

APPENDIX

INLAND  
RAIL 

S

# Construction Noise and Vibration and Operational Road Traffic Noise Technical Report

Part 1 of 4

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

# **Inland Rail Border to Gowrie EIS**

Appendix S – Construction Noise  
and Vibration and Operational  
Road Traffic Noise Technical  
Report

**Australian Rail Track  
Corporation**

Reference: 3100

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## Glossary

| Term                                                 | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sound power level                                    | The total sound emitted by a source.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Sound pressure level                                 | The amount of sound at a specified point.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Decibel [dB]                                         | The measurement unit of sound.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| A-weighted decibel [dB(A)]                           | The A-weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1 kHz and 4 kHz) which the human ear is most sensitive to and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).                                                                                                                                                                                                                                                                                                                                                                                                                        |
| C-weighted decibel [dB(C)]                           | The C-weighting is a frequency filter applied to measured noise levels, which attenuates very low (<50 Hz) and very high (>5000) frequencies. It is typically reserved for peak noise measurements and some entertainment noise applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Decibel scale                                        | <p>The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:</p> <ul style="list-style-type: none"> <li>■ 0 dB(A) Threshold of human hearing</li> <li>■ 30 dB(A) A quiet country park</li> <li>■ 40 dB(A) Whisper in a library</li> <li>■ 50 dB(A) Open office space</li> <li>■ 70 dB(A) Inside a car on a freeway</li> <li>■ 80 dB(A) Outboard motor</li> <li>■ 90 dB(A) Heavy vehicle pass-by</li> <li>■ 100 dB(A) Jackhammer/subway train</li> <li>■ 110 dB(A) Rock concert</li> <li>■ 120 dB(A) 747 take off at 250 m</li> </ul> |
| Frequency [f]                                        | The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Equivalent continuous sound level [L <sub>eq</sub> ] | The constant sound level which, when occurring over the same period of time, would result in the receptor experiencing the same amount of sound energy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| L <sub>Aeq,adj,15mins</sub>                          | A-weighted equivalent noise level measured in decibels over a period of 15 minutes and adjusted for tonality                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| L <sub>max</sub>                                     | The maximum sound pressure level measured over the measurement period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| L <sub>A,max</sub>                                   | The A-weighted maximum sound pressure level measured over the measurement period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| L <sub>ASMax</sub>                                   | The A-weighted maximum sound pressure level with slow response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| L <sub>min</sub>                                     | The minimum sound pressure level measured over the measurement period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| L <sub>A,min</sub>                                   | The A-weighted minimum sound pressure level over the measurement period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| L <sub>10</sub>                                      | The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L <sub>10</sub> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| L <sub>A10</sub>                                     | The A-weighted sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L <sub>10</sub> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| L <sub>A10</sub> (12 hour)                           | The arithmetic average of the L <sub>A10</sub> (1 hour) for each of the 12 one hour periods between 6:00 am and 6:00 pm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| L <sub>A10</sub> (18 hour)                           | The arithmetic average of the L <sub>A10</sub> (1 hour) from 6:00 AM to 12:00 AM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| L <sub>A10</sub> (1 hour)                            | The A-weighted sound pressure level which is exceeded for 10% of the measurement period (1 hour)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| L <sub>90</sub>                                      | The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L <sub>90</sub> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Term                              | Explanation                                                                                                                                                                                                              |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L <sub>A,90</sub>                 | The A-weighted sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L <sub>90</sub> .                                                               |
| Ambient noise                     | The all-encompassing noise at a point composed of sound from all sources near and far.                                                                                                                                   |
| Background noise                  | The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L <sub>90</sub> sound pressure level is used to quantify background noise. |
| Peak particle velocity (PPV)      | A measure of ground vibration magnitude, PPV is the maximum instantaneous particle velocity at a point during a given time interval in mm/s.                                                                             |
| Day                               | The period from 7.00 am to 6.00 pm Monday to Friday or 8.00 am to 1.00 pm on Saturday.                                                                                                                                   |
| Evening                           | The period from 6.00 pm to 10.00 pm Monday to Friday, 1.00 pm to 10.00 pm on Saturday or Sunday 7.00 am to 10.00 pm on Sunday.                                                                                           |
| Night                             | The period from Monday to Sunday 10.00 pm to 7.00 am                                                                                                                                                                     |
| Assessment background level [ABL] | The overall background level for each day, evening and night period for each day of the noise monitoring.                                                                                                                |
| Rating background level [RBL]     | The overall background level for each day, evening and night period for the entire length of noise monitoring.                                                                                                           |
| km/h                              | Kilometres per hour                                                                                                                                                                                                      |

# 1 Introduction

Inland Rail will provide a dedicated freight rail corridor between Melbourne and Brisbane via regional Victoria, New South Wales (NSW) and Queensland (QLD). The Australian Government has appointed the Australian Rail Track Corporation (ARTC) to deliver Inland Rail. The 1,700 km route is being delivered as thirteen distinct projects.

The Border to Gowrie Project (hereafter referred to as the Project) will be constructed as an approximately 216 km long single-track railway with five crossing loops to accommodate double stack freight trains up to 1,800 metres (m) long. The Project will also include land provision for 3,600 m trains.

## 1.1 Purpose of this report

This technical report provides an assessment of the noise and vibration impacts related to construction activities and operational road traffic noise of the Project and has been prepared to support the Border to Gowrie Project Environmental Impact Statement (the EIS), specifically Chapter 14: Noise and vibration.

The construction of the Project has been assessed using the applicable noise and vibration guidelines summarised in Section 2.3 to address the requirements of the *Terms of reference for an environmental impact statement: Inland Rail - Border to Gowrie project (November 2018)* (DSDMIP, 2018) (ToR).

Operational noise from roads which are proposed or would be upgraded due to interface with the Project have also been assessed within this report.

## 1.2 Scope of this report

The scope of this noise and vibration impact assessment has been to:

- Identify noise and vibration sensitive receptors potentially affected by the Project
- Undertake baseline noise and vibration measurements
- Establish construction noise criteria based upon the measured background noise levels, in accordance with the ToR, and therefore the Department of Transport and Main Roads' (DTMR) document *Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration* (CoP Vol 2) (DTMR, 2016).
- Undertake a construction noise and vibration impact assessment of the proposed construction works in accordance with the relevant guidelines
- Assess the noise impact resulting from construction activities and consider the effectiveness of potential mitigation methods, where required, including buffer distances, silencing treatment of mobile plant, management of mobile plant, community consultation and other management mitigation measures, such as respite periods
- Review vibration intensive construction works and recommend minimum working distances and consider the effectiveness of mitigation measures where required, including the use of alternative equipment and construction methods, respite periods and other management mitigation measures
- Describe expected exceedances of noise and vibration criteria following the provision or application of mitigation measures and how residual impacts should be addressed
- Establish operational road traffic criteria and construction road traffic criteria in accordance with DTMR's *Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise* (CoP Vol 1) (DTMR, 2013) and CoP Vol 2, respectively
- Undertake an operational noise impact assessment of operational road traffic noise in accordance with the ToR

- Describe potential exceedances of road noise criteria following the provision or application of mitigation measures and how residual impacts would be addressed.

## 1.3 Report limitations

The findings of this noise and vibration impact assessment are based on the reference design and may change as the Project design progresses. Should the final design/conditions differ from the basis of this assessment, the impact to nearby receptors may differ from the findings presented in this report. Preliminary mitigation measures have been presented in this assessment. However, a finalised mitigation measures, reflective of the construction methodology, will need to be developed as a component of the Construction Environmental Management Plan (CEMP).

Operational noise and vibration associated with rail operation has been assessed separately in Appendix T: Operational Railway Noise and Vibration Technical Report of the EIS.

## 1.4 Key features of the Project

Key components of the Project can be attributed to either the construction or operational phase. The key components of the Project during the pre-construction and construction phases are summarised in Table 1.1 and the key components of the operational phase are summarised in Table 1.2.

Quantities specified here are reflective of the reference design for the Project and may be subject to change through the detail design and construction process.

**Table 1.1 Key reference design components (pre-construction and construction phases)**

| Component                                       | Quantity                                                                                                                                                                       |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Non-resident workforce accommodation facilities | 3                                                                                                                                                                              |
| Bridge laydowns                                 | 35                                                                                                                                                                             |
| Track laydown areas                             | 39                                                                                                                                                                             |
| Cut volume (total)                              | 12,525,037 cubic metre (m <sup>3</sup> ) (rail and road)                                                                                                                       |
| Maximum cut depth                               | 29.7 m                                                                                                                                                                         |
| Fill volume (total)                             | 12,250,669 m <sup>3</sup> (rail)<br>1,096,670 m <sup>3</sup> (road)                                                                                                            |
| Maximum fill depth                              | 24.5 m                                                                                                                                                                         |
| Bridge crossings                                | 34                                                                                                                                                                             |
| Bridge length (total)                           | 11,653 m                                                                                                                                                                       |
| Culverts                                        | Reinforced concrete box culverts: 928 cells in 120 locations<br>Reinforced concrete pipes: 1,553 pipes in 212 locations                                                        |
| Concrete batching plants                        | 2 sites nominated. Only one expected to be required.                                                                                                                           |
| Flash butt welding facilities                   | 1 site nominated.<br>If a second is desirable, opportunities to share the flash butt welding facility established for the adjoining Gowrie to Helidon project will be explored |
| Refuelling                                      | 150,000 litres (L) storage capacity, distributed across 12 sites                                                                                                               |



**Table 1.2 Key reference design components (operational phase)**

| Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Quantity                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rail length (Ch 30.60 km (NS2B) to Ch 206.95 km)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Standard gauge: 7.0 km<br>Dual gauge: 209.2 km<br>Total: 216.2 km                                                                                                                                                     |
| Rail interfaces (tie-ins): <ul style="list-style-type: none"> <li>■ Queensland Rail South Western Line:               <ul style="list-style-type: none"> <li>– Connection at Kildonan, towards Goondiwindi</li> <li>– Connection at Whetstone, towards Warwick</li> <li>– Turnouts to existing sidings and loops (six locations)</li> </ul> </li> <li>■ Queensland Rail Millmerran Branch Line:               <ul style="list-style-type: none"> <li>– Connection at Millmerran</li> <li>– Connection at Yarranlea</li> <li>– Turnouts to existing sidings (two locations)</li> </ul> </li> </ul>        | 12                                                                                                                                                                                                                    |
| State-controlled road interfaces: <ul style="list-style-type: none"> <li>■ Active level crossing</li> <li>■ Grade separation: rail-over-road</li> <li>■ Grade separation: road-over-rail</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                      | 7 roads in 9 locations<br>2<br>5<br>2                                                                                                                                                                                 |
| Local government road interface treatments: <ul style="list-style-type: none"> <li>■ Goondiwindi Regional Council               <ul style="list-style-type: none"> <li>– Passive level crossing</li> <li>– Active level crossing</li> <li>– Grade separation: rail-over-road</li> <li>– Grade separation: road-over-rail</li> </ul> </li> <li>■ Toowoomba Regional Council               <ul style="list-style-type: none"> <li>– Passive level crossing</li> <li>– Active level crossing</li> <li>– Grade separation: rail-over-road</li> <li>– Grade separation: road-over-rail</li> </ul> </li> </ul> | 8<br>8<br>2<br>0<br>12<br>7<br>6<br>1                                                                                                                                                                                 |
| Crossing loops                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 5, located as follows: <ul style="list-style-type: none"> <li>■ Loop 1 – Yelarbon</li> <li>■ Loop 2 – Inglewood</li> <li>■ Loop 3 – Kooroongarra</li> <li>■ Loop 4 – Yandilla</li> <li>■ Loop 5 – Broxburn</li> </ul> |

Construction activities that are anticipated to be necessary to deliver the Project are introduced in Section 5.1.

## 2 Assessment requirements for the Project

### 2.1 Legislation

Legislation which defines requirements for the noise and vibration impact assessment and environmental approval processes for this Project includes:

- **Transport Infrastructure Act 1994 (Qld) (TI Act)**

The TI Act requires the construction, operation and maintenance of all government supported infrastructure to be carried out according to standards published by the Chief Executive. The CoP Vol 1 is implemented as a legislative requirement under the *TI Act* and identifies the requirements for road traffic noise associated with completion of the Project.

- **Environmental Protection Act 1994 (Qld) (EP Act)**

The EP Act outlines the General Environmental Duty of all persons in Queensland which is that a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm. Schedule 1 Part 1 states that noise from the ordinary use of rail transport infrastructure is excluded from environmental nuisance. Specific documents are gazetted under the EP Act to assess impacts.

The CoP Vol 2 has been gazetted under s318E of the EP Act. It is also named as an applicable guideline of the ToR. The CoP Vol 2 has requirements for various stages of projects and is a means of demonstrating compliance with the General Environmental Duty under the EP Act.

- **Environmental Protection (Noise) Policy 2019, (EPP (Noise)), subordinate to the EP Act.**

The (EPP (Noise)) is subordinate legislation under the EP Act. The purpose of the EPP (Noise) is to achieve the objective of the EP Act in relation to the acoustic environment (excluding transportation noise). It achieves this through identifying environmental values to be enhanced or protected to avoid environmental harm, stating acoustic quality objectives for enhancing or protecting these environmental values, and providing a framework for making decisions in relation to the acoustic environment.

Environmental values to be protected under the policy include the health and biodiversity of ecosystems; human health and wellbeing, and the amenity of the community. Schedule 1 of the EPP (Noise) details acoustic quality objectives for protecting these environmental values. These values are used to guide acceptable acoustic criteria for the assessment of items such as steady state noise emission from tunnel ventilation. EPP (Noise) is an applicable policy in the ToR.

### 2.2 Policies, standards and guidelines

Table 2.1 lists the policies and guidelines of relevance to this assessment.

**Table 2.1 Policies, standards and guidelines applicable to the assessment of noise and vibration**

| Policy or Guideline                                                                                                      | Relevance to Project                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Transport Noise Management Code of Practice Volume 1 – Road Traffic Noise (CoP Vol 1) (DTMR, 2013)</i>                | The CoP Vol 1 is a standard under the TI Act. It identifies the requirements for road traffic noise associated with completion of the Project. Applicable criteria and assessment methodologies are included within this document to adequately assess noise associated with road traffic noise.       |
| <i>Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration (CoP Vol 2) (DTMR, 2015)</i> | The CoP Vol 2 is gazetted under the EP Act. It identifies the requirements for construction activities completed for the Project. Applicable criteria and potential mitigation measures are included within this document to adequately assess noise and vibration associated with construction works. |

| Policy or Guideline                                                                                                                                                     | Relevance to Project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| German Standard DIN 4150: Part 3 1999 <i>Structural Vibration in Buildings - Effects on Structures</i> (Deutsches Institut für Normung, 1999)                           | This standard is prescribed by CoP Vol 2. It provides recommended maximum levels of vibration that reduce the likelihood of building damage caused. These recommended maximum levels have been used as vibration criteria.                                                                                                                                                                                                                                                                                           |
| Australian Standard AS 1055.1-2018 – <i>Acoustics – Description and measurement of environmental noise, Part 1: General procedures</i> , 2018                           | The CoP Vol 2 prescribes that noise measurement and reporting should be conducted in accordance with the construction and ambient noise provisions included in AS 1055-2018.                                                                                                                                                                                                                                                                                                                                         |
| <i>Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration</i> (ANZEC, 1990)                                             | The CoP Vol 2 references the blasting vibration criteria contained within this document. This document also provides suggested mitigation measures for blasting noise and vibration impacts.                                                                                                                                                                                                                                                                                                                         |
| Australian Standard 2187.2-2006 <i>Explosives - Storage and Use Part 2: Use of Explosives – Appendix J</i> .                                                            | The CoP Vol 2 recommends the use of AS 2187.2 with respect to blasting vibration criteria for human comfort and structural damage. These ground vibration criteria have been adopted for this assessment.                                                                                                                                                                                                                                                                                                            |
| DEHP Guideline – <i>Noise and Vibration from Blasting</i> (DEHP, 2016)                                                                                                  | The CoP Vol 2 adopts the criteria to minimise annoyance from airblast resulting from blasting from this document.                                                                                                                                                                                                                                                                                                                                                                                                    |
| DES <i>Application requirements for activities with noise impacts</i> (DEHP, 2019)                                                                                      | This guideline under the EP Act provides guidance on the requirements for assessments of noise impacts, including the requirement for supplementary approvals for Environmentally Relevant Activities (ERAs).<br><br>Approval for ERAs that may be required by the Project will be sought separately to the approval being sought through the EIS process. Appropriate noise and vibration assessments, as required, will be undertaken at a later date to inform the necessary development approval application(s). |
| British Standard BS 5228.2-2009 <i>Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration</i> (British Standards, 2009b)   | This standard is referenced for guidelines on vibration analysis and values for the management of building damage.                                                                                                                                                                                                                                                                                                                                                                                                   |
| British Standard BS 6472-1:2008 <i>Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting</i> (British Standards, 2008) | The ToR requires the use of BS 6472 with respect to vibration criteria for human comfort and structural damage. These ground vibration criteria have been adopted for this assessment.                                                                                                                                                                                                                                                                                                                               |
| <i>Policy for Development of Land Affected by Environmental Emission Transport and Transport Infrastructure</i> Version 2 (DTMR, 2013d)                                 | This policy identifies the applicable criteria and assessment requirements where environmental noise and vibration from transport infrastructure has the potential to impact the development of land.                                                                                                                                                                                                                                                                                                                |
| World Health Organisation' <i>Night Noise Guidelines for Europe</i> (WHO, 2009)                                                                                         | This document is referenced for guidelines on environmental noise to manage impacts to health and wellbeing during the night-time period                                                                                                                                                                                                                                                                                                                                                                             |

## 2.3 Terms of reference requirements

This chapter has been prepared to address sections 11.117 to 11.126 of the ToR. A compliance check of this chapter against each of the relevant components of the ToR is presented in Table 2.2. Relevant sections of the ToR have also been addressed in Appendix T: Operational Railway Noise and Vibration Technical Report of the EIS.

**Table 2.2 Compliance against relevant sections of the terms of reference**

| Noise and vibration terms of reference requirements                                                                                           | Report section |
|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Existing environment</b>                                                                                                                   |                |
| 11.117. Describe the existing noise and vibration environment that may be affected by the Project in the context of the environmental values. | Section 3      |

| Noise and vibration terms of reference requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Report section                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.118. Describe and illustrate on maps at a suitable scale, the location of all sensitive noise and vibration receptors adjacent to all Project components and estimate typical background noise and vibration levels based on surveys at representative sites.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Section 3.2<br>Appendix C                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11.119. If the proposed Project could adversely impact on the noise and vibration environment, undertake baseline monitoring at a selection of sensitive receptors potentially affected by the Project. Describe the results of any baseline monitoring.                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Section 3.3                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Impact assessment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 11.120. Describe the characteristics of the noise and vibration sources that would be emitted when carrying out the activity (point source and general emissions). Describe noise and vibration emissions (including fugitive sources) that may occur during construction, commissioning and operation.                                                                                                                                                                                                                                                                                                                                                                                                              | Section 5.1, Section 5.4 and Section 6<br>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS                                                                                                                                                                                                                                                                                                                                |
| 11.121. Predict and map the impacts of the noise and vibration emissions from the construction and operation of the Project on the environmental values of the receiving environment, including sensitive receptors. The assessment of impacts on noise and vibration consider, as applicable the following:<br>a) EPP (Noise) 2019, using recognised quality assured methods<br>b) Environmentally Relevant Activities - DEHP Application Requirements for ERAs with noise impacts (Guideline ESR/2015/1838)<br>c) Construction – The Department of Transport and Main Roads Transport Noise Management Code of Practice: Volume 2 - Construction Noise and Vibration dated March 2016 and gazetted on 29 July 2016 | Section 5.4, Section 6 and Appendix E<br>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS<br>The current project description does not include a confirmed requirement for Environmentally Relevant Activities with a significant noise impact. The need, or otherwise, for Environmentally Relevant Activities will be determined through the detail design phase following confirmation of the construction methodology. |
| 11.122. Discuss separately the key Project components likely to present an impact on noise and vibration for the construction and operation phases of the Project.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Section 5.1, Section 5.4 and Section 6<br>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS                                                                                                                                                                                                                                                                                                                                |
| 11.123. Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the:<br>a) activity's consistency with the objectives of documentation referenced in 11.122<br>b) cumulative impact of the noise and vibration with other known emissions of noise associated with existing major projects and/or developments and those which are progressing through planning and approval processes publicly available<br>c) potential impacts of any low-frequency (<200 Hz) noise emissions.                                                                                                                                                       | Section 2.1, Section 2.2 and Section 4<br>Cumulative impacts are addressed in Section 8<br>Low frequency noise emissions are addressed in Table 4.3<br>Low frequency noise from operational rail impacts are assessed separately in Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS                                                                                                                                      |
| <b>Mitigation measures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 11.124. Describe how the proposed Project and, in particular, the key Project components described above, would be managed to be consistent with best practice environmental management for the activity. Where a government plan is relevant to the activity, or the site where the activity is proposed, describe the activity's consistency with that plan.                                                                                                                                                                                                                                                                                                                                                       | Section 7<br>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS                                                                                                                                                                                                                                                                                                                                                             |
| 11.125. Describe any expected exceedances of noise and vibration goals or criteria following the provision or application of mitigation measures and how any residual impacts would be addressed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Section 7.3<br>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS                                                                                                                                                                                                                                                                                                                                                           |

| Noise and vibration terms of reference requirements                                                                                 | Report section                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.126. Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed. | <p>Section 7.2 and Section 7.3</p> <p>Appendix T: Operational Railway Noise and Vibration Technical Report of the Border to Gowrie EIS</p> <p>Auditing commitments for the Project are covered in Chapter 22: Outline environmental management plan of the Border to Gowrie EIS.</p> |

## 3 Existing noise environment

### 3.1 Impact assessment area

The noise and vibration impact assessment area (hereafter referred to as the impact assessment area) is the area which falls within 2 km of the Project footprint. This footprint encompasses all permanent infrastructure elements of the Project, in addition to the land requirements to enable the safe and efficient construction, operation and maintenance of the Project.

Temporary and permanent components of the Project footprint are shown in Appendix A. The impact assessment area is shown in Appendix B.

### 3.2 Sensitive receptors

Receptors that are sensitive to noise and vibration impacts have been identified if reference to CoP Vol 2 for construction activities and CoP Vol 1 for operational roads. These codes of practice outline the sensitive land uses that could potentially be impacted by noise and vibration emissions during the construction and operation of the Project.

Sensitive land uses/receptors to be considered for this assessment include:

- A dwelling (detached or attached) including house, townhouse, unit, reformatory institution, caravan park or retirement village
- A library, child care centre, kindergarten, school, school playground, college, university, museum, art gallery or other educational institution, hospital, respite care facility, nursing home, aged care facility, surgery or other medical centre
- A community building including a place of public worship
- A court of law
- A hotel, motel or other premises which provides accommodation for the public
- A commercial (office) or retail facility
- A protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the *Nature Conservation Act 1992* (QLD)
- An outdoor recreational area (such as public park or gardens open to the public, whether or not on payment of a fee, for passive recreation other than for sport or organised entertainment) or a private open space.

Each sensitive receptor within the impact assessment area was identified and located using a combination of land property information (Queensland Property Database) and investigation of detailed aerial imagery. For a project of this scale, it is not unusual for the location at which sensitive receptors are modelled to differ slightly from their true location. Differences of this magnitude will not materially impact the results of this assessment. Sensitive receptors were identified both within townships, and on scattered rural properties. All sensitive receptors within the impact assessment area have been included in Appendix C.

The sensitive receptors identified for this assessment have been identified based on information available at the time of assessment and may change as the Project progresses. The extent of property impacts should be re-assessed through the detail design process once the Project footprint and construction methodology has been confirmed. The location and classification of sensitive receptors in proximity to the finalised Project footprint will be confirmed as part of the re-assessment process.

A total of 2,758 sensitive receptors were identified within the impact assessment area. There were 94 sensitive receptors that were identified to be used for industrial purposes and are not classified as “noise sensitive” and therefore have only been included within the vibration and blasting assessments.

Thirty-four heritage areas of interest were identified and have been categorised as heritage sensitive receptors in this assessment. These receptors are considered potentially sensitive to vibration, but not noise.

### 3.3 Noise and vibration monitoring

Ambient noise monitoring was conducted at 11 locations within the impact assessment area in December 2018. Noise monitoring locations were selected as representative of clusters of sensitive receptors, particularly those most at risk of being impacted by construction noise. At each site both long term monitoring and short term attended measurements were taken in accordance with the CoP Vol 2. The noise monitoring locations are shown within the site overview map included in Appendix B.

Noise monitoring was undertaken using a microphone height of 1.8 m at single storey buildings on slab (adjusted for elevated buildings), or 4.6 m for double storey buildings. Microphones were located nominally one metre from the building facade or located 3.5 m away from reflecting walls, depending on the operator's judgement when setting up the equipment.  $L_{Amax}$ ,  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A90}$  and  $L_{Aeq}$  parameters were taken in 15-minute averaging periods.

Unattended noise monitoring was performed at each location over a 7-day period. The first and last 24 hours of noise monitoring additionally included attended measurements. One 15-minute attended measurement was conducted at each site over the first 24 hours, in addition to one 15 minute attended measurement at each site over the final 24 hours.

The unattended noise measurements define the long-term noise environment throughout the impact assessment area and were used to determine the external construction noise limits for standard and non-standard hours. Attended noise measurements were carried out to provide additional information about the existing noise environment and the most significant noise sources.

15-minute attended vibration measurements were conducted at four representative locations within the impact assessment area, using a handheld vibration monitor with a triaxial geophone. The geophone was mounted using small ground stakes where possible in conjunction with a 20-kilogram sandbag. Root mean square particle velocity and peak particle velocity (PPV) were measured in one-third octave bands. The vibration monitoring locations are shown within the site overview map included in Appendix B

#### 3.3.1 Instrumentation

##### 3.3.1.1 Noise instrumentation

Details of the equipment used for unattended long-term noise monitoring are presented in Table 3.1. All noise loggers used for long term monitoring met the class 1 requirements for a sound level meter (SLM).

**Table 3.1 Unattended noise monitoring details**

| Monitor location | Address <sup>1</sup>                       | Start date | End date   | Logger type      | Serial number |
|------------------|--------------------------------------------|------------|------------|------------------|---------------|
| B2G_01           | 16 Georges Lane, Kurumbul QLD, 4388        | 05/12/2018 | 12/12/2018 | Rion NL-52       | 1639          |
| B2G_02           | 36 Taloom Street, Yelarbon QLD, 4388       | 05/12/2018 | 12/12/2018 | Larson Davis 831 | 3300          |
| B2G_03           | 23 Lagoon Street, Yelarbon QLD, 4388       | 05/12/2018 | 12/12/2018 | Larson Davis 831 | 2578          |
| B2G_04           | 71 Kaboon Street, Yelarbon QLD, 4388       | 05/12/2018 | 12/12/2018 | Larson Davis 831 | 3339          |
| B2G_05           | Lovells Crossing Road, Inglewood QLD, 4387 | 06/12/2018 | 13/12/2018 | Larson Davis 831 | 3337          |
| B2G_06           | 46 Daphne Street, Brookstead QLD, 4364     | 06/12/2018 | 13/12/2018 | Larson Davis 831 | 3301          |
| B2G_07           | 2B Short Street, Pittsworth QLD, 4356      | 06/12/2018 | 13/12/2018 | Larson Davis 831 | 3340          |
| B2G_08           | 11 Hadley Street, Pittsworth QLD, 4356     | 07/12/2018 | 14/12/2018 | Larson Davis 831 | 1621          |
| B2G_09           | 5 Bailey Street, Southbrook QLD, 4363      | 07/12/2018 | 14/12/2018 | Larson Davis 831 | 2846          |



| Monitor location | Address <sup>1</sup>                          | Start date | End date   | Logger type | Serial number |
|------------------|-----------------------------------------------|------------|------------|-------------|---------------|
| B2G_10           | 96 Wegener Road, Athol QLD, 4350              | 07/12/2018 | 14/12/2018 | Rion NL-52  | 00553967      |
| B2G_11           | 21A Jannuschs Road, Gowrie Mountain QLD, 4350 | 07/12/2018 | 14/12/2018 | Rion NL-52  | 00164395      |

**Table note:**

1 The noise monitoring locations are shown within the site overview map included in Appendix B.

All acoustic instrumentation used for the assessment complied with the requirements of AS IEC 61672.1-2004 *Electroacoustics – Sound level meters – Specifications* and were calibrated before and after monitoring sessions with a drift in calibration not exceeding  $\pm 0.5$  dB.

All instruments used were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

The sound level meters used to conduct attended noise measurements are presented in Table 3.2. Each item of equipment was calibrated and met the Class 1 requirements for SLM. Copies of all calibration certificates are included in Appendix D.

Attended measurements were conducted at the deployment and removal of each long-term noise logger.

**Table 3.2 Attended measurement monitoring details**

| Monitor location <sup>1</sup> | Attended measurement #1 date | Logger type | Serial number | Attended measurement #2 date | Logger type | Serial number |
|-------------------------------|------------------------------|-------------|---------------|------------------------------|-------------|---------------|
| B2G_01                        | 5/12/2018                    | SVAN 957    | 27551         | 12/12/2018                   | SVAN 957    | 27551         |
| B2G_02                        | 5/12/2018                    | SVAN 957    | 27551         | 12/12/2018                   | SVAN 957    | 27551         |
| B2G_03                        | 5/12/2018                    | SVAN 957    | 27551         | 12/12/2018                   | SVAN 957    | 27551         |
| B2G_04                        | 5/12/2018                    | SVAN 957    | 27551         | 12/12/2018                   | SVAN 957    | 27551         |
| B2G_05                        | 6/12/2018                    | SVAN 957    | 27551         | 13/12/2018                   | SVAN 957    | 27551         |
| B2G_06                        | 6/12/2018                    | SVAN 957    | 27551         | 13/12/2018                   | SVAN 957    | 27551         |
| B2G_07                        | 6/12/2018                    | SVAN 957    | 27551         | 13/12/2018                   | SVAN 957    | 27551         |
| B2G_08                        | 7/12/2018                    | SVAN 957    | 27551         | 14/12/2018                   | SVAN 957    | 27551         |
| B2G_09                        | 7/12/2018                    | SVAN 957    | 27551         | 14/12/2018                   | SVAN 957    | 27551         |
| B2G_10                        | 7/12/2018                    | SVAN 957    | 27551         | 14/12/2018                   | SVAN 957    | 27551         |
| B2G_11                        | 7/12/2018                    | SVAN 957    | 27551         | 14/12/2018                   | SVAN 957    | 27551         |

**Table note:**

1 The noise monitoring locations are shown within the site overview map included in Appendix B.

### 3.3.1.2 Vibration instrumentation

Details of the equipment used for attended vibration monitoring are presented in Table 3.3. All equipment used at the sites listed were calibrated within the past 12 months at a NATA certified laboratory. Copies of all calibration certificates are included in Appendix D.

**Table 3.3 Vibration monitoring instrumentation**

| Monitor location <sup>1</sup> | Address                              | Equipment type | Serial number | Calibration date |
|-------------------------------|--------------------------------------|----------------|---------------|------------------|
| B2G_01                        | 16 Georges Lane, Kurumbul QLD, 4388  | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                      | SVAN 957       | 27551         | 12/3/2018        |
| B2G_02                        | 36 Taloom Street, Yelarbon QLD, 4388 | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                      | SVAN 957       | 27551         | 12/3/2018        |



| Monitor location <sup>1</sup> | Address                                       | Equipment type | Serial number | Calibration date |
|-------------------------------|-----------------------------------------------|----------------|---------------|------------------|
| B2G_03                        | 23 Lagoon Street, Yelarbon QLD, 4388          | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_04                        | 71 Kaboon Street, Yelarbon QLD, 4388          | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_05                        | Lovells Crossing Road, Inglewood QLD, 4387    | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_06                        | 46 Daphne Street, Brookstead QLD, 4364        | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_07                        | 2B Short Street, Pittsworth QLD, 4356         | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_08                        | 11 Hadley Street, Pittsworth QLD, 4356        | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_09                        | 5 Bailey Street, Southbrook QLD, 4363         | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_10                        | 96 Wegener Road, Athol QLD, 4350              | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |
| B2G_11                        | 21A Jannuschs Road, Gowrie Mountain QLD, 4350 | Dytran 3192A   | 151           | 5/12/2018        |
|                               |                                               | SVAN 957       | 27551         | 12/3/2018        |

**Table note:**

1 The noise monitoring locations are shown within the site overview map included in Appendix B.

### 3.3.2 Unattended noise monitoring results

A noise logger measures the noise level over the sample period and then determines  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A90}$ , and  $L_{Aeq}$  levels of the noise environment. The  $L_{A1}$ ,  $L_{A10}$  and  $L_{A90}$  levels are the levels exceeded for one per cent, 10 per cent and 90 per cent of the sample period respectively. The  $L_{A1}$  is indicative of maximum noise levels due to individual noise events. The  $L_{A90}$  is considered to be the background noise level. The  $L_{Aeq}$  is the energy averaged sound level over the measurement period. It is defined as the steady sound level that contains the same amount of acoustic energy as a given time-varying sound.

The ambient background levels (ABL) are established by determining the lowest tenth-percentile level of the  $L_{A90}$  noise data acquired within each of the work periods used in Table 3.4 for each day of monitoring.

The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ambient background levels determined over the entire monitoring duration. The RBL is representative of the average minimum background sound level, or simply the background level.

Reports including graphical representations of the logging results, a summary of the results and the measurement locations are provided in Appendix D. A summary of the existing measured RBL noise levels is presented in Table 3.4.

**Table 3.4 Existing background noise levels**

| Monitoring location <sup>1</sup> | Rating background level, dB(A) |                      |                    |
|----------------------------------|--------------------------------|----------------------|--------------------|
|                                  | Day <sup>2</sup>               | Evening <sup>2</sup> | Night <sup>2</sup> |
| B2G_01                           | 30                             | 34                   | 28                 |
| B2G_02                           | 36                             | 35                   | 25                 |
| B2G_03                           | 41                             | 40                   | 24                 |
| B2G_04                           | 32                             | 34                   | 23                 |
| B2G_05                           | 31                             | 33                   | 23                 |
| B2G_06                           | 39                             | 38                   | 29                 |
| B2G_07                           | 35                             | 40                   | 27                 |
| B2G_08                           | 37                             | 37                   | 25                 |
| B2G_09                           | 40                             | 37                   | 30                 |
| B2G_10                           | 35                             | 36                   | 29                 |
| B2G_11                           | 35                             | 31                   | 26                 |

**Table notes:**

- 1 The noise monitoring locations are shown within the site overview map included in Appendix B
- 2 In accordance with the CoP Vol 2, time of day is defined as follows:
  - Day: the period from 7.00 am to 6.00 pm Monday to Friday or 8.00 am to 1.00 pm on Saturday.
  - Evening: the period from 6.00 pm to 10.00 pm Monday to Friday, 1.00 pm to 10.00 pm on Saturday or Sunday 7.00 am to 10.00 pm on Sunday.
  - Night: Monday to Sunday 10.00 pm to 7.00 am.

### 3.3.3 Attended noise monitoring results

Attended noise monitoring was conducted at all unattended monitoring locations during December 2018. Each measurement was conducted over a 15-minute period. Weather conditions were clear on the days of monitoring with minimal wind, unless stated otherwise in the summary of observations (refer Table 3.5). The monitoring results from the attended measurements are presented in Table 3.5. Monitoring data sheets are provided in Appendix D.

**Table 3.5 Attended noise monitoring results**

| Monitoring location <sup>1</sup> | Date       | Time  | Summary of observations                                                                                                                      | L <sub>Amax,15min</sub> , dB(A) | L <sub>A10,15min</sub> , dB(A) | L <sub>A90,15min</sub> , dB(A) | L <sub>Aeq,15min</sub> , dB(A) |
|----------------------------------|------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|
| B2G_01                           | 05/12/2018 | 8:00  | <ul style="list-style-type: none"> <li>■ Dogs 65 to 86 dB(A)</li> <li>■ Birds 60 dB(A)</li> </ul>                                            | 86                              | 51                             | 40                             | 55                             |
|                                  | 12/12/2018 | 8:15  | <ul style="list-style-type: none"> <li>■ Ute 47 dB(A)</li> <li>■ Birds 34 dB(A)</li> <li>■ Dog 58 to 76 dB(A)</li> </ul>                     | 77                              | 64                             | 34                             | 60                             |
| B2G_02                           | 05/12/2018 | 10:00 | <ul style="list-style-type: none"> <li>■ Road traffic 47 dB(A)</li> <li>■ Truck 58 to 78 dB(A)</li> <li>■ Cars 55 dB(A)</li> </ul>           | 78                              | 52                             | 42                             | 51                             |
|                                  | 12/12/2018 | 9:30  | <ul style="list-style-type: none"> <li>■ Birds and insects 40 to 42 dB(A)</li> <li>■ Car 57 dB(A)</li> <li>■ Truck 62 to 74 dB(A)</li> </ul> | 75                              | 52                             | 36                             | 52                             |

| Monitoring location <sup>1</sup> | Date       | Time  | Summary of observations                                                                                                                                                                                                         | L <sub>Amax,15min</sub> , dB(A) | L <sub>A10,15min</sub> , dB(A) | L <sub>A90,15min</sub> , dB(A) | L <sub>Aeq,15min</sub> , dB(A) |
|----------------------------------|------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|
| B2G_03                           | 05/12/2018 | 11:15 | <ul style="list-style-type: none"> <li>Road traffic noise 43 to 45 dB(A)</li> <li>Angle grinder 55 dB(A)</li> </ul>                                                                                                             | 96                              | 50                             | 39                             | 59                             |
|                                  | 12/12/2018 | 10:30 | <ul style="list-style-type: none"> <li>Meter accidentally bumped, L<sub>max</sub> measurement inaccurate</li> <li>Birds and insects 45 to 46 dB(A)</li> <li>Dog 47 to 66 dB(A)</li> <li>Angle grinder 59 to 60 dB(A)</li> </ul> | -                               | 53                             | 38                             | 64                             |
| B2G_04                           | 05/12/2018 | 12:00 | <ul style="list-style-type: none"> <li>Wind 43 dB(A)</li> <li>Insects 45 dB(A)</li> <li>Trucks 56 to 77 dB(A)</li> </ul>                                                                                                        | 77                              | 53                             | 34                             | 50                             |
|                                  | 12/12/2018 | 11:15 | <ul style="list-style-type: none"> <li>Trucks 60 dB(A)</li> <li>Resident 57 dB(A)</li> <li>Cars 46 dB(A)</li> <li>Insects 30 to 32 dB(A)</li> <li>Plane 37 dB(A)</li> <li>Truck engine breaking 64 to 79 dB(A)</li> </ul>       | 79                              | 52                             | 32                             | 52                             |
| B2G_05                           | 06/12/2018 | 7:30  | <ul style="list-style-type: none"> <li>Wind 50 dB(A)</li> <li>Crows 45 to 81 dB(A)</li> </ul>                                                                                                                                   | 81                              | 54                             | 52                             | 52                             |
|                                  | 13/12/2018 | 7:30  | <ul style="list-style-type: none"> <li>Birds 48 to 59 dB(A)</li> <li>Insects 43 to 45 dB(A)</li> <li>Wind 43 dB(A)</li> </ul>                                                                                                   | 60                              | 48                             | 39                             | 45                             |
| B2G_06                           | 06/12/2018 | 11:38 | <ul style="list-style-type: none"> <li>Road traffic 40 to 45 dB(A)</li> <li>Insects 50 dB(A)</li> <li>Wind 45 to 48 dB(A)</li> <li>Trucks 55 to 83 dB(A)</li> </ul>                                                             | 83                              | 52                             | 40                             | 51                             |
|                                  | 13/12/2018 | 9:30  | <ul style="list-style-type: none"> <li>Trucks 63 to 72 dB(A)</li> <li>Wind 53 dB(A)</li> <li>Insects 50 to 53 dB(A)</li> </ul>                                                                                                  | 72                              | 55                             | 46                             | 52                             |
| B2G_07                           | 06/12/2018 | 13:00 | <ul style="list-style-type: none"> <li>Birds and traffic 40 dB(A)</li> <li>Magpies 52 to 75 dB(A)</li> <li>Wind 45 dB(A)</li> <li>Road traffic 50 to 55 dB(A)</li> </ul>                                                        | 75                              | 50                             | 39                             | 48                             |
|                                  | 13/12/2018 | 10:30 | <ul style="list-style-type: none"> <li>Wind 43 to 45 dB(A)</li> <li>Birds 40 to 80 dB(A)</li> </ul>                                                                                                                             | 80                              | 49                             | 39                             | 48                             |
| B2G_08                           | 07/12/2018 | 9:15  | <ul style="list-style-type: none"> <li>Wind and insects 42 dB(A)</li> <li>Road traffic 45 dB(A)</li> <li>Car 50 dB(A)</li> <li>Birds 50 to 70 dB(A)</li> </ul>                                                                  | 70                              | 49                             | 42                             | 48                             |
|                                  | 14/12/2018 | 8:30  | <ul style="list-style-type: none"> <li>Birds 40 to 77 dB(A)</li> </ul>                                                                                                                                                          | 78                              | 47                             | 39                             | 47                             |

| Monitoring location <sup>1</sup> | Date       | Time  | Summary of observations                                                                                                                                         | L <sub>Amax,15min</sub> , dB(A) | L <sub>A10,15min</sub> , dB(A) | L <sub>A90,15min</sub> , dB(A) | L <sub>Aeq,15min</sub> , dB(A) |
|----------------------------------|------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|
| B2G_09                           | 07/12/2018 | 10:15 | <ul style="list-style-type: none"> <li>Gore Highway traffic 43 to 48 dB(A)</li> <li>Birds 50 to 76 dB(A)</li> <li>O'Shea Avenue traffic 48 dB(A)</li> </ul>     | 77                              | 50                             | 41                             | 48                             |
|                                  | 14/12/2018 | 9:45  | <ul style="list-style-type: none"> <li>Gore Highway traffic 45 to 47 dB(A)</li> <li>Wind 46 to 49 dB(A)</li> <li>Falling object 67 dB(A)</li> </ul>             | 67                              | 55                             | 43                             | 51                             |
| B2G_10                           | 07/12/2018 | 11:30 | <ul style="list-style-type: none"> <li>Strong winds</li> <li>Birds 45 dB(A)</li> <li>Tractor idling 50 dB(A)</li> <li>Tractor driving 55 to 85 dB(A)</li> </ul> | 86                              | 51                             | 44                             | 52                             |
|                                  | 14/12/2018 | 10:45 | <ul style="list-style-type: none"> <li>Wind and birds 36 to 57 dB(A)</li> </ul>                                                                                 | 57                              | 43                             | 34                             | 40                             |
| B2G_11                           | 07/12/2018 | 12:45 | <ul style="list-style-type: none"> <li>Wind 42 dB(A)</li> <li>Birds 45 to 88 dB(A)</li> </ul>                                                                   | 89                              | 48                             | 38                             | 52                             |
|                                  | 14/12/2018 | 11:30 | <ul style="list-style-type: none"> <li>Wind 46 dB(A)</li> <li>Birds 47 to 70 dB(A)</li> <li>Aircraft flyover 59 dB(A)</li> </ul>                                | 71                              | 46                             | 38                             | 46                             |

**Table note:**

1 The noise monitoring locations are shown within the site overview map included in Appendix B.

### 3.3.4 Vibration monitoring results

A summary of vibration measurement results is presented in Table 3.6, showing the PPV vibration levels from the monitoring period. Monitoring data sheets are provided in Appendix D.

Each measurement was 15 minutes in duration. The existing ground vibration measurements are given in PPV. This is considered to best describe the potential for damage to buildings and infrastructure. Sources of existing background vibration include vehicle movements, wind gusts, and nearby fauna movements.

**Table 3.6 Background vibration measurements**

| Monitoring location <sup>1</sup> | Date       | Time     | PPV (mm/s) |
|----------------------------------|------------|----------|------------|
| B2G_V01                          | 04/07/2019 | 11:44 AM | 0.13       |
| B2G_V02                          | 04/07/2019 | 2:03 PM  | 0.29       |
| B2G_V03                          | 04/07/2019 | 2:54 PM  | 0.10       |
| B2G_V04                          | 04/07/2019 | 3:30 PM  | 0.20       |

**Table note:**

1 The noise monitoring locations are shown within the site overview map included in Appendix B

## 4 Assessment criteria

### 4.1 Construction noise

#### 4.1.1 External construction airborne noise criteria

For dwellings (including hotels and motels), noise emissions associated with construction activities are assessed against the noise criteria in Table 4.1, adopted from the CoP Vol 2. The upper limits are considered to cause significant annoyance if exceeded and are adopted as noise criteria. The lower limits are generally considered to be just perceptible and the CoP Vol 2 states that all reasonable and practicable measures should be implemented to achieve the lower limit.

The criteria are for the noise contribution from construction only (component limit) and are defined as external façade corrected noise levels at 1.5 m above floor level. The external noise level is determined based on the measured RBL at representative locations within the impact assessment area.

**Table 4.1 External construction noise criteria**

| Receptor period    |            | External noise level $L_{Aeq, adj, 15min}^{4,5,6}$ dB(A) |                         |
|--------------------|------------|----------------------------------------------------------|-------------------------|
|                    |            | Lower limit                                              | Upper limit             |
| Standard hours     |            | RBL + 10 <sup>1,2,3</sup>                                | 75 where: RBL > 55      |
|                    |            |                                                          | 70 where: 40 < RBL ≤ 55 |
|                    |            |                                                          | 65 where: RBL ≤ 40      |
| Non-standard hours | Evening    | RBL + 5 <sup>3</sup>                                     | RBL + 5                 |
|                    | Night-time |                                                          |                         |

**Table notes:**

**dB(A)** = A-weighted decibel. A term used in noise assessments, which describes the frequency filter that approximates the subjective response of human hearing.

**RBL** = Rating Background Level

- 1 RBL + 5 dB(A) should be considered where a facility, equipment and long-term earthworks are required in an area for greater than six months
- 2 Where the lower limit value exceeds the upper limit value, the lower limit value is taken to equal the upper limit value
- 3 Minimum lower limit is 50 dB(A) for standard hours and 45 dB(A) for non-standard hours. A maximum lower limit of 75 dB(A) applies for non-standard hours
- 4 Noise contribution from construction activity determined as the component level
- 5 The noise level from construction includes adjustment factors in Table 4.3 (for example, low frequency noise, impulsivity, tonality, intermittency and modulation)
- 6 For a single short event in a 24-hour period, the upper limit may be increased by"
  - For standard hours
    - 2 dB(A) for event of 6 minutes to 15 minutes
    - 10 dB(A) for event of 1.5 minutes to 6 minutes
    - 15 dB(A) for event of less than 1.5 minutes
  - For non-standard hours
    - 5 dB(A) for event of less than 1.5 minutes

The definitions of standard hours and non-standard hours are presented in Table 4.2. These hours relate to the construction noise and vibration criteria and requirements of the CoP Vol 2 and do not indicate the times at which construction works are expected or planned to occur.

**Table 4.2 CoP Vol 2 work periods for construction activities**

| Work period                      | General construction and construction traffic                                                      | Blasting                                                                                                                                                                                                                       |
|----------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Standard hours                   | Monday to Friday 7.00 am to 6.00 pm<br>Saturday 8.00 am to 1.00 pm                                 | Monday to Friday 9.00 am to 5.00 pm<br>Saturday 9.00 am to 1.00 pm                                                                                                                                                             |
| Non-standard hours – day/evening | Monday to Friday 6.00 pm to 10.00 pm<br>Saturday 1.00 pm to 10.00 pm<br>Sunday 7.00 am to 10.00 pm | Generally, blasting is not to be conducted outside standard hours. Any blasting outside of standard hours must be approved by the department prior to blasting. It is noted that reduced limits may be required to be achieved |
| Non-standard hours – night time  | Monday to Sunday 10.00 pm to 7.00 am                                                               |                                                                                                                                                                                                                                |

Under CoP Vol 2 a single, short event adjustment (refer table note 6, Table 4.1) is designed to account for unusual and one-off events, and does not apply to regular high-noise levels that occur more frequently than once per day.

Table 4.3 outlines the adjustment factors that should be applied to construction noise of particular characteristics, as specified by Table 2.1.2.1(b) in the CoP Vol 2, to more accurately model the impact of the noise.

**Table 4.3 CoP Vol 2 adjustment factors**

| Factor              | Assessment/measurement                                                                  | When to apply                                                                                                                                                                                                                                                                                                                                                                                                                      | Correction                                                                     | Comments                                                                                                                   |
|---------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Tonal noise         | 1/3 octave or narrow band analysis                                                      | Level of 1/3 octave band exceeds the level of the adjacent bands on both sides by: <ul style="list-style-type: none"> <li>5 dB or more if the centre frequency of the band containing the tone is above 400 Hz.</li> <li>8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive</li> <li>15 dB or more if the centre frequency of the band containing the tone is below 160 Hz</li> </ul> | 5 dB                                                                           | Narrow-band frequency analysis may be required to precisely detect presence of tonality.                                   |
| Low frequency noise | Measurement of C-weighted and A-weighted level                                          | Measure/assess C and A frequency weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more                                                                                                                                                                                                                                                                         | 5 dB                                                                           | C-weighting is designed to be more responsive to low-frequency noise. All noise energy down to 10 Hz should be considered. |
| Impulsive noise     | A-weighted fast response and impulse (I) response or C-weighted for low frequency noise | If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.<br>If difference in C-weighted maximum noise levels between fast response and impulse response is greater than 2 dB for low frequency noise.                                                                                                                                                                     | Apply difference in measured levels as the correction, up to a maximum of 5 dB | Impulse response is defined by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s.                          |

| Factor                            | Assessment/<br>measurement                                                                                               | When to apply                                                                                                                                                                                                                                                                                                                                                                                                                                        | Correction                     | Comments                                      |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------|
| Intermittent/<br>modulating noise | Measurement of difference between LA10 and LA90, average difference between short term samples, or subjectively assessed | <ul style="list-style-type: none"> <li>■ Difference between LA10 and LA90 exceeds 5 dB repeatedly for a characteristic averaging period (for example, 10 seconds) for intermittent sources.</li> <li>■ Average difference between measured LAeq levels exceeds 5 dB for a characteristic sampling frequency (for example, 10 Hz) for rapidly varying source.</li> <li>■ Subjectively annoying for a combination not easily characterised.</li> </ul> | 5 dB                           | Adjustment to be applied for night-time only. |
| Maximum adjustment                | Refer to individual modifying factors                                                                                    | Where two or more adjustment factors are indicated                                                                                                                                                                                                                                                                                                                                                                                                   | Maximum correction of 10 dB(A) | -                                             |

The external noise construction criteria presented in Table 4.1 were applied to RBL obtained at each monitoring location (refer Table 3.4) to determine lower and upper limit external construction noise criteria for the different work areas. The results of this comparison are shown in Table 4.4.

The RBL for standard hours at B2G\_03 is likely to be dominated by a local source and is therefore not representative of the noise catchment area surrounding the noise measurement location.

The conservative minimum noise criteria have been used for this noise catchment area.

**Table 4.4 External façade corrected construction noise criteria**

| Monitor location <sup>3</sup> | Monitor level                   |    | External façade corrected noise level (dB(A)) |                 |
|-------------------------------|---------------------------------|----|-----------------------------------------------|-----------------|
|                               | RBL, dB(A)                      |    | Construction LAeq,adj,15min                   |                 |
|                               |                                 |    | Lower limit                                   | Upper limit     |
| B2G_01                        | Standard hours                  | 30 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 34 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 28 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_02                        | Standard hours                  | 36 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 35 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 25 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_03                        | Standard hours                  | 41 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 40 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 24 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_04                        | Standard hours                  | 32 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 34 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 23 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_05                        | Standard hours                  | 31 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 33 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 23 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |



| Monitor location <sup>3</sup> | Monitor level                   |    | External façade corrected noise level (dB(A)) |                 |
|-------------------------------|---------------------------------|----|-----------------------------------------------|-----------------|
|                               | RBL, dB(A)                      |    | Construction $L_{Aeq,adj,15min}$              |                 |
|                               |                                 |    | Lower limit                                   | Upper limit     |
| B2G_06                        | Standard hours                  | 39 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 38 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 29 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_07                        | Standard hours                  | 35 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 40 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 27 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_08                        | Standard hours                  | 37 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 37 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 25 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_09                        | Standard hours                  | 40 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 37 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 30 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
| B2G_10                        | Standard hours                  | 35 | 50 <sup>1</sup>                               | 65              |
|                               | Non-standard hours (evening)    | 36 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |
|                               | Non-standard hours (night-time) | 29 | 45 <sup>1</sup>                               | 45 <sup>2</sup> |

**Table notes:**

- 1 In accordance with CoP Vol 2, a minimum lower limit of 50 dB(A) for standard hours and 45 dB(A) for non-standard hours has been adopted
- 2 Where the lower limit value exceeds the upper limit value, the lower limit value is taken to equal the upper limit value.
- 3 The noise monitoring locations are shown within the site overview map included in Appendix B

Table 4.4 shows that the minimum lower limit criteria have been reached at all monitoring locations. Therefore a minimum lower limit of 50 dB(A) for standard hours and 45 dB(A) for non-standard hours has been adopted for this assessment across the entire extent of the Project, in accordance with CoP Vol 2.

These minimum criteria are summarised in Table 4.5.

**Table 4.5 Impact assessment area construction working limits**

| Period  | External noise level $L_{Aeq,adj,15 min}$ dB(A) |             |
|---------|-------------------------------------------------|-------------|
|         | Lower limit                                     | Upper limit |
| Day     | 50                                              | 65          |
| Evening | 45                                              | 45          |
| Night   | 45                                              | 45          |

### 4.1.2 Noise criteria for critical facilities

CoP Vol 2 defines internal noise criteria for critical facilities, which are to be met where reasonable and practicable, and which applies for the operational hours of the facility. These are presented in Table 4.6.

**Table 4.6 CoP Vol 2 Internal construction noise criteria for critical facilities**

| Type of occupancy/activity                                                        | Internal noise level $L_{Aeq,adj,15 minute}$ , dB(A) |
|-----------------------------------------------------------------------------------|------------------------------------------------------|
| Medical/health buildings (wards, surgeries, operating theatres, consulting rooms) | 40                                                   |
| Educational/research facilities (rooms designated for teaching/research purposes) | 45                                                   |
| Court of law (court rooms)                                                        | 35                                                   |

| Type of occupancy/activity                                            | Internal noise level<br>$L_{Aeq,adj}$ , 15 minute, dB(A) |
|-----------------------------------------------------------------------|----------------------------------------------------------|
| Court of law (court reporting and transcript areas, judges' chambers) | 40                                                       |
| Community buildings (libraries, places of worship)                    | 45                                                       |

Critical receptors have been identified within the impact assessment area. All applicable facilities are presented below:

- Medical Buildings:
  - Beauaraba Living Aged Care Facility
- Educational/Research facilities:
  - Toomelah Public School
  - St Stephens Catholic Primary School, Pittsworth
  - Pittsworth State School
  - Pittsworth Kindergarten
  - Pittsworth Civic Pool
  - Pittsworth State High School
  - Southbrook Central State School
  - Yelarbon State School
  - Brookstead State School
- Community Buildings
  - Toomelah Community Centre
  - Millmerran Seventh Day Adventist Church
  - St John's Lutheran Church, Millmerran
  - All Saints Anglican Church, Yandilla
  - Pittsworth Uniting Church
  - St Peter's Catholic Church, Pittsworth
  - Anglican Church of Australia, Pittsworth
  - Pittsworth Masonic Centre
  - Pittsworth Library
  - Pittsworth Senior Citizens Club
  - Lutheran Church of Australia, Pittsworth
  - St Brigid's Church, Southbrook
  - St Paul's Anglican Church, Umbiram.

The Pittsworth Civic Pool was identified as an outdoor education facility, due to its hosting of swimming classes. In the absence of external noise criteria for education facilities in CoP Vol 2, the external noise criteria for dwellings summarised in Table 4.4 were used to evaluate the noise impacts at this receptor.

### 4.1.3 Construction road traffic noise criteria

Construction haulage or transportation on public roads has the potential to create noise issues for existing sensitive receptors. The CoP Vol 2 specifies that construction traffic should not increase the pre-construction traffic noise level  $L_{A10(1 \text{ hour})}$  by more than 3 dB(A).

A desktop assessment approach has been implemented to assess construction traffic noise for the Project. The assessment has been completed in accordance with CoP Vol 1.

### 4.1.4 Construction ground-borne noise criteria

The construction ground-borne noise investigation limits set out in the CoP Vol 2 are applicable for the Project and are presented in Table 4.7.

**Table 4.7 Construction ground-borne noise investigation limits**

| Building                                                                          | Ground-borne noise limit                                                                                                                    |                           |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
|                                                                                   | Work period                                                                                                                                 | $L_{A\text{Max}}$ , dB(A) |
| Dwellings (including hotels and motels)                                           | (Standard hours)<br>Monday to Friday, 7.00 am to 6.00 pm<br>Saturday, 8.00 am – 1.00 pm                                                     | 40                        |
|                                                                                   | (Non-standard hours – day/evening)<br>Monday to Friday, 6.00 pm to 10.00 pm<br>Saturday, 1.00 pm to 10.00 pm<br>Sunday, 7.00 am to 10.00 pm | 35                        |
|                                                                                   | (Non-standard hours - night)<br>Monday to Sunday, 10.00 pm to 7.00 am                                                                       | 35                        |
| Medical/health buildings (wards, surgeries, operating theatres, consulting rooms) | All                                                                                                                                         | 35                        |
| Educational/research facilities (rooms designated for teaching/research purposes) | While in use                                                                                                                                | 35                        |
| Community buildings (libraries, places of worship)                                |                                                                                                                                             | 40                        |
| Commercial (offices)                                                              |                                                                                                                                             | 40                        |
| Retail areas                                                                      |                                                                                                                                             | 45                        |

**Table notes:**

- 1 There is no applicable ground-borne noise limit for industrial buildings.
- 2 If the limits are predicted to be exceeded, practicable mitigation options should be investigated

## 4.2 Ground vibration criteria

Ground vibration criteria are defined in CoP Vol 2. The effects of ground vibration from construction activities may be split into the following two categories:

- Human comfort – disturbance to building occupants, arising from vibration which inconveniences or possibly disturbs the occupants or users of the building. The vibration criteria are based on the requirements of British Standard BS 5228-2:2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 2 Vibration* (BS 5228.2).
- Building damage – vibration which may compromise the integrity of the building structure itself. The vibration criteria are based on the requirements of German Standard DIN 4150 - Part 3 - *Structural Vibration in Buildings - Effects on Structures 1999* (DIN 4150.3).

CoP Vol 2 specifically prescribes the 1999 version of DIN 4150.3, therefore the 1999 version of this standard has been used.

### 4.2.1 Human comfort

The CoP Vol 2 adopts the vibration levels presented in Table 4.8 to minimise annoyance due to ground-borne construction vibration. The lower limits are generally considered to be just perceptible if exceeded. The upper limits are considered to cause significant annoyance if exceeded.

All reasonable and practicable measures should be implemented to achieve the lower limit. CoP Vol 2 also requires that “*exceedance of the upper limit requires immediate action and extensive community consultation to determine further mitigation measures*”.

**Table 4.8 Human comfort vibration limits to minimise annoyance**

| Building                                                                          | Work period                  | Resultant PPV (mm/s) |             |
|-----------------------------------------------------------------------------------|------------------------------|----------------------|-------------|
|                                                                                   |                              | Lower limit          | Upper limit |
| Dwellings (including hotels and motels)                                           | Standard hours               | 1.0                  | 2.0         |
|                                                                                   | Non-standard hours – evening | 0.3                  | 1.0         |
|                                                                                   | Non-standard hours – night   | 0.3                  | 1.0         |
| Medical/health buildings (wards, surgeries, operating theatres, consulting rooms) | All                          | 0.3                  | 1.0         |
| Educational facilities (rooms designated for teaching purposes)                   | While in use                 |                      |             |
| Court of law (court rooms)                                                        |                              |                      |             |
| Court of law (court reporting and transcript areas, judges' chambers)             |                              |                      |             |
| Community buildings (libraries, places of worship)                                | While in use                 | 1.0                  | 2.0         |
| Commercial (offices) and retail areas                                             |                              |                      |             |

**Table note:**

Refer Table 4.2 for definition of standard and non-standard hours

For this assessment, only criteria for the following receptors apply:

- Dwellings (including hotels and motels)
- Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)
- Educational facilities (rooms designated for teaching purposes)
- Community buildings (libraries, places of worship)
- Commercial (offices) and retail areas.

### 4.2.2 Building/structural damage

CoP Vol 2 refers to the use of DIN 4150.3 as well as BS5228.2 for building damage. DIN 4150 provides recommended maximum levels of vibration that limit the likelihood of building damage caused and are presented in Table 4.9. DIN 4150.3 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily be damaged.

**Table 4.9** DIN4150.3 Structural damage ‘safe limits’ for building vibration

| Group | Type of structure                                                                                                                                                             | PPV (mm/s) at foundation at a frequency of |             |                           |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------|---------------------------|
|       |                                                                                                                                                                               | 1 to 10 Hz                                 | 10 to 50 Hz | 50 to 100 Hz <sup>1</sup> |
| 1     | Buildings used for commercial purposes, industrial buildings and buildings of similar design                                                                                  | 20                                         | 20 to 40    | 40 to 50                  |
| 2     | Dwellings and buildings of similar design and/or use (i.e. residential)                                                                                                       | 5                                          | 5 to 15     | 15 to 20                  |
| 3     | Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 above and have intrinsic value (e.g. heritage-listed) | 3                                          | 3 to 8      | 8 to 10                   |

**Table notes:**

1 For frequencies above 100 Hz, the higher values in the 50 to 100 Hz column should be used.

‘Damage’ is defined by DIN 4150.3 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load-bearing walls. DIN 4150.3 also states that when vibrations higher than the ‘safe limits’ are present, it does not necessarily follow that damage will occur.

DIN 4150.3 also provides guideline values for evaluating the effects of vibration on buried pipework, summarised in Table 4.10.

**Table 4.10** DIN 4150.3 guideline values for evaluating the effects of short-term vibration on buried pipework

| Line | Pipe material                                                                              | Guideline values for velocity measured on the pipe in mm/s |
|------|--------------------------------------------------------------------------------------------|------------------------------------------------------------|
| 1    | Steel (including welded pipes)                                                             | 100                                                        |
| 2    | Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange) | 80                                                         |
| 3    | Masonry, plastic                                                                           | 50                                                         |

## 4.3 Blasting criteria

Controlled blasting is anticipated to be used in order to excavate material along some sections of the proposed alignment. Construction blasting can result in two adverse effects – airblast and ground vibration. The airblast and ground vibration produced may cause human discomfort and has the potential to cause damage to structures, architectural elements and services.

The CoP Vol 2 includes four documents in relation to airblast overpressure:

- Australian and New Zealand Environment Council (ANZEC) Guidelines – Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration
- AS 2187.2-2006 Explosives - Storage and Use Part 2: Use of Explosives – Appendix J
- EP Act, Section 440ZB
- DEHP Guideline – Noise and Vibration from Blasting (DEHP, 2016).

The DEHP guideline – Noise and vibration from blasting is adopted by the CoP Vol 2 to minimise annoyance and discomfort to persons at noise sensitive land uses as a result of blasting. The CoP Vol 2 also recommends the use of AS 2187.2 with respect to criteria for human comfort and structural damage. This includes consideration of different types of structures such as more sensitive masonry and plasterboard buildings and less sensitive reinforced concrete buildings.

### 4.3.1 Blasting criteria

In relation to airblast overpressure, the following criteria have been adopted from the DEHP Guideline – *Noise and Vibration from Blasting*, as per the CoP Vol 2. These criteria have been used to assess the annoyance from airblast to sensitive land uses:

- Not more than 115 dB(linear) peak for 9 out of any 10 consecutive blasts
- Not more than 120 dB(linear) peak for any blasts.

For the purposes of the Project, the AS 2187.2 ground vibration criteria have been adopted and are summarised in Table 4.11.

**Table 4.11 Blasting ground vibration criteria summary**

| Category                                                                                                                                        | Blasting PPV limit                                                                                                                                                                                                                                                                           |                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
|                                                                                                                                                 | Human comfort <sup>1</sup>                                                                                                                                                                                                                                                                   | Structural damage <sup>2</sup>                                                              |
| Sensitive structures (e.g. residential, theatres, schools)                                                                                      | 5 mm/s for 90% blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply                                                                                                                                                                   | 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above     |
| Occupied non-sensitive structures of reinforced concrete or steel construction (e.g. factories and commercial premises)                         | 25 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacture's specifications or levels that can be shown to adversely affect the equipment operation. | 50 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply |
| Occupied non-sensitive structures that include masonry, plaster and plasterboard in their construction (e.g. factories and commercial premises) | 25 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacture's specifications or levels that can be shown to adversely affect the equipment operation. | 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above     |
| Unoccupied non-sensitive structures of reinforced concrete or steel construction (e.g. factories and commercial premises)                       | N/A                                                                                                                                                                                                                                                                                          | 100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply.  |
| Unoccupied non-sensitive structures that include masonry, plaster and plasterboard in their construction                                        | N/A                                                                                                                                                                                                                                                                                          | 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above     |
| Buildings of special value or significance (may include historical buildings, monuments)                                                        | 2 mm/s                                                                                                                                                                                                                                                                                       | N/A                                                                                         |

**Table notes:**

- 1 Human comfort limits should be based off the values presented from the CoP Vol 2.
- 2 The values above are less stringent than those in DIN 4150.3. This is because DIN 4150.3 considers resonance in buildings from continuous vibration. Due to the short duration of blasting events the propensity for resonance within buildings is minimal, giving rise to higher criteria.

These requirements do not cover buildings with long span floors, specialist structures such as reservoirs, dams and hospitals, or buildings housing equipment sensitive to vibration. These require special considerations, which may necessitate taking additional measurements on the structure itself. No such structures have been identified within the impact assessment area.

### 4.3.2 Recommended hours and frequency of blasting activities

The CoP Vol 2 specifies that blasting should generally only be permitted during the hours of:

- Monday to Friday: 9.00 am – 5.00 pm
- Saturdays: 9.00 am – 1.00 pm.

Generally blasting is not to be conducted outside standard hours. Any blasting outside of standard hours must be approved by DES prior to blasting. Where blasting is to occur outside of standard hours, reduced limits may be required to be achieved.

## 4.4 Operational noise criteria

CoP Vol 1 categorises noise criteria for road traffic noise and provides definitions for road categories. Table 4.12 provides definitions of these road categories.

**Table 4.12 CoP Vol 1 road category definitions**

| Road category           | CoP Vol 1 definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New road                | A new access controlled road in a proposed or existing unused corridor adjacent to existing residences or in a proposed corridor where formal approval by a local government or other statutory authority for adjacent land development is current at the date of acquisition, even if the development is not yet in existence. A new road may include the upgrading of a road (State or local government) to one of a higher functional road hierarchy where there is an increase in the contribution to road traffic noise exposure of at least 3 dB(A). The higher functional road hierarchy must be an access controlled road of at least a collector/distributor function. New road also applies to the situation where land acquisition (resumption) is taken beside an existing corridor and all State - controlled road lanes fall outside the existing corridor. |
| Upgrading existing road | A substantial upgrade such as duplication or additional through lanes within some portion of the existing road corridor. Some additional lanes may fall outside the existing road corridor where land acquisition (resumption) is required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

Operational road traffic noise impacts have been assessed over a 10-year horizon to 2035, as per the CoP Vol 1.

### 4.4.1 Operational road noise criteria –new roads

A desktop assessment approach has been implemented for the assessment of 35 new road sections associated with the Project assessment has been completed in accordance with CoP Vol 1.

Table 4.13 presents the applicable CoP Vol 1 assessment criteria for different noise sensitive land uses with potential to be affected by new roads. The external criteria are assessed one metre from the façade at a height of 1.5 m from finished floor level (FFL) or mid window height, whichever is the higher. Outdoor educational and passive recreational areas are assessed in the free field. Due to the low existing noise levels throughout the impact assessment area, as shown in Table 3.4, the more stringent criteria of 60 LA<sub>10</sub> (18h) dB(A) has been adopted as a conservative measure for residential land uses.

**Table 4.13 Road traffic assessment criteria for new roads (CoP Vol 1)**

| Category                     | Criteria (dB(A))                                                                                                                               |                                                                |                                                                                   |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------|
|                              | Existing residences (façade corrected)                                                                                                         | Educational, community and health buildings (façade corrected) | Outdoor educational and passive recreational areas (including parks) (free field) |
| New road – access controlled | 63 LA <sub>10</sub> (18h), existing level > 55 LA <sub>10</sub> (18h)<br>60 LA <sub>10</sub> (18h), existing level ≤ 55 LA <sub>10</sub> (18h) | 58 LA <sub>10</sub> (1h)                                       | 63 LA <sub>10</sub> (12h)                                                         |

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through reasonable and practicable measures to meet the assessment criteria.

### 4.4.2 Operational road traffic noise criteria – road upgrades

The upgrade of 46 road sections is proposed as part of the reference design. A desktop assessment approach has been implemented for the operation of each of the upgraded sections. The assessment has been completed in accordance with CoP Vol 1.

Table 4.14 presents the applicable CoP Vol 1 assessment criteria for sensitive land uses with potential to be affected by upgraded roads. The external criteria are assessed one metre from the façade at a height of 1.5 m from finished floor level or mid window height, whichever is the higher.

**Table 4.14 Airborne noise criteria for upgraded roads**

| Description             | Criteria (dB(A))                       |                                                                |                                                                                   |
|-------------------------|----------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------|
|                         | Existing residences (façade corrected) | Educational, community and health buildings (façade corrected) | Outdoor educational and passive recreational areas (including parks) (free field) |
| Upgrading existing road | 68 LA <sub>10</sub> (18h)              | 65 LA <sub>10</sub> (1h)                                       | 63 LA <sub>10</sub> (12h)                                                         |



## 5 Construction noise and vibration assessment

### 5.1 Construction activities

Table 5.1 lists the construction activities and associated equipment considered in this assessment. The construction activities and estimated plant schedules listed are reflective of a preliminary construction method, based on the reference design. This list is not to be regarded as exhaustive. Regardless of the construction activities required, the CoP Vol 2 construction noise and vibration criteria, summarised in Table 4.5 and Table 4.6, will need to be achieved.

**Table 5.1 Construction stages and proposed equipment**

| Construction stage                   | Activities                                                                                                                                                                                                                                                                                                                          | Plant and equipment                                                                                                                                                           | Overall sound power level (dB(A)) <sup>2</sup>                                                           |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Site setup/ laydown areas            | <ul style="list-style-type: none"> <li>Establishment of site compounds/laydown areas, site facilities and non-resident workforce accommodation</li> <li>Potential construction of water storage dams to harvest/store construction water</li> <li>Haul road and access roads construction</li> <li>Haul road maintenance</li> </ul> | Grader, truck, dump truck, 40 t excavator, scraper, water cart                                                                                                                | 121                                                                                                      |
| Earthworks                           | <ul style="list-style-type: none"> <li>Clearing and grubbing/topsoil stripping</li> <li>Cut to fill</li> <li>Import general fill</li> <li>Place and compact general fill</li> <li>Import structural fill</li> <li>Place structural fill</li> </ul>                                                                                  | Dozer, 40 t excavator, trucks, scraper, water cart, scraper, front end loader, padfoot roller, compactor, grader, 15 t roller, mulcher <sup>1</sup>                           | 127 – during CoP Vol 2 standard assessment hours<br>122 – during CoP Vol 2 non-standard assessment hours |
| Structures                           | <ul style="list-style-type: none"> <li>Substructure/foundations construction</li> <li>Pier construction</li> <li>Superstructure construction</li> </ul>                                                                                                                                                                             | 40 t excavator, piling rig, concrete truck, crane                                                                                                                             | 123                                                                                                      |
| Drainage                             | <ul style="list-style-type: none"> <li>Install cross drainage</li> </ul>                                                                                                                                                                                                                                                            | Backhoe, 30 t excavator, worktruck (hiab), compactor, concrete truck, concrete pump, franna crane                                                                             | 120                                                                                                      |
| Rail civil works                     | <ul style="list-style-type: none"> <li>Capping material import</li> <li>Capping material placement</li> <li>Bottom ballast</li> <li>Sleeper installation</li> <li>Rail installation</li> <li>Top ballast</li> <li>Track tamping and regulating</li> <li>Rail stressing</li> <li>Rail grinding</li> </ul>                            | Tamper, regulator, 20 t excavator, water cart, trucks, dozer, 40 t excavator, 15 t roller, compactor, grader, 20 t excavator, smooth drum roller, ballast train, rail grinder | 123                                                                                                      |
| Road civil works                     | <ul style="list-style-type: none"> <li>Road works</li> </ul>                                                                                                                                                                                                                                                                        | Grader, 30 t excavator, compactor, water cart, trucks                                                                                                                         | 121                                                                                                      |
| Non-resident workforce accommodation | <ul style="list-style-type: none"> <li>Mechanical plant operation</li> <li>Bus movements</li> <li>Light vehicle movements</li> </ul>                                                                                                                                                                                                | Condenser units, bus, light vehicle                                                                                                                                           | 102                                                                                                      |

| Construction stage                     | Activities                                                                                                | Plant and equipment                                                    | Overall sound power level (dB(A)) <sup>2</sup> |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------|
| Borrow pit establishment and operation | <ul style="list-style-type: none"> <li>Drilling</li> <li>Jack hammering</li> <li>Rock crushing</li> </ul> | Front end loader, trucks, excavator, drill, rock crusher, rock breaker | 128                                            |
| Concrete batching                      | <ul style="list-style-type: none"> <li>Preparation, mixing and discharging of concrete</li> </ul>         | Concrete batching plant                                                | 108                                            |
| Flash-butt welding                     | <ul style="list-style-type: none"> <li>Track welding</li> </ul>                                           | Generator for welding, welder                                          | 104                                            |

**Table notes:**

- 1 The mulcher is expected to only typically operate during standard working hours and as such two scenarios have been assessed to represent typical conditions during standard and non-standard hours.
- 2 These values are based on the sound power data of each individual plant item. Listed in Table 5.2.

## 5.2 Noise modelling methodology

### 5.2.1 Airborne noise

Noise levels due to the construction activities shown in Table 5.1, other than the operation of borrow pits, were predicted at nearby noise sensitive receptors using SoundPLAN (version 8.0) noise modelling software. The calculation method detailed in CONCAWE's *Report no.4/81 the propagation of noise from petroleum and petrochemical complexes to neighbouring communities* (hereafter referred to as the CONCAWE method) was used, as it is especially suited to predicting noise propagation over large distances (CONCAWE, 1981). This is because it accounts for a range of atmospheric conditions that can significantly influence noise levels over larger distances.

The SoundPLAN noise model was created to represent 'reasonable' worst periods of construction work.

The following features were included in the noise model:

- Ground topography
- Ground absorption and reflection
- Receptors
- Construction noise sources
- Different meteorological conditions in accordance with the requirements of CoP Vol 2.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment.

The following assumptions were made in modelling the construction noise scenarios:

- All site equipment would be operating simultaneously, which is unlikely and hence is a conservative assumption
- Equipment is assumed to be operating at the closest point in the Project footprint to each receptor, in order to represent the worst-case scenario. The equipment could only operate at the closest point to each receptor for a limited period and multiple items of equipment could not do so simultaneously.
- All dwellings have been conservatively modelled as two storeys (4.6 m above ground level).

## Borrow pits

Seven operational quarries and 12 potential borrow pit sites have been identified as potential locations for the sourcing of material to enable construction of the Project. These locations are primarily outside of the impact assessment area and range from 80 m to 10 km from the Project.

The viability and feasibility of accessing material from these potential borrow pit sites will be confirmed during the detail design phase of the Project (post-EIS). Assessments of each borrow pit location will be undertaken during detail design to determine material usability, volumes, environmental and social impacts and potential secondary approval triggers. Each potential borrow pit identified has different acoustic conditions e.g. distance to the nearest sensitive receptor and different propagation paths/different terrain between the potential borrow pit and sensitive receptor.

As a preliminary assessment of the potential noise impacts from borrow pit operation, a single typical borrow pit was modelled using proprietary software. The estimated noise impacts to potential residential sensitive receptors as a function of distance from the borrow pit were calculated using the CONCAWE method. It was assumed that typical quarrying activities which would generate operational noise include drilling, excavating, rock breaking (jack hammering), rock crushing, front end loader and truck movements.

For this preliminary assessment of borrow pit noise impacts, construction external noise criteria for dwellings detailed in Table 4.4 were used.

### 5.2.2 Airborne noise emission sources

Table 5.2 presents a summary of the typical sound power levels of the equipment to be used for each construction stage. Except where otherwise noted, these sound power levels are typical values taken from British Standard BS5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*, in accordance with selecting an available database from CoP Vol 2 (British Standards, 2009).

For the noise assessment, the construction scenarios listed in Table 5.1 have been considered. The modelled scenarios include all equipment that could be reasonably assumed to be operating at the same time for an entire 15 minute period.

During the detail design, local site conditions and changes in preferred construction methods may cause some variation in the equipment used. While the equipment may vary, other major infrastructure projects have shown that due to the conservative approach to noise predictions, received noise levels are unlikely to be appreciably higher than those predicted in this assessment. This approach is used at this point in the assessment to ensure that identified impacts are not under predicted and adequate noise management and mitigation measures are considered early in the Project development.

**Table 5.2 Noise emission sources octave band data**

| Source                  | Overall SWL dB(A) | 63 Hz                                                                        | 125 Hz | 250 Hz | 500 Hz | 1,000 Hz | 2,000 Hz | 4,000 Hz |
|-------------------------|-------------------|------------------------------------------------------------------------------|--------|--------|--------|----------|----------|----------|
| Backhoe                 | 116               | 114                                                                          | 108    | 106    | 105    | 109      | 111      | 110      |
| Ballast train           | 111               | 106                                                                          | 105    | 105    | 108    | 107      | 104      | 101      |
| Bus movements           | 102               | 96                                                                           | 101    | 104    | 99     | 97       | 94       | 88       |
| Compactor               | 108               | 98                                                                           | 106    | 107    | 100    | 105      | 96       | 94       |
| Concrete batching plant | 108               | BS 5228.1 does not specify spectral sound power levels for this noise source |        |        |        |          |          |          |
| Concrete pump           | 110               | 111                                                                          | 109    | 106    | 107    | 105      | 102      | 99       |
| Concrete truck          | 108               | 111                                                                          | 102    | 94     | 97     | 98       | 106      | 88       |
| Condenser unit          | 61                | 69                                                                           | 63     | 60     | 59     | 56       | 51       | 45       |
| Crane                   | 99                | 96                                                                           | 99     | 96     | 90     | 94       | 94       | 83       |
| Dozer                   | 108               | 117                                                                          | 118    | 109    | 101    | 102      | 98       | 96       |
| Drill <sup>1</sup>      | 123               | 115                                                                          | 126    | 122    | 121    | 119      | 114      | 108      |

| Source                               | Overall SWL dB(A) | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1,000 Hz | 2,000 Hz | 4,000 Hz |
|--------------------------------------|-------------------|-------|--------|--------|--------|----------|----------|----------|
| Dump Truck                           | <b>115</b>        | 114   | 107    | 107    | 107    | 107      | 112      | 97       |
| Excavator – 20T                      | <b>103</b>        | 100   | 99     | 102    | 101    | 97       | 94       | 91       |
| Excavator – 30T                      | <b>103</b>        | 100   | 99     | 102    | 101    | 97       | 94       | 91       |
| Excavator – 40T                      | <b>107</b>        | 113   | 106    | 105    | 105    | 101      | 99       | 96       |
| Excavator – Borrow pits <sup>1</sup> | <b>123</b>        | 116   | 117    | 110    | 113    | 111      | 106      | 102      |
| Franna Crane                         | <b>94</b>         | 94    | 95     | 88     | 89     | 90       | 89       | 78       |
| Front end loader                     | <b>83</b>         | 88    | 81     | 77     | 80     | 79       | 76       | 71       |
| Generator for welding                | <b>101</b>        | 103   | 100    | 95     | 96     | 98       | 94       | 90       |
| Grader                               | <b>114</b>        | 116   | 115    | 111    | 107    | 112      | 106      | 102      |
| Light vehicle movements              | <b>88</b>         | 95    | 89     | 86     | 84     | 84       | 80       | 76       |
| Mulcher                              | <b>125</b>        | 104   | 113    | 105    | 111    | 119      | 121      | 117      |
| Padfoot Roller                       | <b>109</b>        | 111   | 105    | 105    | 104    | 104      | 103      | 96       |
| Piling Rig                           | <b>117</b>        | 110   | 110    | 110    | 117    | 111      | 106      | 103      |
| Rail grinder <sup>2</sup>            | <b>116</b>        | 114   | 108    | 106    | 105    | 109      | 111      | 110      |
| Regulator                            | <b>116</b>        | 114   | 108    | 106    | 105    | 109      | 111      | 110      |
| Rock Breaker <sup>1</sup>            | <b>110</b>        | 119   | 104    | 105    | 106    | 107      | 104      | 97       |
| Rock Crusher <sup>1</sup>            | <b>126</b>        | 117   | 118    | 117    | 121    | 122      | 120      | 111      |
| Roller - 15T                         | <b>101</b>        | 108   | 103    | 105    | 100    | 95       | 90       | 82       |
| Scraper                              | <b>114</b>        | 116   | 115    | 111    | 107    | 112      | 106      | 102      |
| Smooth drum roller                   | <b>101</b>        | 108   | 103    | 105    | 100    | 95       | 90       | 82       |
| Tamper                               | <b>114</b>        | 116   | 115    | 111    | 107    | 112      | 106      | 102      |
| Truck                                | <b>118</b>        | 127   | 123    | 115    | 114    | 112      | 111      | 105      |
| Water Cart                           | <b>116</b>        | 109   | 107    | 107    | 111    | 112      | 109      | 104      |
| Welder                               | <b>101</b>        | 95    | 96     | 97     | 96     | 97       | 94       | 89       |
| Work truck (hiab)                    | <b>107</b>        | 109   | 110    | 95     | 100    | 99       | 102      | 101      |

**Table notes:**

- 1 Sound power level data taken from an in-house database of onsite measurements of equipment similar to that proposed for borrow pit operation.
- 2 Rail grinding SWL has been conservatively approximated as that of six angle grinders, in the absence of data on the specific plant to be used

### 5.2.2.1 Equipment locations

Locations of the equipment have been determined based on information derived from the constructability assessment of the reference design for the Project. The locations of use for equipment may change as the design develops. However, the most appropriate locations available at the time of this assessment have been applied in developing the assessment model. The temporary construction footprint provides the boundary of works for the following construction activities:

- Earthworks
- Drainage
- Rail civil works.

The footprints for laydown areas, structures and road civil works are proposed within specific locations of the temporary footprint and have been assessed as occurring at the nominated locations for these activities.

### 5.2.2.2 Meteorological conditions

In accordance with Table 6.1.1.2 of the CoP Vol 2, different meteorological conditions were considered in the assessment. These parameters are summarised in Table 5.3.

**Table 5.3 Meteorological conditions for use in noise modelling**

| Time    | Temperature, °C | Humidity, % | Wind speed, m/s | Wind direction | Temperature lapse rate | Pasquil stability class (implied by temperature lapse rate) |
|---------|-----------------|-------------|-----------------|----------------|------------------------|-------------------------------------------------------------|
| Day     | 20              | 70          | 3               | All            | 0 degrees C/100 m      | E                                                           |
| Evening | 15              | 70          | 2               | Drainage flow  | +3 degrees C/100 m     | F                                                           |
| Night   | 15              | 70          | None            | None           | F+3 degrees C/100 m    | F                                                           |

### 5.2.2.3 Ground absorption

Noise propagation is affected by the type of ground cover between the source and receptor. Most standards use a 'ground absorption factor' to evaluate the ground effect. The ground absorption factor ranges from zero (which is applied to hard surfaces such as asphalt and water) to one (which is applied to soft surfaces such as fields and grass). The ground absorption factor can be set to any value in-between to represent an average of soft and hard ground in the impact assessment area. A consistent ground absorption factor of 0.5 was applied along the entire extent of the Project. This factor was chosen based off review of aerial imagery and assumptions of dryness of the ground.

## 5.3 Vibration assessment methodology

BS 5228-2 Table E.1 provides formulae to predict vibration levels from compaction activities. These formulae have been used to predict the vibration impacts and acceptable setback distances and are summarised in Table 5.4. The parameters used are based on the combination of the highest or lowest parameter values provided in BS 5228-2, as appropriate, to derive the greatest possible vibration impact in each instance. The highest potential vibration impacts from construction activities at any given location will depend on its proximity to each of the construction activities.

**Table 5.4 Extract from BS 5228-2 Table E.1 – prediction of vibration levels from compaction activities**

| Operation                                    | Formula                                                                   | Parameters                                                                                                                                                                                                                                          | Parameters Used                                                                                                                        |
|----------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Percussive (Impact) Piling                   | $V_{res} = \frac{k_v}{x^\delta}$                                          | V <sub>res</sub> : predicted vibration level<br>k <sub>v</sub> : Scaling factor<br>x: distance measured along ground surface<br>δ: 1.3 (all operations), 1.2 (Start up and run down), 1.4 (steady state operation)                                  | k <sub>v</sub> : 266<br>δ: 1.2                                                                                                         |
| Vibratory Compaction (start up and run down) | $V_{res} = k_t \sqrt{n_d} \left[ \frac{A^{1.5}}{(x + L_d)^{1.3}} \right]$ | V <sub>res</sub> : predicted vibration level<br>k <sub>t</sub> : Scaling factor<br>n <sub>d</sub> : number of drums<br>A: maximum amplitude of drum vibration<br>x: distance measured along ground surface<br>L <sub>d</sub> : vibrating drum width | k <sub>t</sub> : 276 (5% probability of predicted value being exceeded)<br>L <sub>d</sub> : 2.2 m<br>A: 1.72 mm<br>n <sub>d</sub> : 2  |
| Vibratory compactor (Steady-state)           | $V_{res} = k_s \sqrt{n_d} \left[ \frac{A}{x + L_d} \right]^{1.5}$         | V <sub>res</sub> : predicted vibration level<br>k <sub>s</sub> : Scaling factor<br>n <sub>d</sub> : number of drums<br>A: maximum amplitude of drum vibration<br>x: distance measured along ground surface<br>L <sub>d</sub> : vibrating drum width | k <sub>s</sub> : 177 (5% probability of predicted value being exceeded)<br>L <sub>d</sub> : 0.75 m<br>A: 1.72 mm<br>n <sub>d</sub> : 2 |

## 5.4 Predicted impacts

This Section provides discussion on the results of noise and vibration assessment and the subsequent predicted impacts.

As per the ToR, this assessment has been undertaken in accordance with Queensland legislation, policies and guidelines. Some noise and vibration sensitive receptors have been identified for the Project which are located in Toomelah, NSW. Impacts at these receptors have been assessed and mitigation measures have been recommended as per the relevant Queensland legislation, policies and guidelines, including the CoP Vol 2. Impacts of the Project at sensitive receptors either side of the border have therefore been assessed equitably.

### 5.4.1 Airborne construction noise impacts

A summary of the predicted construction noise impacts associated with each stage of construction are presented for both standard and non-standard hours construction activities in Table 5.5. Specific timing of works is not currently known. It has therefore been assumed, for conservative assessment purposes, that all construction works have the potential to occur during the non-standard hours specified by the CoP Vol 2. Non-standard hours work has been conservatively assessed against the more stringent night-time criteria. Appendix E presents the unmitigated  $L_{Aeq}$  noise level contours for the construction activities throughout the impact assessment area.

Table 5.5 presents the external noise criteria and the number of sensitive receptors that exceed each limit for different construction activities. These are the predicted construction noise impacts over a worst-case 15-minute interval. Both lower and upper criteria exceedances are included for standard and non-standard hours. Due to the low background noise levels measured during both standard and non-standard hours of construction, the lower and upper limit are both set to the minimal level as per CoP Vol 2.

This assessment is representative of the worst case 15-minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receptors for an extended period. This approach is in accordance with the CoP Vol 2, as required by the ToR.

Particularly noisy activities, such as piling, are likely to persist for only a small portion of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receiver; however, in reality, separation distances will vary between plant and sensitive receptors. For works that move along the Project alignment, noise exposure at each receiver would reduce as the sources move away.

The construction stages summarised in Table 5.5 are indicative and are subject to change during detail design as the construction approach is finalised

**Table 5.5** Number of sensitive receptors where noise exceedances may be experienced

| Time of day                                       |                           | Standard hours  |                 | Non-standard hours |
|---------------------------------------------------|---------------------------|-----------------|-----------------|--------------------|
| Limit: Façade $L_{A,eq}(15min)$                   |                           | Lower: 50 dB(A) | Upper: 65 dB(A) | 45 dB(A)           |
| Number of sensitive receptors exceeding criterion | Establishment of drainage | 877             | 302             | 1,356              |
|                                                   | Earthworks                | 1,533           | 452             | 2,169              |
|                                                   | Site setup/laydown        | 889             | 101             | 1,494              |
|                                                   | Rail civil works          | 1,135           | 363             | 1,978              |
|                                                   | Road civil works          | 976             | 266             | 1,721              |
|                                                   | Structures                | 1,024           | 20              | 1,911              |
|                                                   | Flash-butt welding        | 3               | 1               | 7                  |
|                                                   | Concrete batching         | 3               | 1               | 4                  |

An overview of the number of exceedances of the criteria for critical facilities for each construction activity is shown in Table 5.6. Each critical facility has a specific internal construction noise criterion discussed in Section 4.2.2. An assumed attenuation of 7 dB(A) through the building envelope has been applied to the predicted noise level and is supported by AS 3671-1989 – Acoustics – *Road traffic noise intrusion – Building siting and construction*.

For some activities, receptors fall within the construction footprint: the area within which construction equipment is expected to operate. It is anticipated that land within the Project footprint will either be gazetted as rail corridor or will be temporarily utilised to accommodate construction activities. As a consequence, the count of receptors exceeding a criterion does not include those within the Project footprint.

Fugitive sources such as unapproved or unexcepted construction techniques, poorly maintained or fitted equipment (such as selecting an inappropriate engine muffler) cannot be foreseen and therefore have not been assessed. These fugitive sources will be dealt with through the application of mitigation measures as proposed in Section 7.

The number of exceedances drops significantly between the lower and upper limit. A detailed breakdown of all sensitive receptors and their unmitigated airborne noise impacts is shown in Appendix F.

It is important to note that the construction noise impacts are conservative and based on worst case scenarios. The construction works will be temporary in nature and the number of sensitive receptors affected at any one time will vary depending on location of activities and progress of works along the alignment for each stage.

**Table 5.6** Number of critical facilities where noise criteria exceedances may be experienced

| Critical facility                                 |                           | Community buildings | Educational facilities | Medical facilities |
|---------------------------------------------------|---------------------------|---------------------|------------------------|--------------------|
| Limit: Internal $L_{A,eq}(15min)$                 |                           | 45 dB(A)            | 45 dB(A)               | 40 dB(A)           |
| Number of sensitive receptors exceeding criterion | Establishment of drainage | 0                   | 2                      | 0                  |
|                                                   | Earthworks                | 3                   | 4                      | 0                  |
|                                                   | Site setup/laydown        | 0                   | 2                      | 0                  |
|                                                   | Rail civil works          | 1                   | 3                      | 0                  |
|                                                   | Road civil works          | 0                   | 2                      | 0                  |
|                                                   | Structures                | 1                   | 2                      | 0                  |
|                                                   | Flash-butt welding        | 0                   | 0                      | 0                  |
|                                                   | Concrete batching         | 0                   | 0                      | 0                  |

## Borrow pit noise impacts

Table 5.7 shows the predicted noise impacts at various distances from a typical (model) borrow pit. It was found that where sensitive receptors are within 500 m of a proposed borrow pit location that significant operational noise mitigation will be required. Sensitive receptors between 500 m and 2,000 m are estimated to require typical mitigation that is not location-specific (e.g. adherence to nominated hours of construction). Locations with sensitive receptors greater than 2,000 m from a proposed borrow pit location are forecast not to require mitigation.

Proposed mitigation measures are discussed in Section 7.



**Table 5.7 Predicted noise impacts from model borrow pit**

| Distance from borrow pit to receptor (m) | Time of day        | Façade L <sub>A</sub> eq (15mins) limit (dB(A)) |       | Predicted façade L <sub>Aeq</sub> (15 mins) at receptor (dB(A)) |
|------------------------------------------|--------------------|-------------------------------------------------|-------|-----------------------------------------------------------------|
|                                          |                    | Lower                                           | Upper |                                                                 |
| 200                                      | Standard hours     | 55                                              | 65    | 75                                                              |
|                                          | Non-standard hours | -                                               | 45    | 75                                                              |
| 500                                      | Standard hours     | 55                                              | 65    | 64                                                              |
|                                          | Non-standard hours | -                                               | 45    | 64                                                              |
| 1,000                                    | Standard hours     | 55                                              | 65    | 55                                                              |
|                                          | Non-standard hours | -                                               | 45    | 55                                                              |
| 2,000                                    | Standard hours     | 55                                              | 65    | 46                                                              |
|                                          | Non-standard hours | -                                               | 45    | 46                                                              |

## 5.4.2 Construction road traffic noise impacts

Construction vehicle movements and existing traffic flows have been based on information derived from Appendix T: Traffic Impact Assessment of the EIS. Construction traffic movements in this assessment were used to assess the noise impacts resulting from construction traffic against the base traffic volumes. The traffic volumes used for the basis of this assessment are the corresponding peak hour traffic flows for both base volumes and additional construction traffic as part of the Project. Where traffic speeds were not known, 100 km/h was used for highways and motorways, otherwise 60 km/h was used.

The L<sub>A10(1hr)</sub> for each year from 2021 (commencement of early works and construction) to 2026 (end of commissioning) was predicted both with and without the expected construction traffic. The predicted noise impact is the difference between the noise levels with construction traffic and without construction traffic.

As per the CoP Vol 2, the calculation of road traffic noise was conducted using the 1-hour basic noise level algorithm contained in the United Kingdom's Department of Transport (Welsh Office) *Calculation of Road Traffic Noise* (CoRTN) (Department of Transport, 1988). It was assumed that the traffic speeds, road surface pavement types, gradients, surrounding ground types and distances to nearby receptors will not change as a result of the Project. Therefore, the corrections for these factors were omitted and the difference between the basic noise level L<sub>A10 (1hr)</sub> with and without the development were calculated solely based on predicted changes in hourly traffic volumes, and the percentages of heavy vehicles.

Construction traffic noise is predicted to exceed the adopted criteria for 44 different roads within the impact assessment area across the full construction period, with a maximum predicted L<sub>A10</sub> increase of 22 dB(A). Table 5.8 presents the number of roads where the increase in the L<sub>A10(1hr)</sub> due to construction traffic exceeds the 3 dB(A) criterion for any one year. The predicted unmitigated increase in L<sub>A10(1hr)</sub> for all roads is presented in Appendix F.

**Table 5.8 Additional airborne noise levels from construction traffic per year**

| Increase in L <sub>A10(1 hr)</sub> due to construction traffic | Number of roads |           |           |          |          |          |
|----------------------------------------------------------------|-----------------|-----------|-----------|----------|----------|----------|
|                                                                | 2021            | 2022      | 2023      | 2024     | 2025     | 2026     |
| More than 3 dB(A), but less than 5 dB(A)                       | 6               | 13        | 10        | 4        | 3        | 1        |
| More than 5 dB(A), but less than 10 dB(A)                      | 10              | 11        | 7         | 5        | 3        | 1        |
| More than 10 dB(A), but less than 15 dB(A)                     | 3               | 5         | 7         | 0        | 0        | 0        |
| More than 15 dB(A), but less than 20 dB(A)                     | 8               | 10        | 4         | 0        | 0        | 0        |
| More than 20 dB(A)                                             | 0               | 1         | 0         | 0        | 0        | 0        |
| <b>Total</b>                                                   | <b>27</b>       | <b>40</b> | <b>28</b> | <b>9</b> | <b>6</b> | <b>2</b> |

Table 5.9 presents the maximum increase in L<sub>A10(1hr)</sub> due to construction traffic in each year and the road on which it occurs.



The 44 roads on which the predicted increase in noise level is greater than the 3.0 dB(A) criterion are primarily in rural locations and the existing base traffic volumes quantities are small. As such the initial airborne road traffic noise levels are low before the addition of construction traffic and the criteria for these roads is stringent.

**Table 5.9 Construction road traffic noise exceedances by year**

| Year                                                                            | 2021                                          | 2022                                               | 2023                                       | 2024                                          | 2025                                               | 2026                                       |
|---------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|--------------------------------------------|-----------------------------------------------|----------------------------------------------------|--------------------------------------------|
| Maximum increase in $L_{A10}(1 \text{ hr})$ due to construction traffic (dB(A)) | 19                                            | 22                                                 | 18                                         | 9                                             | 9                                                  | 8                                          |
| Road name                                                                       | Bybera Road                                   | Thornton Road                                      | Lovells Crossing Road                      | Bybera Road                                   | Blackwell Road                                     | Lovells Crossing Road                      |
| Segment                                                                         | Between Cunningham Highway and Private Access | Between Millmerran-Inglewood Road and Unnamed Road | Between Callandoon Street and Unnamed Road | Between Cunningham Highway and Private Access | Between Millmerran-Inglewood Road and Gore Highway | Between Callandoon Street and Unnamed Road |
| $L_{A10}$ Without development <sup>1</sup> (dB(A))                              | 37                                            | 29                                                 | 32                                         | 37                                            | 32                                                 | 32                                         |

**Table note:**

- 1 This value does not represent an impact at a receptor. It is a reference level at a default distance of 10 metres, without any corrections, and is only intended to be used as an indicator of the road traffic noise emission.

### 5.4.3 Construction vibration impacts

The setback distances at which the construction vibration criteria are predicted to be achieved (discussed in Section 4.2) are provided in Table 5.10. These are based on the formulae discussed in Section 5.3.

**Table 5.10 Recommended minimum working distances for vibration intensive equipment**

| Plant Item                                     | Predicted setback distance (m) from each receptor type |                                                       |                                   |                                                      |                       |                                                          |                                      |
|------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------|-----------------------------------|------------------------------------------------------|-----------------------|----------------------------------------------------------|--------------------------------------|
|                                                | Human comfort - lower limit (night)                    | Human comfort - lower limit (day) Upper limit (night) | Human comfort - upper limit (day) | Building damage limit - historical heritage building | Building damage limit | Buried pipework (masonry, plastic or metal construction) | Buried pipework (steel construction) |
|                                                | 0.3 mm/s PPV                                           | 1.0 mm/s PPV                                          | 2.0 mm/s PPV                      | 3.0 mm/s PPV                                         | 5.0 mm/s PPV          | 50 mm/s PPV                                              | 100 mm/s PPV                         |
| Vibratory roller – Vibration start Up/Run down | 330                                                    | 130                                                   | 80                                | 60                                                   | 40                    | <5                                                       | <5                                   |
| Vibratory roller – steady state                | 200                                                    | 90                                                    | 60                                | 40                                                   | 30                    | <5                                                       | <5                                   |
| Vibratory piling                               | 290                                                    | 110                                                   | 60                                | 40                                                   | 30                    | <5                                                       | <5                                   |
| Percussive piling                              | 690                                                    | 275                                                   | 160                               | 135                                                  | 80                    | <5                                                       | <5                                   |

The lower night time vibration human comfort limit of 0.3 mm/s is predicted to be exceeded at up to 346 receptors adjacent to the Project due to their relative distance to the temporary construction footprint. In this instance, the CoP Vol 2 recommends the use of practicable and reasonable mitigation to minimise vibration impacts. These mitigation measures are discussed in Section 7.2.

Particularly vibration-intensive activities, such as piling, are likely to persist for only a short duration of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receptor. However, in practice, distances will vary between plant and sensitive receptors. For works that move along the Project alignment, vibration experienced at a receptor would reduce as the vibration source moves further away, along the Project alignment.

The predicted unmitigated impact to each vibration sensitive receptor is included in Appendix F, where impacts are compared against all relevant criteria and exceedances are highlighted.

A summary of the total exceedances for each construction activity is shown in Table 5.11.

**Table 5.11 Construction vibration exceedances against human comfort and structural limit criteria**

| Activity                                                 | Number of exceedances                |       |                                          |       |                  |
|----------------------------------------------------------|--------------------------------------|-------|------------------------------------------|-------|------------------|
|                                                          | Human comfort limit – standard hours |       | Human comfort limit – non-standard hours |       | Structural limit |
|                                                          | Lower                                | Upper | Lower                                    | Upper |                  |
| Site setup/laydown areas                                 |                                      |       |                                          |       |                  |
| Vibratory roller – vibration start up/run down           | 30                                   | 11    | 115                                      | 29    | 4                |
| Vibratory roller – steady state vibration                | 18                                   | 7     | 55                                       | 17    | 4                |
| Structures                                               |                                      |       |                                          |       |                  |
| Vibratory piling – vibration start up/run down           | 0                                    | 0     | 10                                       | 0     | 0                |
| Percussive (impact) piling – vibration start up/run down | 10                                   | 2     | 251                                      | 8     | 0                |
| Earthworks/drainage/rail civil works                     |                                      |       |                                          |       |                  |
| Vibratory roller – vibration start up/run down           | 175                                  | 102   | 346                                      | 165   | 50               |
| Vibratory roller – steady state vibration                | 133                                  | 78    | 250                                      | 124   | 41               |
| Road civil works                                         |                                      |       |                                          |       |                  |
| Vibratory roller – vibration start up/run down           | 135                                  | 87    | 285                                      | 126   | 41               |
| Vibratory roller – steady state vibration                | 103                                  | 66    | 198                                      | 97    | 33               |

For some activities, multiple receptors are located within the Project footprint; the area within which construction equipment is expected to operate. It is anticipated that land within the Project footprint will either be gazetted as rail corridor or will be temporarily utilised to accommodate construction activities. As a consequence, the number of receptors exceeding a criterion does not include the receptors within the Project footprint.

Table 5.12 summarises the extent of construction vibration impacts to non-heritage receptors. These impacts are based on construction activities occurring at the boundary of the area within which works may occur. The impacts stated are therefore indicative of reasonable worst-case conditions and do not represent typical ongoing predicted levels. The predicted unmitigated impact to each vibration sensitive receptor is included in Appendix F, where impacts are compared against all appropriate criteria and exceedances are highlighted.

**Table 5.12 Summary of predicted vibration impacts to non-heritage receptors**

| Activity                                       | Number of receptors within predicted impact range |             |             |              |               |               |                      |
|------------------------------------------------|---------------------------------------------------|-------------|-------------|--------------|---------------|---------------|----------------------|
|                                                | Less than 1 mm/s                                  | 1 to 2 mm/s | 2 to 5 mm/s | 5 to 10 mm/s | 10 to 20 mm/s | 20 to 50 mm/s | Greater than 50 mm/s |
| <b>Site setup/laydown areas</b>                |                                                   |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down | 2,823                                             | 19          | 7           | 1            | 3             | 0             | 0                    |
| Vibratory roller – steady state vibration      | 2,835                                             | 11          | 3           | 1            | 3             | 0             | 0                    |

| Activity                                                 | Number of receptors within predicted impact range |             |             |              |               |               |                      |
|----------------------------------------------------------|---------------------------------------------------|-------------|-------------|--------------|---------------|---------------|----------------------|
|                                                          | Less than 1 mm/s                                  | 1 to 2 mm/s | 2 to 5 mm/s | 5 to 10 mm/s | 10 to 20 mm/s | 20 to 50 mm/s | Greater than 50 mm/s |
| <b>Structures</b>                                        |                                                   |             |             |              |               |               |                      |
| Vibratory piling – vibration start up/run down           | 2,855                                             | 0           | 0           | 0            | 0             | 0             | 0                    |
| Percussive (impact) piling – vibration start up/run down | 2,847                                             | 6           | 2           | 0            | 0             | 0             | 0                    |
| <b>Earthworks/drainage/rail civil works</b>              |                                                   |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down           | 2,664                                             | 72          | 52          | 20           | 13            | 11            | 6                    |
| Vibratory roller – steady state vibration                | 2,706                                             | 54          | 37          | 13           | 11            | 10            | 7                    |
| <b>Road civil works</b>                                  |                                                   |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down           | 2,717                                             | 47          | 46          | 19           | 9             | 9             | 4                    |
| Vibratory roller – steady state vibration                | 2,748                                             | 37          | 33          | 13           | 7             | 8             | 5                    |

Thirty-four heritage areas of interest were identified in the impact assessment area. The number of these receptors predicted to exceed the heritage building criteria (refer Section 4.3) is presented in Table 5.16. Unmitigated predictions for each heritage receptor are provided in Appendix F.

**Table 5.13 Construction vibration heritage exceedances against structural limit criterion**

| Activity                                       | Number of heritage receptors exceeding 3 mm/s PPV |
|------------------------------------------------|---------------------------------------------------|
| <b>Site setup/laydown areas</b>                |                                                   |
| Vibratory roller – steady state vibration      | 6                                                 |
| Vibratory roller – vibration start up/run down | 6                                                 |
| <b>Structures</b>                              |                                                   |
| Vibratory piling – vibration start up/run down | 2                                                 |
| Vibratory piling – vibration start up/run down | 4                                                 |
| <b>Earthworks/drainage/rail civil works</b>    |                                                   |
| Vibratory roller – steady state vibration      | 4                                                 |
| Vibratory roller – vibration start up/run down | 4                                                 |
| <b>Road civil Works</b>                        |                                                   |
| Vibratory roller – steady state vibration      | 4                                                 |
| Vibratory roller – vibration start up/run down | 4                                                 |

Table 5.14 summarises the extent of construction vibration impacts to heritage receptors.

**Table 5.14 Summary of predicted vibration impacts to heritage receptors**

| Activity                                       | Number of heritage receptors within predicted impact range |             |             |              |               |               |                      |
|------------------------------------------------|------------------------------------------------------------|-------------|-------------|--------------|---------------|---------------|----------------------|
|                                                | Less than 1 mm/s                                           | 1 to 2 mm/s | 2 to 5 mm/s | 5 to 10 mm/s | 10 to 20 mm/s | 20 to 50 mm/s | Greater than 50 mm/s |
| <b>Site setup/laydown areas</b>                |                                                            |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down | 18                                                         | 2           | 5           | 1            | 1             | 0             | 3                    |
| Vibratory roller – steady state vibration      | 20                                                         | 3           | 3           | 0            | 1             | 0             | 3                    |

| Activity                                                 | Number of heritage receptors within predicted impact range |             |             |              |               |               |                      |
|----------------------------------------------------------|------------------------------------------------------------|-------------|-------------|--------------|---------------|---------------|----------------------|
|                                                          | Less than 1 mm/s                                           | 1 to 2 mm/s | 2 to 5 mm/s | 5 to 10 mm/s | 10 to 20 mm/s | 20 to 50 mm/s | Greater than 50 mm/s |
| <b>Structures</b>                                        |                                                            |             |             |              |               |               |                      |
| Vibratory piling – vibration start up/run down           | 27                                                         | 2           | 1           | 1            | 0             | 0             | 0                    |
| Percussive (impact) piling – vibration start up/run down | 27                                                         | 0           | 1           | 2            | 1             | 0             | 0                    |
| <b>Earthworks/drainage/rail civil works</b>              |                                                            |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down           | 1                                                          | 0           | 0           | 1            | 2             | 1             | 0                    |
| Vibratory roller – steady state vibration                | 1                                                          | 0           | 1           | 1            | 2             | 0             | 0                    |
| <b>Road civil works</b>                                  |                                                            |             |             |              |               |               |                      |
| Vibratory roller – vibration start up/run down           | 10                                                         | 2           | 0           | 2            | 1             | 2             | 0                    |
| Vibratory roller – steady state vibration                | 12                                                         | 0           | 1           | 2            | 1             | 1             | 0                    |

The vibration predictions in Table 5.11 and Table 5.13 are based on several coarse assumptions in the absence of final details on the construction equipment and methods. These assumptions have been made to ensure that the impact assessment is conservative and are as follows:

- The most conservative parameters and scaling factors have been used in the prediction formulae
- The more conservative building damage criterion has been adopted:
  - The criterion is dependent on the dominant frequency of the vibration impact, and some compaction activities generally have higher dominant frequencies resulting in more lenient criteria
  - A 20 mm/s structural damage vibration criterion has been adopted for industrial receptors as part of this assessment
  - A 5 mm/s structural damage vibration criterion has been adopted for residential receptors as part of this assessment
  - A 3 mm/s structural damage vibration criterion has been adopted for heritage receptors as part of this assessment
- Changes in the terrain which can reduce the propagation of ground vibration impacts, such as drains, are not accounted for in the formula
- The shortest distance from the receptor to the edge of works for each construction activity has been assumed based on footprints derived based on the reference design for the Project.

#### 5.4.4 Blasting impacts

Significant volumes of non-rippable rock are anticipated within some of the cuttings along the rail corridor, particularly in the northern part of the Project alignment. The extent to which drilling and blasting will be required will be confirmed through further geotechnical investigation. However, based on reference design geotechnical information, it is anticipated that blasting may be required for the cuttings between:

- Ch 164.4 km and Ch 165.8 km
- Ch 174.4 km and Ch 175.5 km
- Ch 177.0 km and Ch 179.3 km
- Ch 188.8 km and Ch 190.4 km.

The unmitigated maximum permissible charge weight to meet the sensitive structure criteria outlined in Section 4.3 has been calculated for indicative setback distances in Table 5.15 and for each receptor in Appendix F. A detailed blasting assessment will be completed once blasting locations have been finalised through detail design. The below information is based on a worst case assumption of a confined blast and geotechnical parameters for good vibration transmission.

**Table 5.15 Charge mass ranges for set distances for sensitive structures**

| Distance to receptor | Total number of receptors for the Project in proximity to one or more blast locations | Maximum permissible charge weight (kg)                                            |                                      |                                       |                                           |
|----------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------|---------------------------------------|-------------------------------------------|
|                      |                                                                                       | Ground vibration - human comfort                                                  | Ground vibration - structural damage | Airblast overpressure - human comfort | Airblast overpressure - structural damage |
| 0 to 200 m           | 32                                                                                    | N/A – Specific blast design required or blasting not feasible at these distances. |                                      |                                       |                                           |
| 200 to 400 m         | 12                                                                                    | 180                                                                               | 710                                  | <1                                    | 30                                        |
| 400 to 800 m         | 10                                                                                    | 720                                                                               | >2,000                               | <5                                    | 250                                       |
| 800 to 1,600 m       | 23                                                                                    | >2,000                                                                            | >2,000                               | 30                                    | >2,000                                    |

Thirty-four receptors were identified as being areas of interest for heritage purposes. The unmitigated maximum permissible charge weight to meet the heritage building criteria (refer Section 4.3) has been calculated for indicative setback distances in Table 5.16 and for each receptor in Appendix F. The information in Table 5.16 is based on a worst case assumption of an unconfined blast.

**Table 5.16 Charge mass ranges for set distances for heritage buildings**

| Distance to receptor | Total number of receptors for the Project in proximity to one or more blast locations | Maximum permissible charge weight (kg)                                            |
|----------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 0 to 200 m           | 1                                                                                     | N/A – Specific blast design required or blasting not feasible at these distances. |
| 200 to 400 m         | 2                                                                                     | 57                                                                                |
| 400 to 800 m         | 1                                                                                     | 230                                                                               |
| 800 to 1,600 m       | 1                                                                                     | 920                                                                               |

In addition to the receptors listed in Table 5.16, six heritage receptors were found to intersect with the potential areas in which blasting may occur. It is anticipated that land within these areas will either be gazetted as rail corridor or will be temporarily utilised to accommodate construction activities. As a consequence, the number of receptors exceeding a criterion does not include the receptors within the Project footprint.

A detailed blasting assessment can be completed once blasting locations have been finalised through detail design

## 6 Operational noise assessment

### 6.1 Operational road traffic noise assessment

#### 6.1.1 Operational road traffic noise assessment – new roads

Potential noise impacts of the 35 new road sections were assessed with consideration for the nearest sensitive receptors to the proposed works, as well as the realignment distance in order to predict the change in noise levels brought about by the realignment of the road closer to residents.

The predicted façade corrected  $L_{A10}$  (18 hour) at the nearest sensitive receptor for each new road Section is presented in Table 6.1. Impacts are predictions of operational road traffic noise levels in 2035 at the nearest receptor, as per the requirements of CoP Vol 1.

**Table 6.1 Predicted operational road traffic noise – new roads**

| Location               | Chainage (km) | Existing alignment – distance to nearest receptor (m) | New alignment – distance to nearest receptor (m) | New alignment – Façade corrected $L_{A10}$ , 18 hour at nearest receptor (dB(A)) | Number of receptors which exceed criterion |
|------------------------|---------------|-------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------|
| Eukabilla Road         | 33.4 (NS2B)   | 1,243                                                 | 1,243                                            | 28                                                                               | 0                                          |
| Georges Lane           | 3.6           | 1,978                                                 | 1,948                                            | 41                                                                               | 0                                          |
| Wondall-Kurumbul Road  | 7.2           | 831                                                   | 831                                              | 20                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 8.6           | 240                                                   | 258                                              | 35                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 12.2          | 2,430                                                 | 2,430                                            | 25                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 14.6          | 80                                                    | 94                                               | 42                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 19.0          | 124                                                   | 124                                              | 56                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 20.8          | 1,077                                                 | 1,077                                            | 45                                                                               | 0                                          |
| Yelarbon-Kurumbul Road | 23.6          | 112                                                   | 84                                               | 59                                                                               | 0                                          |
| Cunningham Highway     | 25.2          | 14                                                    | 14                                               | 73                                                                               | 29                                         |
| Yelarbon-Kurumbul Road | 25.6          | 230                                                   | 230                                              | 36                                                                               | 0                                          |
| Yelarbon-Keetah Road   | 25.2          | 17                                                    | 17                                               | 59                                                                               | 0                                          |
| Railway Parade         | 25.2          | 49                                                    | 49                                               | 60                                                                               | 0                                          |
| Suttons Road           | 30.0          | 1,867                                                 | 1,777                                            | 28                                                                               | 0                                          |
| Bybera Road            | 60.6          | 815                                                   | 815                                              | 36                                                                               | 0                                          |
| Heckendorfs Road       | 115.6         | 414                                                   | 414                                              | 38                                                                               | 0                                          |
| Commodore Peak Road    | 123.4         | 384                                                   | 200                                              | 42                                                                               | 0                                          |
| Scraggs Road           | 123.8         | 63                                                    | 63                                               | 55                                                                               | 0                                          |
| Schwartens Road        | 127.4         | 206                                                   | 206                                              | 50                                                                               | 0                                          |
| Harris Road            | 146.8         | 30                                                    | 36                                               | 55                                                                               | 0                                          |
| Fysh Road              | 147.2         | 58                                                    | 58                                               | 52                                                                               | 0                                          |
| Pampas Pit Road        | 147.2         | 96                                                    | 115                                              | 39                                                                               | 0                                          |
| Elsden Road            | 149.6         | 122                                                   | 122                                              | 39                                                                               | 0                                          |
| Mann Silo Road         | 151.8         | 58                                                    | 58                                               | 53                                                                               | 0                                          |
| Saal Road              | 153.0         | 71                                                    | 64                                               | 58                                                                               | 0                                          |
| Desmond Road           | 161.2         | 38                                                    | 38                                               | 55                                                                               | 0                                          |
| Murlaggan Road South   | 163.6         | 500                                                   | 195                                              | 42                                                                               | 0                                          |

| Location                  | Chainage (km) | Existing alignment – distance to nearest receptor (m) | New alignment – distance to nearest receptor (m) | New alignment – Façade corrected L <sub>A10</sub> , 18 hour at nearest receptor (dB(A)) | Number of receptors which exceed criterion |
|---------------------------|---------------|-------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------|
| Murlaggan Road North      | 164.2         | 750                                                   | 180                                              | 43                                                                                      | 0                                          |
| Tip Road                  | 169.0         | 136                                                   | 136                                              | 46                                                                                      | 0                                          |
| Quibet Road               | 171.0         | 45                                                    | 45                                               | 61                                                                                      | 2                                          |
| Lochabor Road             | 172.6         | 54                                                    | 25                                               | 63                                                                                      | 1                                          |
| McEwan Lane               | 173.2         | 97                                                    | 97                                               | 57                                                                                      | 0                                          |
| Bushy Lane                | 182.8         | 55                                                    | 138                                              | 51                                                                                      | 0                                          |
| Biddeston-Southbrook Road | 183.0         | 80                                                    | 55                                               | 61                                                                                      | 1                                          |
| Athol School Road         | 187.2         | 89                                                    | 50                                               | 56                                                                                      | 0                                          |

**Table notes:**

Orange highlighted cells indicate exceedances of criterion are predicted.

The operation of four new road sections is predicted to produce exceedance of the façade corrected L<sub>A10</sub> (18 hour) criterion at one or more sensitive receptors. These sections will need to be assessed in more detail during detail design of the Project to confirm exceedances against the requirements of COP Vol 1.

Specific mitigation measures are recommended in Section 7.

## 6.1.2 Operational road traffic noise assessment – upgraded roads

Potential noise impacts of the 46 upgraded road sections were assessed with consideration for the nearest sensitive receptors to the proposed works to predict the change in noise levels brought about by the realignment of the road closer to residents.

The predicted façade corrected L<sub>A10</sub> (18 hour) at the nearest sensitive receptor for each road is presented in Table 6.2. Impacts are predictions of operational road traffic noise levels in 2035 at the nearest receptor, as per the requirements of CoP Vol 1.

**Table 6.2 Predicted operational road traffic noise – upgraded roads**

| Location                  | Chainage (km) | Distance to nearest receptor (m) | Façade Corrected L <sub>A10</sub> (18 hour) (dB(A)) at nearest receptor | Number of receptors which exceed criterion |
|---------------------------|---------------|----------------------------------|-------------------------------------------------------------------------|--------------------------------------------|
| Kildonan Road             | 33.1 (NS2B)   | 2,600                            | 37                                                                      | 0                                          |
| South Kurumbul Road       | 5.8           | 12                               | 57                                                                      | 0                                          |
| Kera Street               | 25.2          | 12                               | 67                                                                      | 0                                          |
| Cunningham Highway        | 26.6          | 98                               | 57                                                                      | 0                                          |
| East of Sawmill Road      | 26.8          | 60                               | 40                                                                      | 0                                          |
| Springborg Road           | 37.6          | 1,980                            | 25                                                                      | 0                                          |
| Whetstone Access Road     | 45.2          | 250                              | 40                                                                      | 0                                          |
| Mcdougalls Road           | 50.0          | 1,055                            | 32                                                                      | 0                                          |
| Cremascos Road            | 54.4          | 134                              | 51                                                                      | 0                                          |
| Lovells Crossing Road     | 65.8          | 1,202                            | 27                                                                      | 0                                          |
| Thornton Road             | 68.6          | 1,536                            | 24                                                                      | 0                                          |
| Millmerran-Inglewood Road | 72.8          | 777                              | 48                                                                      | 0                                          |
| Grays Road                | 78.2          | 1,043                            | 30                                                                      | 0                                          |
| Wongavale-Yugibar Road    | 80.8          | 1,200                            | 28                                                                      | 0                                          |
| Millmerran-Inglewood Road | 91.8          | 4,784                            | 38                                                                      | 0                                          |

| Location                     | Chainage (km) | Distance to nearest receptor (m) | Façade Corrected LA10 (18 hour) (dB(A)) at nearest receptor | Number of receptors which exceed criterion |
|------------------------------|---------------|----------------------------------|-------------------------------------------------------------|--------------------------------------------|
| Kooroongarra-Andersons Road  | 96.0          | 750                              | 20                                                          | 0                                          |
| Millmerran-Kooroongarra Road | 102.8         | 454                              | 35                                                          | 0                                          |
| Patons-Kooroongarra Road     | 105.8         | 925                              | 35                                                          | 0                                          |
| Nicol Creek Road             | 107.8         | 168                              | 47                                                          | 0                                          |
| Millwood Road                | 112.0         | 823                              | 35                                                          | 0                                          |
| Millmerran-Inglewood Road    | 115.6         | 408                              | 51                                                          | 0                                          |
| Blackwell Road               | 120.2         | 1,085                            | 35                                                          | 0                                          |
| Millmerran-Inglewood Road    | 126.8         | 148                              | 57                                                          | 0                                          |
| Millmerran-Owens Scrub Road  | 129.8         | 229                              | 54                                                          | 0                                          |
| Lindenmayer Road             | 133.4         | 439                              | 43                                                          | 0                                          |
| Hall Road                    | 138.4         | 590                              | 33                                                          | 0                                          |
| Millmerran-Leyburn Road      | 140.0         | 470                              | 50                                                          | 0                                          |
| Gilgai Lane                  | 144.4         | 543                              | 33                                                          | 0                                          |
| Gore Highway                 | 146.6         | 47                               | 71                                                          | 2                                          |
| Gore Highway                 | 149.6         | 118                              | 66                                                          | 0                                          |
| Gore Highway                 | 153.0         | 65                               | 69                                                          | 2                                          |
| Longhurst Road               | 157.8         | 1,031                            | 45                                                          | 0                                          |
| Yarranlea Road               | 161.2         | 368                              | 45                                                          | 0                                          |
| Roche Road                   | 163.2         | 260                              | 62                                                          | 0                                          |
| Oakey-Pittsworth Road        | 170.8         | 250                              | 53                                                          | 0                                          |
| Gore Highway                 | 172.2         | 192                              | 64                                                          | 0                                          |
| Lochabor Road                | 172.6         | 25                               | 63                                                          | 0                                          |
| Linthorpe Road               | 175.8         | 144                              | 51                                                          | 0                                          |
| Linthorpe Valley Road        | 180.8         | 163                              | 48                                                          | 0                                          |
| Gore Highway                 | 183.4         | 60                               | 70                                                          | 1                                          |
| Purcell Road                 | 187.4         | 61                               | 57                                                          | 0                                          |
| Toowoomba-Cecil Plains Road  | 196.0         | 246                              | 65                                                          | 0                                          |
| Brimblecombe Road            | 198.6         | 298                              | 44                                                          | 0                                          |
| Warrego Highway              | 203.0         | 101                              | 67                                                          | 0                                          |
| Chamberlain Road             | 204.4         | 484                              | 48                                                          | 0                                          |
| Leesons Road                 | 206.6         | 41                               | 51                                                          | 0                                          |

**Table notes:**

Orange highlighted cells indicate exceedances of criterion are predicted

The operation of three existing road sections is predicted to produce exceedance of the façade corrected LA10 (18 hour) criterion at one or more sensitive receptors. The prediction methodology used in this assessment only considers road traffic noise and influence from operational rail noise or other infrastructure is not included.

These sections will need to be assessed in more detail during detail design of the Project to confirm exceedances against relevant legislation. Specific mitigation measures are recommended in Section 7.



## 7 Mitigation measures

This Section provides discussion on the mitigation and management measures for noise and vibration impacts that have been incorporated into the reference design (refer Section 7.1) in addition to those that will need to be implemented through future phases of the Project (refer Section 7.2). It also discusses the noise and vibration monitoring which will be undertaken to support the Project.

The mitigation measures proposed are considered to be consistent with the principles of best practice environmental management based on similar projects and referenced documents such as CoP Vol. 1 (operational road noise) and Vol. 2 (construction noise).

### 7.1 Mitigation through the reference design phase

Development of the reference design for the Project has progressed in parallel with the impact assessment process. As a consequence, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the reference design as appropriate and where possible.

Mitigation measures and controls that have been factored into the reference design, or otherwise implemented during the reference design phase of the Project are summarised in Table 7.1.

**Table 7.1** Initial mitigation measures of relevance to noise and vibration

| Aspect                               | Initial mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction noise and vibration     | <ul style="list-style-type: none"><li>■ Laydown areas and other construction-phase facilities have been located to avoid impacts to environmental and social receptors, with the aim of achieving compliance with the adopted construction noise and vibration criteria, as per CoP Vol 2</li><li>■ The horizontal and vertical alignment has been established to optimise the earthworks required and achieve as close to a net-balance as is possible. By minimising the material deficit for construction of the Project, the volume of material required to be imported has been reduced. Less imported material equates to fewer construction phase truck movements and less construction traffic noise.</li></ul> |
| Operational road noise and vibration | <ul style="list-style-type: none"><li>■ The Project has been aligned to minimise the number of road-rail interfaces, where possible, thereby limiting the number of:<ul style="list-style-type: none"><li>– Road upgrades or new roads required in the reference design, which may result in an increase in road traffic noise for adjacent sensitive receptors</li><li>– Level crossings where wayside horns, alarm bells or other types of audible warning may be required for safety purposes.</li></ul></li></ul>                                                                                                                                                                                                   |

### 7.2 Proposed mitigation measures

In order to manage and mitigate the Project's risks, several mitigation measures have been proposed for implementation in future phases of project delivery. These proposed mitigation measures have been identified to address Project specific issues and opportunities.

Table 7.2 identifies the relevant Project phase, the aspect to be managed and the proposed mitigation measure.

**Table 7.2 Construction noise and vibration mitigation measures**

| Delivery phase | Aspect                                                          | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Detail design  | Construction noise and vibration impacts on sensitive receptors | <ul style="list-style-type: none"> <li>■ Develop and refine the construction methodology with the aim of achieving compliance with construction noise and vibration performance criteria as specified in COP Vol 2</li> <li>■ Confirm the proximity of sensitive receptors to the finalised locations for construction activities, laydown areas and other construction facilities. Re-assess the predicted noise and vibration levels from these activities.</li> <li>■ A Noise and Vibration Management Sub-plan will be developed as a component of the CEMP. This Sub-plan will include: <ul style="list-style-type: none"> <li>– Construction noise and vibration criteria for the Project, as detailed in CoP Vol 2</li> <li>– Location of sensitive receptors in proximity to the Project footprint.</li> <li>– Location specific management measures for activities that could exceed the construction noise and vibration criteria, for example: <ul style="list-style-type: none"> <li>■ Earthworks and civil works</li> <li>■ Structural work, including piling</li> <li>■ Concrete batching</li> <li>■ Blasting.</li> </ul> </li> <li>– Location, design and timing of need for temporary noise barriers</li> <li>– Community notification process to advise of significant works with potential for noise nuisance or vibration at sensitive receptors and surrounding residences/premises</li> <li>– Locations and procedures for: <ul style="list-style-type: none"> <li>■ Pre and post-condition surveys</li> <li>■ Noise or vibration monitoring in response to validated complaints.</li> </ul> </li> <li>– Requirements for training, inspections, corrective actions, monitoring, notification and classification of environmental incidents/complaints, record keeping and performance objectives for handover on completion of construction.</li> </ul> </li> </ul> |
|                | Road traffic noise                                              | <ul style="list-style-type: none"> <li>■ The vertical and horizontal alignment of new and upgraded road components will be designed to minimise the number of receptors at which CoP Vol 1 criteria are predicted to be exceeded. The design will be reviewed in all locations, but with particular focus on locations where criteria are projected to be exceeded by the reference design, as follows: <ul style="list-style-type: none"> <li>– New road components: <ul style="list-style-type: none"> <li>■ Cunningham Highway (Ch 25.2 km)</li> <li>■ Quibet Road (Ch 171.0 km)</li> <li>■ Lochabor Road (Ch 172.6 km)</li> <li>■ Biddeston-Southbrook Road (Ch 183.0 km).</li> </ul> </li> <li>– Upgrades of the Gore Highway at Ch 146.6 km, Ch 153.0 km and Ch 183.4 km.</li> </ul> </li> <li>■ Operational road traffic noise impacts will be iteratively re-assessed during the detail design process, in accordance with CoP Vol 1, to confirm the receptors at which noise criteria may be exceeded</li> <li>■ Where CoP Vol 1 criteria may be exceeded at a sensitive receptor, the following potential mitigation measures for both upgraded and new road sections will be investigated for effectiveness and incorporated into the detail design, as appropriate: <ul style="list-style-type: none"> <li>– A noise barrier in the form of a landscaped earth mound and/or a noise fence</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Delivery phase   | Aspect                         | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                | <ul style="list-style-type: none"> <li>– Pavement surface treatment</li> <li>– Provision of acoustic façade treatments to affected sensitive receptors.</li> </ul> <p>A combination of mitigation measures may be appropriate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Pre-construction | Pre-condition surveys          | <ul style="list-style-type: none"> <li>■ Building condition/dilapidation surveys will be undertaken at the following locations: <ul style="list-style-type: none"> <li>– Receptors which are expected to exceed the structural damage vibration criteria given by DIN 4150.3 and recommended by the CoP Vol 2.</li> <li>– Receptors identified as being particularly sensitive to vibration. These are: <ul style="list-style-type: none"> <li>■ Heritage buildings within: <ul style="list-style-type: none"> <li>– 60 m of possible vibratory roller start up/run down – six identified</li> <li>– 135 m of percussive piling – none identified</li> </ul> </li> <li>■ Other buildings within: <ul style="list-style-type: none"> <li>– 40 m of possible vibratory roller start up/run down</li> <li>– 80 m percussive piling</li> </ul> </li> <li>■ Structures within the damage radius of a blast location, calculated based on charge mass</li> </ul> </li> <li>– Structures within the damage radius of a blast location, calculated based on charge mass (refer to Section 5.4.4).</li> <li>– Receptors which are expected to exceed the structural damage vibration performance criteria in DIN 4150.3 and recommended by the CoP Vol 2.</li> </ul> </li> </ul> |
| Construction     | Communication and notification | <ul style="list-style-type: none"> <li>■ The results of refined construction noise and vibration modelling will be communicated to potentially affected residents and occupants (sensitive receptors) with information to enable them to understand the likely nature, extent and duration of noise and vibration impacts during construction</li> <li>■ Construction progress and upcoming activities will be communicated to local residents and stakeholders, particularly when noisy or vibration generating activities are planned, such as vibratory compaction and piling</li> <li>■ A telephone line will be advertised for the Project to enable members of the public to notify ARTC of issues, including the generation of excessive noise and/or vibration.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  | Monitoring                     | <ul style="list-style-type: none"> <li>■ Vibration monitoring will be undertaken at representative locations where the potential for building/structural damage risk has been identified due to potential exceedance of the Project structural damage performance criteria as specified in DIN 4150.3 and recommended by the CoP Vol 2.</li> <li>■ Monitoring will occur for the duration of vibratory activities that have the potential to result in exceedance of criteria at one or more receptor locations.</li> <li>■ Vibration monitoring will be undertaken by a suitably qualified professional, in accordance with the CoP Vol 2</li> <li>■ Noise and/or vibration monitoring may be undertaken in response to noise or vibration complaints to assess compliance of construction activities against adopted criteria.</li> <li>■ All acoustic instrumentation will comply with AS IEC 61672.1-2004 <i>Electroacoustics – Sound level meters – Specifications</i></li> </ul>                                                                                                                                                                                                                                                                                  |

| Delivery phase | Aspect                           | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | Construction work hours          | <ul style="list-style-type: none"> <li>■ The construction program will generally be based on the hours presented in the Outline EMP. Construction works will aim to achieve the construction noise performance criteria as specified in the Outline EMP.</li> <li>■ Noise generating construction activities outside of standard hours (CoP Vol 2) will only be undertaken where: <ul style="list-style-type: none"> <li>– A location and activity specific noise assessment has been undertaken</li> <li>– Assessment has concluded that there are no nearby sensitive receptors or impacts to receivers can be appropriately managed, as defined by the CoP Vol 2</li> <li>– Consultation with the local community is demonstrated.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                |
|                | Equipment selection              | <ul style="list-style-type: none"> <li>■ Equipment selections will be reviewed with a preference for adopting quieter and non-vibratory plant items near sensitive receptors, where feasible and reasonable. This is particularly important for any non-standard hours construction activities where sensitive receptors are nearby. Vibration-intensive stationary plant such as generators located near sensitive receptors will be isolated with isolation pads</li> <li>■ Appropriately sized equipment will be selected for the task, such as vibratory compactors and rock excavation equipment. For example, a 22 t excavator is expected to operate 8 dB(A) quieter than a 40 t excavator, based on equipment noise emissions given by BS5228.1.</li> </ul>                                                                                                                                                                                                                                                                                                         |
|                | Alternative construction methods | <ul style="list-style-type: none"> <li>■ Alternative construction methods will be assessed and adopted, where practicable, to reduce noise and vibration impacts, such as: <ul style="list-style-type: none"> <li>– Using damped tips on rock-breakers</li> <li>– Using rock saws instead of blasting</li> <li>– During clearing, using excavators with grabs and rake attachments instead of chainsaws</li> <li>– Mulching at locations away from sensitive receptors</li> <li>– Avoiding onsite fabrication work where possible</li> <li>– Using alternatives to impact pile driving where possible, such as continuous flight auger injected piles, pressed-in preformed piles, auger bored piles, impact bored piles or vibratory piles</li> <li>– When piling, avoiding dynamic compaction using large tamping weights near sensitive and critical receptors where possible</li> <li>– Reducing energy per blow when piling (consider first whether this may result in prolonged exposure with no realised reduction in community disturbance).</li> </ul> </li> </ul> |
|                | Blasting                         | <ul style="list-style-type: none"> <li>■ Vibration impacts from blasting will be assessed by the Principal Contractor once the locations and depths of blasting and the charges to be used are confirmed. This assessment will confirm the receptors/locations at which blasting impacts are expected to exceed the Project blasting vibration performance criteria as specified in the Outline EMP, if at all.</li> <li>■ Where blasting impacts are expected to exceed the Project blasting performance criteria as specified in the Outline EMP, the following measures are proposed where practicable: <ul style="list-style-type: none"> <li>– Reducing the charge size by use of delays and reduced charge masses</li> <li>– Ensuring adequate blast confinement to minimise the amount of overpressure</li> <li>– Avoiding secondary blasting where possible. The use of rock breakers or drop hammers may be an acceptable alternative.</li> </ul> </li> </ul>                                                                                                      |

| Delivery phase | Aspect                                        | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |                                               | <ul style="list-style-type: none"> <li>– Avoiding blasting during heavy cloud cover or during strong winds blowing towards sensitive receptors</li> <li>– Establishing a blasting timetable through community consultation, with blasts times negotiated with surrounding sensitive receptors.</li> <li>■ Residents, occupants and other stakeholders within 1 km radius of a blast location (or wider, if deemed appropriate by pre-blast assessment) will be notified a minimum of three calendar days in advance of a blast occurring.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                | Use and siting of plant                       | <ul style="list-style-type: none"> <li>■ Where possible, plant will be located and oriented away from nearby receptors for example, non-resident workforce accommodation.</li> <li>■ Where possible, the duration of simultaneous operation of noise or vibration-intensive plant will be minimised. Plant and equipment used intermittently or no longer in use will be throttled or shut down.</li> <li>■ Construction plant, vehicles and machinery will be maintained and operated in accordance with manufacturer's instructions to minimise noise and vibration emissions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                | Silencers and dampers                         | <ul style="list-style-type: none"> <li>■ All mechanical plant near sensitive receptors will be silenced by best practical means, such as: <ul style="list-style-type: none"> <li>– Internal combustion engines will be fitted with a suitable muffler operating as per the manufacturer's specifications</li> <li>– Pneumatic tools will be fitted with an effective silencer on their air exhaust port, where feasible and practicable</li> <li>– Aggregate bins and chutes will be lined with a rubber material, to dampen the vibration of the structure</li> <li>– When piling, acoustic damping will be provided to sheet steel piles to reduce vibration and resonance</li> <li>– When piling, resilient pads will be used between pile and hammerhead. Care will be taken when selecting a resilient pad as energy is transferred to the pad in the form of heat.</li> </ul> </li> <li>■ Where vibration impacts at sensitive receptors are expected to exceed the Project vibration performance criteria as specified in the Outline EMP, cut-off trenches to interrupt the direct transmission path of vibrations between source and receptors may be provided where reasonable and safe to do so.</li> </ul> |
|                | Shield stationary noise sources               | <ul style="list-style-type: none"> <li>■ Stationary noise sources (such as pumps, compressors, generators etc.) near noise sensitive receptors will be shielded or enclosed where feasible and reasonable</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                | Shield sensitive receptors from noise sources | <ul style="list-style-type: none"> <li>■ Where possible, structures and noise-emitting plant will be located such that the structures provide some shielding to nearby receptors. Structures include: <ul style="list-style-type: none"> <li>– Temporary site buildings such as sheds</li> <li>– Materials stockpiles</li> <li>– Fencing</li> <li>– Storage/shipping containers.</li> </ul> </li> <li>■ The need for and practicability of temporary noise barriers will be assessed following confirmation of the construction methodology for the Project during the detail design phase.</li> <li>■ If temporary noise barriers are required, the location, design and timing of need will be documented in the Noise and Vibration Management Sub-plan, as a component of the CEMP.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Delivery phase | Aspect                                                                                                       | Mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | Minimise disturbance arising from construction vehicle movements and delivery of goods to construction sites | <ul style="list-style-type: none"> <li>Non-tonal reversing beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work</li> <li>Site access points and roads will be sited as far as is practical from sensitive receptors</li> <li>Acoustic shielding will be considered if loading/unloading areas are close to sensitive receptors</li> <li>Delivery vehicles will be fitted with straps rather than chains where possible</li> <li>Designated parking areas for light vehicles and trucks will be established away from residences</li> </ul>                                        |
|                | Construction traffic                                                                                         | <ul style="list-style-type: none"> <li>To reduce noise from construction vehicles, where reasonable to do so: <ul style="list-style-type: none"> <li>Regularly grade unsealed roads</li> <li>Fill in potholes on sealed access roads and hardstand areas</li> </ul> </li> <li>Marshalling and queuing of trucks and worksite vehicles to occur away from residential areas and other sensitive receptors, where possible</li> <li>Where practicable, night time construction traffic would be redirected away from noise sensitive receptors.</li> <li>The speed of construction traffic restricted to the sign posted speed limit and maintained near noise sensitive receptors.</li> </ul> |

## 7.3 Residual impact mitigation

Across all construction activities assessed against the construction noise criteria specified in CoP Vol 2:

- 55 per cent of exceedances of the upper standard hours noise limit are within 10 dB(A) of the limit
- 60 per cent of exceedances of the evening non-standard hours noise limit are within 10 dB(A) of the limit.

Of the construction noise mitigation measures identified in Section 7.2, those which can be quantified can be expected to provide between 4 and 11 dB(A) of attenuation.

Exceedances that are greater than 10 dB(A) may not be fully mitigated to below the applicable noise criteria through the application of physical attenuation alone. In some circumstances residual noise impacts may still be experienced after all reasonable and practicable mitigation measures have been applied. Where such residual impacts are experienced, further administrative controls or architectural treatments may be considered in consultation with the affected occupant. Administrative controls may include periods of respite incorporated into the construction schedule or temporary relocation of affected occupants.

Respite involves scheduling work periods when people are least affected, such as by:

- Scheduling work for when premises are not in operation
- Restricting the works to occur within standard hours as defined by CoP Vol 2
- Restricting the number of nights per week that works are undertaken near sensitive receptors.

Respite is the preferred method of mitigating residual exceedances, in accordance with the CoP Vol 2.

Temporary relocation involves the relocation of affected occupants for short periods of time where all other reasonable and practicable measures, including respite periods, are proven ineffective and further mitigation is impractical. Examples of temporary relocation may involve the offer of alternative accommodation for the duration of impact.

Architectural treatments may involve the provision of alternative ventilation where the windows are to remain closed. However, the performance of the building envelope may be limited by specific elements (for example, windows and doors) and architectural treatments would primarily focus on those elements.

Residual impacts are reduced for construction activities as these are not permanent noise sources and will cease once nearby construction is complete.

## 7.4 Monitoring of noise and vibration

A program of noise and vibration monitoring will be undertaken within six months of the commencement of railway operation on the Project. The purpose of the monitoring surveys will be to:

- Quantify the rail noise and vibration levels from the daytime and night-time rail operations and determine the  $L_{Aeq(15 \text{ hour})}$  daytime,  $L_{Aeq(9 \text{ hour})}$  night-time and  $L_{Amax}$  rail noise levels at the most affected sensitive receptors
- Assess the Project's compliance with the adopted operational noise and vibration criteria
- Provide an assessment of the effectiveness of any noise and vibration management and mitigation measures implemented on the Project
- Identify, if required, further noise and vibration mitigation measures to meet the adopted operation noise and vibration criteria.

The following recommendations have been developed to assist the preparation of a noise and vibration monitoring plan for monitoring during operation:

- Provide a monitoring strategy consistent with the requirements of relevant acoustic standards and guidelines for monitoring environmental and transport noise and vibration

- Plan and schedule the monitoring surveys with consideration to:
  - The rail movements during each daytime and night-time period. The survey period shall include the days during which the highest number of train movements would be expected.
  - At locations free from localised buildings and structures (other than noise barriers) that may screen or reflect noise
  - The condition of the rails and other rail infrastructure
  - Weather conditions during the monitoring periods
- Monitoring should be conducted at the sensitive receptors with the potential for the highest received noise and vibration levels from rail operations
- Where feasible, noise levels should be assessed 1 m in front of the most affected building façade. Where noise levels are monitored in the free-field a +2.5 dBA correction should be considered to adjust the free-field level for a noise level at the building façade.
- Should monitoring be required within a property, the noise monitoring would be conducted at the centre of the habitable room that is most exposed to noise from rail operations
- Vibration shall be monitored in the three axes representing horizontal, vertical and axial direction of displacement (movement). Vibration shall be monitored as the Peak Particle Velocity (mm/s) and vibration acceleration ( $\text{m/s}^2$ ).
- If required, reference the monitored noise levels to update the predicted rail noise levels and re-assess rail noise and vibration levels at the sensitive receptors aligning the Project
- If the noise and/or vibration levels are above the applicable criteria at any sensitive receptors, allowing for any monitoring and compliance tolerances, the key sources of rail noise and contributing factors (e.g. rail defects, excessive rail roughness levels, turnouts, locomotive engine exhausts) shall be identified to inform the investigation of reasonable and practicable mitigation measures.

The results of the monitoring surveys are to be applied, as-required, to revise and update the rail noise and vibration predictions for the rail operations. In this regard, the validated noise and vibration levels can be applied to continually refine the conservatism and uncertainty in the predictions and support the selection of reasonable and practicable mitigation measures.



## 8 Cumulative impacts

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. This Section provides a discussion on the potential for cumulative impacts in relation to noise and vibration.

Once operational, it is expected that road components of the Project will be handed over to the asset manager for the adjoining road network. Therefore noise and vibration impacts that may arise from operation of the road network will not be managed by ARTC. For this reason, cumulative noise and vibration impacts that may arise from road operation has been excluded from this assessment.

### 8.1 Assessment methodology

The approach used to identify and assess potential construction phase cumulative impacts of the Project is as follows:

- A review of the potential impacts identified within the assessment. The environment at the time of the ToR is the baseline, prior impacts from past land use has not be considered.
- A preliminary list of projects for consideration in the cumulative impact assessment was collated with timelines to demonstrate the temporal relationship between projects. This preliminary list of projects was compiled through consideration of the following:
  - Projects subject to assessment under the EP Act or SDPWO Act, with an Initial Advice Statement published by DES or Department of State Development, Tourism and Innovation (DSDTI)
  - Projects listed in GRC and TRC development application databases
  - Development within Priority Development Areas and State Development Areas
  - Economic Development Queensland development projects
  - Community Infrastructure Designation projects
  - Projects within the public register of environmental authorities
  - DTMR infrastructure projects
  - Private infrastructure facilities
  - Development in accordance with Regional Planning Interests
  - The Inland Rail projects immediately adjacent to the Project, being the North Star to NSW/QLD Border and Gowrie to Helidon projects
- The preliminary list of projects was assessed to identify those that meet one of the following criteria:
  - Projects that have been approved but where construction has not commenced
  - Projects that have commenced construction subsequent to issuance of the ToR for the Project, but have potential for overlap in construction activities with the Border to Gowrie Project
  - Projects that have been completed subsequent to issuance of the ToR for the Project
  - Are operational developments that have future plans for expansion
- Projects that were excluded from further assessment were:
  - Existing projects, with no known plans for expansion. Such projects are typically considered part of the 'existing environment' and have been accounted for in the impact assessment of each specific matter.
  - Proposed projects that have not been developed to the point that details of their scale, size, location and core activities would be publicly available

- Where there is a potential overlap in impacts (either spatially or temporally), a cumulative impact assessment was undertaken to determine the nature of the cumulative impact. Where possible, the assessment method was quantitative in nature however qualitative assessment has also been undertaken.
- An assessment matrix method (refer to Section 8.2) has been used to determine the significance of cumulative impacts with respect to beneficial or detrimental effects
- Where cumulative impacts are deemed to be of 'medium' or 'high' significance, additional mitigation measures are proposed, beyond those already proposed by the relevant technical impact assessments.

## 8.2 Assessment matrix

The significance of construction phase cumulative impacts has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 8.1. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 8.2. For example, if an environmental value (such as noise) is considered to have a probability of impact of 2, duration of impact of 3, magnitude/intensity of impact of 1 and a sensitivity of receiving environment of 1 the significance of impact would be Medium ( $2+3+1+1 = 7$ ).

Table 8.1 Cumulative impact assessment matrix

| Aspect                               | Relevance factor |        |      |
|--------------------------------------|------------------|--------|------|
|                                      | Low              | Medium | High |
| Probability of impact                | 1                | 2      | 3    |
| Duration of impact                   | 1                | 2      | 3    |
| Magnitude/Intensity of impact        | 1                | 2      | 3    |
| Sensitivity of receiving environment | 1                | 2      | 3    |

Table 8.2 Cumulative impact significance consequence definitions

| Impact significance | Sum of relevant factors | Consequence                                                                                                                                                       |
|---------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low                 | 1-6                     | Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.                  |
| Medium              | 7-9                     | Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.              |
| High                | 10-12                   | Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate. |

## 8.3 Cumulative impact assessment

A total of 23 projects were initially identified as having potential to contribute to cumulative impacts in combination with the Border to Gowrie Project. These projects are either currently operational, expected to undergo future expansion or are currently going through an approval process.

For the purposes of noise and vibration, projects that directly interface the Border to Gowrie Project and will have temporal overlap in construction, expansion activities or commencement of operation are considered to have the potential to result in cumulative impacts. Only five of the initial 23 projects meet these criteria. These projects are listed in Table 8.3.

**Table 8.3 Projects considered for the cumulative impact assessment**

| Projects                                    | Location                                                                                                                                                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Construction dates                                                                                                                                                |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InterLinkSQ                                 | 13 km west of Toowoomba<br>The northern limit of the Project is situated adjacent to the InterLinkSQ site                                                                         | A 200 ha transport, logistics and business hub. Located on the narrow gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego and New England highways.                                                                                                                                                                                                                                                                                 | 2018 to unknown.<br>Assumed to continue development until Inland Rail is operational                                                                              |
| Commodore Mine and Millmerran Power Station | Domville, QLD<br>The Project is aligned adjacent to potential future coal reserves for the mine                                                                                   | The Commodore Mine is an open cut coal mine which provides coal for the 850 MW Millmerran Power Station.<br>The Millmerran Power Station is a coal-fired power station that supplies enough electricity to power approximately 1.1 million homes.                                                                                                                                                                                                                                | 2001 to 2003.<br>Subject to annual maintenance shutdown and continual pit expansion. Also potential for coal reserves to be accessed beyond the current footprint |
| North Star to NSW/QLD Border (Inland Rail)  | Rail alignment from North Star, NSW to the NSW/QLD border<br>Adjoins the Project at its southern limit                                                                            | New 37 km rail corridor to connect North Star (NSW) to the QR South West Rail Line just north of the NSW/QLD border.                                                                                                                                                                                                                                                                                                                                                             | 2021 to 2024                                                                                                                                                      |
| Gowrie to Helidon (Inland Rail)             | Rail alignment from Gowrie to Helidon, QLD<br>Adjoins the Project at its northern limit                                                                                           | New 26 km dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba), extending through the LGAs of Toowoomba and Lockyer Valley. The project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.                                                                                                                                                                                            | 2021 to 2025                                                                                                                                                      |
| Asterion Medicinal Cannabis Facility        | Wellcamp, QLD<br>Located adjacent the eastern construction footprint boundary of the Project. The facility will be located between the Project and the Toowoomba Wellcamp Airport | A high-tech medicinal cannabis cultivation, research and manufacturing facility. The project involves construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products, including single patient packs, cannabis oils, gels, salts and related products, destined solely for the medicinal market. The facility will be powered by renewable energy. | 2020 to 2021                                                                                                                                                      |

Cumulative noise and vibration impacts may be in the form of increased noise and vibration levels at sensitive receptors during construction or cooperation of the Project.

An assessment of cumulative impacts that may arise from the above-mentioned projects in combination with the Project is presented in Table 8.4, with a summary of how potential cumulative impacts would be managed. Quantitatively combining the predicted noise levels with impacts from other projects would overstate the impacts of the Project. Therefore, the noise levels due to cumulative impacts that may arise from adjoining projects have been assessed qualitatively.

This assessment has concluded that the construction phase cumulative noise and vibration impacts of the Project are expected to be of **Medium Significance** and operational road cumulative noise and vibration impacts are expected to be of **Low Significance**. The following factors contributed to this determination:

- Simultaneous noise from construction works of adjoining projects has the potential to increase noise levels at nearby noise sensitive receivers also impacted by construction noise associated with the Project. However, the modelling approach adopted for the impact assessment methodology includes simulation of simultaneous construction works, by assuming that as a worst-case, all activities could occur at any time within a defined area, including up to the limit of the Project footprint. The noise levels due to cumulative impacts are not expected to significantly increase above the levels predicted for the Project in isolation.

- The construction methodology will be developed and refined with the aim of achieving compliance with construction noise and vibration performance criteria as specified in the Outline EMP (EIS Chapter 22: Outline environmental management plan)
- Mitigations for operational road noise and vibration will be implemented to achieve compliance with operational noise and vibration performance criteria as specified in CoP Vol 1. The type of mitigations and their location will be confirmed based on assessment of the Project detail design.

The Project alignment will, in places, intersect and be alongside the existing road network and the future new and upgraded roads proposed with the Project. Concern has been raised regarding the potential for road traffic and railway operations to result in cumulative noise impacts.

The subjective response to the different noise levels and noise characteristics of the intermittent sources of road traffic and railway noise are such that individuals are less likely to perceive or determine impacts based on a cumulative exposure of the combined transport noise. Consequently, the ToR requires road traffic and noise and railway noise to be assessed, and if necessary mitigated, separately. Whilst the policies and guidelines referenced by the ToR do not specify criteria or management objectives for combined road and railway transport noise, an overview assessment of potential cumulative transport noise has been undertaken to inform the EIS.

Based on the predicted existing road traffic noise levels and the assessed road traffic and railway noise with the Project the overview assessment determined:

- In general terms, cumulative transport noise levels would generally be expected only where road traffic or railway noise is within 10 dBA of each other (where the same noise metric and timeframes are applied to quantify both sources of transport noise)
- The majority of the new and upgraded roads with the Project are adjacent to or intersect with the Project alignment. Consequently, at the nearest sensitive receptors to the local road networks, the predicted road traffic and railway noise levels are typically within 10 dBA of each other. The future noise environment could therefore be influenced by the cumulative noise from both sources of transport noise.
- Any increase in the overall daily transport noise at sensitive receptors in proximity to both the local road traffic and the Project's rail alignment would be a marginal perceptible increase of not more than 3 dBA. Because road traffic and railway noise are perceived differently there may not be an increased potential for noise related impacts where there is a cumulative increase in transport noise levels.
- The road and railway traffic will not be continuous and there will be periods throughout the daytime and night-time where there could be minimal or no transport noise
- Specific measures to manage or mitigate cumulative transport noise are not required in areas where the Project's rail alignment crosses, or is adjacent to, the future local road network. Any specific mitigations implemented to control railway noise at road-rail interfaces would be expected to also assist in reducing and controlling perceived cumulative noise impacts.

Operational road traffic noise impacts will be iteratively re-assessed during the detail design process, in accordance with CoP Vol 1, to confirm the receptors at which noise criteria may be exceeded.

Where CoP Vol 1 criteria may be exceeded at a sensitive receptor, the following potential mitigation measures for both upgraded and new road sections will be investigated for effectiveness and incorporated into the detail design, as appropriate:

- A noise barrier in the form of a landscaped earth mound and/or a noise fence
- Pavement surface treatment
- Provision of acoustic façade treatments to affected sensitive receptors.

A combination of mitigation measures may be appropriate.

**Table 8.4 Cumulative impact assessment for construction and operational road noise**

| Project                              | Potential cumulative impact                                                    | Impact characteristic                    | Relevance factor | Sum of relevance factors | Impact significance | Comments and management measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------|--------------------------------------------------------------------------------|------------------------------------------|------------------|--------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InterLinkSQ                          | Increased noise and vibration levels at sensitive receptors - construction     | Probability of the impact                | Medium (2)       | 7                        | Medium              | <p>The potential for cumulative impacts from noise and vibration during construction will be managed through:</p> <ul style="list-style-type: none"> <li>Development and implementation of a Noise and Vibration Management Sub-plan, as a component of the CEMP for the Project.</li> <li>Consultation with InterLinkSQ regarding scheduling of construction activities to avoid simultaneous undertaking of noisy construction activities, e.g. piling.</li> <li>Consultation with sensitive receptors within the extent of impact from noise and vibration generated by construction activities for the Project to agree appropriate mitigation measures.</li> </ul> |
|                                      |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Magnitude/intensity of the impact        | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      | Increased noise and vibration levels at sensitive receptors – operational road | Probability of the impact                | Low (1)          | 5                        | Low                 | <p>The potential for cumulative impacts from noise and vibration is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the implementation of design measures to ensure compliance with performance criteria in CoP Vol 1.</p>                                                                                                                                                                                                                                                                  |
|                                      |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Asterion Medicinal Cannabis Facility | Increased noise and vibration levels at sensitive receptors - construction     | Probability of the impact                | Medium (2)       | 6                        | Low                 | <p>The potential for cumulative impacts from noise and vibration during construction is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Noise and Vibration Management Sub-plan, as a component of the CEMP for the Project.</p> <p>ARTC will consult with Asterion regarding scheduling of construction activities to avoid the simultaneous undertaking of activities that generate loud noises, where possible.</p>                              |
|                                      |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      | Increased noise and vibration levels at sensitive receptors – operational road | Probability of the impact                | Low (1)          | 5                        | Low                 | <p>The potential for cumulative impacts from noise and vibration is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the implementation of design measures to ensure compliance with performance criteria in CoP Vol 1.</p>                                                                                                                                                                                                                                                                  |
|                                      |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                      |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Project                                     | Potential cumulative impact                                                    | Impact characteristic                    | Relevance factor | Sum of relevance factors | Impact significance | Comments and management measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------|------------------|--------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commodore Mine and Millmerran Power Station | Increased noise and vibration levels at sensitive receptors - construction     | Duration of the impact                   | Medium (2)       | 6                        | Low                 | <p>The potential for cumulative impacts from noise and vibration during construction is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Noise and Vibration Management Sub-plan, as a component of the CEMP for the Project.</p> <p>ARTC will consult with Intergeren regarding scheduling of construction activities to avoid the simultaneous undertaking of activities that generate loud noises, where possible.</p>                                                                                               |
|                                             |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Sensitivity of the receiving environment | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             | Increased noise and vibration levels at sensitive receptors – operational road | Probability of the impact                | Low (1)          | 5                        | Low                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| North Star to NSW/QLD Border (Inland Rail)  | Increased noise and vibration levels at sensitive receptors - construction     | Probability of the impact                | Medium (2)       | 8                        | Medium              | <p>The potential for cumulative impacts from noise and vibration during construction will be managed through:</p> <ul style="list-style-type: none"><li>Development and implementation of a Noise and Vibration Management Sub-plan, as a component of the CEMP for the Project.</li><li>ARTC will facilitate discussions between Principal Contractors on adjoining Inland Rail sections regarding the scheduling of construction activities to avoid simultaneous undertaking of noisy construction activities, e.g. piling.</li><li>Consultation with sensitive receptors within the extent of impact from noise and vibration generated by construction activities for the Project to agree appropriate mitigation measures.</li></ul> |
|                                             |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Magnitude/intensity of the impact        | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Sensitivity of the receiving environment | High (3)         |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             | Increased noise and vibration levels at sensitive receptors – operational road | Probability of the impact                | Low (1)          | 6                        | Low                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                             |                                                                                | Sensitivity of the receiving environment | High (3)         |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



| Project                         | Potential cumulative impact                                                    | Impact characteristic                    | Relevance factor | Sum of relevance factors | Impact significance | Comments and management measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|--------------------------------------------------------------------------------|------------------------------------------|------------------|--------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gowrie to Helidon (Inland Rail) | Increased noise and vibration levels at sensitive receptors - construction     | Probability of the impact                | Medium (2)       | 7                        | Medium              | <p>The potential for cumulative impacts from noise and vibration during construction will be managed through:</p> <ul style="list-style-type: none"> <li>Development and implementation of a Noise and Vibration Management Sub-plan, as a component of the CEMP for the Project.</li> <li>ARTC will facilitate discussions between Principal Contractors on adjoining Inland Rail sections regarding the scheduling of construction activities to avoid simultaneous undertaking of noisy construction activities, e.g. piling.</li> <li>Consultation with sensitive receptors within the extent of impact from noise and vibration generated by construction activities for the Project to agree appropriate mitigation measures.</li> </ul> |
|                                 |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                 |                                                                                | Magnitude/intensity of the impact        | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                 |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                 | Increased noise and vibration levels at sensitive receptors – operational road | Probability of the impact                | Low (1)          | 5                        | Low                 | <p>The potential for cumulative impacts from noise and vibration is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the implementation of design measures to ensure compliance with performance criteria in CoP Vol 1.</p>                                                                                                                                                                                                                                                                                                                                         |
|                                 |                                                                                | Duration of the impact                   | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                 |                                                                                | Magnitude/intensity of the impact        | Low (1)          |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                 |                                                                                | Sensitivity of the receiving environment | Medium (2)       |                          |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Table notes:**

Relevance factors between 1 and 3 were determined using professional judgement to select most appropriate relevance factor for each aspect and summing the relevance factors.

Sum of relevant factors definition:

- Low (1-6): Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
- Medium (7-9): Mitigation measure likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
- High (10-12): Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate

## 9 Conclusion

### 9.1 Construction noise and vibration

A construction noise impact assessment has been carried out in accordance with the CoP Vol 2 and the ToR. Reasonable worst-case construction scenarios have been assessed for each of the main construction activities.

The assessment of noise associated with the construction of the Project indicates a high number of exceedances against both the lower and upper external noise limits within the impact assessment area. The magnitude and number of exceedances of the CoP Vol 2 construction noise criteria are detailed in Section 5.4.

The 'earthworks' and 'rail civil works' construction stages are predicted to have the greatest impact from construction noise, however, other construction stages may have greater overall impact depending on actual timing and duration of each construction stage.

Construction traffic noise is predicted to exceed the adopted criteria for 44 different roads within the impact assessment area across the full construction period, with a maximum predicted increase of 22 dB(A). The 44 roads on which the predicted increase in noise level is greater than the 3.0 dB(A) criterion are primarily in rural locations and the existing base traffic volumes quantities are insignificant. As such the initial airborne road traffic noise levels are low before the addition of construction traffic and the criteria for these roads is stringent.

Vibration-intensive work is likely to be undertaken at times as part of the construction works. This may include the use of piling rigs and vibratory rolling activities. Minimum working distances for vibration intensive construction work have been predicted for human comfort and structural damage limits. The potential for exceedances of the construction vibration criteria adopted from CoP Vol 2 have been predicted at several sensitive receptors. The primary form of mitigation of vibration would be ensuring vibration intensive works do not occur within the minimum working distances. If vibration intensive works are planned within the minimum working distances identified, alternative equipment would be identified or rescheduling of works would occur (i.e. to occur during the day), and vibration monitoring would be implemented. Further mitigation of vibration would not be required where the minimum working distances are adhered to.

Significant volumes of non-rippable rock are anticipated within some of the cuttings along the rail corridor, particularly in the northern part of the Project alignment. The extent to which drilling and blasting will be required will be confirmed through further geotechnical investigation. Maximum charge mass amounts based on indicative setback distances of sensitive structures and heritage buildings have been identified. A detailed blasting assessment will be completed once blasting locations have been finalised through detail design.

Measures have been proposed to mitigate construction noise impacts upon nearby sensitive receptors. The final number, degree and nature of these measures would be selected by the Principal Contractor and be largely dependent on the construction strategy and work carried out. Specific noise management and mitigation measures will be detailed in the Principal Contractor's Noise and Vibration Management Sub-plan, as a component of the CEMP. The management and mitigation measures which will be considered in the plan include:

- Effective community consultation
- Training of construction site workers
- Use of temporary noise barriers
- Monitoring
- Appropriate selection and maintenance of equipment
- Scheduling of work for less sensitive time periods



- Situating plant in less noise sensitive locations
- Construction traffic management
- Respite periods.

## 9.2 Operational road traffic noise

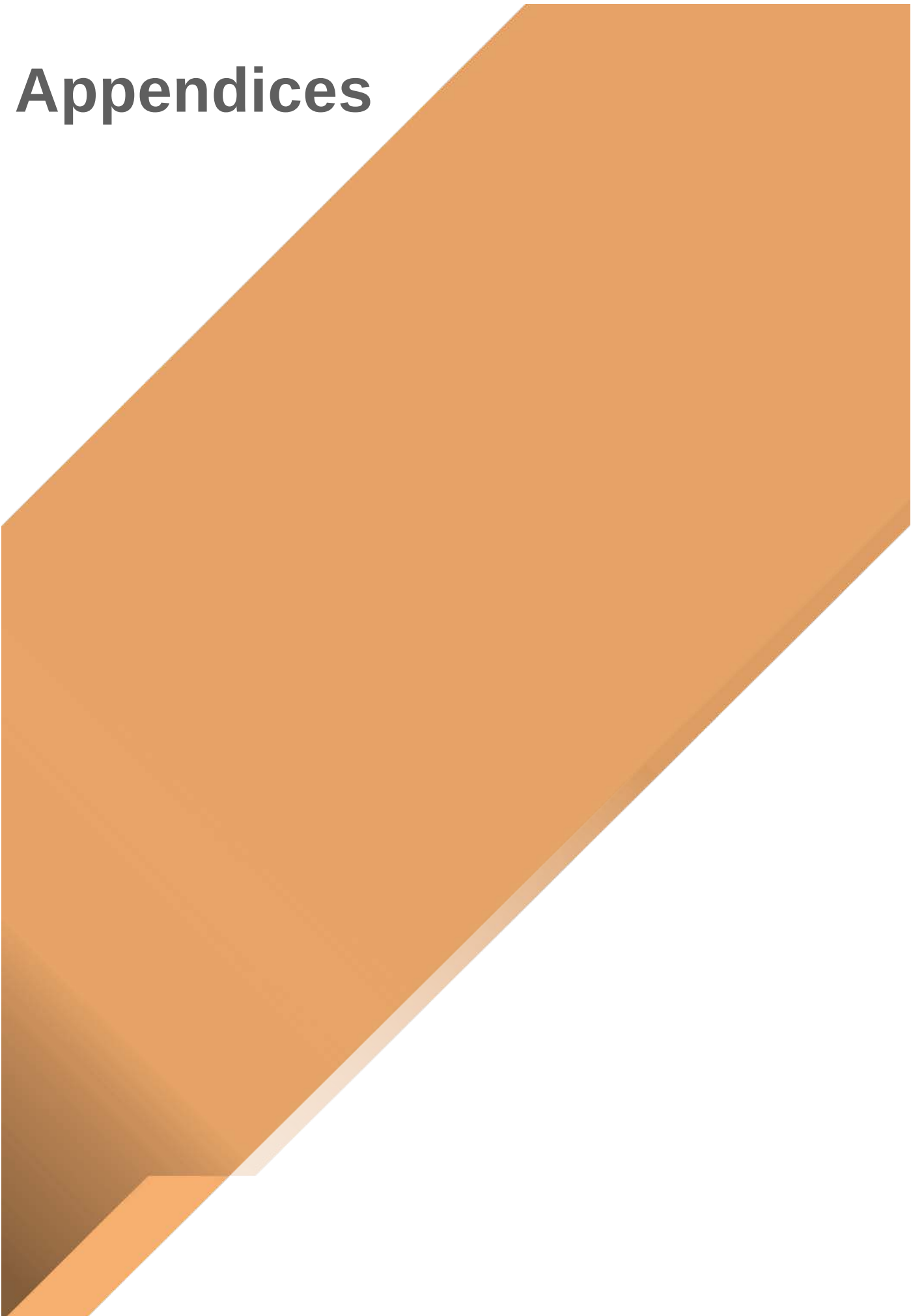
A desktop assessment of 35 new road sections and 46 upgraded road sections was undertaken to predict the potential noise impacts associated with each road alteration. These roads were assessed against relevant criteria from the CoP Vol 1. The desktop assessment considered the increase in traffic flows and relative distance to the nearest sensitive receptors for each road. Influence from other dominant noise sources has not been considered.

Operational noise from four new road sections and three upgraded road sections are predicted to exceed the relevant criteria at one or more sensitive receptors. Details of the results are given in Section 6.1 and mitigation measures are recommended in Section 7. Operational road traffic noise impacts will be iteratively re-assessed during the detail design process, in accordance with CoP Vol 1, to confirm the receptors at which noise criteria may be exceeded. Where criteria are expected to be exceeded, location specific mitigation measures will be incorporated into the detail design, where possible.

## 10 References

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# Appendices



# APPENDIX

# S

## Construction Noise and Vibration and Operational Road Traffic Noise Technical Report

### **Appendix A** Project Overview

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

# Appendix A

## Project overview





# INLAND RAIL = ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- North Star to NSW/QLD border alignment
- Minor roads
- Watercourse
- NSW/QLD border
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material.

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Author: FFJV GIS

Data Sources: FFJV

Paper: A4

Scale: 1:100,000





# INLAND RAIL = ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- NSW/QLD border
- Elevation contours (mAHD)
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Water infrastructure
- Waste water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material.

ARTC will not be responsible for any loss or damage suffered as a result of any person whatsoever placing reliance upon the information contained within this GIS map.

Date: 07/05/2020  
 Author: FFJV GIS  
 Data Sources: FFJV

Paper: A4  
 Scale: 1:100,000





# INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Water infrastructure
- Waste water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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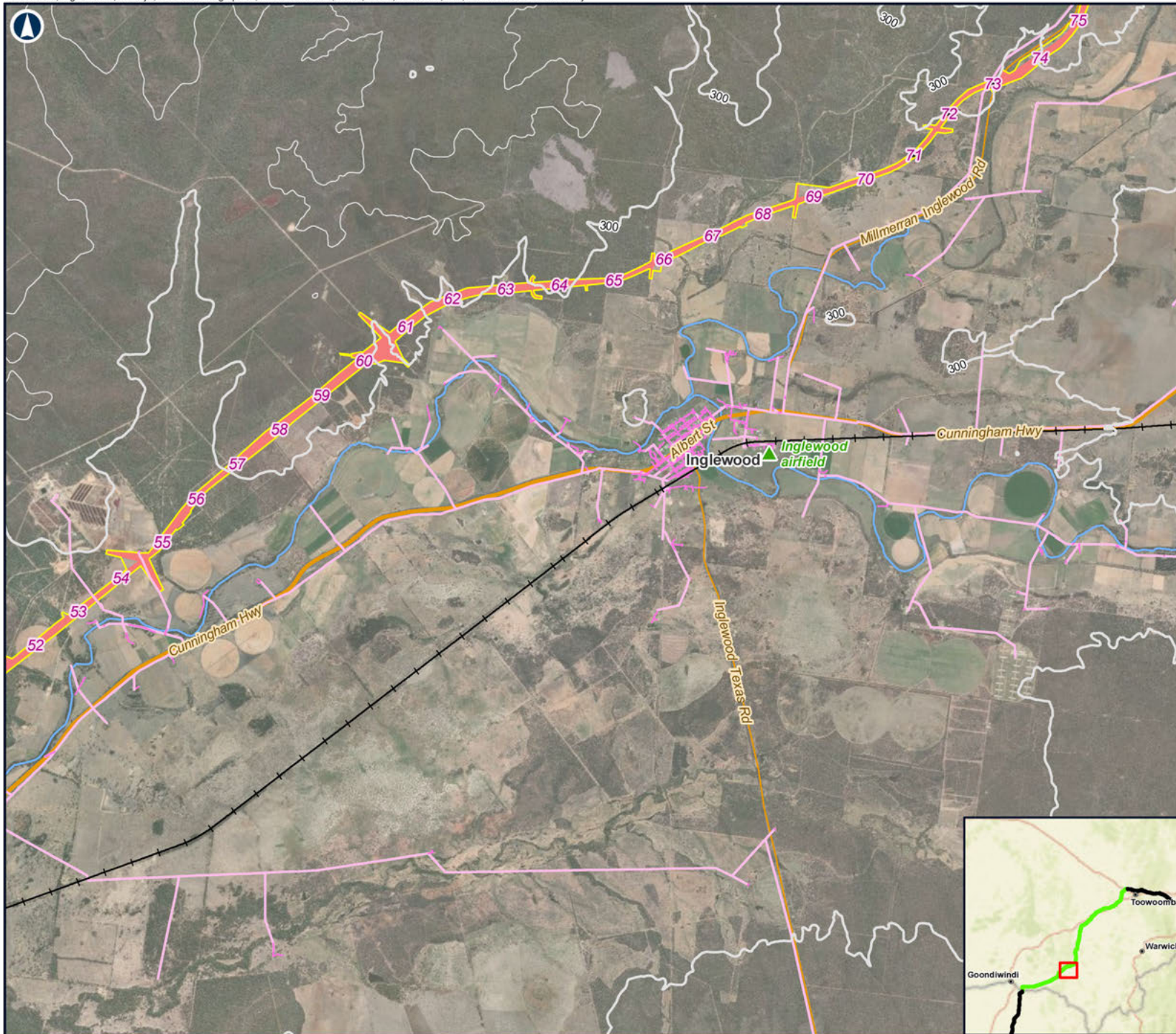
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Author: FFJV GIS  
Data Sources: FFJV

Paper: A4  
Scale: 1:100,000







# INLAND RAIL = ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- ▲ Airports/airfields
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

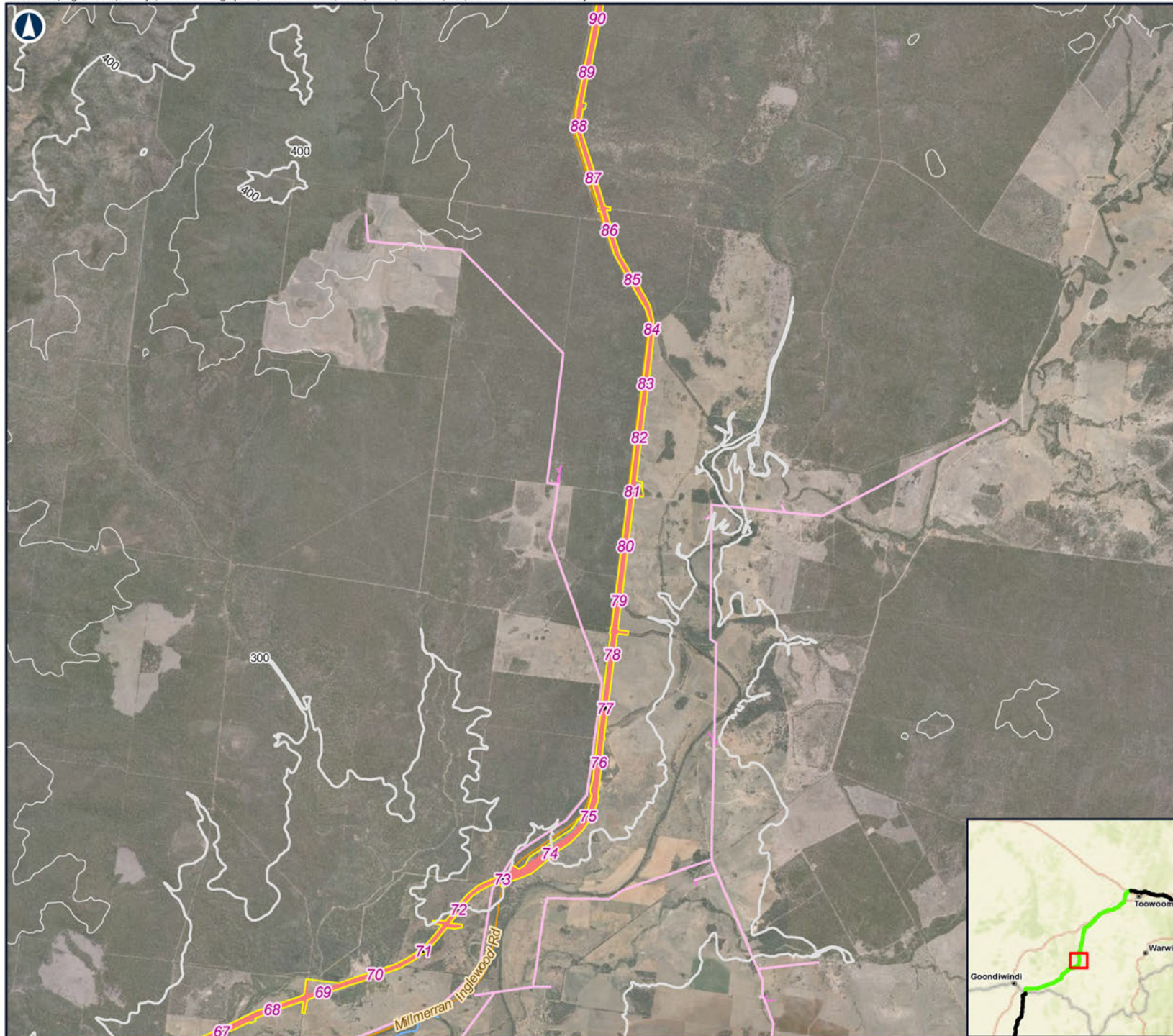
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 Scale: 1:100,000





# INLAND RAIL ARTC

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## BORDER TO GOWRIE

### Local context

### LEGEND

- 5 Chainage (km)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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Date: 07/05/2020

Author: FFJV GIS

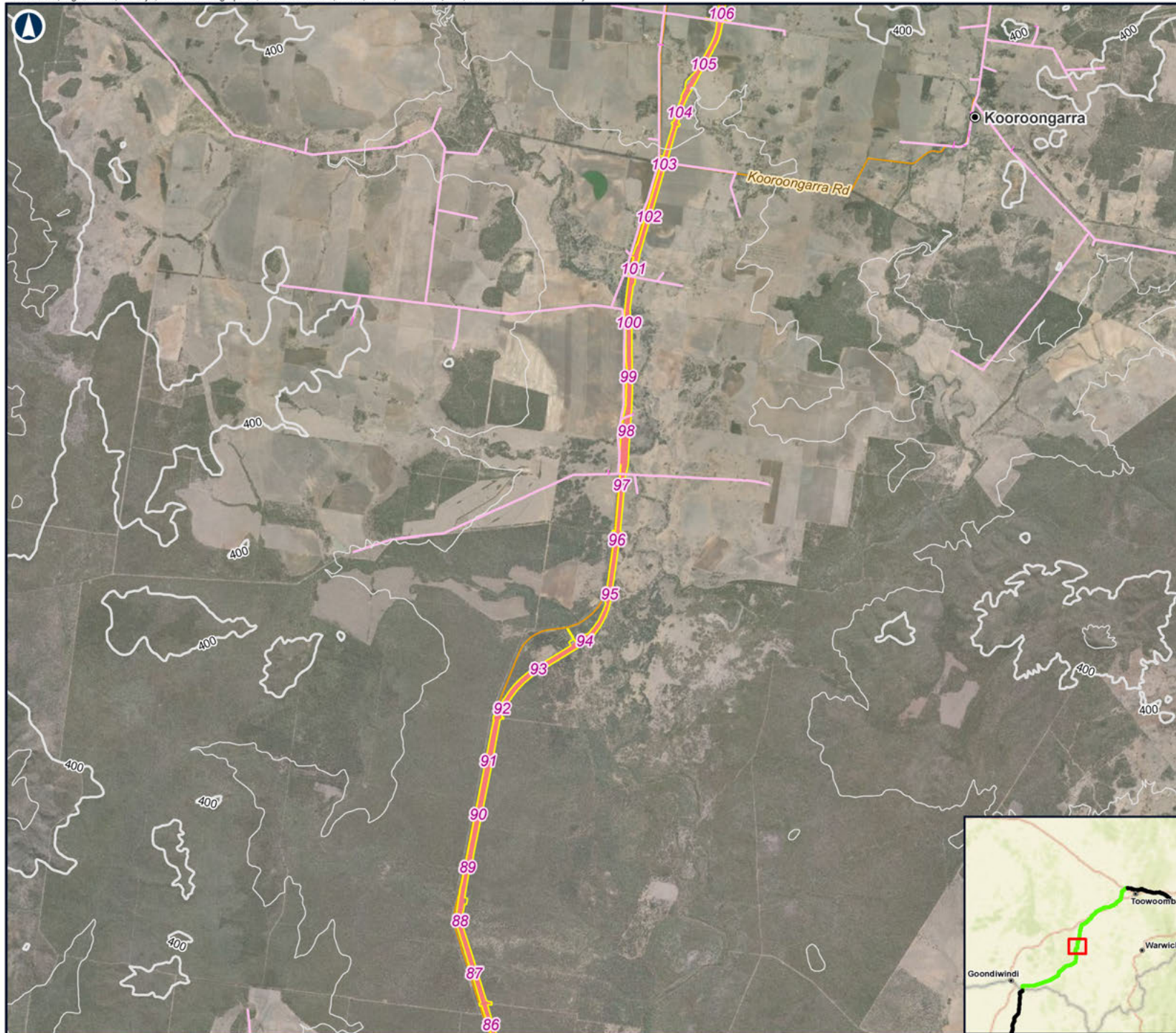
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Paper: A4

Scale: 1:100,000







# INLAND RAIL = ARTC

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## BORDER TO GOWRIE

### Local context

### LEGEND

- 5 Chainage (km)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Minor roads
- Elevation contours (mAHD)
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

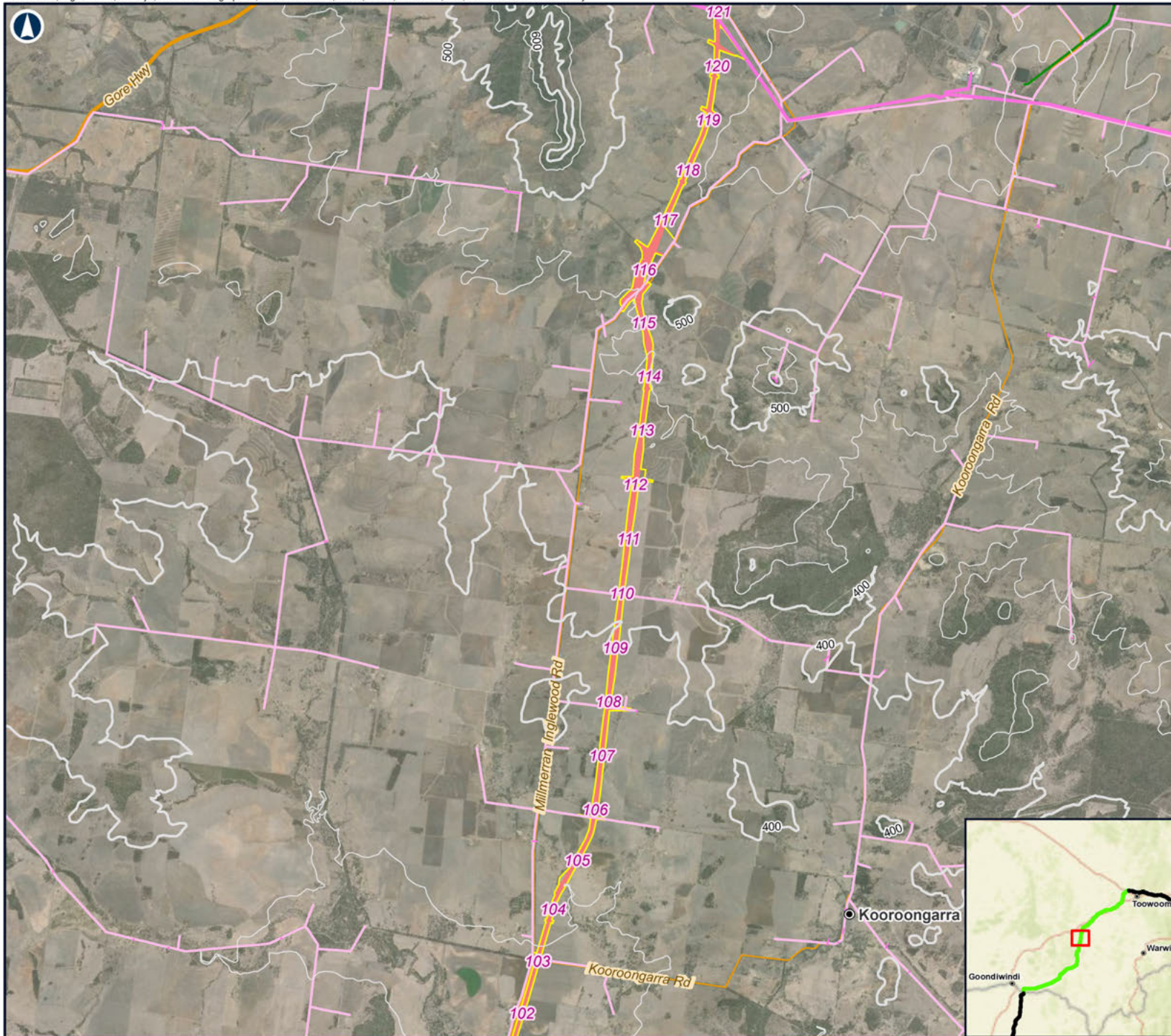
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## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Recycled water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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Author: FFJV GIS

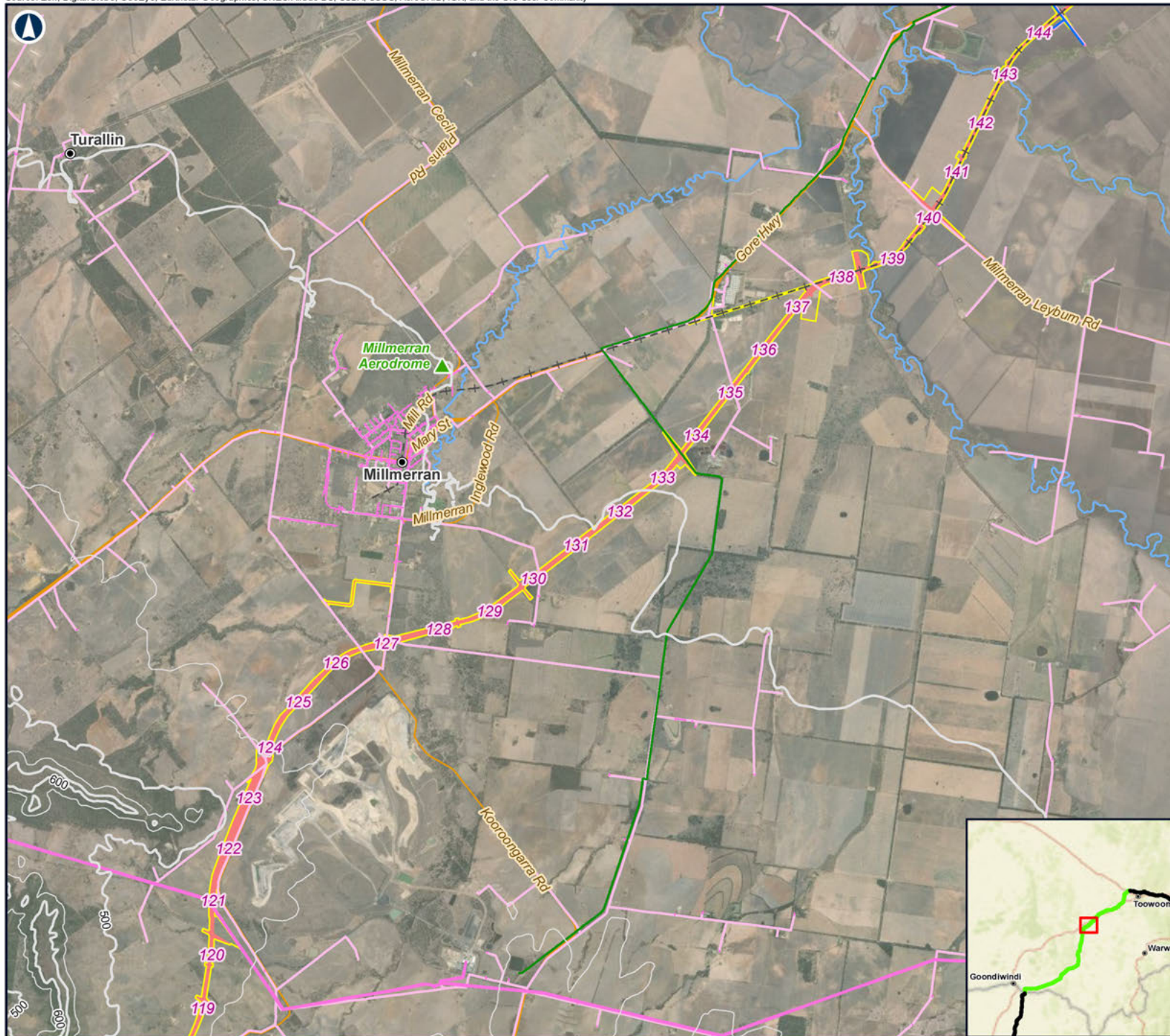
Data Sources: FFJV

Paper: A4

Scale: 1:100,000







# INLAND RAIL = ARTC

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## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- ▲ Airports/airfields
- + - Existing rail (non-operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Water infrastructure
- Recycled water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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Date: 07/05/2020

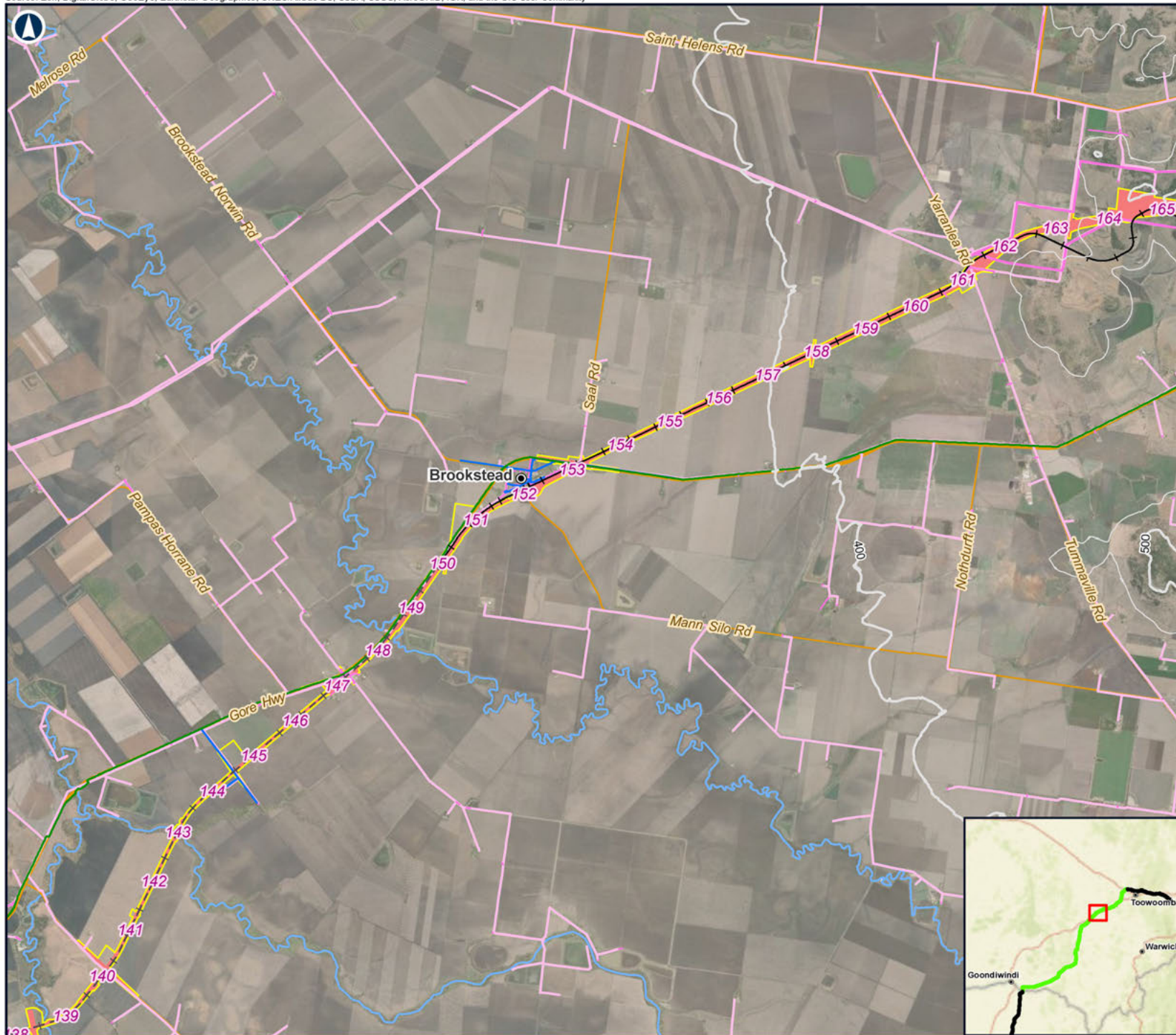
Author: FFJV GIS

Data Sources: FFJV

Paper: A4

Scale: 1:100,000





# INLAND RAIL = ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- Existing rail (operational)
- - - Existing rail (non-operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Water infrastructure
- Recycled water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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Date: 07/05/2020

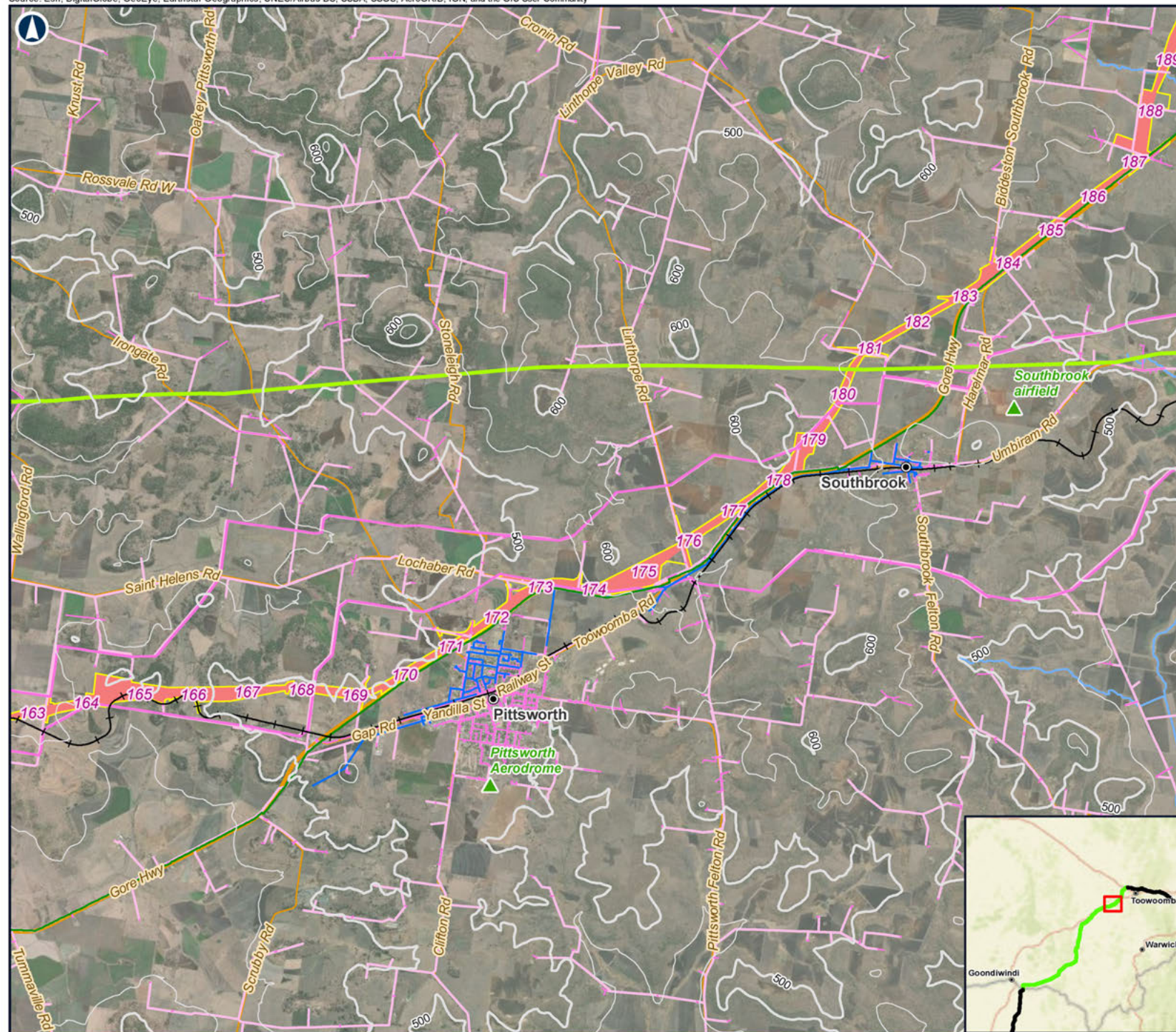
Paper: A4

Author: FFJV GIS

Scale: 1:100,000

Data Sources: FFJV





# INLAND RAIL = ARTC

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## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- ▲ Airports/airfields
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Santos Moonie-Brisbane oil pipeline
- Water infrastructure
- Recycled water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

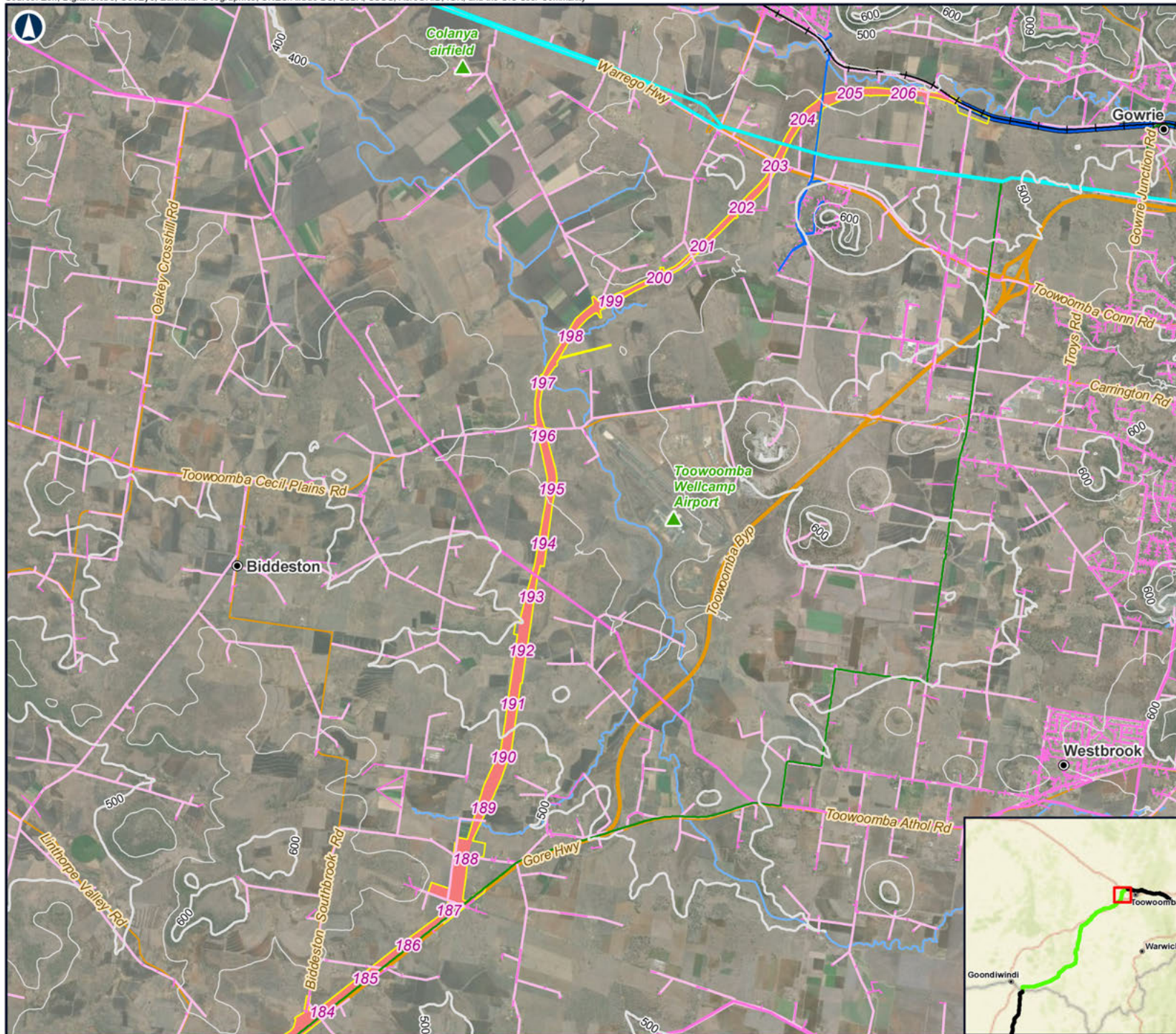
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Author: FFJV GIS  
Data Sources: FFJV

Paper: A4  
Scale: 1:100,000





# INLAND RAIL = ARTC

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## BORDER TO GOWRIE Local context

### LEGEND

- 5 Chainage (km)
- ▲ Airports/airfields
- Gowrie to Helidon alignment
- Existing rail (operational)
- Temporary disturbance footprint
- Permanent disturbance footprint
- Major roads
- Minor roads
- Watercourse
- Elevation contours (mAHD)
- National HV transmission infrastructure
- HV distribution infrastructure (>1,000V)
- LV distribution infrastructure (≤1,000V)
- Gas pipeline
- Gas infrastructure
- Santos Moonie-Brisbane oil pipeline
- Water infrastructure
- Recycled water infrastructure

Data per vendor/theme is displayed to the data supply extent - in some cases supply is pre-clipped proximal to the proposed rail alignment.

HV/LV definitions per Electricity Regulation 2006.

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 56

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Date: 07/05/2020

Author: FFJV GIS

Data Sources: FFJV

Paper: A4

Scale: 1:100,000



# APPENDIX

# S

## Construction Noise and Vibration and Operational Road Traffic Noise Technical Report

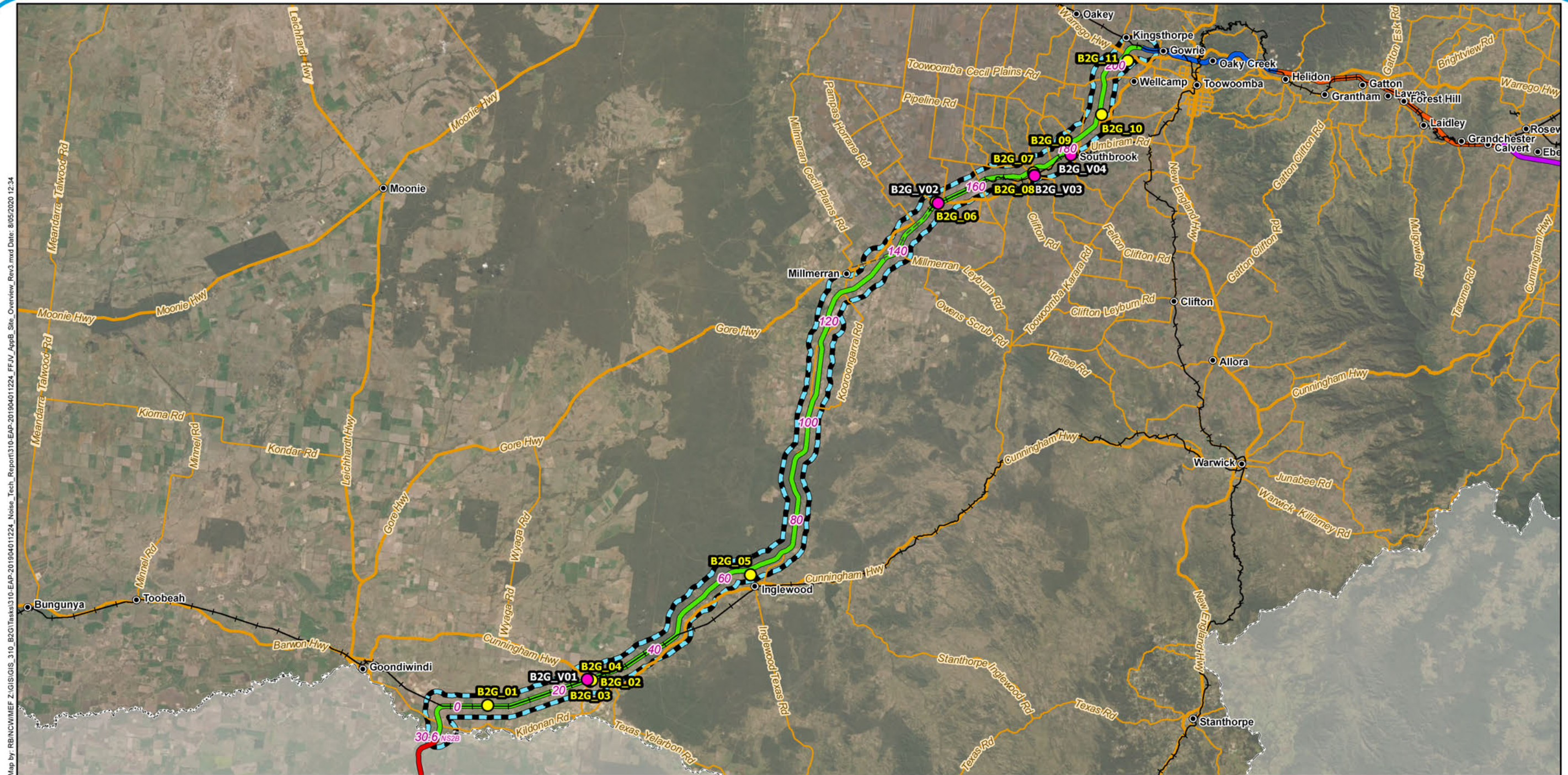
### **Appendix B** Site Overview

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

# Appendix B

## Site overview

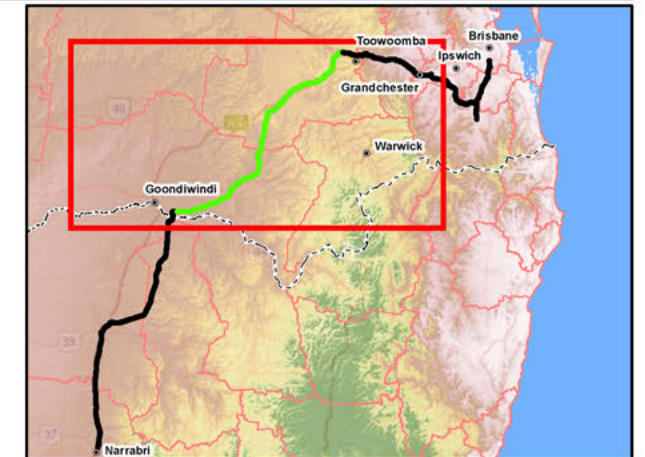




Map by: REINCMWMEF 2:IGISIGIS\_310\_B2GTask310-EAP-201904011224\_Noise\_Tech\_Report310-EAP-201904011224\_FFJV\_AppB\_Site\_Overview\_Rev3.mxd Date: 8/05/2020 12:34

#### Legend

- 5 Chainage (km)
- Localities
- North Star to NSW/QLD border alignment
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Helidon to Calvert alignment
- Calvert to Kagaru alignment
- Existing rail (operational)
- Existing rail (non-operational)
- NSW/QLD border
- Major roads
- Minor roads
- Noise and vibration impact assessment area
- Vibration monitoring locations
- Noise Loggers



A3 scale: 1:800,000  
0 6 12 18 24 30 km



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Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 3  
Coordinate System: GDA 1994 MGA Zone 56

**Border to Gowrie**  
**Appendix B: Site overview**



# APPENDIX

# S

## Construction Noise and Vibration and Operational Road Traffic Noise Technical Report

### **Appendix C** Noise and Vibration Sensitive Receptors

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

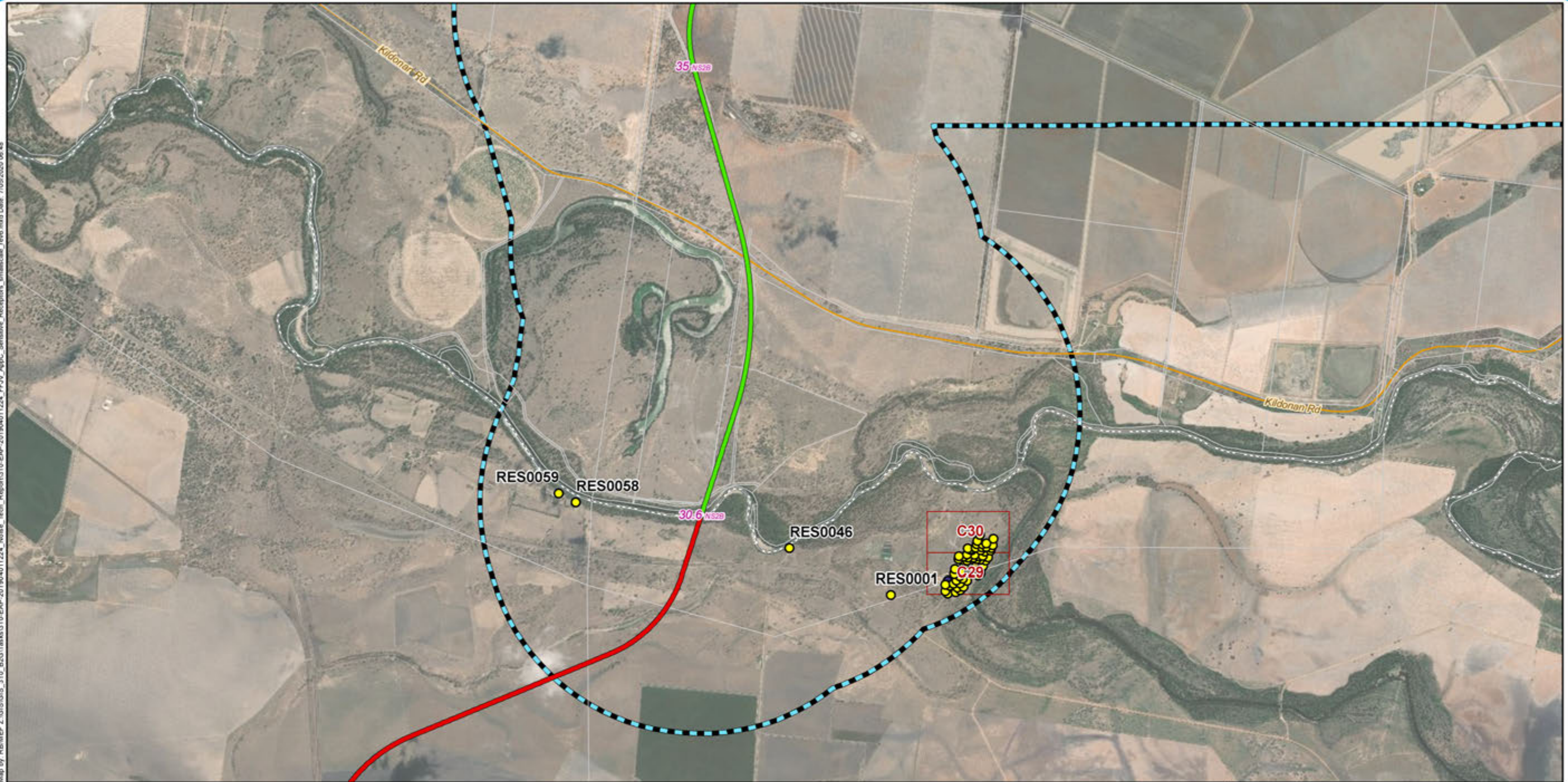
# Appendix C

## Noise and Vibration sensitive receptors

### Part 1 of 2



Map by: RB/MEF Z:GIS/GIS\_310\_B2G/Trunks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6 and Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- North Star to NSW/QLD border alignment
- Minor roads
- NSW/QLD border
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

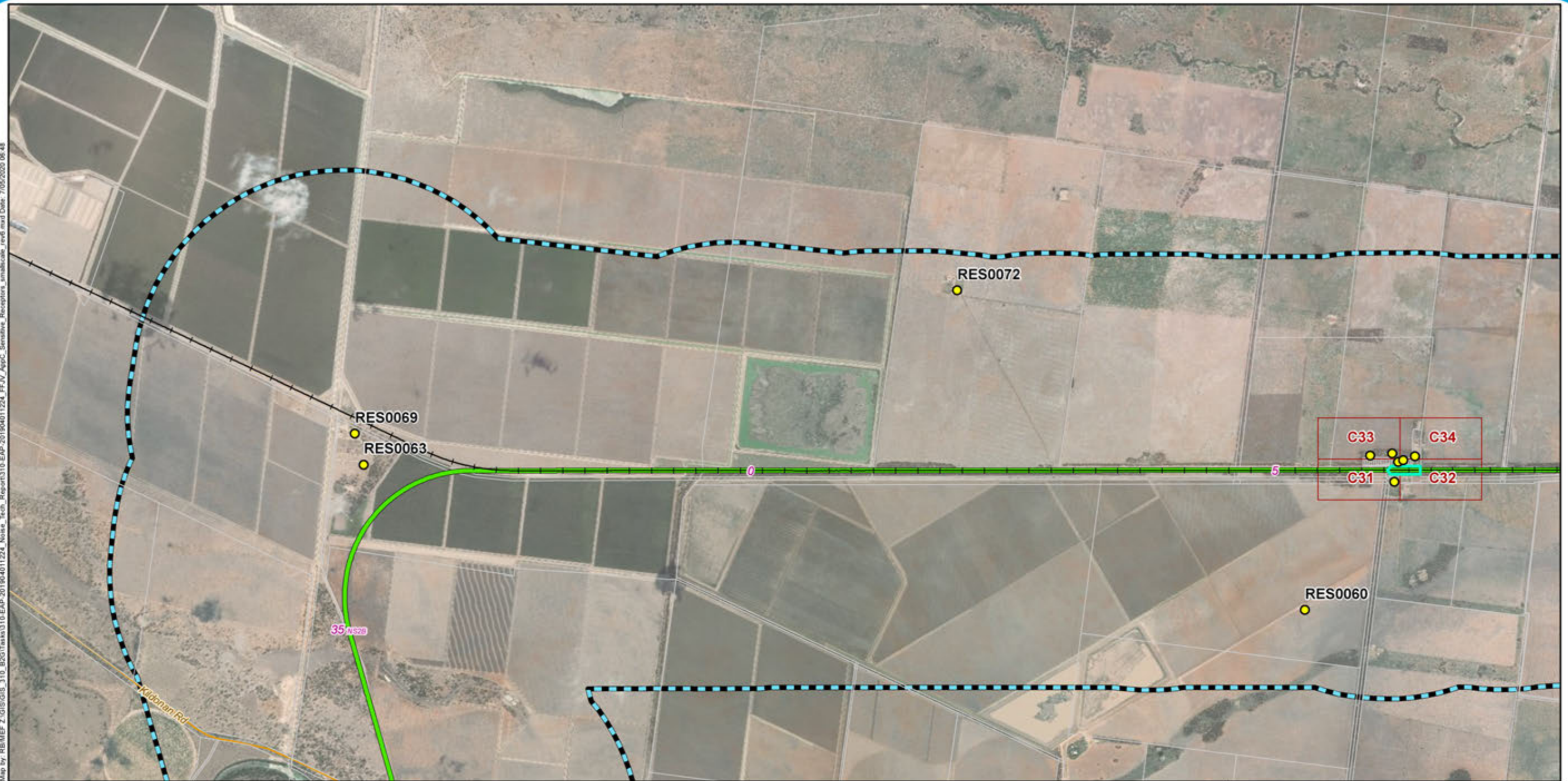
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:GIS/GIS\_310\_B2G/Tracks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 08:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Minor roads
- Cadastral
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by RBMEF Z:\GIS\310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

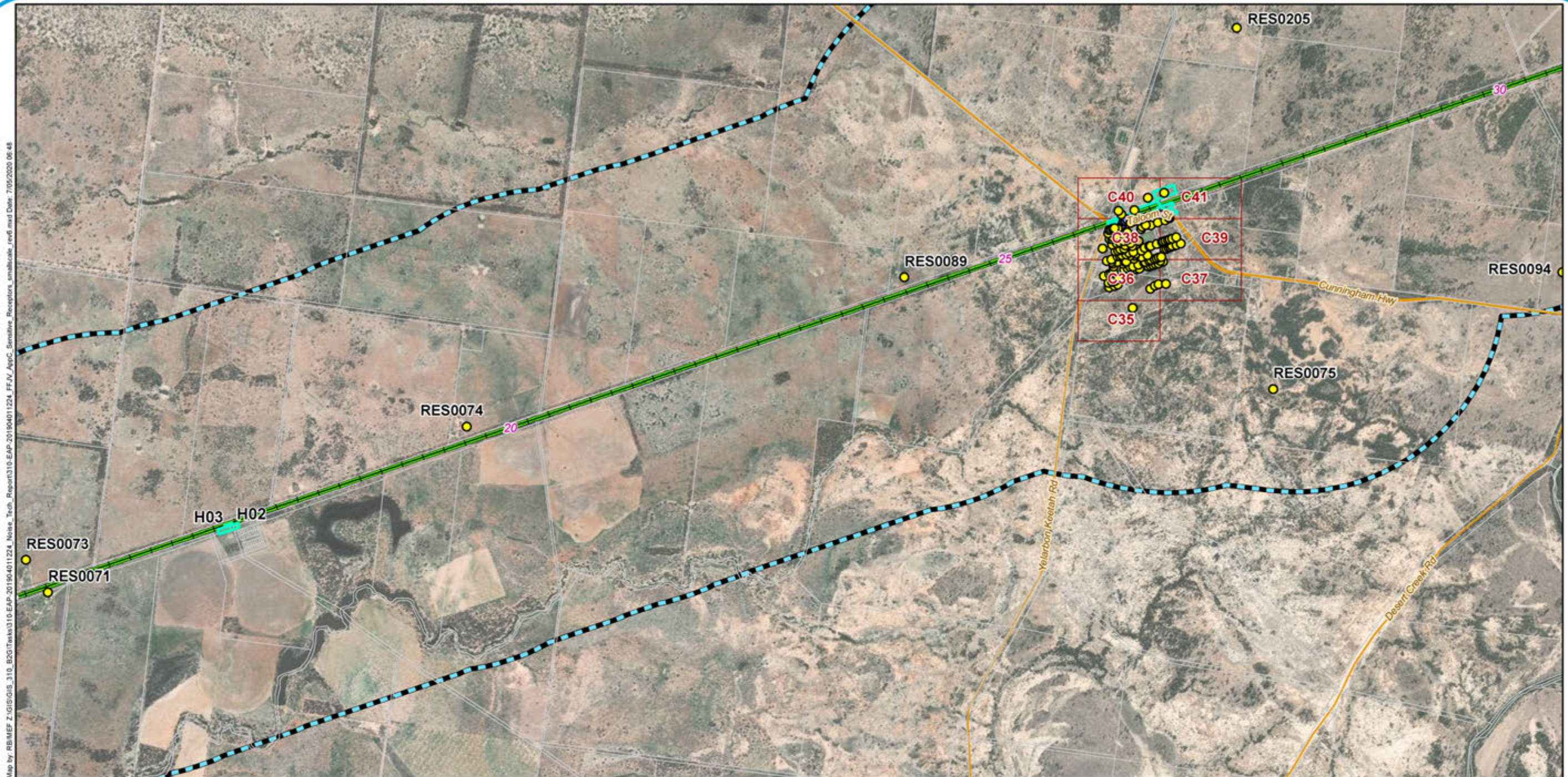
#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km





#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

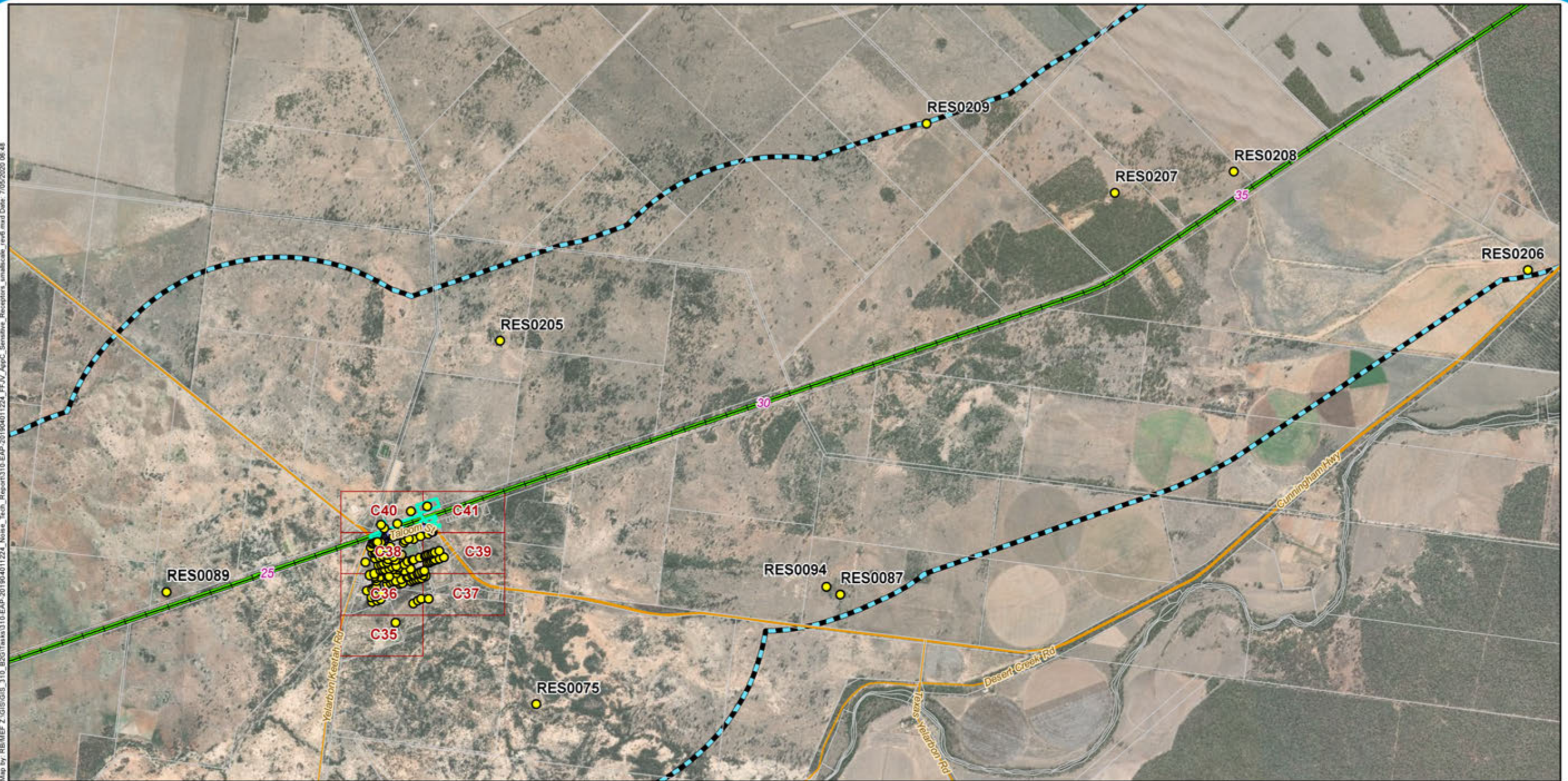
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
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- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5 km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:GIS/GIS\_310\_B2G/Tracks310-EAP-201904011224\_Noise\_Tech\_Report310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 08:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

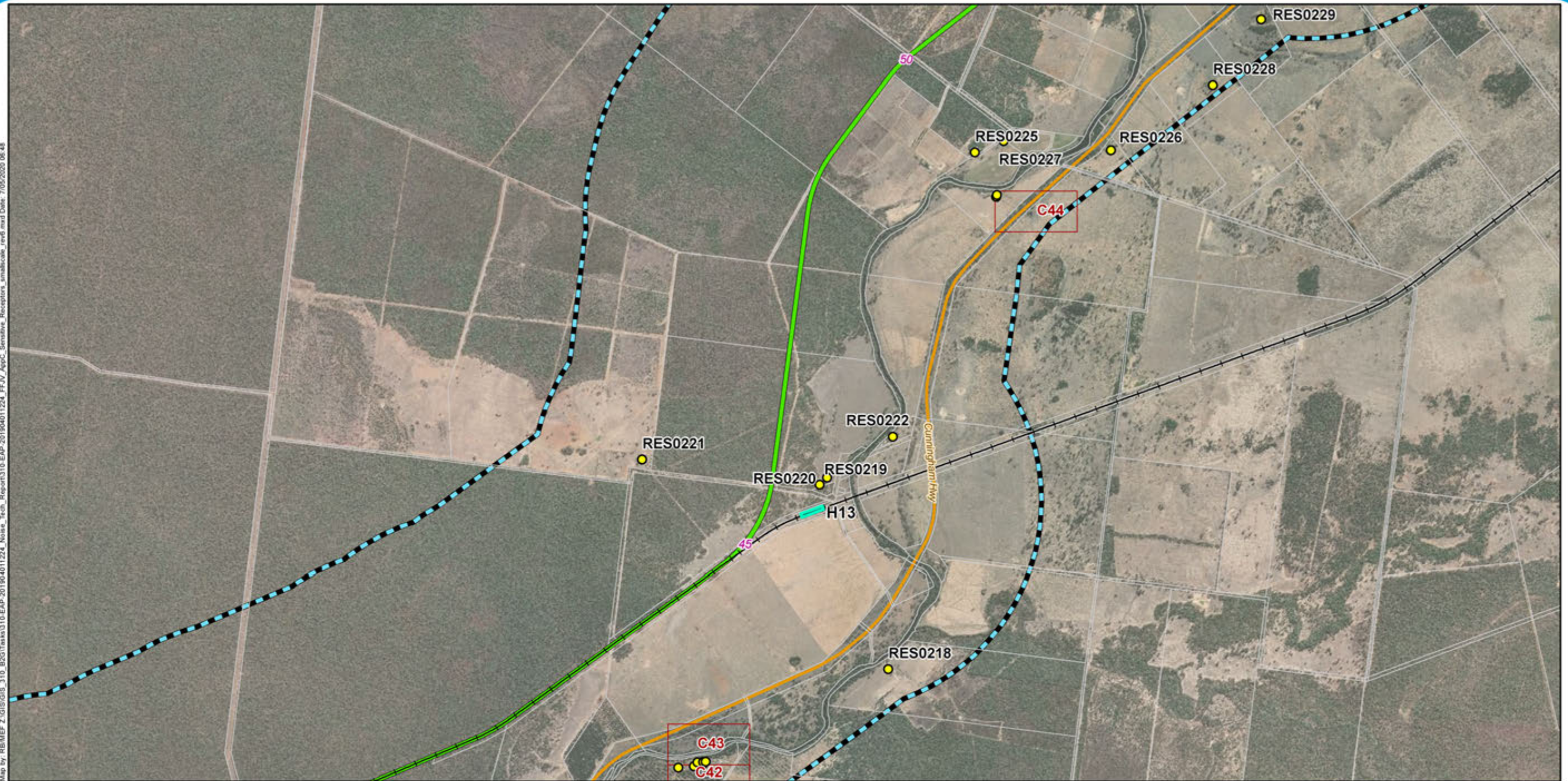
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
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- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tracks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 08:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

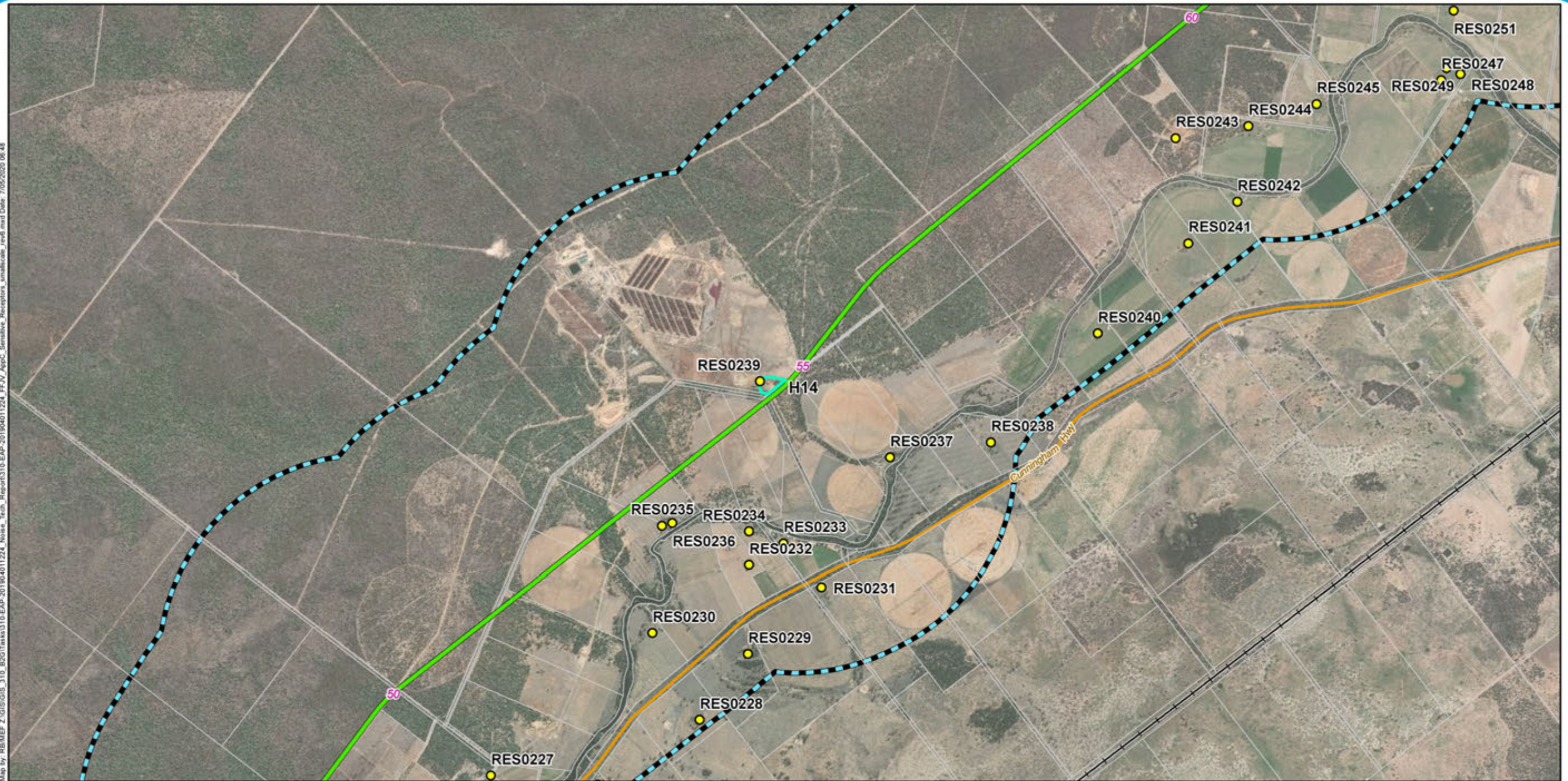
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by: RBMEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_ApPC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

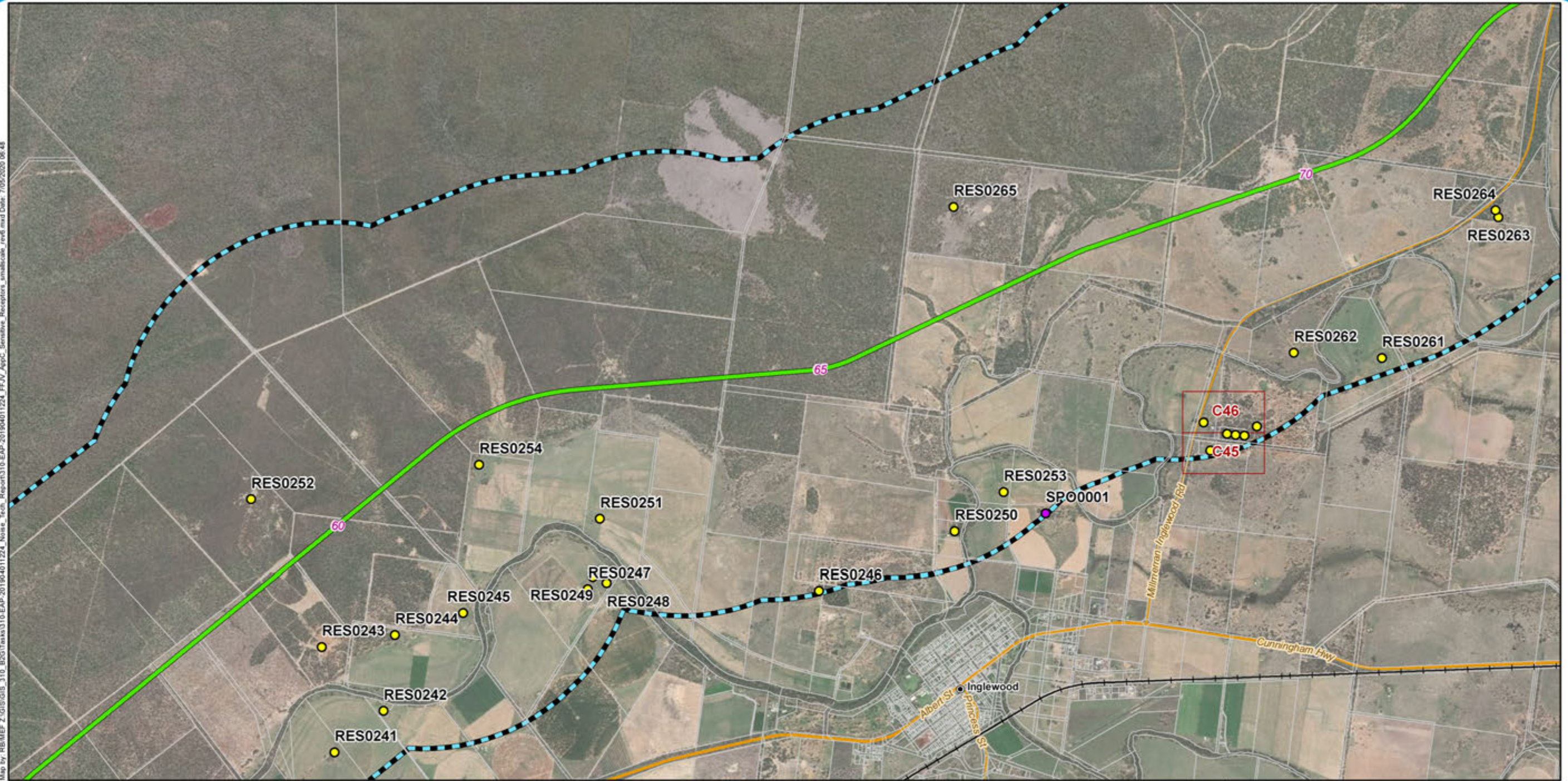
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by RBMEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
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- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



**Future Freight**  
Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
Coordinate System: GDA 1994 MGA Zone 56



Map by: RBMEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310-EAP-20190401\224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- ▤ Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
 Coordinate System: GDA 1994 MGA Zone 56



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310-EAP-20190401\224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 08:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- ▨ Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tracks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

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- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Trunks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310\_EAP-20190401\224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

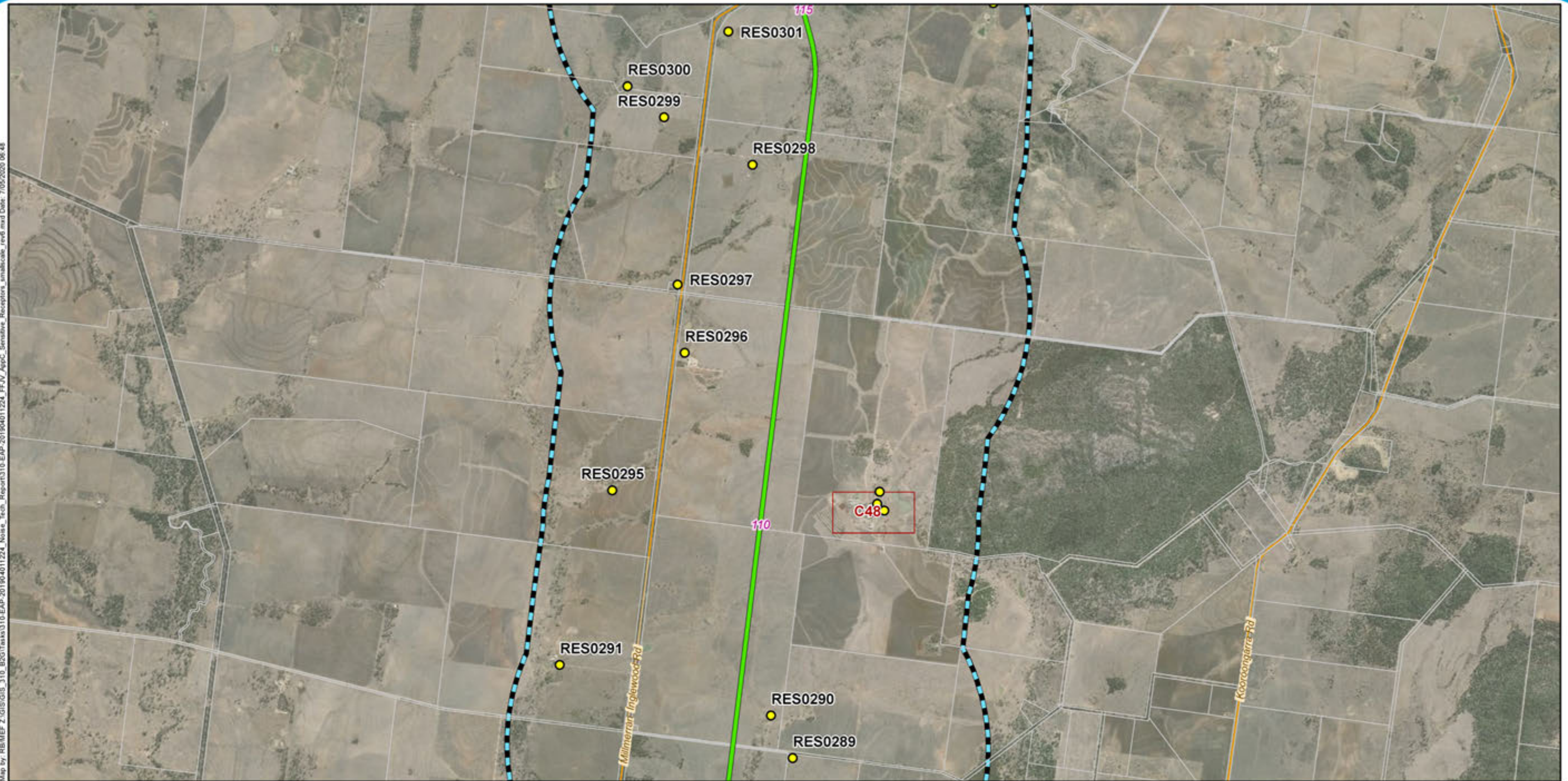
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by RB/MEF 2:GIS/GIS\_310\_B2G/Task310\_EAP-201904011224\_Noise\_Tech\_Report310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6 and Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
- Cadastral
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

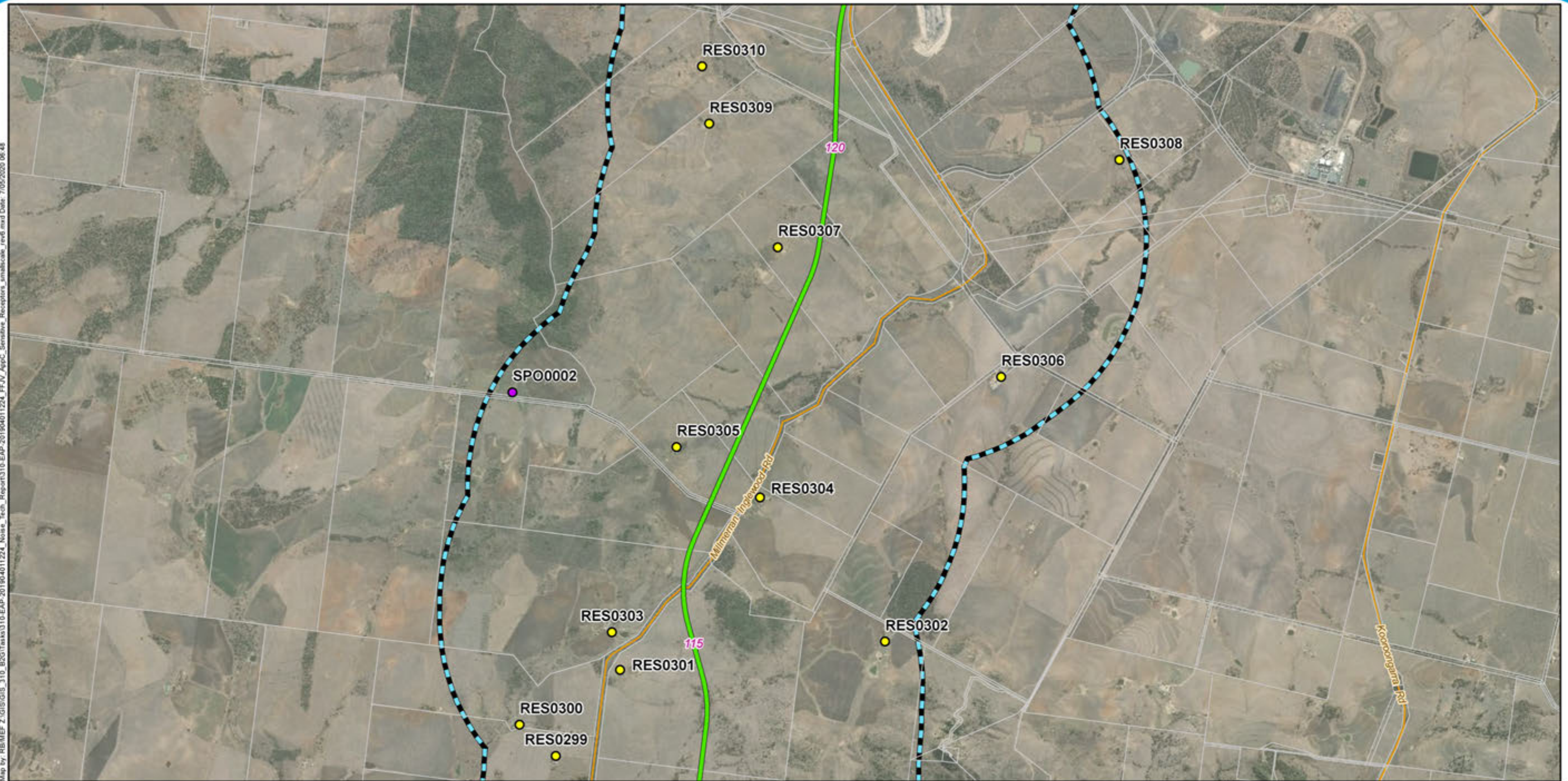
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
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- Medical Building
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- Residential
- Sporting Facility
- Heritage



A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by RBMEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310-EAP-20190401\224\_FF\_V\_ApPC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Minor roads
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- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km



**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
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Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Trunks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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- Residential
- Sporting Facility
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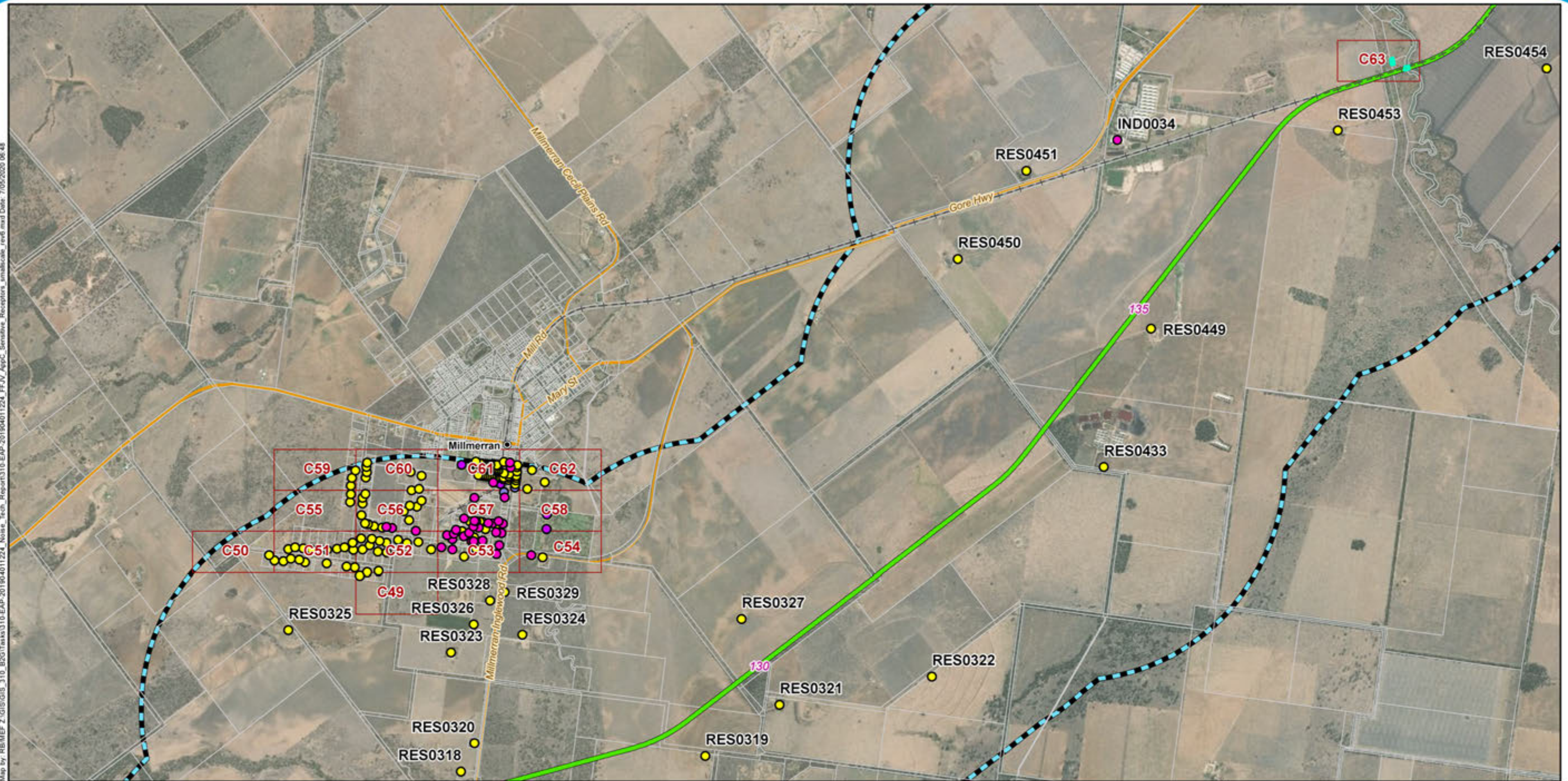
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**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
 Coordinate System: GDA 1994 MGA Zone 56





#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- ▨ Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
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A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



**Future Freight**  
Integrating Community, Environment and Engineering

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Map by RBMEF Z:\GIS\GIS\_310\_B2G\Trunks\310\_EAP-201904011224\_Noise\_Tech\_Report\310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 08:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (non-operational)
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#### Sensitive Receptors

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**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
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### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Existing rail (non-operational)
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- Minor roads
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### Sensitive Receptors

- Commercial Office
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A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by RBMEF Z:\GIS\GIS\_310\_B2G\Trunks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

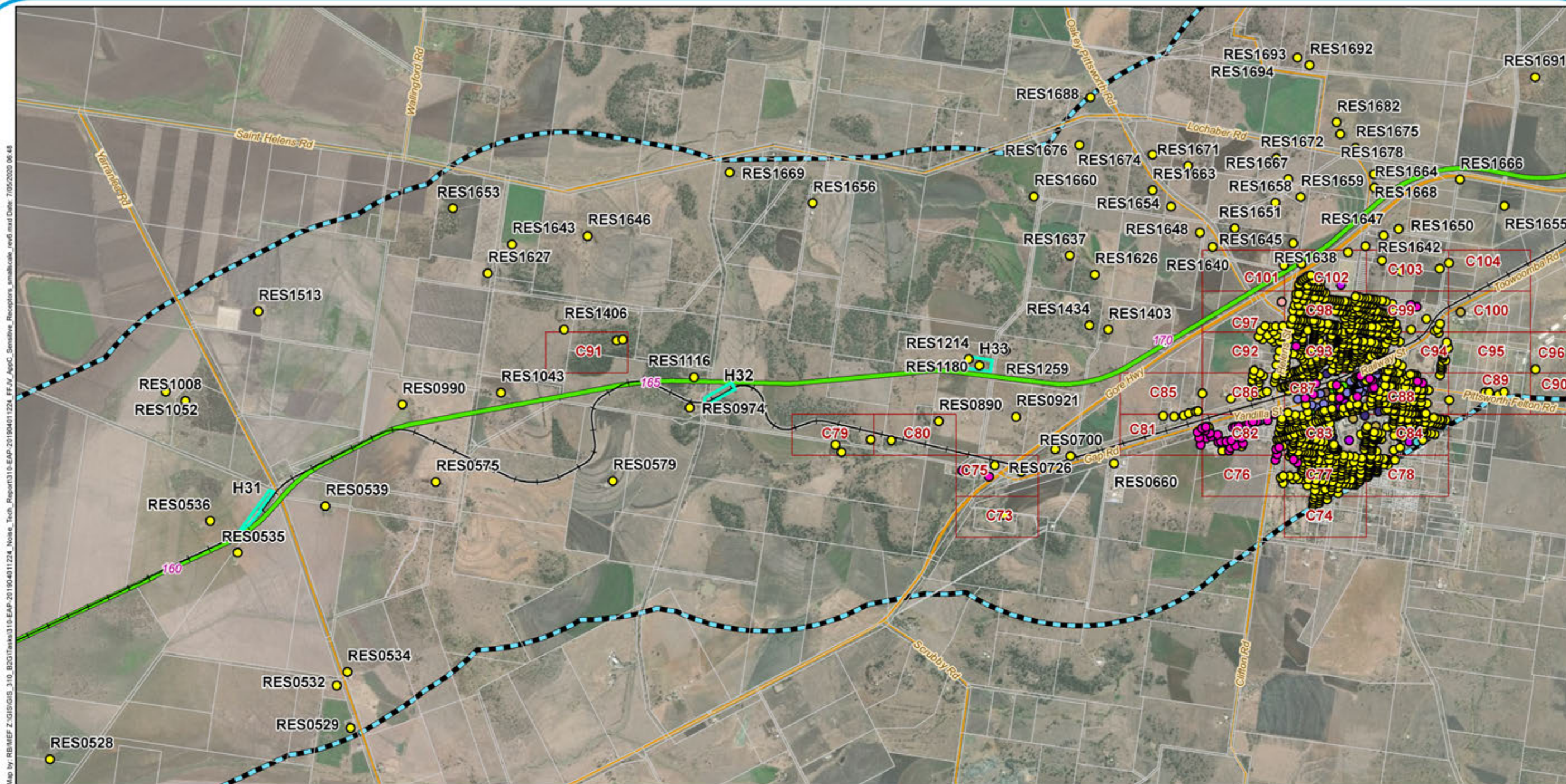
#### Sensitive Receptors

- Commercial Office
- Commercial Retail
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- Educational Building
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A3 scale: 1:40,000  
 0 0.3 0.6 0.9 1.2 1.5km





#### Legend

- 5 Chainage (km)
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- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
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- Noise and vibration impact assessment area

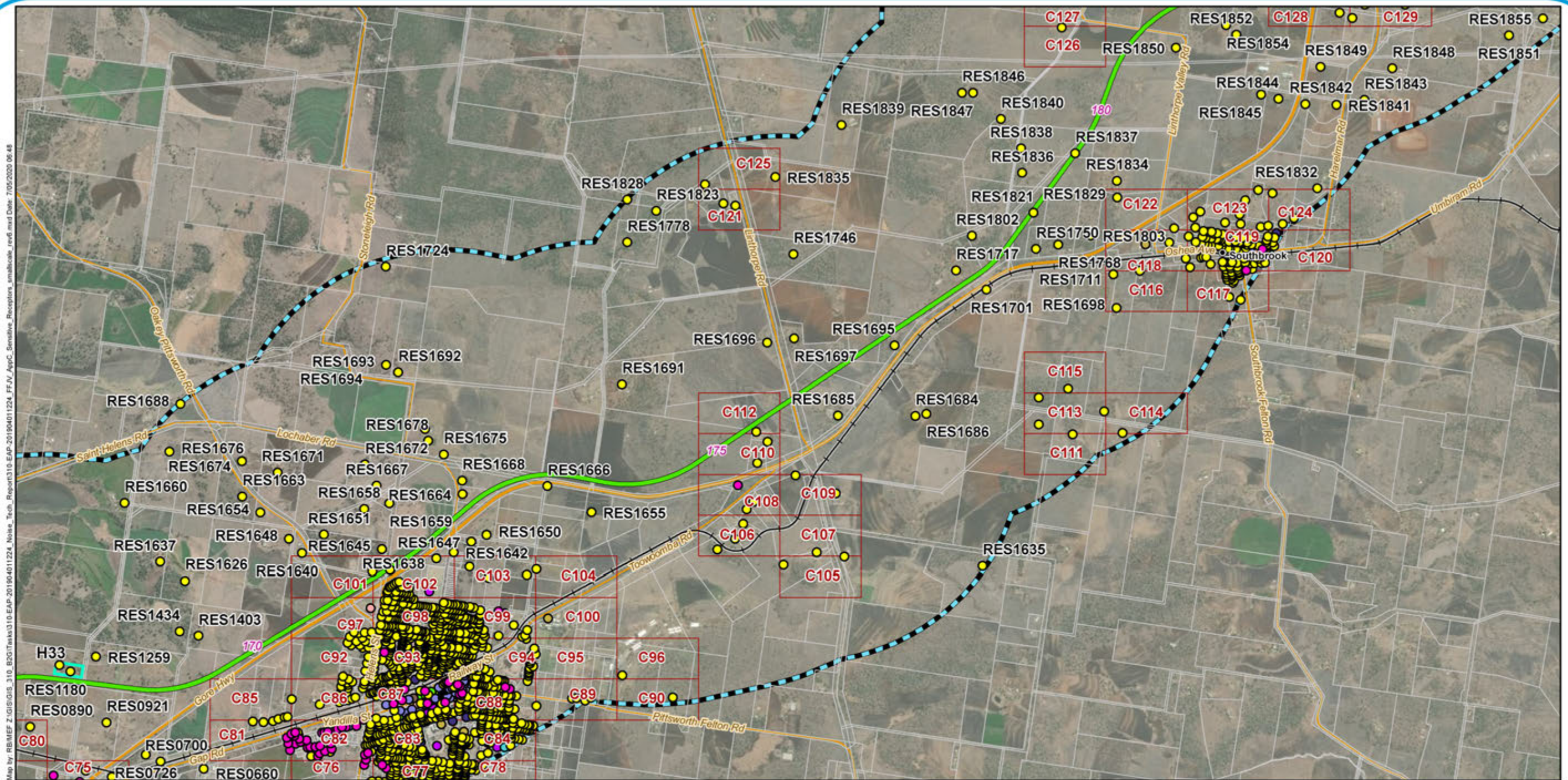
#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km





#### Legend

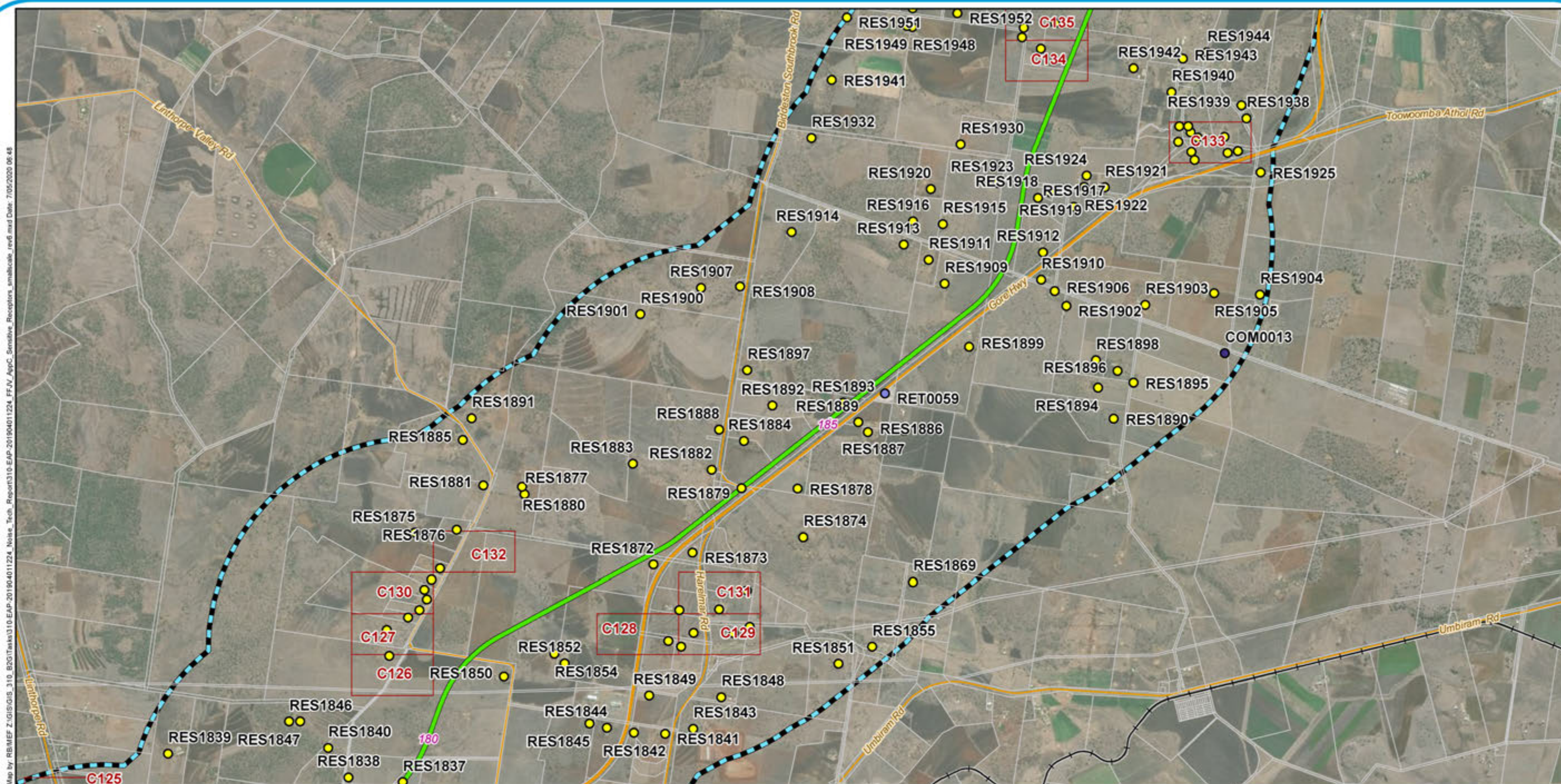
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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- Outdoor Recreation
- Residential
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#### Legend

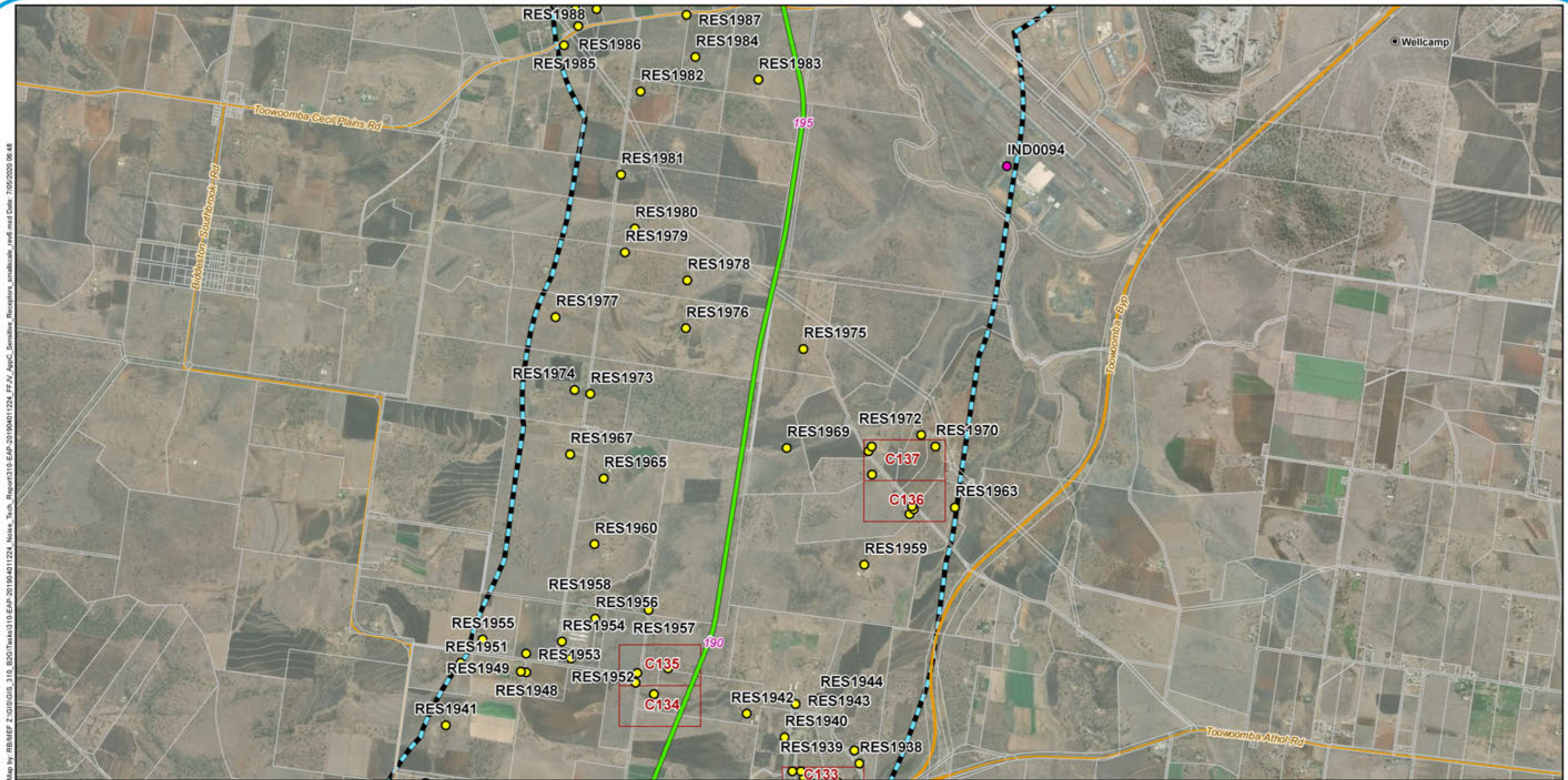
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

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#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

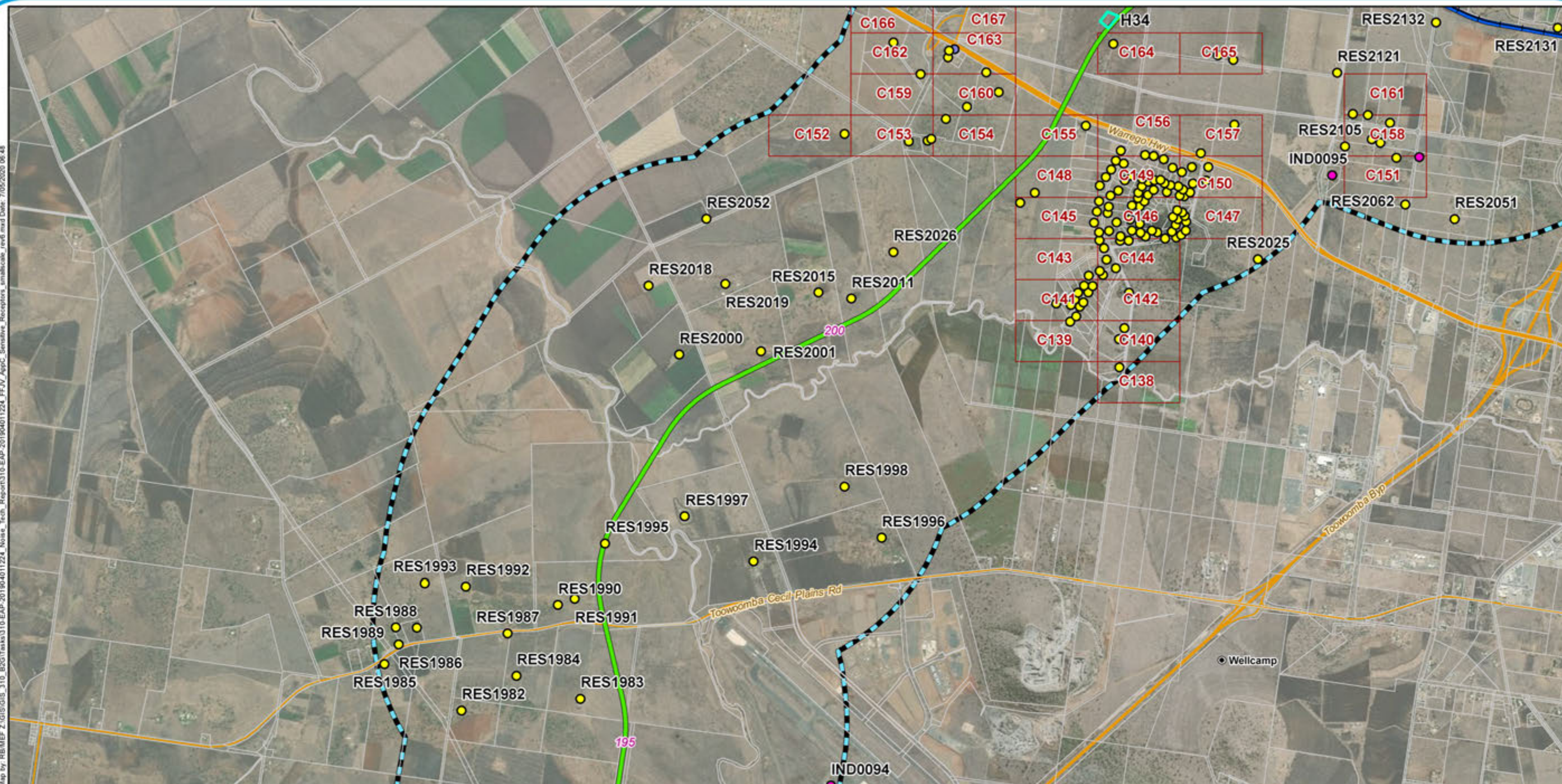
- Commercial Office
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A3 scale: 1:40,000  
0 0.3 0.6 0.9 1.2 1.5km



Map by: RB/MEF Z:GIS/015\_310\_B2G/Trunks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_smallscale\_rev6.mxd Date: 7/05/2020 06:48



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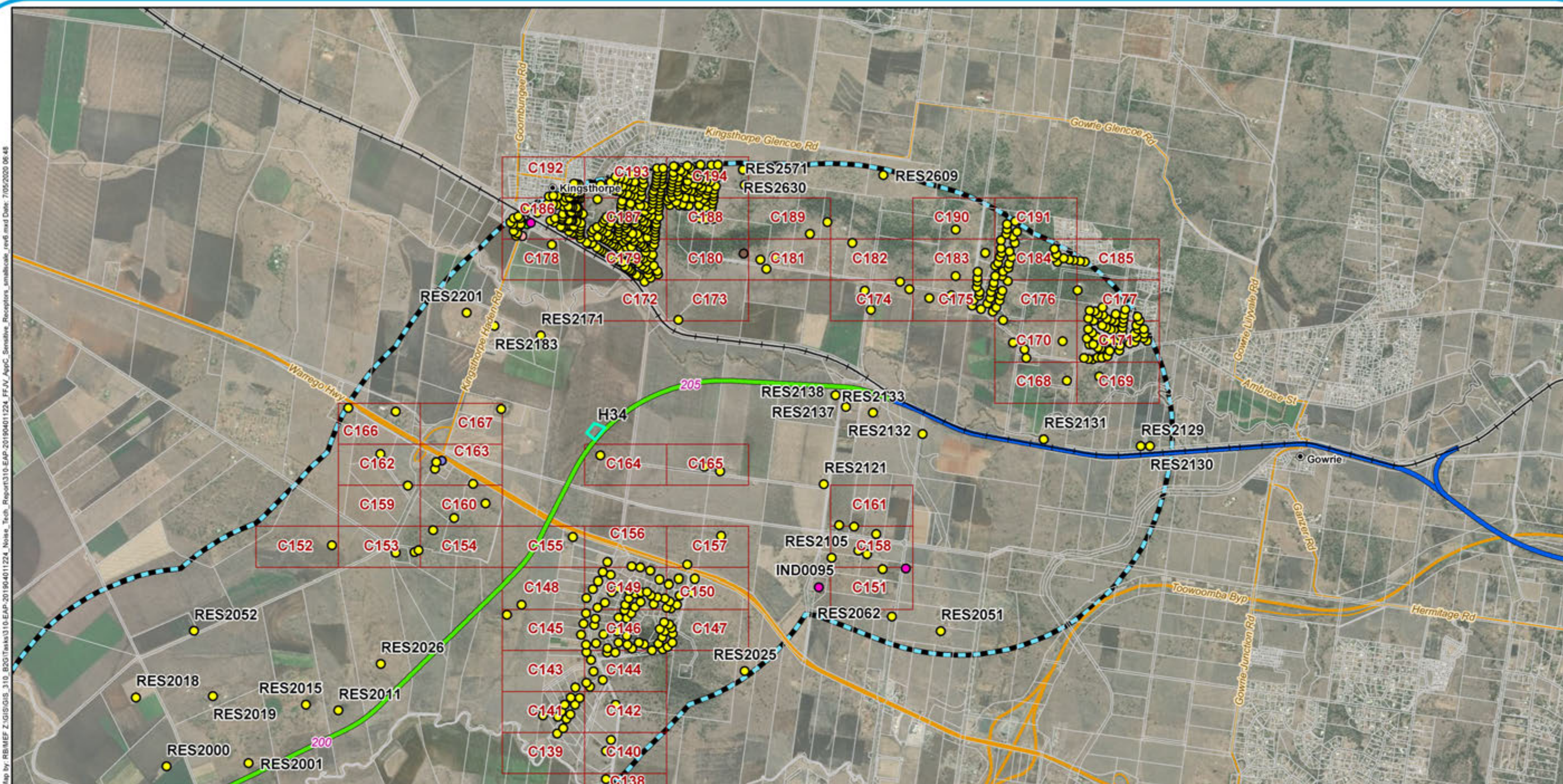
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Cadastre
- Areas mapped separately
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
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- Residential
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- Heritage







- 5 Chainage (km)
- Localities
- █ Border to Gowrie alignment
- █ Gowrie to Helidon alignment
- Existing rail (operational)
- █ Major roads
- █ Minor roads
- Cadastre
- Areas mapped separately
- █ Noise and vibration impact assessment area

- Commercial Office
- Commercial Retail
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- Educational Building
- Hotel/Motel

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- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage







#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

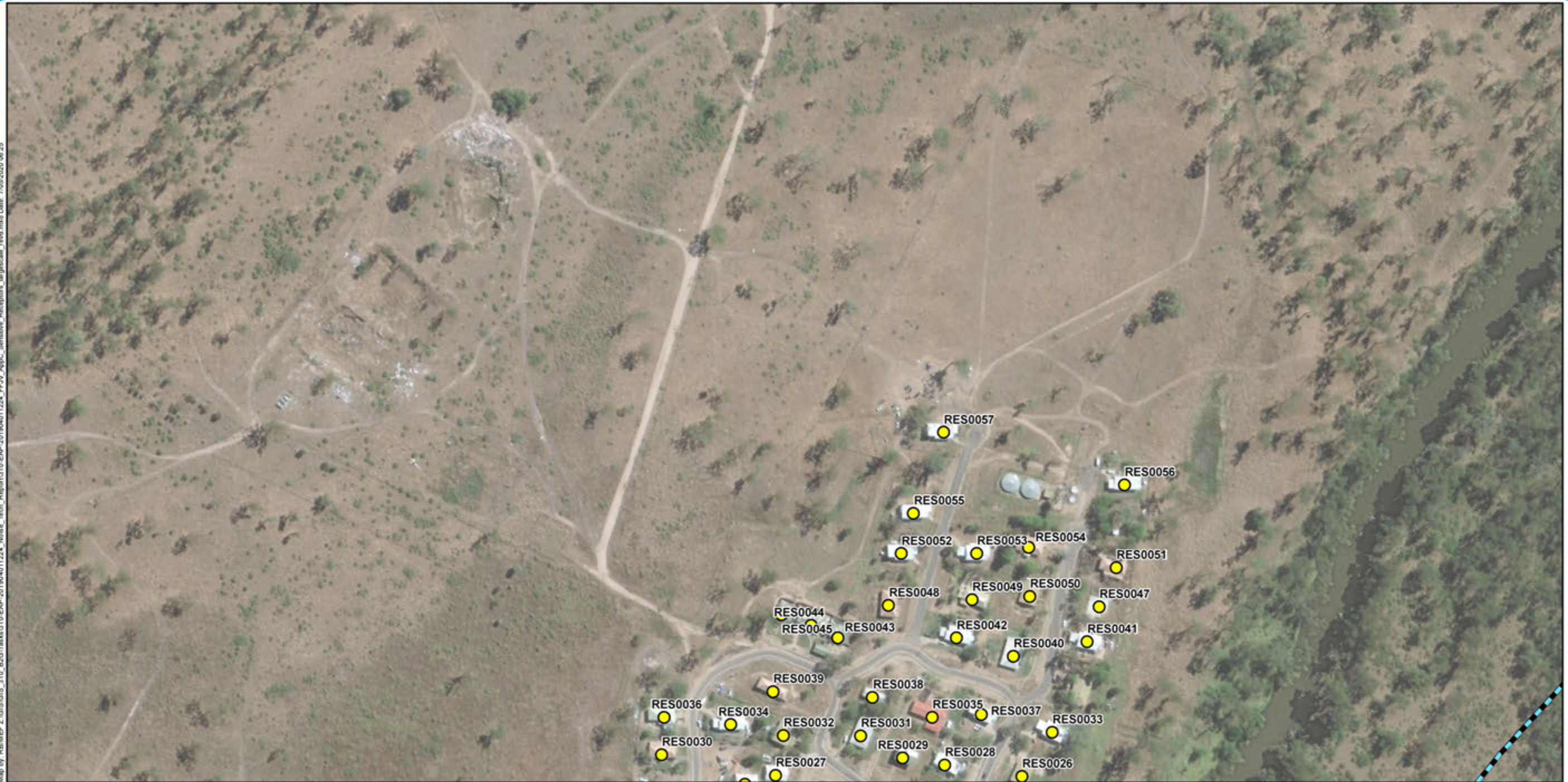
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\N\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



**Future Freight**  
 Integrating Community, Environment and Engineering

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#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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- Residential
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A3 scale: 1:3,000  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:3,000  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_targetscale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:3,000  
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#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largeScale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Minor roads

#### Sensitive Receptors

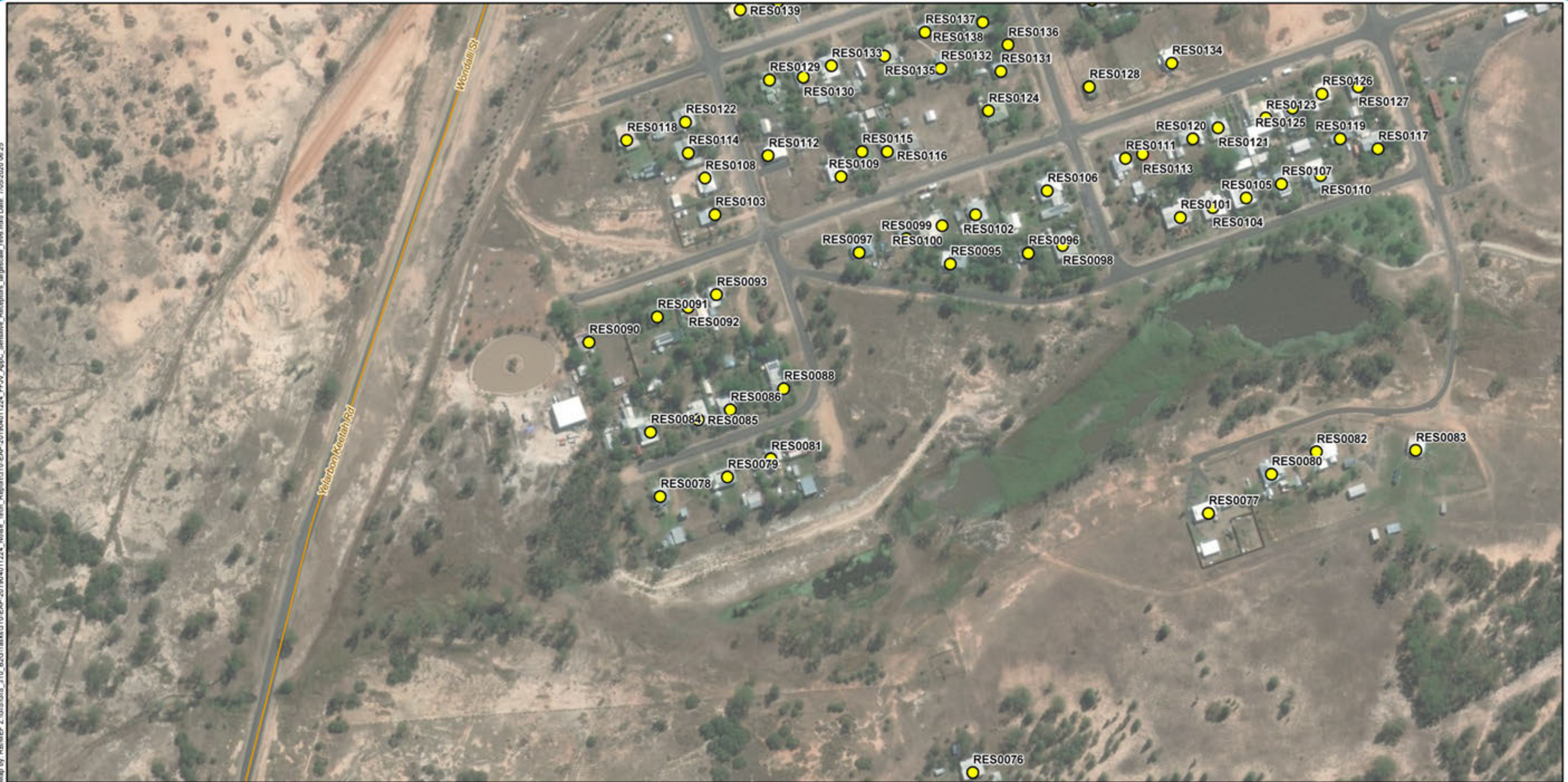
- Commercial Office
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**Future Freight**  
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#### Legend

- 5 Chainage (km)
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#### Sensitive Receptors

- Commercial Office
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 0 0.04 0.08 0.12 0.16 0.2km



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 Integrating Community, Environment and Engineering

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#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

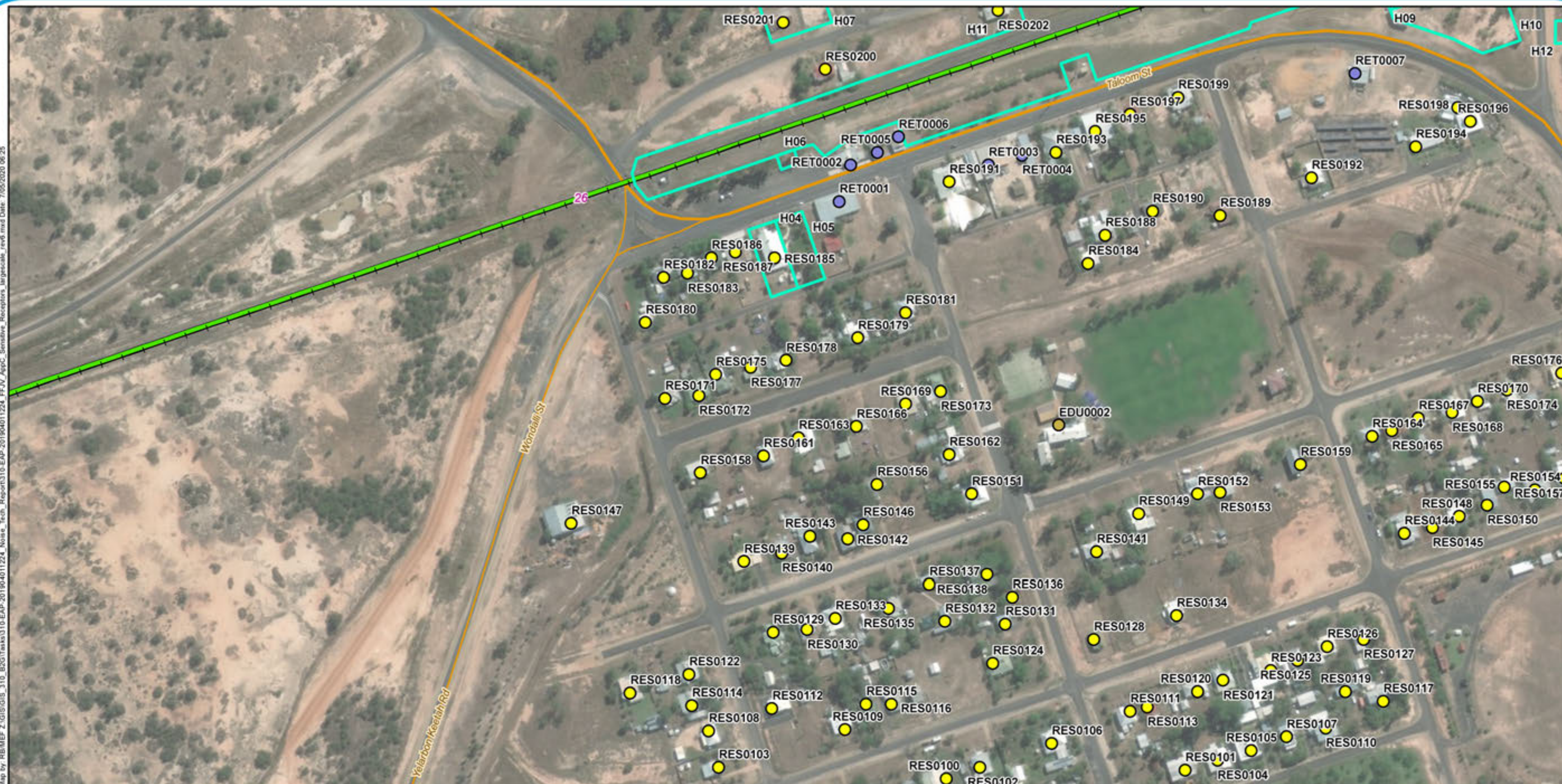
- Commercial Office
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A3 scale: 1:3,000  
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Map by RBMEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area
- Major roads
- Minor roads

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km





#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
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- Major roads

#### Sensitive Receptors

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A3 scale: 1:3,000  
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Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area
- Major roads
- Minor roads

### Sensitive Receptors

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**Future Freight**  
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Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310-EAP-201904011224\_Noise\_Tech\_Report\310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
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- Hotel/Motel

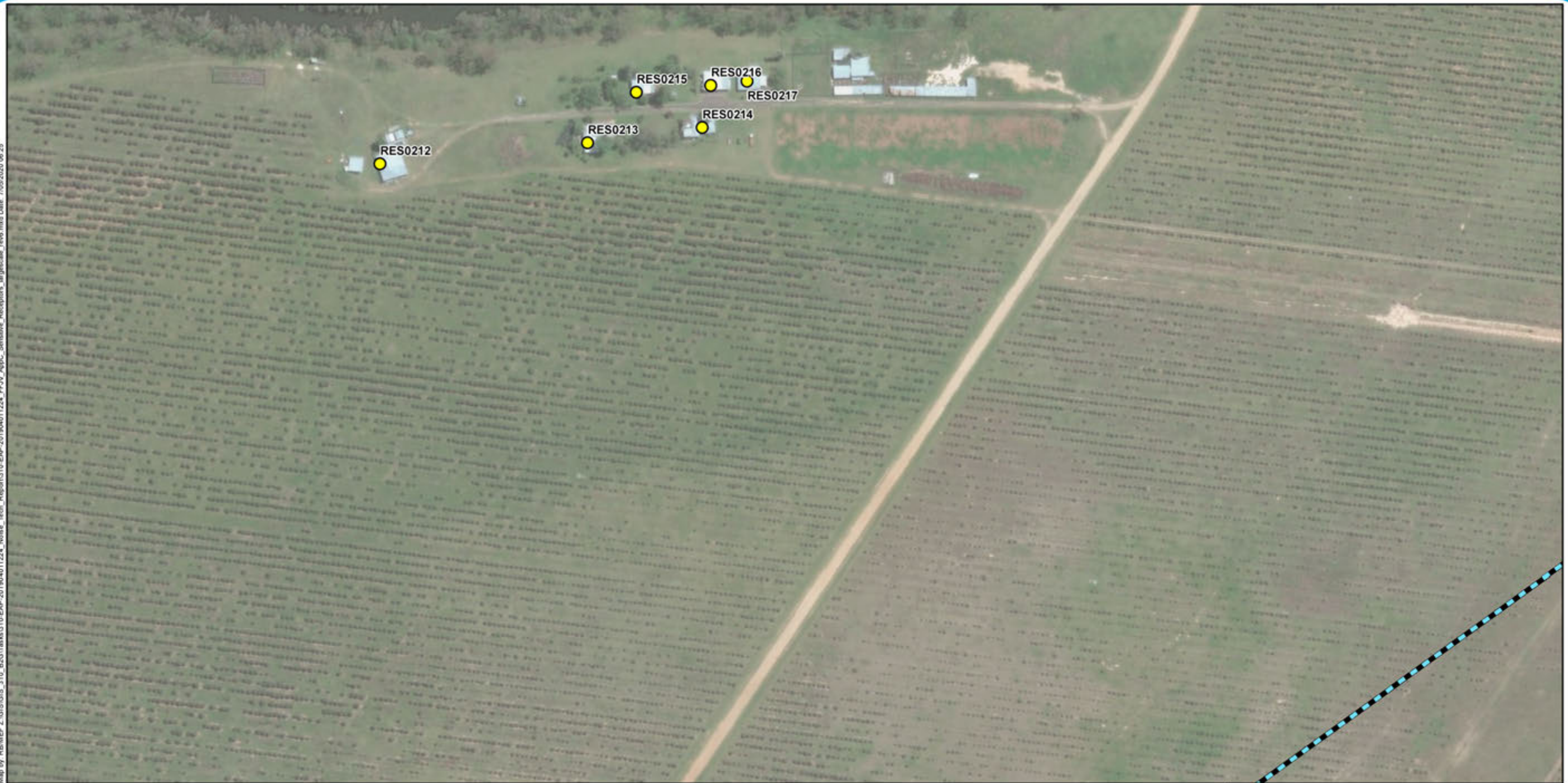
- Industrial
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A3 scale: 1:3,000  
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Map by: RB/MEF Z:GIS/GIS\_310\_B2G/Tracks310-EAP-201904011224\_Noise\_Tech\_Report310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_targetscale\_rev6.mxd Date: 7/05/2020 06:25

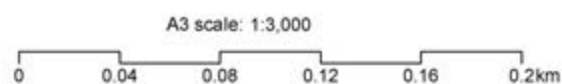


#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
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Map by: RB/MEF Z:GIS/GIS\_310\_B2G/Traffic310-EAP-201904011224\_Noise\_Tech\_Report310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large-scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

- Commercial Office
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 0 0.04 0.08 0.12 0.16 0.2km



**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
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Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Appl\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 08:25

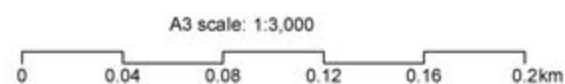


#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

- Commercial Office
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Map by RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\N\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



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**Future Freight**  
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Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Tracks310\_EAP-201904011224\_Noise\_Tech\_Report310\_EAP-201904011224\_FF/V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

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A3 scale: 1:3,000  
0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25

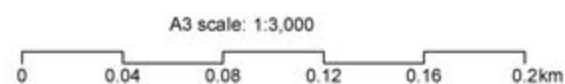


#### Legend

- 5 Chainage (km)
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- Noise and vibration impact assessment area

#### Sensitive Receptors

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**Future Freight**  
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#### Legend

- 5 Chainage (km)
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- Noise and vibration impact assessment area

#### Sensitive Receptors

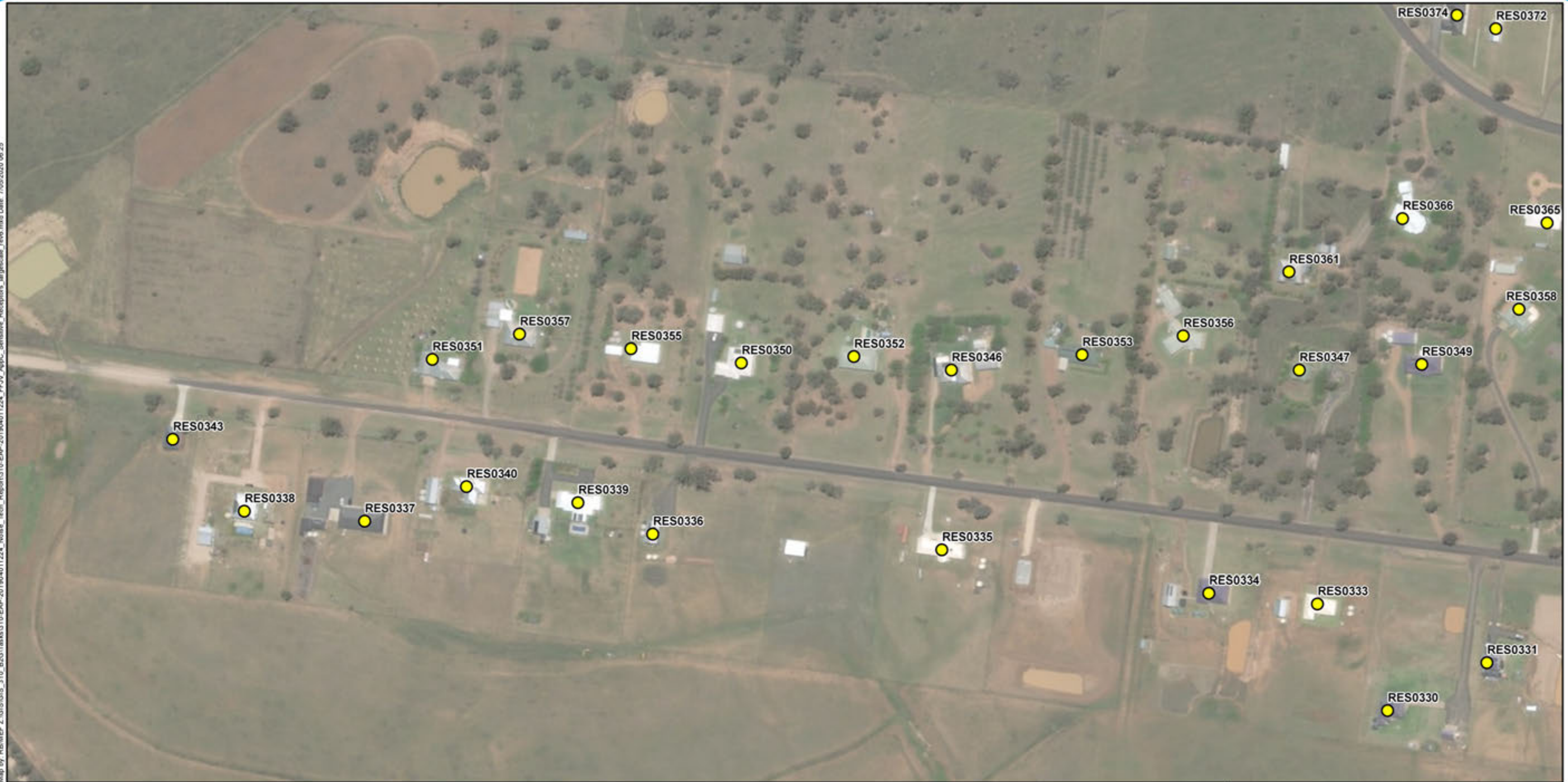
- Commercial Office
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A3 scale: 1:3,000  
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#### Legend

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A3 scale: 1:3,000  
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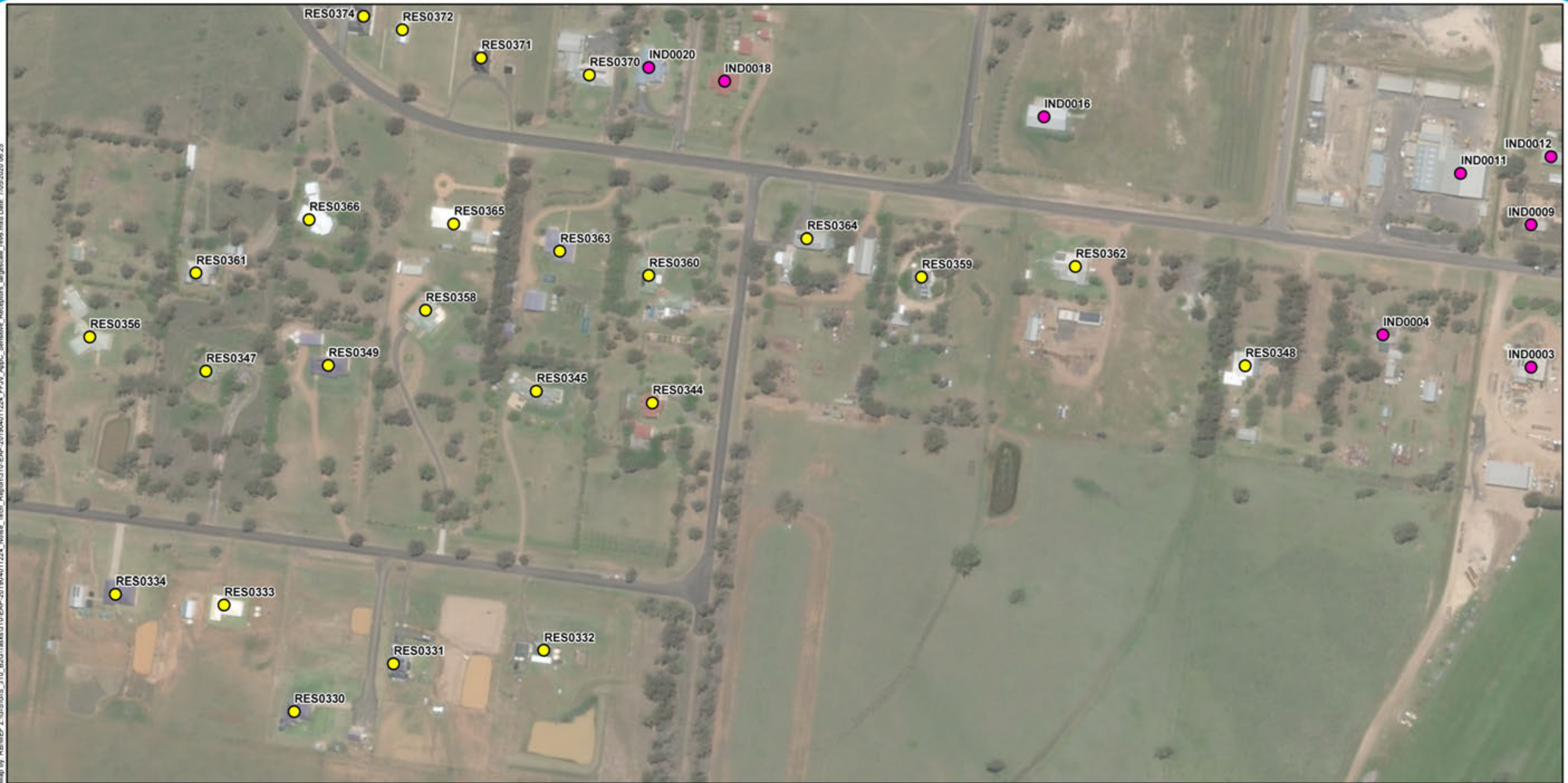


**Future Freight**  
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#### Legend

- 5 Chainage (km)
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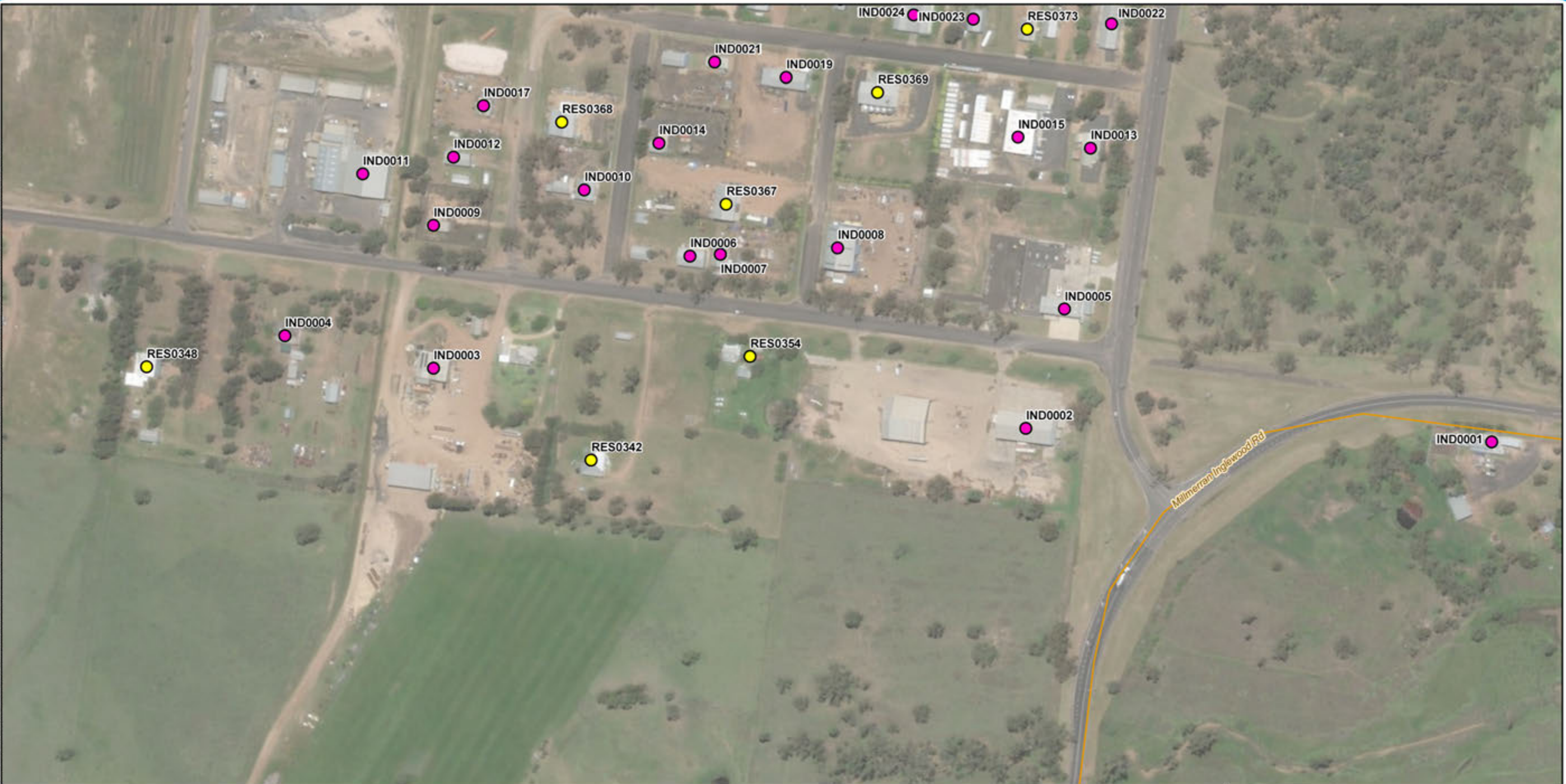
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A3 scale: 1:3,000  
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#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Minor roads

#### Sensitive Receptors

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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km





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- 5 Chainage (km)
- Localities
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- Minor roads

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#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

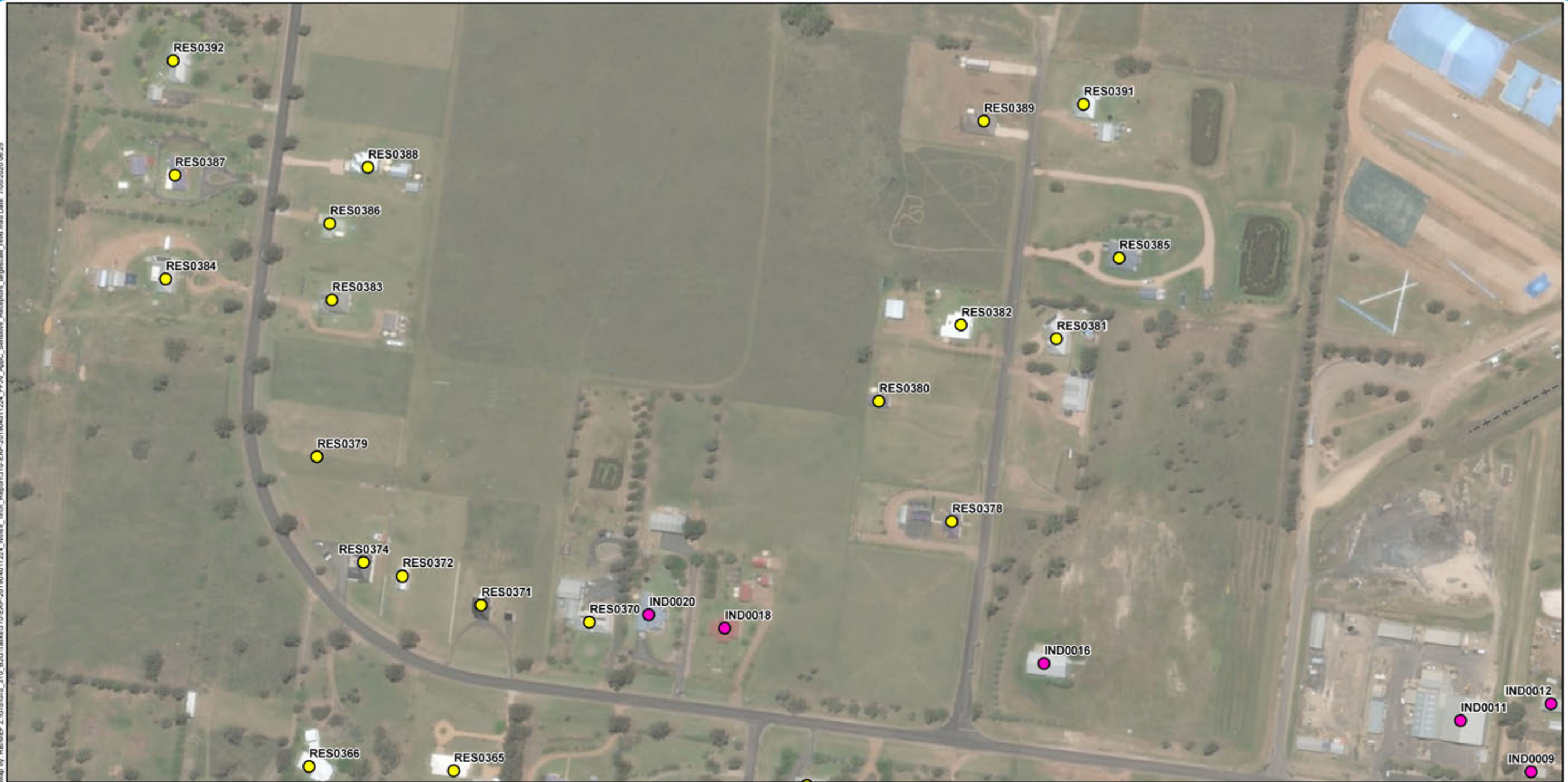
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 0 0.04 0.08 0.12 0.16 0.2km



Map by RBMEF 2:GIS/GIS\_310\_B2G/Tasks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largeScale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Existing rail (non-operational)
- Noise and vibration impact assessment area

#### Sensitive Receptors

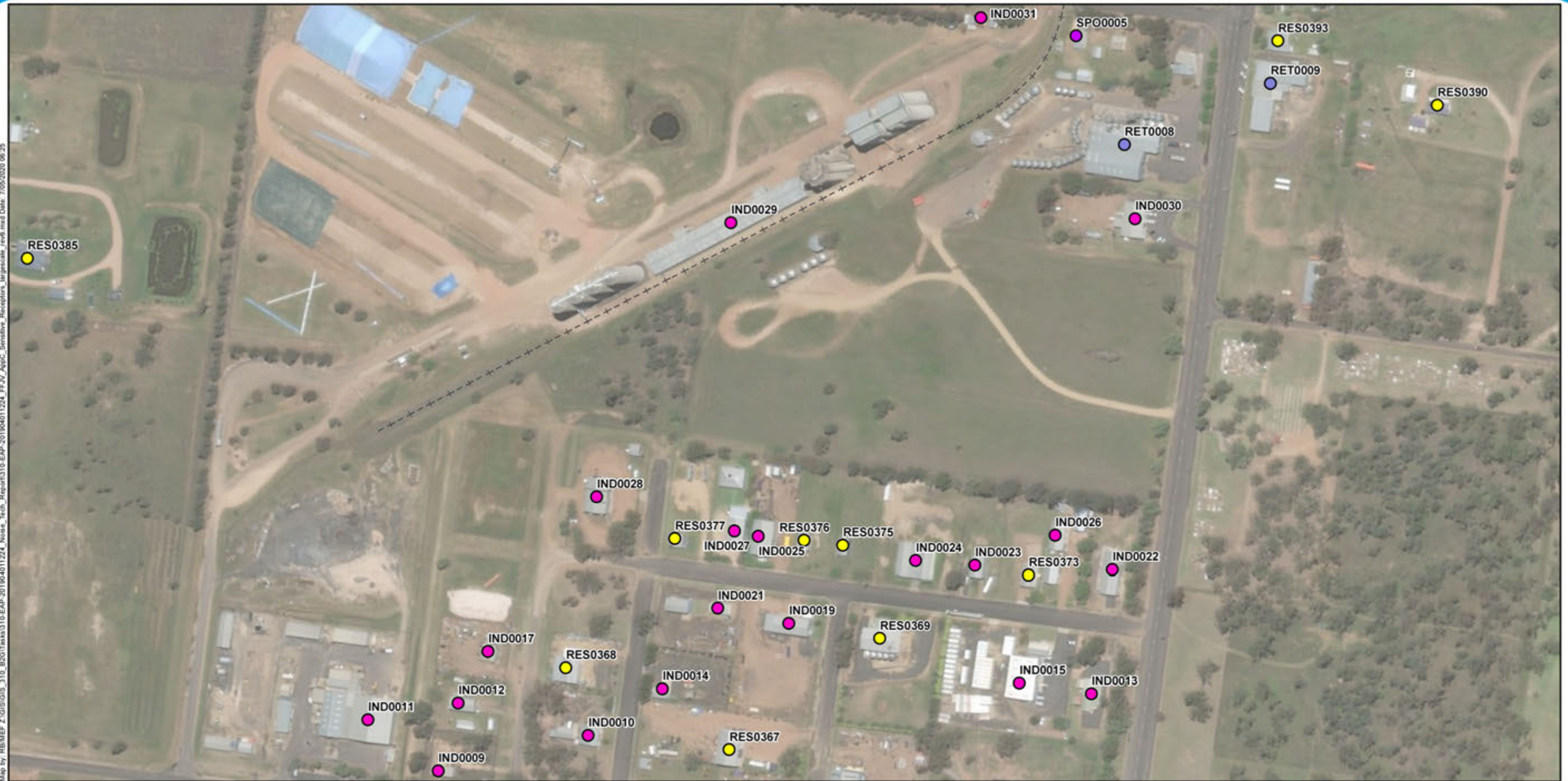
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A3 scale: 1:3,000  
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#### Legend

- 5 Chainage (km)
- Localities
- Existing rail (non-operational)
- ▭ Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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A3 scale: 1:3,000  
0 0.04 0.08 0.12 0.16 0.2km





#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
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#### Sensitive Receptors

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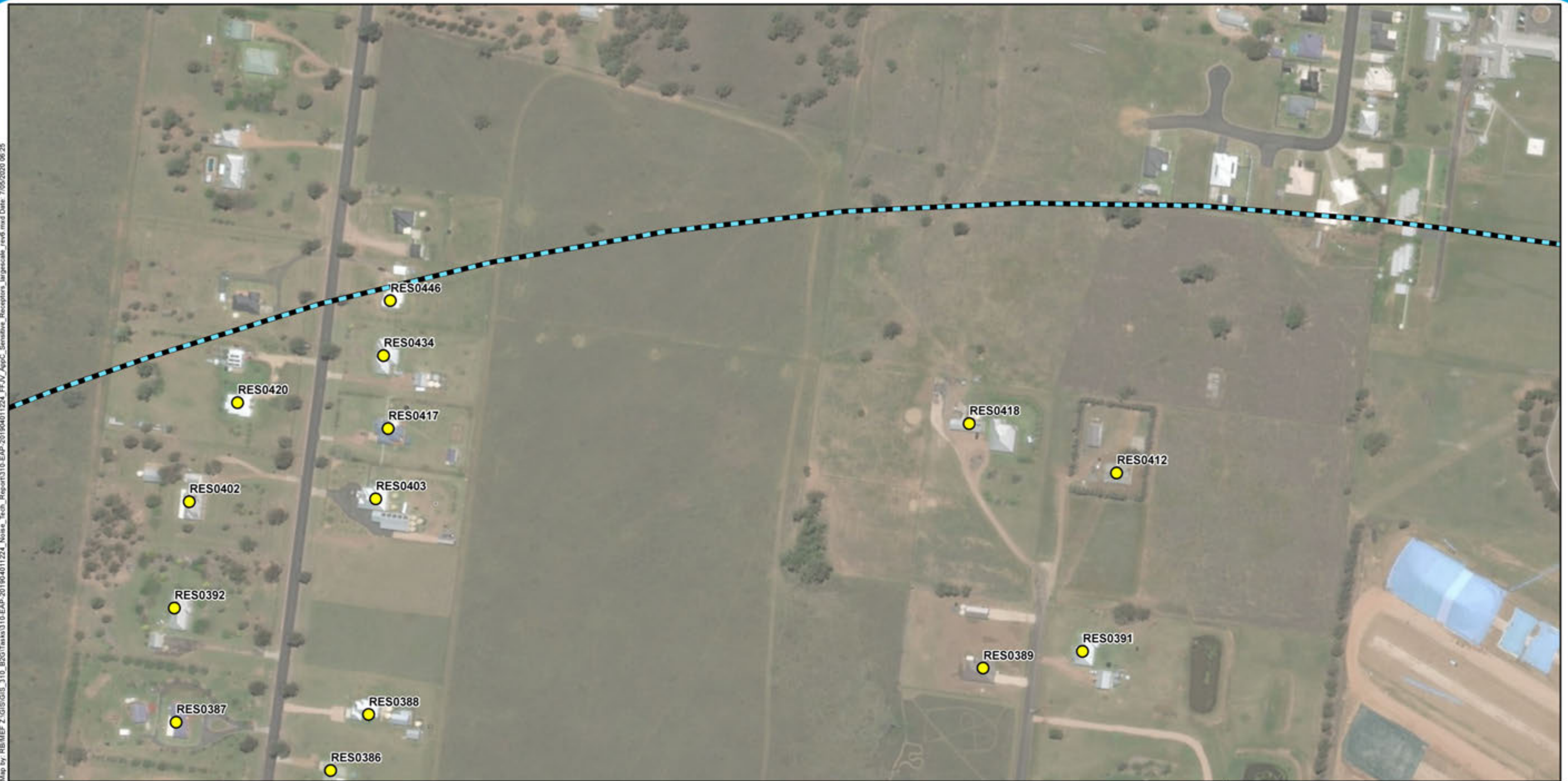


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#### Legend

- 5 Chainage (km)
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- Noise and vibration impact assessment area

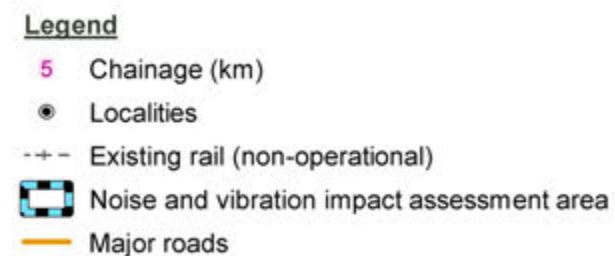
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 0 0.04 0.08 0.12 0.16 0.2km





● Commercial Office      ● Medical Building  
● Commercial Retail      ● Outdoor Recreation  
● Community Building      ● Residential  
● Educational Building      ● Sporting Facility  
● Hotel/Motel      ■ Heritage







#### Legend

- 5 Chainage (km)
- Localities
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#### Sensitive Receptors

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#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads
- Minor roads

#### Sensitive Receptors

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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

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**Future Freight**  
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#### Legend

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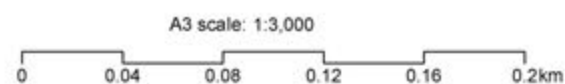
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#### Legend

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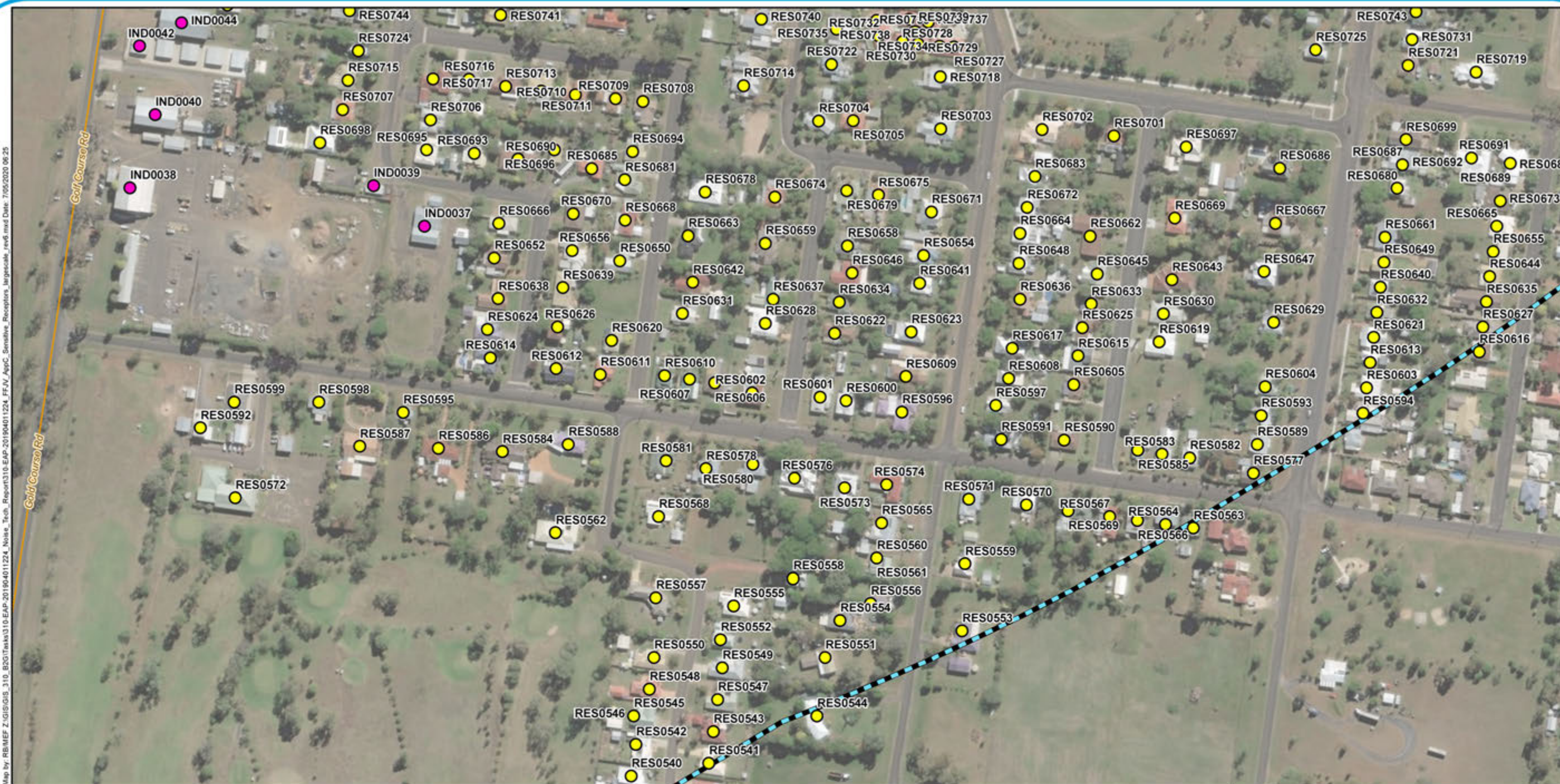
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 Chainage (km)  
 Localities  
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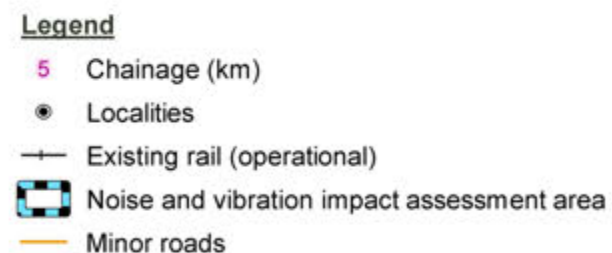
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- Commercial Office
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- 
- A map showing the proposed road project area. The project route is highlighted in green, starting from Goondiwindi in the southwest and extending northeast towards Toowoomba. The route follows the A39 corridor. Key locations marked include Goondiwindi, Toowoomba, and Warwick. Major roads shown include the A39, A40, and A41. The map also indicates the location of the project area relative to the Murrumbidgee River and the Murrumbidgee Highway.







#### Legend

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- Localities
- Existing rail (operational)
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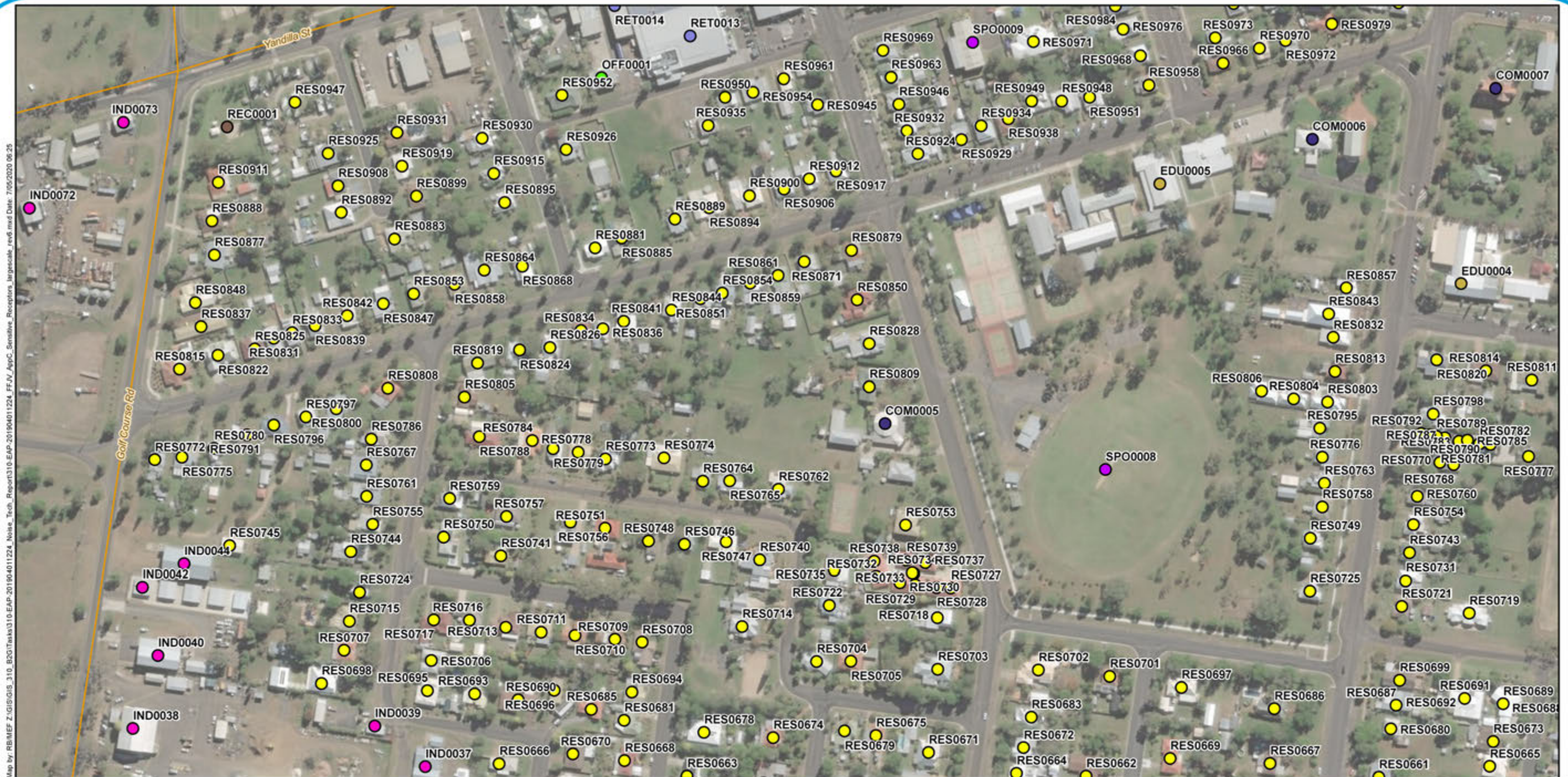
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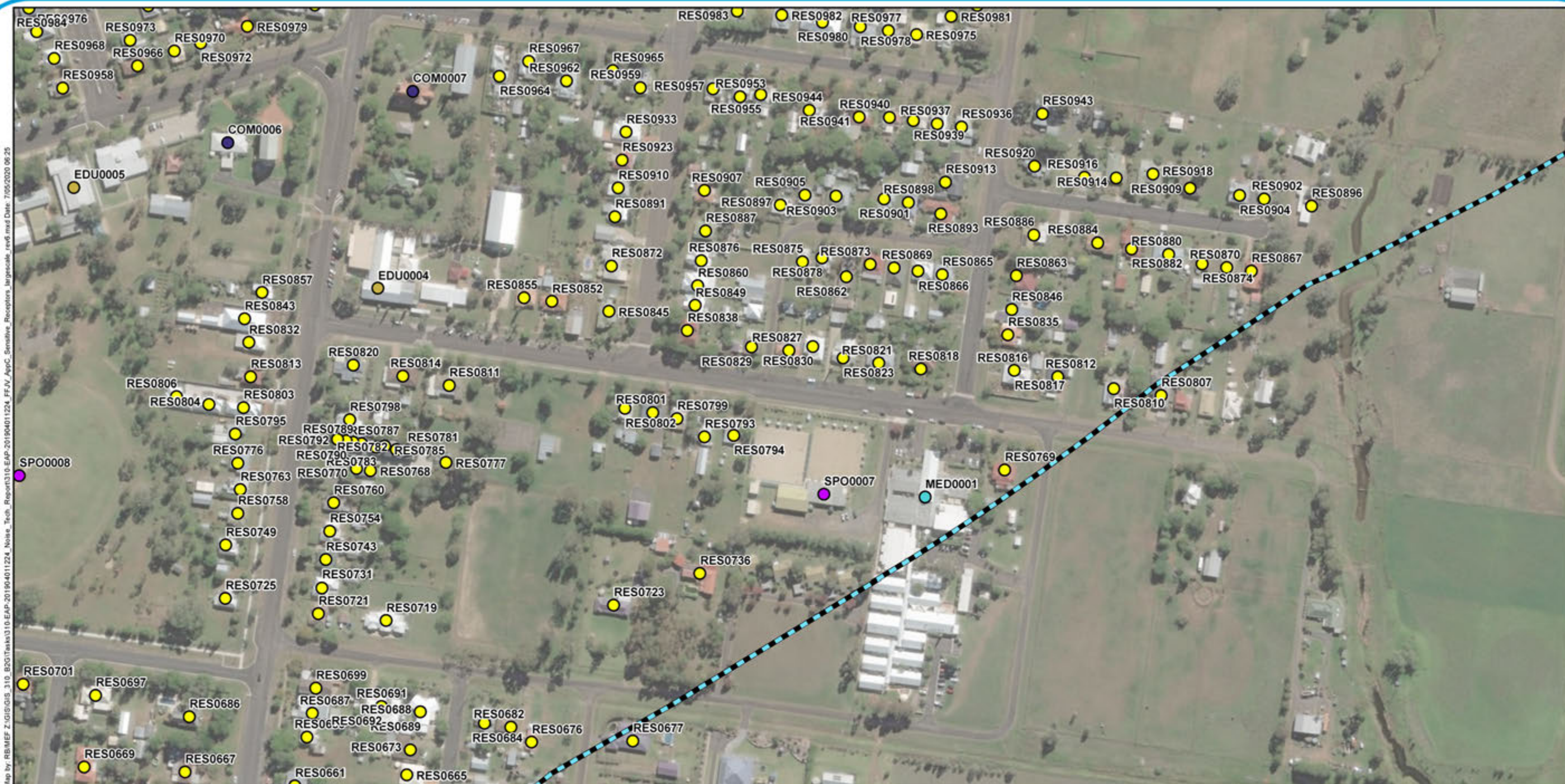
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Issue date: 06/05/2020 Version: 6  
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#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Noise and vibration impact assessment area
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A3 scale: 1:3,000  
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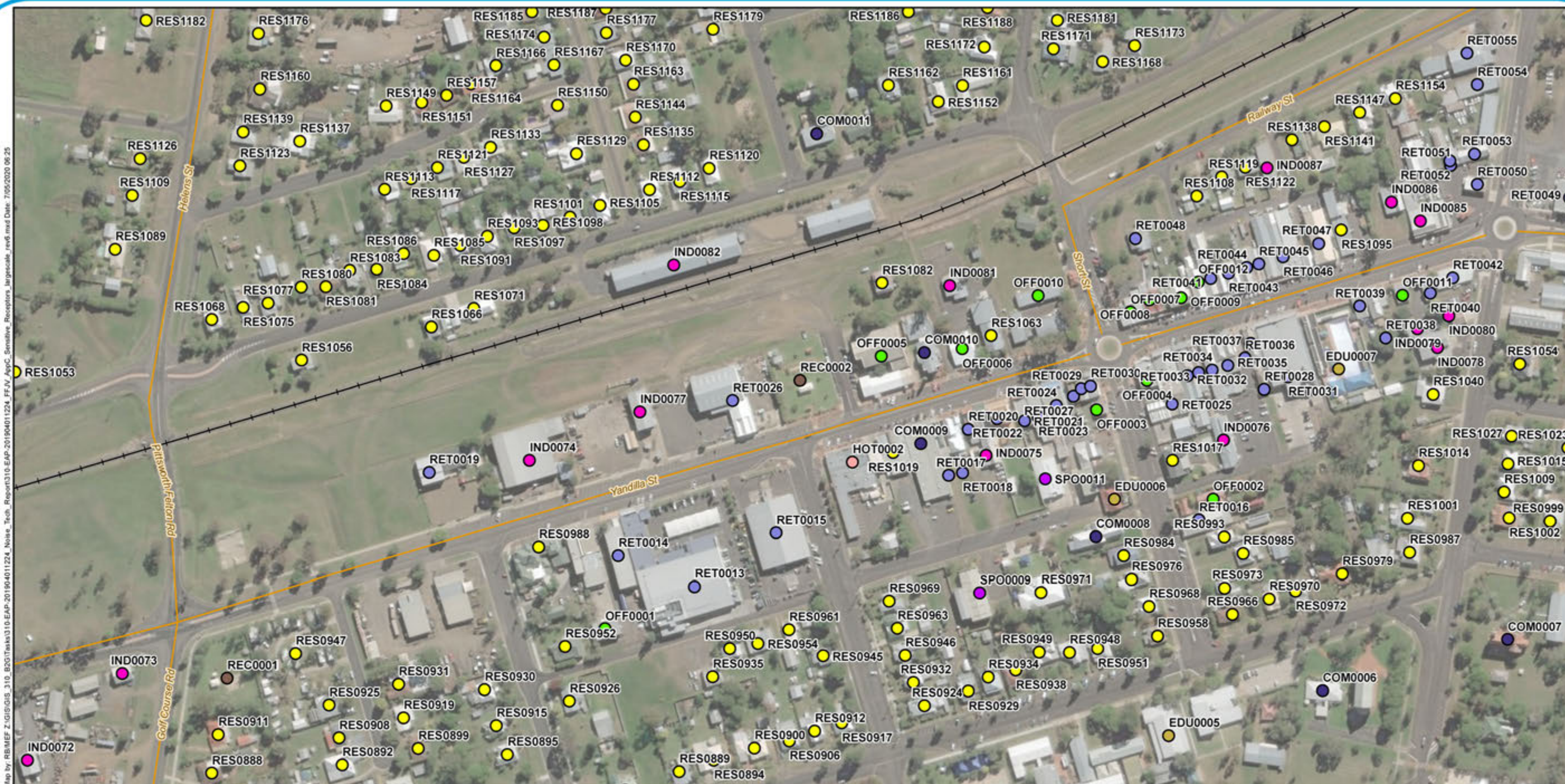
 Chainage (km)  
 Localities  
 Existing rail (operational)  
 Noise and vibration impact assessment area  
 Minor roads

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# Legend

- 5 Chainage (km)
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#### Legend

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#### Sensitive Receptors

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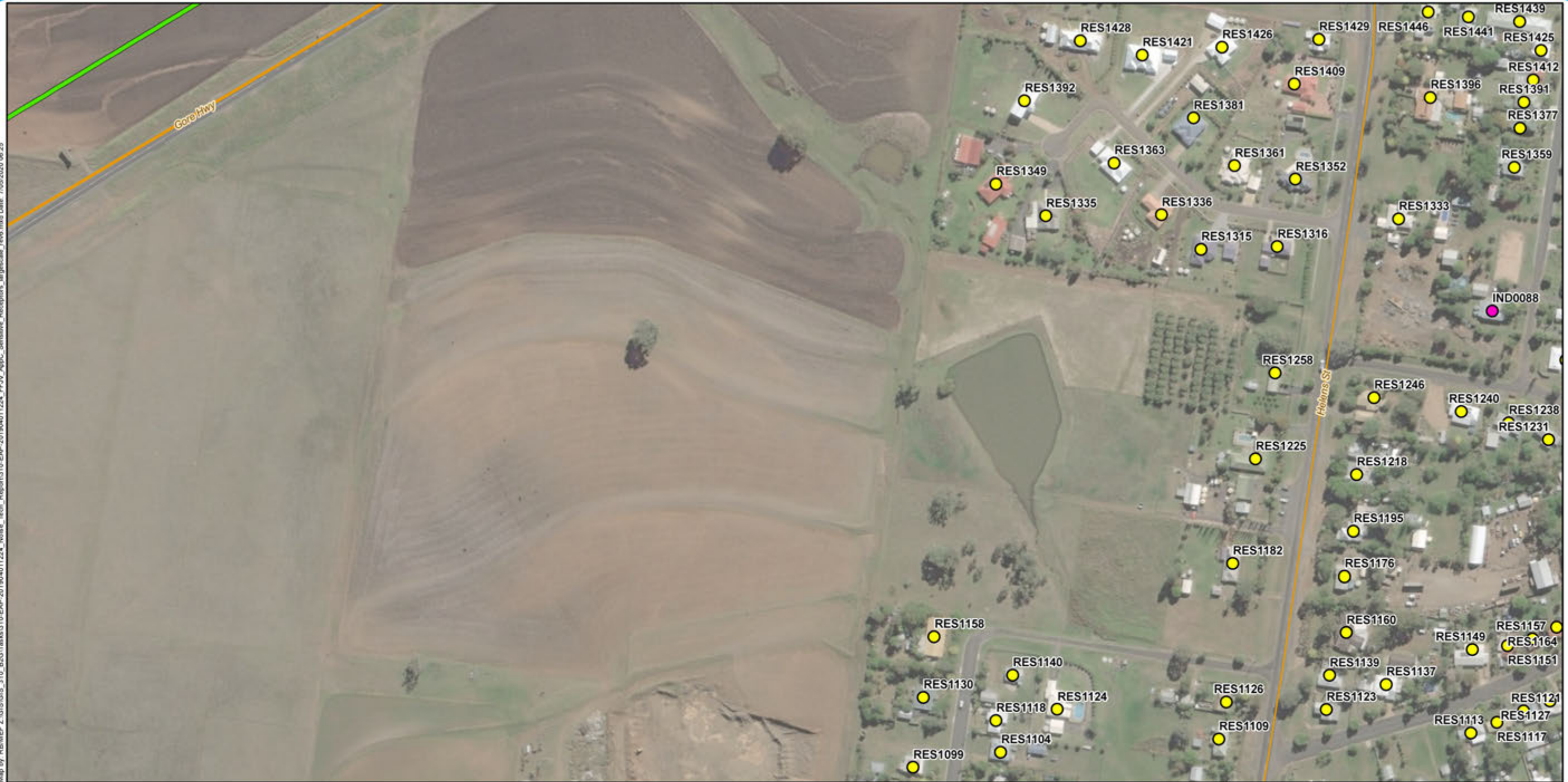
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A3 scale: 1:3,000  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largescale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

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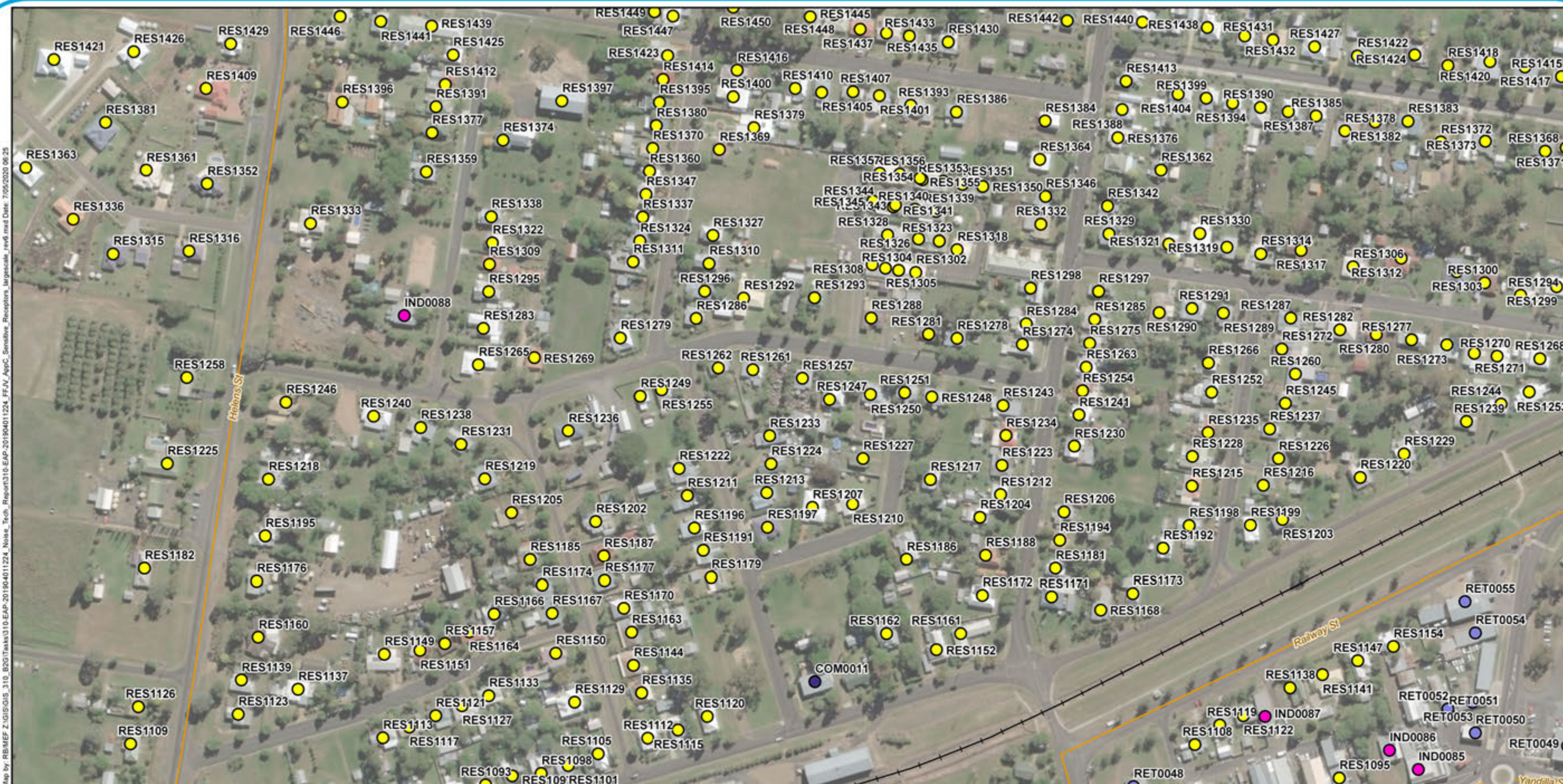
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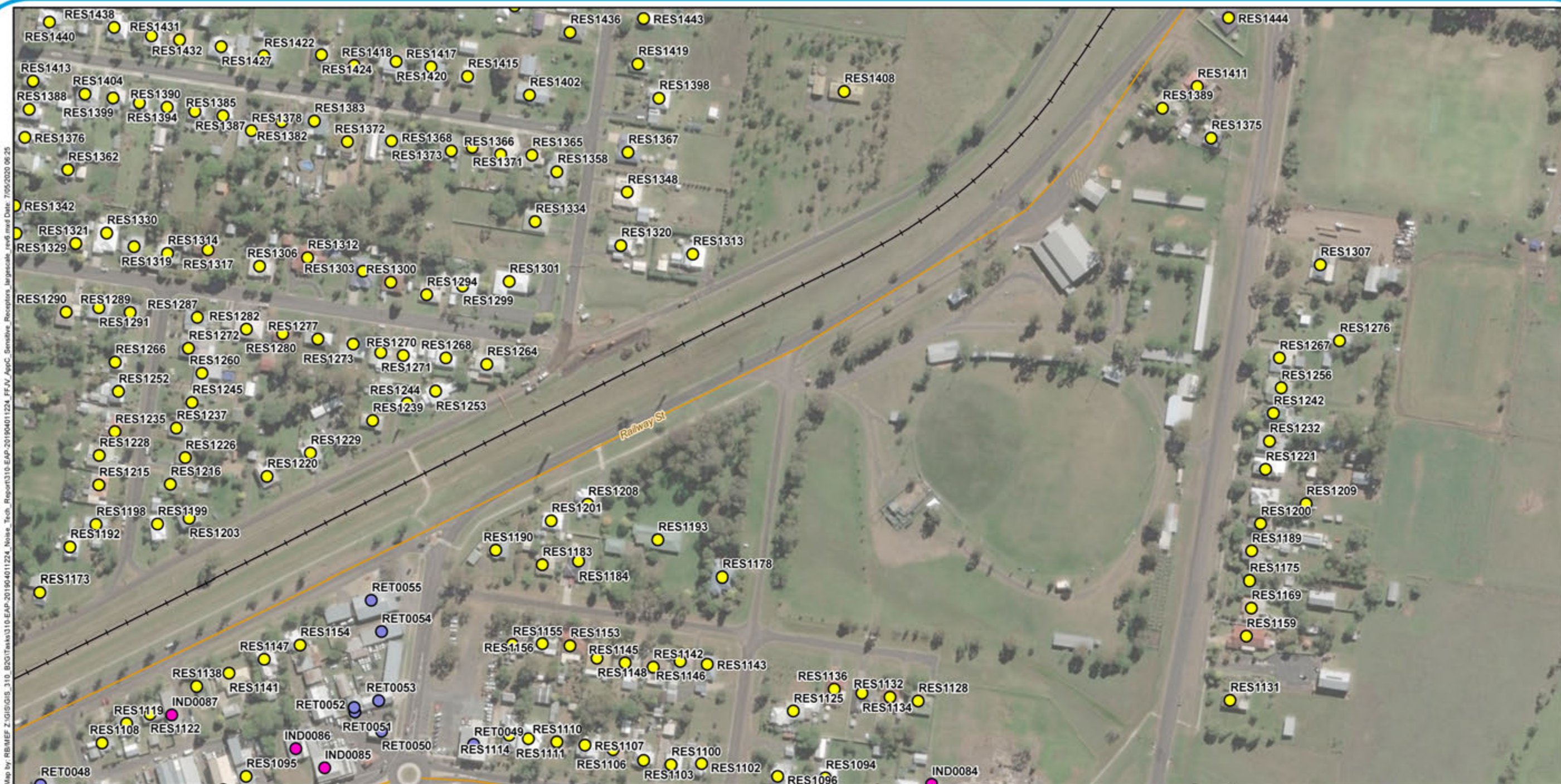
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 Localities  
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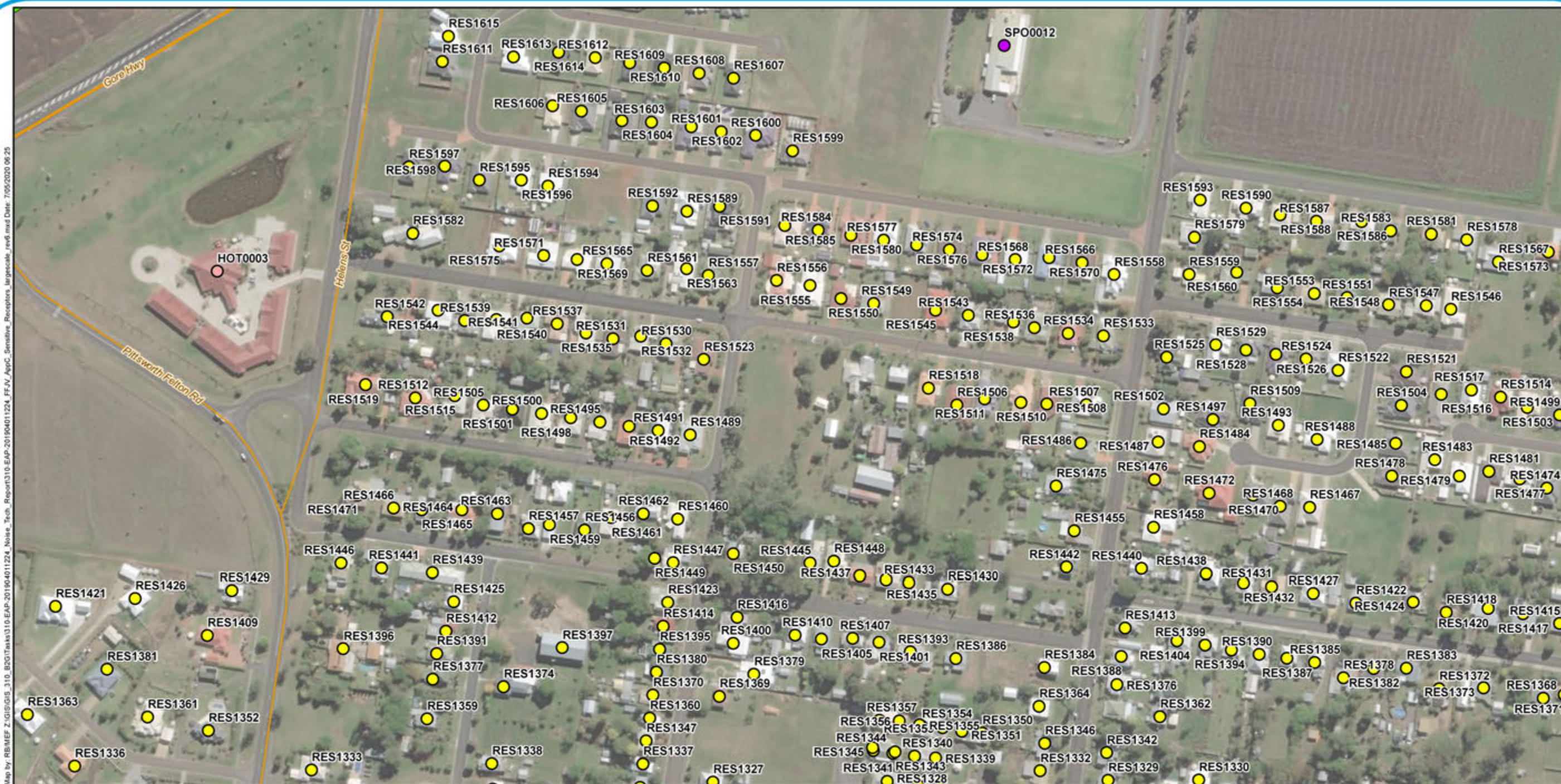
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**Future Freight**  
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#### Sensitive Receptors

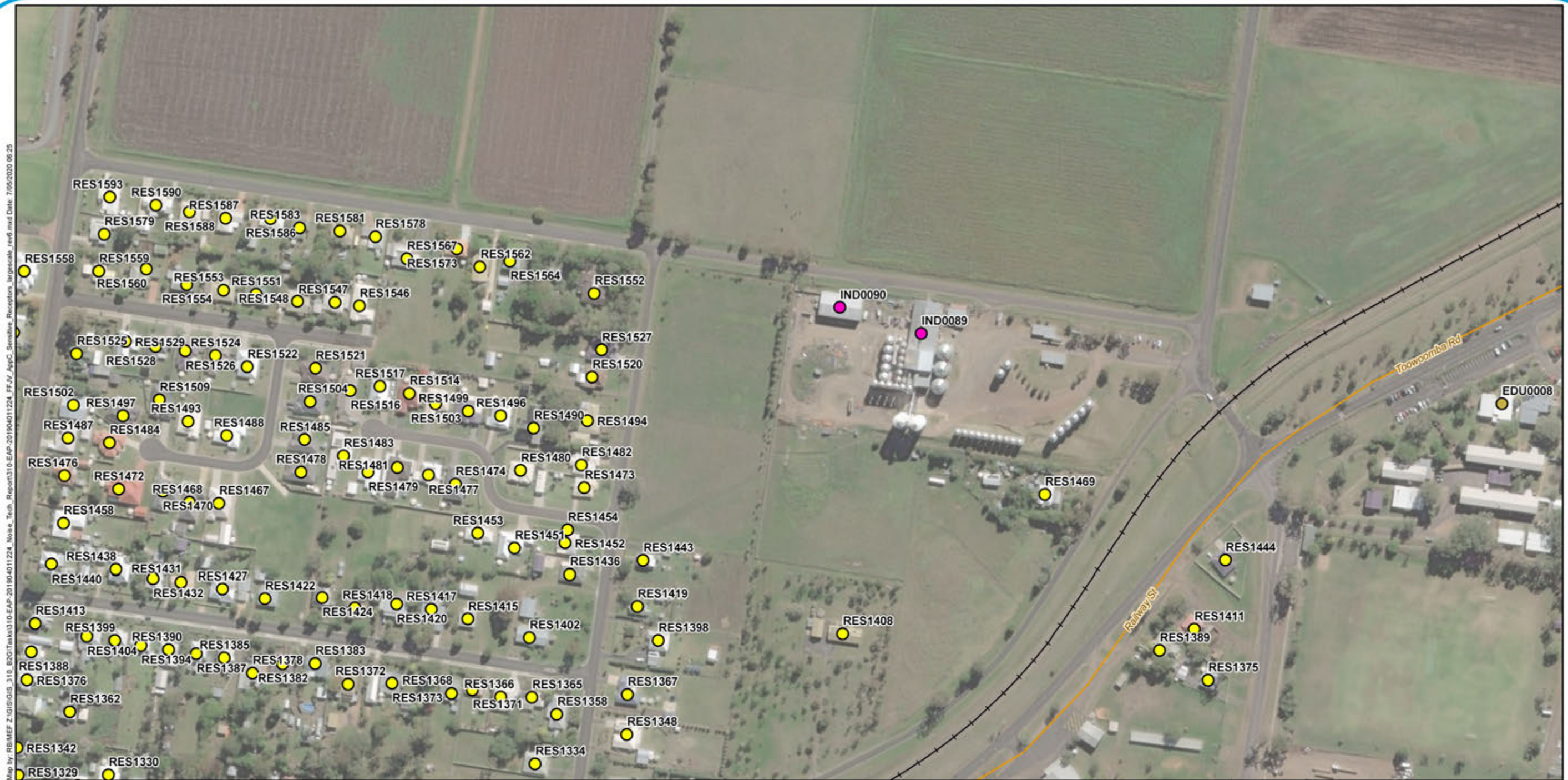
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310-EAP-201904011224\_Noise\_Tech\_Report\310-EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 08:25



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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_N\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



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#### Legend

- 5 Chainage (km)
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#### Sensitive Receptors

- |                                                            |                                                                                                          |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <span style="color: green;">●</span> Commercial Office     | <span style="color: magenta;">●</span> Industrial                                                        |
| <span style="color: blue;">●</span> Commercial Retail      | <span style="color: cyan;">●</span> Medical Building                                                     |
| <span style="color: darkblue;">●</span> Community Building | <span style="color: brown;">●</span> Outdoor Recreation                                                  |
| <span style="color: orange;">●</span> Educational Building | <span style="color: yellow;">●</span> Residential                                                        |
| <span style="color: pink;">●</span> Hotel/Motel            | <span style="color: purple;">●</span> Sporting Facility                                                  |
|                                                            | <span style="border: 2px solid cyan; display: inline-block; width: 10px; height: 10px;"></span> Heritage |



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Task310\_EAP-201904011224\_Noise\_Tech\_Report310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



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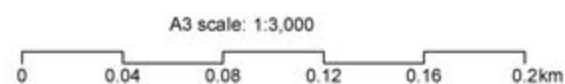


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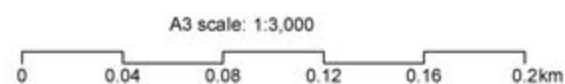


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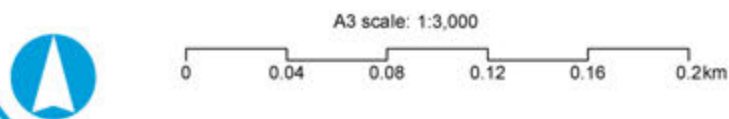
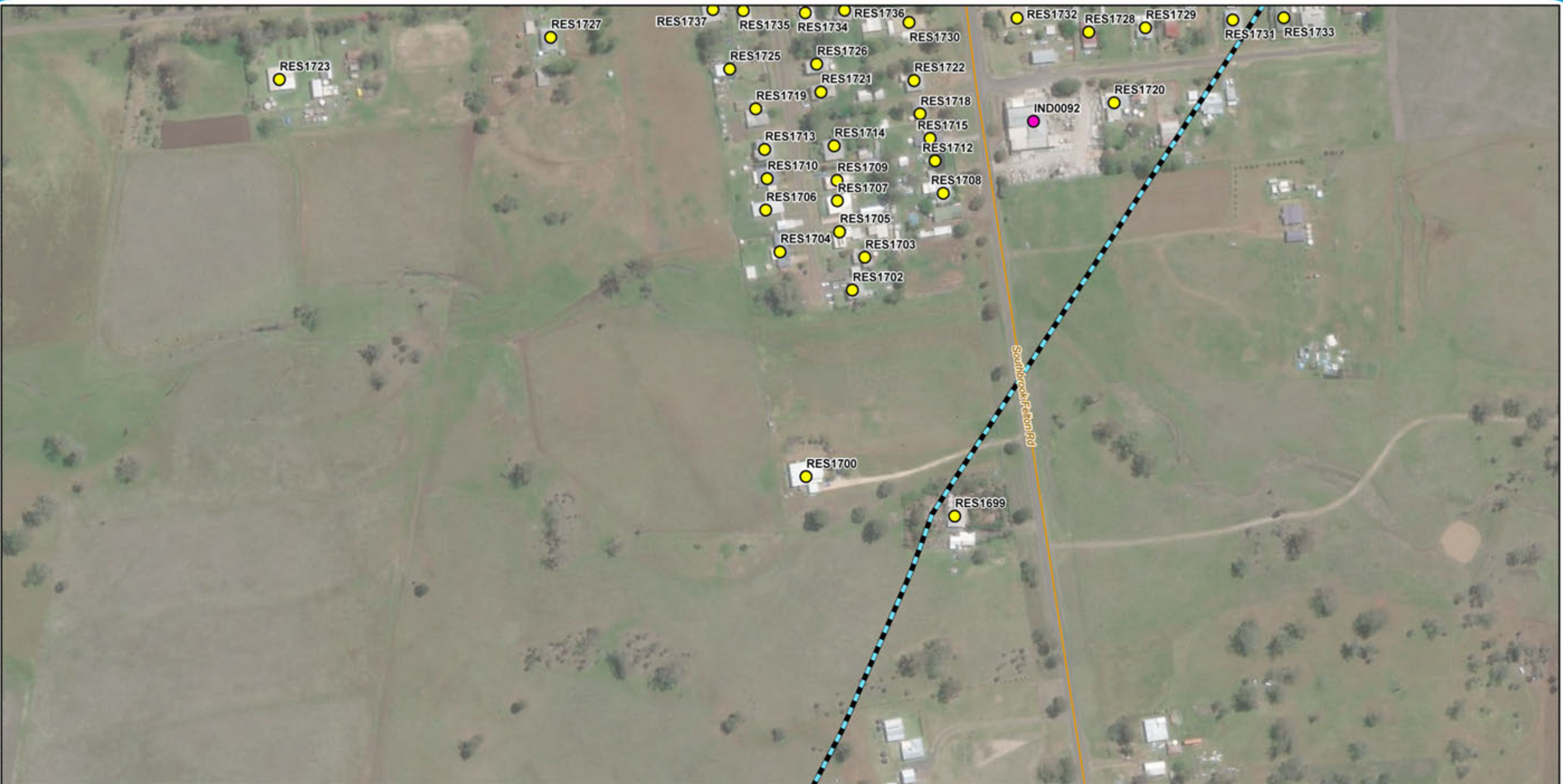
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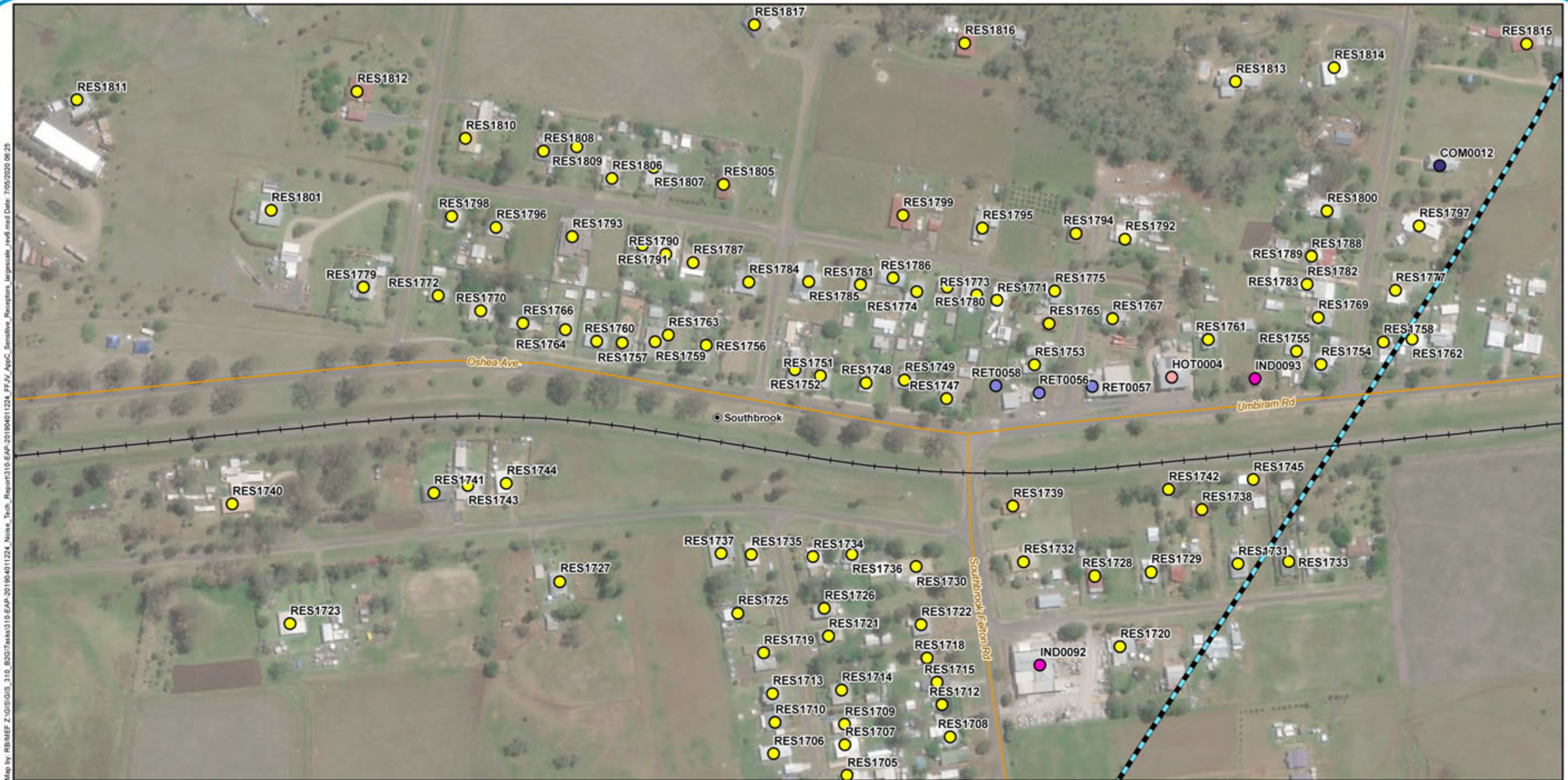


**Future Freight**  
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**Border to Gowrie**  
**Appendix C118: Sensitive receptors**





#### Legend

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0 0.04 0.08 0.12 0.16 0.2km



**Future Freight**  
Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
Coordinate System: GDA 1994 MGA Zone 56



Map by: RB/MEF 2:GIS/015\_310\_B2G/Tasks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largeScale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads
- Minor roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel

- Industrial
- Medical Building
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- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
 Coordinate System: GDA 1994 MGA Zone 56



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

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 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Tasks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large-scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
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Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310\_EAP-20190401\224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Noise and vibration impact assessment area
- Minor roads

#### Sensitive Receptors

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Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Tracks310-EAP-201904011224\_Noise\_Tech\_Report310-EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largeScale\_rev6.mxd Date: 7/05/2020 06:25



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#### Legend

- 5 Chainage (km)
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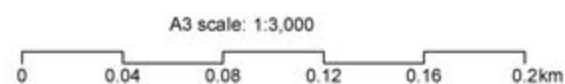


#### Legend

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Issue date: 06/05/2020 Version: 6  
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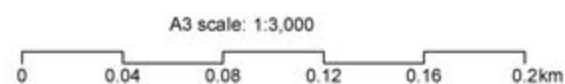


#### Legend

- 5 Chainage (km)
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#### Sensitive Receptors

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#### Legend

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#### Sensitive Receptors

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#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Noise and vibration impact assessment area

#### Sensitive Receptors

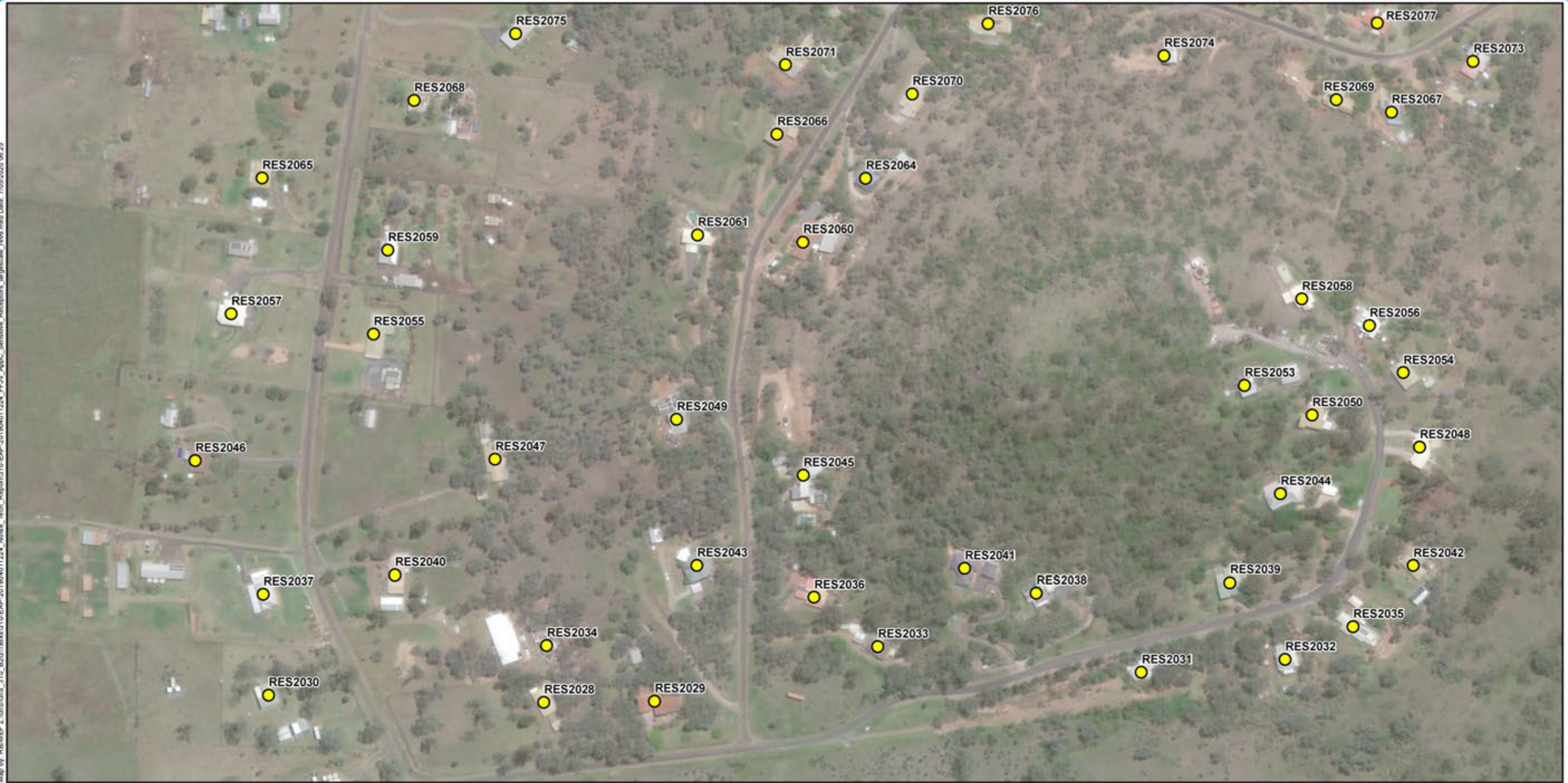
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#### Legend

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#### Sensitive Receptors

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Issue date: 06/05/2020 Version: 6  
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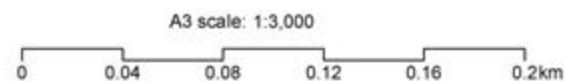


#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
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#### Sensitive Receptors

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#### Legend

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#### Sensitive Receptors

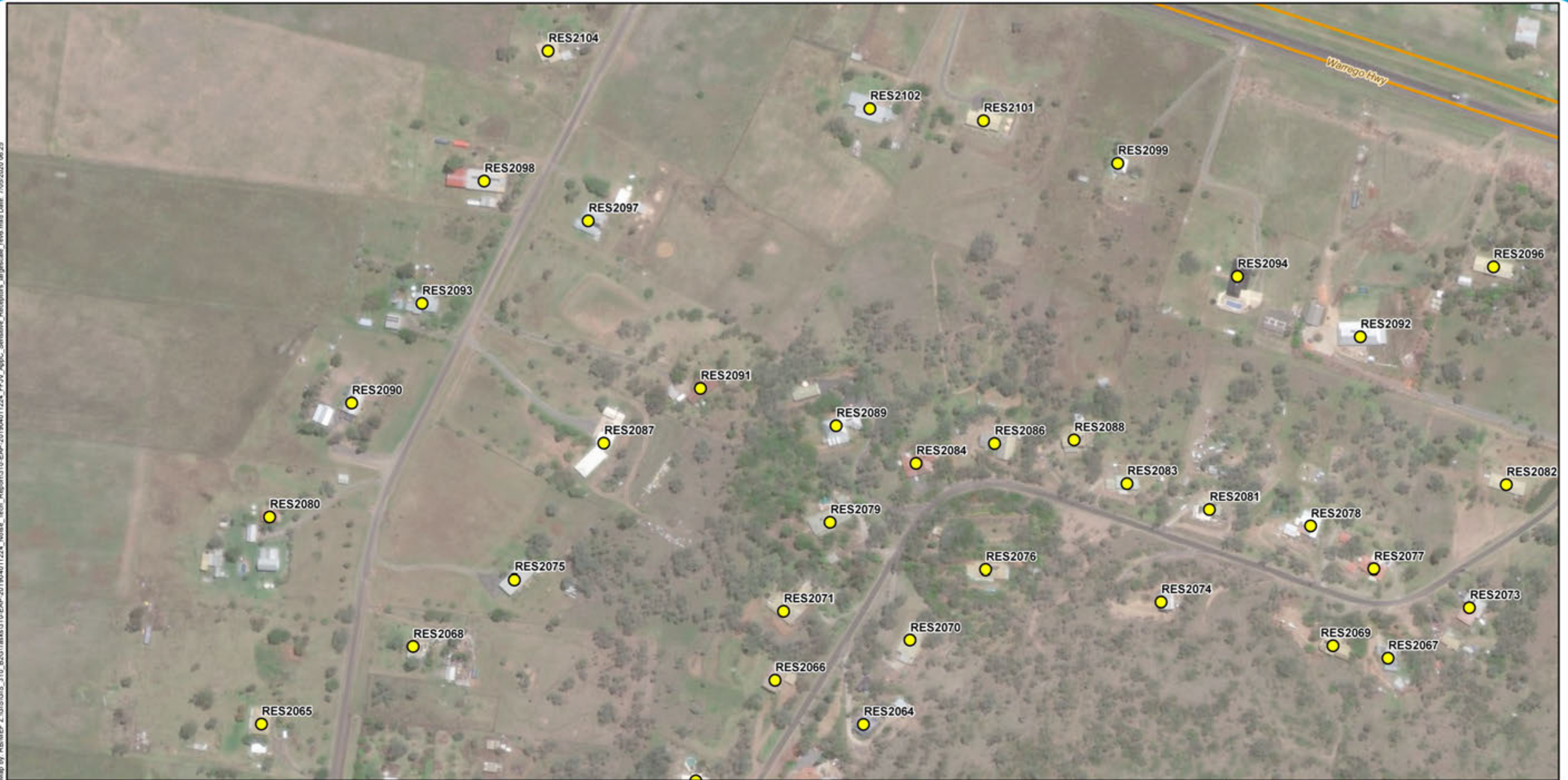
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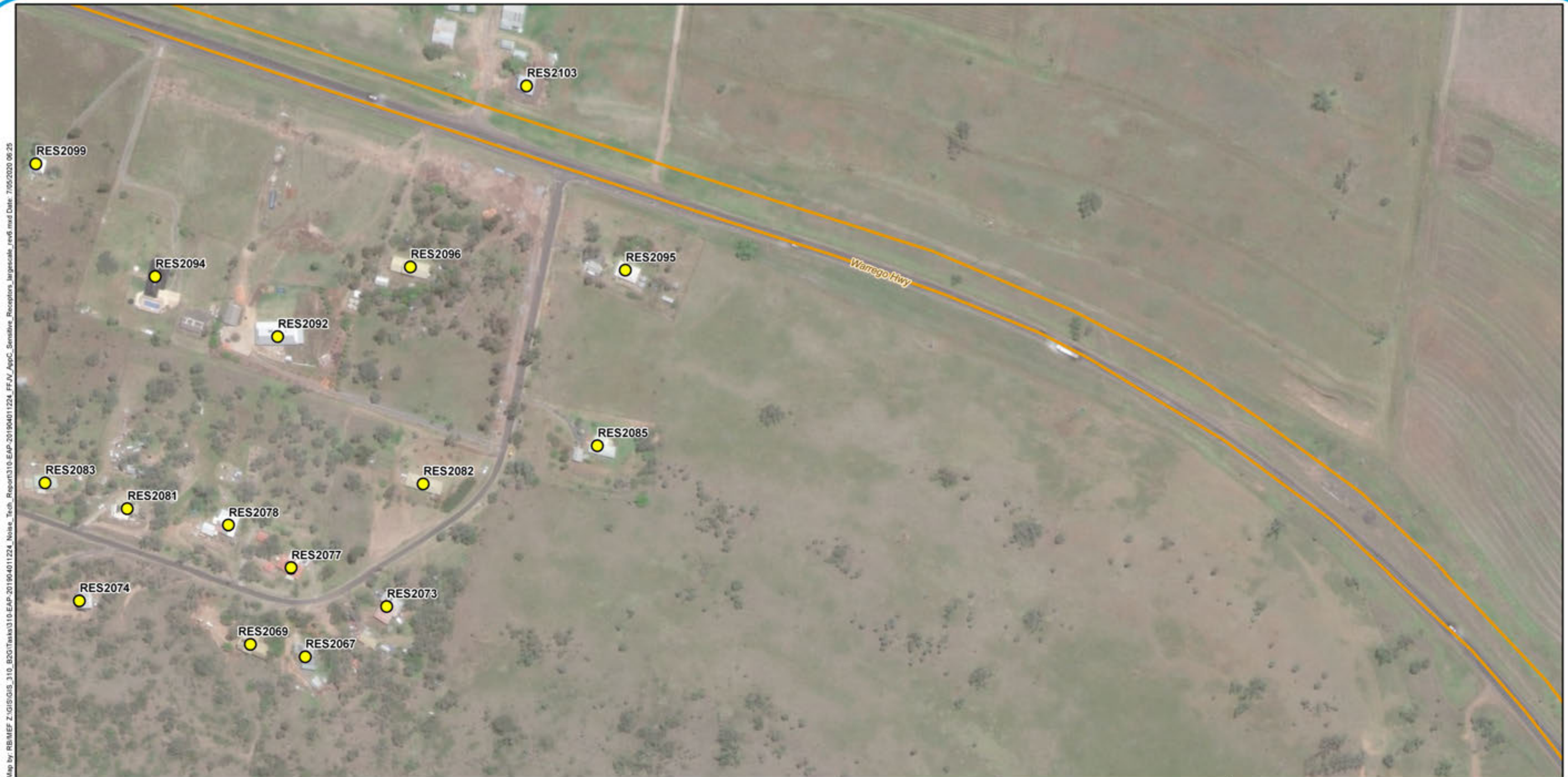
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#### Legend

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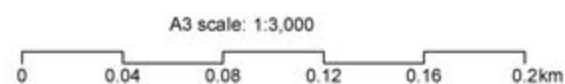


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#### Legend

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#### Sensitive Receptors

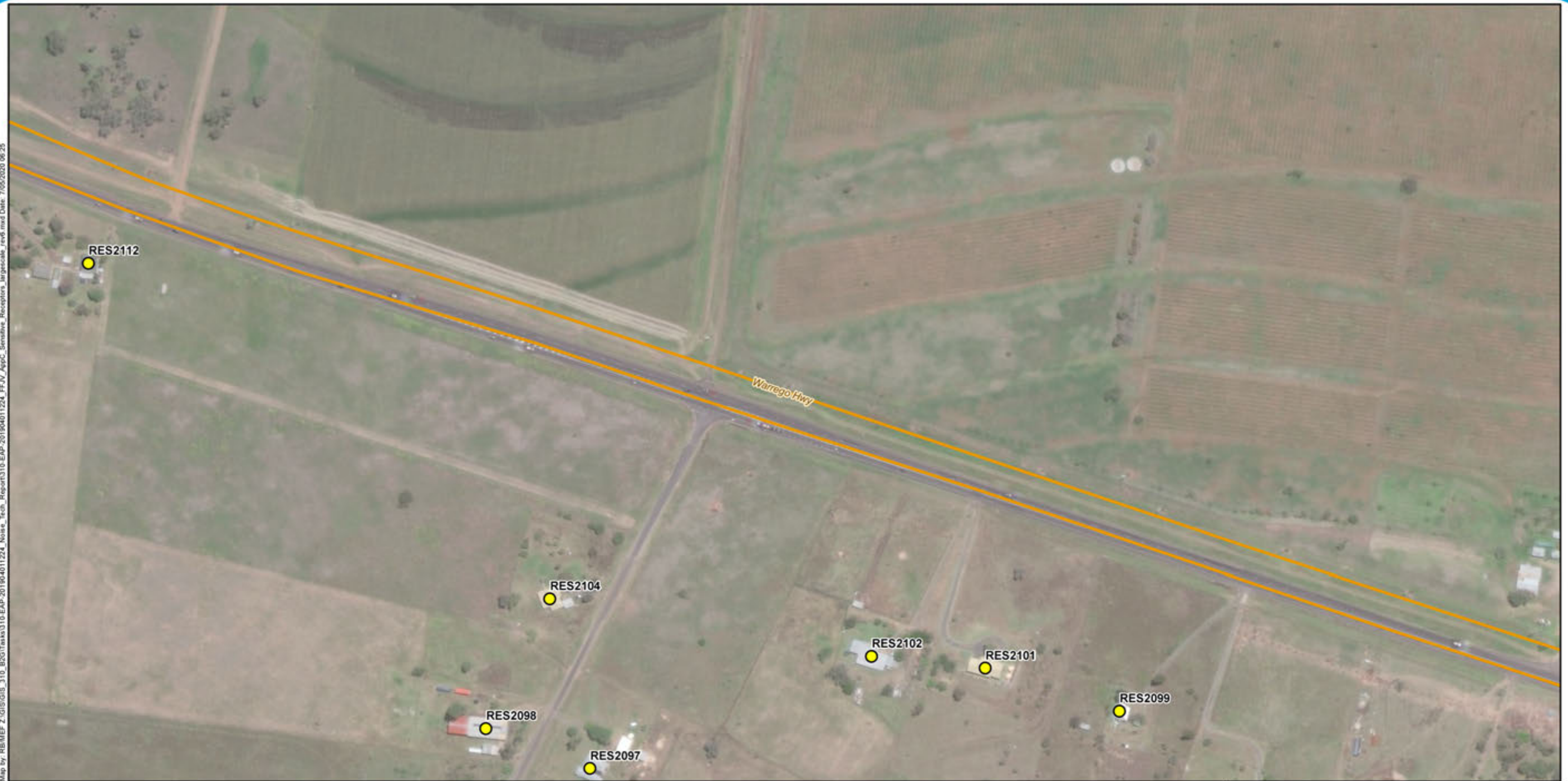
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Tasks/310\_EAP-201904011224\_Noise\_Tech\_Report/310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 08:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
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- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\N\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

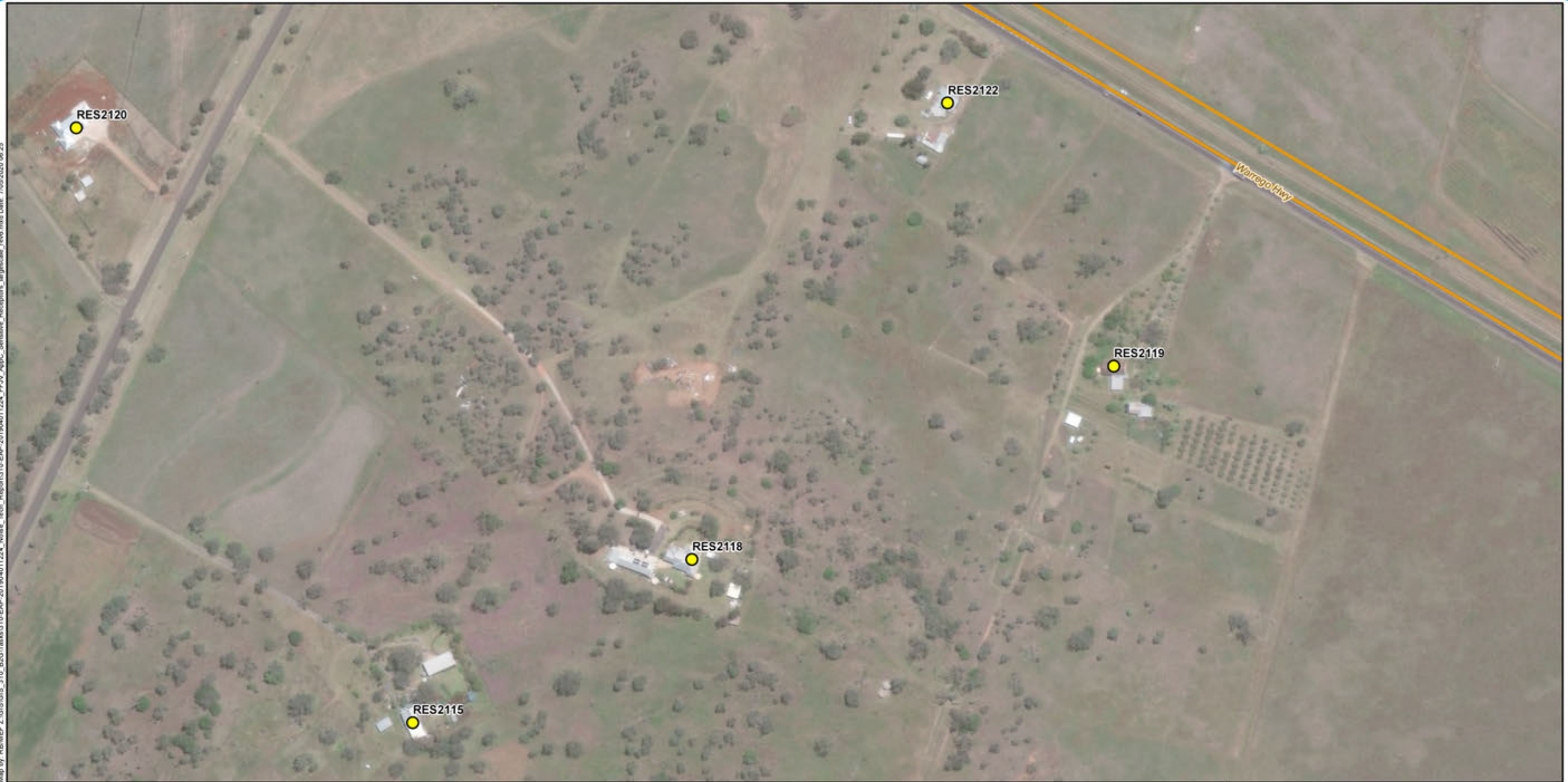
- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF 2:GIS/GIS\_310\_B2G/Task310\_EAP-201904011224\_Noise\_Tech\_Report310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_largeScale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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- Outdoor Recreation
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- Heritage



A3 scale: 1:3,000  
0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25

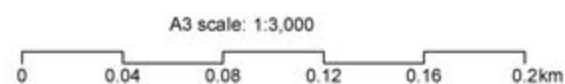


#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- |                                                            |                                                                                                          |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <span style="color: green;">●</span> Commercial Office     | <span style="color: magenta;">●</span> Industrial                                                        |
| <span style="color: blue;">●</span> Commercial Retail      | <span style="color: cyan;">●</span> Medical Building                                                     |
| <span style="color: darkblue;">●</span> Community Building | <span style="color: brown;">●</span> Outdoor Recreation                                                  |
| <span style="color: orange;">●</span> Educational Building | <span style="color: yellow;">●</span> Residential                                                        |
| <span style="color: pink;">●</span> Hotel/Motel            | <span style="color: purple;">●</span> Sporting Facility                                                  |
|                                                            | <span style="border: 2px solid cyan; display: inline-block; width: 10px; height: 10px;"></span> Heritage |





Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-20190401\224\_Noise\_Tech\_Report\310-EAP-20190401\224\_FF\N\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads
- Minor roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel

- Industrial
- Medical Building
- Outdoor Recreation
- Residential
- Sporting Facility
- Heritage



A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



**Future Freight**  
 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
 Coordinate System: GDA 1994 MGA Zone 56



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area
- Major roads
- Minor roads

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_AppC\_Sensitive\_Receptors\_large\scale\_rev6.mxd Date: 7/05/2020 06:25



#### Legend

- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
- Educational Building
- Hotel/Motel
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A3 scale: 1:3,000  
 0 0.04 0.08 0.12 0.16 0.2km



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 Integrating Community, Environment and Engineering

Issue date: 06/05/2020 Version: 6  
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Map by: RB/MEF Z:\GIS\GIS\_310\_B2G\Tasks\310\_EAP-201904011224\_Noise\_Tech\_Report\310\_EAP-201904011224\_FF\_V\_Apoc\_Sensitive\_Receptors\_large.mxd Date: 7/05/2020 06:25

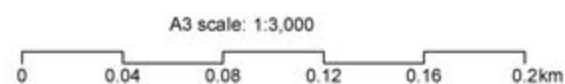


#### Legend

- 5 Chainage (km)
- Localities
- Noise and vibration impact assessment area

#### Sensitive Receptors

- Commercial Office
- Commercial Retail
- Community Building
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