Appendix Q
Noise and vibration impact assessment

Billabong Creek Regulators

Noise and Vibration Impact Assessment

NSW Department of Climate Change, Energy, the Environment and Water

September 2024

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Executive Summary

Purpose of the report

This noise and vibration impact assessment has been prepared to assess the potential noise and vibration impacts associated with the proposed construction and operation of the Wanganella and Hartwood regulators, and associated works. The report is being prepared as part of the Environmental Impact Statement and has been prepared to address the relevant SEARs, issued on 8th December 2022. Potential noise and vibration impacts have been assessed in accordance with the relevant guidelines provided in the SEARs, as well as other key guidelines.

Existing environment

A total of 26 sensitive receivers have been defined in the overall study area, with:

– 4 sensitive receivers in Hartwood

– 22 sensitive receivers in Wanganella.

All identified receivers have been assumed to be residential land uses based on a desktop review using aerial imagery. This is a conservative approach as the criteria residential land uses is more stringent than non-residential land uses.

Noise monitoring has not been undertaken to determine the rating background levels (RBLs) for the assessment as it is expected that the existing background noise levels would be below the minimum RBLs prescribed in the Noise Policy for Industry (EPA 2017). The minimum assumed RBLs have been adopted in determining construction and operational noise criteria.

Construction noise and vibration impacts

Based on the proposed site layouts of each regulator, and on indicative construction activities and equipment provided, construction noise impacts were assessed to nearby noise sensitive receivers. The Hartwood Regulator has one exceedance of the standard hours NML predicted to occur (from four receivers and four construction scenarios) at H04 during power supply route construction activities. The Wanganella Regulator has a total of six exceedances of the standard hours NML predicted to occur (from a total of 22 receivers across 6 construction scenarios). The majority of these exceedances are expected to occur over a very limited period where site access upgrade works take place adjacent to receivers. W05 is the only receiver predicted to exceed the standard hours NML during construction works at the regulator site itself, with a maximum predicted exceedance of 2 dB above the NML. The exceedances at both sites range from 1 dB to 8 dB above the NML, with no exceedances of the highly noise affected level predicted. Standard construction noise mitigation measures have been recommended to reduce construction noise impacts.

An assessment of potential vibration impacts was undertaken. Safe working distances to comply with the human comfort and cosmetic damage criteria were adopted for all proposed vibration intensive equipment. Two receivers in Wanganella were identified as within 100 metres of the site access tracks and may experience human comfort impacts should a (>18 tonne) vibratory roller be used within 100 metres of the dwellings. This would be a temporary impact as the works are linear in nature and vibration levels would decrease as the construction equipment moves away from the receiver. No vibration impacts are expected to occur during works at the regulator sites. No buildings were identified within the structural damage safe working distance.

Road traffic noise impacts

To assess the potential increase in road traffic noise levels during construction, a screening assessment has been undertaken. The increase in-road traffic noise levels have been calculated using the CoRTN road traffic noise prediction method. Two receivers were identified as within the construction road traffic noise exceedance distance located near Cobb Highway, however they do not exceed the relative increase 2 dB criteria.

The maintenance required to operate each regulator would require about 20 truck visits per month for the first two years, requiring less over time. Therefore, no exceedances of the relative increase noise criteria are predicted to occur because of the operation of the regulators.

Operational noise impacts

WaterNSW would own and operate the new regulators once constructed. Based on the expected operation of the Hartwood and Wanganella Regulators, noise emissions from the sites are expected to be minimal and comparable to the existing regulator structures. Therefore, qualitative assessment has been undertaken. Based on the distance between nearby noise sensitive receivers, and the expected operational equipment on site, it is expected that operational equipment can be designed to comply with the operational noise criteria.

Cumulative noise impacts

A review of NSW state significant projects was undertaken to identify other projects, existing or proposed, that have the potential to generate cumulative impacts for sensitive receivers adjacent to either proposed regulator. One future project was identified as within a 10 kilometre radius to either site:

– Yanco Creek Modernisation Project Part1b: Wanganella Swamp (four kilometres south east from Wanganella Regulator).

Based on the proposed commencement date of the project, consecutive impacts are possible. Cumulative impacts are however, unlikely given the distance between the proposal site, the Yanco Creek Modernisation Project Part1b site, and sensitive receivers.

Glossary

Term	Description
A weighting	The human ear responds more to frequencies between 500 Hz and 8 kHz and is less sensitive to very low-pitch or high-pitch noises. The frequency weightings used in sound level measurements are often related to the response of the human ear to ensure that the meter better responds to what you actually hear.
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the Leq descriptor.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L90 descriptor.
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative impacts	The combined impacts of the proposal on a matter with other relevant future projects
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Fish passage	The ability of fish or other aquatic species to move through an aquatic system.
Fishway	Structures placed on or around constructed barriers (such as dams or weirs) to give fish the opportunity to move past the barrier.
Ground-borne vibration	Vibration transmitted from a source to a receptor via the ground.
Hertz	The measure of frequency of sound wave oscillations per second. One oscillation per second equals 1 hertz.
$L_{A10(period)}$	The noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
L_{Amax}	The absolute maximum noise level in a noise sample.
Maximum noise event	The loudest event or events within a given period of time. This is generally described using the L_{max} descriptor.
Noise management level	The Noise Management Level (NML) as defined as the EPA's ICNG. To be measured and assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the residential property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most affected point within 30 metres of the residence.
Non-compliance	Development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit (exceptions may be given if the noise level exceeds by less than 2 dB).
NPfI	*Noise Policy for Industry* (EPA, 2017).
Octave	A division of the frequency range into bands, the upper frequency limit.

Term	Description
PPV	Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.
Project noise trigger level	Target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise generating facility.
proposal site	The immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction and operation.
RBL	Rating Background Level . The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
the Regulation	Environmental Planning and Assessment Regulation 2021 (NSW)
regulator	A gated structure used to actively manage or control the amount of water that flows from one location to another.
rms	Root Mean Square Amplitude (rms) is the square root of the average of the squared values of the waveform. In the case of the sine wave, the RMS value is 0.707 times the peak value, but this is only true in the case of the sine wave.
Study area	The area investigated for this assessment which includes the proposal site and surrounding area, with the potential to be directly or indirectly affected by the proposal. Land in the vicinity of, and including, the proposal site. The ‘study area’ is the wider area surrounding the proposal site.
Temperature inversion	An atmospheric condition in which temperature increases with height above the ground.
The proposal	The construction and operation of the two regulators.
The proposal site	The area that would be directly affected by construction and the location of operational infrastructure.
Third-octave	Single octave bands divided into three parts.
VDV	Vibration dose value - As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.
Weir	A low barrier or dam that is built across a watercourse and is designed to store water, control or alter the flow of water in a creek.

Abbreviations

Abbreviations	Definitions
AHD	Australian height datum
AVTG	*Assessing Vibration: a Technical Guideline* (DEC, 2006)
CEWO	Commonwealth Environment Water Office
CNVS	*Construction Noise and Vibration Strategy* (Transport for NSW, 2019a)
CoRTN	*Calculation of Road Traffic Noise* (Delaney et al, 1975)
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water (formerly Water Infrastructure NSW)
Cwth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EIS	Environmental Impact Assessment
EPA	NSW Environment Protection Authority
DPE	NSW Department of Planning and Environment, now renamed as the Department of Planning, Housing and Infrastructure
DPIE	NSW Department of Planning, Industry and Environment (formerly known as NSW Department of Planning and Environment)
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwth)
FM Act	*Fisheries Management Act 1994* (NSW)
GL	Gigalitre
ICNG	*Interim Construction Noise Guideline* (DECC, 2009).
km^2	Square kilometres
LEP	Local environmental plan
LGA	Local government area
NPfI	*Noise Policy for Industry* (EPA, 2017)
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment
OOHW	Out-of-hours Works
RNP	*Road Noise Policy* (DECCW, 2011).
SDLAM	Sustainable diversion limit adjustment mechanism
SEARs	Secretary's environmental assessment requirements
SEPP	State environmental planning policy
SPL	Sound Pressure Level
SSI	State Significant Infrastructure
SWL	Sound Power Level

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1. Introduction

1.1 Overview

NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) is proposing to replace two existing weirs along Billabong Creek with new regulators (the proposal). The two existing weirs to be demolished are Hartwood Weir and Wanganella Weir. These are situated on Billabong Creek within the Yanco Creek system in south-west NSW (refer Figure 1.1).

These weirs were built in the early 20th century and have been used to regulate flows through Billabong Creek, create weir pools for irrigation and, in the case of Wanganella Weir, provide town water supply. The weirs are currently in states of declining condition and functionality and are barriers to the movement of fish through the creek. Their condition limits their ability to regulate flows through the Yanco Creek system and leads to inefficiencies in how water is delivered to the environment and irrigators.

The new regulators would be fully automated and remotely operable meaning that operators could control the delivery of water more efficiently. The proposal is needed to improve the ability of river regulators to deliver the right amount of environmental and productive water to the right place at the right time. The new regulators would also feature fishways to support fish movement past the new structures. WaterNSW would own and operate the new regulators once constructed.

The proposal is subject to environmental and planning approvals in accordance with the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The proposal is State significant infrastructure (SSI), and the Minister for Planning is the approval authority. An environmental impact statement (EIS) is required to accompany the application for approval of the proposal.

1.2 Purpose and scope of this report

This Noise and Vibration Impact Assessment (NVIA) has been prepared by GHD Pty Ltd (GHD) as part of the EIS for the proposal. The EIS has been prepared to accompany the application for approval of the proposal and addresses the environmental assessment requirements of the Secretary's Environmental Assessment Requirements (the SEARs), issued on 17 October 2024.

This report documents the assessment of the potential noise and vibration impacts during the construction and operation of the proposal, and where required, identifies feasible and reasonable mitigation and management measures. Specifically, this report:

– addresses the SEARs as listed in Table 1.2
– describes the existing acoustic environment and identifies the receivers sensitive to noise and vibration
– assesses the potential noise and vibration impacts of constructing and operating the proposal on the identified sensitive receivers
– recommends measures to mitigate and manage the impacts identified.

1.3 Summary of the proposal

1.3.1 Location

The proposal is located on Billabong Creek, which is part of the Yanco Creek system in south-west New South Wales (NSW). The Yanco Creek system forms a part of the Murray-Darling Basin. The proposal is located within the local government area (LGA) of Edward River.

An overview of the location of the proposal is shown in Figure 1.1

Figure 1.1 - Location of the proposal

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1.3.2 Key features of the proposal

The proposal involves replacing two existing weirs along Billabong Creek with new regulators including fishways.

The core structure of the two regulators is similar and would include:

- concrete piers with maintenance bulkhead slots
- automated layflat gates across the crest of the structure to assist with flow management and downstream fish passage
- a low turbulence 'keyhole' type vertical slot fishway with allowances for variable headwater to provide upstream fish passage
- automated sidewinder gates within the vertical slot fishway to allow for variable headwater conditions
- fixed concrete crests on the opposite side of the gates to the vertical slot fishway
- concrete apron downstream of the structure
- concrete wingwalls upstream and downstream of the structure
- access from a trafficable deck for maintenance (Hartwood Regulator only)
- pedestrian walkway access part way across Wanganella Regulator structure to facilitate housing of gate actuators and for maintenance
- walkway grating over gates to facilitate operations and maintenance
- crushed rock maintenance pads, access and turnaround areas adjacent to the structure
- rip rap and rock beaching upstream and downstream of structure for erosion protection
- control house
- sheet pile cut-off walls beneath the structure
- fencing of the structures to prevent public access
- SCADA control system.

An indicative layout of a regulator is shown in Figure 1.2. This example is of a five gate regulator with a fish passage and trafficable deck for maintenance vehicles.

Figure 1.2 Indicative layout of a regulator

The proposal would also involve the following elements:

- Power supply to the regulators would be provided by a mix of underground and overhead electricity cables connecting the structures to the grid.
- Access to the regulators would require permanent tracks for maintenance and some additional tracks to support construction only. Track upgrades include a new drainage culvert at Hartwood.
- The existing Forest Creek block bank, associated with the Hartwood Regulator, would be replaced with a similar earthen structure to the existing. This would include two concrete sills to define the upstream and downstream top of bank and armoured with rock beaching and crushed rock for erosion protection.

– Wanganella flood bypass channel would be constructed to reduce potential upstream flooding impacts from the Wanganella Regulator. The channel would enable flood waters to drain between the billabongs in the Wanganella Reserve during flood events. It would be 85 metres long, around 40 metres wide and 1.7 metres deep and located north of the Wanganella landfill. Once completed, the channel sides and base would be natural and vegetated with appropriate local native species.
– An existing borrow pit on private land at lot 56 / DP756322 near Hartwood Weir would be extended to provide material for the construction of Hartwood Regulator and Forest Creek block bank.

The location of the existing weirs, proposed infrastructure, and the indicative proposal footprints are shown on Figure 1.3 and Figure 1.4.

1.3.3 Timing

Construction of the proposal is anticipated to start in mid 2025 and be completed by the end of 2026. The construction period is anticipated to be around 18 months. Construction would pause during periods of high flow.

Standard construction hours would be adopted in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) as shown in Table 1.1. Most construction activities would be undertaken during this time.

Table 1.1 ICNG standard construction hours

Day	Start time	Finish time
Monday to Friday	7.00 am	6.00 pm
Saturday	8.00 am	1.00 pm
Sundays and public holidays	No regular work	

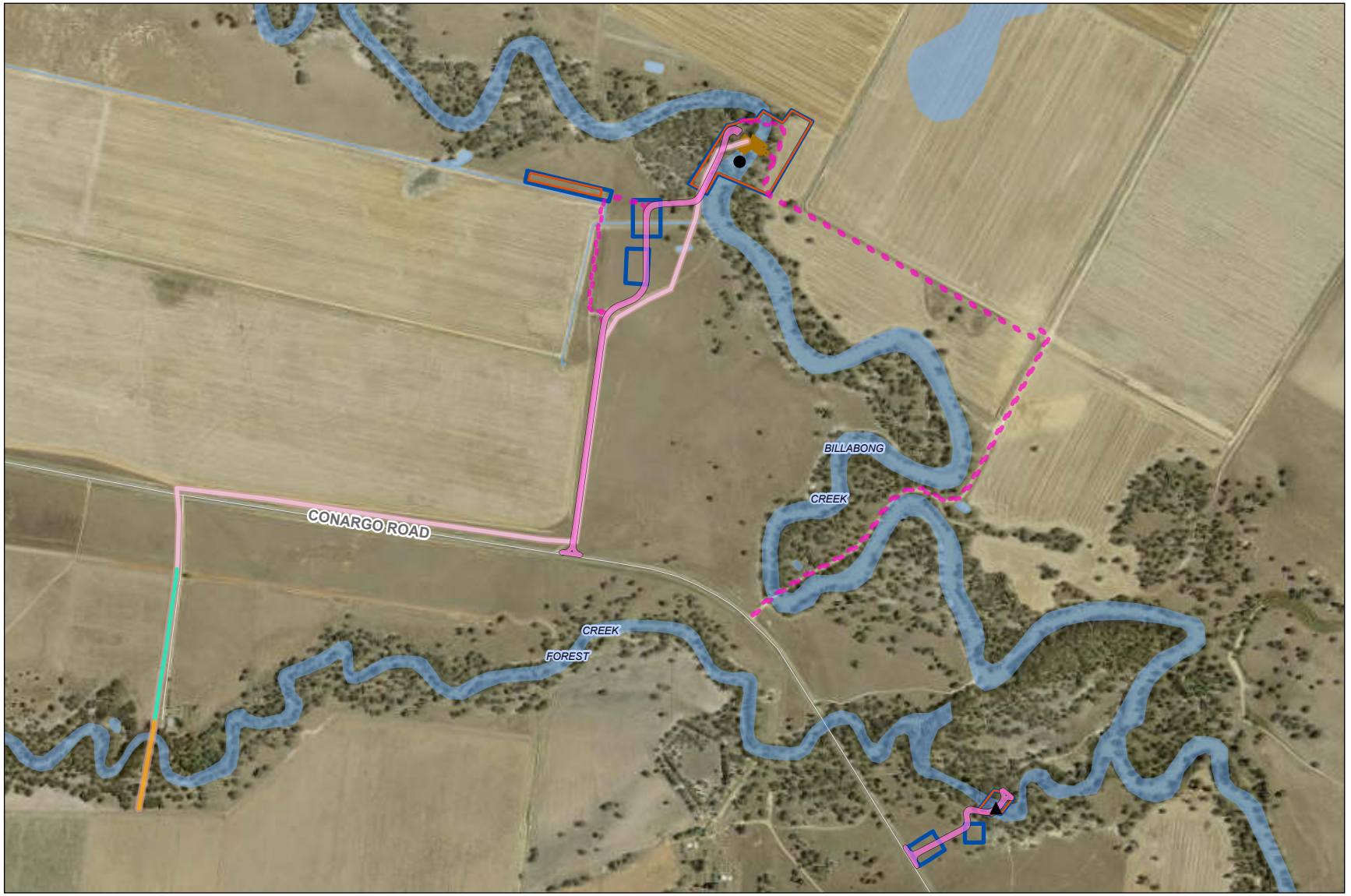
Notwithstanding this, the *Interim Construction Noise Guideline* (DECC, 2009) acknowledges that the following activities may need to be undertaken outside the recommended construction hours:

– emergency work
– delivery of oversized plant or structures
– works for which it can be demonstrated that there is a need to operate outside the recommended standard hours.

1.3.4 Operation

The proposal would be operated in accordance with the operating requirements established with the new asset owner and developed in consultation with key stakeholders. These operating requirements are known as the Yanco Creek System Operations Plan. The plan would take into account the regulation requirements at each regulator, as well as constraints such as limits to rates of rise and fall to accommodate fish breeding requirements.

The proposed regulators would provide greater control of water levels which would be operated to meet environmental and water supply objectives. WaterNSW would own and operate the new regulators.



Proposal

- Proposed Hartwood Regulator
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Existing Block Bank
- Main Road
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:16,000

0 100 200 300 400

Metres

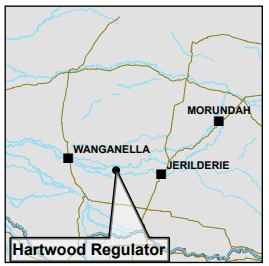


Figure 1.3 Location of Hartwood Regulator and Proposed Works

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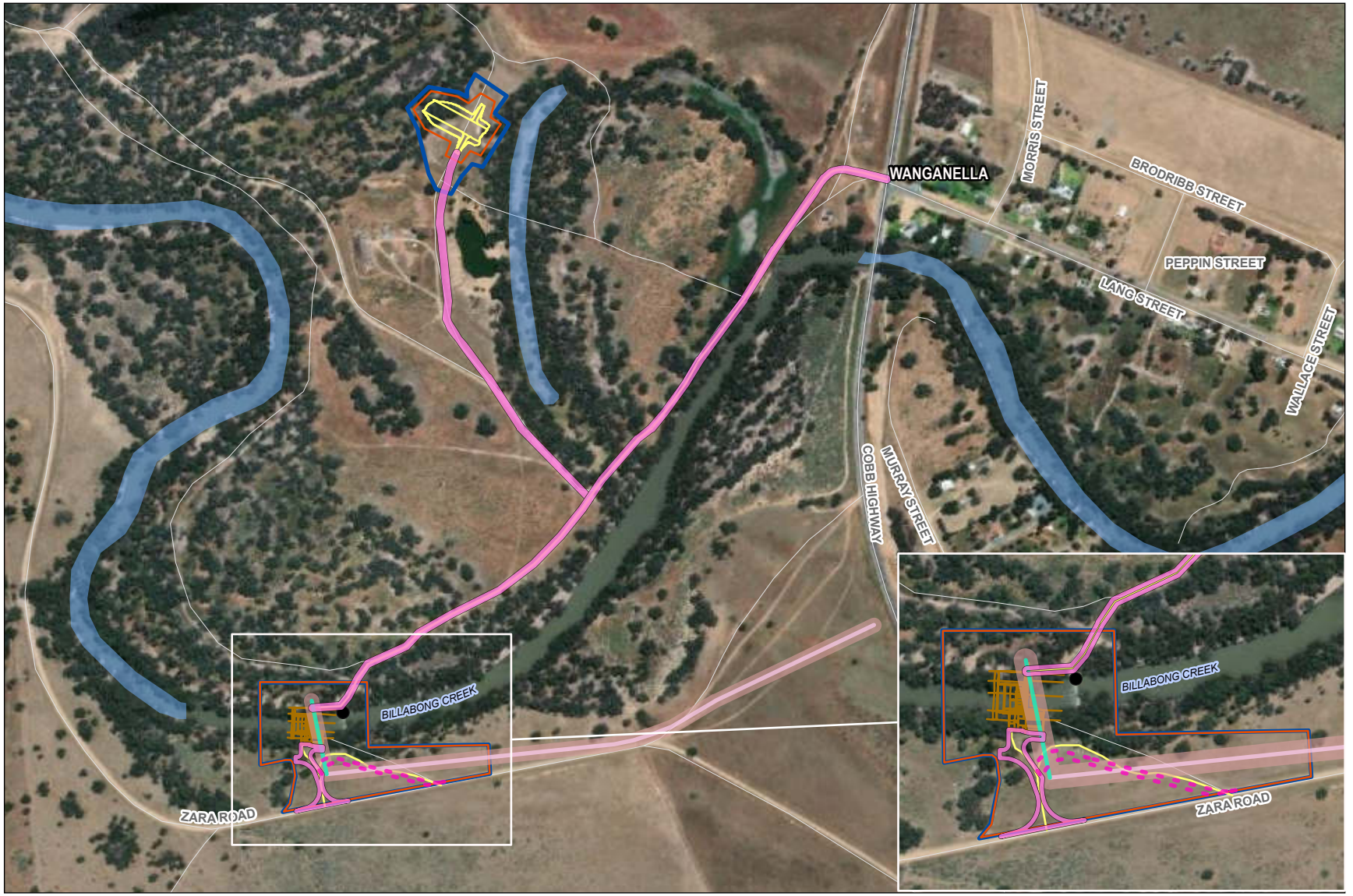

Proposal

- Proposed Wanganella Regulator
- Wanganella Bypass Channel
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Roads
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:8,000

0 75 150 225 300

Metres

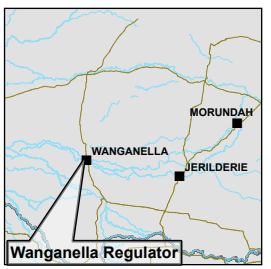

Figure 1.4 Location of Wanganella Regulator and Proposed Works

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1.4 Secretary's environmental assessment requirements

This noise and vibration assessment has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs). Table 1.2 outlines the requirements relevant to this assessment. The assessment also considers requirements raised by the NSW Environmental Protection Authority.

Table 1.2 Relevant SEARs

SEARs	Relevant guideline / standard	Where addressed in this report
34	Provide an assessment of noise and vibration impacts during demolition, site preparation, bulk excavation, construction and operation in accordance with relevant guidelines. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Section 5.2 (Construction noise impacts) Section 5.3 (Construction vibration) Section 5.4 (Construction traffic) Section 5.5 (Operational noise) Section 6.1.1 (Reasonable and feasible mitigation measures) Section 6.1 (CNVMP requirements) Section 6.1 (Construction management measures)
35	Identify proposed construction hours and provide details of the instances where it is expected that works would be required to be carried out outside the standard construction hours.	Section 4.1.1(Construction hours) Section 4.1.4 (Works outside the recommended Standard hours)

1.5 Assumptions

The following list outlines assumptions and limitations applying to the preparation of this NVIA and should be kept in mind when interpreting the analysis in this assessment:

– details of the proposal are current as of January 2024
– noise monitoring has not been undertaken to determine the rating background levels (RBLs) for the assessment as it is expected that the existing background noise levels would be below the minimum RBLs prescribed in the Noise Policy for Industry (EPA 2017).

1.6 Structure of this report

The report is structured as follows:

– Section 1 – introduces the report and includes a description of the proposal
– Section 2 – describes the methodology for the assessment
– Section 3 – describes the existing noise environment and the identified sensitive receivers in the study area
– Section 4 – summarises the assessment criteria used to identify potential noise and vibration impacts
– Section 5 – identifies potential noise and vibration impacts arising from the proposal
– Section 6 – outlines the recommended mitigation and management measures to reduce impacts
– Section 7 – provides a conclusion for the report
– Section 8 – provides sources for references used in this report.

2. Assessment approach and methodology

2.1 Legislative and policy context to the assessment

This section summarises the legislation, guidelines and/or policies driving the approach to the assessment. Table 2.1 provides the noise and vibration guidelines listed in the SEARs, as well as additional relevant guidelines used to assess noise and vibration impacts from the proposal

The SEARS requirements relevant to noise and vibration and where these have been addressed in this report, are discussed in section 1.4..

Table 2.1 Applicable guidelines used in this assessment

Assessment guideline	Relevance to the assessment
Guidelines referenced in SEARs Attachment 1	
Assessing Vibration: a technical guideline (AVTG) (DEC, 2006)	Assessment of human comfort vibration impacts to sensitive receivers during construction
Interim Construction Noise Guideline (ICNG) (DECC, 2009)	Assessment of construction airborne noise impacts at sensitive receivers, including noise management levels (NMLs)
Noise Policy for Industry (NPfI) (EPA, 2017)	Assessment of operational noise impacts at sensitive receivers, including project noise trigger levels
Additional guidelines referenced in this assessment	
Construction Noise and Vibration Strategy and Addendum (CNVS) (Transport for NSW, 2019a)	Determination of safe working distances for vibration intensive equipment (human comfort and cosmetic damage)
Evaluation and measurement for vibration in buildings Part 2 (BS7385) (British Standards, 1993)	Determining relevant criteria for cosmetic damage to vibration sensitive standard structures (e.g. residential dwellings)
NSW Road Noise Policy (RNP) (DECCW, 2011)	Assessment of a road traffic noise impacts associated with the proposal during construction including noise trigger levels
Structural Vibration – effects of vibration on structures (DIN 4150-3) (German Standards, 1999)	Determining relevant criteria for cosmetic damage to vibration sensitive structures of heritage significance (if found to be structurally unsound) and buried pipework/utilities

2.2 Methodology

2.2.1 Study area

For the purposes of the assessment the construction footprint, operation footprint, and study area have been defined as follows:

– Proposal site – The area that would be directly affected by construction and the location of operational infrastructure.
– Study area – is the area investigated which includes the proposal site and surrounding area, with the potential to be directly or indirectly affected by the proposal. The area of investigation covered by this noise and vibration assessment comprised the area approximately 1.5 kilometres from the main work areas and 1.5 kilometres for all other areas.

2.2.2 Description of the existing environment

The study areas were investigated for this assessment by the following procedure:

– identified noise and vibration sensitive receivers within each of the study areas
– classified the sensitive receivers based on their type (residential, commercial, industrial etc.)
– determined the minimum distance between each sensitive receiver and the closest part of the proposal area (i.e. main work area, access track or power lines)
– assumed the minimum rating background levels (RBLs) prescribed in the Noise Policy for Industry (EPA 2017) to establish the relevant noise criteria for residences (operation and construction phases).

2.2.3 Construction noise and vibration assessment

The following steps were taken to assess the effect of each construction noise source on surrounding sensitive receivers:

– reviewed the proposed construction activities, equipment, work areas, construction hours for the proposal
– established the noise management levels for each receiver type in accordance with the ICNG
– based on the worst-case construction activities for each work area, undertook a screening assessment to identify where noise management levels have the potential to be exceeded
– identified whether noise management levels can be exceeded at any sensitive receivers near access tracks and the power lines (short-term works)
– where the noise management levels have the potential to be exceeded at sensitive receivers near each main work site (long-term works), undertook detailed noise modelling to predict noise levels based on indicative construction scenarios and likely equipment to be used for each scenario
– established safe working distances for vibration intensive equipment based on the CNVS and identified any sensitive receivers that fall within these distances.

2.2.4 Operational noise assessment

The following steps were taken to assess the effect of each operational noise source on surrounding sensitive receivers:

– established the operational noise criteria at sensitive receivers in accordance with the NPfI requirements
– listed any noise-generating equipment that would be installed at each of the regulators and assumed indicative sound power levels
– provided a qualitative assessment of potential operational noise impacts at sensitive receivers.

2.2.5 Road traffic noise assessment

The following steps were taken to assess the effect of road traffic noise sources on the surrounding sensitive receivers:

– The additional traffic generation during the operation of the proposal is anticipated to be negligible. As such, an assessment of the increase in road traffic noise levels from the operation is not deemed necessary. However, construction road traffic noise has been assessed.
– Identified the construction haulage routes for each site.
– Estimated the worst-case increase in traffic volumes for each section of road during the construction phase.
– An initial screening test has been applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB due to construction traffic. No traffic counts have been undertaken for the proposed haulage route roads. As such, the increase in road traffic noise levels expected during construction (compared to the existing noise levels) cannot be calculated. However, it is expected that existing traffic volumes along the majority of the haulage routes would be negligible or low. Given this, it is expected that existing road traffic noise levels would increase by more than 2 dBA for the majority (if not all) of the sections of roads proposed to be used by construction vehicles.

– As a greater than 2 dBA increase is predicted for the majority of haulage route roads, road traffic noise levels have been compared against the RNP controlling noise criteria. Mitigation distances have been calculated using the CoRTN prediction algorithm for both the day and night period criteria and any residences that fall within the mitigation distances have been identified.

2.2.6 Noise mitigation and management measures

Where exceedances of the relevant criteria have been predicted (construction, operation and road traffic), provide mitigation and management measures to reduce the potential of impacts.

3. Existing environment

Table 3.1 shows the details for the lots on which the new regulators are located, as well as the lots on either side of the creek adjacent to the regulators. Those portions of the structures within the creek banks would be on Crown land.

Table 3.1 Regulator details

Area ID	Regulator	Lot and DP	Land zone
2A	Hartwood Regulator	1 / DP707463 28 / DP756330	RU1 Conargo Local Environmental Plan 2013
2b	Wanganella Regulator	7006 / DP1055647 7015 / DP1053753 7005 / DP1024202 7004 / DP1024203	RU1 Conargo Local Environmental Plan 2013

3.1.1 Sensitive receivers

Noise sensitive land uses are defined based on the type of occupancy and the activities performed in the land use. Receivers sensitive to noise and vibration can be categorised as:

– residential dwellings
– non-residential land uses:
  - educational institutes and classrooms at schools
  - hospital wards and operating theatres
  - places of worship
  - passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied.
  - hotels and other temporary accommodation buildings
  - commercial buildings including businesses, retail, offices, sports centres, bars/cafes etc.
  - industrial premises.

All identified receivers have been assumed to be residential land uses based on a desktop review using aerial imagery. This is a conservative approach as the criteria residential land uses is more stringent than non-residential land uses.

3.1.2 Identified sensitive receivers

A total of 26 sensitive receivers have been identified with the overall study area.

– 4 sensitive receivers in Hartwood
– 22 sensitive receivers in Wanganella.

These sensitive receivers are listed in Table 3.2 and Table 3.3 for Hartwood and Wanganella respectively. The location of the proposed infrastructure, and the indicative disturbance footprints, are shown on Figure 3.1 and Figure 3.2. All sensitive receivers are in the Conargo Local Government Area (LGA) and have been assumed to be ‘rural residential receivers’ for the purposes of the NPfI classification.

Table 3.2 Hartwood noise sensitive receivers

Receiver ID	Address	Land use zone
H01	4483 Conargo Road	RU1
H02	76 Conargo Road	RU1
H03	4144 Conargo Road	RU1
H04	4144 Conargo Road	RU1

Table 3.3 Wanganella sensitive receivers

Receiver ID	Address	Land use zone
W01	3955 Cobb Hwy	RU1
W02	4 Lang Street	RU5
W03	3 Lang Street	RU5
W04	10 Lang Street	RU5
W05	40 Murray Street	RU1
W06	13 Morris Street	RU5
W07	20 Lang Street	RU5
W08	19 Lang Street	RU5
W09	Brodibb Street	RU5
W10	25 Lang Street	RU5
W11	30 Lang Street	RU5
W12	8 Murray Street	RU1
W13	50 Lang Street	RU5
W14	8 Murray Street	RU1
W15	45 Lang Street	RU5
W16	52 Lang Street	RU5
W17	53 lang Street	RU5
W18	8 Murray Street	RU1
W19	58 Lang street	RU5
W20	70 Lang street	RU5
W21	6 Wallace street	RU5
W22	86 Lang street	RU1

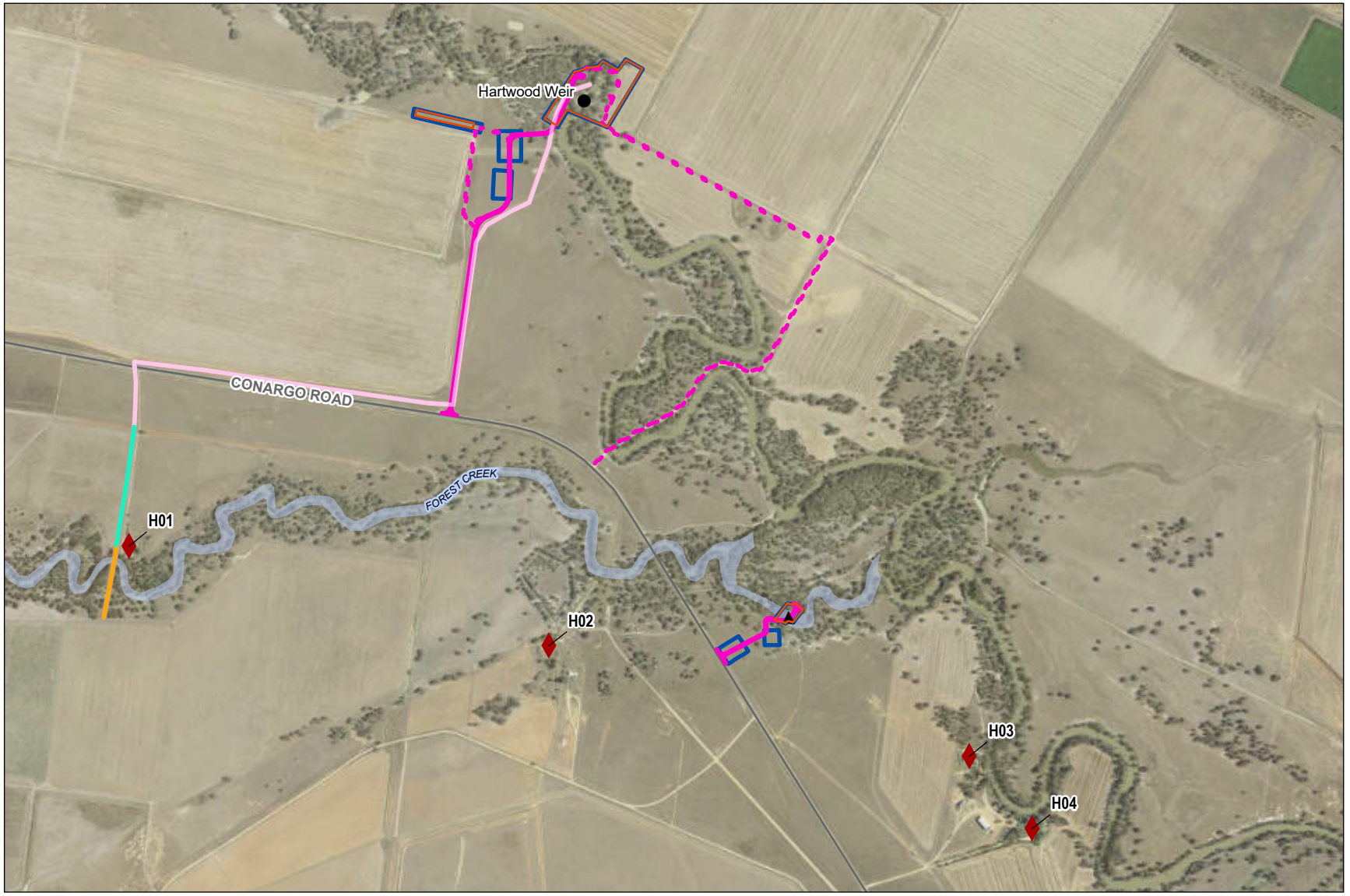

Figure 3.1 Hartwood proposal site and sensitive receivers

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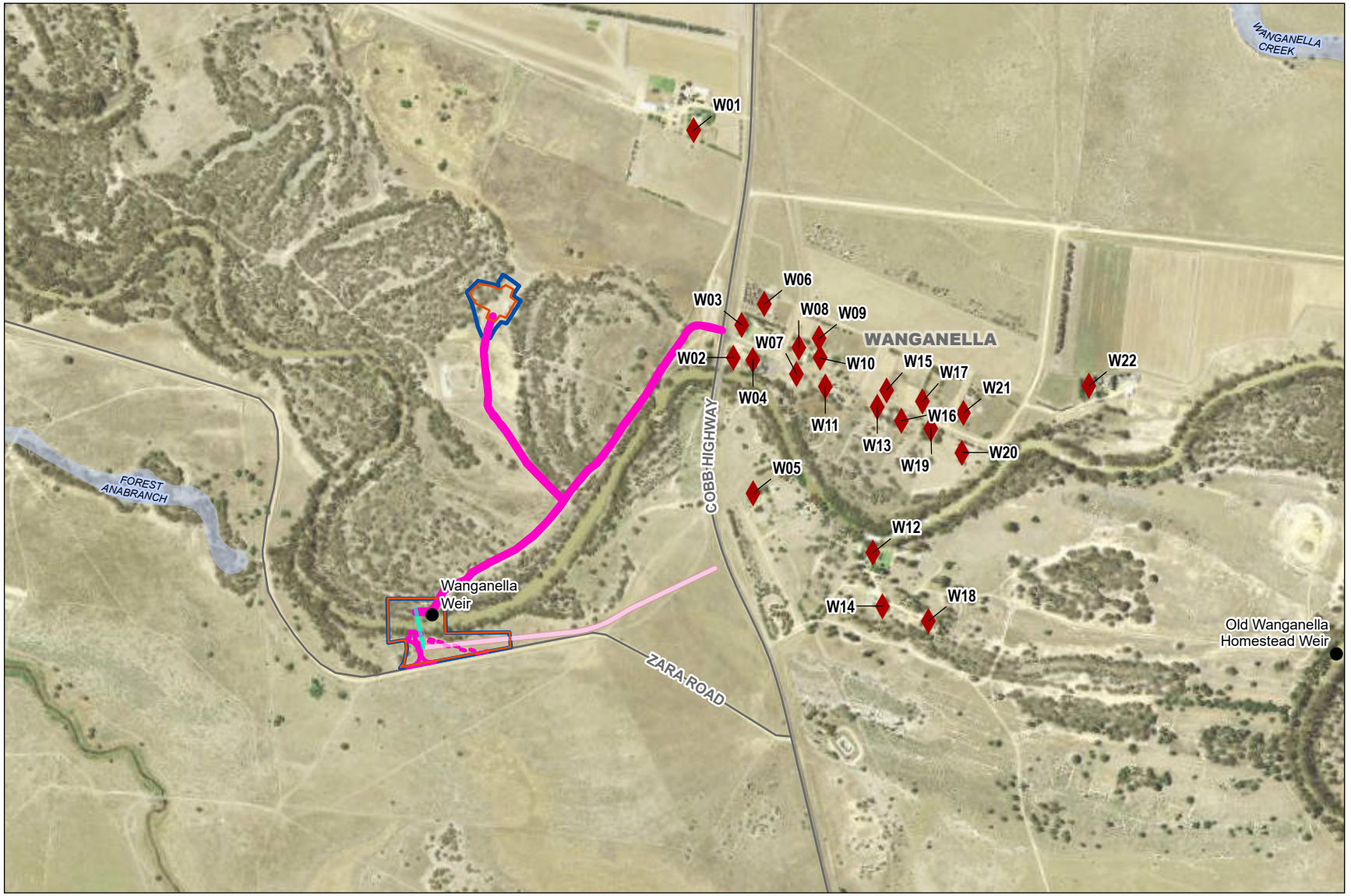

Figure 3.2 Wanganella proposal site and sensitive receivers

3Rivers

3.2 Existing noise environment

Noise monitoring has not been undertaken to determine the rating background levels (RBLs) for the assessment as it is expected that the existing background noise levels would be below the minimum RBLs prescribed in the Noise Policy for Industry (EPA 2017). The minimum assumed RBLs are presented in Table 3.4

Due to the rural nature of the study area at each site, it is anticipated that the acoustical environment is dominated by natural sounds, as there would be little to no road traffic noise and no significant noise emissions due to no commerce or industry in the vicinity.

Table 3.4 Minimum assumed Rating Background Levels (NPfI, 2017)

Time of day	Minimum assumed RBL
Day	35
Evening	30
Night	30

4. Assessment criteria

4.1 Construction criteria

4.1.1 Construction hours

Construction works have the potential to result in impacts where there are sensitive receivers identified within the study area. To minimise the potential noise and vibration amenity impacts, construction works would be undertaken during the following ICNG recommended standard working hours:

– Monday to Friday: 7am to 6pm
– Saturday: 8am to 1pm
– no works on Sundays or public holidays.

These hours are shown visually in Figure 4.1.

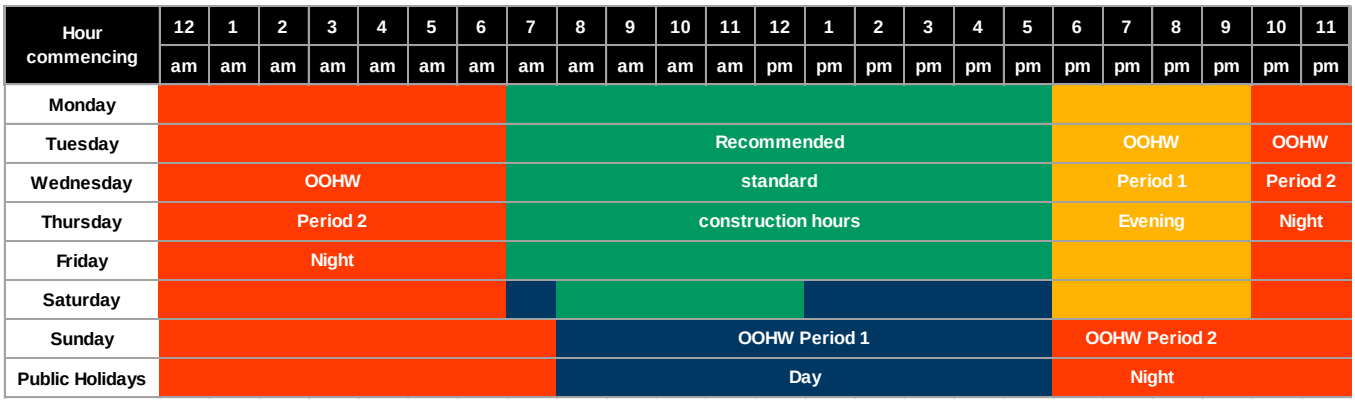

Figure 4.1 ICNG recommended standard hours

4.1.2 Construction noise management levels

The construction noise management levels during recommended standard hours represent a noise level that, if exceeded, would require management measures including:

– reasonable and feasible work practices
– contact with the residences to inform them of the nature or works to be carried out, the expected noise levels and durations and contact details.

The management measures are aimed at reducing noise impacts at the residential receivers. However, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level.

The noise affected construction noise management levels during recommended standard hours are not intended as a noise limit but rather a level where noise management is required and as such should not be included as a noise limit in the environmental protection license or Consent Condition.

The determination of the NML is dependent on the time of day and the existing rating background level (RBL) at the residential receiver locations. This is explained in detail in Table 4.1 including a description of each relevant NML.

Table 4.1 Residential construction noise management levels, dBA

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise: – Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices 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 contact details.
	Highly noise affected: 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. 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: – times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences) – if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside standard hours	Noise affected: RBL + 5 dBA	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 measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

The noise management levels at sensitive receivers in the study area are summarised in Table 4.2. The implications of exceeding the NML is explained in Table 4.1. The minimum NMLs have been used to assess the potential for construction noise impacts (minimum RBLs have been adopted for all residential receiver locations). Note should be made that all works are proposed to be undertaken during standard hours only and the outside of standard hours NMLs have been provided for reference only.

Table 4.2 Construction noise management levels

Sensitive receiver type	Construction Noise Management Levels, $L_{Aeq(15min)}$, dBA				
	Standard construction hours		Outside standard construction hours		
	Noise affected	Highly noise affected	Day	Evening	Night
All residential receivers	**45**	**75**	40	35	35

A comparison of typical noise levels is provided in Figure 4.2 for reference.

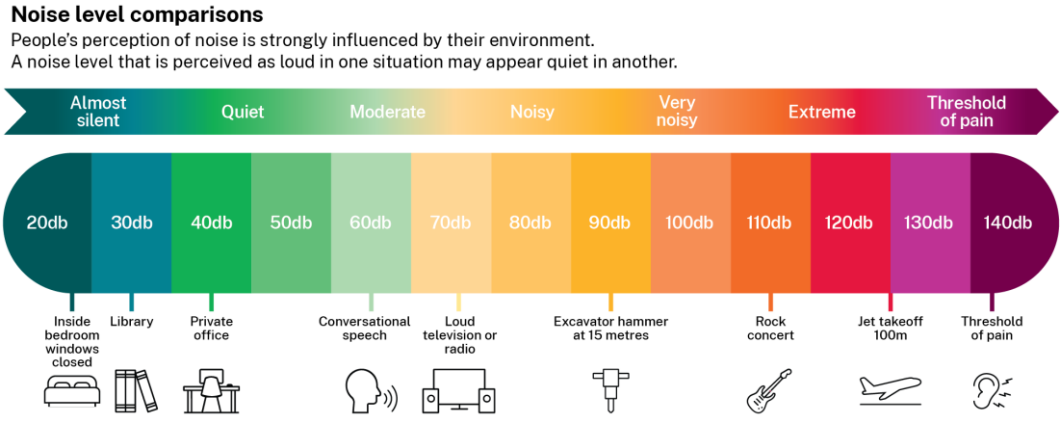

Figure 4.2 Noise level comparisons

4.1.3 Works outside the recommended standard hours

The ICNG states that '*the five categories of works that might be undertaken outside the recommended standard hours are:*

– the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
– emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
– maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
– public infrastructure works that shorten the length of the project and are supported by the affected community
– works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

4.1.4 Sleep disturbance screening levels

Construction works are to occur during standard construction hours in accordance with the ICNG, therefore no sleep disturbance impacts are anticipated and sleep disturbance has not been assessed.

4.1.5 Vibration guide values

Vibration is assessed based on the criteria in Assessing Vibration: a technical guideline (DEC, 2006). British Standard (BS) 6472 – 2008, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) is recognised by the guideline as the preferred standard for assessing the 'human comfort criteria'. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 4.3 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak particle velocity, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans can detect vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration,* as shown below in Table 4.4.

Table 4.3 Human comfort intermittent vibration dose values (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Educational institute	When in use	0.4	0.8

Table 4.4 Guidance on effects of vibration levels for human comfort (BS 5228.2 – 2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments would cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

4.2 Operational criteria

4.2.1 Operational noise criteria

The NPfI provides guidance on the assessment of operational noise impacts. The guideline includes both intrusiveness and project amenity noise levels that are designed to protect receivers from noise significantly louder than the background level, and to limit the total noise level from industry near a receiver.

The NPfI project noise trigger levels provide an objective for assessing a project and are not mandatory limits required by legislation. The project noise trigger levels assist the regulatory authorities to establish licensing conditions. Where project noise trigger levels are predicted to be exceeded, feasible and reasonable noise mitigation strategies would be considered. In circumstances where noise criteria cannot be achieved, residual noise impacts are used to assess noise impacts and manage noise from the site in negotiation between the regulatory authority and community. The regulatory authority then sets statutory compliance levels that reflect the achievable and agreed noise limits from the development.

The intrusiveness noise level controls the relative audibility of operational noise compared to the background level at residential receivers. The amenity noise level limit the total level of extraneous noise for all receiver types. Both levels are calculated and the lower of the two in each time period is set as the project noise trigger level. The intrusiveness noise level is assessed over a 15-minute period however the amenity noise level is assessed over the day, evening, or night-time period. For the purposes of assessment to standardise the approach the NPfI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA unless an alternative approach can be justified.

4.2.2 Intrusiveness noise level

The intrusiveness noise level is determined by a 5 dB addition to the measured or adopted background noise level with a minimum intrusiveness noise level of 35 dBA for the evening and night period and 40 dBA for the day period. The NPfI recommends that the intrusiveness noise level for the evening and day period should not exceed the daytime period. The intrusiveness noise levels are only applicable to residential receivers.

4.2.3 Project amenity noise level

The recommended amenity noise level applies to all industrial noise in the area which when combined should remain below the recommended amenity noise level. The recommended amenity noise level represents the total industrial noise at a receiver location and a Project Amenity Noise Level is set at 5 dBA below the recommended amenity noise level.

4.2.4 Summary of project noise trigger levels – residential receivers

For residential receivers, the project noise trigger levels are provided in Table 4.5.

The project noise trigger levels reflect the most stringent noise level requirements derived from the intrusiveness and project amenity noise level. Daytime, evening, and night-time project noise trigger levels (PNTLs) should aim to be achieved as project works may span across a full day.

Table 4.5 Project noise trigger levels – residential noise receivers, dBA

PNTL $L_{Aeq(15min)}$ at residential receivers	Assessment period		
	Day	Evening	Night
Intrusive noise level	40	35	35
Project amenity noise level	48	43	38
Project noise trigger level	**40**	**35**	**35**

Notes:

– The minimum project intrusive noise level $L_{Aeq(15min)}$ of 40 dBA has been used for the day period and $L_{Aeq(15min)}$ 35 for the night period.

– The NPfI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 1 pm Sunday & Public Holidays.

– Noise from the site is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the project noise trigger levels, except where otherwise specified below.

To standardise the time periods for the intrusiveness and amenity noise levels, the NPfI assumes that the $L_{Aeq,15min}$ is equal to $L_{Aeq, period}$ + 3 dBA.

4.3 Road traffic noise criteria

The Road Noise Policy (RNP) (DECCW, 2011) provides road traffic noise criteria for residential land uses affected by additional traffic on the public road network.

Section 3.4.1 of the RNP states that any increase in the total noise level at existing residences and other sensitive land uses affected by traffic generation on existing roads should be limited to 2 dBA above current levels. The sections of road that would be used during by light and heavy vehicles during the construction phase of the proposal are presented in Table 4.7 along with the relevant RNP road classification and the assessment type.

Where road traffic noise levels are predicted to increase by more than 2 dBA and the controlling noise criteria (Table 4.6) is also exceeded, feasible and reasonable mitigation and management measures would be considered to minimise impacts.

Table 4.6 RNP controlling noise criteria for additional traffic on public roads

Road category	Type of project / land use	Assessment criteria, dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways / arteria l /sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

Table 4.7 Proposal haulage routes and road classifications

Proposal site	Applicable roads	Sections	Road classification	Assessment type
Hartwood	Conargo Road	Hartwood site (all access points) to Conargo Recreation Reserve Conargo Recreation Reserve to Deniliquin	Sub-arterial road	15 hour (day) / 9 hour (night)
Wanganella	Zara Road	Wanganella site (south) to Cobb Highway	Local road	Peak 1 hour (day and night)
	Cobb Highway	Wanganella Post office to Deniliquin	Sub-arterial	15 hour (day) / 9 hour (night)

5. Impact assessment

5.1 Construction methodology

5.1.1 Construction hours

Standard construction hours would be adopted in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) as shown in Table 5.1. Most construction activities would be undertaken during this time.

Table 5.1 Proposal construction hours

Day	Start time	Finish time
Monday to Friday	7.00 am	6.00 pm
Saturday	8.00 am	1.00 pm
Sundays and public holidays	No regular work	

5.1.2 Construction activities

Subject to receiving planning approval, it is expected that construction would commence in mid-2024 and take about 17 months to complete by the end of 2025. The construction methodology is typical for both sites. Generally, site establishment works would occur, then the fishway and layflat gates would be constructed (Stage 1 works), then the fixed crest regulator would be constructed (Stage 2 works). Finally the site would be rehabilitated. The list of activities to be undertaken during each phase is presented in Table 5.2.

Table 5.2 Indicative activities for construction components of the proposal

Phase	Activities
Fishway and lay flat gates	– Construct hardstands for the compound, laydown areas and crane pad(s) – Install site facilities and mobilise plant – Demolish small section of existing weir to allow cofferdam through structure – Install all the temporary cofferdams around new structures and old weirs separately and dewater – Prepare subgrade and initial earthworks including any remediation if required – Install permanent sheet pile wall Billabong Creek Regulators (Part B Introduction and proposal context) – Draft | 3.16 Phase Activities – Form, reinforce and pour all slabs (fixed crest structure, stilling pool, apron and fishway) – Form, reinforce and pour all walls (gates and fishway) – Install scour protection and finalise backfill of new structure – Demolish existing weir including reshaping of creek bed – Install and commission layflat gates and fishway furniture – Flood cofferdam and remove the sheet piles around the new structure only
Fixed Crest Structure	– Install temporary sheet pile cofferdam for the fixed crest weir section and seal against the new structure (at this point the new gates would be operational) – Remove the cofferdam around existing weir and reinstall around the other side of the existing weir – Dewater the two new work zones – Prepare subgrade and initial earthworks including any remediation if required – Install remaining permanent sheet pile wall – Form, reinforce and pour remaining slabs (fixed crest structure, stilling pool and apron) – Form, reinforce and pour remaining walls (fixed crest structure) – Install scour protection and finalise backfill of other side – Demolish other side of the existing weir including reshaping of creek bed – Flood both cofferdams and remove the sheet pile – Rehabilitate work areas and demobilise from site

The expected equipment to be used is provided below in Table 5.3

Table 5.3 Indicative construction equipment list

Equipment		
Light vehicles (4wd)	Compactor	Mobile crane
Crew bus	Pneumatic hammer	Franna crane
Frontend Loader	Grader	Concrete pump
Dump Truck	Roller (large pad foot)	Sumps and dewatering pumps
Asphalt truck & sprayer	Tub grinder/ mulcher	Piler driver (vibratory)
Smooth drum roller	Excavator (25t and 13t)	Vibratory roller
Bulldozer d9	Chainsaw 4-5hp	Power generator
Crew boat or barge	Fixed crane	Light tower
Scraper 651	160-220t capacity pin jab crawler crane	
Various truck combinations including: – Truck and Trailer combinations – Concrete truck	Truck or crawler crane (60t)	

5.1.3 Construction equipment

Sound power levels for each item of construction equipment is presented in Table 5.4 and have been sourced from the following documents:

– AS2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (Australian Standards, 2010)
– *Construction Noise and Vibration Guideline* (CNVG) (Transport for NSW, 2016)
– *Construction Noise and Vibration Strategy* (CNVS) (Transport for NSW, 2019)

Table 5.4 Construction equipment list and sound power levels

Equipment	Sound Power Level (dBA)	Source
160-220t capacity pin jab crawler crane	104	AS2436
Asphalt truck & sprayer[1]	103	TfNSW CNVG
Bulldozer D9[1]	108	AS2436
Chainsaw 4-5 hp[1]	114	TfNSW CNVG
Compactor	113	AS2436
Concrete pump	108	AS2436
Concrete truck	108	AS2436
Concrete vibrator	103	AS2436
Crew Bus (assumed from Truck- medium rigid)	103	TfNSW CNVG
Crew Barge (assumed from Truck- medium rigid)	103	TfNSW CNVG
Daymakers[1]	98	TfNSW CNVG
Dump truck	110	TfNSW CNVG
Excavator (13t)	100	TfNSW CNVS
Excavator (25t)	105	TfNSW CNVS
Fixed crane	105	AS2436
Franna Crane	98	TfNSW CNVS
Frontend loader	113	AS2436

Equipment	Sound Power Level (dBA)	Source
Grader	110	AS2436
Light Tower	80	TfNSW CNVS
Light vehicles (e.g., 4wd)	106	AS2436
Mobile Crane	104	AS2436
Pile driver (vibratory)	121	TfNSW CNVS
Pneumatic hammer	113	AS2436
Power generator	99	AS2436
Roller (large pad foot)	109	TfNSW CNVG
Scraper 651	116	AS2436
Smooth drum roller[1]	107	TfNSW CNVG
Tub grinder/ mulcher[1]	116	TfNSW CNVG
Vibratory roller[1]	108	AS2436
Water cart	107	AS2436
Water pump	109	TfNSW CNVS

Note: 1. Equipment that could be used for site access construction works (either clearing or upgrade of road)

5.1.4 Indicative construction scenarios

The worst-case construction activities associated with the proposal are presented in Table 5.3 and have been assessed to determine the potential for noise impacts at sensitive receivers (i.e. exceedances of the standard hours noise management level). It should be noted that the use of less-noise intensive equipment would result in noise levels below those predicted in section 5.2.

Table 5.3 Indicative construction scenarios and activity sound power levels

Scenario ID	Construction scenario description	Assumed worst case equipment	Activity SWL (dBA)
S1	Regulator piling works	Pile driver (vibratory) for sheet piling	121
S2	Regulator works (non-piling)	Tub grinder/mulcher or bulldozer	116
S3	Site access (clearing/upgrade works)	Tub grinder/mulcher or bulldozer	116
S4	Power supply route	Tub grinder/mulcher or bulldozer	116
S5	Wanganella flood bypass channel clearing works (Wanganella only)	Tub grinder/mulcher or bulldozer	116
S6	Wanganella flood bypass channel earthworks (Wanganella)	Tub grinder/mulcher or bulldozer	116

Table 5.5 Activity and equipment sound power levels

Plant Description	Sound Power Level, $L_{Aeq(15min)}$	Source	Construction Scenario					
			S1	S2	S3	S4	S5	S6
Excavator (25t)	105	TfNSW CNVS	✓	✓			✓	✓
Fixed crane	105	AS2436	✓					
Franna Crane	98	TfNSW CNVS				✓		
Frontend loader	113	AS2436		✓	✓	✓	✓	✓
Grader	110	AS2436		✓	✓	✓	✓	✓
Light Tower	80	TfNSW CNVS	✓	✓	✓	✓	✓	✓
Light vehicles (e.g., 4wd)	106	AS2436	✓		✓	✓		
Mobile Crane	104	AS2436				✓		
Pile driver (vibratory)	121	TfNSW CNVS	✓					
Pneumatic hammer	113	AS2436		✓			✓	✓
Power generator	99	AS2436	✓	✓	✓	✓	✓	✓
Roller (large pad foot)	109	TfNSW CNVG		✓	✓		✓	✓
Scraper 651	116	AS2436			✓			
Smooth drum roller[1]	107	TfNSW CNVG			✓			
Tub grinder/ mulcher[1]	116	TfNSW CNVG		✓	✓	✓	✓	✓
Vibratory roller[1]	108	AS2436			✓			
Water cart	107	AS2436			✓			
Water pump	109	TfNSW CNVS			✓			

5.1.5 Modelling inputs and parameters

A screening assessment was undertaken to identify the potential for construction noise impacts using the industry standard ISO 9613-2 algorithm and CadnaA 2020 software to model noise emissions at both sites. Table 5.6 provides a list of assumptions and parameters used in the modelling.

Table 5.6 Modelling Parameters

Variable	Parameter Used
Calculation method	ISO 9613-2:1996
Atmospheric absorption	Based on an avg. temperature of 10 °C and an avg. humidity of 70%.
Meteorology	Well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.
Topography	No topography included in the screening assessment for the Hartwood site. As there are sensitive receivers within 1 kilometre of the main work site at Wanganella (where piling would occur), 2 metre resolution Digital Elevation Model (DEM) data has been used to account for noise attenuation due to intervening terrain.
Equipment height	General construction equipment has been modelled at a height of two metres.
Receiver heights	1.5 metres above ground level.
Buildings	No buildings have been included within the noise model.
Ground absorption	1 for all areas. (0 is non-porous ground and 1 is porous ground such as that found in a rural setting comprising of mainly grass and vegetation).

5.2 Construction noise impacts

5.2.1 Hartwood Regulator

The predicted construction noise levels at each sensitive receiver within the Hartwood regulator study area are presented in Table 5.7.

Table 5.7 Predicted construction noise levels at sensitive receivers at Hartwood, $L_{Aeq(15min)}$ dBA

Receiver ID	Regulator piling works	Regulator works (non-piling)	Site access (clearing/upgrade works)	Power supply route
	S1	S2	S3	S4
H01	35	30	35	47
H02	35	40	44	38
H03	30	41	40	28
H04	28	36	36	26

Note 1: Where the standard hours NML of 45 dBA is predicted to be exceed, the cell has been shaded in grey.

Regulator piling works (S1 works)

Sheet piling works (S1) are predicted to range from 28 dBA to 35 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

Regulator works (non-piling) (S2 works)

Non-piling construction works (S2), are predicted to range from 30 dBA to 41 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

Site access (S3 works)

Site establishment works at the site access tracks (S3 works) are predicted to range from 35 dBA to 43 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

Power supply route (S4 Works)

Power supply routes works are predicted to range from 25 dBA to 47 dBA at sensitive receivers. The standard hours NML of 45 dBA is predicted to be exceeded at receiver H01.

However, this would be a temporary impact as the works are linear in nature and construction noise levels would decrease as the construction equipment moves away from the receiver. While initially close to receivers, as the site access track is established construction vehicles would move further from receivers reducing the noise experienced.

5.2.2 Wanganella Regulator

The predicted construction noise levels at each sensitive receiver within the study area are presented in Table 5.8. Where the standard hours NML of 45 dBA is predicted to be exceed, the cell has been shaded in grey.

Table 5.8 Predicted construction noise levels at sensitive receivers at Wanganella, $L_{Aeq(15min)}$ dBA

Receiver ID	Regulator piling works	Regulator works (non-piling)	Site access (clearing/upgrade works)	Power supply route	Flood bypass channel clearing works	Flood bypass channel earthworks
	S1	S2	S3	S4	S5	S6
W01	39	33	40	32	41	41
W02	44	38	52	40	40	40
W03	40	35	53	38	42	42
W04	44	38	49	40	39	39
W05	47	41	44	46	39	39
W06	39	34	48	37	39	39
W07	43	37	45	39	38	38
W08	43	37	45	38	38	38
W09	42	36	43	37	38	38
W10	42	37	43	38	37	37
W11	43	37	43	39	37	37
W12	44	38	38	41	35	34
W13	42	36	40	38	36	35
W14	44	38	37	41	34	33
W15	41	36	39	37	35	35
W16	38	34	38	36	35	35
W17	40	35	38	36	34	34
W18	42	36	35	38	32	32
W19	41	35	37	37	34	34
W20	40	35	36	36	33	33
W21	40	34	36	35	33	32
W22	36	31	33	32	30	30

Note 1: Where the standard hours NML of 45 dBA is predicted to be exceed, the cell has been shaded in grey.

Regulator piling works (S1 works)

Sheet piling works (S1) are predicted to range from 36 dBA to 47 dBA at sensitive receivers. The standard hours NML of 45 dBA is predicted to be exceeded at receiver W05.

Regulator works (non-piling) (S2 works)

Non-piling construction works (S2) are predicted to range from 31 dBA to 41 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

Site access (S3 works)

Site establishment works at the site access tracks (S3 works) are predicted to range from 33 dBA to 53 dBA at receivers. The standard hours NML of 45 dBA is predicted to be exceeded at four receivers. These exceedances are the result of site access works occurring in close proximity to the township of Wanganella, which only represents a small portion of the work area for site access upgrade works. For the majority of site access upgrade works, noise levels will be far lower as the works are linear in nature and construction noise levels would decrease as the construction equipment moves away from the receiver. Additionally, the noise intensive duration of these works is expected to be approximately one week in length, therefore, the predicted exceedances are expected to be very temporary in nature.

Power supply route (S4 Works)

Power supply routes works are predicted to range from 32 dBA to 46 dBA at sensitive receivers. The standard hours NML of 45 dBA is predicted to be exceeded at receiver W05 by 1 dB. However, these works are only expected to take one week to complete (excluding testing) and impacts would be temporary in nature.

Flood bypass channel clearing works (S5 Works)

Flood relief channel clearing works (S2) are predicted to range from 30 dBA to 42 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

Flood bypass channel earthworks (S6 Works)

Flood relief channel earthworks are predicted to range from 30 dBA to 42 dBA at sensitive receivers. The standard hours NML of 45 dBA is not predicted to be exceeded at any receivers.

5.2.3 Summary of construction noise impacts

No receivers are predicted to experience noise levels above the highly noise affected level of 75 dBA.

The results of the noise modelling indicate a number of receivers are predicted to experience noise levels above the standard working hours NML of 45dBA.

The noise modelling indicates that during regulator works (non-piling), it is not predicted that the standard hours NML of 45 dBA will be exceeded for receivers at either site.

The results of the noise modelling also indicate that during piling work it is predicted that the standard hours NML of 45 dBA to be exceeded at one (1) receiver in Wanganella.

The results of the noise modelling also indicate that during site establishment works along the site access tracks (either vegetation clearing or upgrading the track), the standard hours NML of 45 dBA is predicted to be exceeded at the following:

– 4 receivers in Wanganella near the construction site access track.

The results of the noise modelling indicate that during power supply route establishment, the standard hours NML of 45 dBA to be exceeded at the following:

– 1 receiver in Hartwood near the power supply route
– 1 receiver in Wanganella near the power supply route.

The results of the noise modelling indicate that during flood bypass channel works (clearing and earthworks), the standard hours NML of 45 dBA are not predicted to be exceeded at any receiver location. The highest received noise level for these scenarios are both predicted to be 42 dBA at W03.

Where noise is above the construction noise management levels, all feasible and reasonable work practices to minimise noise would be implemented, and all potentially affected receivers would be informed. These are described in Section 6.1.

5.3 Construction vibration

5.3.1 Vibration safe working distances

The method for the construction vibration assessment included:

– Identifying safe working distances to comply with the human comfort and the cosmetic damage criteria. These buffer distances have been adopted from *Construction Noise and Vibration Strategy* which has been provided as a reference document in the SEARs.
– Safe working distances for vibration intensive equipment are shown in Table 5.9. The vibratory equipment associated with the proposal include vibratory piling rigs (sheet piling), vibratory rollers, excavators.
– Buildings within the safe working distances have been identified for consideration of management measures.

Table 5.9 Vibration safe working distances

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Piling rig – Bored <800 mm	N/A	2 m (nominal)
Piling rig–Hammer (12 t down force)	50 m	15 m
Piling rig – Vibratory (sheet piles)	20 m	2 m to 20 m
Vibratory roller (>18 tonnes)	100 m	25 m
Vibratory roller (13-18 tonnes)	100 m	20 m
Vibratory roller (7-13 tonnes)	100 m	15 m
Vibratory roller (4-6 tonnes)	40 m	12 m
Vibratory roller (2-4 tonnes)	20 m	6 m
Vibratory roller (1-2 tonnes)	15 m	5 m
Small hydraulic hammer 300 kg (5-12t excavator)	7 m	2 m
Medium hydraulic hammer 900 kg (12-18t excavator)	23 m	7 m
Large hydraulic hammer 1600 kg (18-34t excavator)	73 m	22 m
Jackhammer (handheld)	Avoid contact with structure	1 m (nominal)

5.3.2 Human comfort

The most vibration intensive activity associated with the construction works are anticipated to be vibratory rolling works with a roller up to 18 tonnes. Rolling activities have the potential to exceed the human comfort vibration criteria should these works occur within 100 metres of residences.

No residences have been identified within 100 metres of the main work sites at Hartwood or Wanganella. As such, no adverse human comfort vibration impacts are anticipated during the construction period at all regulation sites.

Two receivers in Wanganella (W02 and W03) have been identified to be within 100 metres of the site access tracks:

– W02: 75m
– W03: 55m

These receivers may experience human comfort impacts should vibratory rolling work occur within 100 metres of these dwellings. This would be a temporary impact as the works are linear in nature and vibration levels would decrease as the construction equipment moves away from the receiver.

5.3.3 Structural damage

Rolling activities (vibratory roller up to 18 tonnes) have the potential to exceed the structural damage vibration criteria should these works occur within 20 metres of any buildings. No buildings have been identified within 20 metres of the main work sites or the site access tracks at Hartwood or Wanganella.

As such, no adverse structural damage vibration impacts are anticipated as a result of the proposal.

5.4 Road traffic noise assessment

5.4.1 Noise screening assessment

To assess the potential increase in road traffic noise levels during construction, a screening assessment has been undertaken based on the traffic volumes presented in Table 5. The increase in-road traffic noise levels have been calculated using the CoRTN road traffic noise prediction method. An exceedance of the RNP criteria requires both of the following criteria to have been triggered:

– where a greater than 2.0 dBA increase has been predicted
– an exceedance of the $L_{Aeq(1\ hour)}$ 55 dBA local road criteria at a residential receiver.

Existing road traffic volumes have been estimated from road traffic volumes counts from previous years. Traffic data was obtained from Edward River Council for the main roads in the study area. For roads with no available data, traffic volumes have been assumed based on data from nearby roads. A summary of the available data and assumptions are outlined in Table 5.10.

Table 5.10 Traffic volume data (directional mid-block counts)

Road Name	Available counts	Count Year	Source
Cobb Highway	Daily average	2011	Edward River Council
Conargo Road	Daily average	2020	Edward River Council
Zara Road	No data	N/A	For a highly conservative assessment, assumed same as Wanganella-Conargo Road traffic volumes.
Pretty Pine Road	Daily average	2020	Edward River Council

Using this information, some assumptions have been made to conduct the road traffic noise assessment:

– zero growth rate per annum according to previous data
– peak hour existing traffic levels are equivalent to 10 percent of average daily traffic.
– 50 percent northbound/southbound and 50 percent eastbound/westbound of existing traffic counts.
– existing heavy vehicle traffic has been assumed to be 10%
– half of the daily construction road traffic movements occur during the peak one-hour period.

Table 5.5 Pre-existing traffic levels

Road Name	Existing traffic			
	AM Peak		PM- Peak	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Cobb Highway	31	3	31	3
Conargo Road	63	7	63	7
Zara Road	2	1	2	1

5.4.2 Construction road traffic noise

All construction traffic movements are expected to occur between 7:00am and 6:00 pm during Monday to Friday and 8.00am to 1.00pm on Saturday. Table 5.6. presents the peak daily vehicle movement. This is a conservative assessment as these peak movements would only occur for the most intensive activities and are not indicative of the typical movements throughout the construction work.

Table 5.6 Peak daily movements

Location	Peak daily movement- light vehicles	Peak daily movement- heavy vehicles
Hartwood	39	51
Wanganella	51	80

Table 5.11 presents the distance at which both the 55 dBA criteria is predicted to be exceeded and an increase greater than 2 dBA is predicted. Any residents within this area are also identified.

Table 5.11 Increase in road traffic noise levels (existing vs during construction)

Location	Road	Relevant RNP criteria	Distance where relevant RNP criteria is exceeded (m)	Receivers within exceedance distance?
Hartwood	Conargo Road	Sub-arterial $L_{Aeq(15hour)}$ 60	19	No
Wanganella	Cobb Highway	Sub-arterial $L_{Aeq(15hour)}$ 60	16	No
	Zara Road	Local road $L_{Aeq(1hour)}$ 55	91	No

Although there are two receivers within exceedance distance located near Cobb Highway, they do not exceed the relative increase 2 dB criteria.

5.4.3 Operational road traffic noise

The maintenance required to operate each Regulator would require about 20 truck visits per month for the first two years, requiring less over time. Therefore, no exceedances of the relative increase noise criteria are predicted to occur because of the operation of the Regulators.

5.5 Operational noise

Based on the expected operation of the Hartwood and Wanganella Regulators, noise emissions from the sites are expected to be minimal and comparable to the existing weirs. Therefore, qualitative assessment has been undertaken. The nearest residential receivers to each regulator are:

– Hartwood: H03 – 750 metres from the work site
– Wanganella: W05 – 785 metres from the work site.

The nearest receiver to each regulator is approximately 750 metres away and 785 metres away for Hartwood and Wanganella respectively. The primary operational noise would be hydraulics in adjusting the Regulators to change the flow rate.

Assuming geometric spreading with a Q-factor of 3 (one reflective surface), a noise-generating source would need to have a minimum sound power level of 101 dBA. to exceed the 35 dBA operational trigger level at a distance of 750 metres. Based on the distance between nearby noise sensitive receivers, and the expected operational equipment on site, it is expected that operational equipment can be designed to comply with the operational noise criteria provided in section 4.2.4.

5.6 Cumulative impacts

Cumulative noise impacts may occur where the construction or operation of a nearby project coincides with that of the proposal's construction or operation. Additionally, when consecutive impacts occur, the duration of noise impact on any noise sensitive receiver may be extended.

A review of NSW state significant projects was undertaken to identify other projects, existing or proposed, that have the potential to generate cumulative impacts for sensitive receivers adjacent to either proposed regulator. One future project was identified as within a 10 kilometre radius to either site:

– Yanco Creek Modernisation Project Part1b: Wanganella Swamp (four kilometres south east from Wanganella Regulator).

The project involves the upgrades and construction of a series of structures to raise and control inundation of the swamp for the purposes of facilitating bird breeding events and other environmental outcomes. The project's construction phase is anticipated to commence in 2025.

Based on the proposed commencement date of the project, consecutive impacts are possible. Cumulative impacts are however, unlikely given the distance between the proposal site, the Yanco Creek Modernisation Project Part1b site, and sensitive receivers.

6. Mitigation and management of impacts

6.1 Construction mitigation measures

6.1.1 Reasonable and feasible mitigation measures

The *Interim Construction Noise Guideline* identifies that, due to the nature of construction, it is inevitable that impacts arise where construction occurs near sensitive receivers. During construction there would be noise impacts on some receivers during certain times and during certain construction activities.

Where noise is above the construction noise management levels, all feasible and reasonable work practices to minimise noise would be implemented, and all potentially affected receivers would be informed.

Table 6.1 Environmental safeguards during the construction phase

ID	Impact	Environmental safeguard	Responsibility	Timing
Standard mitigation measures (all sites)				
NV1	Construction hours and scheduling	Where feasible and reasonable, construction will be carried out during the ICNG standard daytime working hours. Work generating high noise and/or vibration levels will be scheduled during less sensitive time periods.	NSW DCCEEW / Construction contractor	During construction
NV2	Equipment selection	The use of quieter and less vibration emitting construction methods will be considered and implemented, where feasible and reasonable. This will include high-noise generating equipment such as the use of a pile driver, pneumatic hammer, scraper, tub grinder/mulcher and compactors.	NSW DCCEEW / Construction contractor	Before and during construction
NV3	Location of plant	As much distance as possible will be placed between the plant or equipment and residences and other sensitive land uses, where possible	NSW DCCEEW / Construction contractor	Before and during construction
NV4	Operate plant quietly	Reduce throttle setting and turn off equipment when not being used	Construction contractor	During construction
NV5	Reduced equipment power	Only the necessary size and power of equipment would be used.	NSW DCCEEW / Construction contractor	Before and during construction
NV6	Minimise disturbance arising from delivery of goods to construction sites.	– Loading and unloading of materials/deliveries will occur as far as possible from sensitive receivers. – Delivery vehicles will be fitted with straps rather than chains for unloading, wherever possible. – Out of hours movements will be avoided or minimised where possible.	NSW DCCEEW / Construction contractor	During construction
Site access tracks (all sites)				
NV7	Reduce size of vibratory roller or compactor	Where required, limit the size of the vibratory compactor to maintain the safe work buffer distances.	NSW DCCEEW / Construction contractor	During construction
NV8	Notification to affected residences	Where site establishment works at site access tracks (vegetation clearing or upgrade of tracks) will occur within 700 metres of residences, the affected residences would be notified a minimum of 7 days prior to work including: – a description of the works to be undertaken including its timing and duration – the expected noise levels during the works	NSW DCCEEW / Construction contractor	Before construction

ID	Impact	Environmental safeguard	Responsibility	Timing
		– a contact number for further information or for complaints		
Construction traffic movements				
NV9	Reduce construction traffic noise impacts	– Reduce the speed of vehicles when approaching sensitive receivers – With the exception of delivery of oversized plant or structures, schedule deliveries to nominated hours only. – Optimise the number of vehicle trips to and from site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads. – Limit access routes to the site to the designated routes Manage driver behaviour and avoidance of the use of engine compression brakes.	Construction contractor	During construction

6.2 Operational mitigation measures

A qualitative assessment of operational noise impacts has been undertaken in section 4.2. Operational noise generating equipment should be selected or designed to comply with the operational noise criteria provided in section 4.2.4. In order to ensure that compliance is maintained, the following mitigation measures are recommended and should be incorporated as part of the design where feasible and reasonable.

Table 6.2 Environmental safeguards during the operational phase

ID	Impact	Environmental safeguard	Responsibility	Timing
NV10	Minimise mechanical plant noise	Mechanical plant will be designed to meet the Noise Policy for Industry project noise trigger levels.	NSW DCCEEW / Contractor	Before operational stage
NV11	Minimise mechanical plant noise	Mechanical plant will be well maintained and operate in an efficient manner. This is to limit any excess noise generation that may arise when plant is not functioning correctly.	NSW DCCEEW / Contractor	Before operational stage

7. Conclusion

This noise and vibration impact assessment has assessed the potential noise and vibration impacts associated with the construction and operation of both the Hartwood and Wanganella Regulators. The assessment included an assessment of construction road traffic noise impacts. Reasonable and feasible construction noise and vibration mitigation measures have been provisioned for implementation. This noise and vibration impact assessment has been prepared to address the relevant SEARS requirements provided in Table 1.2, and has been prepared in accordance with the relevant assessment guidelines provided in Table 2.1.

7.1 Construction noise

Construction noise impacts have been assessed in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009). Construction of the proposal is expected to commence would commence in mid-2024 and take about 17 months to complete by the end of 2025. Construction is proposed to be undertaken during standard construction hours with out of hour works not expected.

The predicted noise levels are expected to exceed the noise management levels for two receivers in Hartwood and several receivers in Wanganella. No receivers are expected to experience noise levels above the highly affected noise level of 75 dBA.

It is typical for construction projects to exceed the construction noise management levels. Any impacts due to construction works are temporary in nature and would not represent a permanent impact on the community and surrounding environment. The predicted noise levels are generally conservative and would only be experienced for limited period during construction.

Reasonable and feasible construction noise mitigation measures have been provided in section 6.1 to reduce potential construction noise impacts.

7.2 Construction vibration

Construction vibration impacts have been assessed in accordance with the *Assessing Vibration: a technical guideline* (AVTG) (DEC, 2006), and other guidelines presented in Table 2.1. No sensitive receivers have been identified as within the cosmetic safe working distances for vibratory intensive works, give the mitigation measures recommended in section 6.1 are implemented. Two receivers in Wanganella (W02 and W03) have been identified as within the human comfort buffer distance of 100 metres for site access tracks works and may experience human comfort impacts should vibratory rolling work occur within 100 metres of these dwellings.

7.3 Construction traffic noise

Construction road traffic noise impacts have been assessed in accordance with the *Road Noise Policy* (RNP) (DECCW, 2011). No exceedances of the 2 dB relative increase criteria and the RNP road traffic noise criteria are predicted to occur. Standard construction traffic noise mitigation measures have been provided in section 6.1.

7.4 Operational noise

Operational noise impacts have been assessed in accordance with the *Noise Policy for Industry* (NPfI) (EPA, 2017). A qualitative assessment of operational noise impacts has been undertaken and it is not expected that any exceedances of the Noise Policy for Industry project noise trigger levels would occur, provided that the operational noise mitigation measures provided in section 6.2 are implemented.

8. References

British Standards. (1993). *Evaluation and measurement for vibration in buildings Part 2 – Guide to damage .*
DEC. (2006). *Assessing Vibration: a technical guideline .*
DECC. (2009). *Interim Construction Noise Guideline.*
DECCW. (2011). *Road Noise Policy.*
DPE. (2021a). *Social Impact Assessment Guideline for State Significant Projects.* Retrieved from https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/Policy-and-legislation/Social-Impact-Assessment/SIA-Guideline.pdf
EPA. (2017). *Noise Policy for Industry.*
German Standards. (1999). *DIN 4150-3 Structural Vibration – Part 3: Effects of vibration on structure .*
Transport for NSW. (2019a). *Construction Noise and Vibration Strategy (CNVS).*

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