'
- Installation of protection and exclusion fencing around vegetation that is to be protected and to delineate area of works
- Installation of fencing and signage to restrict pedestrian access
- Installation of microbat exclusion curtains and microbat exclusion prior to internal tunnel works
- Installation of bat boxes for alternative bat roosting habitat.

## 3.2.2. Tunnel remediation works

The remediation works proposed for the tunnel will improve its structural condition to meet a 100-year design life requirement, improve the operating performance and reduce the risk of future maintenance and inspection works due to rock fall. To achieve the design life, the remediation measures propose to install a new shotcrete / concrete lining in the existing concrete lined sections and to install new rock bolts and / or new shotcrete / concrete lining in low rock quality areas along the unlined (natural rock) sections.

Specifically, the proposed remediation methodology (to be confirmed as part of the detailed design) can be separated into natural rock, concrete lined and tunnel portal categories with proposed remediation methodologies for each outlined below.

### **Natural rock sections**

- 1. From supported ground, the rock surface over the next advance length is to be cleaned and scaled by high pressure water jetting.
- 2. Site geotechnical engineer to map the exposed rock face and set out the required support in accordance with the design.
- 3. Site geotechnical engineer to confirm location of microbat roosting habitat with project ecologist. Remediation works to critical areas of microbat roosting habitat will be avoided, where possible.
- 4. Detailed measurements will be taken of microbat roosting habitat that cannot be avoided during remediation works. These will be used to contour and shape the shotcrete applied to the location of the impacted microbat roosting habitat to replicate the original features. The resultant surface created must be approved by the project ecologist.
- 5. Dependent upon the quality classification of the rock, one of the following remediation approaches will be utilised, and any microbat habitat recreated where required:
  - Application of dental shotcrete combined with spot rock bolting of identified rock wedges
  - Application of dental shotcrete, installation of patterned rock bolting with 1.7 m radial spacing and 1.5 m longitudinal spacing and spot rock bolting of identified rock wedges
  - Installation of patterned rock bolting with 1.1 m radial spacing and 1.5 m longitudinal spacing and spot rock bolting of identified rock wedges
  - Application of 100 mm thick steel fibre reinforced (SFR) shotcrete with mass concrete invert.

Where rock quality is poor, the existing rock support is highly degraded and presents an unacceptably high risk of collapse. There are short stretches of poor quality rock spread throughout the natural rock sections of the tunnel.

## **Concrete lined tunnel sections**

- 1. Confirm through inspection and engineering assessment that the existing lining has sufficient useful life to undertake the rehabilitation works in a safe manner.
- 2. Undertake a condition assessment of the structure, testing to determine thickness of existing concrete lining and estimate concrete strength.
- 3. Site geotechnical engineer to confirm location of microbat roosting habitat with project ecologist. Remediation works to critical areas of microbat roosting habitat will be avoided, where possible.
- 4. Detailed measurements will be taken of microbat roosting habitat that cannot be avoided during remediation works. These will be used to contour and shape the shotcrete applied to the location of the impacted microbat roosting habitat to replicate the original features. The resultant surface created must be approved by the project ecologist.
- 5. Concrete lining to be cleaned and the surface aggregate exposed by high pressure water jetting.
- 6. Apply 150 mm of SFR shotcrete to tunnel roof and side walls and recreate microbat roosting habitat, where required.
- 7. Cast a new concrete invert for additional durability and robustness.

### **Portal zones**

- 1. Confirm through inspection and engineering assessment that the existing lining has sufficient useful life to undertake the rehabilitation works in a safe manner.
- 2. Undertake a condition assessment of the structure, testing to determine thickness of existing concrete lining and estimate concrete strength.
- 3. Site geotechnical engineer to confirm location of microbat roosting habitat with project ecologist. Remediation works to critical areas of microbat roosting habitat will be avoided, where possible.
- 4. Detailed measurements will be taken of microbat roosting habitat that cannot be avoided during remediation works. These will be used to contour and shape the shotcrete applied to the location of the impacted microbat roosting habitat to replicate the original features. The resultant surface created must be approved by the project ecologist.
- 5. Concrete lining to be cleaned and the surface aggregate exposed by high pressure water jetting.
- 6. Cast new 200 mm thick concrete lining with reinforcement bar at 200 mm spacing and recreate microbat habitat, where required.

Shotcrete will provide a surface that promotes microbat attachment as it is roughened in comparison to cast concrete. Recreation of microbat roosting habitat through the application of shotcrete will aim to mimic the contours, size and shape of the original roosting habitat located on natural rock surfaces, without compromising the structural integrity of the shotcrete. It will also involve preservation / recreation of at least 40 of the 106 cylindrical 20 cm diameter vertical holes found within the concrete lined sections, ensuring that the structural integrity of the shotcrete lining is maintained. Approximately 20% of the existing natural rock surface of the tunnel is anticipated to be sprayed with shotcrete.

The works will be carried out from both ends of the tunnel at the same time, progressing in 3 m sections and operating 24 hours a day. The bats would be excluded from the tunnel for the duration of internal tunnel works (a maximum of five months) using exclusion curtains and a secondary external barrier placed at either end of the tunnel. The details of the proposed exclusion are presented in a microbat management plan included as part of the SIS.

### 3.2.3. Coffer dam

A coffer dam is required to allow dewatering of the Balickera Canal to facilitate tunnel remediation works. The coffer dam will isolate the canal from Grahamstown Dam. Dewatering upstream of the coffer dam (and lock-out of Balickera pump station pumps) will provide safe access for plant and personnel to the canal and tunnel.

The coffer dam is proposed to be located 200 m downstream of the downstream tunnel portal and will be constructed of general fill placed on the upstream and downstream shoulders, separated by a compacted clay fill zone. The upstream and downstream batters on the structure will be 2. 5H:1V. The coffer dam will have a crest width of 7 m, constructed at a level 300 mm above the Grahamstown Dam normal full supply level of RL 13.1 m AHD.

Following construction of the temporary coffer dam the tunnel will be dewatered using pumps (initially operating 24 hours per day, then intermittently when water accumulates in the tunnel) to transfer water from upstream of the coffer dam to the downstream, Grahamstown Dam, side.

Access to the coffer dam is provided through minor upgrades to the existing access tracks on the southern side of the canal. No traffic can access the crest of the coffer dam and no works will occur on the northern side.

### 3.2.4. Machinery and Equipment

Works will be undertaken predominantly using machinery such as:

- Construction Access track upgrades
  - o Excavator
  - o Vibratory roller
  - Articulated dump truck (40t)
  - Road truck (Truck & Dog)
- Construction Tunnel restoration works
  - Concrete truck (Agitator)
  - Shotcrete pump
  - Grout pump
  - Compressor
  - o Water pump
  - Copco 104 jumbo driller
  - Axera 5 Single Boom Jumbo 65Kw diesel power
  - o Generator (1000W)
  - Hand tools
  - o Crane (15t)
  - Elevated work platform
  - Excavator / Caterpillar Loader 1300.

### 3.2.5. Post-construction

Post construction work will involve:

- Removal of microbat exclusion devices
- Decommissioning and removal of coffer dam
- Removal of excess materials and disposal of excavated debris as appropriate
- Reinstate disturbed surfaces.

### 3.2.6. Operation

Hunter Water conducts condition assessments in accordance with the Asset Condition Assessment Standard, to determine the serviceability of an asset and any foreseeable likelihood of failure. Hunter Water would plan to undertake a visual condition assessment of the Balickera Tunnel on a 5 yearly frequency whilst water is present in the tunnel. The visual condition assessment would be conducted using Remotely Operated Vehicle (ROV) equipment or similar, with procedures developed to minimise impacts to microbats roosting within the tunnel.

If the visual condition assessment were to identify areas of concern, then there may be a requirement for a more detailed condition assessment that may or may not require dewatering of the tunnel. Under these circumstances, procedures would be developed to minimise environmental impacts from the dewatering and impacts to microbats roosting within the tunnel.



Figure 2: Overview of site plan



Figure 3: Site plan upstream of tunnel



Figure 4: Site plan downstream of tunnel

# 3.3. Timing and Staging

Access track upgrades, establishment of compounds, coffer dam construction and dewatering will occur prior to tunnel remediation works as part of site establishment. These works are expected to take up to eight weeks and be completed during normal construction hours (Monday to Friday 7am-6pm, Saturday 8am-1pm), except for dewatering which will operate 24 hours per day until dewatering is complete and then intermittently during tunnel remediation.

Tunnel remediation works will occur from both ends of the tunnel with construction operating 24 hours a day, seven days a week. Out of hours work is required to minimise the length of time bats are excluded from the tunnel and to minimise the length of time the tunnel is offline.

Tunnel remediation works may take up to five months. The internal tunnel remediation works are proposed as a single event to begin in December and extend until the end of April at the latest. This period has been selected to minimise impacts on bat populations in the tunnel.

The works are proposed to commence in late 2021.

# 3.4. Ancillary facilities and access

Three site compounds for lay down areas, spoil management, and materials storage will be located in existing cleared areas. The main compound will be in the upstream section of the study area in Balickera Park near the Balickera Pumping Station (Figure 2). Two secondary compounds are proposed, one near each tunnel portal (Figure 3 and Figure 4).

Site access will be from Italia Road. Access to the upstream portion of the study area will be from the existing tarred road into to Balickera Park. Access to the downstream portion of the study area will be from an existing gated entry to maintenance tracks near the downstream portal.

# 4. Statutory Framework

# 4.1. Environmental Planning Instruments

#### Table 1: Relevant Environmental Planning Instruments

Name	Relevance to the Project
State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)	The aim of this Policy is to facilitate the effective delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development.
	Pursuant to clause 125 of the ISEPP, development the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land. In particular section 5 (e) of clause 125 specifies the development of the canals, tunnels and channels are permitted without consent when carried out on behalf of a public authority.
	Part 2 of the Infrastructure SEPP contains provisions for public authorities to consult with other agencies prior to the commencement of development, these are described in Section 5.
State Environmental Planning Policy (Koala Habitat Protection) 2021	The Koala Habitat Protection SEPP 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 Port Stephens LGA is considered land to which the Koala Habitat Protection SEPP applies and the Port Stephens Comprehensive Koala Plan of Management (2002) is adopted under the SEPP. However, the proposal is to be assessed under Part 5, Division 5.1 of the EP&A Act, to which this SEPP does not apply.
	Potential habitat for the Koala was identified within the proposal area and impacts to habitat will be offset in accordance with the NSW Biodiversity Assessment Method (BAM), as described in Section 6.1.
Port Stephens Local Environmental Plan	In accordance with the Port Stephens LEP 2013, the study area is zonedSP1: Special Activities, therefore the following objectives apply:
2013	SP1 (Special Activities)
	<ul> <li>To provide for special land uses that are not provided for in other zones</li> <li>To provide for sites with special natural characteristics that are not provided for in other zones</li> <li>To facilitate development that is in keeping with the special characteristics of the site or its</li> </ul>
	<ul> <li>existing or intended special use, and that minimises any adverse impacts on surrounding land</li> <li>To ensure the protection of water catchment areas to safeguard the quality and quantity of</li> </ul>
	<ul> <li>groundwater and surface water</li> <li>To facilitate the provision of infrastructure provided by Hunter Water Corporation.</li> </ul>
	As such, the proposal is in accordance with land use zone objectives.
	Heritage Conservation
	ELA has undertaken a historical heritage assessment which identified one (1) heritage item listed in Schedule 5 of the Port Stephens LEP 2013 Conservation Item 13; Balickera House, as being immediately adjacent to the proposed area of works. This item must be avoided. If impacts cannot be avoided a Statement of Heritage Impacts assessment must be completed prior to the proposed works.

# 4.2. NSW and Commonwealth Legislation

### Table 2: Relevant Legislation

Name	Relevance to the Project
	Commonwealth
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act protects Matters of National Environmental Significance (MNES), such as threatened species and ecological communities, migratory species (protected under international agreements), and National Heritage places (among others). Any actions that will or are likely to have a significant impact on the MNES require referral and approval from the Australian Government Environment Minister. Significant impacts are defined by the Commonwealth for MNES.
	MNES have been identified within and near the site. Significance Assessments were undertaken for the following threatened fauna species:
	<ul> <li>Koala – Listed as Vulnerable under the EPBC Act</li> <li>Grey-headed Flying-fox – listed as Vulnerable under the EPBC Act.</li> </ul>
	The assessments concluded that no significant impact to MNES is expected to occur as a result of the proposal, as such an EPBC Referral is not required
	State
Environmental Planning and Assessment Act 1979 (EP&A Act)	The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of proposals. The EP&A Act allows for the creation of environmental planning instruments (EPIs) including Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). Presented below is a discussion on the approval process under the EP&A Act and the relevance of specific EPIs. Also discussed below are other legislative requirements of relevance to the proposal. As Hunter Water is the proponent, the works are to be assessed as 'development permissible without consent' under Part 5, Division 5.1 of the EP&A Act. Accordingly, Hunter Water must satisfy Sections 5.5 and 5.6 of that Act by examining, and taking into account to the fullest extent possible, all matters which are likely to affect the environment. This REF is intended to assist, and ensure compliance, with the EP&A Act including Sections 5.5 and 5.6.
	This report addresses the requirements of s228 of the EP&A Regulation 2000. Hunter Water are the determining authority under Division 5.1 of the EP&A Act.
Biodiversity Conservation Act 2016 (BC Act)	The BC Act seeks to conserve biological diversity at bioregional and State scales; to maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations; to assess the extinction risk of species and ecological communities and identify key threatening processes through an independent and rigorous scientific process; and to establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity.
	Section 7.3 of the Act requires proponents of activities subject to Part 5, Division 5.1 of the EP&A Act to determine whether they will have a significant impact on threatened species. The test for significant impact is described in section 7.3 of the Act.
	If a significant impact is likely to occur, the proponent of the activity must prepare a Species Impact Statement (SIS) in accordance with section 7.20 or a Biodiversity Development Assessment Report (BDAR).
	The proposal was considered likely to have a significant impact on the threatened species known to utilise the tunnel. In accordance with section 7.8 (4) of the BC Act, Hunter Water elected to

Name	Relevance to the Project
	prepare an SIS to assess the likely significant impact on threatened species, as summarised in Section 6.1
<i>Biosecurity Act 2015</i>	The Biosecurity Act repealed the <i>Noxious Weeds Act 1993</i> and provides a framework for the prevention, elimination and minimisation of biosecurity risks posed by a biosecurity matter, dealing with a biosecurity matter, carriers and potential carriers, and other activities that involve a biosecurity matter, carriers or potential carriers.
	Part 3 of the Biosecurity Act applies a general biosecurity duty for any person who deals with a biosecurity matter or a carrier to prevent, eliminate or minimise any biosecurity risk they may pose. Under section 23 of the Act, a person who fails to discharge a biosecurity duty is guilty of an offence.
	Whilst the Act provides for all biosecurity risks, implementation of the Act for weeds is supported by Regional Strategic Weed Management Plans (RSWMP) developed for each region in NSW. Appendix 1 of each RSWMP identifies the priority weeds for control at a regional scale. However, landowners and managers must take appropriate actions to reduce the impact of problem weed species regardless of whether they are listed in Appendix 1 of the RSWMP or not as the general biosecurity duty applies to these species.
	A number of priority weeds, as identified within the Hunter RSWMP, were present within the study area and will require management by Hunter Water, as described in Section 6.1.
Fisheries Management Act 1994 (FM Act)	The FM Act provides for the protection, conservation and recovery of threatened species defined under the Act. It also makes provisions for the management of threats to threatened species, populations and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general.
	Threatened aquatic species, populations and communities are listed under Schedules 4, 4A and 5 of the FM Act, while key threatening processes are listed under Schedule 6. Part 7A Division 4 of the Act prohibits the carrying out, without a licence, of activities that damage habitats or harm threatened species, populations or ecological communities. In determining the significance of impacts, the determining authority must consider the matters listed in section 1.7 of the EP&A Act
	No threatened species listed under the FM Act are likely to occur within the study area (Appendix B). Southern Purple Spotted Gudgeon is modelled to occur upstream in the Williams River (Riches et al 2016) but is unlikely to enter the canal due to the physical barrier of the pumping station and the behavioural barrier of the long dark tunnel.
	Balickera Canal at the upstream extent and near the downstream extent of the study area is mapped as Key Fish Habitat (KFH) by NSW Fisheries (Figure 16). The tunnel itself is not identified as KFH but would still provide fish passage between the Williams River and Grahamstown Dam. As the works involve obstruction of fish passage and Hunter Water are considered a public authority under the FM Act, approval from DPI Fisheries under s199 of the FM Act is required before works can proceed (see Section 6.4). Management of potential impacts to water quality in nearby water bodies is discussed in Section 7.
National Parks and Wildlife Act 1974 (NPW Act)	The NPW Act is administered by the Director-General of the National Parks and Wildlife Services, who is responsible for the control and management of all national parks, historic sites, nature reserves, and Aboriginal areas (among others). The main aim of the Act is to conserve the natural and cultural heritage of NSW. The Act aims to conserve the natural and cultural heritage of NSW. Where works will disturb Aboriginal objects, an Aboriginal Heritage Impact Permit (AHIP) is required.
	ELA has undertaken an Aboriginal Heritage Due Diligence Assessment to determine any potential impacts to Aboriginal objects or places, this is presented in Section 6.5 of this document. The

Name	Relevance to the Project
	assessment did not identify any Aboriginal items or objects within the study area. Therefore, a significant impact as a result of the proposal will not occur to any registered Aboriginal items or objects.
Heritage Act 1977	The Heritage Act provides protection of the environmental heritage of the State which includes places, buildings, works, relics, movable objects or precincts that are of State or local heritage significance. A key measure for the identification and conservation of State significant items is listing on the State Heritage Register (SHR) as provided in Part 3A of the Heritage Act.
	The Non-Aboriginal heritage assessment concluded that the proposal would not impact on any known heritage items. The assessment identified three heritage items listed within the vicinity of the study area. Two are located immediately within the study area and are identified as the 'Grahamstown - Balickera Pumping Station' and the associated 'Grahamstown Canal'. Both are listed as heritage items under Section 170 of the <i>Heritage Act</i> 1977, and are listings by a State Agency (Hunter Water). The third heritage item is listed under Schedule 5 of the Port Stephens LEP 2013; Conservation Item 13 'Balickera House' and is located in the property adjacent to the north western edge of the study area. The significance of the items and any potential impacts resulting from the proposal were assessed, which found that no impact as a result of the proposed works are likely. The Non-Aboriginal heritage assessment is presented in Section 6.5.2.
Protection of the Environment Operations Act 1997 (POEO Act)	<ul> <li>The POEO Act is the key environmental protection and pollution statute. The POEO Act is administered by NSW Environment Protection Authority and establishes a licensing regime for waste, air, water and pollution. Relevant sections of the Act are listed below:</li> <li>Part 5.3 Water Pollution</li> <li>Part 5.4 Air Pollution</li> <li>Part 5.5 Noise Pollution</li> <li>Part 5.6 Land Pollution and Waste.</li> <li>Any work potentially resulting in pollution must comply with the POEO Act. Relevant licences must be obtained if required. No licences have been identified as being required including an Environmental Protection Licence (EPL).</li> </ul>
Water Management Act 2000 (WM Act)	The WM Act aims to provide for the sustainable and integrated management of water resources for NSW. The Act requires developments on waterfront land to be ecologically sustainable and recognises the benefits of aquatic ecosystems to agriculture, fisheries, and recreation. The WM Act is administered by the Natural Resources Access Regulator (NRAR) and establishes an approval regime for activities within waterfront land, defined as the land 40 m from the highest bank of a river, lake or estuary.
	A Controlled Activity Approval (CAA) is typically required for work within waterfront land. Section 91E of the Act creates an offence for carrying out a controlled activity within waterfront land without approval. According to Section 41 of the <i>Water Management (General) Regulation 2018,</i> a public authority is exempt from Section 91E (1) of the Act. Therefore, Hunter Water does not need to obtain a CAA from the NRAR as part of these works. However, works should be designed and constructed as per the NRAR's 'Guidelines for instream works on waterfront land' (NSW Office of Water 2013) where relevant to the scene of works.

# 5. Consultation

Division 1 of the Infrastructure SEPP provides guidance on consultation with stakeholders.

**Table 3: Infrastructure SEPP consultation requirements** 

ISEPP Clause	Clause Relevance	Consultation Undertaken
Clause 13	Impacts on council-related infrastructure or services	No. The works will be undertaken on land owned by Hunter Water Corporation
	Consultation is required if the public authority is of the opinion that the development:	
	(a) will have a substantial impact on stormwater management services provided by a council, or	
	(b) is likely to generate traffic to an extent that will strain the capacity of the road system in a local government area, or	
	(c) involves connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council, or	
	(d) involves connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council, or	
	(e) involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential, or	
	(f) involves excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the Roads Act 1993 (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath).	
Clause 14	Impacts on local heritage	No consultation required.
	Consultation is required if the development:	Impacts on local heritage are unlikely. A s.170
	(a) is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area, and	register item is located within the study area but unlikely to be impacted
	(b) is development that this Policy provides may be carried out without consent.	and listed by Hunter Water.
Clause 15	Impacts on flood liable land	The site is not mapped as
	In this clause, flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled Floodplain Development Manual: the management of flood liable land published by the New South Wales Government and as in force from time to time.	flood liable land.
Clause 16	Consultation with public authorities other than councils	Consultation with public
	Consultation is required if the development is:	authorities was not required.
	(a) development adjacent to land reserved under the National Parks and Wildlife Act 1974—the Department of Environment and Climate Change,	

ISEPP Clause	Clause Relevance	Consultation Undertaken
	(b) development adjacent to a marine park declared under the Marine Parks Act 1997—the Marine Parks Authority,	
	(c) development adjacent to an aquatic reserve declared under the Fisheries Management Act 1994—the Department of Environment and Climate Change,	
	(d) development in the foreshore area within the meaning of the Sydney Harbour Foreshore Authority Act 1998—the Sydney Harbour Foreshore Authority,	
	(e) development comprising a fixed or floating structure in or over navigable waters—the Maritime Authority of NSW,	
	(f) development for the purposes of an educational establishment, health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land (as defined by the Act)—the NSW Rural Fire Service.	
	Note. The Act defines bush fire prone land, in relation to an area, as land recorded for the time being as bush fire prone land on a map certified as referred to in section 146 (2) of the Act.	
	Note. When carrying out development of a kind referred to in paragraph (f), consideration should be given to the publication of the NSW Rural Fire Service Planning for Bush Fire Protection 2006.	
	(g) (Repealed)	

## 5.1. Government Agency and Other Stakeholder Consultation

The NSW DPI Fisheries was consulted in relation to the construction of the coffer dam and obstruction of fish passage in an area of mapped Key Fish Habitat.

The NSW DPI Fisheries was contacted in June 2021 regarding necessary approvals under the FM Act for the proposal. DPI Fisheries advised that obstruction of fish passage in mapped KFH requires approval from DPI Fisheries under s199 of the FM Act. This correspondence is provided in Appendix E. The advice has been included in Section 6.4.2.1.

# 6. Environment Assessment

# 6.1. Biodiversity

## 6.1.1. Existing Environment

The potential impacts of the proposal are assessed in the Balickera Tunnel Remediation works Species Impact Statement (ELA, 2021). The potential impacts and safeguards are summarised in the following section.

## 6.1.1.1. Native vegetation

Four native Plant Community Types (PCTs) were recorded within the study area (Table 4; Figure 5):

- 1588: Grey Ironbark Broad-leaved Mahogany Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast
- 1589: Spotted Gum Broad-leaved Mahogany Grey Gum grass shrub open forest on Coastal Lowlands of the Central Coast
- 1598: Forest Red Gum grassy open forest on floodplains of the lower Hunter
- 1729: Swamp Oak swamp forest on coastal lowlands of the Central Coast and Lower North Coast.

Areas of non-native/exotic vegetation were also recorded.

Two PCTs identified within the northern portion of the study area comply with final determinations for listed Threatened Ecological Communities (TECs) (Table 4). PCT 1598 in the study area corresponds to *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* listed as Endangered under the BC Act and Critically Endangered under the EPBC Act. PCT 1729 in the study area corresponds *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* listed as Endangered inder the BC Act and Critically Endangered under the BPBC Act. PCT 1729 in the study area corresponds *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* listed as Endangered under the BC Act and EPBC Act. The location of TECs within the study area is shown on Figure 6.

#### Table 4: PCTs and TECs within the study area

РСТ	TEC Status	Area within study area	Area impacted
1588: Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	Not listed	3.48 ha	0.05 ha
1589: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Not listed	3.14 ha	0
1598: Forest Red Gum grassy open forest on floodplains of the lower Hunter	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria – EPBC Act Critically Endangered	0.76 ha	0
	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – BC Act Endangered		

РСТ	TEC Status	Area within study area	Area impacted
1729: Swamp Oak swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland – EPBC Act Endangered Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions – BC Act Endangered	0.63 ha	0

### 6.1.1.2. Threatened flora

Targeted flora surveys within the study area recorded one threatened species, *Pterosytlis chaetophora*, listed as Vulnerable under the BC Act (Figure 7). *Pterostylis chaetophora* was not recorded within the proposal area. The species was previously recorded by Port Stephens Council in 2019 in the upstream portion of the study area, near the proposal area and upstream portal, although it was not detected at this location during targeted surveys in October 2020 for the SIS.

No other threatened flora species were recorded or are considered likely to occur in the proposal area following targeted surveys of potential habitat.

### 6.1.1.3. Priority weeds

Several weeds listed under the Hunter RSWMP were recorded in the study area including *Lantana* camara (Lantana) and *Eragrostis curvula* (African Lovegrass).

### 6.1.1.4. Habitats and threatened fauna

Fauna habitat in the downstream portion of the study area consists of regenerating open forest on the banks of the canal with connectivity to large areas of remnant forest within the adjacent Wallaroo State Forest and National Park to the north and east and forested private property to the south. Exotic grass areas dominate the immediate surrounds of the canal where existing access tracks are present.

The upstream portion of the study area is generally disturbed with cleared and partially cleared grassland areas immediately surrounding the canal with some patches of regenerating forest present more broadly. Tree hollows and logs are generally absent from this area. One small open and vegetated dam is located adjacent to the study area approximately 100 m north east of the upstream portal. Short exotic grass areas dominate the immediate surrounds of the canal and Balickera Park, both of which are maintained by Hunter Water. The Balickera Tunnel provides roosting habitat for microbats. Habitat features of the study area are summarised in Table 5.

Fauna habitat type	Site characteristics
Site topography	Generally flat to low hills. Edge of floodplain landscape in the northwest, low coastal hills in the centre and east. The tunnel passes through a central high point.
Soil landscapes	Ten Mile Road: undulating low hills on carboniferous sediments and acid volcanics in the Medowie Lowlands and Clarencetown Hills regions.
	Medowie: gently undulating low hills on relict sediments in the Medowie Lowlands region.
	Nungra: widespread gently inclined footslopes and drainage plains of the Medowie Lowlands and Karuah Mountains physiographic regions.

#### Table 5: Habitat features within the study area

Fauna habitat type	Site characteristics	
Habitat types	Dry Sclerophyll Forest, cleared areas, water canal.	
Hollow-bearing trees	No hollow-bearing trees were recorded in the study area.	
	Hollows are likely to be present in adjacent forest.	
Rocky outcrops	Canal construction has created some areas of steep rocky slopes near tunnel entrances. Some surface rocks associated with ephemeral stream near downstream portal.	
Watercourses	Balickera Canal.	
	Drainage line near site entry off Italia Road.	
Wetland areas	Balickera Canal.	
Leaf litter	Leaf litter present within forest areas.	
Flowering tree species	Eucalyptus species, Corymbia maculata.	
Flowering shrubs	Sparse cover of diverse shrubs is generally present in forest areas. Species present include Acacia longifolia subsp. longifolia, Callistemon salignus, Ozothamnus diosmifolius, Daviesia ulicifolia, Lissanthe strigose and Melaleuca ericifolia.	
Bush rock and rocky outcrops	No bush rock recorded.	
Natural burrows	None observed.	
Logs	Some logs are present within forest areas. Generally few logs are present due to historical clearing.	
Standing or flowing water	Balickera Canal. Ephemeral stream.	
Nests and roosts	No nests were recorded.	
	Balickera Tunnel is a known roost for bats. No other roosts were recorded.	
Den trees	No den trees recorded.	
Distinctive scats	No distinctive scats recorded.	
Latrine or den sites	No latrine or den sites recorded.	
Allocasuarina sp.	No Allocasuarina species recorded.	
Bat tree roosts	No bat tree roosts recorded.	
Bat subterranean roosts	Yes. Balickera Tunnel.	
Winter flowering eucalypts	Corymbia maculata	
Permanent soaks and seepages	None.	
Disturbance history	Canal construction in 1960s.	
Koala habitat	Forests within the study area are potential Koala habitat.	

Based on the assessment of likelihood of occurrence and the results of targeted field surveys, twelve threatened fauna species were known (Figure 7) or considered likely to occur within the study area and have potential to be affected by the proposal:

- Little Bent-winged Bat (Miniopterus australis) (Vulnerable BC Act)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis* (syn. *Miniopterus schreibersii oceanensis*)) (Vulnerable BC Act)
- Southern Myotis (*Myotis macropus*) (Vulnerable BC Act)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Vulnerable BC Act)
- Eastern Coastal Free-tailed Bat (Micronomus norfolkensis) (Vulnerable BC Act)
- Koala (*Phascolarctos cinereus*) (Vulnerable BC Act; Vulnerable EPBC Act)
- Grey-headed Flying-fox (Pteropus poliocephalus) (Vulnerable BC Act; Vulnerable EPBC Act)
- Little Lorikeet (*Glossopsitta pusilla*) (Vulnerable BC Act)
- White-bellied Sea-Eagle (Haliaeetus leucogaster)
- Powerful Owl (*Ninox strenua*) (Vulnerable BC Act)
- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) (Vulnerable BC Act)
- Masked Owl (*Tyto novaehollandiae*). (Vulnerable BC Act)

These species were identified as affected species in the SIS and were subject to detailed impact assessment.

The Balickera Tunnel is a known roosting site for three threatened microbat species listed under the BC Act and as such these species were given special consideration in the SIS. Original study questions were used to guide the survey with the aim of developing the best possible understanding of the microbat colonies within the tunnel. The original study questions and summary of the study findings is provided in Table 6.



Figure 5: Plant Community Types within the study area



Figure 6: Threatened Ecological Communities within the study area


Figure 7: Threatened species recorded within the study area

#### Table 6: Summary of bat survey results in relation to original study questions

Original study questions	Survey methods used for investigation	Summary of results	
Which species of microbat	Harp trapping and	Little Bent-winged Bat – year round resident, non-breeding.	
are currently roosting in Balickera Tunnel?	ultrasonic call recording	Large Bent-winged Bat – year round resident, non-breeding.	
		Southern Myotis – year round resident, breeding over summer in October / November and January / February.	
		Eastern Horseshoe Bat – year round resident, possible breeding site.	
How many individuals of each microbat species	Thermal imaging and ultrasonic recording	The bat population in the tunnel peaks in winter and spring at around 5500 – 6000 bats and decreases in summer and autumn to between 2000 – 3000 bats.	
roost Balickera Tunnel?		The majority of bats are Little Bent-winged Bats (77.8 % of ultrasonic calls). Southern Myotis account for 12.5 % of recorded calls and Large Bent-winged Bats just 2.4 % of recorded calls.	
		Estimated population of Southern Myotis is 50 – 200 bats.	
		Estimated population of Large Bent-winged Bats is 300 – 500 bats.	
		Estimated population of Little Bent-winged Bats is 2000 – 5000 bats.	
		Estimated population of Eastern Horseshoe Bats is 10 – 50 bats.	
Where in the tunnel are Tunnel Inspection, microbats roosting what previous studies are the characteristics of the roosts?		<b>Bent-winged Bats:</b> Main roost and majority of these species are within the first natural rock section from upstream portal, between chainage 173 and 290 m from the upstream portal. The main roost is estimated to be located at 240 m from the upstream portal, with smaller clusters and scattered individuals in the vicinity of this roost. The location of this roost matches that recorded during surveys undertaken by Ecotone in 2000 and in imagery taken in April and September 2018. Another large cluster of bats was recorded in a separate natural rock section between chainage 304 and 493 m from the upstream portal. Scattered individuals and pairs were recorded roosting on natural rock and in vertical cylindrical 20 cm diameter holes in the concrete lined sections between chainages 493 to 1072 m.	
		<b>Southern Myotis:</b> Predominantly roost in vertical cylindrical 20 cm diameter holes within concrete lined sections of the tunnel. The majority of these sites are within the upstream half of the tunnel and at least some of these are likely to be used for breeding. There are 106 vertical holes within the concrete lined sections of the tunnel and 39 of those have been recorded to contain roosting microbats (Ecotone 2000). Those observed to be used regularly are located between chainages 0 to 172 m (22 roosts) and 287 to 304 m (2 roosts). Southern Myotis were also recorded roosting in holes between, 493 to 580 m (6 roosts), 629 to 655 (4 roosts) and 957 to 1010 (5 roosts).	

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Original study questions	Survey methods used for investigation	Summary of results
Are there seasonal differences in bat numbers or sex ratios?	Harp trapping	<b>Bent-winged Bats:</b> The population of Little Bent-winged Bats halves over summer when females leave to give birth and raise young in a maternity cave elsewhere. There are very few females present between December and February. The population builds up gradually over autumn when males outnumber females and reaches peak occupancy throughout winter and early spring when sex ratios approach 1:1 for breeding / mating purposes.
		<b>Southern Myotis:</b> The ultrasonic evidence suggests that Southern Myotis numbers build up over spring reaching a peak during summer. Trapping data was insufficient to provide detail on sex ratios. However Myotis generally form colonies of related females attended by a dominant breeding male. It is expected that prior to giving birth in October / November, sex ratios would be skewed towards females. Once the young are born in October / November and January / February, sex ratios should approach 1:1 until autumn when the young (predominantly males) disperse from the maternal roost. Females are likely to outnumber males at a maternity roost for the majority of the year.
Is Balickera Tunnel being	Harp trapping,	Bent-winged Bats: No. Females appear to vacate the tunnel during the summer breeding period.
used as a maternity roost for the affected threatened microbat species?	ultrasonic recording and previous studies	Southern Myotis: Yes. Southern Myotis previously recorded breeding in tunnel, and was recorded through all seasons, including high levels of ultrasonic call activity during the breeding seasons.
Do any of the microbat	All	Bent-winged Bats: Yes. The tunnel is used by both Bent-winged Bat species as an over-wintering / hibernation roost.
species inhabiting Balickera tunnel use it as a hibernation or staging roost?		Southern Myotis: Yes. Southern Myotis are present year round and would undertake extended torpor bouts over winter.
What elements of the population of each species of microbat (adults,	Harp trapping, previous studies	<b>Bent-winged Bats:</b> Adult males and females during autumn, winter and spring, mostly adult males during summer. No juveniles have been recorded at Balickera Tunnel. Sub-adults were recorded in autumn indicating that the young from the previous summer that are not yet sexually mature also roost within Balickera Tunnel.
juveniles, males, females) inhabits Balickera Tunnel?		Southern Myotis: Adult males and females captured during spring harp trapping. Pregnant and lactating females and juveniles observed in January and February 1999 (Ecotone 2000).
What alternative habitat for each species of microbat inhabiting Balickera Tunnel is	Regional microbat assessment, desktop review, consultation	<b>Bent-winged Bats:</b> Several potential alternative roosts within nightly flight range (33 km) for Little Bent-winged Bats at Brookfield Tunnel, M1 Tunnel, Pilcher's Mountain Caves, Dungog WTP Tunnel and Blue Gum Hills Derelict Mine. Unknown whether Brookfield Tunnel is suitable as a year round roost, M1 Tunnel is unsuitable for large numbers and at risk from development, Dungog WTP contains mostly Large Bent-winged Bats and the current status of Blue Gum Hills Derelict Mine is unknown. Seven alternative Little Bent-winged

Original study questions	Survey methods used for investigation	Summary of results
available within the surrounding area?		Bats roosts known within a 50 km radius; many of which are capable of accommodating 500 – 1000 additional bats and would be suitable as year round (non-breeding) roost sites. Eighteen potential alternative roosts within nightly flight range (50km) for Large Bent-winged Bats have been identified. Many of these are suitable only for individuals or small numbers of bats. At least six are capable of accommodating 50 – 500 Large Bent-winged Bats and would be suitable as roost sites year round. <b>Southern Myotis</b> : At least three known alternative maternity roosts within nightly flight range (10 - 12 km) at the Pacific Highway Bridges over Twelve Mile Creek and Grahamstown Drain and Clarencetown Bridge over the Williams River. Grahamstown Drain is
		known to have capacity to accommodate an additional 50-100 Southern Myotis.

## 6.1.2. Impact Assessment

## 6.1.2.1. Construction

The proposal is likely to result in direct and indirect impacts to biodiversity from:

- removal of approximately 0.05 ha of native vegetation associated with upgrading existing access tracks
- temporary exclusion of bats from Balickera Tunnel for up to 5 months
- temporary dewatering of a section of Balickera Canal
- modification to bat roosting habitat within Balickera Tunnel
- disturbance from noise, lighting and dust
- greater susceptibility to weeds, pests, competition and disease.

The two TECs within the study area do not occur within the proposal area. The TECs are located outside of the Hunter Water fenced area that contains the existing access tracks that will be used for the proposal. As such, no impacts to these TECs are expected to occur.

No threatened flora species were recorded within the proposal area. An area of habitat for *Pterosylis chaetophora* in close proximity to the proposal area will be demarcated and fenced as a no-go-zone during construction to ensure no impacts to this habitat area occur.

Twelve threatened fauna species were identified as known or likely to occur within the study area and have potential to be affected by the proposal. Detailed assessment in accordance with the CERs and Tests of significance (Section 7.3 of the BC Act) for these species concluded that the proposal was likely to result in a significant impact to the following threatened microbat species that roost in the tunnel:

- Little Bent-winged Bat
- Southern Myotis
- Large Bent-winged Bat

The tests of significance concluded that the proposal was unlikely to result in a significant impact to the other threatened species assessed:

- Eastern False Pipistrelle
- Eastern Coastal Free-tailed Bat
- Koala
- Grey-headed Flying-fox
- Little Lorikeet
- White-bellied Sea-Eagle
- Powerful Owl
- Grey-crowned Babbler (eastern subspecies)
- Masked Owl.

Offsets required to compensate for the residual direct impacts of the proposal to native vegetation have been calculated using the BAM Credit Calculator (BAM-C) in accordance with the Biodiversity Assessment Method (BAM). The offsets required offsets are:

- Ecosystem credits
  - PCT1588: Grey Ironbark Broad-leaved Mahogany Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast – 1 credit

- Species Credits
  - Southern Myotis 1 credit
  - White-bellied Sea-Eagle 1 credit
  - Koala 1 credit.

The required offset will be achieved by retiring all credits as calculated by the BAM-C in accordance with the Biodiversity Offsets Scheme under the BC Act.

MNES protected under the EPBC Act have been identified on and near the site. Significance Assessments were undertaken for the following threatened fauna species known or likely to occur in the study area and with potential to be impacted by the proposal:

- Koala listed as Vulnerable under the EPBC Act
- Grey-headed Flying-fox listed as Vulnerable under the EPBC Act.

The assessments concluded that no significant impact to MNES is expected to occur as a result of the proposal, as such an EPBC Referral is not required.

Detailed mitigation measures for biodiversity, including the Microbat Management Plan, are included within the SIS. A summary of the recommended mitigation measures is included in Section 7.

# 6.1.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Tunnel condition inspections would be undertaken with procedures developed to minimise impacts to microbats roosting within the tunnel. Operation of the proposal is not likely to have any significant impacts on biodiversity.

# 6.2. Soils and Geology

## 6.2.1. Existing Environment

Pells Consulting undertook a Geotechnical and Hydraulic Advice and Risk Assessment in 2015, which noted that small cobbles becoming dislodged from the conglomerate rock mass over time could fall and injure or kill. Sections of the tunnel have been previously lined with concrete as part of canal construction. In these sections the concrete lining is to be cleaned and shotcrete lining is to be applied, with new concrete lining and inverts to be cast. In currently unlined tunnel zones, the exposed rock face will be mapped by a site geologist geotechnical engineer and support will be applied as required consisting of rock bolting or shotcreting based upon prevailing conditions. It is anticipated that these works will improve the useful life and slow the rate of erosion and degradation of the tunnel. Construction works will be designed to meet specific load factors as outlined within GHD's preliminary design report (GHD, 2021).

# 6.2.1.1. Geology

The study area is predominately located on Carboniferous age geological units with a small portion of the upstream section of the study area, in the vicinity of the Balickera Pumping Station, located on Quaternary age alluvial terrace deposits. The tunnel is located within two geological units, the Eagleton Volcanics and the Mount Johnstone Formation (GHD, 2021). The Eagleton Volcanics make up the western section of the tunnel and is comprised of an interlayered volcanic and sedimentary rock sequence of rhyodacite, ignimbrite, rhyolitc lavas and tuff. The Mount Johnstone formation makes up the eastern section of the tunnel and is predominantly comprised of massive tillitic conglomerate with minor beds of shale and tuffaceous sandstone. A high degree of variability in the thickness of individual rock units should be anticipated due to the nature of how these volcanic and sedimentary rocks were formed (GHD, 2021).

# 6.2.1.2. Tunnel Condition

Within the unlined section of the tunnel, some dykes and weathered zones of Rhyodacite were left unlined, the location of the lined and unlined sections of tunnel are shown in Figure 9 and Figure 10. The majority of the unlined conglomerate sections of the tunnel are unsupported and have experienced degradation since completion of construction (Pells Consulting, 2015). It is noted that loosened pebbles and cobbles in these sections poses workplace safety concern (Pells Consulting, 2015). The zones of the tunnel that are lined are assumed to represent a poorer quality of rock either as a result of blast damage, alteration/weathering, or in-tact rock strength reduction along flow contact with country rock (GHD, 2021).

## 6.2.1.3. Soils

The study area is located within the Hexham Swamp, Medowie, Nungra and Ten Mile Road soil landscapes outlined in Table 7 below and presented in Figure 8 (NSW Department of Land and Water Conservation, 1995).

Soil Landscape	Description
Hexham Swamp	The Hexham Swamp landscape is typified by broad, swampy, estuarine backplains on the Hunter delta. The landscape is predominantly used for cattle grazing, with small areas of Hexham Swamp occupied by Shortland sewage treatment works and some manufacturing/light industrial areas. The landscape has a local relief of below 2 m and elevation to 2 m. The soil matrix present consists of

#### Table 7: Soil landscapes within the study area

Soil Landscape	Description
	deep (>200 cm), waterlogged Humic Gleys. Limitations include flood hazard, permanently high watertable, seasonal waterlogging, foundation hazard, ground water pollution hazard, localised tidal inundation, highly plastic potential and acid sulphate soils of low fertility.
Medowie	The Medowie landscape is characterised by gently undulating low hills on relict sediments in the Medowie Lowlands region. It consists of very broad, flat crests and long, gently inclined sideslopes, with elevation of 30–70 m and local relief to 30 m. The soil types present include deep (>150 cm), well-drained red and yellow Structured Loams on deeply weathered clay deposits and moderately deep to deep (60–>200 cm), well-drained Red Podzolic Soils, and deep (200–>300 cm) Yellow Podzolic Soils, with some shallow well-drained Lithosols on sandy/ pebbly deposits with clay lenses. Limitations include seasonal waterlogging, water erosion hazard, strongly acid soils with low inherent fertility and high potential aluminium toxicity.
Nungra	The Nungra landscape consists of widespread gently inclined footslopes and drainage plains of the Medowie Lowlands and Karuah Mountains physiographic regions. The area is mostly cleared tall open-forest and is predominantly used for cattle grazing. Dominant soil materials consist of greyish yellow brown weakly pedal silty loam, bleached hardsetting silty clay loam, and greyish yellow brown mottled silty clay. Some limitations of the landscape include water erosion hazard, localised salinity, high run-on, seasonal waterlogging, localised flood hazard and foundation hazard.
Ten Mile Road	The ten-mile road landscape is characterised by undulating low hills on carboniferous sediments and acid volcanics in the Medowie Lowlands and Clarencetown Hills regions. Local relief is 40–80 m while elevation is 70–150 m. Soil types consist of moderately deep (55 cm) to deep (>200 cm), well to imperfectly drained brown Soloths, yellow Soloths, and shallow (<45 cm), well-drained Bleached Loams/Lithosols. Limitations include high water erosion hazard, localised shallow soils, high run-on and seasonal waterlogging and strongly to extremely acid soils of low fertility.



Figure 8: Soil landscapes within the study area



Douglas Partners (DJD) measured approximate chainage from the downstream portal using a 'cotton reel tape'. They recorded their chainages at the edges of certain portions of concrete lining which allows approximate correlations with the chainages measured form the upstream portal.

Figure 9: As Constructed Records of Lining and Geology Pt 1 (Pells Consulting, 2015)



Massive, infrequent joints, no rockfalls

Douglas Partners ( DJD) measured approximate chainage from the downstream portal using a 'cotton reel tape'. They recorded their chainages at the edges of certain portions of concrete lining which allows approximate correlations with the chainages measured from the unstream portal

some block fallout

Figure 10: As Constructed Records of Lining and Geology Pt 2 (Pells Consulting, 2015)

4 jt sets, calcite, no rockfalls

## 6.2.2. Impact Assessment

# 6.2.2.1. Construction

The works proposed for the construction of access tracks will require vegetation removal and excavation, including soil disturbance and movement of machinery within the proposal area. The access tracks will be backfilled with graded earth material that is free from topsoil, organic matter, oversize materials, silt and other deleterious matter, and will be placed evenly to avoid differential soil pressures (Hunter Water, 2021).

Excavation and exposure of soil has potential to promote erosion of soils and sedimentation of waterways and drains that may impact adjacent watercourses. Mitigation measures which would be implemented to reduce erosion and sediment impacts are provided in Section 7 which aim to minimise the volume of exposed soil, time of exposure, and potential runoff into nearby water bodies. Dust may be generated during vehicle movements to and from the Proposal and during earthworks.

The proposal will have a negligible impact on landform, geology and soils within the study area as the tunnel being reinforced. Additionally, the access tracks only requiring grading and a 150mm layer of fill to be applied which poses a minimal risk of sedimentation and erosional impacts.

# 6.2.2.2. Operation

Operation of the proposal would not have any impacts to landform, geology or soils as no impacts below the ground surface will occur during infrequent maintenance activities.

The potential impacts of erosion and sedimentation is expected to be minor with the implementation of mitigation measures in Section 7.

# 6.3. Contaminated Land and Acid Sulphate Soils

# 6.3.1. Existing Environment

A search of the NSW EPA Contaminated land register on 19 May 2021 did not identify any registered contaminated sites within the suburb of Balickera. There are no current or previous contamination notices that apply within the study area. There was no obvious indication of gross contamination (i.e. staining, odours or distressed vegetation) noted on the soil surface during the field survey.

This does not however eliminate the risk of contaminated soils occurring within the site. Given the site is located a long distance from developments, it is unlikely that gross contamination exists or that any existing contamination would pose a risk to human health or the environment. However, illegal dumping may have occurred within the area.

A review of databases in accordance with clause 7.1 of the Port Stephens LEP 2013 (ePlanning Portal) and the Office of Environment and Heritage (OEH) 2017 mapping indicated that the study area is located in an environment that has been mapped as containing Class 5 Acid Sulphate Soils (ASS) (Figure 11). Acid Sulfate Soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent class 1, 2, 3 or 4 lands. Works in a Class 5 area that are likely to lower the water table below 1 metre AHD on adjacent class 1, 2, 3 or 4 land may encounter ASS.

Left undisturbed, ASS do not present any risk. But when they are exposed to air, the iron sulfides they contain react with oxygen to create sulfuric acid. This acid can make metals in the soil more soluble which can have detrimental effects, particularly on waterways and aquatic life, where rainfall can wash acid and toxic metals into waterways. Once formed, sulfuric acid can also significantly impact geology and man-made structures such as those within the tunnel.



Figure 11: Mapped Acid Sulfate Soils in relation to the study area

# 6.3.2. Impact Assessment

# 6.3.2.1. Construction

Excavation to a depth which may potentially disturb ASS is not required for this scope of works, and fill will be used on constructed access tracks which will minimise the potential for exposure. Within the tunnel, there is no risk of the disturbance of ASS as the works will only require the reinforcement and restoration of existing infrastructure. No excavation will be required for this portion of the works. Construction of the proposal would not involve excavating to below 1 m AHD where there would be potential to impact ASS. Construction of the proposal is unlikely to disturb ASS within the study area.

There would be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials. Spill containment would be used at ancillary sites to contain spills and spill response procedures would be followed. These impacts would generally be temporary.

If contaminated sediments are suspected such as through visual assessment, odorous smells or evidence of seepage within the study area, further surveys should be undertaken to assess the risk.

Use of hazardous chemicals will be required to undertake the works. Chemicals such as fuel and oil for the running of machinery will be used. The potential environmental impacts associated with the proposal that relate to contamination include:

- Pollution of the surrounding area from chemical spills (e.g. fuel or oil from machinery and storage)
- Incidental discovery of contaminated materials.

# 6.3.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal is not likely to result in any impacts relating to contaminated land or ASS.

Mitigation measures have been provided in Section 7 to address and mitigate any impacts associated with the incidental discovery of soil contamination and accidental chemical spills.

# 6.4. Waterways and Aquatic Habitat

# 6.4.1. Existing Environment

The Balickera Canal is mapped as a first and second order stream within the study area, within the Williams River catchment. The canal is used to transfer water from the Williams River and discharges to Grahamstown Dam located to the south of the site. The Dam is an off-river storage source that supplies up to 40% of the region's drinking water (Hunter Water, 2021). The length of the canal within the study area has been highly modified, with the canal and tunnel excavated out to facilitate the transfer of water. There is likely poor fish passage between the Williams River and Grahamstown Lake due to the pumping station and long dark tunnel that would be both a physical and behavioural barrier to fish passage. The Protected Matter Search Tool (PMST) was used on the 19<sup>th</sup> of January 2021 with a 10 km radius of the study area. No threatened fish species were recorded within 10 km of the site.

At the upstream extent of the study area, the canal is a straight channel with banks sloping at approximately 45° away from the bed. Vegetation within the channel is limited to grassy and herbaceous exotic species and the bed of the channel is predominantly rock rubble (Figure 12). This area of the canal is dry when the pumping station upstream is not operating. The channel bed at the entrance to the Balickera Tunnel on the upstream side was also mainly rock rubble and is considered poor aquatic habitat (Figure 13). The banks of the channel in this area were vertical and comprised of natural rock excavated to form the channel.

The bed of the Balickera Tunnel is unable to be safely surveyed, however historical photos taken during the tunnel's construction between 1958 and 1960 show the bed of the tunnel as highly disturbed and consisting predominantly of rock rubble (Figure 14). It is unlikely that this section of the study area provides good aquatic habitat, and fish would be deterred by a long dark environment if exploring for passage.

The downstream reach of the study area is an area where water backs up from Grahamstown Dam when dam water levels are high. When water levels are low (Figure 15), the Canal can be seen as a straight, narrow channel excavated out at the base of steeply sloping rock banks. When water levels in the Canal are high the water is generally still and has been observed to be densely covered in floating macrophytes such as *Azolla* sp. was observed on the water's surface.

Habitat modelling completed by NSW Fisheries (Riches et al, 2016) identified the Williams River upstream of the study area as suitable habitat for the Southern Purple Spotted Gudgeon (*Mogurnda adspersa*), listed as an Endangered species under the FM Act. While this species occurs in a variety of watercourse types, cover in the form of aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks or snags are important habitat for the species (DPI, 2017). Due to the highly disturbed nature of the aquatic habitat in the Balickera Canal and Tunnel and the lack of instream features that would provide quality habitat, it is considered unlikely that this species would be found in the study area.



Figure 12: Balickera Canal near the upstream extent of the study area, looking south



Figure 13: The upstream entrance to Balickera Tunnel, looking south east





Figure 14: Balickera Tunnel during construction (Pells Consulting, 2015)

Figure 15: Downstream extent of study area, looking south west



Figure 16: Waterways and Key Fish Habitat in relation to the study area

#### 6.4.2. Impact Assessment

### 6.4.2.1. Construction

### Temporarily blocking fish passage

As part of the tunnel stabilisation works, there would be the need to ensure that the immediate works area is dry. This will require installing a coffer dam on the downstream side of the tunnel to prevent water from Grahamstown Dam backing up into the works area to create the dry works area. This coffer dam would obstruct fish passage through the site, however the long dark tunnel would not be an attractive passage for fish.

DPI Fisheries were contacted in June 2021 regarding necessary approvals under the FM Act for the proposal and advised that obstruction of fish passage in mapped KFH requires approval from DPI Fisheries under s199 of the FM Act.

### Degradation of water quality

There is the potential for sediment and waste material generated as part of the works to enter the waterway. Sediment and waste material entering the channel would increase turbidity of the water and potentially introduce chemicals. This could then lead to degraded water quality within the Canal and in downstream environments, including Grahamstown Dam. Erosion and sediment controls should be in place within the immediate works area and downstream prior to instream works commencing to prevent sediment and waste material entering the water column and achieve no visible turbid plumes. Provided that appropriate water quality management measures are implemented as discussed in Section 7, construction of the proposal is not expected to have significant impacts on water quality.

### Impact to threatened aquatic species

Impacts on threatened aquatic fauna, including the Purple Spotted Gudgeon, during the construction stage of the proposal are unlikely to be significant. The pumping station also contributes to being a significant barrier to fish migration from the Williams River.

With the implementation of mitigation measures included in Section 7, the proposal would result in a minimal residual risk to surface water quality.

### 6.4.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. The potential impacts of operation on existing aquatic habitat are expected to be minor.

# 6.5. Aboriginal Heritage

Aboriginal heritage assessment has been conducted in accordance with the due diligence code of practice as set out in the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (hereafter referred to as 'CoP') (DECCW 2010). This due diligence process determines whether Aboriginal objects will be harmed by the proposal, as required under Part 6 of the NPW Act. The CoP sets out the reasonable and practicable steps which individuals and organisations need to take in order to:

- Identify whether or not Aboriginal objects are, or are likely to be, present in an area
- Determine whether or not their activities are likely to harm Aboriginal objects (if present)
- Determine whether an Aboriginal Heritage Impact Permit (AHIP) from the Department of Industry, Planning and Environment (DPIE) is required, and/or further assessment is required.

The Aboriginal heritage due diligence and cultural heritage assessment comprised:

- A search of the Aboriginal Heritage Information Management System (AHIMS) database maintained by DPIE to establish if there are any previously recorded Aboriginal objects or places within the study area
- A search of the NSW State Heritage Register, the Australian Heritage Database, and the Port Stephens Local Environment Plan 2013 Schedule 5 (Environmental Heritage) in order to determine if there are any sites of Aboriginal significance or sensitivity located within the study area
- Desktop review of relevant previous archaeological assessments to understand the local archaeological context and assist in predicting the likely occurrence of unrecorded archaeological sites or objects
- Site inspection to assess landscape features and survey the potential for previously unidentified archaeological items and sites.

Consultation with the Aboriginal community was not undertaken as part of this assessment. The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* states that 'consultation with the Aboriginal community is not a formal requirement of the due diligence process'. The Port Stephens DCP was also reviewed and consultation with the Aboriginal community is not a requirement of the local government.

# 6.5.1. Existing Environment

Searches of the Australian Heritage Database (AHD), the State Heritage Register (SHR) and the Port Stephens LEP 2013 were conducted on 29 January 2021.

No Aboriginal places listed under the AHD, SHR or the Port Stephens LEP were identified within the study area. Database Search

A search of the AHIMS database was conducted on 21 January 2021 (Appendix A). The search parameters consisted of GDA, Zone: 56, Eastings: 386716 – 389333, Northings: 6383297 – 6385487 with a buffer of 200 metres. Three previously recorded Aboriginal sites were identified within this search area (Table 8; Figure 27), none of these are located within the study area.

Table	8:	AHIMS	database	search	results

Site ID	Site Name	GPS Coordinates	Site Type
38-4-0533	Seaham Quarry	387552E, 6383989N	Artefact
38-4-0534	Seaham Quarry	387714E, 6384076N	Artefact

Site ID	Site Name GPS Coordinates		Site Type
38-4-1190	Balickera PAD 1	386965E, 6385160N	Potential Archaeological Deposit, Artefact

## 6.5.1.1. Former Land Use and Disturbance

A desktop assessment of the study area was conducted to determine the likelihood of previously unrecorded Aboriginal artefacts or areas of Aboriginal archaeological sensitivity being present.

The CoP states that further investigation in the form of a visual inspection must be conducted if activities are proposed to be:

- Within 200 metres of waters, or
- Located within a sand dune system, or
- Located on a ridge top, ridge line or headland, or
- Located within 200 metres below or above a cliff face, or
- Within 20 metres of or in a cave, rock shelter, or a cave mouth and is on land that is not disturbed land.

The definition of disturbed land is as follows:

"Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes the remain clear and observable" Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks)

construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks' (DECCW 2010).

Although the study area is located within 200 metres of water, the drainage channel is artificial, and would constitute a disturbed landscape

## 6.5.1.2. Field Survey

A site inspection of the study area was conducted by ELA Senior Archaeologist Tyler Beebe on 1 February 2021. The site inspection involved a pedestrian survey of the northern and southern study areas. No Aboriginal objects or areas or archaeological potential were identified.

The study area was found to be highly disturbed by the construction of the tunnel, drainage line, pumping station infrastructure and access roads, resulting in a heavily modified landscape. All areas of exposure were inspected for the presence of Aboriginal objects, none were identified.

The level of disturbance observed across the study area (Figure 17 to Figure 26) makes it highly unlikely that intact Aboriginal archaeological sites are present.



Figure 17: Construction spoil



Figure 19: Maintenance track (drainage line is down slope to the right)



Figure 18: Modified slope landscape



Figure 20: Further modified slope



Figure 21: Existing drainage infrastructure



Figure 22: Typical encountered soil exposure



Figure 23: Modified landscape (view to the south with drainage line to the right)



Figure 24: Artificial dam in background with evidence of scraping in foreground



Figure 25: Modified landscape (view to the north with drainage line on the left)



Figure 26: Evidence of scraping and mounding within proposed laydown area



Figure 27: Mapped AHIMS sites in relation to the study area

## 6.5.2. Impact Assessment

### 6.5.2.1. Construction and operation

The level of disturbance observed within the study area makes it highly unlikely that intact Aboriginal archaeological sites are present. Therefore, construction and operation of the proposal are not likely to have a significant impact on the aboriginal cultural heritage of the study area.

However, mitigation measures listed in Section 7 will be implemented to minimise potential impacts.

# 6.6. Non Aboriginal Heritage

# 6.6.1. Existing Environment

A search of the following heritage databases was carried out on 21 January 2021:

- World Heritage List
- Nation Heritage List
- Commonwealth Heritage List
- NSW State Heritage Register
- NSW State Heritage Inventory
- Port Stephens LEP (2013)
- Hunter Water Heritage Assets.

The results of the searches indicate that there are three heritage items listed within the vicinity of the study area. Two are located immediately within the study areas and are is identified as the 'Grahamstown - Balickera Pumping Station' and the associated 'Grahamstown Canal'. Both are listed as heritage items under Section 170 of the Heritage Act 1977, which is a listing by a State Agency (Hunter Water). The third heritage item is listed under Schedule 5 of the Port Stephens LEP 2013; Conservation Item 13 'Balickera House' and is located in the property adjacent to the north western edge of the study area. The house itself is approximately 450 m south west of the study area. It is listed as being located at 303 Italia Road, Balickera NSW. Figure 28 illustrates the location of each non-Aboriginal heritage item. The Grahamstown Canal heritage item is not mapped but the listing includes the entire Balickera Canal and Balickera Tunnel.

The statement of significance on the SHR identifies Grahamstown - Balickera Pumping Station as "Balickera Pumping Station is the major pumping station for the Grahamstown Scheme, the last major expansion of the Hunter water supply. The massive steel framed and metal clad building is well-designed and, through continual upgrading, continues in service for its original function."

Historical notes (courtesy of the SHR listing):

A two storey rectangular industrial building constructed with a metal frame and clad in corrugated metal. Above the main entrance is the Hunter District Water Board crest and below metal lettering stating "BALICKERA PUMPING STATION 1964". In the 1962-63 Annual Report it was noted that all concrete works for the pumping station structure, as well as installation of all structural steel work and all pipe work had been completed. The installation of internal stairways, access platforms and ladders were 80% completed by the close of the 1962-63 year. The installation of the Control Room flooring was completed during December 1962, and erection of the framework of the superstructure building construction of the Bulkhead Gate structure commenced in January 1963. All works associated with the Balickera Rising Mains were finished during this year, with the exception of the bypass pipeline and final painting, and excavations and trimming for the Balickera Trashrack structure commenced.

The S170 Register for Grahamstown Canal states in its description that the item extends from the Williams River to the Balickera Pumping Station and includes the 1200m Balickera Tunnel. It is primarily significant for its function within the Grahamstown Scheme rather than for its fabric.

Historical notes (courtesy of the SHR listing):

The Grahamstown Moors had a catchment area covering more than 78 square kilometres, and for years it had been known that a large amount of water could be impounded at the site. The local catchment however, was inadequate to cater for the demands of the region, posing a significant challenge in regards to its exploitation as a storage site. The scheme proposed by Vattenbyggnadsbyran provided for fresh water to be drawn from the Williams River near Seaham and conveyed by open canals and a tunnel to the storage dam constructed on the moors, formed by constructing an embankment across the natural depression.

Once collected, this fresh water would be conveyed by open canal for approximately 3 miles to a pumping station at Balickera, where the water would be lifted 15 meters before gravitating towards the dam through a 1200m long tunnel cut through a high ridge between the sites. The water would then feed into an outlet canal that delivered it to Grahamstown Dam.

The statement of significance on the SHR identifies Balickera House as "farmhouse built using convict labour circa 1830".

Historical notes (courtesy of the SHR listing):

"In 1828, Lt William Caswell received a grant of 1920 acres in three sections at East Seaham that he named Balickera. This land was without river frontage. He also received 50 acres for a homestead site at Port Stephens, 14 miles from Balickera. He also received almost 600 acres at Salt Ash, mid-way between Port Stephens and Balickera. Caswell's family moved to Port Stephens to live, at first in a small cottage and then at Tanilba House (1837). The family lived here until the severley depressed times of the early 1840's. However during the previous 15 years, Caswell and his convict workforce made a success of mixed farming. Caswell had a farmhouse built at Balickera and the properties were managed together. In 1844 economic necessity led to the family moving to Balickera. This was due to the depressed times, prolonged drought and the phasing out of convict farm workers. William Caswell took a significant role in the Raymond Terrace community between 1844 and 1859. William Caswell returned to England for a visit in 1859 after 15 years at Balickera and a previous 15 years at Tanilba. A sale disposed of all their furniture and effects and Balickera with garden and vineyard was advertised to let. Much of the cultivated land was already let in small farm lots to tenant farmers. William died during a sea voyage and Susan did not return to Australia. Balickera was let to tenant until 1897 when it was sold to Frederick Reid. He was the son of Alexander Reid, a settler/farmer of Washpool who came to the Stroud area as a result of the AA Company's land sale and settlement scheme of the late 1840's. Frederick Reid had a large pastoral property in the Gloucester district and used the Balickera property to fatten cattle prior to sale. He lived here. Frederick Reid died in 1926. Today, his grandson and family occupy Balickera. In recent years Balickera property has been extensively modified by Hunter Water Board activity."

Heritage Listing	Listing Title	Listing No.	Gazette Date
LEP	Port Stephens LEP 2013	13	23 December 2013
Heritage Act - s.170 NSW State agency heritage register	Grahamstown - Balickera Pumping Station	3630048	19 August 2010
Heritage Act - s.170 NSW State agency heritage register	Grahamstown Canal	363011	12 September 2010

#### **Table 9: Listed Heritage Items**

### 6.6.2. Impact Assessment

### 6.6.2.1. Construction

During construction the greatest potential impact on the locally listed heritage items is related to the vibrating roller rolling the access tracks. However, this piece of plant only has potential to cause cosmetic damage to buildings within 25m of operation. Balickera House is located approximately 500m away from the nearest extent of the study area, therefore it is considered that there are no potential impacts on this heritage item from the proposal. Access tracks are in closer proximity to Grahamstown - Balickera Pumping Station and at the closest will operate at approximately 30m from the heritage item. This is considered a safe distance, however mitigation measures listed in Section 7 will be implemented to minimise impacts.

Visually there are no impacts on the heritage item as works are confined to maintenance works to existing infrastructure and will not change the amenity of the location.

The S170 register lists the Grahamstown Canal's primary significance as function rather than its fabric. As such improvements to the tunnel which will improve the function of the canal is not considered a heritage impact.

### 6.6.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal is unlikely to result in any impacts to heritage items.



Figure 28: Mapped Historic Heritage Items in relation to the study area

# 6.7. Noise and Vibration

A Noise and Vibration Assessment (NVIA) was undertaken by EMM Consulting (2021). The NVIA quantifies and outlines the potential impacts of noise and vibration associated with the proposal. The findings of this assessment are outlined below.

# 6.7.1. Existing Environment

The NVIA was prepared with reference to the methods outlined in:

- NSW Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPfl)
- NSW Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG)
- NSW Department of Environment and Conservation (DEC) 2006, Assessing Vibration: a technical guideline
- Australian Standard AS 2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

In order to determine applicable noise management levels (NMLs), the following assessment locations were used to consider potential impacts to noise and vibration receivers (Table 10). These locations are presented in relation to the study area on Figure 29.

#### Table 10: Assessment locations (from EMM, 2021)

ID	Address	Type/description	Easting	Northing
R1	16 Italia Road, Balickera NSW	Residential	388836	6383503
R2	209 Italia Road, Balickera NSW	Residential	386842	6384603
R3	241 Italia Road, Balickera NSW	Residential	387333	6385154
R4	267 Italia Road, Balickera NSW	Residential	387263	6385431
R5	299 Italia Road, Balickera NSW	Residential	387147	6385699
R6	303 Italia Road, Balickera NSW	Residential	386570	6385180

In order to determine the level of impact of the works, the following applicable minimum rating background noise levels (RBLs) were adopted from the Noise Policy for Industry (NSW EPA, 2017). These RBLs represent those typical for a sparsely populated, rural location and are presented in Table 11.

Table 11: Adopted RBLs (from EMM, 2021)

Time of day	Minimum rating background noise level (dBA)
Day	35
Evening	30
Night	30

Notes: 1. Day: 7 am–6 pm Monday to Saturday; 8 am–6 pm Sundays and public holidays; Evening: 6 pm–10 pm; Night: Remaining periods.



GDA 1994 MGA Zone 56

Figure 29: Noise Assessment Locations

As such, construction noise management levels (NML) (Table 12Table 12) for assessment locations are based off the adopted RBLs stipulated above and are developed in accordance with the Interim Construction Nosie Guideline (NSW DECC, 2009).

Table 12: Construction NMLs	(from EMM, 2021)
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Assessment location	Period <sup>2, 3, 4</sup>	RBL <sup>1</sup> , dB	NML, L <sub>Aeq,15 minute</sub> , dB
All residential assessment locations	Day (Standard hours)	35	45 75 (Highly affected)
	Day (Outside of standard hours)	35	40
	Evening	30	35
	Night	30	35

Notes:

- 1. Minimum RBL as per the NPfl.
- 2. Standard hours is 7 am-6 pm Monday to Friday, 8 am to 1 pm Saturday.
- 3. Outside of standard hours is 6 pm to 7 am Monday to Friday and 1 pm Saturday to 7 am Monday.
- 4. Day: 7 am–6 pm Monday to Saturday; 8 am–6 pm Sundays and public holidays; Evening: 6 pm–10 pm; Night: Remaining periods.

Potential for night-time sleep disturbance from maximum noise level events was considered based on guidance provided in the Noise Policy for Industry (NSW EPA, 2017). Sleep disturbance criteria for the residential assessment locations are shown in Table 13.

Table 13: Maximum noise level event screening criteria

Assessment location	Assessment period1	RBL, dB	Maximum noise level event screening criteria, dB	
			L <sub>Aeq,15</sub> minute	L <sub>Amax</sub>
All residential assessment locations	Night	30	40	52

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 14.

Table 14: Acceptable VDV for intermittent vibratior	(from	EMM,	2021)
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Location	Day				Ni	ght	
	Preferred value m/s1.75	e, Maximum m/s1.75	value,	Preferred m/s1.75	value,	Maximum m/s1.75	value,
Critical areas	0.10	0.20		0.10		0.20	
Residences	0.20	0.4		0.13		0.26	
Offices, schools, educational institutions, and places of worship	0.40	0.80		0.40		0.80	
Workshops	0.80	1.60		0.80		1.60	

Location	Day	Night
Notes:	1. Day is 7 am to 10 pm and night is 10 pm to 7 am.	

### 6.7.2. Impact Assessment

### 6.7.2.1. Noise

## Construction

Construction noise emissions were predicted at all assessment locations, presented in Table 12 and Figure 29, with respect to three works stages; the north track maintenance works, south track maintenance works and the tunnel restoration works.

In order to determine predicted noise levels, the following noise modelling assumptions were made:

- All construction plant is conservatively assumed to operate continuously in any 15 minute period
- All construction plant for tunnel works are assumed to operate within the first 25 m inside the tunnel
- Track maintenance work is assumed to be conducted separately to tunnel works
- All vehicle movements are 20 km/hr or less.

The construction noise predictions are summarised in Table 15.

#### Table 15: Construction noise predictions

Scenari	io		Assessment locations	Period	Predicted maximum construction noise level, (dB)	Scenario	Assessment locations
North works	track	maintenance	R1	Day	<20	45	Nil
			R2	Day	41	45	Nil
			R3	Day	54	45	+9
			R4	Day	47	45	+2
			R5	Day	42	45	Nil
			R6	Day	39	45	Nil
South works	track	maintenance	R1	Day	43	45	Nil
			R2	Day	21	45	Nil
			R3	Day	24	45	Nil
			R4	Day	23	45	Nil
			R5	Day	21	45	Nil
			R6	Day	<20	45	Nil
Tunnel	restorat	tion works	R1	Day	37	45	Nil
				Day (OOH)	37	40	Nil
				Evening/Night	37	35	+2

Scenario	Assessment locations	Period	Predicted maximum construction noise level, (dB)	Scenario	Assessment locations
	R2	Day	37	45	Nil
		Day (OOH)	37	40	Nil
		Evening/Night	37	35	+2
	R3	Day	53	45	+8
		Day (OOH)	53	40	+13
		Evening/Night	53	35	+18
	R4	Day	42	45	Nil
		Day (OOH)	42	40	+2
		Evening	42	35	+7
	R5	Day	41	45	Nil
		Day (OOH)	41	40	+1
		Evening	41	35	6
	R6	Day	35	45	Nil
		Day (OOH)	35	40	Nil
		Evening/Night	35	35	Nil

Noise emissions associated with the southern track maintenance works are predicted to comply with NMLs at all locations during standard construction hours. For northern track maintenance works, an exceedance of up to 9 dB of the relevant NML is predicted to occur at 241 Italia Road, Balickera and an exceedance of up to 2 dB at 267 Italia Road, Balickera. During tunnel restoration works, an exceedance of up to 8 dBA is predicted to occur at 241 Italia Road, Balickera.

Outside of standard hours, exceedances are predicted at all assessment location, excluding 303 Italia Road, Balickera. However, given that the above predictions assume all construction equipment operating simultaneously, it is likely that actual construction noise levels would be less than those predicted.

Proposed night construction works are likely to primarily generate constant, steady-state noise. Modelling of intermittent noise events during the night-time construction periods was considered and indicated that maximum noise events are predicted to be below the maximum screening criteria of 52 dB at all assessment locations, with the exception of 241 Italia Road, Balickera where this may be exceeded at a level of 62 dB. However, external noise levels in the order of 60 – 65 dB are deemed unlikely to cause awakening effects.

The noise assessment has taken a conservative approach, this means the predicted noises levels in the assessment are likely to be higher than what is generated by the construction process. The assessment indicates that there is potential for noise sensitive receivers to be impacted by construction noise. However, whilst there is potential for construction activities to generate noise impacts at sensitive

receivers, all reasonable and practical mitigation management measures provided in Section 7 will be implemented during construction to minimise noise impacts.

### Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to change existing operation noise levels.

# 6.7.2.2. Vibration

### Construction

The main construction activities with potential to generate vibration include rock bolting and vibratory rollers when undertaking track maintenance. Recommended safe working distances for cosmetic damage to buildings and human discomfort are presented in Table 16Table 16.

Plant Item	Rating/description	Safe Wor	king Distance
		Cosmetic Damage	Human Response
		(BS 7385)	(BS 6472)
Vibratory Roller	<50 kN (typically 1–2 tonnes)	5 m	15 to 20 m
	<100 kN (typically 2–4 tonnes)	6 m	20 m
	<200 kN (typically 4–6 tonnes)	12 m	40 m
	<300 kN (typically 7–13 tonnes)	15 m	100 m
	>300 kN (typically 13–18 tonnes)	20 m	100 m
	>300 kN (>18 tonnes)	25 m	100 m
Rock Drill	Small	5 m	20 m
Small hydraulic hammer	(300 kg - 5 to 12 tonne excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg - 12 to 18 tonne excavator)	7 m	23 m
Large hydraulic hammer	(1,600 kg - 18 to 34 tonne excavator)	22 m	73 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Table 16: Recommended safe	working distances	for vibration i	ntensive plant
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Source: Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects) (2007).

Plant Item	Rating/description	Safe Working Distance	
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Notes: 1. Plant and equipment items are indicative to illustrate safe working distances, not all plant items will be used during the proposed works.

The nearest residential facades are located approximately 300 m from the proposed works. Based on the assumed construction equipment list, the risk of cosmetic damage to structures and human comfort response is low given relevant safe-working distances of greater than 100 m.

A number of site-specific noise and vibration mitigation and management measures have been provided in Section 7 to further reduce noise and vibration impacts of the works.

### 6.7.2.3. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to generate vibration impacts.
## 6.8. Air Quality

## 6.8.1. Existing Environment

Th Boral operates a quarry adjacent to the study area. The quarry sources and process hard rock for aggregate production which results in dust emissions to the local area. A previous air quality assessment was undertaken by Pacific Environment Limited for the quarry in 2017 (PEL, 2017), which estimated that the site generates an average of 1.8g/m2/month of dust depositions a month. The quarry has an EPL for its operation but is not required to monitor dust levels.

Emissions from motor vehicles, including farm machinery, quarry plant and vehicle use associated with motorsports at the nearby Ringwood Park Motor Complex would be the primary source of air pollutants within the study area. The impact of this source is considered minimal due to the low population density and relatively low traffic volumes. Also, emissions from agricultural activities within the area may periodically affect air quality (slashing, ploughing, harvesting).

The air quality monitoring station located closest to the study area is approximately 30 km southwest of the site, in Beresfield. The National Environment Protection Measure sets maximum goals or standards a number of pollutant types. Generally, air quality within the Lower Hunter region would be considered good, with the number of annual exceedances for various pollutant types being less than 10 since 2015.

## 6.8.2. Impact Assessment

## 6.8.2.1. Construction

Construction of the proposal has the potential to impact local air quality due to:

- Dust generation from,
  - Clearing and grubbing of vegetation
  - Earthworks to form the accessway
  - Aeolian transport from stockpiles (if any) during dry and windy conditions
- Emissions from fuel burning vehicles and equipment.

It is considered that the resulting additional exhaust emissions and associated odour from this activity will be negligible. This determination considered that any additional impacts are negligible when compared to the emissions associated with other activities in the locality i.e. the quarry, agriculture and motorsports, as well as general vehicle movements on the Pacific Highway. Implementation of mitigation measures in Section 7 would further minimise air quality impacts.

## 6.8.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to generate air quality impacts.

## 6.9. Waste Management

## 6.9.1. Existing Environment

No significant sources of waste are present within the study area. Some wastes may exist in the surrounding study area associated with agricultural activities of local residents and their domestic waste. Some minor groundwater seepage may also occur through the tunnel due to degradation.

## 6.9.2. Impact Assessment

## 6.9.2.1. Construction

The proposed works are not expected to generate a significant volume of waste. However, some may be produced during the construction phase, potentially including:

- Excess spoil from earthworks
- Vegetation waste from clearing of vegetation
- Minor spills from hazardous fuel and chemical use
- General waste from staff and contractors.

Potential impacts from waste generation may include pollution of the environment and the Balickera Canal from chemical spills and general wastes. In order to ensure that no wastes from construction can enter the water supply, a dry works area will be established through the installation of a coffer dam within the downstream section of the study area.

If any excess sediment is to be taken offsite for disposal or reuse, material should be tested to ensure it is safe for re-use or disposed of in accordance with Environmental Protection Authority Waste Classification Guidelines EPA (2014). If contamination is suspected, contact the Construction Project Manager.

The following waste management principles, in order of priority, shall be used in the delivery of this project:

- Avoid the use of excess materials and production of waste
- Reuse waste materials on site where possible or on alternative projects
- Recycle waste
- Dispose of waste correctly at an appropriately licensed waste facility. All excess/waste materials shall be disposed of in accordance with all regulatory and EPA NSW requirements.

Removal and appropriate disposal of general waste generated by the contractors during the proposed works is the responsibility of the contractors. Further mitigation measures are provided in Section 7.

## 6.9.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to change existing waste levels.

## 6.10. Traffic

## 6.10.1. Existing Environment

The proposal is located next to Italia Road and would be accessed from Italia Road, Balickera. Italia Road is a local road and is under the management of Port Stephens Council. Italia Road experiences a relatively low traffic density, with typical road users consisting primarily of workers accessing the pumping station and Boral Quarry. Due to the low population density within the study area, use by local residents is infrequent, and access to the Ringwood Park Motor Sports complex is largely subject to held events.

## 6.10.2. Impact Assessment

## 6.10.2.1. Construction

There is potential for construction to impact traffic on Italia Road. Impacts may include increased traffic from construction vehicles and in particular, heavy vehicle movements. It is unlikely that partial or full road closures will be required due to the works area being located outside of the alignment of any roads. Any traffic impacts will be temporary and short term and the implementation of mitigation measures will minimise traffic impacts.

It is recommended that notification be given to individual landowners existing in close proximity to the works area to ensure that any potential disruptions to local road users are minimised, particularly with regard to the Ringwood Park Motor Complex and Boral Quarry.

## 6.10.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal is not likely to generate traffic impacts.

## 6.11. Visual Amenity and Landscape

## 6.11.1. Existing Environment

The study area is located in an area that is predominantly located within a vegetated area adjacent to the Wallaroo State Forest. The Pacific Highway is located approximately 400 m east of the study area and a number of large lot acreage properties that have been converted to agricultural land exist near the upstream extent of the study area.

Businesses located near the study area include the Ringwood Park Motor Complex, which provides club members with an opportunity to participate in motorsports activities. As such, the area is defined by cleared roads and dirt tracks.

## 6.11.2. Impact Assessment

## 6.11.2.1. Construction

Visual impacts will occur during the construction phase of the project. Excavated ground, environmental control measures, stockpiles and construction compounds will reduce the visual amenity of the area during construction. However, public access to construction areas will be limited, and construction works will be constrained to areas that have been the subject of previous, historical disturbance.

Minor vegetation clearance (0.05 ha) will be required in order to facilitate the works; however, this will only occur in one location to modify an existing access track, and this is in an area not visible to the public.

## 6.11.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to generate visual impacts.

## 6.12. Socio-Economic

## 6.12.1. Existing Environment

The study area is located in the suburb of Balickera in the Port Stephens LGA. At the time of the 2016 census, Balickera had a small population of 27, a median age of 37 and an average of 3.7 people per household. The suburb is typically characterised by agricultural activities. Businesses located near the study area include the Boral Quarry and the Ringwood Park Motor Complex, which provides club members with an opportunity to participate in motorsports activities.

The Grahamstown Dam is the Lower Hunter region's largest drinking water supply dam, providing 40% of water to the region and meeting up to 75% of its daily supply requirements (Hunter Water, 2021). The Grahamstown Dam is classified as an off-river storage facility which stores raw water that's pumped from the Williams River through the Balickera Canal and tunnel and into the dam's northern end.

## 6.12.2. Impact Assessment

## 6.12.2.1. Construction

During construction there is the potential for noise, air quality, traffic and visual impacts on surrounding receivers. However, these are temporary in nature and are unlikely to affect the operation of local businesses. It is unlikely that road closures will be required as the works are located outside of the alignment of any roads. Although traffic may increase from construction vehicles and heavy vehicle movements, access to local businesses and private residences will be maintained.

As the tunnel is essential for providing a significant proportion of the water supply of the Lower Hunter region, its structural condition and operating performance has direct economic and social implications. Once operational, the improvement of the tunnel will therefore have a positive socio-economic impact for the Lower Hunter region by ensuring the long-term viability of an existing critical asset.

In addition, assuming that construction contractors and materials are sourced from local businesses where possible, there will be positive impacts to the local economy in this regard.

## 6.12.2.2. Operation

Operation of the proposal will involve resumption of normal use of the Balickera Canal and Tunnel for water transfer from the Williams River to the Grahamstown Dam and tunnel condition inspections every five years. Operation of the proposal does not involve activities likely to result in negative socio-economic impacts.

## 6.13. Cumulative Impacts

In accordance with clause 228 of the EP&A Regulation, any cumulative environmental effects of the project associated with other existing and likely future activities must be considered in determining the potential impacts of the project on the environment.

Future cumulative impacts to the area will need to be considered taking into account the construction of the proposed future Stone Ridge Quarry Project located at Italia Road, Balickera. However, it is unlikely that timeframes for these projects will overlap. If an overlap is predicted, access will be undertaken from different areas.

## 7. Mitigation Measures

#### Table 17: Recommended mitigation measures for the proposal

Impact	Safeguards/Mitigation Measures	Timing	Responsibility
General	• Prepare a Construction Environmental Management Plan (CEMP) prior to any construction works to address measures to be adopted to minimise impacts on the environment as a result of the proposal.	Prior to construction	Project Manager
Biodiversity	<ul> <li>Pre-works briefing to be undertaken by Hunter Water environmental representative, advising of sensitive areas and relevant safeguards for these areas</li> <li>Implement Microbat Management Plan (Appendix J of the SIS)</li> <li>Install alternative microbat roosting habitat (bat boxes) prior to works, in accordance with the Microbat Management Plan</li> <li>Extent of works for access track upgrades to be clearly demarcated prior to works to avoid damage to vegetation not proposed for removal</li> <li>No-go zone to be fenced in potential <i>Pterostylis chaetophora</i> habitat near upstream portal</li> <li>The CEMP must include requirement for a qualified ecologist to be present for preclearance surveys of native vegetation for access track upgrades</li> <li>The CEMP must include instructions for dealing with orphaned or injured native animals and include the contact details for the NSW Wildlife Information, Rescue and Education Service Inc (WIRES)</li> <li>Wash down all equipment and vehicles prior to entry and before leaving site, to manage the introduction and spread of weed propagules</li> <li>Procedures to minimise impacts to microbats roosting in the tunnel during operational tunnel condition assessments are to be developed prior to any inspections.</li> </ul>	Prior to and during construction	Project Manager All Staff/Contractors
Soil Erosion and Sedimentation	<ul> <li>The Sediment and Erosion Control Plan is to be prepared in accordance with <i>The Blue Book – Managing Urban Stormwater: Soils and Construction</i> (Landcom 2004) and implemented prior to works, with the aim of achieving an outcome of 'no visible turbid plumes migrating through the waterway'. The Plan must include, but not be limited to:         <ul> <li>Locations and type of instream sediment controls to be erected downstream of the tunnel. These can be constructed from hay bales or sandbags and lined with geofabric; however, they must be secured in the channel to ensure they do not mobilise</li> <li>Prior to forecast heavy rain, work is to cease, accumulated material is to be removed from within the instream sediment controls and then these are to be removed from the waterway to prevent them from being mobilised and causing a flood hazard or other environmental damage downstream</li> </ul> </li> </ul>	Prior to and during construction	Project Manager All Staff/Contractors

#### Balickera Tunnel - Review of Environmental Factors | Hunter Water Corporation

Impact	Safeguards/Mitigation Measures	Timing	Responsibility	
	<ul> <li>Works area within the tunnel and canal should be dewatered prior to works commencing to reduce likelihood of sediment entering the waterway. As part of dewatering the works area, any fish caught in the dewatering process must be immediately released downstream of the site by an experienced aquatic ecologist.</li> <li>Inspect erosion controls regularly (daily during workdays) and after rainfall. Fix damaged controls immediately. Remove accumulated sediment or waste material from within the sediment controls regularly and dispose of at a licensed waste facility</li> <li>Leave erosion and sediment controls in place until after the works are completed</li> <li>Where works are required outside of the tunnel, schedule the works outside of predicted heavy rain periods</li> <li>Minimise work outside of the tunnel during heavy rainfall to reduce risk of mobilising sediment</li> <li>Where vegetation on the banks of the Canal is removed, the area should be stabilised with jute matting and revegetated as soon as possible, with ongoing maintenance of the areas to ensure survival of planted vegetation.</li> </ul>			
Soil Contamination	<ul> <li>If contaminated soils are uncovered during the works, all works within the vicinity of the find must cease immediately and the Hunter Water Project Manager and must be notified immediately</li> <li>For any excess spoil material which requires offsite disposal, formal waste classification will be required before being taken to an appropriately licensed landfill in accordance with the EPA (2014) Waste Classification Guidelines</li> <li>Store all chemicals (e.g. fuel, oil) in appropriate bunding/storage systems within the approved storage facility</li> <li>Ensure appropriate spill kits are carried with the equipment</li> <li>Dedicated refuelling areas are to be established outside of the canal and riparian zones. These areas are to bunded to ensure any spills do not enter the canal.</li> </ul>	During construction	Project Manager All Staff/Contractors	
Water Quality and Hydrology	<ul> <li>Weather forecasts will be checked daily to ensure that work is not carried out before or during high rainfall</li> <li>Prior to use at the site and/or entry into the waterway, machinery is to be appropriately cleaned, degreased and serviced</li> <li>Store all chemicals (e.g. fuel, oil) offsite and if required to be stored onsite, chemicals should be stored in appropriate bunding/storage systems and only for short periods</li> <li>Ensure appropriate spill kits, are present onsite</li> <li>Ensure all equipment is in good working order</li> <li>Carry associated Safety Data Sheets (SDS) for all chemicals</li> <li>Do not use any chemicals that are labelled as 'harmful to marine life' or 'Class 9 Environmentally hazardous' as part of the proposed activities</li> </ul>	During construction	Project Manager All Staff/Contractors	

#### Balickera Tunnel - Review of Environmental Factors | Hunter Water Corporation

Impact	Safeguards/Mitigation Measures	Timing	Responsibility
	<ul> <li>Any collected surface water should be discharged into a suitable Council approved drainage system and not adversely impact downslope surface and subsurface conditions (Martens 2019)</li> <li>Wash all equipment, including, erosion and sediment control measures and trailers to prevent spread of exotic species. A visual check for vegetation and seeds on all equipment machinery to be used in the activities must be carried out before work commences.</li> </ul>		
Aboriginal Heritage	<ul> <li>All contractors undertaking works on site should be briefed on the protection of Aboriginal heritage objects under the NPW Act, and the penalties for damage to these items</li> <li>Contractors will be made aware through toolbox talks, inductions and training that it is an offence under Section 86 of the NPW Act to harm or desecrate an Aboriginal object unless that harm or desecration is the subject of an AHIP (which is not applicable to this site)</li> <li>Should an unexpected Aboriginal object be identified during construction, work in the immediate vicinity of the find is to stop and the area must be fenced off with suitable markers (star pickets, flagging or barrier mesh). The Hunter Water Project Manager is to be notified. Engage an archaeologist to determine the significance of the find, and if required, determine the notification, consultation, and approval requirements. Works must not recommence until Hunter Water has provided written approval to do so</li> <li>If human remains are discovered, works should immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the DPIE may also be contacted at this time to assist in determining appropriate management.</li> </ul>	Prior to and during construction	Project Manager All Staff/Contractors
Historic Heritage	<ul> <li>The vibrating roller must not be operated within 25m of the heritage item known as 'Grahamstown - Balickera Pumping Station'</li> <li>In accordance with Section 146 of the <i>Heritage Act 1977</i>, if an archaeological relic (such as a deposit or artefact) is uncovered during works, work must cease in the affected area and a qualified archaeologist contacted to assess the find. Further advice and clarification may be sought from the Heritage Council of NSW, or the Heritage Division under delegation regarding assessment and approvals.</li> </ul>	During construction	Project Manager All Staff/Contractors
Noise and Vibration	<ul> <li>Implement the following work practices:         <ul> <li>regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration</li> <li>regular identification of noisy activities and adoption of improvement techniques</li> <li>avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents</li> <li>developing routes for the delivery of materials and parking of vehicles to minimise noise</li> <li>minimising the movement of materials and plant and unnecessary maximum noise events</li> <li>minimising vehicle movements</li> </ul> </li> </ul>	During construction	Project Manager All Staff/Contractors

Impact	Safeguards/Mitigation Measures	Timing	Responsibility
	<ul> <li>choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks</li> <li>using temporary noise barriers to shield intensive construction noise activities from residences</li> <li>operating plant and equipment in the quietest and most efficient manner</li> <li>regularly inspecting and maintaining plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively</li> <li>scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events</li> <li>optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours</li> <li>include contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.</li> </ul>		
	• Hunter Water can use the following method to mitigate impacts to noise sensitive receivers during work outside of standard hours. Hunter Water and construction contractor can determine most appropriate course of action.		
	<ul> <li>Respite periods: Construction works during evening and night-time periods would be restricted so that assessment locations R1 – R5 are impacted for no more than three consecutive evenings and no more than two consecutive nights in any one week. A minimum respite period of four evenings/five nights would be implemented between periods of consecutive evening and/or night works</li> </ul>		
	<ul> <li>Duration reduction: Where respite periods are not reasonable or feasible, the number of consecutive evenings and/or nights would be increased and the duration of the activity each night reduced. Impacted receivers would be consulted and evidence of support for the duration reduction provided as justification</li> </ul>		
	<ul> <li>Alternative accommodation: Where respite periods and reductions in duration are not agreed to, alternative accommodation options would be considered for evening and night-time periods where construction works are likely to incur highly intrusive impacts. Alternative accommodation would provide a replacement for permanent residents, including provisions for pets, where reasonable and feasible</li> <li>Resident agreement: Where respite periods and reductions in duration are not agreed to, Hunter</li> </ul>		
	Water may develop an agreement with residents where noise could not be mitigated to meet the night-time noise level. The form and content of such an agreement would be determined through consultation between the parties.		
Air Quality	Works must be minimised during high wind periods	During construction	Project Manager

• Dust suppression should be applied as required to limit excessive dust generation

#### Balickera Tunnel - Review of Environmental Factors | Hunter Water Corporation

Impact	Safeguards/Mitigation Measures	Timing	Responsibility	
	<ul> <li>Plant and equipment must be regularly inspected to ascertain that fitted emission controls are operating efficiently</li> <li>Plant and equipment must be maintained in accordance with manufacturer's specifications to ensure that it is in a proper and efficient condition</li> <li>Do not have machinery running while not in use</li> <li>Minimise use of machinery for required activity only</li> <li>Vehicles to maintain recommended speed</li> <li>Look for excessive dust generation and slow down if needed.</li> </ul>		All Staff/Contractors	
Waste Management	<ul> <li>Resource management options for the project must be considered against a hierarchy of the following order embodied in the Waste Avoidance and Resource Recovery Act 2001:         <ul> <li>Avoid unnecessary resource consumption</li> <li>Recover resources (including reuse, reprocessing, recycling and energy recovery)</li> <li>Dispose (as a last resort).</li> </ul> </li> <li>All wastes and excess spoil must be classified in accordance to the Waste Classification Guidelines (EPA, 2014) prior to disposal and transported to a licensed waste disposal facility</li> <li>All waste must be removed from the site on completion of the works</li> <li>Upon completion of waste disposal, all original weighbridge / disposal receipts issued by the receiving waste facility must be retained in a waste register as evidence of proper disposal</li> <li>An adequate number of bins must be placed at the site for workers and all litter will be placed in these bins. Work areas would be kept clean and free of litter, including cigarette butts, at all times.</li> </ul>	During construction	All Staff/Contractors	
Traffic	<ul> <li>Vehicles, materials and equipment must be positioned to minimise impacts to public access and parking</li> <li>Heavy vehicles, if required, will be restricted to specified routes.</li> </ul>	During construction	Project Manager All Staff/Contractors	
Visual Amenity and Landscape	<ul> <li>Ensure vegetation clearance is undertaken within delineated footprint only</li> <li>Works areas are to be cleared of plant and construction equipment and rehabilitated to pre-works condition following completion of the project.</li> </ul>	During and post construction	Project Manager All Staff/Contractors	

## 8. Conclusion

The proposal is required to secure ongoing transfer of water from Williams River to Grahamstown Dam through ensuring the long-term structural stability of the Balickera Tunnel. The Tunnel is the only means of transferring water from the Williams River to Grahamstown Dam, which constitutes the main drinking water supply for the Lower Hunter region. The failure of the tunnel could result in a reduction of 50% in yield for the Grahamstown dam. The proposal will reduce the risk of requiring expensive unplanned emergency repair/replacement works in the event of catastrophic failure. Due to these concerns and under the consideration of intergenerational equity it is deemed necessary to ensure that the drinking water supply for current and future generations of the Region is maintained through implementation of the proposal.

The potential impacts of the proposal to restore the Balickera Tunnel have been assessed in accordance with the environmental impact assessment requirements of the EP&A Act. Hunter Water is the determining authority of the proposal in accordance with Division 5.1 of the EP&A Act. Additionally Hunter Water has elected to prepare an SIS to assess likely impacts on threatened species in accordance with the Chief Executives' Requirements (CERs) from the NSW Office of Environment and Heritage (OEH) (now DPIE). The DPIE will assess the findings of the SIS and must provide concurrence prior to Hunter Water determining this REF.

This REF describes the proposal and assess the potential construction and operational impacts with consideration of the factors listed in clause 228 of the Environmental Planning and Regulation 2000. Furthermore, the REF identifies safeguards to mitigate identified impacts.

The proposed works are likely to have a significant impact on biodiversity; therefore an SIS has been prepared to assess the impacts to three microbat species that roost in the tunnel:

- Little Bent-winged Bat
- Southern Myotis
- Large Bent-winged Bat

The SIS conclusion utilises the precautionary principle as it recognises that there is uncertainty associated with the reestablishment of the microbat colonies in the tunnel. As such the SIS determines the proposal has the potential to significantly impact three threatened microbat species that currently roost in the tunnel. However, detailed management and mitigation measures, including a microbat management plan, are outlined in the SIS in order to mitigate impacts to microbats.

No other significant impacts on the environment are likely to occur and as such it is not necessary for an Environmental Impact Statement (EIS) to be prepared and approval sought from the NSW Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Hunter Water is the consent authority for this proposal.

The proposal is unlikely to have a significant impact on Matters of National Environment Significance (MNES) or Commonwealth land within the meaning of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999(EPBC Act). A referral to the Australian Government Minister for the Environment is not recommended.

As the proposal will temporarily obstruct fish passage, Hunter Water will need to seek approval for the works under s199 of the FM Act.

## 9. Declaration

## 9.1. Assessor Declaration

This REF provides a true and fair review of the activity in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the project and provides sufficient information to determine whether there is likely to be a significant impact on the environment as a result of the Project.

I have considered all environmental impacts and safeguards to the best of my knowledge and have sought advice where required.

Project Name	Balickera Tunnel - Review of Environmental Factors
Project Director	
Sophie Powrie	Date: 5/8/21
Eco Logical Australia	
Level 3, 101 Sussex Street, Sydney 2000	
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## References

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# Appendix A Aboriginal Heritage Information Management System Search



AHIMS Web Services (AWS) Search Result

Purchase Order/Reference : 18722 Client Service ID : 562749

Date: 21 January 2021

Eco Logical Australia Pty Ltd - Sydney - Individual users PO Box 12 668 Old Princes Hwy Sutherland New South Wales 1499

Attention: Tyler Beebe

Email: tylerb@ecoaus.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA. Zone : 56. Eastings : 386716 - 389333. Northings : 6383297 - 6385487 with a Buffer of 200 meters. conducted by Tyler Beebe on 21 January 2021.

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:

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

	Office of Environment & Heritage	AHIMS Web Services Extensive search - Site list r	(AWS) eport							Your Re Client	ef/PO Number : 16722 Service ID : 562749
SiteID	SiteName		Datum	Zone	Easting	Northing	Context	Site Status	<u>SiteFeatures</u>	<u>SiteTypes</u>	Reports
38-4-0533	Seaham Quarry		AGD	56	387552	6383989	Open site	Valid	Artefact : -	Isolated Find	
	Contact		Recorders	Meg	an Mebberso	n			Permits		
38-4-0534	Seaham Quarry		AGD	56	387714	6384076	Open site	Valid	Artefact : -	Isolated Find	
	Contact		Recorders	Мер	an Mebberso	n			Permits		
38-4-1190	Balickera PAD 1		GDA	56	386965	6385160	Open site	Valid	Potential Archaeological Deposit (PAD) : 1, Artefact : 1		
	Contact		Recorders	Doc	tor.Alan Will	iams,Doctor.Al:	an Williams		<u>Permits</u>	3260,3344	

Report generated by AHIMS Web Service on 21/01/2021 for Tyler Beebe for the following area at Datum :GDA, Zone : 56, Eastings : 386716 - 389333, Northings : 6383297 - 6385487 with a Buffer of 200 meters. Additional Info : Aboriginal Due Diligence. Number of Aboriginal sites and Aboriginal objects found is 3

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Page 1 of 1

## Appendix B Noise and Vibration Assessment



## **Balickera Tunnel Restoration**

Noise and Vibration Impact Assessment

Prepared for Eco Logical Australia July 2021

EMM Newcastle Level 3, 175 Scott Street Newcastle NSW 2300

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www.emmconsulting.com.au

## **Balickera Tunnel Restoration**

Noise and Vibration Impact Assessment

DevertNursher	
H210068 RP#1	
Client	
Eco Logical Australia	
Date	
15 July 2021	
Version	
v1 Final	
Prepared by	Approved by

Durrer

Andrew Durrer Acoustic Consultant 15/07/2021

MSC

Katie Teyhan Associated 15/07/2021

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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## 1 Introduction

## 1.1 Project overview

Balickera Tunnel (the Tunnel) is located in the Hunter Valley on the NSW mid North Coast and is owned and operated by Hunter Water Corporation (Hunter Water). The Tunnel is used to provide pumped raw water from the Williams River at Seaham Weir through Balickera pumping station to Grahamstown Dam which is used as an offriver storage facility. The Balickera pumping station is designed to transfer flows from the River's very high flow periods that would otherwise just make their way out to sea. On average, half of the inflow to Grahamstown Dam is pumped from the Williams River. Water stored in Grahamstown Dam is accessed at George Schroder Pump Station for supply to customers.

The tunnel was originally constructed between 1958 and 1960 using drill and blast methods. The tunnel is partly concrete lined (for a total of approximately 380 m of the 1200 m long tunnel) and partly rock bolted. Recent inspections by Douglas Partners (June 2007) and a further review by Pells Consulting (Jan 2015) have determined that there is no useful life left in the rock bolts, but there is at least a further 5 to 15 years in the concrete lined sections. Hunter Water wish to rehabilitate the tunnel and improve its structural condition to meet a 100 year design life requirement and to improve the operating performance. It is proposed to replace the existing rock bolts in the unlined sections and install a new shotcrete/concrete lining in the lined sections. The proposed rehabilitation measures are to be confirmed as part of the detailed design.

## 1.2 Project location

The project is in the Port Stephens LGA, in central Newcastle and Hunter region of NSW. The nearest residents to the project are located along Italia Road on both the northern and southern inlets and outlets of the tunnel. Balickera tunnel feeds water from the Williams River (west of Balickera Tunnel) into the northern end of the Grahamstown Dam. The existing Grahamstown Dam is the Hunter's largest drinking water supply dam, providing 40% of water to the region and meeting up to 75% of the daily supply requirements.

The project construction footprint includes access track works, tunnel restoration works, west access track and cofferdam works.

## 1.3 Purpose of this report

This noise and vibration impact assessment (NVIA) presents an assessment of the potential noise and vibration impacts from the proposed works on the surrounding community and provides recommendations regarding appropriate mitigation and management measures. It has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies.

Several technical terms are required for the discussion of noise and vibration. These are explained in the glossary.

## 1.4 Assessment guidelines and requirements

The NVIA has been prepared with reference to the methods outlined in:

- NSW Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPfI);
- NSW Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG);
- NSW Department of Environment and Conservation (DEC) 2006, Assessing Vibration: a technical guideline; and
- Australian Standard AS 2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

## 2 Existing noise environment

## 2.1 Assessment locations

Sensitive receivers which have the potential to be affected by noise from the proposed works are mainly residential receivers (hereafter referred to as assessment locations) surrounding the project area. Assessment locations used for the purpose of this assessment are presented in Table 2.1 and shown on Figure 2.1.

## Table 2.1 Assessment locations

ID	Address	Type/description	Easting	Northing
R1	16 Italia Rd, Balickera NSW	Residential	388836	6383503
R2	209 Italia Rd, Balickera NSW	Residential	386842	6384603
R3	241 Italia Rd, Balickera NSW	Residential	387333	6385154
R4	267 Italia Rd, Balickera NSW	Residential	387263	6385431
R5	299 Italia Rd, Balickera NSW	Residential	387147	6385699
R6	303 Italia Road, Balickera NSW	Residential	386570	6385180

## 2.2 Background and ambient noise levels

In order to determine applicable noise management levels, background noise levels have been determined following methodology outlined in the Noise Policy for Industry (NPfI). As the surrounding environment in the project region is sparsely populated and rural, the applicable minimum rating background noise levels (RBLs) have been used for the purpose of this assessment and are provided in Table 2.2.

## Table 2.2Adopted RBLs

Time of day	Minimum rating background noise level (dBA)
Дау	35
Evening	30
Night	30

Notes: 1. Day: 7 am-6 pm Monday to Saturday; 8 am-6 pm Sundays and public holidays; Evening: 6 pm-10 pm; Night: Remaining periods.



GDA 1994 MGA Zone 56 N

## 3 Assessment criteria

## 3.1 Construction noise

The Interim Construction Noise Guideline (ICNG) suggests the following time restrictions for construction activities where noise is audible at residential premises:

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- No construction work on Sundays or public holidays.

These are recommended standard hours for construction activity and these time restrictions are the primary management tool of the ICNG. Table 3.1, reproduced from the ICNG, provides noise management levels for residential receivers during and outside of the recommended standard construction hours.

## Table 3.1 ICNG residential criteria

Time of day	Management level L <sub>Aeq,15 minute</sub>	How to apply		
Recommended standard hours:	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise.		
Monday to Friday 7 am to 6 pm		• Where the predicted or measured L <sub>Aeq(15min)</sub> is greater than the noise affected level, the proponent should apply all feasible and reasonable		
Saturday 8 am to 1 pm		work practices to meet the noise affected level;		
No work on Sundays or public holidays		<ul> <li>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>		
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise.		
		<ul> <li>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:</li> </ul>		
		<ul> <li>times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; and</li> </ul>		
		<li>ii) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li>		
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours.		
		The proponent should apply all feasible and reasonable work practices to meet the noise affected level.		
		Where all feasible and reasonable practices have been applied and noise is more than 5 dB (A) above the noise affected level, the proponent should negotiate with the community.		

Note:

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

In summary, the noise goals for residences provided in the ICNG are:

- 10 dB above the existing background levels (RBL + 10 dB) for standard construction hours; and
- 5 dB above the existing background levels (RBL + 5 dB) outside of the standard construction hours, if works are justifiable.

The construction noise management levels (NMLs) for the assessment locations presented in Table 3.2 are based on the background noise levels provided in Section 2.2 and in accordance with the ICNG.

## Table 3.2 Construction NMLs

Assessment location	Period <sup>2, 3, 4</sup>	RBL <sup>1</sup> , dB	NML, L <sub>Aeq,15 minute</sub> , dB
All residential assessment locations	Day (Standard hours)	35	45 75 (Highly affected)
	Day (Outside of standard hours)	35	40
	Evening	30	35
	Night	30	35

Notes: 1. Minimum RBL as per the NPfl.

2. Standard hours is 7 am-6 pm Monday to Friday, 8 am to 1 pm Saturday.

3. Outside of standard hours is 6 pm to 7 am Monday to Friday and 1 pm Saturday to 7 am Monday.

4. Day: 7 am-6 pm Monday to Saturday; 8 am-6 pm Sundays and public holidays; Evening: 6 pm-10 pm; Night: Remaining periods.

## 3.2 Maximum noise level event assessment

The potential for night-time sleep disturbance from maximum noise level events has been considered based on guidance provided in the NPfI.

The NPfI requires that a detailed maximum noise level event assessment be undertaken where the development night-time noise levels at a residential location exceed:

- LAeq,15 minute 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L<sub>Amax</sub> 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels (L<sub>Amax</sub>) below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels (L<sub>Amax</sub>) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies that a facade, including a partially open window, will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence are unlikely to cause awakening affects.

Table 3.3 provides the sleep disturbance criteria for the residential assessment locations based on the results of ambient noise monitoring.

### Table 3.3 Maximum noise level event screening criteria

Assessment location	Assessment period <sup>1</sup>	RBL, dB	Maximum noise level event screening criteria, dB	
			L <sub>Aeq,15</sub> minute	L <sub>Amax</sub>
All residential assessment locations	Night	30	40	52

Notes: 1. Night: 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sundays and public holidays.

## 3.3 Construction vibration

## 3.3.1 Human comfort

### i Overview

*Environmental Noise Management – Assessing Vibration: a technical guideline* (DEC 2006) (the guideline) is based on advice contained within the British Standard BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80 Hz).

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines vibration types and provides direction for assessing and evaluating the applicable criteria. Vibration-generating activities associated with the project include bulk earthworks and rock-bolting. Hence, of relevance to this assessment is intermittent vibration only due to the nature of the proposed activities.

### ii Intermittent vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz. The acceptable VDV for intermittent vibration are reproduced in Table 3.4.

#### Night Day Location Preferred value. Maximum value. Preferred value. Maximum value. m/s<sup>1.75</sup> m/s<sup>1.75</sup> m/s<sup>1.75</sup> m/s<sup>1.75</sup> Critical areas 0.10 0.20 0.10 0.20 Residences 0.20 0.4 0.13 0.26

### Table 3.4 Acceptable VDV for intermittent vibration

## Table 3.4 Acceptable VDV for intermittent vibration

	D	ау	Night		
Location	Preferred value, m/s <sup>1.75</sup>	Maximum value, m/s <sup>1.75</sup>	Preferred value, m/s <sup>1.75</sup>	Maximum value, m/s <sup>1.75</sup>	
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80	
Workshops	0.80	1.60	0.80	1.60	

Notes: 1. Day is 7 am to 10 pm and night is 10 pm to 7 am.

There is a low probability of adverse comment or disturbance to building occupants at VDV below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

## 3.3.2 Structural vibration criteria

Most commonly specified "safe" structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks and are set well below the levels that have potential to cause damage to the main structure.

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 – 2006 Explosives - Storage and Use - Use of Explosives recommends the frequency dependent guideline values and assessment methods given in the British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2 be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting, piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 3.5 and shown in Figure 3.1.

## Table 3.5 Transient vibration guide values - minimal risk of cosmetic damage

Line Type of building		Peak component particle velocity in frequency range of predominant pulse		
		4 Hz to 15 Hz	15 Hz and above	
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above	

The standard states that the guide values in Table 3.5 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.



### Figure 3.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequencies where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 3.5, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculations indicate that the magnitude and number of load reversals are significant (in respect to the fatigue life of building materials), the guide values in Table 3.5 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS 2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Figure 3.1.

It is noteworthy that extra to the guide values nominated in Table 3.5, the standard states that:

Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

Also that:

A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

## 3.4 Construction blasting

Construction blasting is not required during the restoration works and as such vibration impacts due to blasting have not been considered.

## 4 Noise assessment methodology

## 4.1 Overview

This section presents the methods and base parameters used to model and assess noise emissions from construction activity associated with the restoration works.

Quantitative modelling of construction noise was carried out using the ISO9613 algorithms within DGMR Software *iNoise*. This software calculates total noise levels at receptors from the concurrent operation of multiple noise sources. The model incorporates factors such as:

- the lateral and vertical location of plant and equipment;
- source-to-receptor distances;
- ground effects;
- atmospheric absorption;
- topography; and
- meteorological conditions.

Three-dimensional digitised ground contours of the site and surrounding land were incorporated to model topographic effects. Equipment was modelled at locations and heights representative of a typical scenario. The model was used to predict noise levels at each of the assessment locations identified in Table 2.1. The modelling results were then compared against the relevant noise levels described in Chapter 3, to determine potential impacts.

## 4.2 Modelling scenarios for construction operations

The modelling scenarios were based on recommended construction methodologies outlined in GHD's *Preliminary Design report* (16 April 2021) and information supplied by Eco Logical Australia. Proposed plans for the north and southern access track works along with the supplied tunnel construction methodologies have been used to calculate noise levels from the proposed activities. Multiple scenarios were modelled in order to understand representative noise emissions at the surrounding receptors for the various activities. Standard working hours (weekdays) are required for the compound, access track and the temporary cofferdam. Estimated duration for these secondary works are 3-4 weeks. Tunnel restoration works are expected to occur 24 hours per day, 7 days per week for a minimum total of 8 weeks.

The scenarios are summarised as follow:

- Scenario 1 includes northern track maintenance works for the daytime period.
- Scenario 2 includes southern track maintenance works for the daytime period.
- Scenario 3 includes tunnel maintenance works for the daytime standard hours, day (OOH) and evening/night-periods. Tunnel works were assumed to occur within 25 m of both tunnel entrances simultaneously to represent an acoustically worst case scenario. Front end loader is modelled to be operating outside the tunnel along with a generator.

## 4.3 Plant and equipment items

The assessment has adopted plant and equipment sound power levels from the Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, where available. Otherwise, data was sourced from an EMM database of similar equipment which is based on measurements at other construction sites as indicated.

Sound power levels and quantities of plant and equipment adopted for each phase of work for the purpose of predicting noise levels are summarised in Table 4.1.

### Table 4.1Noise source sound power levels

Noise source	Sound power level per unit, L <sub>w</sub> , dB				
construction – Access track upgrades					
Excavator	110				
Vibratory roller	108				
Articulated dump truck (40t)	107				
Road truck (Truck & Dog)	103				
Construction - Tunnel restoration works					
Concrete truck (Agitator)	108				
Shotcrete pump	106				
Grout pump	106				
Compressor	103				
Water pump	63				
Generator	102				
Hand tools	101				
Crane (15t)	98				
Elevated work platform	94				
Excavator	110				

Not 1. Within any 15-minute period

2. These cone valves are located in a dissipation chamber, which is assumed to provide an additional 10 dB reduction in noise levels which has been included in the noise model .

## 4.4 Modelling assumptions

In addition to the sound power levels, other noise modelling assumptions are as follows:

- all construction plant is conservatively assumed to operate continuously in any 15 minute period;
- all construction plant for tunnel works are assumed to operate within the first 25 m inside the tunnel;
- track maintenance work is assumed to be conducted separately to tunnel works; and
- all vehicle movements are 20 km/hr or less.

## 5 Noise assessment

## 5.1 Construction noise

Construction noise emissions have been predicted at all assessment locations with respect to each proposed activity. Refer to Table 5.1 for a summary of the results. Predictions are for the worst-case scenario for each assessment location based on the scenarios shown in Table 5.1. The predicted noise levels have been assessed against the relevant criteria for standard construction hours (7 am to 6 pm Monday to Friday, and 8 am to 1 pm Saturday) and all periods outside of standard construction hours (OOH).

## Table 5.1 Construction noise predictions

Scenario	Assessment locations	Period	Predicted maximum construction noise level, L <sub>Aeq,15 minute</sub> , dB	NML, L <sub>Aeq,15 minute</sub> , dB	Maximum exceedance, dB
North track	R1	Day	<20	45	Nil
maintenance	R2	Day	41	45	Nil
works	R3	Day	54	45	+9
	R4	Day	47	45	+2
	R5	Day	42	45	Nil
	R6	Day	39	45	Nil
South track	R1	Day	43	45	Nil
maintenance	R2	Day	21	45	Nil
WORKS	R3	Day	24	45	Nil
	R4	Day	23	45	Nil
	R5	Day	21	45	Nil
	R6	Day	<20	45	Nil
Tunnel	R1	Day	37	45	Nil
restoration		Day (OOH)	37	40	Nil
WORKS		Evening/Night	37	35	+2
	R2	Day	37	45	Nil
		Day (OOH)	37	40	Nil
		Evening/Night	37	35	+2
	R3	Day	53	45	+8
		Day (OOH)	53	40	+13
		Evening/Night	53	35	+18
	R4	Day	42	45	Nil
		Day (OOH)	42	40	+2
		Evening	42	35	+7
	R5	Day	41	45	Nil
		Day (OOH)	41	40	+1
		Evening	41	35	6
	R6	Day	35	45	Nil
		Day (OOH)	35	40	Nil
		Evening/Night	35	35	Nil

Noise emissions from construction works associated with South track maintenance works are predicted to comply with NMLs at all assessment locations during standard construction hours. During North access track maintenance works, an exceedance of up to 9 dB of the relevant NML is predicted to occur at the nearest residential assessment location to the works (assessment location R3) and an exceedance of up to 2 dB at assessment location R4. Prediction track maintenance noise emissions at both of these locations is below the Highly Noise Affected level of 75 dB. All other assessment locations are predicted to comply with the relevant NMLs during standard hours of construction for track maintenance works.

During tunnel restoration works, an exceedance of up to 8 dBA of the relevant NML is predicted to occur at the nearest residential assessment location to the works (R3) during standard construction hours. Construction noise emissions from tunnel restoration works are predicted to comply with the relevant NML for standard construction hours at all other assessment locations.

Outside of standard construction hours, exceedances are predicted at most assessment locations; R1, R2, R3, R4 and R5. This is not unusual for such works being undertaken in a rural environment.

Given that the OOH predictions assume all equipment operating simultaneously it is likely that actual OOH construction noise levels would be less than those predicted for the majority of the time, and as such these noise level predictions can be considered conservative.

Given the likelihood of exceedance of the relevant NMLs, noise mitigation measures and application of good practice noise management has been considered. Noise mitigation measures are discussed in Section 7 of this report along with good practice management measures that would be implemented to minimise potential impacts to the surrounding community.

## 5.2 Maximum noise level events

The proposed construction activities that would occur during the night-time period are likely to primarily generate constant, steady-state noise during the night-time period. Occasional maximum noise events could be generated by front end loader bucket noise or reverse alarms. These events are unlikely to occur often and are assumed to occur intermittently through the night.

Modelling of intermittent  $L_{Amax}$  noise events during the night-time construction periods has been considered. A maximum sound power level of 122 dB was used to represent activities such as bangs associated with front-end loader operation or reversing alarms. Potential for these events was considered for the full extent of the construction area and predicted to the assessment locations. The results indicate the maximum noise events are predicted to be below the maximum screening criteria of 52 dB at all assessment locations with the exception of R3, where maximum noise events are predicted to be up to 61 dB.

As per the findings presented in the RNP, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence are unlikely to cause awakening affects. Notwithstanding, consideration should be given to appropriate operator training to promote awareness of the proximity of residential neighbours and to minimise the potential for maximum noise events at the subject site particularly during the night-time period.

## 6 Construction vibration assessment

The main construction activities with the potential to generate vibration include the rock bolt drilling operations within the tunnel structure and vibratory rollers for track maintenance.

As a guide, safe working distances for typical items of vibration intensive plant are listed in Table 6.1 for both cosmetic damage (BS 7385) and human comfort (BS 6472).

Plant item <sup>1</sup>	Rating/description	Safe working distance		
		Cosmetic damage (BS 7385)	Human response (BS 6472)	
Vibratory Roller	<50 kN (typically 1–2 tonnes)	5 m	15 to 20 m	
	<100 kN (typically 2–4 tonnes)	6 m	20 m	
	<200 kN (typically 4–6 tonnes)	12 m	40 m	
	<300 kN (typically 7–13 tonnes)	15 m	100 m	
	>300 kN (typically 13–18 tonnes)	20 m	100 m	
	>300 kN (>18 tonnes)	25 m	100 m	
Rock Drill	Small	5 m	20 m	
Small hydraulic hammer	(300 kg - 5 to 12 tonne excavator)	2 m	7 m	
Medium hydraulic hammer	(900 kg - 12 to 18 tonne excavator)	7 m	23 m	
Large hydraulic hammer	(1,600 kg - 18 to 34 tonne excavator)	22 m	73 m	
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure	

### Table 6.1 Recommended safe working distances for vibration intensive plant

Source: Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects) (2007).
 Notes: 1. Plant and equipment items are indicative to illustrate safe working distances, not all plant items will be used during the proposed works.

The safe working distances in Table 6.1 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

In relation to human comfort response, the safe working distances in Table 6.1 relate to continuous vibration and apply at residential receivers. For the proposed works, vibration emissions are intermittent and, in accordance with BS 6472, higher vibration levels occurring over shorter periods are allowed.

The nearest residential facades are located approximately 300 m from the proposed works. Based on the assumed construction equipment list, the most vibration intensive item of plant to be utilised could be a large vibratory roller. Hence, the risk of cosmetic damage is low given relevant safe-working distances of greater than 100 m.

In the first instance the guide values presented in Table 6.1 should be followed. Allowing for the known separation distances between construction activity and nearest receptors, it is unlikely that the project will cause vibration impacts at any surrounding receivers.
# 7 Mitigation and management

#### 7.1 Overview

As provided in Section 5.1, it is likely that construction noise levels will be above the relevant noise management levels at some assessment locations at times during the proposed construction activities. The ICNG states that, where this is the case, there may be some community reaction to noise and the proponent should apply all feasible and reasonable work practices with the aim to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as relevant contact details.

#### 7.2 Community consultation and notification

The community is more likely to be understanding and accepting of noise if the information provided is frank, does not attempt to understate the likely noise level, and if commitments are firmly adhered to.

Where construction noise levels are predicted to be above the applicable noise management levels, a letter will be provided to residences informing them of the nature and duration of the proposed works as well as the expected noise emission levels and contact details for relevant site personnel. These letters will be provided no later than seven calendar days ahead of commencement of the proposed activities.

A site information board will also be installed at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after-hours emergency contact details.

#### 7.3 Complaint handling and information requests

To effectively manage any requests for information or respond to any public concerns in relation to the proposed construction activities, the following systems would be maintained:

- supply the relevant governing authorities with the names and appropriate contact numbers for the site construction manager during the construction period and one other senior staff member;
- an emergency after hours contact phone number would be put in place to allow contact with the proponent in relation to any environmental matter including those concerned with noise and vibration issues;
- use a complaint handling system to monitor environmental noise and vibration complaints. All information relating to such complaints would be kept in a register. The register would include the following information:
  - date and time of complaint;
  - complainant details (ie full name, address and contact details);
  - nature and source of complaint;
  - action taken; and
  - follow-up with complainant.
- the complaint register would be made available to any relevant regulatory authority on request; and

• the requirement to respond to any complaint within one working day of its receipt would be included as a key performance indicator.

#### 7.4 Noise mitigation measures

AS 2436-2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented during the construction works are listed below.

#### 7.4.1 Universal work practices

These include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- developing routes for the delivery of materials and parking of vehicles to minimise noise;
- minimising the movement of materials and plant and unnecessary maximum noise events; and
- minimising vehicle movements.

#### 7.4.2 Plant and equipment

Additional measures for plant and equipment include:

- choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- using temporary noise barriers to shield intensive construction noise activities from residences;
- operating plant and equipment in the quietest and most efficient manner; and
- regularly inspecting and maintaining plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

#### 7.4.3 Work scheduling

Additional work scheduling measures to reduce noise include:

- scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events;
- optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours; and
- include contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

## 8 Conclusion

EMM has prepared a construction noise and vibration impact assessment for the proposed Balickera Tunnel restoration works. The assessment considered the potential for noise and vibration impacts of the proposed works and has been prepared in accordance with the methodology outlined in the NPfl, ICNG, as well as other relevant guidelines and standards.

Noise goals for the project construction activities have been established based on methodology provided in the NPfI, ICNG (and others).

Construction noise levels were assessed for the daytime and OOH periods during noise-enhancing meteorological conditions. Predictions indicate that construction noise levels are likely to comply with the noise management levels during South track maintenance works, however, are likely to be above the noise management levels at times during North track maintenance works and tunnel restoration works. This is not unexpected in rural residential areas with low background noise levels and is common for such situations. Given that the predictions assume equipment operating simultaneously it is likely that actual construction noise levels would be less than those predicted for the majority of the time. Notwithstanding, the proponent should actively manage construction noise from the site and recommended measures have been provided herein.

## Glossary

Technical terms typically utilised in a noise assessment report are explained in Table G.1.

#### Table G.1 Glossary of acoustic terms and abbreviations

Abbreviation or term	
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L <sub>A90</sub> statistical noise levels.
Amenity noise criteria	The amenity noise criteria relate to the overall level of industrial noise. Where existing levels of industrial noise (excluding the subject development) approach the acceptable amenity noise criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise.
A-weighting	There are several different weightings utilised for describing noise, the most common being the 'A- weighting'. This attempts to closely approximate the frequency response of the human ear.
CEMP	Construction environment management plan
C-weighting	There are several different weightings utilised for describing noise, with the 'C-weighted' scale typically used to assess low frequency noise and is also utilised in the assessment of occupational noise.
Day period	Monday–Saturday: 7.00 am to 6.00 pm, on Sundays and public holidays: 8.00 am to 6.00 pm.
dB	Noise is measured in units called decibels (dB).
DP&E	Department of Planning and Environment
EA	Environmental assessment
EMM	EMM Consulting Pty Limited
EP&A Act	Environmental and Planning Assessment Act 1979 (NSW)
EPA	The NSW Environment Protection Authority (formerly the Department of Environment, Climate Change and Water).
Evening period	Monday–Saturday: 6.00 pm to 10.00 pm, on Sundays and public holidays
ICNG	Interim Construction Noise Guideline
Intrusive noise criteria	The intrusive noise criteria refer to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in Section 3.1.1.
L <sub>A1</sub>	The A-weighted noise level exceeded for 1% of the time.
L <sub>A10</sub>	The A-weighted noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L <sub>A90</sub>	The A-weighted noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L <sub>Aeq</sub>	The A-weighted energy average noise level. This is the equivalent continuous sound pressure level over a given period. The L <sub>Aeq(15-minute)</sub> descriptor refers to an L <sub>Aeq</sub> noise level measured over a 15 minute period.
Linear peak, L <sub>peak</sub>	The peak level of an event is normally measured using a microphone in the same manner as linear noise (i.e. unweighted), at frequencies both in and below the audible range.
L <sub>Amax</sub>	The maximum A-weighted sound pressure level received during a measurement interval.
Night period	Monday–Saturday: 10.00 pm to 7.00 am, on Sundays and public holidays: 10.00 pm to 8.00 am.

#### Table G.1 Glossary of acoustic terms and abbreviations

#### Abbreviation or term

NMP	Noise management plan
NPfl	Noise Policy for Industry
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
PNTL	Project noise trigger level
PSNL	The project-specific noise level (PSNL) is criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive noise criteria or amenity noise criteria.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy
SEARs	Secretary's environmental assessment requirements
Sound power level (L <sub>w</sub> )	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure G.1.

#### Table G.2Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	Just perceptible
5	Noticeable difference
10	Twice (or half) as loud
15	Large change
20	Four times (or quarter) as loud





## Appendix C Matters of National Environmental Significance

Under the environmental assessment provisions of the EPBC Act, the following Matters of National Environmental Significance (MNES) and impacts on Commonwealth land are required to be considered to assist in determining whether the project should be referred to the Australian Government Department of the Environment. Table 18 addresses the MNES for the project.

MNES	Impact
Any environmental impact on a World Heritage property?	No
Any environmental impact on National heritage places?	No
Any environmental impact on RAMSAR wetlands?	No
Any environmental impact on Commonwealth listed threatened species or ecological communities?	No
Any environmental impact on Commonwealth listed migratory species?	No
Does any part of the project involve nuclear action?	No
Any environmental impact on a Commonwealth marine area?	No
Any impact on Commonwealth land?	No

#### Table 18: Consideration of Matters of National Environmental Significance

# Appendix D Clause 228 of the Environmental Planning and Assessment Regulation

Clause 228 of the EP&A Regulation sets out 16 factors that need to be considered when assessing environmental impact under Part 5, Division 5.1 of the EP&A Act. These factors are addressed in this report and relevant sections are listed in Table 19.

Claus	e 228 Factors	Impact
(a)	Any Environmental Impact on a Community?	Noise and other impacts on the community are anticipated to be minimal. The proposal will result in a positive impact on the community through maintaining water supply infrastructure which is relied on by a number of community members in the wider Lower Hunter region.
(b)	Any transformation of a locality?	No significant transformation of locality is likely as part of the works. The proposal involves the remediation of existing infrastructure. Some vegetation clearance will be required; however, this will predominantly be constrained to previously disturbed areas and will be outside of areas that are publicly accessible. Thus, the works will not significantly transform the locality.
(c)	Any environmental impact on the ecosystems of the locality?	The proposal would result in the loss of 0.05 ha of native forest habitat (PCT 1588: Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest). The proposal would also permananetly modify microbat roosting habitat within the tunnel and temporarily exclude microbats from the tunnel. A significant impact to three threatened microbat species which roost in the tunnel is likely to occur and will impact the ecosystems in the locality. Impacts to microbats would be mitigated through implementation of a Microbat Management Plan. There will be no significant impact to any other species. The overall impact of the proposal on the ecosystems in the locality is not expected to be significant if the recommended mitigation measures are followed.
(d)	Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	The proposal involves the rehabilitation of previously constructed water infrastructure and maintenance of existing access tracks. The majority of the proposed works are located in areas where the public are excluded. The upstream portion of the study area includes a public park used as a recreational area. This will be impacted during construction as it will be used as a laydown area. However, the impact is temporary and normal use will be reinstated after construction. Therefore, the proposal will not reduce aesthetic and recreational quality or value of the locality.
		A significant impact on three threatened microbat species which roost in the tunnel is likely to occur. These impacts are assessed in detail in the SIS. This has the potential to reduce the scientific and environmental quality or value of the locality. However, potential impacts to microbats are to be mitigated through implementation of a Microbat Management Plan.

#### Table 19: Clause 228 Factors

Clause 228 Factors		Impact
(e)	) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural,	Impacts on Aboriginal cultural heritage and non-aboriginal heritage items are anticipated to be non-significant if the recommended mitigation measures are followed.
historical, scientific or social significance or other special value for present or future generations?	There are no known Aboriginal heritage sites within the study area. The study area has been highly disturbed during construction of the canal and associated infrastructure. The Grahamstown - Balickera Pumping Station is located within the study area and will not be impacted by the proposal if mitigation measures excluding operation of the vibrating roller within 25m of the structure are implemented	
		The Grahamstown Canal (including the Balickera Tunnel) is a listed heritage item. The S170 register lists the Grahamstown Canal's primary significance as function rather than its fabric. As such improvements to the tunnel which will improve the function of the canal is not considered a heritage impact.
(f)	Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?	The impacts on threatened fauna has been assessed and mitigated as far as possible while allowing critical repairs to existing water supply infrastructure. A significant impact to three threatened microbat species which roost in the tunnel is likely to occur and poses a risk of degradation of the environment in relation to biodiversity. Impacts to microbats would be mitigated through implementation of a Microbat Management Plan. There will be no significant impact to any other species. In addition, the impact resulting from the loss of 0.05 ha of forest habitat as a result of vegetation removal is not likely to result in the loss or reduction in the viability of more common fauna species.
(g)	Any endangering of any species of animal, plant or other form of life whether living on land, in water or in the air?	Potential impacts on flora and fauna have been considered as part of this REF. A significant impact to three threatened microbat species which roost in the tunnel is likely to occur and poses a risk of degradation of the environment in relation to biodiversity. Impacts to microbats would be mitigated through implementation of a Microbat Management Plan. There will be no significant impact on any other threatened species or other more common fauna species.
(h)	Any long-term effects on the environment?	The project will not result in long-term impact to biophysical character of the environment, as the works are the redevelopment of an existing impact. The potential impacts to flora and fauna excluding aquatic matters, is subject to the SIS.
		through the rehabilitation of water infrastructure.
(i)	Any degradation of the quality of the environment?	The works are a continuation of previous works in an area previously modified. The overall outcome will be beneficial to the community.
(j)	Any risk to the safety of the environment?	A significant impact to three threatened microbat species which roost in the tunnel is likely to occur and poses a risk of degradation of the environment in relation to biodiversity. Impacts to microbats would be mitigated through implementation of a Microbat Management Plan.
		For other factors, a low risk to the environment is associated with the works for matters assessed in this REF. Potential for a small chemical

Claus	e 228 Factors	Impact
		spill (e.g. petrol or oil) is possible. There is a small potential for sedimentation from the works. The risk to the environment is considered minimal if the prescribed mitigation measures are adopted.
(k)	Any reduction in the range of beneficial uses of the environment?	No reduction in the range of beneficial uses of the environment will result as part of the works. The works involve rehabilitating previously existing water infrastructure and will be undertaken wholly within land that Is not publicly accessible and owned by Hunter Water. The beneficial uses of the environment will not be reduced as a result of the works.
(1)	Any pollution of the environment?	No pollution of the environment is proposed or likely. The risk is minimal if the appropriate mitigation measures are followed. Short- term noise and air quality impacts (dust and exhaust emissions) would be expected during the construction of the proposal. Management of noise and air quality impacts would be carried out in accordance with the mitigation measures
(m)	Any environmental problems associated with the disposal of waste?	Waste associated with the proposal would be managed in accordance with the Waste Avoidance and Resource Recovery Act 2001 and recycled where possible or disposed of by a license contractor at a license facility. Issues associated with the disposal of waste are not expected.
(n)	Any increased demands on resources (natural or otherwise) that are or are likely to become in short supply?	No resources that are being utilised as part of this project are likely to become in short supply. The works will ensure that the existing water infrastructure and supply is not compromised as a result of degradation.
(o)	Any cumulative environmental effect with other existing or likely future activities?	Minimal cumulative environmental effect is likely as a result of the works.
(p)	Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	There are no impacts on coastal processes or hazards that will result as part of the works.

### Appendix E Government Agency and Other Stakeholder Consultation

From:	Scott Carter
To:	Schmidt, Tom
Subject:	RE: Key Fish Habitat - Balickera Canal
Date:	Wednesday, June 23, 2021 12:11:33 PM
Attachments:	image002.png

CAUTION: This email originated from an external sender. Verify the source before opening links or attachments.

Tom

Not sure why its included as KFH to be honest, though fish do use it when its full as habitat, particularly eels.

I would not require a permit for the works as Hunter Water are a relevant public authority so a s199 approval/sign off is all that is required.

Scott Carter Senior Fisheries Manager Coastal Systems NSW Department of Primary Industries | Fisheries Port Stephens Fisheries Institute| Taylors Beach | NSW 2316 T: | E: scott.carter@dpi.nsw.gov.au

ALL MAIL TO: DPI Fisheries, Attn: R. Philps, 1243 Bruxner Hwy, Wollongbar NSW 2477

PERMIT APPLICATION FORMS & FISH HABITAT POLICIES AVAILABLE AT: https://www.dpi.nsw.gov.au/fishing/habitat/protecting-habitats/toolkit

Submit permit applications via email to: ahp.central@dpi.nsw.gov.au

Turnaround times: from date of receipt of application, please allow up to 28 days for Land Owners Consent, Permits and Consultations. Please allow up to 40 days for Integrated Development Applications.

From: Schmidt, Tom <Tom.Schmidt@ecoaus.com.au> Sent: Wednesday, 23 June 2021 11:08 AM To: Scott Carter <scott.carter@dpi.nsw.gov.au> Subject: Key Fish Habitat - Balickera Canal

Hi Scott,

I hope to get confirmation from DPI Fisheries on whether a Permit under Part 7 of the Fisheries Management Act is required for proposed works in the Balickera Canal, near Raymond Terrace, in an area mapped as Key Fish Habitat (KFH).

We (Eco Logical) are preparing a REF for Hunter Water, who propose to undertake repair work inside the 1.2km Balickera Tunnel which is part of the canal. Construction of a temporary coffer dam is required within the Balickera Canal approximately 200m downstream of the tunnel. The tunnel will then be dewatered between the coffer dam and the Balickera Pumping Station upstream of the tunnel to allow access to the tunnel.

KFH is mapped up to and including a portion of the tunnel (see attached mapping showing KFH, Strahler stream order and coffer dam location). However, Balickera Canal in this area does not appear to meet the description of KFH in the *Policy and guidelines for fish habitat conservation and management* (DPI 2013) as the canal is a second order stream. The Threatened Species Distribution maps show that Purple Spotted Gudgeon is modelled to have habitat in the Williams River upstream of the Balickera Canal, however the Williams River is separated from the Balickera Canal by the generally closed Pumping Station upstream of the tunnel.

Can you please confirm whether DPI Fisheries considers the Balickera Canal to be KFH, and whether a Permit under Part 7 of the *Fisheries Management Act* is required for the proposed temporary obstruction of fish passage?

Thanks very much, Tom

Tom Schmidt Senior Ecologist BAM Accredited Assessor

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