# NSW Roads and Maritime Services

## WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

## ENVIRONMENTAL IMPACT STATEMENT

## MAIN VOLUME 1B

### Chapter 15 Noise and vibration


**Chapter summary**

This chapter presents a summary of a detailed assessment of potential issues relating to noise and vibration during construction and operation of the upgraded highway.

During construction there would be high to moderate temporary construction noise impact at residential properties. Noise affected properties include those near ancillary facilities, major bridge sites, major cuts and fills, and during periods of concrete cutting, blasting, rock hammering and piling. The level of impacts would depend on the agreed working hours and would be more apparent during extended / out of hours work. Cumulative impacts from construction of adjoining Pacific Highway upgrade projects have also been assessed.

An increase in construction traffic of at least 25 per cent, or decrease by 20 per cent is required to change noise levels by 1dB(A), and this increase in traffic numbers is not predicted. The number of haul trucks moving between external sites and the project are not sufficient to create a significant noise increase.

The operational noise assessment has considered all aspects of the project's design including interchanges, service roads, bridges, rest areas, and heavy vehicle checking station. Reflective noise impacts from proposed mitigation barriers and bridges have been considered, where appropriate. The operational noise assessment finds that the upgraded highway would not cause significant noise and vibration impacts at most locations due to increased traffic noise. There would be moderate permanent increases of noise at external residential areas at several properties currently not exposed to road traffic noise.

With the application of low noise wearing surface, levels of traffic noise are predicted to exceed relevant criteria at about 219 residential properties across the 11 project sections. This would necessitate the application of additional noise management measures at these properties. Noise mitigation locations would be further developed at the detailed design stage. Operation noise mitigation in some locations would include architectural treatments of properties

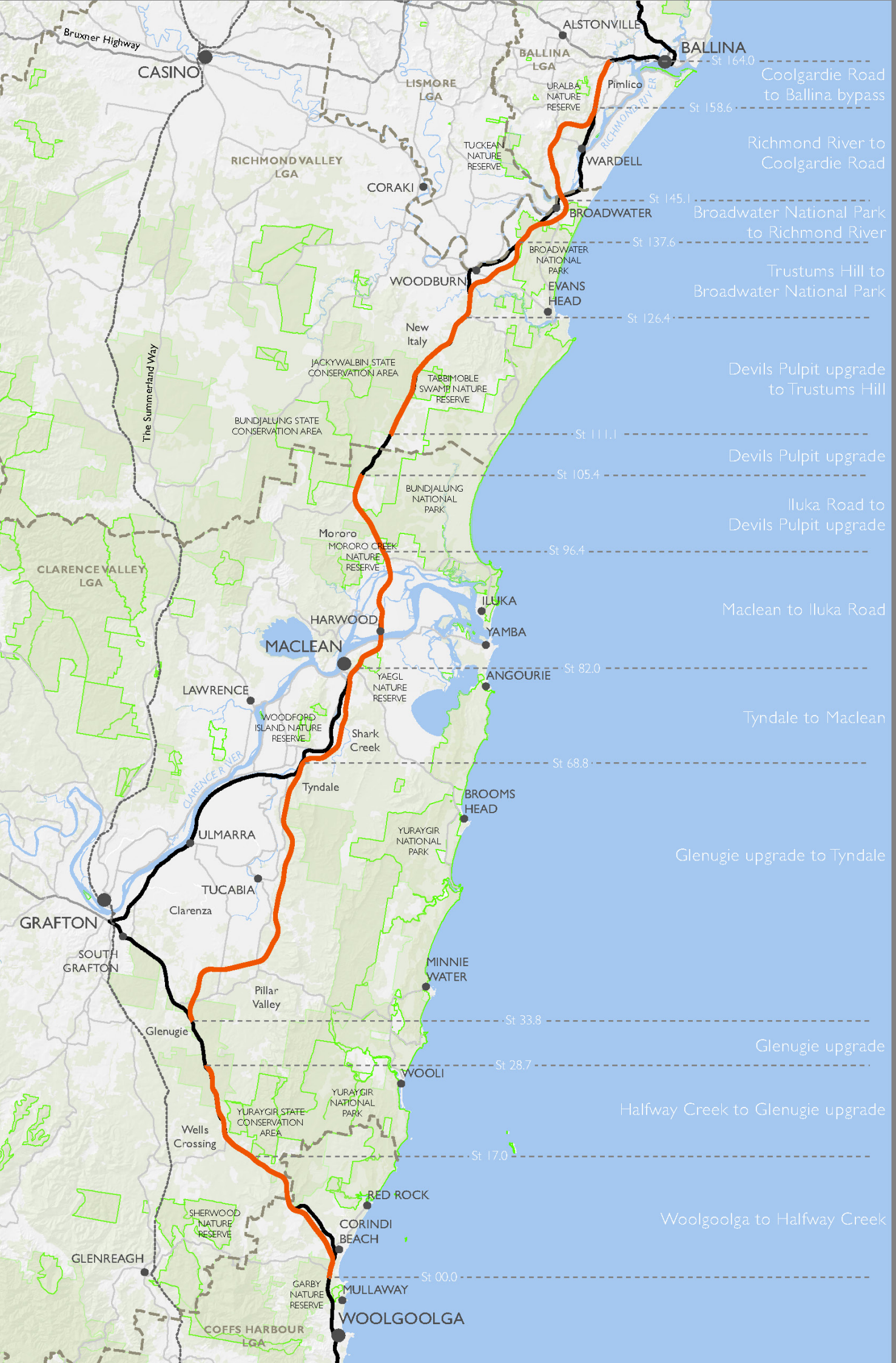
Management measures for both the construction and operation phases would be documented in a management plan to address noise during construction and operation.

Management measures would include consultation with potentially affected residents located on or near proposed ancillary sites during construction, and residents affected by construction activities during extended or out of hours work.



RMS 12.60B

ISBN 978-1-922041-81-4


Bruxner Highway
CASINO
ALSTONVILLE
BALLINA
BALLINA LGA
LISMORE LGA
URALBA NATURE RESERVE
Pimlico
RICHMOND RIVER
St 164.0
11
Coolgardie Road to Ballina bypass
St 158.6
TUCKEAN NATURE RESERVE
RICHMOND VALLEY LGA
WARDELL
Richmond River to Coolgardie Road
10
CORAKI
St 145.1
BROADWATER
Broadwater National Park to Richmond River
9
St 137.6
BROADWATER NATIONAL PARK
WOODBURN
EVANS HEAD
Trustums Hill to Broadwater National Park
8
St 126.4
New Italy
JACKYWALBIN STATE CONSERVATION AREA
TABBIMOBLE SWAMP NATURE RESERVE
The Summerland Way
Devils Pulpit upgrade to Trustums Hill
7
BUNDJALUNG STATE CONSERVATION AREA
St 111.1
Devils Pulpit upgrade
St 105.4
BUNDJALUNG NATIONAL PARK
Iluka Road to Devils Pulpit upgrade
6
Mororo
MORORO CREEK NATURE RESERVE
St 96.4
CLARENCE VALLEY LGA
ILUKA
HARWOOD
YAMBA
MACLEAN
Maclean to Iluka Road
5
St 82.0
ANGOURIE
YAEGL NATURE RESERVE
LAWRENCE
WOODFORD ISLAND NATURE RESERVE
Shark Creek
Tyndale to Maclean
4
St 68.8
CLARENCE RIVER
Tyndale
BROOMS HEAD
YURAYGIR NATIONAL PARK
ULMARRA
TUCABIA
Clarenza
GRAFTON
Glenugie upgrade to Tyndale
3
SOUTH GRAFTON
MINNIE WATER
Pillar Valley
St 33.8
Glenugie
Glenugie upgrade
St 28.7
WOOLI
YURAYGIR NATIONAL PARK
YURAYGIR STATE CONSERVATION AREA
Wells Crossing
Halfway Creek to Glenugie upgrade
2
St 17.0
RED ROCK
SHERWOOD NATURE RESERVE
CORINDI BEACH
Woolgoolga to Halfway Creek
1
GLENREAGH
St 00.0
GARBY NATURE RESERVE
MULLAWAY
WOOLGOOLGA
COFFS HARBOUR LGA

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# 15 Noise and vibration

This chapter presents a summary of a detailed assessment of potential issues relating to noise and vibration. The full assessment is presented in the Working paper – Noise and vibration (SKM, 2012). The assessment addressed the Director General's environmental assessment requirements, which are provided below.

| Director General's requirements | Where addressed |
|---|---|
| • Construction noise and vibration impacts, including impacts from construction traffic, ancillary facilities, batch plants and blasting. The EIS must identify sensitive receivers and assess construction noise/ vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc.; | Section 15.3.1 |
| • Cumulative impacts during construction, having regard to other developments (both existing and approved) in the locality, the staged construction of the project and the construction of adjoining Pacific Highway Upgrade projects; | Section 15.3.1 |
| • Operational road traffic noise impacts of the project (including service roads and rest areas) on sensitive receivers, including reflective noise impacts from proposed noise mitigation barriers and bridges; and | Section 15.3.2 |
| • Taking into account the following guidelines, as relevant:<br>  • NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011),<br>  • Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009),<br>  • Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006), and<br>  • Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (Australian and New Zealand Environment and Conservation Council, 1990). | Section 15.1<br>Section 15.1.2 |

## 15.1 Assessment methodology

### 15.1.1 Technical terms

This noise assessment uses technical terms that are described in more detail in the Working paper – Noise and vibration. These terms include:

- LA10: The noise level which is exceed for 10% of the sample period. During the sample period, the noise level is below LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.
- LA10 (18 hour): This is the arithmetic average of the L10 (1 hour) levels for the 18-hour period between 6am and 12 midnight on a normal working day
- LA90: The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below LA90 level for 10% of the time. This measure is commonly referred to as the background noise level.
- LAeq: The equivalent continuous sound level. This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise
- LAeq (15 hour): This is the average noise level (Leq) for the 15-hour period from 7am to 10pm
- LAeq (9 hour): This is the average noise level (Leq) for the nine-hour period from 10pm to 7am
- LAmax: The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

**KEY TERM – Sensitive receiver/receptor**

**An environmental modelling term used to describe a map reference point where the impact is predicted. A sensitive receptor is a home, work place, school or other place where people spend some time. An elevated receiver is a point above ground level.**

### 15.1.2 Construction noise guidelines

The construction noise assessment has considered the Environment Protection Authority (EPA) Interim Construction Noise Guideline (DECC, 2009), which requires a quantitative noise assessment of proposed public roads.

Construction noise has been assessed for various noise-generating activities that would be undertaken to construct the project. Typical activities would include soft soil treatment, clearing and mulching, earthworks, batching, haulage, blasting, bridge building, paving and asphalting, concrete saw-cutting and other high noise generating works.

Operational noise has been assessed based on forecast traffic using the project. Traffic forecasts have considered vehicles using the main alignment, interchanges, service roads, rest areas and heavy vehicle checking stations.

The assessment has considered the project's potential development in stages, split into 11 individual project sections. The Interim Construction Noise Guideline identifies that predicted noise management levels can be used to assess construction noise. These are project-specific criteria used to assess noise impacts at a sensitive receiver, such as a home, school or business. These criteria should be met where reasonable and feasible. Noise management levels have been derived from measured noise data (rating background level data) collected on site during background noise surveys. Because of the scale of the project, monitoring at representative receivers has informed the impact assessment. Noise levels have been applied to receivers, or broader noise catchment areas, using actual monitoring data collected at appropriate locations on site. The noise monitoring data is considered to be representative of the noise catchment areas used to assess noise impacts from the project. These are described in the Working paper – Noise and vibration

**KEY TERM – Noise catchment area (NCA)**

**A noise catchment area comprises the grouping together of sensitive receivers including residential dwellings into a single geographic area. Across the noise catchment area, there is likely to be a similar noise environment audible by residents and passers-by.**

A noise management level has been applied to the property boundary most exposed to construction noise. In cases where the property boundary is more than 30 metres from the residential receiver, the location for measuring or predicting noise levels is at the most noise-affected point. This would be within 30 metres of the residence, or one metre from the facade of the residence.

Residential and non-residential receivers have been classed as properties in the impact assessment and mitigation parts of this chapter.

The noise assessment has considered construction noise impacts within 600 metres of the project boundary. The construction noise assessment has been completed in line with relevant guidelines which do not stipulate a set assessment distance. The assessment has considered all construction work sites, which would potentially be used as ancillary sites, their footprint and likely construction activities across the project. The assessment is considered to be representative of typical construction activities taking place on large-scale infrastructure projects.

The Interim Construction Noise Guideline methodology used to derive noise management levels for both residential and non-residential receivers are described below. These criteria are from the Interim Construction Noise Guideline and apply to this type of assessment. This includes deriving a background noise level (RBL) for the shoulder periods (6–7am and 6–7pm) and the standard working hours of 7am–6pm. The lowest of these three background noise levels (RBL) has been used to assess noise impacts from construction for all proposed hours of working, to provide a more conservative noise assessment.

**KEY TERM – Background noise level**

**The ambient sound-pressure noise level in the absence of the sound under investigation exceeded for 90% of the measurement period. Normally equated to the average minimum A-weighted sound pressure level.**

**KEY TERM – Rating background level (RBL)**

**The median value of the assessment background levels values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night-time.**

## Residential criteria

The Interim Construction Noise Guideline (Table 2) identifies a noise management level for a residential receiver is described in Table 15-1**.** It outlines the procedures for determining a noise management level for a sensitive receiver and how the level should be applied across a 24-hour period.

**KEY TERM – Noise management level (NML)**

**A Noise Management Level is a noise target for construction activities, as described in the NSW Interim Construction Noise Guideline. Noise management levels can be assigned to noise catchment areas to inform construction noise management.**

This table shows construction noise levels at different times of day and what the potential impact could be in terms of different assessment outcomes. In the case of a residential receiver being highly noise affected, restrictions to construction work hours may apply. This is where construction noise would be above 75 dB(A) at a sensitive receiver.

**Table 15-1: Construction noise management levels**

| Construction work hours | Noise affected level | Assessment outcomes |
|---|---|---|
| Recommended standard hours:<br><br>Monday to Friday 7am–6pm<br><br>Saturday 8am–1pm<br>No work on Sundays or public holidays | Noise affected (RBL + 10 dB) | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all reasonable and feasible work practices to meet the noise affected level.<br>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, expected noise levels and an activity's duration. Contact details for a construction representative should be provided. |
| Outside recommended standard hours | Noise affected (RBL + 5 dB) | A strong justification would typically be required for works outside recommended standard hours.<br>The proponent, in this case RMS, should apply all reasonable and feasible work practices to meet the noise affected level.<br>Where all reasonable and feasible practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should then complete negotiations with the community.<br>For guidance on negotiating agreements refer to Section 7.2.2 of the Interim Construction Noise Guideline (DECC, 2009). |

RBL = the background noise level

## Non-residential criteria

For other land uses located near the project, the following noise criteria apply (from Section 4.1.2, Table 3 of the Interim Construction Noise Guideline):

- Industrial premises: external LAeq (15 minute) 75 dB(A)
- Offices, retail outlets: external LAeq (15 minute) 70 dB(A)
- Classrooms: internal LAeq (15 minute) 45 dB(A)
- Places of worship: internal LAeq (15 minute) 45 dB(A)
- Passive recreational areas: external LAeq (15 minute) 60 dB(A)

For further information, refer to the Working paper – Noise and vibration.

**KEY TERM – dB(A)**

**Decibels using the A-weighted scale measured according to the frequency of the human ear.**

Schools located near the project are shown in Figure 15-1 to Figure 15-11, and described in Table 15-2.

**Table 15-2: Location of schools**

| Receiver | Section | Noise catchment area | Distance from project centreline |
|---|---|---|---|
| Corindi Beach Public School | 1 | n/a | 850 metres |
| Chatsworth Public School | 5 | n/a | 1 kilometre |
| Woodburn Primary School | 8 | n/a | 1.25 kilometres |
| Maclean High School | 4 | n/a | 640 metres |
| Harwood Island Primary School | 5 | 5-e | 170 metres |
| Broadwater Public School | 9 | n/a | 630 metres |

Where a non-residential receiver is located within the noise study area, internal noise levels have been predicted. The assessment has estimated the different noise reduction characteristics of each building type common to a particular receiver. These estimates are shown in Table 15-3, which are based on typical data experienced on similar projects. The internal noise levels have been calculated using the predicted external level, less the noise reduction from the building facade.

**Table 15-3: Estimated non-residential sound reduction index**

| Building type | Estimated weighted sound reduction index Rw/dB(A) |
|---|---|
| Weatherboard | 20 |
| Demountable | 23 |
| Masonry | 30 |

Rw = weighted sound reduction index

### 15.1.3 Construction vibration

Vibration during construction can be separated into three types (DEC, 2006):

- Continuous: This is where vibration is uninterrupted. This vibration type can be from sources such as machinery and constant road traffic
- Impulsive: This is where vibration is over a short duration (typically less than two seconds) and happens less than three times in a study period. This period is not defined and could include activities like the occasional dropping of heavy equipment or loading/unloading activities
- Intermittent: This is where continuous vibration activities are regularly interrupted, or where impulsive activities recur. This could be from rock hammering, drilling, pile driving and movement of heavy vehicles or trains.

**KEY TERM – Vibration**

**Vibration is a force which can be created during some construction activities (eg rock hammering, drilling). Vibration is commonly expressed in terms of frequency such as cycles per second (cps), or cycles per minute (cpm) and can affect human comfort and the structural integrity of a building.**

Vibration impacts from construction have been considered using the criteria in the following guidelines:

- The Environment Protection Authority (EPA)'s Assessing Vibration: A Technical Guideline (DEC, 2006); and the Australian Standard AS 2670.2 *Evaluation of Human Exposure to Whole-body Vibration*, for the assessment of human comfort within a building
- The Australian Standard AS 2187.2-2006 Explosives – Storage, Transport and Use, based on the British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings. This can assess the potential for structural damage to buildings from vibration. In particular, the standard considers the likelihood of building damage from ground vibration including piling, compaction, construction equipment and road and rail traffic. BS 7385 provides levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur
- In the absence of an appropriate relevant Australian standard, German Standard 4150-3 *Structural Vibration, Part 3: Effects of Vibration on Structures* (DIN 4150-3) provides further guidance on how to assess ground vibration. The standard provides guide values for short term vibration impacts for sensitive receivers including heritage buildings/structures
- The Australian and New Zealand Environment Council (ANZEC) guidelines. These are based on data contained in Australian Standard AS 2187.3-2006 *Australian Standard: Explosives – Storage and Use*. These guidelines can be used to assess ground-borne vibration and overpressure from air blasts. This assessment helps to consider impacts on human amenity and/or buildings and infrastructure at sites near to controlled blasting (that is, those sites where explosives are used to create a deep excavation, hole or 'cut' within the landscape).

A summary of the minimum vibration limits for human comfort and building damage is provided in Table 15-4. These limits provide the lowest threshold levels for identifying impacts on residential dwellings and their inhabitants. Guidelines for vibration impact assessment are further described in the Working paper – Noise and vibration.

**Table 15-4: Vibration criteria summary**

| Area | Vibration limit |
|---|---|
| Human comfort 1-80 Hz (continuous) | 0.01 m/sec$^2$ daytime |
| | 0.007 m/sec$^2$ night-time |
| Human comfort 1-80 Hz (impulsive) | 0.3 m/sec$^2$ daytime |
| | 0.1 m/sec$^2$ night-time |
| Human comfort 1-80 Hz (intermittent – vibration dose value) | 0.2 m/sec1.75 daytime |
| | 0.13 m/sec1.75 night-time |
| Residential building damage – BS7385 | 15 mm/sec |
| Heritage building damage – DIN4150-3 | 3 mm/sec |
| Air blast overpressure | Must be not more than 115 dB peak for 95% of blasts over 12 months<br>Must not exceed 120 dB peak for any blast |
| Blast-induced ground-borne vibration | Must not exceed a peak particle velocity of 5 mm/sec for 9 out of any 10 consecutive blasts, regardless of the interval between blasts<br>Must not exceed a peak particle velocity of 10 mm/sec for any blast. |

### 15.1.4 Construction activities

The construction activities proposed for the project have been assessed for the noise and vibration study. These are identified in Table 15-5. At this stage, construction methods are indicative and may change during detailed design.

**Table 15-5: Summary of construction activities**

| Area | Vibration limit |
|---|---|
| **Soft soil treatments (early and enabling works)** | |
| Fill activities | Bulk earthworks including dumping of fill material, spreading and compaction.<br>These works would be undertaken in specific areas only and not across the entire project corridor. |
| **Formation, clearing and mulching** | |
| Ground clearance | Clearing and grubbing of vegetation and processing of materials (such as timber for milling, or stockpiling as mulch).<br>These works would be undertaken along the length of the project corridor. |
| **Earthworks** | |
| Earthworks and ground preparation | Excavation of cuttings, including processing, stockpiling or haulage of material, batter stabilisation (such as benching, rock bolting and/or soft seam treatment) and cut foundation treatments such as the installation of rock drainage blankets (where required).<br>These earthworks would be undertaken along the length of the project corridor. For the purpose of the assessment, earthworks do not include controlled blasting, which is assessed separately (see below). |
| **Ancillary sites, compounds and concrete batch plants** | |
| Construction compounds including site offices, stockpiles and concrete batch plants | Office activities, deliveries, preparation of services equipment (gantries, lighting rigs etc), equipment repairs, concrete production and dispatch, materials stockpiling.<br>These would be undertaken across about 90 ancillary sites covering the length of the project corridor. Some would be within the construction boundary; others would be a short distance from the boundary. |

| Area | Vibration limit |
|---|---|
| **Haulage Routes** | |
| Heavy vehicle movements | Hauling fill between compounds, ancillary sites, quarries and work areas.<br>Haul routes would be located between the project corridor and ancillary sites. Where possible, existing routes (including the existing and proposed alignment) are to be used as haul routes. |
| **Blasting** | |
| Cutting activities – specifically those related to controlled blasting | Blasting would be undertaken at specific cut locations along the length of the project. Blasting would only occur in hard rock. The need for blasting would be confirmed prior to construction following further geotechnical investigations.<br>Any blasting would be undertaken in accordance with the Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (Australian and New Zealand Environment Council, 1990) and the Australian Standard AS 2187.2-2006 Explosives – Storage and use in populated areas.<br>With regard to blasting limits, RMS proposes greater flexibility in the application of these guidelines to achieve greater efficiency with earthworks and the construction program. Opportunities to review the criteria in detailed design would be considered by RMS taking into account the locations where blasting would be required, the blast design, identified impacts, and the consultation and management strategy, as necessary. Where necessary, any variation in blasting vibration limits would be negotiated with affected landowners and agreed with the Department of Planning and Infrastructure. |
| **Bridge building** | |
| Construction of small-scale and large-span bridges | Construction of bridges, including foundations (driven and/or bored piles, pile caps and pad footings), bridge abutments, bridge piers and pile caps, bridge superstructure (including bearings, girders, deck and parapets) and miscellaneous works such as deck water proofing, asphalt surfacing and the installation of bridge railings and anti-throw screens.<br>There would be about 15 bridges over 100 metres long. |
| **Paving and asphalting** | |
| Road surface construction | Laying of road surface, including concreting, asphalt laying and rolling, and concrete saw-cutting.<br>These works would be undertaken along the length of the project. |

For the purpose of the construction noise assessment, each of these activities has been considered separately to identify specific impacts. Where there is potential for simultaneous construction activities to occur, these have been assessed qualitatively. For the purpose of this assessment, construction activities such as earthworks, formation, clearing, paving and asphalting, are referred to as ‘linear construction works’.

**Photo 1: Typical general construction activities including earthworks**

No single construction scenario is necessarily classed as ‘high noise generating’; rather, the individual plant item is classed as such (eg a road miller, concrete saw-cutting or impact piling rig). Therefore, impacts from high-noise-generating plant have been assessed and are included in the assessment. For details refer to the Working paper – Noise and vibration.

Table 15-6:  summarises the likely equipment to be used during each stage of construction and their sound power levels. The range and types of equipment used would be confirmed during detailed design. The table also identifies the modelling method used to predict noise levels.

**Table 15-6: Proposed equipment and associated sound power levels (per area of work)**

| Activity | Plant noise source | LAeq Sound power level dB(A) | |
|---|---|---|---|
| Site enabling works (soft soil treatments) | 2 x Excavator – 30 tonne<br>1 x Dozer – 20 tonne<br>18 x Product truck – 4 axle, 25t<br>2 x Vibratory compactor – 12 tonne<br>1 x Padfoot compactor<br>1 x Grader – 25 tonne<br>1 x Smooth barrel roller – 18 tonne<br>1 x Water cart – extracting water | 103<br>103<br>108<br>112<br>107<br>114<br>107<br>107 | Modelled as single point source at shortest separation to receivers taking account of plant operating duration. |
| Formation, clearing and mulch | 2 x excavator – 30 tonne<br>1 x dozer – 20 tonne<br>18 x product truck – 4 axle, 25 tonne<br>2 x vibratory compactor – 12 tonne<br>1 x padfoot compactor<br>1 x grader – 25 tonne<br>1 x smooth barrel roller – 18 tonne<br>1 x water cart – extracting water | 103<br>103<br>108<br>112<br>107<br>114<br>107<br>107 | Modelled as single point source at 25 metre intervals along the project with highest level at each receiver reported, taking account of plant operating duration. |
| Earthworks | 2 x excavators (30 tonne)<br>2 x dozers (20 tonne)<br>18 x product trucks – 4 axle (25 tonne)<br>2 x vibratory compactors (12 tonne)<br>1 x padfoot compactor<br>1 x grader (25 tonne)<br>1 x smooth barrel roller (18 tonne)<br>1 x watercart (to extract water)<br>1 x backhoe<br>2 x front end loaders<br>2 x scrapers | 103<br>103<br>108<br>112<br>107<br>114<br>107<br>107<br>110<br>114<br>108 | Modelled as single point source at 25-metre intervals along the project with highest level at each receiver reported, taking account of plant operating duration. |
| Paving and asphalting | 2 x generators<br>2 x backhoes<br>1 x asphalt paver<br>1 x concrete paver<br>1 x concrete truck<br>1 x concrete vibrator<br>2 x concrete saws<br>2 x bob cats | 111<br>110<br>111<br>111<br>111<br>110<br>105<br>104 | Modelled as single point source at 25-metre intervals along the project with highest level at each receiver reported, taking account of plant operating duration. |
| Bridge works | 1 x impact piling rig<br>1 x bored piling rig<br>1 x pneumatic hammer<br>1 x excavator<br>3 x haul trucks<br>2 x generator<br>2 x mobile cranes (45 tonne)<br>1 x concrete truck<br>1 x concrete pump<br>2 x air compressors<br>1 x air ratchet gun | 121<br>114<br>113<br>112<br>112<br>111<br>105<br>110<br>107<br>105<br>101 | Modelled as single point source at 10-metre intervals along the bridgework boundary with highest level at each receiver reported, taking account of plant operating duration. |

| Activity | Plant noise source | LAeq Sound power level dB(A) | |
|---|---|---|---|
| Haul roads | 25-tonne haul trucks (various numbers) | 108 | Modelled as various point sources along haul road length, taken account of road length, assumed truck speed and truck sound exposure level (SEL) |
| Ancillary sites – stockpiles | 1 x excavator (30 tonne)<br>1 x dozer (20 tonne)<br>2 x product trucks – 4 axle (25 tonne)<br>1 x watercart (water bowser)<br>1 x backhoe<br>2 x front-end loaders | 103<br>103<br>108<br>107<br>110<br>114 | Modelled as an area source from sum of all sound power of all plant operating, taking account of plant operating duration. |
| Ancillary sites – concrete batching plant | Batch plant | 120 | Modelled as an area source from the sum of all sound power of all plant operating, taking account of plant operating duration. |
| Ancillary sites – site offices | Office vehicles | - | Construction activity noise not anticipated. |
| Ancillary sites – plant workshop | 1 x product truck – 4 axle (25 tonne)<br>1 x front-end loader<br>2 x forklift trucks<br>3 x powered hand tools | 108<br>114<br>101<br>115 | Modelled as an area source from the sum of all sound power of all plant operating, taking account of plant operating duration. |

### 15.1.5 Construction noise modelling and prediction

Noise from each construction activity has been considered to predict impacts at each residential and non-residential receiver within 600 metres of the project centreline (based on a representative sample). Predicted noise levels have been calculated using SoundPLAN modelling software. Potential noise impacts have been modelled using the CONCAWE algorithm. This approach has assumed typical equipment and likely operating areas for construction plant across the project. Noise emissions from individual plant items have been corrected for their likely usage (in terms of ratio ‘on’ and ‘off’). Because the Interim Construction Noise Guideline assessment period is 15 minutes, the correction factor applied to the assessment is often minimal.

Noise predictions have considered the shielding likely to be provided by the existing topography found across the project. However, shielding from buildings has not been included in the noise model. For this reason, predictions are likely to equate to maximum noise levels. In built-up areas (eg Maclean) buildings and adjoining properties are likely to provide some degree of screening resulting in lower noise levels.

As noted above, the noise model has considered the existing terrain across the project. The model has excluded project cuttings to provide for a conservative assessment. Noise from cuttings could initially be substantial until the floor level drops below the natural ground surface. Although noise from blasting at sites requiring cutting would reduce as the cutting depth increases, a worst case assessment has been undertaken.

Meteorological factors have assumed a light breeze (two metres per second) blowing from a noise source to the noise receiver. The assessment has also considered as temperature inversion. This can mean noise is more audible during certain weather conditions, which can increase predicted noise levels. This is of particular note for receivers more than 500 metres away from a noise source.

Each construction activity's predicted noise impact has been considered against noise management targets for each project section. Where impacts are predicted to exceed appropriate limits, mitigation measures have been recommended. Noise management levels have been derived from the results of baseline noise monitoring. These levels have been used to check if there are likely to be noise exceedances or not. Monitoring has taken place across the study area to collect background noise levels used in this assessment. It has not been possible to monitor noise at all locations so receivers have been grouped into noise catchment areas (see the Working paper – Noise and vibration for maps showing the noise catchment areas). The noise environment in a noise catchment area is likely to be similar for all receivers. Because of this, to predict noise each receiver has been assigned the same background noise level (RBL) and noise management level.

Noise emissions included in the model have been based on a range of values from similarly large infrastructure projects, Australian Standard 2436 *Guide to noise and vibration control on construction, demolition and maintenance sites*, and other noise-level databases provided by government agencies.

### 15.1.6 Proposed construction hours

The following working hours are proposed for the project:

- Monday to Friday: 6am to 7pm
- Saturday: 8am to 5pm
- Sunday and Public Holidays: no work.

These proposed hours of work include what are termed 'extended working hours' within the construction industry. RMS is proposing to operate two additional hours each weekday and four additional hours on Saturday (standard construction hours in NSW are 7am–6pm Monday to Friday, and 8am–1pm on Saturday). This would be throughout the construction phase across all 11 project sections. RMS is proposing to extend working hours in response to a NSW Government Submission to Infrastructure Australia. The rationale for proposing extended working hours is to improve construction efficiencies and to complete construction of the project earlier than would otherwise be the case with normal working hours.

Early completion of construction would provide considerable benefits to the community and road users. In particular, it would:

- Reduce the volume of traffic on the roads during peak hours (construction staff and some construction vehicles would travel to and from the work sites outside peak traffic periods)
- Potentially bring forward the opening date for the project
- Cause less disruption to the community, local business, motorists, pedestrians and cyclists as work would be completed earlier than currently planned
- Enable greater flexibility in project scheduling; this would enable the contractor to make allowances for adverse weather or reduce impacts at the weekend should there be a need (such as a special community event).

To assess these proposed working hours, a consideration of background noise levels outside the daytime period is required. Only one hour of each of the adjacent assessment periods needs to be assessed and these are termed shoulder periods. Information outlined in the Interim Construction Noise Guideline does not provide a firm method of setting noise management level for the shoulder periods; however, the application notes for the NSW Industrial Noise Policy (EPA, 2000) provide methods for assessing noise during these periods.

Deriving project-specific noise management levels for the proposed working hours involves various steps. These include deriving a background noise level (RBL) for the shoulder periods (6am–7am and 6pm–7pm) and the standard working hours of 7am–6pm. The lowest of these three background noise levels (RBL) has been used to assess noise impacts from construction for all proposed hours of work. This assessment approach provides the most conservative noise management level (and is therefore more likely to overstate than understate the potential impacts).

## Out of hours work

### Guidelines for undertaking out of hours work

Construction of the project would typically occur during the proposed hours of work noted above. However, major infrastructure projects sometimes require night-time or 'out of hours work' for health and safety reasons or because of particular construction/engineering requirements. Generally, out of hours work is considered reasonable where the noise level is 10dBA below the RBL (rating background level) at the nearest or most affected receiver locations. However, sometimes out of hours work can have a noise impact and so has to be managed.

The Interim Construction Noise Guidelines have been developed by a number of NSW government agencies to provide guidance on managing noise from construction work in NSW. Section 2.3 of the guidelines provides details on the five categories of work that might be undertaken outside the recommended standard hours. These categories are:

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

In addition, the guidelines state that, in general, only work undertaken on public infrastructure needs to be undertaken outside the recommended standard hours. This need is typically based on a requirement to sustain the operational integrity of public infrastructure, as work to restore operation of the infrastructure provides a benefit to the greater community (that is, more than just local residents).

Activities that may be undertaken outside the standard hours and would have some level of noise impact typically include, but are not limited to:

- The delivery of materials (such as oversize elements of plant and large construction equipment) required outside these hours by the Police or other authorities for safety reasons
- Bridge work:
  - The lifting and setting of bridge spans, particularly highway overpasses
  - The lifting and setting of girders over the existing highway or road network
  - The demolition of existing highway bridges
- Road tie-in work (the tie-ins of the project to the existing highway would need to maintain the safety of the travelling public)
- Traffic management and traffic switches (to reduce inconvenience to road users and to provide safety for construction workers working on existing highway)
- Utility relocations near the existing highway
- Compound operations required to support any activities which may be undertaken out of hours
- Refuelling operations (to maximise the plant and machinery operations during the recommended standard hours)
- Work required in an emergency to avoid the loss of lives and property, and/or to prevent environmental harm
- Short-term major traffic diversions, including full or partial road closures of the existing highway
- Work that would not cause construction noise disturbance at any sensitive receivers
- Work as agreed between RMS and potentially affected sensitive receivers

- Work as agreed by the Environment Protection Authority
- Deliveries to asphalt and concrete batch plants
- Concrete paving, concrete saw-cutting and concrete batch plant operations (including truck deliveries). In some places, the project would use plain concrete pavement, which is an unreinforced pavement. To manage cracking associated with drying and shrinkage, saw cutters are used to cut the pavement. The timing of concrete cutting is governed by the hydration rate of the concrete and may require cutting at any time within four and 24 hours after paving, with a 'cutting window' as short as 30 minutes. As the timing of the cutting is critical to the quality of the pavement and acceptance of the finished product, concrete saw-cutting may be needed at any time including outside standard construction hours. Concrete saw-cutting is a construction activity that is transient in nature, and each saw cut would be of a short duration.

## Assessing impacts of working out of hours

The assessment has provided a series of maps to show likely noise impacts, which are included in the Working paper – Noise and vibration. These maps indicate where out of hours work could happen with minimal impact. Where high noise impacts are predicted, targeted consultation with receivers would be required. Appropriate noise management would be required; mitigation measures are included in Section **Error! Reference source not found.** .

The risk matrix in Table 15-7 categorises risk levels from construction works at nearby properties (ie receivers). The levels are based on a comparison with the proposed noise management level (NML), and the Interim Construction Noise Guideline 'highly noise affected' level of 75 dB(A). Table 15-8 describes what measures would be required to permit out of hours work to go ahead.

**Table 15-7: Out of hours risk matrix for impact**

| Predicted noise levels | | | | |
|---|---|---|---|---|
| | < (NML -10 ) | (NML -10) to NML | NML to (NML +5) | > (NML + 5) |
| | No impact | Low impact | Moderate impact | High impact |
| No impact | Closest out of hours construction works predicted to be a level of 10 dBA below the RBL (rating background level). | | | |
| Low impact | Construction levels equal to the out of hours noise management level are unlikely to cause significant disturbance. This is in terms of the majority of receivers, particularly for short-term work periods. | | | |
| Moderate impact | Levels exceeding the out of hours noise management level by up to 5 dB(A) would be perceptible by the majority of receivers. The impact would be greatest in highly populated areas. Where areas are less populated, the potential for mitigation is more achievable. Therefore, impacts may be mitigated. | | | |
| High impact | Levels exceeding the out of hours noise management level by more than 5 dB(A) would be perceptible by almost all receivers. Receivers exposed to this magnitude of impact are likely to be significantly affected. The potential for adverse community reaction is almost certain without mitigation/management measures. | | | |

NML = noise management levels

**Table 15-8: Out of hours risk matrix for identification of suitable work areas**

| Area classification | Requirements |
|---|---|
| Unrestricted | Closest out of hour construction work predicted to be a level of 10 dBA below the RBL (rating background level). Therefore, the work area is considered suitable for out of hours work without the need for specific consultation, assessment, management or mitigation. |
| Restricted with consultation | Area is suitable for out of hours work. Consultation would be required at the nearest noise-sensitive receivers. All feasible and reasonable mitigation measures would be required. |
| Restricted with further assessment and consultation | Out of hours construction works may be suitable for these areas. This is provided reasonable justification can be provided. A detailed noise assessment and suitable targeted community consultation would be required. All feasible and reasonable mitigation would be required. |
| Highly restricted | Standard construction work is unlikely to be suitable for these areas for all but the most essential of work, ie one of the following:<br>• Work to satisfy health and safety requirements<br>• Work required by emergency services<br>• Work required on existing highway where total road closures are required<br>• Work required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm<br>• Work where there is a strong technical or engineering reason (eg concrete saw–cutting).<br>Even in the above circumstances, strong justification for the work would be required. Community consultation and mitigation would be required. |

## Community consultation

To permit work outside of standard construction hours, community consultation would be required in line with guidance from the Interim Construction Noise Guideline. Part 2.3 of this guideline indicates that construction activities are possible outside of standard hours where work on public infrastructure is required. The requirement is that the work should shorten the construction period and community consultation has taken place.

For this project, community consultation would include the following measures:

- Receivers potentially impacted by construction activities would be identified through the construction noise assessment. Impacts would be based on predicted noise impacts from the adopted extended working hours
- Identified receivers would be notified by letter of the proposed hours and asked for comment and feedback. This would include justification for the proposed extended working hours along with the benefits the community can expect
- Where the community or individual residents wish to receive further clarification on the proposed hours, individual interviews or public meetings would be organised to address any further issues. Discussions would be sufficiently detailed to provide a general summary of the expected impacts but also how this relates to individual receivers
- Property owners would be provided with the complaints management procedures for extended working hours
- Feedback would be collected prior to construction to help determine the final adopted working hours for the project, with community consultation continuing throughout the project.

### 15.1.7 Traffic noise during construction

The NSW Roads Noise Policy does not provide guidelines to assess road traffic noise from construction. In general, an increase in traffic numbers of at least 25 per cent (or decrease of 20 per cent) is required to change noise levels by 1 dB(A). Where construction traffic would use newly built haul roads, this impact has been assessed against noise management levels related to general work activities.

Noise impacts from haulage have been assessed where a completely new haul road is required. Noise impacts have been considered based on predicted construction traffic numbers, sourced from the Working paper – Traffic and transport.

### 15.1.8 Controlled blasting assessment

Controlled blasting can cause noise impacts from:

- Air-blast overpressure: A pressure wave is created by an explosive movement of rock and gases at the blast trigger point, and is transmitted through the air
- Ground-borne vibration: This is generated at the moment of the blast and transmitted through the ground. The effects of vibration can be divided into three main categories:
    - Occupants or users of the building are disturbed or inconvenienced
    - The building contents may be affected
    - The integrity of the building or the structure itself may be prejudiced.

Controlled blasting would mainly be restricted to where deep excavation or cuttings are required, and where cuttings cannot be excavated economically using mechanical equipment. RMS has identified several cuttings likely to require controlled blasting to open up the ground. To provide an indication of potential impact, a general assessment has considered the receivers potentially affected. However, the assessment has not calculated a minimum separation distance between the blast site and receivers.

Acceptable blast levels have been worked out using the Australian Standard 2187.2-2006, as shown in Table 15-9. Maximum blast levels may vary from site to site. Acceptable limits would depend on the geology of an area, local shielding from the terrain and meteorological factors. Trials can also help to determine site-specific blast response characteristics, and ensure that the vibration and over-pressure objectives can be met.

**Table 15-9: Summary of typical MIC (maximum instantaneous charges) and compliant separation distance**

| Criteria<br>Charge size | | Charge separation distance (metres) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 kg | 5 kg | 10 kg | 15 kg | 20 kg | 25 kg |
| Over- pressure | Residential | 175 | 290 | 375 | 440 | 490 | 530 |
| | Commercial | 80 | 138 | 172 | 190 | 220 | 230 |
| Vibration | Residential | 29 | 66 | 94 | 115 | 133 | 149 |
| | Commercial | 11 | 24 | 34 | 42 | 48 | 54 |

### 15.1.9 Operational road noise impacts

The assessment of operational road traffic noise impacts has been guided by the NSW Office of Environment and Heritage Road Noise Policy (OEH, 2011) and RMS' Environmental Noise Management Manual (RTA, 2001).

These guidelines describe noise criteria and assessment methods for road projects in NSW, and can be used to assess noise impacts on sensitive receivers such as houses, schools and businesses. (Receivers are the occupants of properties including residential dwellings, caravan parks, and schools that would be most likely to be affected by road traffic noise.)

The assessment of operational noise has considered a study area of 600 metres either side of the project's centreline as per the Road Noise Policy. Noise level targets from the guidelines have been applied to those residential and non-residential receivers identified in the study area. Where noise goals cannot be achieved through the design of the project, noise mitigation would be required (to the noise-affected properties).

Road traffic noise criteria from the Road Noise Policy have been used in this assessment. The noise assessment has also considered "interim approaches" provided by RMS, as a supplement to the Road Noise Policy. These interim approaches describe how the Environmental Noise Management Manual (RTA, 2001) applies to the Road Noise Policy.

**Photo 2: View along the existing Pacific Highway near Tyndale**

#### Base criteria

Under the Road Noise Policy, road development is classed as 'new road' or 'redevelopment of an existing road'. The appropriate noise goals for the daytime and night-time assume noise levels 10 years after the project has opened (this is termed the 'design year'). The noise criteria for each road classification are listed in Table 15-10.

**Table 15-10: Road traffic noise base criteria**

| Road category | Type of project | Noise criteria | |
|---|---|---|---|
| | | Daytime 7am–10pm | Night-time 10pm– 7am |
| Freeway, arterial and sub-arterial roads | 1. Existing residences affected by noise from new freeway, arterial, or sub-arterial road corridors | LAeq (15 h) 55 dB(A) | LAeq (9 h) 50 dB(A) |
| | 2. Existing residences affected by noise from redevelopment of existing freeway, arterial, or sub-arterial roads | LAeq (15h) 60 dB(A) | LAeq (9h) 55 dB(A) |

Where the project duplicates the existing Pacific Highway, the nearest sensitive receivers have been set an external daytime noise level of 60 dB(A) and night-time level of 55 dB(A). Where the project deviates from the existing Pacific Highway, the noise criteria relate to the new freeway criteria (ie using the 'new road' criteria of 55 dB(A) during the daytime and 50 dB(A) during the night-time).

## Additional criteria

The Environmental Noise Management Manual (RTA, 2001) identifies a category of sensitive receivers classed as 'acutely affected'. Within the project, where receivers experience noise levels greater than or equal to LAeq (15 hour) 65 dB(A) and LAeq (9 hour) 60 dB(A), impacts would be classed as 'acute'. In these instances a detailed assessment of noise mitigation is necessary.

The Road Noise Policy includes recommendations that a relative increase of more than 12 dB(A) in total traffic noise requires mitigation to be considered. This relative increase criterion does not apply for open spaces or where the main road to be assessed is a local road. Table 15-11 presents a summary of the relative increase criteria adopted across the project.

**Table 15-11: Relative increase criteria for residential land use**

| Road category | Type of proposal/land use | Total traffic noise level increase dB(A) | |
|---|---|---|---|
| | | Daytime noise criteria | Night-time noise criteria |
| Freeway/arterial/ sub-arterial roads | New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road | Existing traffic LAeq (15 h) + 12 dB (external) | Existing traffic LAeq (9 h) + 12 dB (external) |

Assessment criteria for other non-residential land uses are listed in Table 15-12 (this is from Section 2.3.2 of the Road Noise Policy).

**Table 15-12: Noise criteria for non-residential land use**

| Existing sensitive land use | Assessment criteria dB(A) | | Additional considerations |
|---|---|---|---|
| | Day (7am-10pm) | Night (10pm-7am) | |
| School classrooms | LAeq (1 h) 40 (internal) when in use | _ | In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia, 2000). |
| Hospital wards | LAeq (1 h) 35 (internal) | LAeq (1 h) 35 (internal) | |
| Places of worship | LAeq (1 h) 40 (internal) | LAeq (1 h) 40 (internal) | |

| Existing sensitive land use | Assessment criteria dB(A) | | Additional considerations |
|---|---|---|---|
| | Day (7am-10pm) | Night (10pm-7am) | |
| Open space (active use) | LAeq (15 h)<br>60 (external) when in use LAeq (15 h) | – | Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, eg playing chess, reading. In determining whether areas are used for active or passive recreation, the type of activity that occurs in that area and its sensitivity to noise intrusion should be established. For areas where there may be a mix of passive and active recreation, eg school playgrounds, the more stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses. |
| Open space (passive use) | LAeq (15 h)<br>55 (external) when in use | – | |
| Isolated residences in commercial or industrial zones | – | – | For isolated residences in industrial or commercial zones, the external ambient noise levels can be higher than those in residential areas. Internal noise levels in such residences are likely to be more appropriate in assessing any road traffic noise impacts, and the proponent should determine suitable internal noise level targets, taking guidance from Australian Standard 2107:2000 (Standards Australia, 2000). |
| Mixed use development | – | – | Each component of use in a mixed use development should be considered separately. For example, in a mixed use development containing residences and a childcare facility, the residential component should be assessed against the appropriate criteria for residences. |
| Childcare facilities | LAeq (1 h)<br>35 (internal)<br>– Play areas<br>Indoor<br>40 (internal)<br>Outdoor<br>55 (external) | – | Multi-purpose spaces, eg shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility or, if these are not known, during the highest hourly traffic noise level during the opening hours of the facility. |
| Aged care facilities | – | – | Residential land use noise assessment criteria should be applied to these facilities. |

### Maximum noise level assessment: sleep disturbance

Noise that exceeds a relatively continuous ambient noise level is more likely to wake people up. This can generate annoyance within the community. For assessment purposes, at locations where traffic noise is continuous rather than intermittent, the Environmental Noise Management Manual (RTA, 2001) makes recommendations that these impacts be considered based on the LAmax over the LAeq (1 hour) noise level.

While the sleep disturbance guideline does not necessarily require mitigation, the assessment has considered where this might be necessary.

## 15.1.10 Rest areas and vehicle checking stations

Rest areas and vehicle inspection stations do not generate the same type of continuous noise as a major road. Noise types at rest areas are likely to vary. Noise could be created by a mixture of heavy vehicles, passenger vehicles, refrigerated units, and short-term loud noises such as car doors and truck air brakes. The noise types at vehicle inspection stations might consist of heavy vehicles at slow speeds only, and staff occupying a site office, weighbridge and inspection area.

The NSW Industrial Noise Policy (EPA, 2000) provides guidance on how to assess noise emissions from premises that are scheduled under the *Protection of the Environment and Operations Act 1997*. The Industrial Noise Policy identifies acceptable levels of impact from various noise sources that might have the potential to affect sensitive receivers. Noise levels from rest areas should therefore be managed as they could create some degree of noise impact.

While the Industrial Noise Policy is not strictly used for the assessment of non-industry based noise emissions, the criteria can be used to provide guidance on appropriate noise levels. The Industrial Noise Policy requires the project to comply with the lower of the amenity or intrusive noise criteria. The intrusive level requires the noise level to be no greater than 5 dB(A) above the background level (RBL). The amenity level considers the zoning and general land use of the properties likely to be affected by noise.

According to the Industrial Noise Policy, a noise source is considered non-intrusive if:

- The LAeq (15 minute) level does not exceed the background noise level (RBL) by more than 5 dB(A) for each of the day, evening and night-time periods
- The subject noise does not contain tonal, impulsive, or other modifying factors as detailed in Chapter 4 of the Industrial Noise Policy.

## 15.1.11 Operational and construction noise

### Receiver identification and background noise monitoring

Residential and non-residential receivers potentially sensitive to noise have been identified using cadastral information and aerial photography. The receiver locations were used to identify where to measure background noise along the length of the project. The noise levels at these locations have been measured using noise monitoring loggers. Monitoring took place at the same time as vehicle counts so that measured noise levels could be correlated with traffic numbers. This data provide baseline noise levels, which have been used in the noise model used in this assessment. The project noise model predicts noise from the project once it is open to traffic. The noise model has been calibrated against data collected during the background noise survey.

**KEY TERM – Noise logger**

**A data logging device (data and audio in some cases) which records noise. Usually used for unattended noise monitoring of background or ambient noise.**

Monitoring was undertaken between February and March 2012. Background noise monitoring has been completed in line with Australian Standard AS 2702 *Methods for the Measurement of Road Traffic Noise* and AS 1055:1997 *Description and Measurement of Environmental Noise*. The monitoring approach also considered the requirements of the Environmental Noise Management Manual (RTA, 2001) and Road Noise Policy.

To capture noise level data, unattended and attended monitoring was undertaken. The unattended monitoring used equipment to gather statistical data continually over the survey period. The attended monitoring collected data over short periods (around 15 minutes). Property access was obtained for 56 unattended monitoring locations and 12 attended monitoring locations. These measurements helped to establish the existing noise environment across the 11 project sections between Woolgoolga and Ballina. The monitoring locations were chosen as potentially being most noise affected or representative of the noise environment in each section.

In assessing road traffic noise, these periods were defined as:

- LAeq (15 hour) representing the LAeq noise level for the daytime period 7am–10pm
- LAeq (9 hour) representing the LAeq noise level for the night-time period 10pm–7am.

Noise monitoring data has also been used to measure the background noise level for daytime, evening and night-time periods, to inform the construction noise assessment. Background noise levels provide the base levels against which construction noise goals can be set. In specifying the project noise goals, target construction noise goals can be set to minimise the likelihood of there being disturbance.

## Modelling of existing road traffic noise and project noise

Noise modelling has been used to establish noise impacts using different inputs. These include terrain data, current and projected traffic volumes and mixes, and the existing and proposed highway design. The noise model has then been calibrated using monitoring data from field surveys. The model has been used to predict noise levels at all receiver locations for each assessment scenario.

The assessment considered two main scenarios:

- The year of project opening (assumed to be 2016)
- A design year (typically 10 years) after opening (assumed to be 2026).

For each of these timeframes, a comparison has been made between the road traffic noise levels if the project goes ahead (this is the ‘build option’), and the corresponding road traffic noise levels, from typical traffic growth if the project did not go ahead (this is the ‘no build option’).

Modelling of traffic noise levels used the Calculation of Road Traffic Noise method and the SoundPLAN noise-modelling program. The Calculation of Road Traffic Noise method predicts the LA10(18h) and the LA10(1h) noise levels at a given receiver. This is based on specific project design inputs. The model includes several variables including traffic volumes, traffic mix, traffic speed, road surface conditions, road gradient, surface terrain, building heights, facade reflections, air and ground absorption. Model inputs are discussed in more detail in Part A of the Working paper – Noise and vibration.

Modelled noise levels have been predicted in terms of an LA10 level. This has then converted to an LAeq level, which has then been compared with road noise criteria from the Road Noise Policy. RMS and the Environment Protection Authority recommend a general conversion factor between LA10 and LAeq of 3 dB(A) where site-specific details are not known. This has been used in this assessment.

Over longer distances between a noise source and a noise receiver (eg more than 600 metres), meteorological factors and ambient noise sources reduce the accuracy of a noise model. This is because the contribution of traffic to a noise level reduces with distance. Generally the calibration of the noise model used in this assessment is expected to be accurate to ± 3 dB(A). This accuracy is considered probable out to the 600-metre study area boundary.

The predicted noise levels have then been compared to the appropriate noise goals and, where exceedances are predicted to occur, further assessment has determined the exceedance level and noise mitigation measures required.

The noise model used in this assessment has also taken into consideration the rest area and heavy vehicle checking station, which forms part of the project.

## Traffic volumes and mix

Traffic forecasts have been based on traffic data from recent studies and available RMS traffic counts.

Modelled noise predictions for 2016 and 2026 include traffic flow on both the proposed highway and remaining traffic flow on sections of the old highway where applicable. The proposed alignment would become the major service road with other service roads having minor traffic volumes providing access for local communities (not generally for through traffic). Noise impacts from interchanges including on- and off-ramps and service road traffic have been considered in the assessment.

The traffic data include forecast levels for light and heavy vehicles, for the daytime and night-time periods. The data include average traffic flows over the whole year, in terms of annual average daily traffic (AADT) flows. These have been calculated from 2011 traffic counts for the project, available data and RMS permanent counting stations.

For more information on the analysis and forecasting of traffic impacts, refer to the Working paper – Traffic and transport.

## Operational vibration

The vibration study has been designed to quantify the level of ground-borne vibration to which residents and buildings would be exposed. It has predicted and assessed changes in vibration levels that could occur should the project go ahead.

Ground-borne vibration from road traffic is caused by a vehicle's suspension reacting to irregularities in the road surface. The vibration from the vehicle is translated into the ground. Vibration can then be transmitted to nearby buildings including houses, businesses and schools. However, the effects of ground-borne vibration are quickly dissipated with vibration generally not impacting beyond five metres from the edge of the carriageway.

## Mitigation options

Where noise levels at sensitive receivers are predicted to exceed the relevant criteria, mitigation has been considered. The aim of this is to reduce impacts where possible. Where the external noise environment cannot be controlled, options for treating individual properties may be necessary. To determine where and how noise mitigation would be applied, the noise assessment predicts noise impacts against acceptable levels.

Mitigation may be directed at one or more of the following:

- The noise source: This involves controlling the source of the noise emissions. This could be via reducing vehicle noise (using low noise wearing surfaces), or by implementing reduced speed zones
- The noise path: This involves providing a barrier to the source of the emissions. This increases the distance the noise must travel to reach the receiver location. This is achieved by constructing noise walls or mounds between the receiver location and the noise source. These barriers are typically constructed within the road reserve
- The noise receiver: This involves reducing noise emissions into a building's internal environment. This can be achieved by using some form of acoustic treatment on the building. This form of mitigation can also include local (at-dwelling) noise barriers. These help to reduce noise impacts but would require consultation and further assessment, as the barriers would be located on private property.

## 15.2 Existing environment

### 15.2.1 Noise environment and sensitive receivers

The project boundary includes land extending from the Coffs Harbour local government area in the south to the Ballina local government area in the north. The study area for noise assessment has been defined as including all land within 600 metres of the project centre-line. Across this study area, there are towns and smaller rural communities, forested areas and agricultural land used for grazing and cropping.

As the distance from the existing Pacific Highway increases, other noise sources can become more dominant. However, the existing highway would still be audible throughout most of the noise study area. The exception is in Section 3 (between Glenugie and Tyndale) and Section 10 (between Richmond River and Coolgardie Road). Due to the distance from the existing highway, these sections are not subject to highway noise.

Parts of the study area include national park, State forest and nature reserve. In these areas, there are few sensitive receivers because there are not many inhabitants. In the Richmond Valley local government area, land use is mainly rural with sugarcane grown near Broadwater and Woodburn in particular. When sugarcane is harvested, heavy vehicles, such as harvesters, can operate 24 hours per day. In these areas, agricultural operations like this would influence existing noise levels.

There are around 2550 residential receivers within the study area. The locations of noise sensitive-receivers are shown in the Working paper – Noise and vibration. A summary of the noise environment and identified noise-sensitive receivers within each section is presented in Table 15-13. The table identifies the number of receivers subject to the noise “redeveloped road” or “new road” criteria.

**Photo 3: View of nearby receivers along the existing Pacific Highway near Townsend and Maclean**

**Table 15-13: Summary of noise-sensitive receivers in each section**

| Project section | Number of structures (ie receivers) | Number of redeveloped road receivers | Number of new road receivers | Noise environment |
|---|---|---|---|---|
| 1 | 668 | 446 | 34 | A cluster of receiver locations is located in the south of Section 1 near Corindi and Red Rock. There are also scattered rural residential receivers north of Corindi Beach. Several commercial and industrial receivers are also located in this project section. In this project section, there is a mix of residential receivers subject to new and redeveloped road criteria.<br>The project would be located in the existing road reserve from Arrawarra to south of Corindi Beach. The project would then deviate to the west of the existing Pacific Highway. Residences along this project section currently experience road traffic noise to some degree. From Corindi Beach to just north of Dirty Creek, the project would pass through rural areas. These are located around 600 metres from the existing Pacific Highway. Receivers in this area would currently experience distant traffic noise. There are some residences just south of Corindi Creek that would be closer to the alignment.<br>Where the project rejoins the existing Pacific Highway north of Dirty Creek it would follow the existing highway to Halfway Creek. Receivers along this project section experience existing traffic noise. |
| 2 | 108 | 28 | 1 | The project would closely follow the existing Pacific Highway through rural areas including State forest (eg Glenugie State Forest). This section contains few residential receivers within 600 metres of the project. Receivers tend to be generally scattered across the southern part of the section. These are located between the villages of Halfway Creek and Wells Crossing.<br>In the northern part of the section, the Glenugie upgrade is complete and so no further noise assessment is required here. The proposed and existing highway would share the current road corridor to a large extent in this part of the project. The main noise source is from road traffic. The road category applicable to the majority of residential receivers in this section is redeveloped road criteria. |
| 3 | 151 | 2 | 56 | To the east of the existing highway, the project would mainly traverse rural areas, with few receivers. In this section, the project would bypass Grafton and Ulmarra. Tucabia is located about two kilometres to the west. Around 37 residential receivers are located in this area.<br>The nearby area is largely rural, including State forest, open paddock and land used for grazing and cropping. No townships are located along the project's alignment. Existing noise sources include dogs, livestock and tractors. There are also natural noise sources including crickets, birds and frogs. |

| Project section | Number of structures (ie receivers) | Number of redeveloped road receivers | Number of new road receivers | Noise environment |
|---|---|---|---|---|
| 4 | 589 | 404 | 45 | The project would be located between the northern extent of Tyndale and the southern area of Maclean, where receivers potentially sensitive to noise are mainly residential. In the south of the section, receivers are typically rural and residential properties, and tend to be isolated. However, in the north of the section, residential receivers are more concentrated. Residential properties are located to the south of Maclean, and near Gulmarrad and Townsend. Maclean High School is located about 500 metres to the west of the existing Pacific Highway. Around 210 residential receivers were identified in this area.<br>Land use is mainly involves growing sugarcane. Noise levels are mainly from farming and existing road traffic. When sugarcane is harvested (typically July to November), noise can occur over a 24-hour period. |
| 5 | 299 | 159 | 0 | The area most built up in this section is Harwood, to the north of the existing bridge crossing of the Clarence River. Around 70 residential properties have been identified as being potentially sensitive to road noise. These receivers are mainly around Morpeth Street and River Street, as well as to the west of the existing Pacific Highway, near the existing sugar mill. Harwood Island Primary School is also located on Morpeth Street and would be classed as a sensitive receiver.<br>Small clusters of residential properties are located on Serpentine Channel Road and to the north-east of Chatsworth. The built-up area of Chatsworth is unlikely to be impacted, being over one kilometre from the project. Around 105 residential properties have been identified as potentially sensitive to road noise in this area. |
| 6 | 21 | 8 | 0 | Sections 6 and 7 of the project are located along the existing Pacific Highway, near Bundjalung National Park. Residential properties are sparsely distributed with no built-up areas nearby. Around 35 residential receivers have been identified as potentially sensitive to road noise in this area. |
| 7 | 77 | 30 | 0 | |
| 8 | 110 | 31 | 10 | Receivers potentially sensitive to noise are mainly to the south-east of Woodburn. There are some rural properties distributed across the study area, which tend to be fairly isolated. Woodburn is built up and outside the predicted area of noise impacts from the project. However, Trustums Hill Road contains about 18 residential properties potentially sensitive to road traffic noise. Woodburn Public School is located adjacent to the existing Pacific Highway to the south of Woodburn. Around 40 residential receivers are located in this area.<br>Land use is mixed, with mainly bush land in the south, and grazing and sugarcane land in the north. The project would run about 1.5 kilometres to the east of the existing Pacific Highway. Existing noise levels are dominated by local road traffic and rural noise sources including dogs, cattle and tractors. When sugarcane is harvested, noise can occur over a 24-hour period. |
| 9 | 81 | 5 | 23 | West of the town of Broadwater, residential receivers potentially sensitive to road traffic noise are generally isolated rural properties. These are widely spread across the area. However, the village of Rileys Hill is located in this section, and comprises a cluster of properties. Around 12 residential receivers are located in this area.<br>This section would pass to the west of the existing Pacific Highway, through a mix of land uses, including grazing, sugarcane land and Broadwater National Park. Existing noise is mainly from rural and natural sources, and local roads. When sugarcane is harvested, noise impacts can occur over a 24-hour period |

| Project section | Number of structures (ie receivers) | Number of redeveloped road receivers | Number of new road receivers | Noise environment |
|---|---|---|---|---|
| 10 | 229 | 20 | 83 | Land use is mainly involves growing sugarcane and grazing. Residential receivers potentially sensitive to noise are rural properties, which tend to be fairly isolated. A small cluster of houses is located near Wardell Road. Around 65 residential receivers are located in this area.<br>Existing noise is mainly rural in nature, and from local road traffic. During harvesting of sugarcane, noise impacts can occur over a 24-hour period. The existing Pacific Highway is generally audible in the evening and night-time when other noise sources have dropped off. |
| 11 | 160 | 31 | 0 | Residential receivers potentially sensitive to traffic noise are scattered across the study area. They are mainly located along Pimlico Road to the east of the project, or to the west of the project. Around 25 residential receivers are located in this section.<br>Land use mainly involves growing sugarcane. Road traffic noise from the existing Pacific Highway is the dominant noise source. In the north of the section, heavy vehicle noise from the Bruxner Highway is also audible. When sugarcane is harvested, noise impacts can occur over a 24-hour period. |

### 15.2.2 Noise monitoring locations

The project area supports a wide variety of land uses. Each is potentially capable of creating noise during the day, evening or night-time. While each project section currently experiences road traffic noise from the existing Pacific Highway to some extent (except in sections 3 and 10), other noise sources should also be considered. Noise monitoring helps to do this by identifying existing noise levels at various locations across the study area. Noise monitoring serves two main purposes:

- Monitoring of background noise is combined with road traffic counts. These two data sources are used to calibrate a noise model. This model is used to predict future noise levels that could be experienced by residents living near the Pacific Highway once the project is constructed and open to traffic
- Monitoring of background noise is used to establish existing noise levels at various locations near to the project. This exercise helps to identify appropriate construction and operational noise targets for the project. The noise impact assessment then informs where mitigation or management is required to protect the amenity of residents living near the project.

The number of noise monitoring locations is summarised in Table 15-14. Each monitoring location is described in more detail in Table 15-15.

Each noise monitoring location has been selected based on the number of properties in a particular section, the location's proximity to the existing Pacific Highway and project. In Section 3 and Section 5, the number of locations is quite large compared to other sections. While Section 3 is the longest project section, it would deviate significantly from the existing highway. For this section in particular, the number of logger locations is duplicated to capture the existing noise levels for both the existing highway and the project alignment. This is also the case for Section 10, which would also deviate from the existing alignment of the highway. Section 5 has a large number of properties located near the existing highway and project, which influenced the number of monitoring locations.

**Table 15-14: Summary of noise monitoring location by section**

| Project section | Approximate location | Number of unattended monitoring locations |
|---|---|---|
| 1 | Woolgoolga to Halfway Creek | 6 |
| 2 | Halfway Creek to Glenugie upgrade | 2 |
| 3 | Glenugie upgrade to Tyndale | 6 |
| 4 | Tyndale to Maclean | 9 |
| 5 | Maclean to Iluka Road, Mororo | 11 |
| 6 | Iluka Road to Devils Pulpit upgrade | 1 |
| 7 | Devils Pulpit upgrade to Trustums Hill | 4 |
| 8 | Trustums Hill to Broadwater National Park | 7 |
| 9 | Broadwater National Park to Richmond River | 4 |
| 10 | Richmond River to Coolgardie Road | 4 |
| 11 | Coolgardie Road to Ballina Bypass | 3 |
| **Total** | | **57** |

Because of the number of receivers in each section, it is not possible to monitor noise at all receivers across the study area. This is also unnecessary as the existing noise environment has been broadly characterised. This has been done from a combination of unattended and attended noise monitoring at a representative number of locations. The approach taken involves the grouping of residential receiver locations into noise catchment areas. This allows the noise assessment to consider noise management criteria most appropriate to a particular location.

Each of the 11 sections has been split into noise catchment areas. Each catchment area represents a typical background noise environment. This is based on noise levels measured across the project. The areas are based on a buffer located either side of the project, as follows:

- 0–200 metres either side of the project centreline
- 200–400 metres either side of project centreline
- 400–600 metres either side of the project centreline.

The project study area and noise monitoring locations are shown in Figure 15-1 to Figure 15-11. Noise catchment areas and monitoring locations are listed in Table 15-15. The specific noise catchment area assigned to each section is shown graphically in the Working paper – Noise and vibration.

Monitoring data have been used to provide a background noise level, and noise management level, for a particular location. Both noise levels have influenced where noise mitigation is potentially required. For each monitoring location, noise management levels have been identified using the Interim Construction Noise Guideline.

**Table 15-15: Noise monitoring locations, and project noise catchment area**

| Project section | Logger identifier | Distance from highway ( metres) | | Location | Project noise catchment area |
|---|---|---|---|---|---|
| | | Existing | Project | | |
| 1 | 1 | 175 | 125 | 47 Kangaroo Trail Road, Corindi Beach | 1-c |
| 1 | 2 | 30 | 520 | 3674 Pacific Highway, Corindi Beach | 1-a |
| 1 | 3 | 105 | 555 | 7 Dirty Creek Road, Dirty Creek | 1-a |
| 1 | 4 | 35 | 45 | 4470 Pacific Highway, Halfway Creek | 1-c |
| 1 | 5 | 240 | 240 | 4644 Pacific Highway, Halfway Creek | 1-b |
| 1 | 6 | 80 | 80 | 4925 Pacific Highway, Halfway Creek | 1-d |
| 2 | 7 | 250 | 265 | 5092 Pacific Highway, Halfway Creek | 2-b |
| 2 | 8 | 130 | 190 | 5559 Pacific Highway, Wells Crossing | 2-d |
| 3 | 9 | 160 | 215 | 6639 Pacific Highway, Glenugie | 3-e |
| 3 | 10 | 8215 | 360 | 247 Wants Lane, Glenugie | 3-e |
| 3 | 11 | 9450 | 245 | 961 Wooli Road, Pillar Valley | 3-b |
| 3* | 12 | 155 | 8420 | 44 Edward Olgivie Drive, Clarenza | - |
| 3 | 13 | 11670 | 135 | 106 Firth-Heinz Road, Pillar Valley | 3-c |
| -* | 14 | 45 | 11540 | Candole Street, Tucabia | - |
| -* | 15 | 40 | 11590 | 9 School Lane, Swan Creek | - |
| 3 | 16 | 5610 | 90 | 625 Tucabia-Tyndale Road, Tucabia | 3-d |
| -* | 17 | 230 | 8270 | 1853 Pacific Highway | - |
| -* | 18 | 65 | 4500 | 2319 Pacific Highway | - |
| 4 | 19 | 630 | 370 | 130 Fitzgerald Lane, Tyndale | 4-b |
| 4 | 20 | 60 | 320 | 2991 Pacific Highway, Tyndale | 4-e |
| 4 | 21 | 65 | 495 | 3358 Pacific Highway, Tyndale | 4-f |
| -* | 22 | 65 | 670 | 425 Shark Creek Road, Shark Creek | - |
| -* | 23 | 100 | 1020 | 3718 Pacific Highway, Shark Creek | - |
| -* | 24 | 105 | 1015 | 86 O'maras Lane, Gulmarrad | - |
| 4 | 25 | 895 | 250 | 125 Clyde Essex Drive, Gulmarrad | 4-b |
| 4 | 26 | 355 | 1020 | 4 Highlands, Gulmarrad | 4-a |
| 4 | 27 | 35 | 180 | 4064 Pacific Highway, Gulmarrad | 4-d |
| 4 | 28 | 260 | 330 | 40 Cameron Street, Maclean | 4-e |
| 4 | 29 | 60 | 75 | 9A Jubilee Street, Townsend | 4-c |

| Project section | Logger identifier | Distance from highway ( metres) | | Location | Project noise catchment area |
|---|---|---|---|---|---|
| | | Existing | Project | | |
| 4 | 30 | 465 | 485 | 13 Scullin Street, Townsend | 4-a |
| 5 | 31 | 360 | 330 | 35 James Creek Road, James Creek | 5-b |
| 5 | 32 | 320 | 355 | 8 Martins Point Road, Harwood | 5-e |
| 5 | 33 | 205 | 170 | 1 Petticoat Lane, Harwood | 5-c |
| 5 | 34 | 140 | 185 | 40 Morpeth Street, Harwood | 5-d |
| 5 | 35 | 45 | 60 | 4928 Pacific Highway, Harwood | 5-c |
| 5 | 36 | 25 | 10 | 5055 Pacific Highway, Chatsworth | 5-d |
| 5 | 37 | 300 | 325 | 50 Serpentine Channel Road, Harwood | 5-d |
| 5 | 38 | 600 | 600 | 389 Chatsworth Road, Chatsworth | 5-f |
| 5 | 39 | 550 | 555 | 395 Chatsworth Road, Chatsworth | 5-f |
| 5 | 40 | 110 | 105 | 53 Old Pacific Highway, Woombah | 5-c |
| 5 | 41 | 465 | 480 | Pacific Highway, Mororo | 5-a |
| 6 | 42 | 50 | 65 | 6530 Pacific Highway, Jackybulbin | 6-c |
| - | 43 | 60 | 70 | 7175 Pacific Highway, Tabbimoble | - |
| 7 | 44 | 170 | 210 | 8120 Pacific Highway, Tabbimoble | 7-c |
| 7 | 45 | 215 | 215 | Pacific Highway, The Gap | 7-c |
| 7 | 46 | 375 | 340 | 65 Whites Road New Italy | 7-e |
| 7 | 47 | 55 | 70 | 8750 Pacific Highway, The Gap | 7-c |
| 8** | 48 | 85 | 75 | 60 The Gap Road, Trustums Hill | 8-b |
| 8 | 49 | 385 | 385 | 60 The Gap Road, Trustums Hill | 8-b |
| 8 | 50 | 140 | 140 | 20 The Gap Road, Trustums Hill | 8-c |
| 8 | 51 | 65 | 145 | 32 Trustums Hill Road, Woodburn | 8-d |
| 8 | 52 | 125 | 355 | 82 Trustums Hill Road, Woodburn | 8-e |
| 8 | 53 | 25 | 1080 | 165 Woodburn Evans, Woodburn | 8-e |
| 8* | 54 | 35 | 1450 | 63 River Street, Woodburn | - |
| -* | 55 | 330 | 330 | 9810 Pacific Highway, Woodburn | - |
| -* | 56 | 380 | 1370 | 9810 Pacific Highway, Broadwater | - |
| 9 | 57 | 30 | 600 | 4 Pacific Highway, Broadwater | 9-f |
| 9 | 58 | 100 | 760 | 85 Broadwater – Evans Head Road, Broadwater | |
| 9* | 59 | 40 | 485 | 10770 Pacific Highway, Broadwater | 9-d |
| 9* | 60 | 30 | 2170 | 10950 Pacific Highway, East Wardell | - |
| 10* | 61 | 45 | 3140 | 11184 Pacific Highway, East Wardell | - |
| 10 | 62 | 3140 | 145 | 1202 Wardell Road, Wardell | 10-f |
| 10 | 63 | 3250 | 200 | 1175 Wardell Road, Wardell | 10-e |
| -* | 64 | 255 | 310 | 848 Pimlico Road, Wardell | - |
| 10 | 65 | 1120 | 350 | 109 Meridian Drive, Coolgardie | 10-e |
| 11 | 66 | 65 | 35 | 3 McAndrews Lane, Pimlico | 11-d |
| 11 | 67 | 590 | 570 | 55 Whytes Lane, Pimlico | 11-f |
| 11 | 68 | 570 | 555 | 151 Uralba Road, Uralba | 11-f |

*Modelling calibration point for existing alignment

**Calibration point for project

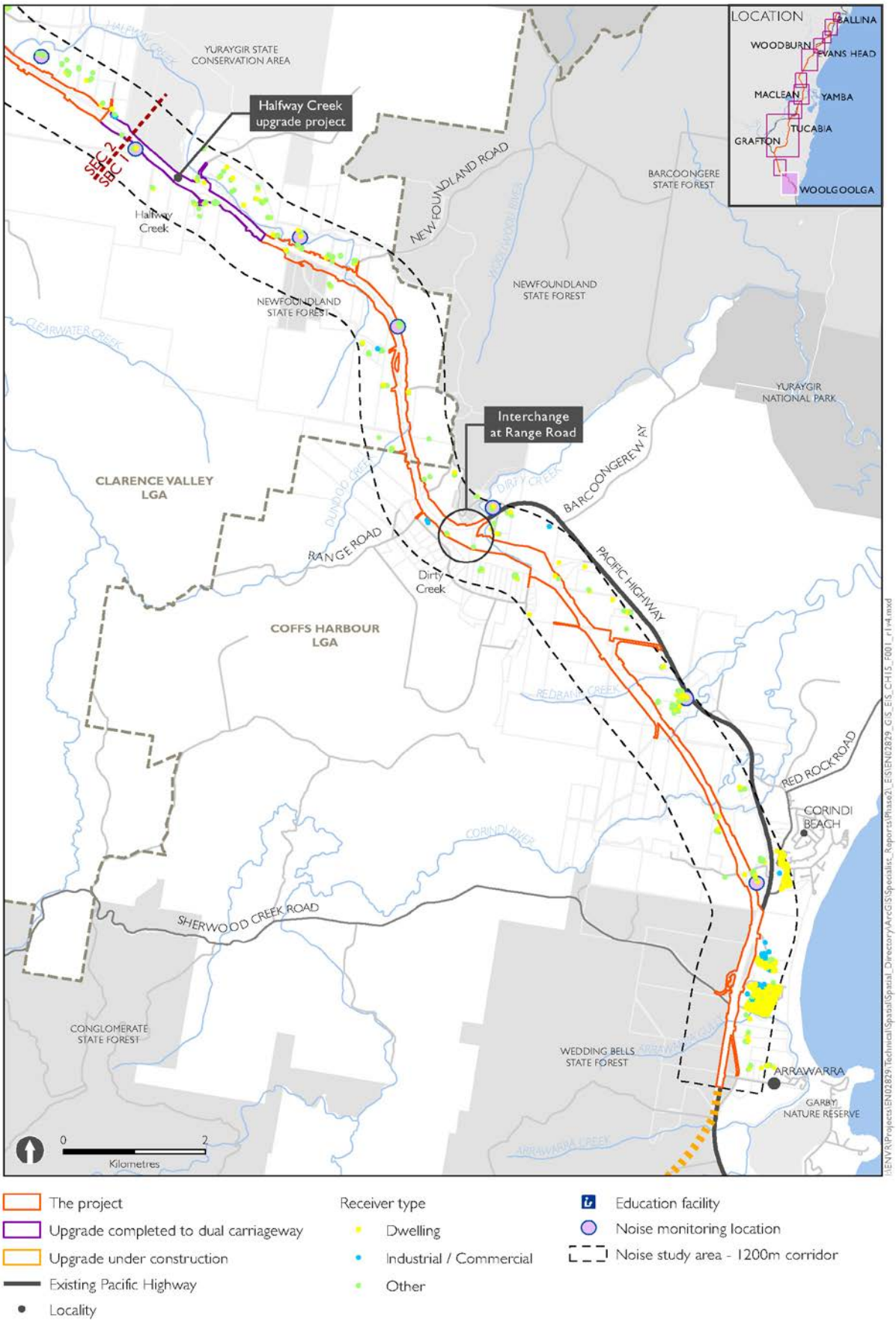


**Figure 15-1: Receivers and monitoring locations within noise study area for Section 1**

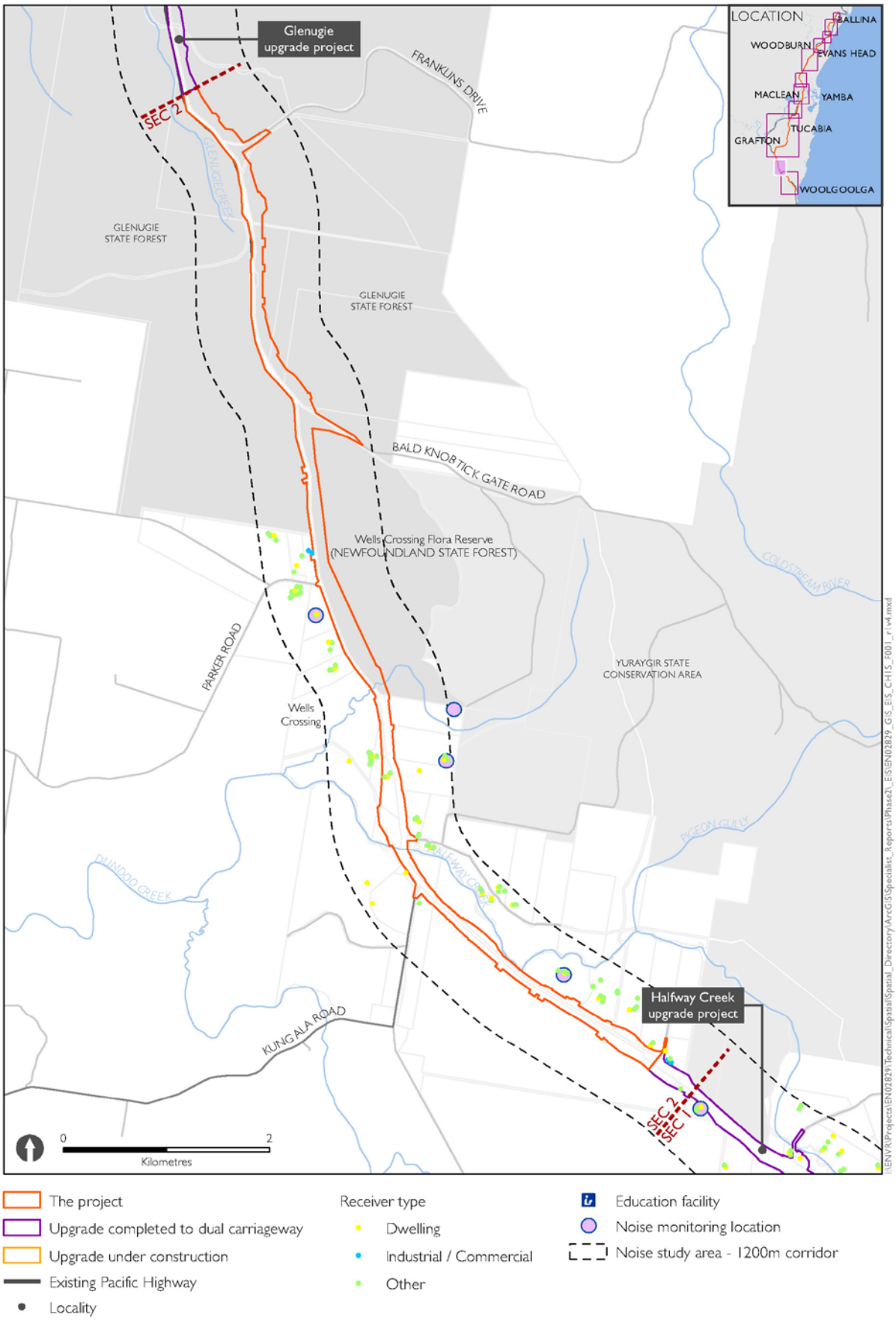


**Figure 15-2: Receivers and monitoring locations within noise study area for Section 2**

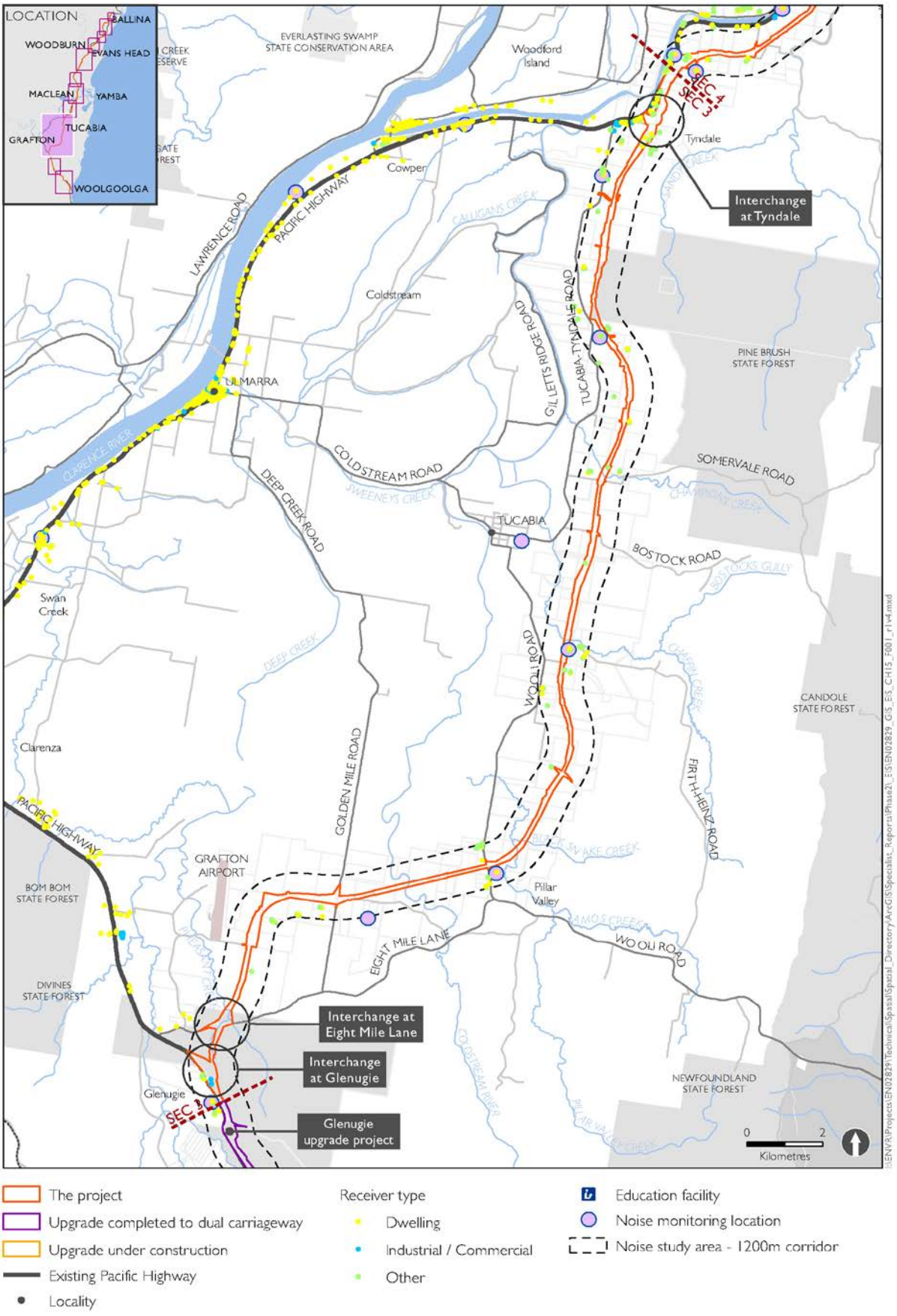


**Figure 15-3: Receivers and monitoring locations within noise study area for Section 3**

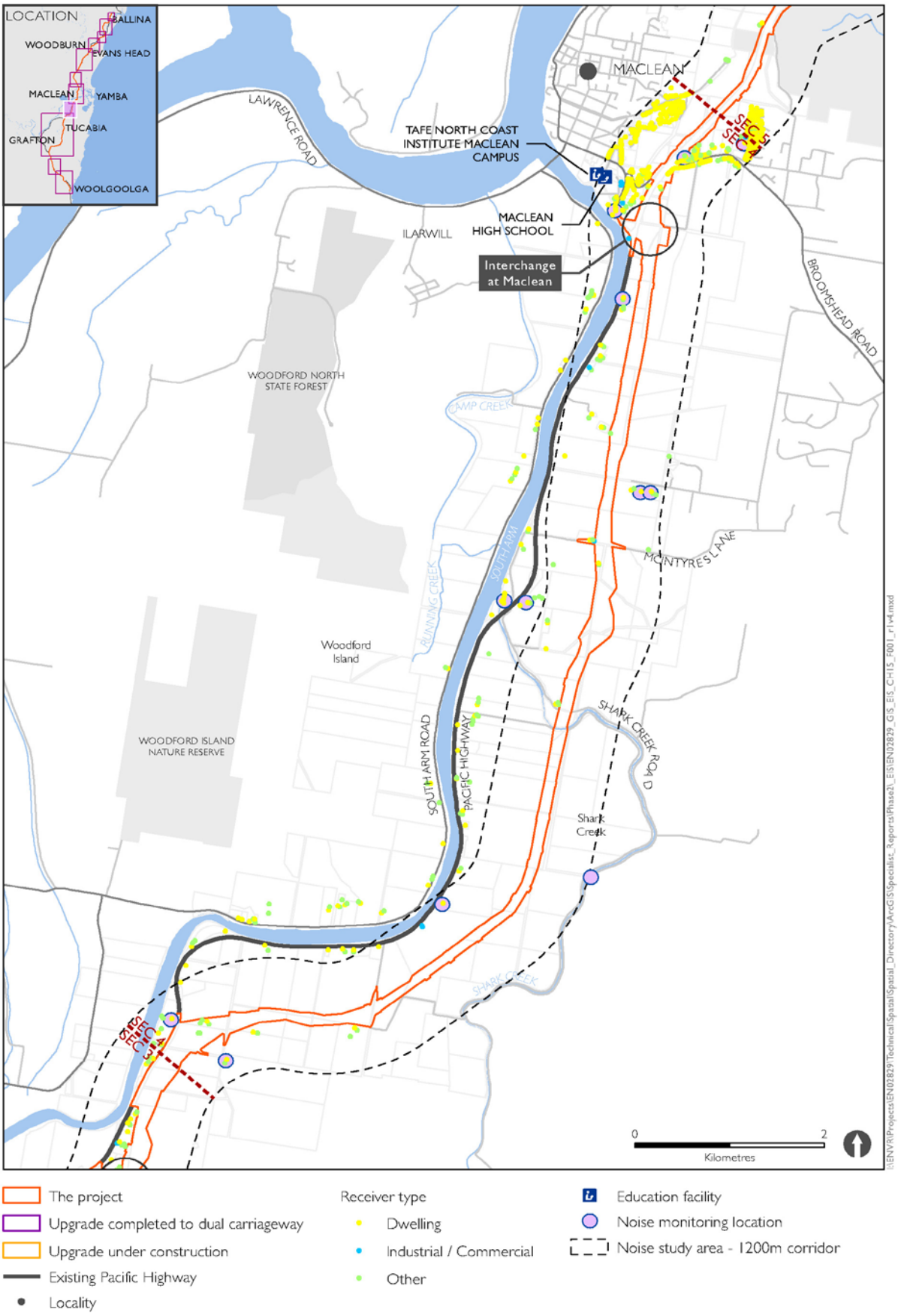


**Figure 15-4: Receivers and monitoring locations within noise study area for Section 4**

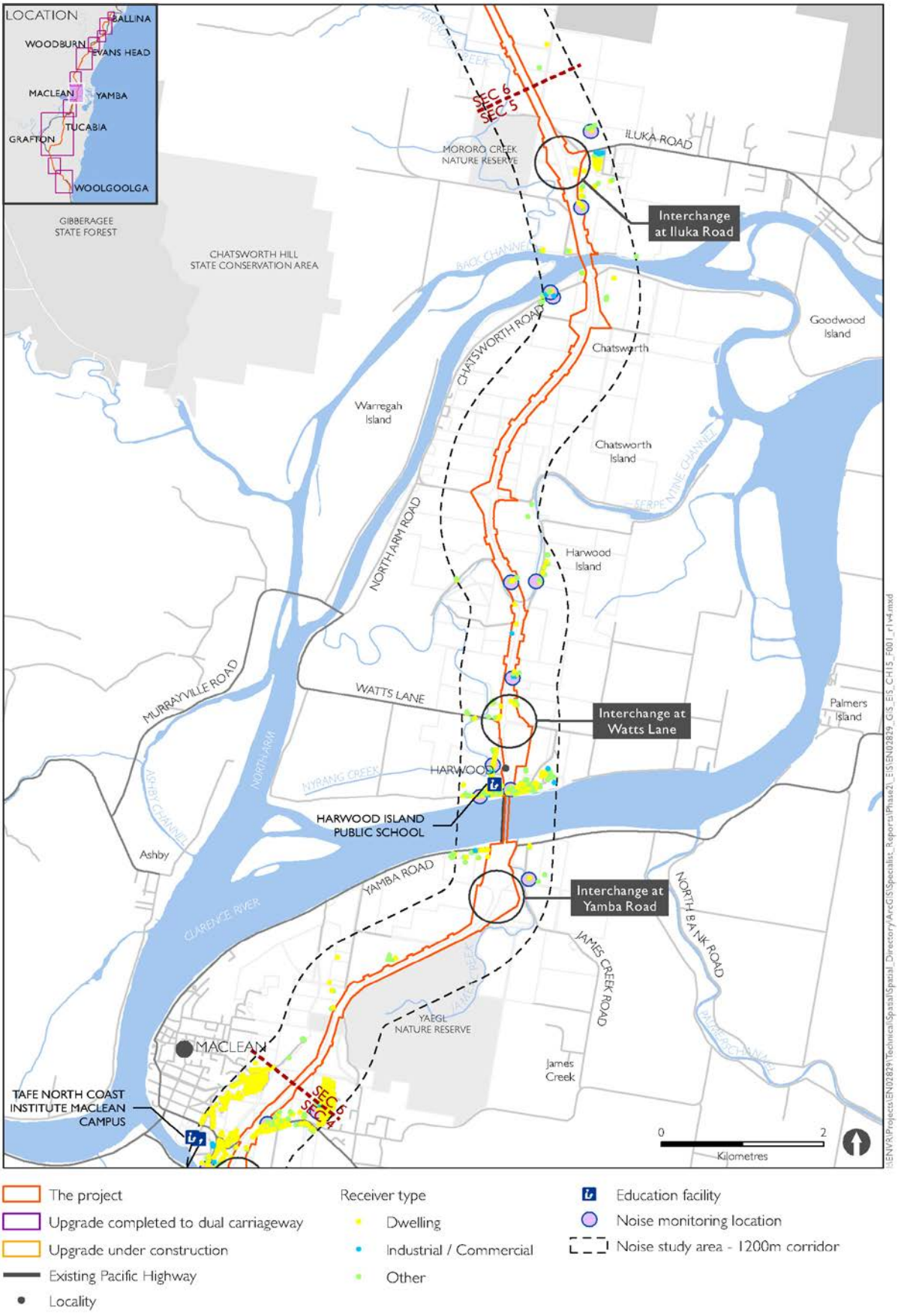


**Figure 15-5: Receivers and monitoring locations within noise study area for Section 5**

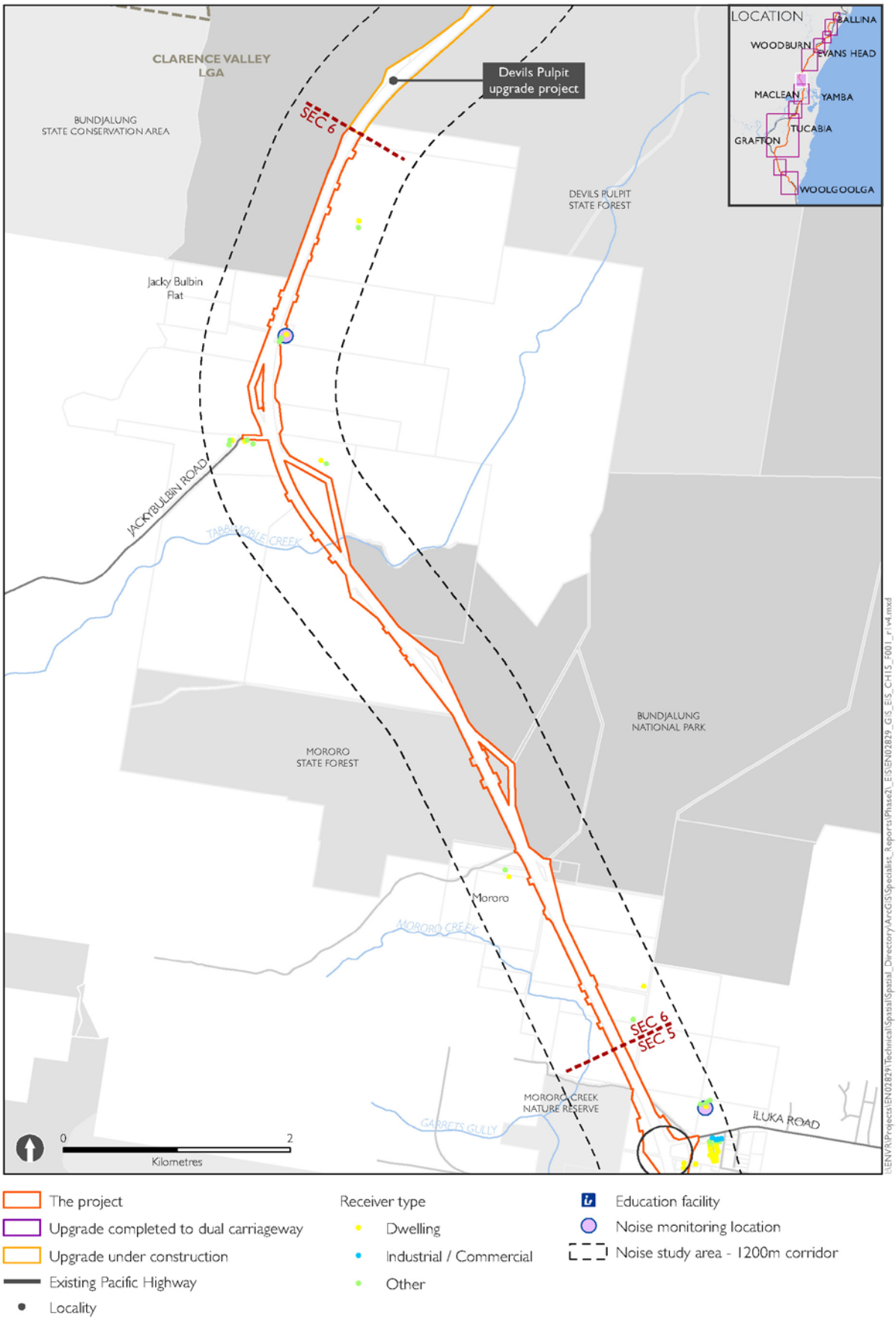


**Figure 15-6: Receivers and monitoring locations within noise study area for Section 6**

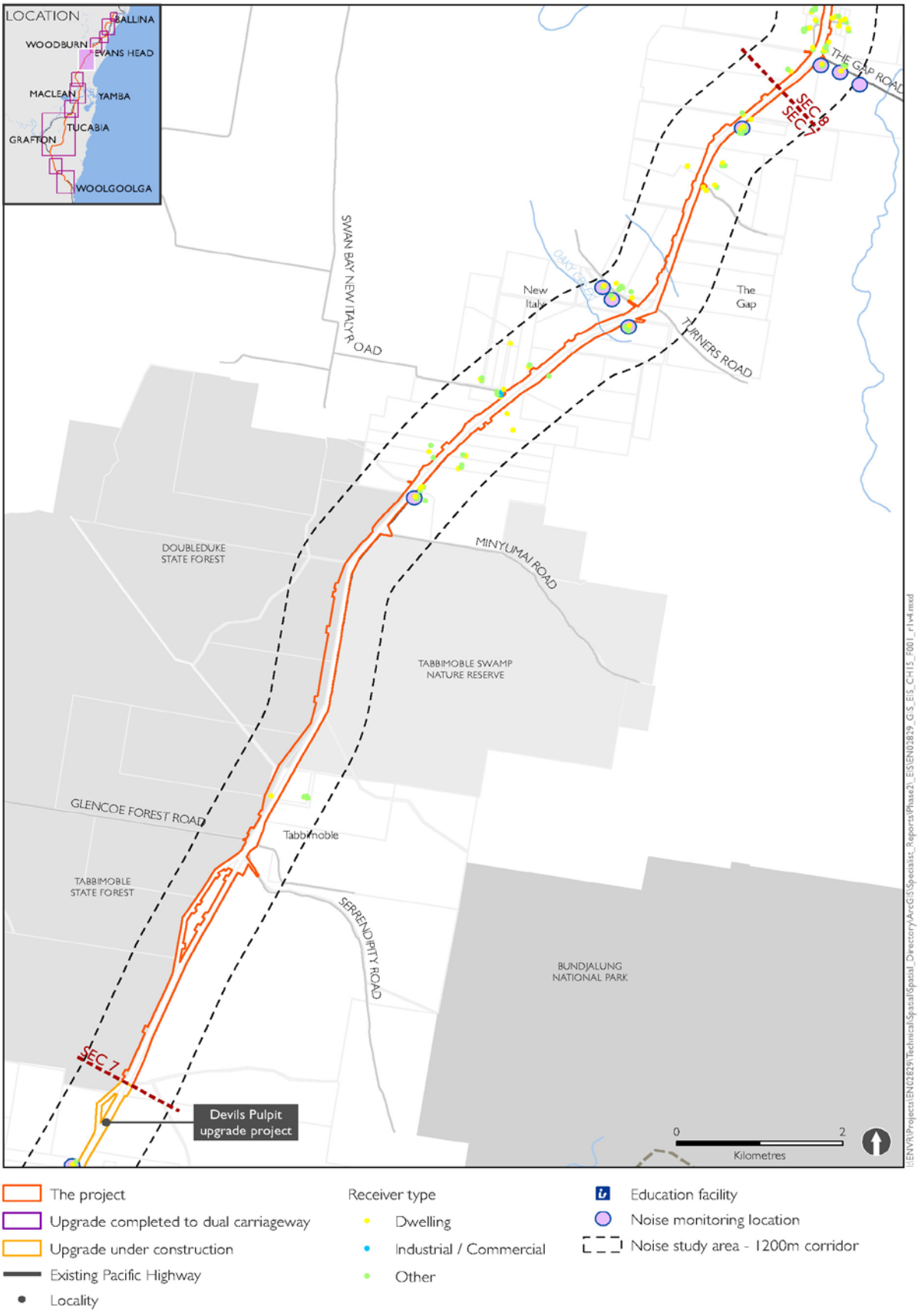


**Figure 15-7: Receivers and monitoring locations within noise study area for Section 7**

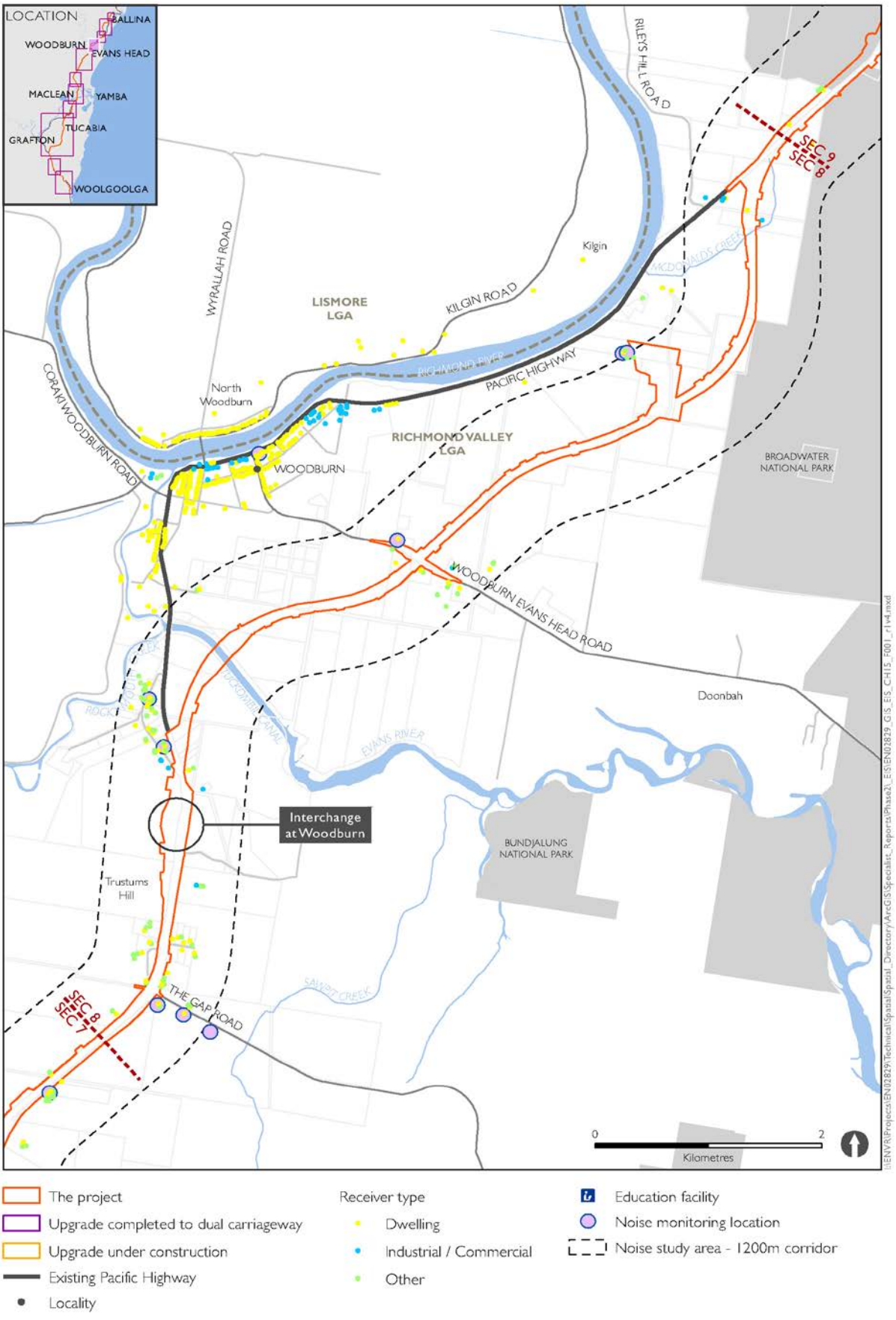


**Figure 15-8: Receivers and monitoring locations within noise study area for Section 8**

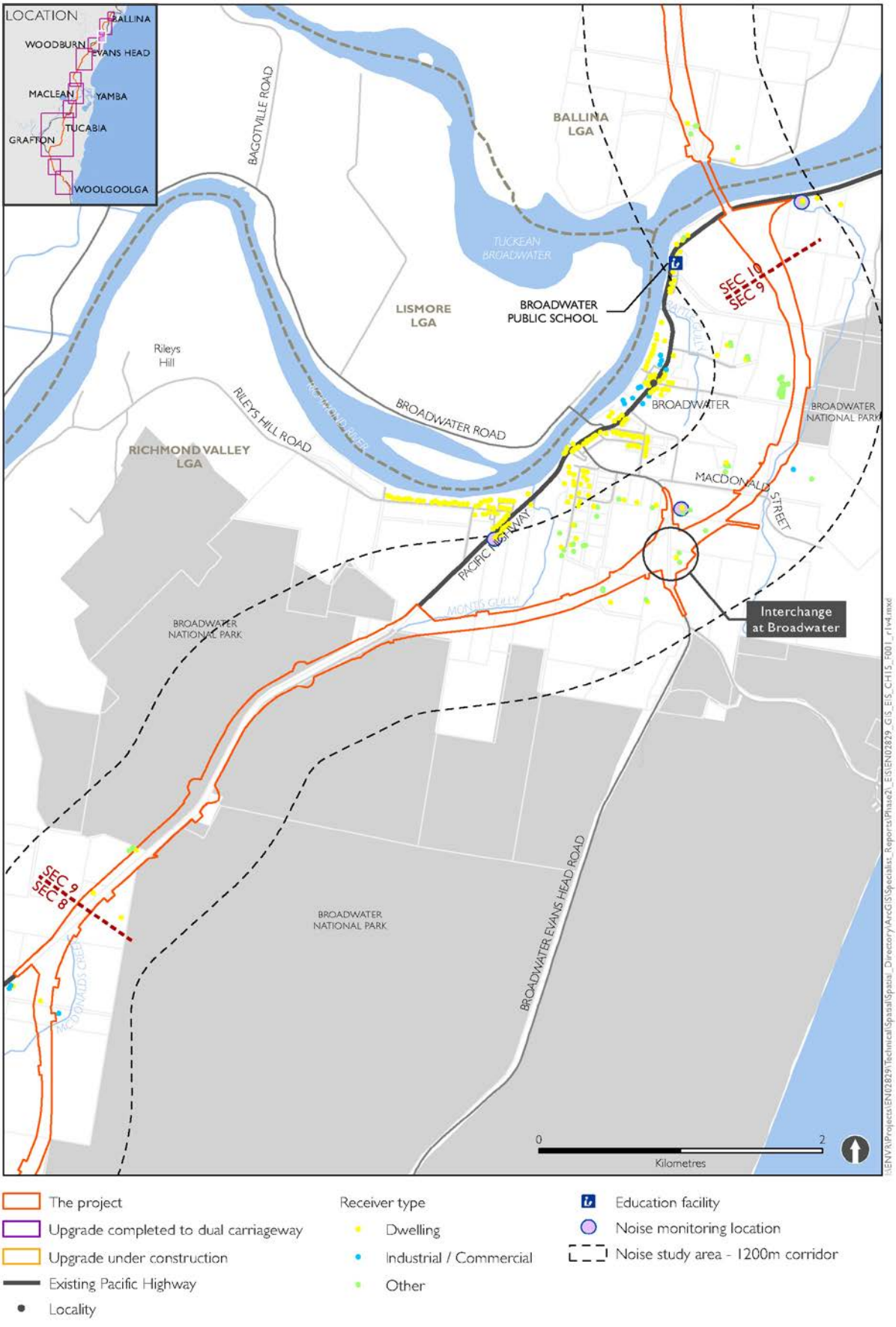


**Figure 15-9: Receivers and monitoring locations within noise study area for Section 9**

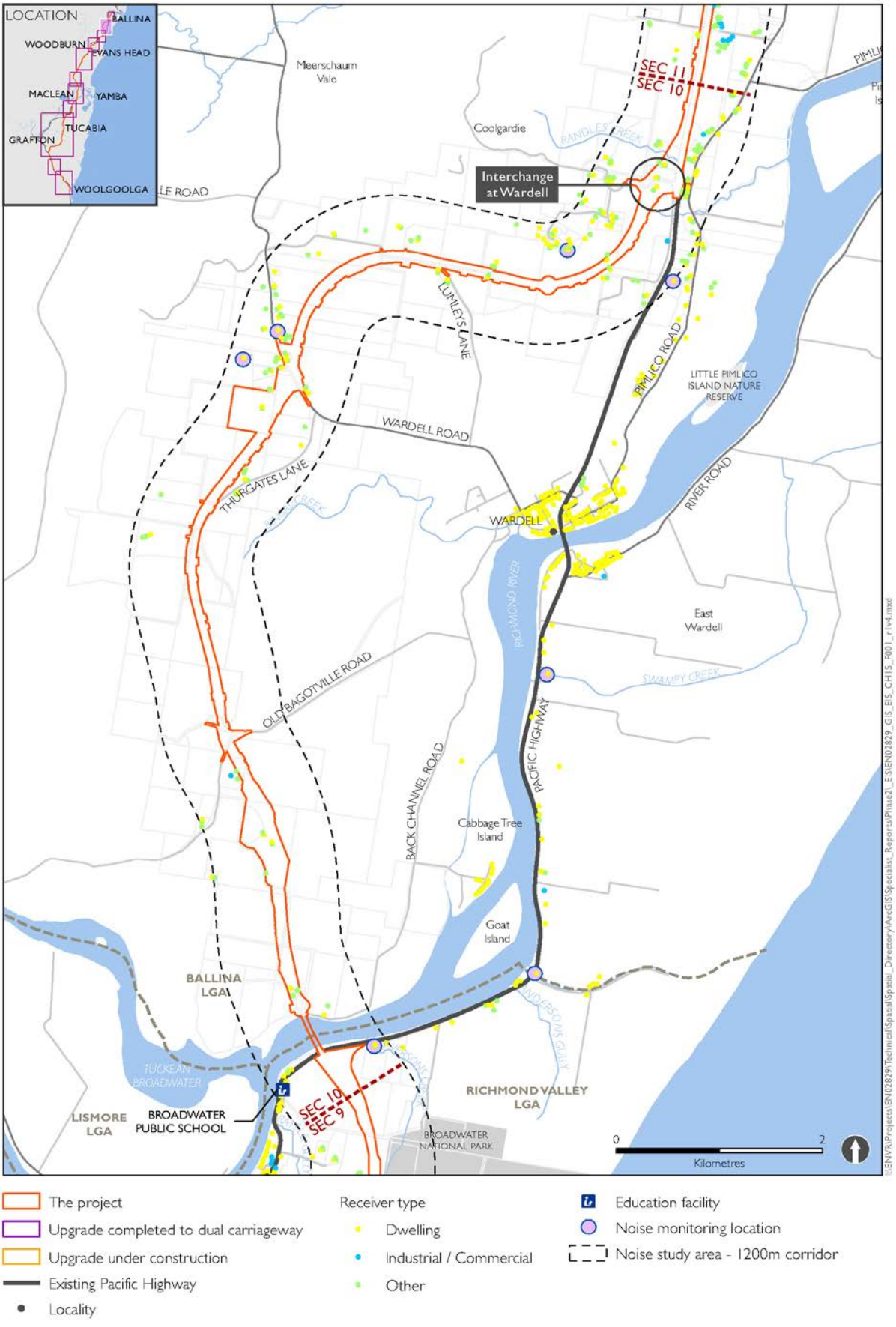


**Figure 15-10: Receivers and monitoring locations within noise study area for Section 10**

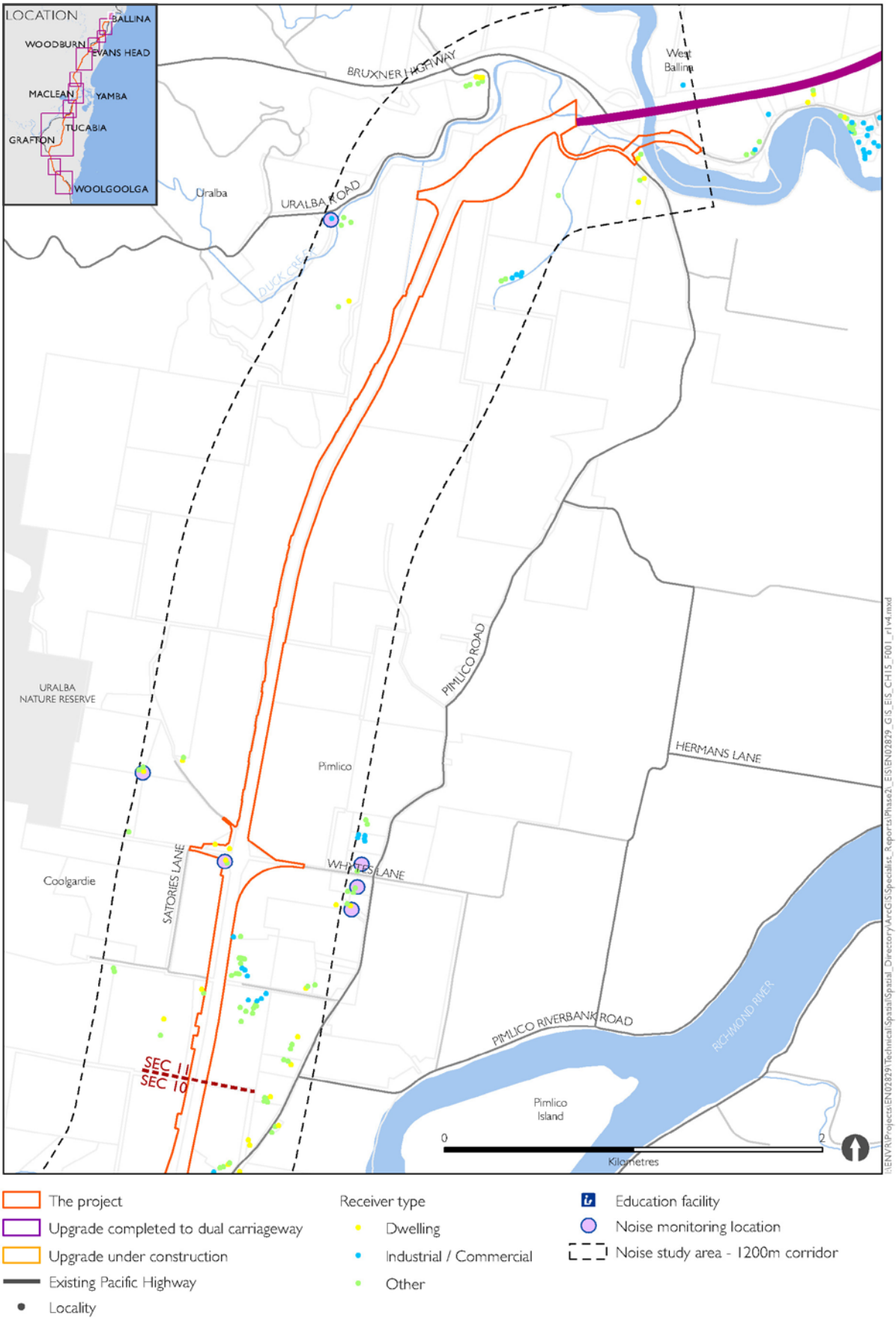


**Figure 15-11: Receivers and monitoring locations within noise study area for Section 11**

### 15.2.3 Noise monitoring and calibration

Table 15-16 to Table 15-26 include a summary of noise levels collected during the unattended noise survey for the 11 sections of the project. Traffic counts from February and March 2012 were used to calibrate the noise model used to identify predicted impacts. The traffic counts took place at the same time as the background noise surveys for each project section.

**Table 15-16: Measured noise levels: Section 1**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 335 | 59.9 | 59 |
| 414 | 69.2 | 68.8 |
| 468 | 57.8 | 55.9 |
| 495 | 66.6 | 66.2 |
| 526 | 55.8 | 55.2 |
| 575 | 58.5 | 55.5 |

**Table 15-17: Measured noise levels: Section 2**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 575 | 58.5 | 55.5 |
| 597 | 56.1 | 56 |
| 651 | 56.6 | 54.2 |

**Table 15-18: Measured noise levels: Section 3**

| Receiver identification | $L_{Aeq}$ Day dB(A) | $L_{Aeq}$ Evening dB(A) | $L_{Aeq}$ Night dB(A) | $L_{A90}$ RBL Day dB(A) | $L_{A90}$ RBL Evening dB(A) | $L_{A90}$ RBL Night dB(A) |
|---|---|---|---|---|---|---|
| 748 | 54 | 52 | 48 | 34 | 39 | 42 |

**Table 15-19: Measured noise levels: Section 4**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 842 | 65.6 | 65 |
| 849 | 65.9 | 64.9 |
| S4_1 | 60 | 58.9 |
| 892 | 67.1 | 66.4 |
| 1026 | 61.7 | 59.8 |
| 1080 | 57.6 | 50.1 |

**Table 15-20: Measured noise levels: Section 5**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 1331 | 59.3 | 58.6 |
| 1396 | 57.4 | 55.1 |
| 1438 | 72.3 | 71.4 |
| 1471 | 57.7 | 58.1 |

**Table 15-21: Measured noise levels: Section 6**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 1542 | 62.5 | 61.3 |

**Table 15-22: Measured noise levels: Section 7**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 1557 | 65.9 | 63.8 |
| 1591 | 60.9 | 59.4 |
| 1592 | 53.7 | 53.3 |

**Table 15-23: Measured noise levels: Section 8**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 1631 | 60.8 | 53.7 |
| 1698 | 59.7 | 57.9 |
| S8_2 | 54.1 | 49.7 |

**Table 15-24: Measured noise levels: Section 9**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 1756 | 64.6 | 63.7 |

**Table 15-25: Measured noise levels: Section 10**

| Receiver identification | LAeq Day dB(A) | LAeq Evening dB(A) | LAeq Night dB(A) | LA90 RBL Day dB(A) | LA90 RBL Evening dB(A) | LA90 RBL Night dB(A) |
|---|---|---|---|---|---|---|
| 1817 | 50 | 53 | 52 | 33* | 38 | 46 |

**Table 15-26: Measured noise levels: Section 11**

| Receiver identification | Day LAeq (15 h) dB(A) Measured | Night LAeq (9 h) dB(A) Measured |
|---|---|---|
| 2068 | 61.2 | 59.2 |
| 2072 | 48.6 | 45.9 |

## 15.3 Assessment of impacts

### 15.3.1 Construction noise and vibration

In general, it is considered that most construction would not cause noise impacts because:

- Construction traffic would use the existing local road network, or the existing Pacific Highway, with traffic numbers small enough to be absorbed into general traffic numbers without an audible change in noise level
- The haulage of earthworks material would generally happen without the need for specially built haul roads (imported material sources are unlikely to be confirmed until a contractor is appointed and construction starts). The number of haul trucks moving between external sites and the project would not be sufficient to create a significant noise increase
- Where haul trucks use the new formation and project alignment, truck numbers would be at a level that is not anticipated to add to noise levels from other construction activities. Noise from haul trucks is likely to blend in with general construction activities such as earthworks, ground clearing and asphalting.

However, construction noise would exceed the appropriate noise target in some places. This would mainly occur where properties would be near the project. Because the project is linear, properties would tend to experience construction noise over short periods as work progresses along the upgrade. In the assessment section, 'receivers' potentially sensitive to noise – include residential dwellings, schools and businesses. For details, refer to the Working paper – Noise and vibration.

Ancillary site locations are shown in Chapter 6 (Description of the project: construction).

Construction noise and vibration impacts for each section are summarised below.

#### Section 1 (Woolgoolga to Halfway Creek)

The construction noise and vibration assessment for Section 1 has found that:

- Around 40 per cent of receivers are likely to experience noise above the respective noise management level, due to site clearing, earthworks and paving. One property is likely to be 'highly noise affected'. The disturbance potential is relatively high
- Predicted noise levels from ancillary sites would be below the appropriate noise management level at all but four receivers. The disturbance potential would be small. Where receivers are located on or near to ancillary sites, appropriate noise management levels would be exceeded
- Predicted noise levels from the Corindi access road would be below the appropriate noise management level at all identified receivers and so the disturbance potential would be minimal
- The construction of overpasses would create noise. For example, noise from the construction of Sherwood Creek Road overpass, Kangaroo Trail Road overpass and McPhillips Road overpass and the bridge over Corindi River is likely to exceed appropriate criteria at some of the nearest receivers (this assumes a piling rig would be operating at each bridge site)

- The construction of the twin bridges across the Corindi floodplain is unlikely to exceed the appropriate noise management level provided no out of hours work is required
- Should work on the twin bridges across the Corindi floodplain be required out of hours (ie at night), up to nine receivers could experience noise above the appropriate night-time noise management level. A further four receivers would experience audible construction noise
- No receivers have been identified within 50 metres of a potential bridge site where piling might be required. Therefore, vibration risks (structural damage and residential amenity) would be small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at specified cut sites along the project may result in some receivers nearby being exposed to vibration and overpressure above appropriate levels. Therefore, a detailed assessment would be required pre-construction to confirm where appropriate mitigation is required. Refer to Section 6.1.5 of Working paper – Noise and vibration for details of the Section 1 blasting assessment.

### Section 2 (Halfway Creek to Glenugie upgrade)

The construction noise and vibration assessment for Section 2 has found that:

- Over 46 per cent of receivers are likely to experience noise above appropriate criteria due to site clearing, earthworks and paving. No receivers would be 'highly noise affected'. This disturbance potential is relatively high
- Predicted noise levels from ancillary sites would be below the appropriate noise management level at all but nine receivers. Therefore, the disturbance potential is small. However, one property is likely to be 'highly noise affected'
- The construction of overpasses would result in appropriate noise management level being exceeded at 18 of 29 receivers
- No receivers are within 50 metres of a bridge site potentially requiring piling. Therefore, vibration risk would be small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at specified cut sites along the project may result in some receivers nearby being exposed to vibration and overpressure above the appropriate noise management level. Therefore, a detailed assessment would be required pre-construction to confirm where appropriate mitigation is required
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- At this stage, residential receivers are far enough away from potential blast sites for impacts to be small. Appropriate management arrangements would be required pre-construction to confirm blast sites and required mitigation. Refer to Section 6.2.5 of Working paper – Noise and vibration for details of the Section 2 blasting assessment.

### Section 3 (Glenugie upgrade to Tyndale)

The construction noise and vibration assessment for Section 3 has found that:

- Over 46 per cent of receivers are likely to experience noise levels above the appropriate noise management level due to site clearing, earthworks and paving. No receivers would be 'highly noise affected'
- Predicted noise levels from ancillary sites show that around 17 receivers might experience noise above appropriate criteria. No receivers would be 'highly noise affected'
- Simultaneous bridge construction would result in 12 receivers experiencing noise above the appropriate noise management level. No receivers would be 'highly noise affected'
- Where work on the bridge crossings of the Coldstream River is required out of hours (ie at night), this work could be heard at one property. Where work on the Pillar Valley Creek bridges is required out of hours, this work could exceed noise criteria at up to six receivers
- Where work on the bridge north of Pillar Valley is required out of hours (ie at night), this work is unlikely to be heard at any receivers. Therefore, the assessment indicates 24-hour bridge work is possible
- No receivers are within 50 metres of a bridge sites potentially requiring piling. Therefore, the vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further investigation would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at specified cut sites along the project may result in some receivers nearby being exposed to vibration and overpressure above the appropriate noise management level. Therefore, a detailed assessment would be required pre-construction to confirm where appropriate mitigation is required. . Refer to Section 6.3.1 of Working paper – Noise and vibration for details of the Section 2 blasting assessment.

### Section 4 (Tyndale to Maclean)

The construction noise and vibration assessment for Section 4 has found that:

- Six receivers are likely to be exposed to noise above the appropriate noise management level during site enabling work. No receivers would be 'highly noise affected
- Over 32 per cent of receivers would experience noise above the appropriate noise management level due to site clearing, earthworks and asphalting. During earthworks, one property would be 'highly noise affected'
- Predicted noise levels from ancillary sites would be below the appropriate noise management level for all receivers (except for two receivers). Both receivers would be on land identified for use as an ancillary site and would be 'highly noise affected'
- Bridge construction is likely to exceed the appropriate noise management level at eight of the nearest receivers. None would be 'highly noise affected'. However, it is predicted that the property closest to the bridge crossing of Shark Creek would be exposed to noise levels of 74 dB(A)
- One property is within 50 metres of an overpass site so noise from piling might be audible. However, predicted vibration levels are below structural damage and human comfort criteria
- Controlled blasting at sites where deep excavations are required is unlikely to have an impact on the nearest receivers. Refer to Section 6.4.5 in Working paper – Noise and vibration for details of the Section 4 blasting assessment

- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact.

### Section 5 (Maclean to Iluka Road, Mororo)

The construction noise and vibration assessment for Section 5 has found that:

- Two receivers would experience noise levels above the appropriate noise management level during site enabling work. No receivers would be 'highly noise affected'
- Over 70 per cent of receivers affected by construction work (site clearing, earthworks and paving) would experience noise levels above the appropriate noise management level
- Predicted noise levels are likely to exceed the appropriate noise management level at around 46 receivers but these receivers would not be 'highly noise affected'
- The construction of the high-level bridge crossing of the Clarence River at Harwood would exceed the appropriate noise management level at some of the nearest receivers.
- No receivers are within 50 metres of a bridge site potentially requiring piling. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential receiver be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential receiver. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at specified cut sites along the project may result in some receivers nearby being exposed to vibration and overpressure above appropriate levels. Therefore, a detailed assessment would be required pre-construction to confirm where appropriate mitigation is required. Refer to Section 6.5.3 in Working paper – Noise and vibration for details of the Section 5 blasting assessment.

### Section 6 (Iluka Road to Devils Pulpit upgrade)

The construction noise and vibration assessment for Section 6 has found that:

- Over 40 per cent of receivers are likely to experience noise above the appropriate noise management level due to site clearing, earthworks and paving
- Predicted noise levels would exceed the appropriate noise management level at one property, and this property would be 'highly noise affected'. This is because the property is located near a proposed ancillary site
- The construction of the bridge crossing of Tabbimoble Creek would not exceed the appropriate noise management level. No receivers would be 'highly noise affected'
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact

- At this stage, no deep excavations would require controlled blasting in this section of the project so noise impacts from blasting would be nil. However, this would need to be confirmed during detailed design; if this requirement changes, appropriate noise management may be required. Refer to Section 6.6.5 in Working paper – Noise and vibration for details of the Section 6 blasting assessment.

### Section 7 (Devils Pulpit upgrade to Trustums Hill)

The construction noise and vibration assessment for Section 7 has found that:

- Over 80 per cent of receivers are likely to experience noise above the appropriate noise management level due to site clearing, earthworks and paving. Five of these receivers would be 'highly noise affected'
- Predicted noise from ancillary sites would be above the appropriate noise management level at six receivers. No receivers would be 'highly noise affected'
- No receivers are likely to be affected by bridge construction noise
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential residential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact. Refer to Section 6.7.5 for further information regarding blasting in Section 7 of the project
- At this stage, no deep excavations would require controlled blasting in this section of the project so noise impacts would be nil. However, this would need to be confirmed during detailed design; if this requirement changes, appropriate noise management may be required.

### Section 8 (Trustums Hill to Broadwater National Park)

The construction noise and vibration assessment for Section 8 has found that:

- Three receivers would experience noise above the appropriate noise management level during site enabling work. No receivers are likely to be 'highly noise affected'
- Because of site clearing, earthworks and paving, 67 per cent of receivers would experience noise above the appropriate noise management level. One receiver is likely to be 'highly noise affected'
- Predicted noise levels from ancillary sites would be above the appropriate noise management level at 12 receivers. Two receivers are likely to be 'highly noise affected' as they are on land identified for ancillary sites
- The construction of the bridge over Tuckombil Creek would exceed the appropriate noise management level at seven of the nearest receivers, assuming piling rigs are used
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Noise from controlled blasting would be within appropriate limits for those closest receivers. However, vibration levels may be perceptible to occupants of the nearest receivers, but be within acceptable limits. This assessment has assumed an explosive charge size of up to 25 kilograms. Where a higher blast charge is used or controlled blasting is closer to receivers, further

assessment would be required pre-construction to determine potential impacts and appropriate impact management arrangements. Refer to Section 6.8.5 within Working paper – Noise and vibration for details of the Section 8 blasting assessment.

### Section 9 (Broadwater National Park to Richmond River)

The construction noise and vibration assessment for Section 9 has found that:

- Over 30 per cent of receivers are likely to experience noise above the appropriate noise management level due to site clearing, earthworks and paving. No receivers are likely to be 'highly noise affected'
- Predicted noise from ancillary sites would be above the appropriate noise management level at 11 receivers. However, no receivers are likely to be 'highly noise affected'
- The construction of the access road at Broadwater – Evans Head Road would not exceed the appropriate noise management level. Similarly, no receivers are likely to be 'highly noise affected'
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at deep excavation sites may expose some receivers to vibration levels close to appropriate levels. Therefore, further assessment and mitigation would be required pre-construction based on specific controlled blasting requirements. Refer to Section 6.9.5 of Working paper – Noise and vibration for the details of the Section 9 blasting assessment.

### Section 10 (Richmond River to Coolgardie Road)

The construction noise and vibration assessment for Section 10 has found that:

- Over 85 per cent of receivers are likely to experience noise above the appropriate noise management level due to site clearing, earthworks and paving. Of these, five are likely to be "highly noise affected"
- Appropriate noise management levels would be exceeded at just over half the identified receivers
- Noise from bridge construction, including the crossing of the Richmond River, would exceed appropriate noise management levels at around 50 per cent of the identified receivers
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential residential impact
- During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential impact
- Controlled blasting at deep excavation sites may expose some receivers to vibration levels close to appropriate levels. Therefore, further assessment and mitigation would be required pre-construction based on specific controlled blasting requirements. Refer to Section 6.10.3 in Working paper – Noise and vibration for details of the Section 10 blasting assessment.

### Section 11 (Coolgardie Road to Ballina bypass)

The construction noise and vibration assessment for Section 11 has found that:

- No receivers are likely to experience noise above the appropriate noise management level during site establishment work
- Over 80 per cent of receivers are likely to experience noise above the appropriate noise management level due to site clearing, earthworks and paving. No receivers are likely to be 'highly noise affected'
- Predicted noise from ancillary sites would be above appropriate criteria at 14 receivers
- No receivers are likely to be affected by bridge construction noise from the crossing of Emigrant Creek
- No receivers are within 50 metres of a bridge or piling site. Therefore, vibration risk is small
- During detailed design, sites might be nominated for rock hammering or breaking. Should a residential property be located within 30 metres of this type of site, further assessment would be required pre-construction to confirm the potential impact

During detailed design, sites might be nominated as additional piling sites within 50 metres of a residential property. Should this be the case, further assessment would be required pre-construction to confirm the potential residential impact. Refer to Section 6.11.4 of Working paper – Noise and vibration for details of the Section 11 blasting assessment.

## Cumulative noise impacts during construction

Cumulative construction impacts could be caused by the simultaneous construction of different sections of the highway upgrade, and the simultaneous construction of the highway upgrade and external projects. These potential impacts are discussed below.

### Simultaneous construction of different project sections

Simultaneous construction of different project sections may be required. Minor cumulative impacts may occur at receivers located close to the start or end of a section where adjoining sections are staged at the same time.

Cumulative impacts may also occur where there are non-linear works (bridge building, ancillary site operations and controlled blasting) happening at the boundary between adjoining project sections.

Further details are in the Working paper – Noise and vibration.

### External projects

The cumulative impact of construction would not create 'highly noise affected' receivers.

Cumulative noise impacts could result from:

- Adjacent construction activities south of Woolgoolga, such as the Sapphire to Woolgoolga project, or north of Ballina, as shown in Table 15-27, these impacts would generally be minor
- Receivers near multiple construction activities being exposed to cumulative noise. For example, at tie-in locations, receivers could experience a maximum construction noise increase of 0–3 dB(A). However, those receivers impacted by cumulative work would already be affected by the construction of individual project sections, and the impacts would be similar).

The timing of each stage of the project is not defined, and so the timeframes in Table 15-41 are indicative and serve as a guide only.

**Table 15-27: Overview of external projects in close proximity to study area**

| Location | Cumulative noise impacts |
|---|---|
| Tyndale | The boundary of sections 3 and 4 would be at the interchange at Tyndale – about 500 metres north of the closest Section 3 receivers that are potentially sensitive to noise. Therefore, the potential for cumulative impact is small. In addition, Section 4 work is expected to start one year before Section 3 in 2013, so cumulative impacts are unlikely. |
| Southern end of Devils Pulpit | In the unlikely event of an overlapping period of construction, those receivers impacted by cumulative work would already be affected by individual project work and impacts would be similar. No receivers would be 'highly noise affected' from cumulative impacts. |
| Northern end of Devils Pulpit | In the unlikely event of an overlapping period of construction, those receivers impacted by cumulative work would already be affected by individual project work and impacts would be similar. No receivers would be 'highly noise affected' from cumulative impacts. |
| Woodburn | Sections 8, 9, 10 and 11 are scheduled to start in the first quarter of 2014. Therefore, Section 8 and Section 9 could be built at the same time. However, Woodburn is about 1.1 kilometres to the west of Section 8. This distance is sufficient to suggest cumulative impacts from construction are not likely to affect Woodburn residents. |
| Ballina | Section 11 of the project is scheduled to start in the first quarter of 2014. A tie-in to Ballina bypass is required at station 164.0. The Ballina bypass has recently opened and so works would not happen when Section 11 work is happening. Cumulative impacts from these two neighbouring projects are unlikely. |

**Photo 4: View across part of the Glenugie upgrade located between sections 2 and 3 of the project. The project will tie into this recently completed upgrade.**

### 15.3.2 Operational noise and vibration

The assessment of operational noise has been informed by:

- Existing background noise information and noise predictions for once the project is built and open to traffic
- The location of residential receivers and terrain near the project
- The concept design
- Predicted traffic levels.

The design used for noise modelling is based on a three-dimensional road model. This allows the noise model to replicate areas of shielding potentially provided by deep excavations and embankments located across the project.

Traffic forecasts from all aspects of the project have been considered including vehicles using the main alignment, interchanges, service roads, rest areas and heavy vehicle checking station.

The predicted noise and vibration impacts of the project are summarised in the following sections. In summary, following a design review and the application of low noise wearing surfaces, operational traffic noise is predicted to exceed relevant criteria at around 219 residential receivers. A further review would be completed at the detailed design stage to determine which receivers require noise controls, including architectural treatments.

#### Section 1 (Woolgoolga to Halfway Creek)

Section 1 would involve the duplication of the Pacific Highway within and adjacent to the existing road reserve. Most of the new road development would be to the west of the existing Pacific Highway. The project would move road traffic noise closer to some receivers to the west and further away from some receivers to the east.

The operational noise and vibration assessment for Section 1 has found that:

- The majority of receivers potentially sensitive to noise currently experience some noise from the existing Pacific Highway
- Some receivers south of Halfway Creek would experience a new noise impact. This would result from realigning the Pacific Highway to the west of its current location between Arrawarra and Halfway Creek. Many receivers would experience traffic noise on a previously unaffected facade of their property
- With the exception of the communities at Arrawarra, Corindi Beach and Cassons Creek, most receivers are located on large residential or rural blocks. Typically, there is a space of more than 100 metres between dwellings
- Receivers potentially requiring noise mitigation would be generally within 100 metres of the project. They are separated by large distances, so noise barriers are not recommended. Low noise wearing surfaces would be considered between station 0.2 and 1.6, near Darlington Park. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-28: Summary of noise modelling results: Section 1**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 199 | 75 | 10 |
| B | 166 | 166 | 19 |
| C | 17 | 17 | 15 |
| D | 3 | 3 | 2 |
| E | 7 | 6 | 4 |
| F | 2 | 1 | 1 |
| **Total** | **394** | **268** | **51** |

## Section 2 (Halfway Creek to Glenugie upgrade)

Section 2 would involve the duplication of the Pacific Highway within and adjacent to the existing road reserve. The project would pass through Glenugie State Forest and be in a heavily vegetated area. In noise terms, this is classed as a road redevelopment. Noise levels would also be influenced by a heavy vehicle checking station proposed at station 19.4. This would result in estimated noise levels of 76 dB(A), 85 dB(A) and 88 dB(A) from truck doors, truck acceleration and brakes. Noise from this feature of the project has been considered in the assessment.

The operational noise and vibration assessment for Section 2 has found that:

- The majority of receivers potentially sensitive to noise currently experience noise from the existing Pacific Highway
- Receivers are sparsely populated, and are typically more than 100 metres apart
- Receivers potentially requiring noise mitigation are generally within 100 metres of the project
- Receivers potentially requiring noise mitigation are typically far apart, so noise barriers and low noise wearing surfaces are not recommended. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-29: Summary of noise modelling results: Section 2**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 3 | 2 | 2 |
| B | 7 | 7 | 3 |
| C | 2 | 2 | 2 |
| D | 3 | 3 | 1 |
| E | 4 | 4 | 1 |
| F | 3 | 0 | 0 |
| **Total** | **22** | **18** | **9** |

## Section 3 (Glenugie upgrade to Tyndale)

Section 3 is the largest project section, and would deviate significantly from the existing Pacific Highway. This section would require a new road development on land previously unaffected by road traffic noise. This project section would be in a rural setting, passing adjacent to Pine Brush State Forest, and the area is generally quite heavily vegetated. A rest area is proposed at station 63.3 to 64.3, which incorporates a car and truck stop with public amenities. The noise assessment has considered noise levels from use of this rest area during the day and night-time.


**Photo 5: Residential and commercial receivers located at Tyndale**

The operational noise and vibration assessment for Section 3 has found that:

- Most receivers potentially sensitive to noise currently experience no road traffic noise except from Eight Mile Lane, Wooli Road and Tucabia–Tyndale Road
- Receivers are sparsely populated with population densities increasing significantly around Tyndale. Rural receivers are typically 150 metres apart
- Receivers potentially requiring noise mitigation are located at distances of up to 600 metres or more from the centreline of the project. The requirement for noise mitigation has been informed by 'relative increase criteria', which is a method of identifying an appropriate noise limit in areas previously unaffected by noise
- Receivers potentially requiring noise mitigation are typically far apart. Low noise wearing surfaces would be considered for the more densely populated areas around Tyndale between station 66.4 and station 68.3. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-30: Summary of noise modelling results: Section 3**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 6 | 6 | 6 |
| B | 9 | 9 | 9 |
| C | 2 | 2 | 2 |
| D | 10 | 10 | 8 |
| E | 8 | 6 | 6 |
| F | 17 | 15 | 10 |
| **Total** | **52** | **48** | **41** |

## Section 4 (Tyndale to Maclean)

Section 4 is classed in noise terms as a new road until Townsend (around station 81.2). This is where the existing Pacific Highway and the project would merge. From this point north, the project is classed as a road redevelopment (it would be adjacent to receivers in this part of the section). Most receivers are located around Maclean and Townsend. The community of Gulmarrad is located on the eastern boundary of the study area about three kilometres south of Townsend.

The operational noise and vibration assessment for Section 4 has found that:

- Some receivers would experience road traffic noise on both sides of their property. This is because the existing Pacific Highway is to the west of their property and the realigned highway would be to the east
- Receivers potentially requiring noise mitigation south of MacLean and Townsend are typically far apart. Because of this, noise barriers and low noise wearing surfaces are not recommended
- Low noise wearing surfaces would be considered for use north of the interchange at Maclean between stations 80.5 and 82.5. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-31: Summary of noise modelling results: Section 4**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 21 | 1 | 1 |
| B | 20 | 2 | 2 |
| C | 23 | 19 | 6 |
| D | 27 | 17 | 9 |
| E | 80 | 5 | 1 |
| F | 79 | 4 | 2 |
| **Total** | **250** | **48** | **21** |

## Section 5 (Maclean to Iluka Road, Mororo)

Section 5 would involve the duplication of the existing Pacific Highway. A further high-level bridge crossing of the Clarence River at Harwood would be constructed to the east of the existing bridge. The noise model has considered all aspects of the project design including potential reflective noise impacts for Harwood residents from the location and operation of this bridge. The existing bridge at Harwood would remain and continue to open, providing access upstream to maritime traffic.

The operational noise and vibration assessment for Section 5 has found that:

- Receivers experience noise from the existing Pacific Highway
- Receivers potentially sensitive to noise are mainly located around Harwood, Mororo and to the north of Townsend. At Mororo, the majority of receivers are located in the Woombah Woods Caravan Park
- Low noise wearing surfaces would be considered for receivers requiring noise mitigation between Townsend and Harwood around stations 85.9 to 88.0. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-32: Summary of noise modelling results: Section 5**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 64 | 1 | 0 |
| B | 65 | 6 | 0 |
| C | 23 | 8 | 8 |
| D | 30 | 9 | 5 |
| E | 23 | 2 | 0 |
| F | 10 | 0 | 0 |
| **Total** | **215** | **26** | **13** |

## Section 6 (Iluka Road to Devils Pulpit upgrade)

Section 6 would involve the duplication of the existing Pacific Highway. A rest area is proposed at Mororo Road (for southbound traffic) at station100.4, which incorporates a car and truck stop with public amenities. The noise assessment and proposed mitigation has considered noise levels from use of this rest area during the day and night-time. The noise assessment has considered this feature of the project.

The operational noise and vibration assessment for Section 6 has found that:

- Receivers are generally concentrated at each end of the section and experience noise from the existing Pacific Highway
- Low noise wearing surfaces are not recommended because receivers are far apart. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-33: Summary of noise modelling results: Section 6**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 1 | 1 | 0 |
| B | 2 | 2 | 0 |
| C | 1 | 1 | 1 |
| D | 0 | 0 | 0 |

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| E | 3 | 3 | 0 |
| F | 0 | 0 | 0 |
| **Total** | **7** | **7** | **1** |

## Section 7 (Devils Pulpit upgrade to Trustums Hill)

Section 7 would involve the duplication of the Pacific Highway. In noise terms, this is classed as a road redevelopment.

The operational noise and vibration assessment for Section 7 has found that:

- Most receivers are in the northern part of the section and experience noise from the existing Pacific Highway
- Low noise wearing surfaces are not recommended because receivers are far apart. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-34: Summary of noise modelling results: Section 7**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 0 | 0 | 0 |
| B | 6 | 5 | 3 |
| C | 10 | 10 | 10 |
| D | 8 | 8 | 8 |
| E | 2 | 1 | 0 |
| F | 3 | 0 | 0 |
| **Total** | **29** | **24** | **21** |

## Section 8 (Trustums Hill to Broadwater National Park)

Section 8 would involve the duplication of the Pacific Highway. It would also require new road development (which would be classed as such in noise terms) to the east of the existing highway and Woodburn. The community of The Gap and Trustums Hill is located on the eastern boundary of the 600 metre study area. This area is around three kilometres south of Townsend. Woodburn would be bypassed by the project.

The operational noise and vibration assessment for Section 8 has found that:

- Most receivers are in the southern part of the section, near the existing highway, and experience road traffic noise to some extent
- Some receivers would experience road traffic noise on both sides of their property. This is because the existing Pacific Highway is to the west of their property and the realigned highway would be to the east
- Receivers potentially requiring noise mitigation are typically far apart, so noise barriers are not recommended. Low noise wearing surface would be considered around Trustums Hill – The Gap Road between station 127.0 and 128.1. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-35: Summary of noise modelling results: Section 8**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 2 | 2 | 2 |
| B | 5 | 1 | 1 |
| C | 10 | 7 | 2 |
| D | 8 | 7 | 5 |
| E | 12 | 12 | 2 |
| F | 3 | 1 | 1 |
| **Total** | **40** | **30** | **13** |

## Section 9 (Broadwater National Park to Richmond River)

Section 9 would involve the duplication of the Pacific Highway. It would also require new road development (which would be classed as such in noise terms) to the east of Broadwater. The project passes through Broadwater National Park on the existing highway alignment and emerges to the south east of Broadwater, which would be bypassed by the project. The operational noise and vibration assessment for Section 9 has found that:

- Most receivers would experience a new noise impact from the realignment of the highway to the east of Broadwater. Most receivers would experience traffic noise on a previously unaffected facade of their home
- Receivers are mainly on large rural blocks, typically 100 metres or more apart
- Receivers potentially requiring noise mitigation are far apart, so noise barriers are not recommended. Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-36: Summary of noise modelling results: Section 9**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 0 | 0 | 0 |
| B | 2 | 2 | 2 |
| C | 1 | 1 | 1 |
| D | 2 | 2 | 2 |
| E | 6 | 6 | 6 |
| F | 10 | 9 | 6 |
| **Total** | **21** | **20** | **17** |

## Section 10 (Richmond River to Coolgardie Road)

Section 10 would mainly involve new road development. Access would be provided via an interchange at Coolgardie Road, north of Wardell, in the northern part of the section. The project would bypass Wardell to the north, and include a high level bridge crossing of the Richmond River. The noise model has considered all aspects of the project design including potential reflective noise impacts from the location and operation of this bridge. A rest area with potential heavy vehicle checking station is proposed within this section between station 147.2 and 148.2. The rest area incorporates a car and truck stop with public amenities. The noise assessment and proposed mitigation has considered noise levels from use of this rest area during the day and night-time. The operational noise and vibration assessment for Section 10 has found that:

- Most receivers would experience a new noise impact from the realignment of the highway to the east of its current location thorough Meerschaum Vale and Coolgardie
- Receivers are mainly on rural farms or large rural blocks, typically 100 metres or more apart
- Most receivers potentially requiring noise mitigation are on high ground. They overlook the project and are far apart. Because of this, noise barriers are not recommended. Instead, low noise wearing surface would be considered around station 155.4 to station 157.7 and architectural treatments would be considered to mitigate noise impacts.

**Table 15-37: Summary of noise modelling results: Section 10**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 7 | 2 | 0 |
| B | 17 | 9 | 3 |
| C | 7 | 7 | 7 |
| D | 7 | 7 | 7 |
| E | 24 | 15 | 8 |
| F | 22 | 15 | 5 |
| **Total** | **84** | **55** | **30** |

## Section 11 (Coolgardie Road to Ballina bypass)

Section 11 would involve the duplication of the existing Pacific Highway. In noise terms, this is classed as a road redevelopment. The project would tie into the Ballina bypass.

The operational noise and vibration assessment for Section 11 has found that:

- Most receivers experience some level of noise from the existing Pacific Highway
- Receivers are mainly on farms or large rural blocks often more than 100 metres apart
- Receivers potentially requiring noise mitigation are generally located away from the existing Pacific Highway, far apart. Because of this, the use of noise barriers is not recommended
- Architectural treatments would be considered for those receivers where road traffic noise exceeds appropriate noise limits.

**Table 15-38: Summary of noise modelling results: Section 11**

| Noise catchment area | Number of receivers | Number exceeding base criteria | Number of receivers considered for mitigation |
|---|---|---|---|
| A | 4 | 0 | 0 |
| B | 0 | 0 | 0 |
| C | 0 | 0 | 0 |
| D | 1 | 1 | 1 |
| E | 3 | 3 | 1 |
| F | 1 | 0 | 0 |
| **Total** | **9** | **4** | **2** |

## Rest areas

In addition to operational traffic noise, the project would incorporate a number of rest areas, each with toilets, rest facilities and parking spaces for B-double trucks and car parking. Locations for the rest areas include Tucabia (north and southbound), Mororo Road (southbound) and at Richmond River (north and southbound). Rest area locations are shown in Chapter 5 (Description of the project – operation).

Table 15-39 includes data used to estimate the noise impacts from the rest areas located across the project.

**Table 15-39 Noise data for rest area assessment**

| Rest area activity | Estimated Noise Level at 10 m |
|---|---|
| Truck air brake (bleed off) | 88 dB(A) |
| Truck movement (accelerating) | 85 dB(A) |
| Truck refrigeration unit (continuous) | 77 dB(A) |
| Truck door | 76 dB(A) |
| Car starting | 76 dB(A) |

Section 3 has a rest area located around station 63.8. The rest area is located in an area of agricultural farms and bush land around 800 metres south and about 500 metres to the south west of the nearest receivers in Section 3. The layout of the northbound and southbound rest areas includes space for around 10 B-Doubles, as well as car parking bays. The assessment of noise impacts for the rest area has been based on a typical usage of either the northbound or southbound rest areas over any given fifteen minute period, at any time of the day or night.

The noise level (LAeq 15 minute) predicted at the closest receiver has been estimated based on each of the activities in Table 15-39 occurring once in any fifteen minute period. The predicted level for the closest receiver location for the south bound rest area is 32 dB(A). This level is lower than the project noise goal for intrusive noise impacts of 39 dB(A) at this location. The noise level (LA1) from the rest area has been predicted based on the worst case event from the above table being the exhaust bleed off from truck brakes. The estimated noise level resulting from this impact is 40 dB(A), and is below the calculated threshold for sleep disturbance impacts of 48 dB(A) for this location.

Section 6 has a rest area located at station 100.4. The nearest receivers are located between 1.8 and two kilometres away from this rest area. The predicted noise level has been based on each activity in Table 15-39 occurring once in any fifteen minute period. This results in a noise level (LAeq 15 minute) at the closest receiver location of less than 30 dB(A). This is lower than the project noise criteria of 47 dB(A) for intrusive noise.

The noise level (LA1) from the rest area has been predicted based on the worst case event from Table 15-39 due to the exhaust bleed off from truck brakes. The estimated noise level resulting from this impact is predicted to be less than 30 dB(A), and is below the calculated threshold for sleep disturbance impacts of 59 dB(A) for this location.

Section 10 has a rest area located between station 147.5 and 148.2 for both north bound and south bound traffic. The rest area is situated amid farming land with the nearest receivers located on the western side of the project around 520 metres from the rest area.

The resulting noise level (LAeq 15 minute) at the closest receiver location is predicted to be 35 dB(A), which is lower than the project noise goal for intrusive noise of 38 dB(A). The predicted noise level (LA1) from the rest area is predicted to be 39 dB(A), which is below the project threshold for sleep disturbance impacts of 48 dB(A).

### Heavy vehicle checking station

In addition to rest areas, two heavy vehicle checking stations have been identified across the project. In Section 2, a checking station would be located between station 19.100 and station 20.0. This would replace the current station operating near Glenugie State Forest (station 26.6). Provision has also been made within the design for a potential further checking station within the proposed rest area at Richmond River within Section 10 of the project.

The checking station in Section 2 is situated around 550 metres away from the nearest receiver. The intrusive noise level at the nearest receiver has been estimated based on each activity in Table 15-40 occurring twice in any fifteen minute period. Sleep disturbance has been assessed against the noise that could result from an air brake bleed off, as this is the noisiest potential activity.

**Table 15-40 Noise data for heavy vehicle checking station in Section 2 (Halfway Creek)**

| Heavy vehicle checking station activity | Estimated noise level at 10 m |
|---|---|
| Truck air brake (bleed off) | 88 dB(A) |
| Truck movement (accelerating) | 85 dB(A) |
| Truck door | 76 dB(A) |

The assessment of noise impact from the heavy vehicle checking station indicates a noise level (LAeq 15 minute) at the closest residential receiver location of less than 30 dB(A). This is less than the project noise goal of 40 dB(A) for intrusive noise. Therefore, noise from the checking station would not be an issue for nearby dwellings.

## 15.4 Management of impacts

The design of the project, including the use of low noise wearing surface, would still leave about 219 residential receivers where levels of operational traffic noise are predicted to exceed relevant noise-level criteria. This would necessitate the application of additional noise management measures at these receivers.

Measures identified for the management of noise and vibration impacts are shown in Table 15-41 and Figure 15-12 to Figure 15-22. These measures would be re-assessed during detailed design to confirm their appropriateness. Receivers potentially requiring acoustic treatment and project sections potentially requiring low noise wearing surface may be subject to change. The locations of low noise wearing surfaces and architectural treatment would be further developed as part of the detailed design.

Management measures would include consultation with potentially affected residents located on or near proposed ancillary sites during construction, and residents affected by construction activities during extended or out of hours work (refer to Section 15.1.6). There would also be a need for consultation with residents affected by traffic noise from operation of the highway upgrade.

Management measures would also include architectural treatments. These could include a range of noise controls, which are generally considered to be the most cost-effective solution for isolated receivers where noise barriers and/or low noise wearing surfaces are not feasible.

Noise controls include sealing off wall vents, upgrading windows, double-glazing, replacing hollow-core doors with solid-core doors within the noise-exposed facade(s), and installing air-conditioning or ventilation systems to meet the Building Code of Australia requirements for fresh air (in receivers deemed too noise-affected to open windows for natural ventilation). For these measures to be effective, the property must be in a reasonable state of repair.

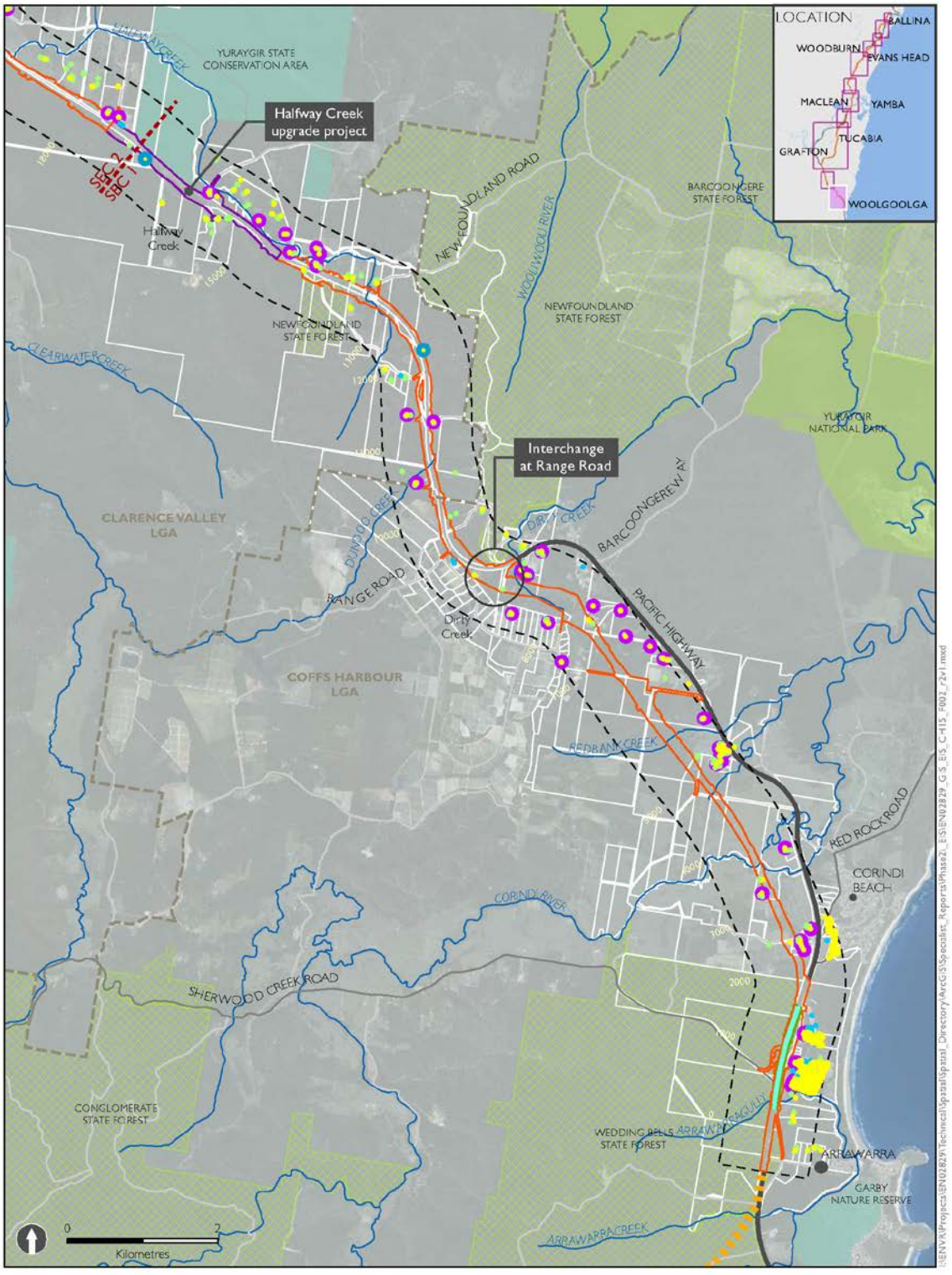


**Figure 15-12: Noise impacted receivers and proposed mitigation: Section 1**

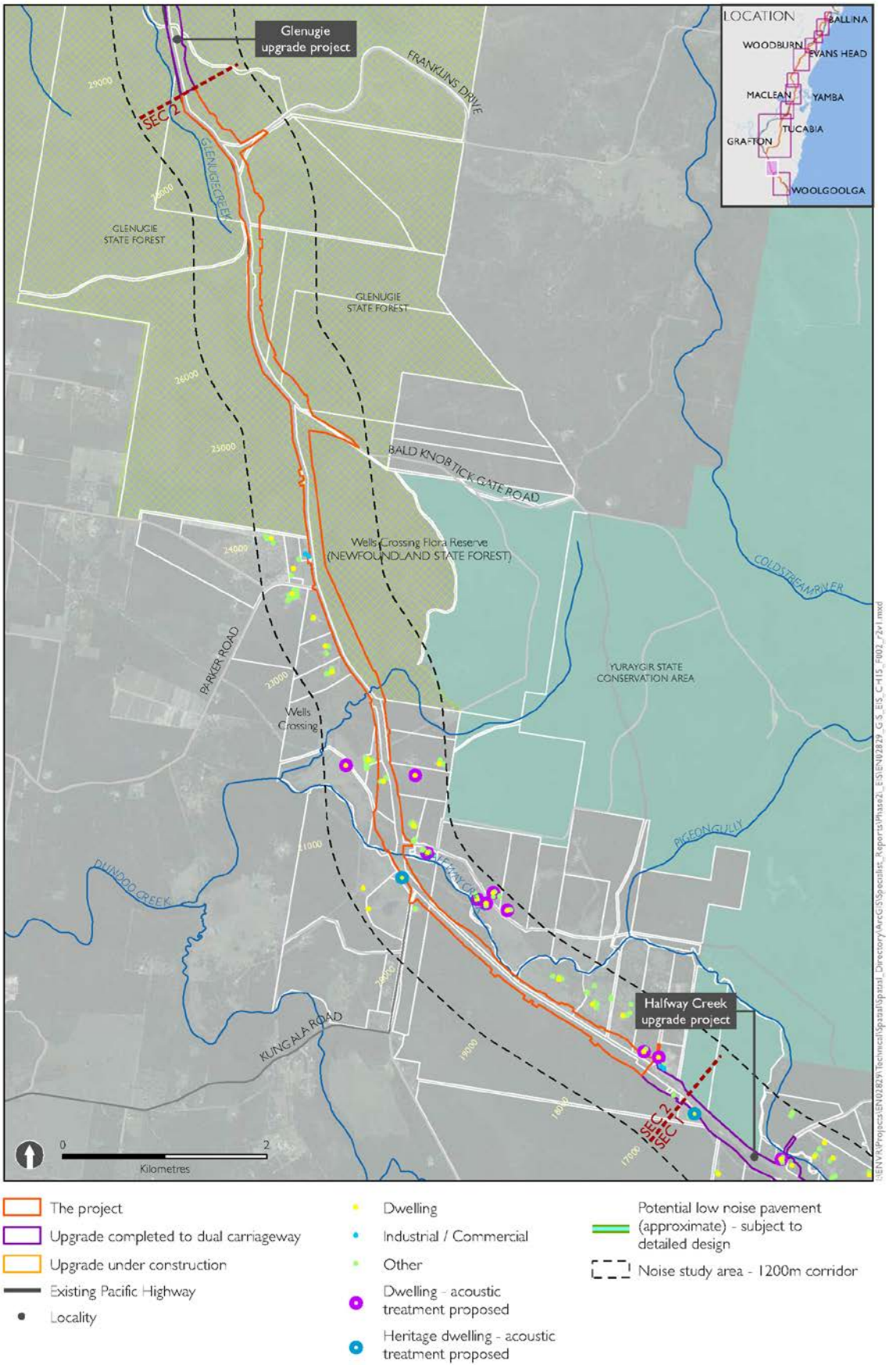


**Figure 15-13: Noise impacted receivers and proposed mitigation: Section 2**

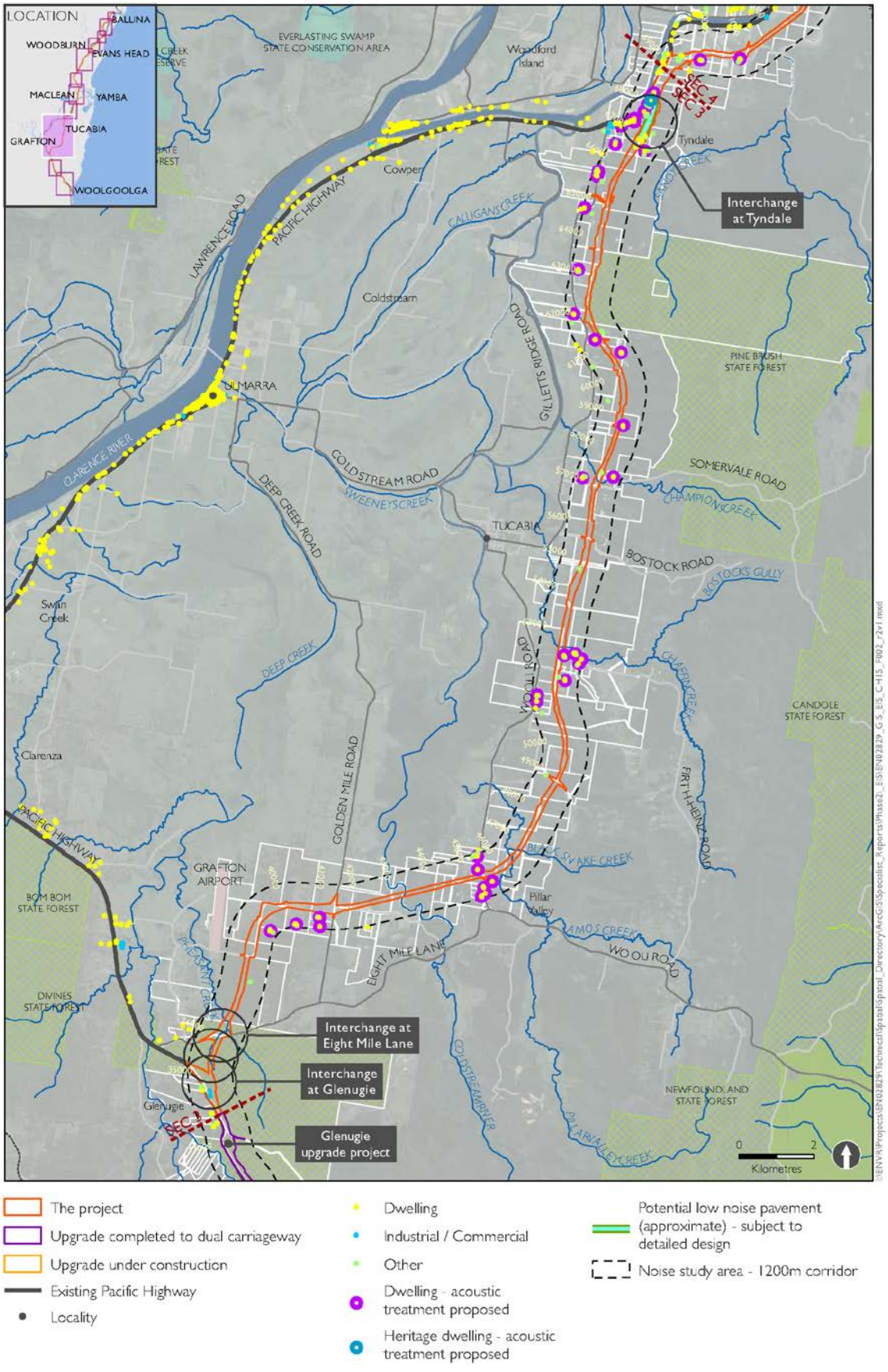


**Figure 15-14: Noise impacted receivers and proposed mitigation: Section 3**

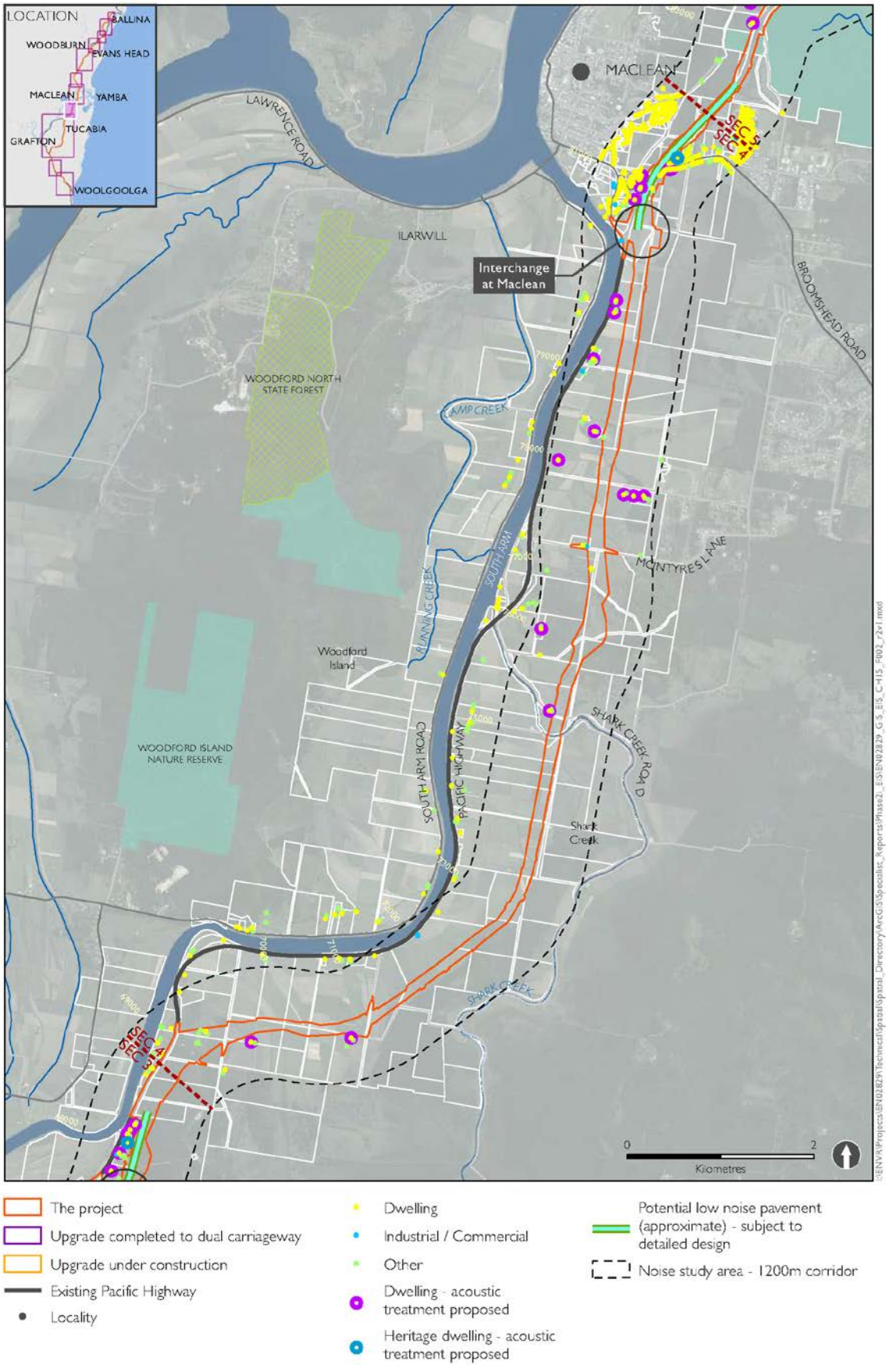


**Figure 15-15: Noise impacted receivers and proposed mitigation: Section 4**

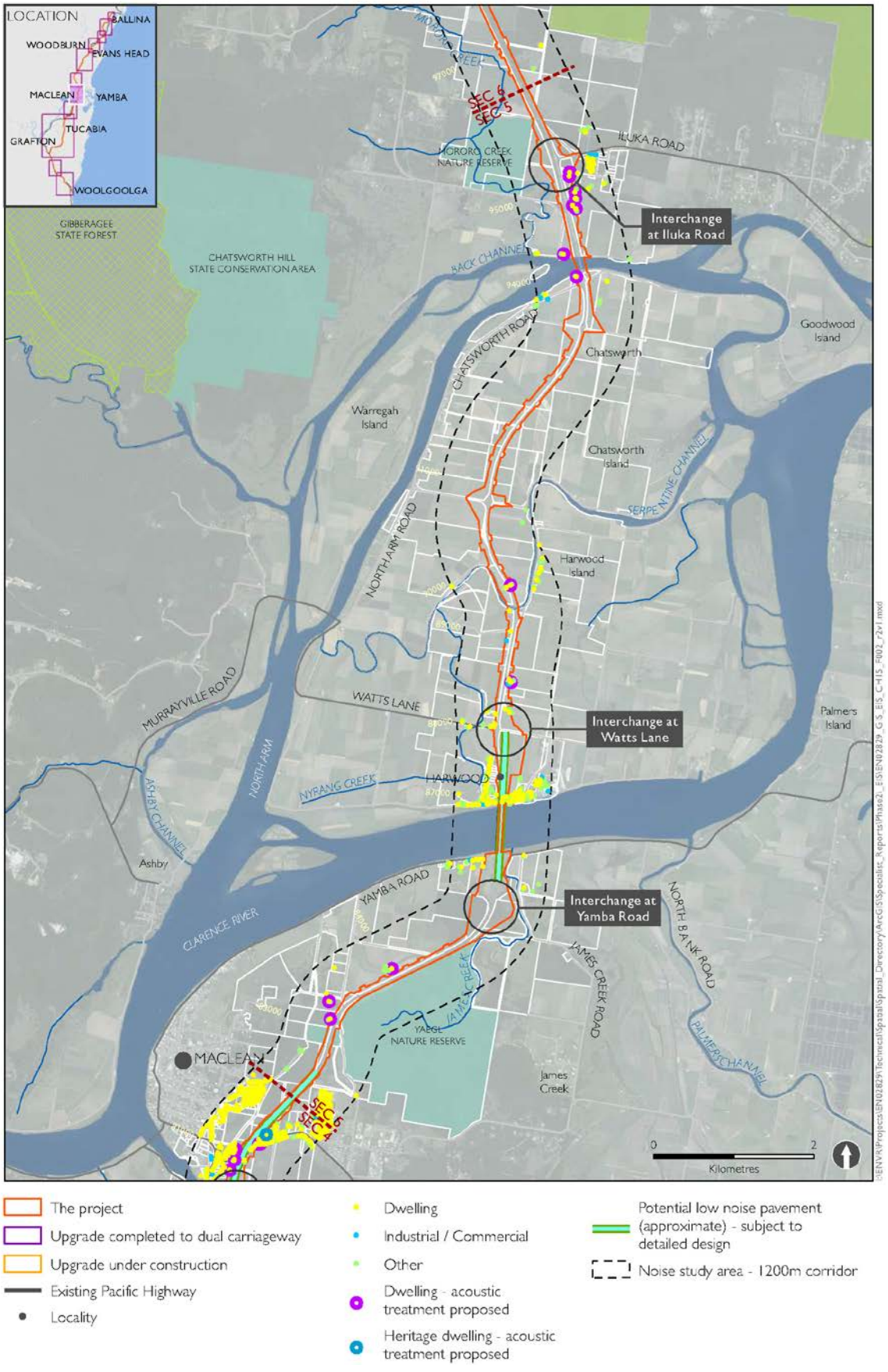


**Figure 15-16: Noise impacted receivers and proposed mitigation: Section 5**


**Figure 15-17: Noise impacted receivers and proposed mitigation: Section 6**

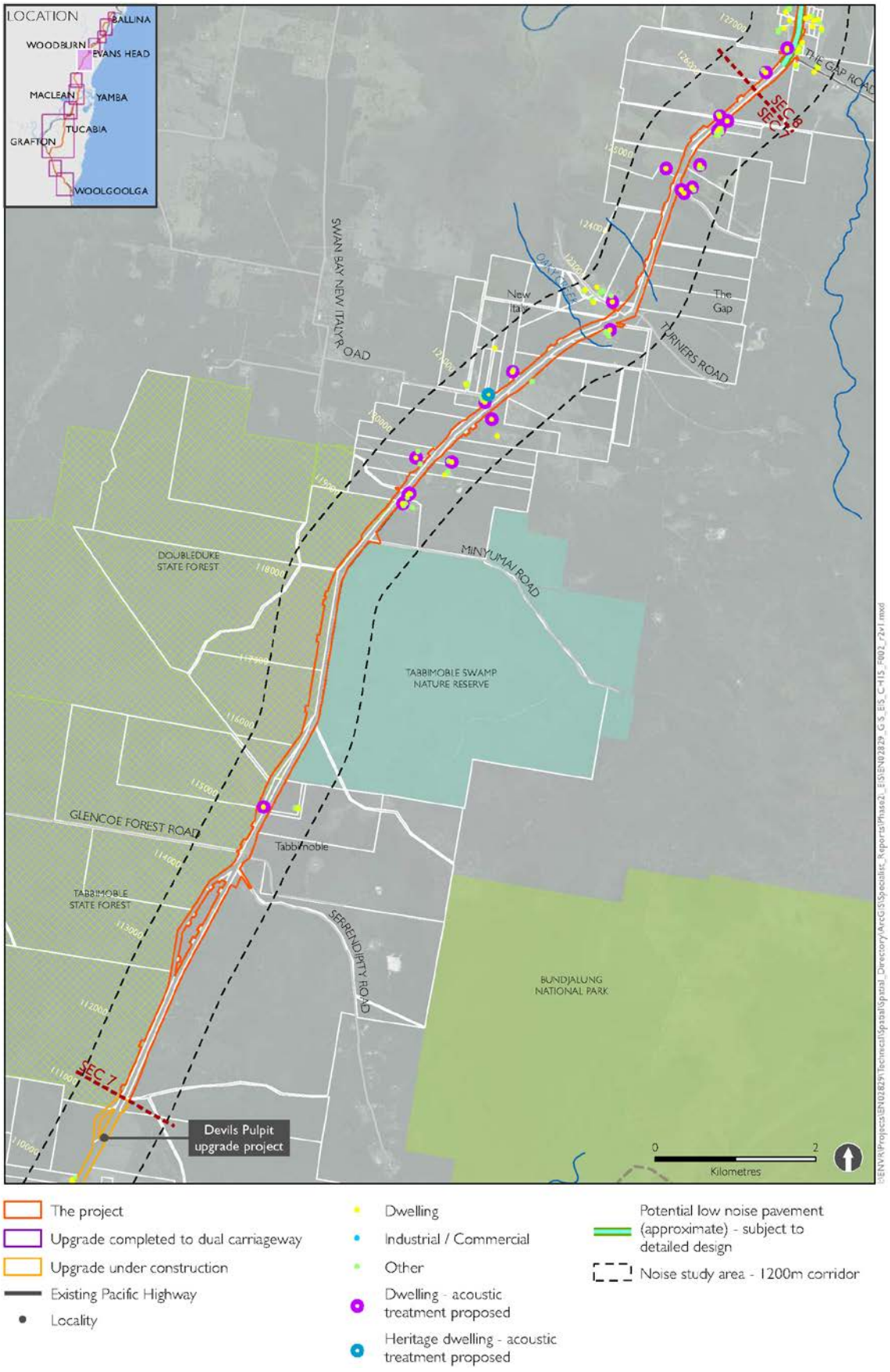


**Figure 15-18: Noise impacted receivers and proposed mitigation: Section 7**


**Figure 15-19: Noise impacted receivers and proposed mitigation: Section 8**


**Figure 15-20: Noise impacted receivers and proposed mitigation: Section 9**

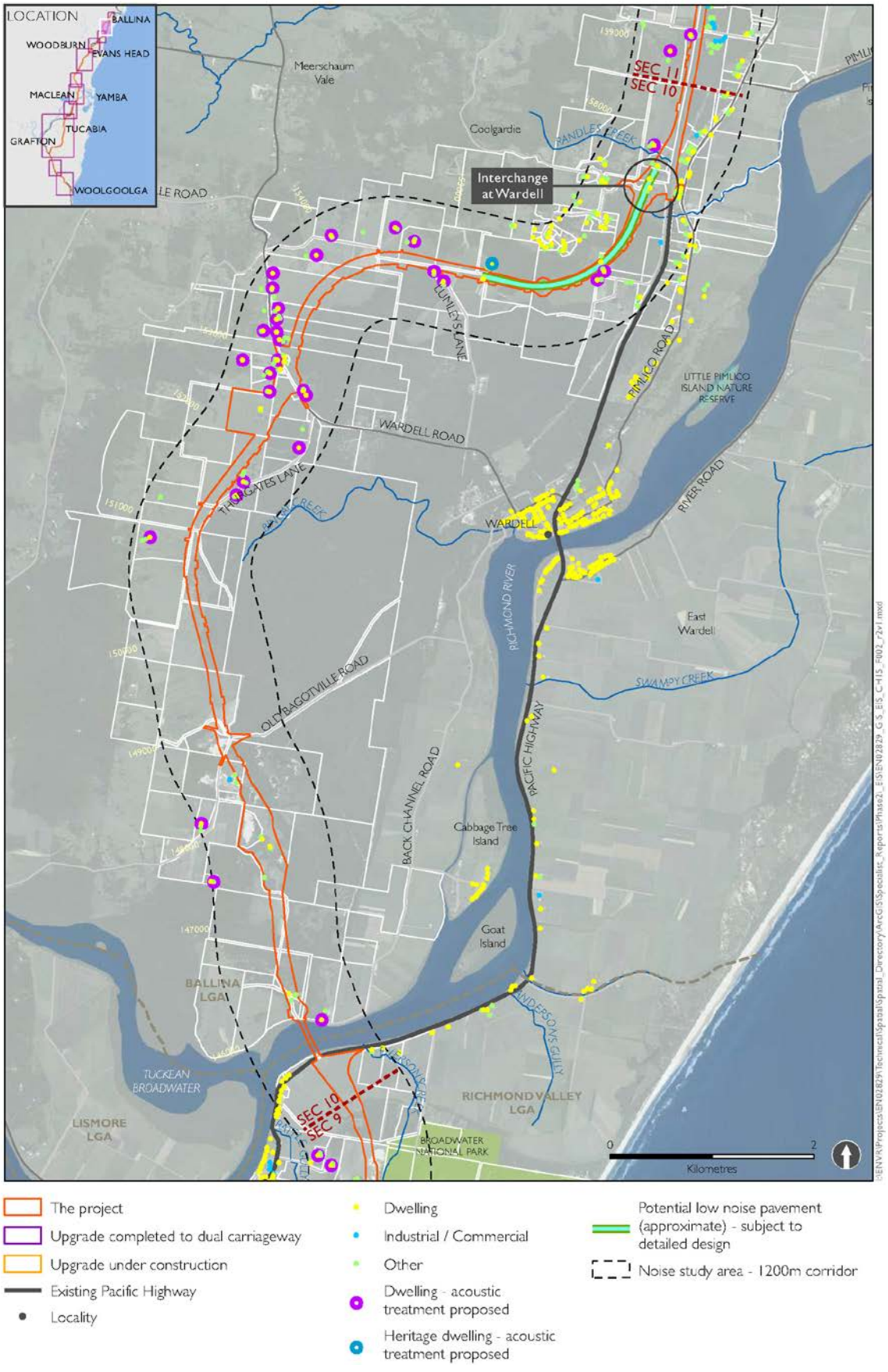


**Figure 15-21: Noise impacted receivers and proposed mitigation: Section 10**

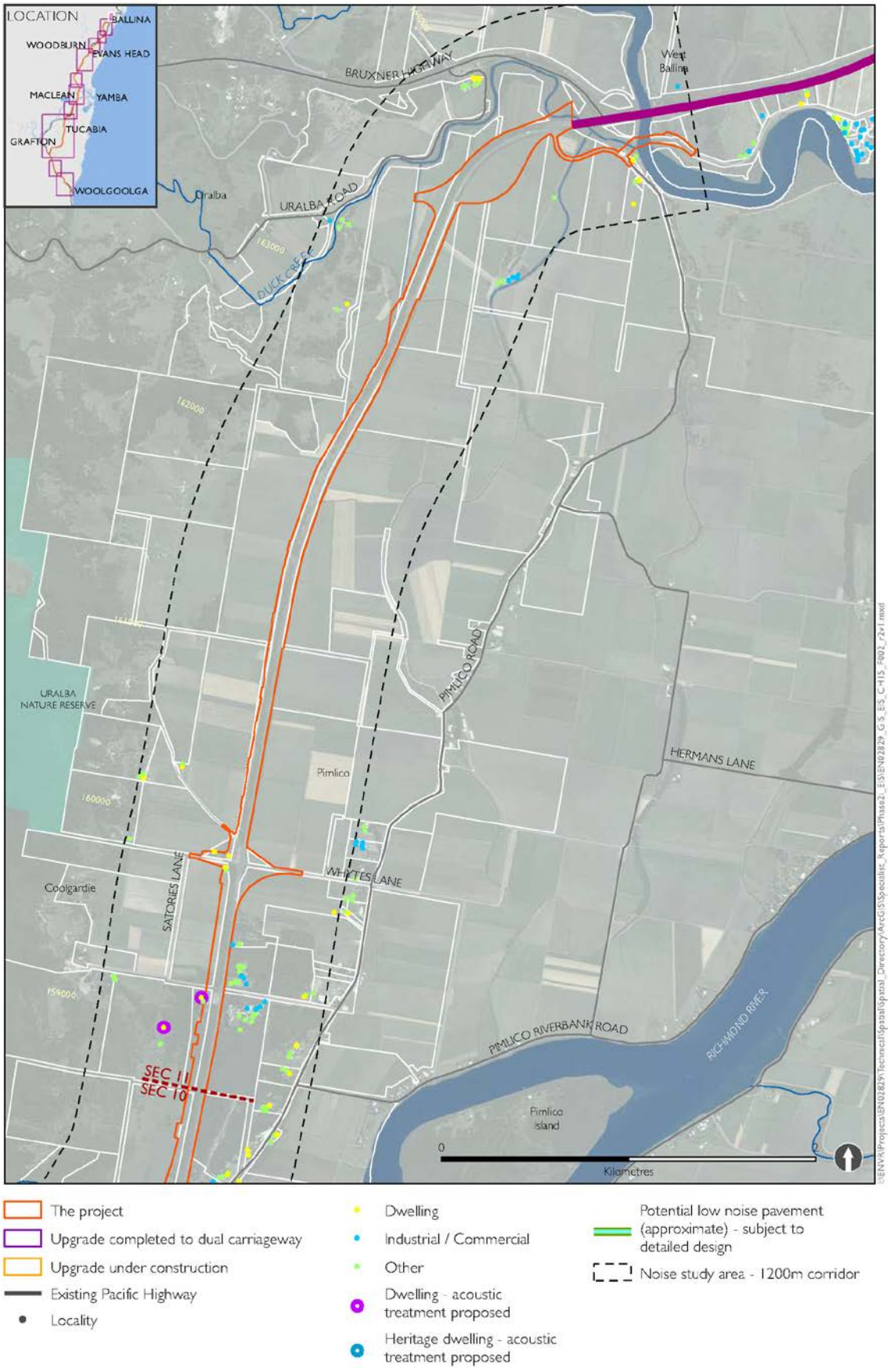


**Figure 15-22: Noise impacted receivers and proposed mitigation: Section 11**

**Table 15-41: Noise and vibration mitigation measures**

| Issue | Mitigation ID no. | Mitigation measure | Timing | Relevant section |
|---|---|---|---|---|
| **Construction phase** | | | | |
| Construction noise | CNV1 | Affected receivers would be consulted prior to the commencement of out of hours work. | Construction | All sections |
| Construction noise | CNV2 | Construction would be timetabled to minimise noise impacts where feasible and reasonable. This may include time and duration restrictions and respite periods. These measures would be considered after consultation with affected receivers. | Construction | All sections |
| Construction noise | CNV3 | Haulage routes would be located as far away as possible from residential receivers, where this is reasonable and feasible. | Construction | All sections |
| Construction noise | CNV4 | The use of noisy plant simultaneously and/or close together would be avoided, where possible. This would include equipment operating at separate early work sites to avoid cumulative noise impacts. | Construction | All sections |
| Construction noise | CNV5 | Equipment/plant within ancillary facilities would be located as far as possible from receivers. | Construction | All sections |
| Construction noise | CNV6 | Equipment would be maintained in efficient working order. | Construction | All sections |
| Construction noise | CNV7 | Quieter construction methods would be used, where there are sensitive receivers potentially affected and where this is considered reasonable and feasible. These may include grinding, rock splitting or terrain levelling instead of hydraulic rock breaking. | Construction | All sections |
| Construction noise | CNV8 | Where acceptable from a work health and safety perspective, quieter alternatives to reversing alarms (such as spotters, closed circuit television monitors and ‘smart’ reversing alarms) would be used, particularly during night-time activities. | Construction | All sections |
| Construction noise | CNV9 | All noise complaints received would be dealt with promptly. Construction methods may need to be altered to reduce noise impacts at the affected locations. | Construction | All sections |
| Construction noise | CNV10 | Machinery would not be turned on prior to the work hours outlined in this EIS. This would include daily maintenance activities and/or ‘warming up’ of engines. | Construction | All sections |
| Construction noise | CNV11 | Truck movements would be restricted to identified haulage routes and the routes outlined in the Construction Traffic Management Plan. | Construction | All sections |
| Construction noise | CNV12 | Where it has been identified as necessary (eg in response to community complaints), noise monitoring would be undertaken to check that the noise mitigation measures are effective. | Construction | All sections |
| Construction noise | CNV13 | After community consultation, the use of temporary noise shielding should be considered at locations where substantial exceedances of noise criteria are predicted. | Construction | All sections |
| Construction noise | CNV14 | Static noise sources, such as generators, pumps and lighting towers, would be located as far as possible from sensitive receivers. | Construction | All sections |
| Construction noise | CNV15 | Regular noise monitoring would be undertaken during normal business hours at a representative | Construction | All sections |

| Issue | Mitigation ID no. | Mitigation measure | Timing | Relevant section |
|---|---|---|---|---|
| | | receiver location. | | |
| Construction noise | CNV16 | The selection of plant and equipment would be based on noise emission levels. This equipment would be operated and maintained so that noise emissions are minimised. | Construction | All sections |
| Vibration from construction | CNV17 | Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any structure or service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor. | Construction | All sections |
| Vibration from construction | CNV18 | Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any heritage structure or potentially structurally unsound service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor. A follow-up survey would be conducted in response to any vibration complaints. | Construction | All sections |
| Vibration from construction | CNV19 | Appropriately sized equipment would be selected in order to minimise vibration emissions, where required. | Construction | All sections |
| Controlled blasting | CNV20 | A blast management plan would be prepared prior to the start of blasting activities. | Pre-construction | All sections |
| Controlled blasting | CNV21 | Where sensitive receivers are located close to the blast site, a series of trials would be undertaken at a reduced scale to determine site-specific blast response characteristics, in order to define allowable blast sizes to occur within the criteria. | Construction | All sections |
| Controlled blasting | CNV22 | Controlled blasting activities would only be undertaken between the hours of:<br>• 8am to 5pm, Monday to Friday<br>• 8am to 1pm, Saturday.<br>These times may be increased with the written agreement of affected residents.<br>Where the blast management plan has identified potential impacts on sensitive receivers, these hours would be subject to change. | Construction | All sections |
| Controlled blasting | CNV23 | A minimum of 24 hours' notice would be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number. | Construction | All sections |
| Controlled blasting | CNV24 | Monitoring of overpressure and vibration levels would be undertaken for each blast at the potentially most affected receivers. | Construction | All sections |
| Controlled blasting | CNV25 | A building condition survey would be undertaken for all buildings located within 200 metres of the proposed blasting area prior to the start of blasting. The proponent would be responsible for rectifying any damage occurring from the blasting, with the cost to be borne by the proponent. | Construction | All sections |
| Controlled blasting | CNV26 | The maximum instantaneous charge (MIC) would be reduced to the lowest possible level by the use of delays, reduced diameter holes, and/or deck loading. | Construction | All sections |
| Controlled blasting | CNV27 | Adequate stemming would be provided and exposed detonating cord would be eliminated (by | Construction | All sections |

| Issue | Mitigation ID no. | Mitigation measure | Timing | Relevant section |
|---|---|---|---|---|
| | | covering with at least 300 millimetres of quarry dust or road base). | | |
| Controlled blasting | CNV28 | Secondary blasting would be eliminated. (A rock breaker or drop hammer would be used instead of popping). Effort would be made to eliminate the need for toe shots (eg by better control of drill patterns). | Construction | All sections |
| Controlled blasting | CNV29 | Weather conditions at the time of the blast would be assessed. Blasting would be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion would be avoided where possible or, (if not possible) blasting would occur between 11am and 1pm. | Construction | All sections |
| Controlled blasting | CNV30 | Strict control would be exercised over the spacing and orientation of all blast drill holes. Holes would be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size. | Construction | All sections |
| Controlled blasting | CNV31 | Controlled blasting times would be determined in consideration of site-specific conditions and in consultation with affected residents and would take place, where possible, when impacts are likely to be the least intrusive (eg all blasts would be fired at a set time acceptable to residents and preferably when the background noise is highest). | Construction | All sections |
| Consultation regarding construction work hours | CNV32 | Identified receivers would be notified by letter of the proposed hours and asked for comment and feedback. This would include justification for the proposed extended working hours along with the benefits the community can expect<br>Where the community or individual residents wish to receiver further clarification on the proposed hours, individual interviews or public meetings would be organised to address any further issues. Discussions would be sufficiently detailed to provide a general summary of the expected impacts but also how this relates to individual receivers. At this stage, more detail would be available regarding the proposed construction activities to be undertaken in the extended hours<br>Property owners would be provided with the complaints management procedures to be in place for extended working hours<br>Feedback would be collected to help determine the final adopted working hours for the project, with community consultation continuing throughout the project. | Pre-construction | All sections |
| Road traffic noise | ONV1 | Architectural treatments would be considered for all identified noise-affected receivers, subject to confirmation at the detailed design stage. | Pre-operation | Noise affected sections |
| Road traffic noise | ONV2 | Low noise wearing surface would be considered for noise affected sections of the project where required, subject to confirmation at the detailed design stage. | Pre-operation | Noise affected sections |
| Road traffic noise | ONV3 | No later than one year after commencement of operation of the project, RMS would undertake operational noise monitoring to compare the actual noise performance of the project against predicted noise performance. The report would include, but not necessarily be limited to: | Post-operation | All sections |

| Issue | Mitigation ID no. | Mitigation measure | Timing | Relevant section |
|---|---|---|---|---|
| | | • Noise monitoring to assess compliance with the operational noise levels predicted<br>• A review of the operational noise levels in terms of criteria and noise goals<br>• Methodology, location and frequency of noise monitoring undertaken<br>• Details of any complaints and enquiries received in relation to operational noise<br>• Any required recalibrations of the noise model<br>• An assessment of the performance and effectiveness of applied noise mitigation measures<br>• Any additional feasible and reasonable measures required. | | |

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