APPENDIX

P

Non-Operational Noise and Vibration Technical Report

PART 1 OF 3

Main Report and Appendix A

CALVERT TO KAGARU ENVIRONMENTAL IMPACT STATEMENT

IR_1381

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

Inland Rail: - Calvert to Kagaru

Appendix P – Non-operational Noise and Vibration Technical Report

Australian Rail Track Corporation

Reference: 3400

Document Number:
2-0001-340-EAP-10-RP-0213

Contents

Appendices

Figures

Tables

Abbreviations

Abbreviation	Explanation
ARTC	Australian Rail Track Corporation
EP Act	*Environmental Protection Act 1994* (Qld)
Inland Rail	Melbourne to Brisbane Inland Rail
km	kilometre
m	metre
NSW	New South Wales
PPV	peak particle velocity
QLD	Queensland
SPL	Sound Pressure Level
SWL	Sound power level
the proponent	Australian Rail Track Corporation
TI Act	*Transport Infrastructure Act 1994* (Qld)

Glossary

Term	Explanation
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 1kHz 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).
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Assessment background level [ABL]	The overall background level for each day, evening and night period for each day of the noise monitoring.
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_{90} sound pressure level is used to quantify background noise.
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 (>5,000) frequencies. It is typically reserved for peak noise measurements and some entertainment noise applications.
Decibel [dB]	The measurement unit of sound.
Decibel scale	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: ▪ 0 dB(A) Threshold of human hearing ▪ 30 dB(A) A quiet country park ▪ 40 dB(A) Whisper in a library ▪ 50 dB(A) Open office space ▪ 70 dB(A) Inside a car on a freeway ▪ 80 dB(A) Outboard motor ▪ 90 dB(A) Heavy vehicle pass-by ▪ 100 dB(A) Jackhammer/subway train ▪ 110 dB(A) Rock concert ▪ 120 dB(A) 747 take off at 250 m
Equivalent continuous sound level [L_{eq}]	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.

Term	Explanation
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.
L_{10}	The sound pressure level exceeded for 10 per cent of the measurement period. For 10 per cent of the measurement period it was louder than the L_{10}.
L_{90}	The sound pressure level exceeded for 90 per cent of the measurement period. For 90 per cent of the measurement period it was louder than the L_{90}.
$L_{A,10}$	The A-weighted sound pressure level exceeded for 10 per cent of the measurement period. For 10 per cent of the measurement period it was louder than the $L_{A,10}$.
$L_{A,90}$	The A-weighted sound pressure level exceeded for 90 per cent of the measurement period. For 90 per cent of the measurement period it was louder than the $L_{A,90}$.
$L_{A,max}$	The A-weighted maximum sound pressure level measured over the measurement period
$L_{A,min}$	The A-weighted minimum sound pressure level over the measurement period.
L_{ASMax}	The A-weighted maximum sound pressure level with slow response
L_{max}	The maximum sound pressure level measured over the measurement period.
L_{min}	The minimum sound pressure level measured over the measurement period.
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.
Rating background level [RBL]	The overall background level for each day, evening and night period for the entire length of noise monitoring.
Sound power level [SWL]	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified point.

Executive summary

The Calvert to Kagaru section of Inland Rail (the Project) will be constructed as an approximately 53 kilometres (km) long single-track dual-gauge railway with crossing loops to accommodate double stack freight trains up to 1,800 metres (m) long initially, and ultimately accommodate trains up to 3,600 m long. The Project will also include a 1,015 m tunnel through the Teviot Range.

Although ARTC are applying for approval to build infrastructure to accommodate trains up to 1,800 m in length, infrastructure will be designed such that the future extension of some crossing loops to accommodate 3,600 m trains is not precluded. ARTC intend to acquire the land for the future 3,600 m crossing loop extension with the initial land acquisition, however, the approval for the construction of future 3,600 m crossing loops will be subject to separate approval applications in the future.

FFJV has been commissioned by ARTC to carry out a non-operational noise and vibration impact assessment in accordance with the Project Terms of Reference (ToR). Operational railway noise and vibration is reported separately in the EIS Appendix Q: Operational Railway Noise and Vibration Technical Report.

The non-operational noise and vibration assessment have been carried out under relevant legislation including the *Transport Infrastructure Act 1994* (Qld) (TI Act) and the *Environmental Protection Act 1994* (Qld) (EP Act).

Nearby sensitive receptors potentially affected by the Project have been identified. The existing noise and vibration environment have been described by noise and vibration monitoring. Baseline noise measurements were used to establish construction noise criteria.

Reasonable worst-case construction scenarios have been assessed for each of the main construction activities. The assessment was undertaken in accordance with the Transport Noise Management Code of Practice Volume 2: Construction Noise and Vibration (CoP Vol 2). Construction noise and vibration impacts vary with the construction activity undertaken and the time of day in which it occurs. The worst-case impacts of construction noise and vibration associated with the Project are summarised in Table 1. Appendix C presents the typical worst-case $L_{Aeq,\,15\,min}$ noise level contours for the construction activities for individual properties. It is important to consider that 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 receptor 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.

A desktop assessment of the operational road traffic noise associated with the Project has been carried out in accordance with the Transport Noise Management Code of Practice: Volume 1 – Road Traffic Noise (CoP Vol 1) and ToR. Table 1 summarises the findings of the operational road traffic noise assessment.

An assessment of the operational fixed infrastructure noise has been carried out using ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. Operational fixed infrastructure noise is predicted to meet the Environmental Protection (Noise) Policy 2019 (EPP (Noise)) acoustic quality objectives at all sensitive receptors. Table 1 summarises the findings of the operational fixed infrastructure assessment. Predicted noise levels at the noise sensitive locations are mapped in Appendix F.

Table 1 Non-operational noise and vibration impact assessment findings

Impact	Activity (highest impact)	Criterion (most stringent)	Criterion source	Predicted impacts without mitigation
Construction noise	Earthworks	Non-standard hours: 45 dB(A) $L_{Aeq,\ 15\ min}$	CoP Vol 2	Noise impacts at 781 noise sensitive receptors are predicted to exceed this limit.
Construction road traffic noise	Construction traffic movements	3 dB(A) increase in the $L_{A10,\ 1hr}$ due to construction traffic	CoP Vol 2	Eighteen roads are predicted to exceed this limit. The maximum predicted increase is 12 dB(A)
Construction vibration	Percussive (impact) piling	Non-standard hours, human comfort: 0.3 mm/s peak particle velocity (PPV)	CoP Vol 2	Vibration impacts at 71 vibration sensitive receptors are expected to exceed this limit.
Blasting ground vibration and airblast overpressure	Construction blasting	Blasting charge masses are not known at this stage. Therefore, maximum allowable instantaneous charge masses have been provided at indicative distances and sensitive receptors.		
Tunnel construction ground-borne noise	Roadheader operation	Non-standard hours: 45 dB(A) $L_{Aeq,\ 15\ min}$	CoP Vol 2	Ground-borne noise impacts of tunnel construction are not predicted to exceed this limit at any sensitive receptors.
Tunnel construction vibration	Roadheader operation	Non-standard hours, human comfort: 0.3 mm/s PPV	CoP Vol 2	Vibration impacts of tunnel construction are not predicted to exceed this limit at any sensitive receptors.
Operational road traffic noise	Traffic movements on roads changed as part of the project	New roads: 60 dB(A) $L_{A10,\ 18\ hr}$ where existing ≤ 55 dB(A) New roads: 63 dB(A) $L_{A10,\ 18\ hr}$ where existing > 55 dB(A) Upgraded roads: 68 dB(A) $L_{A10,\ 18\ hr}$	CoP Vol 1	All road sections undergoing works as part of the project are predicted to comply with the appropriate limit. One exceedance at residential receptor RES0411 is predicted adjacent to the section of Ipswich Boonah road to be upgraded.
Operational fixed infrastructure noise	Operation of tunnel ventilation fans	30 dB(A) internal $L_{Aeq,\ 1\ hr}$	EPP (Noise)	All fixed infrastructure associated with the project is predicted to comply with the noise objective at all sensitive receptors.

To mitigate construction noise and vibration impacts upon nearby sensitive receptors, specific noise management and mitigation measures are incorporated in the Construction Noise and Vibration Management Sub-plan, which will form as part of the construction environmental management plan (CEMP). Mitigation measures will include the following:

- Effective community consultation
- Training of construction site workers
- Use of temporary noise barriers
- Monitoring
- Appropriate selection and maintenance of equipment
- Scheduling of work during less sensitive time periods
- Situating plant away from noise sensitive locations
- Construction traffic management
- Respite periods.

Based on the construction noise assessment and recommended examples of mitigation, construction noise impacts at 45 per cent of receptors are not predicted to be feasibly mitigated to below the appropriate criterion by physical attenuation alone. Where further mitigation is also similarly infeasible or unreasonable, residual impacts may need to be managed. The management of residual impacts should be undertaken in consultation with the community and affected residents. Residual construction noise impacts present after the application of mitigation will be temporary and will cease once construction finishes. It is recommended that residual construction noise impacts be managed through:

- Temporary relocation of affected occupants
- Respite periods
- Architectural treatments

Operational noise impacts will be mitigated as required to meet the relevant criteria. Residual operational noise levels after the application of mitigation will therefore be acceptable.

1 Introduction

1.1 Project background

The Inland Rail Program will provide a dedicated 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, in partnership with the private sector. The 1,700 kilometres (km) route is being delivered in thirteen distinct project sections.

The Calvert to Kagaru section of Inland Rail (the Project) will be constructed as an approximately 53 km single-track dual gauge railway with crossing loops to accommodate double stack freight trains up to 1,800 metres (m) long, with for future capacity for trains up to 3,600 m long. The Project will also include a 1,015 m tunnel through the Teviot Range.

Although ARTC are applying for approval to build infrastructure to accommodate trains up to 1,800 m in length, infrastructure will be designed such that the future extension of some crossing loops to accommodate 3,600 m trains is not precluded. ARTC intend to acquire the land for the future 3,600 m crossing loop extension with the initial land acquisition, however, the approval for the construction of future 3,600 m crossing loops will be subject to separate approval applications in the future.

1.2 Key features of the Project

Key components of the Project include:

- 53 km of single track dual gauge rail line with four crossing loops to ultimately accommodate trains up 3,600 m long based on business needs, but initially constructed for 1,800 m long train sets
- 1,015 m Teviot Range tunnel, and bridges to accommodate topography and Project crossings of waterways and other infrastructure
- Tie-ins to the existing West Moreton Railway Line at the Project boundary
- Allowance for a future connection to the Ebenezer Industrial Area at Willowbank
- The construction of associated rail infrastructure including maintenance sidings and signalling infrastructure to support the Advanced Train Management System (ATMS)
- Rail crossings including level crossings, grade separations/road overbridges, occupational/private crossings, fauna crossing structures
- Tie-ins to the existing operational Sydney to Brisbane Interstate railway line at Kagaru
- Significant embankments and cuttings will be required along the length of the alignment
- Ancillary works including road and public utility crossings and realignments, signage and fencing and provision of services within the corridor (excluding those undertaken as enabling works)
- Construction worksites, laydown areas and access roads.

1.3 Purpose of this report.

This technical report provides an assessment of noise and vibration impacts related to construction activities, operational road traffic noise and fixed infrastructure of the Project and has been prepared to support the Project's Environmental Impact Statement (EIS). The noise and vibration impacts of the Project have been assessed to address the ToR. Operational noise from road sections which would be re-aligned due to the road and rail interface and fixed infrastructure are also been assessed within this report.

1.4 Scope of this report

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

- Identify nearby sensitive receptors potentially affected by the Project
- Undertake baseline noise and vibration measurements
- Establish construction noise criteria based upon the measured background noise levels, Department of Transport and Main Roads' (DTMR) document Transport Noise Management Code of Practice: Volume 2 – Construction Noise and Vibration (CoP Vol 2)
- Undertake a construction noise and vibration impact assessment of the construction works in accordance with the relevant guidelines
- Assess the noise impact resulting from construction activities and 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
- Identify potential impacts present after the application of recommended mitigation and recommend methods to manage these residual impacts.
- Review vibration intensive construction works and recommend minimum working distances and mitigation measures where required, including the use of alternative equipment and construction methods, respite periods and other management mitigation measures
- 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), and CoP Vol 2 respectively
- Undertake an operational noise impact assessment of proposed steady state noise sources such as fixed infrastructure and new or upgraded road sections that are required as part of the Project in accordance with the ToR.

Operational noise and vibration from rail movements has been assessed in a separate report, refer Appendix Q: Operational Railway Noise and Vibration Technical Report of the EIS.

2 Assessment requirements for the Project

2.1 Legislation

QLD legislation which includes requirements for the construction noise and vibration, operational road traffic noise, and operational fixed infrastructure noise assessment and environmental approval processes for the Project includes:

- *Transport Infrastructure Act 1994* (Qld) (TI Act)
- *Environmental Protection Act 1994* (Qld) (EP Act).

The TI Act requires that the construction, maintenance and operation of government supported infrastructure is carried out according to standards published by the Chief Executive administering the TI Act. The CoP Vol 1 is a standard under the TI Act.

The EP Act regulates activities which cause or have the potential to cause environmental harm and includes a requirement for a person to comply with the general environmental duty, which requires a person to take all "reasonable and practicable measures" to prevent or minimise environmental harm. Compliance with the general environmental duty is a defence to causing environmental harm under the EP Act.

Schedule 1, Part 1 of the EP Act excludes noise from the ordinary use of rail transport infrastructure as constituting unlawful environmental nuisance or unlawful contravention of a noise standard. Specific documents are gazetted under the EP Act to assess impacts.

The CoP Vol 2 is an approved code of practice made under the EP Act which states ways of achieving compliance with the general environmental duty. CoP Vol 2 is an applicable noise guideline in the ToR.

The Environmental Protection (Noise) Policy 2019 (Qld) (EPP (Noise)) supports the operation of the EP Act by identifying environmental values to be enhanced or protected, stating acoustic quality objectives for enhancing or protecting environmental values and providing a framework for consistent, equitable and informed decisions about the acoustic environment.

Environmental values that are to be enhanced or protected under the EPP (Noise) include the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems, human health and wellbeing and protecting the amenity of the community. Schedule 1 of the EPP (Noise) includes acoustic quality objectives for sensitive receptors and those environmental values that are to be enhanced or protected under the policy.

Table 2.1 describes the policies, guidelines and plans relevant to the Project. No other government plans were considered relevant for this assessment.

Table 2.1 Guidelines and policies relevant to the Project

Guideline or policy	Guideline/policy description
CoP Vol 1	The CoP Vol 1 is a standard under the TI Act. It identifies the criteria for road traffic noise for established road categories.
CoP Vol 2	The CoP Vol 2 is gazetted under the EP Act. It identifies the criteria for construction noise and vibration. Relevant criteria and potential mitigation measures are included within this document in relation to noise and vibration associated with construction works.
German Standard DIN 4150: Part 3 1999 Structural Vibration in Buildings - Effects on Structures, 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 for the Project.
Australian Standard AS 1055.1-1997 – Acoustics – Description and measurement of environmental noise, Part 1: General procedures, 1997	The CoP Vol 2 prescribes that noise measurement and reporting should be conducted in accordance with the construction and ambient noise provisions included in this standard.

Guideline or policy	Guideline/policy description
Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, Australian and New Zealand Environment Council (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 Explosives - Storage and Use Part 2: Use of Explosives – Appendix J.	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.
Department of Environment, Heritage and Protection (DEHP) Guideline – Noise and Vibration from Blasting (DEHP 2016)	The CoP Vol 2 adopts the criteria to minimise annoyance from airblast resulting from blasting from this document.
DES Application requirements for activities with noise impacts (DES 2019)	This guideline under the EP Act provides guidance on the requirements for assessments of noise impacts. The current proposal includes no Environmentally Relevant Activities (ERAs) with a significant noise impact. Final ERAs and applications will be finalised at later stages of the project and if ERAs are required then the application will utilise this guideline.
British Standard BS5228-1 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise	Noise source data from this standard is recommended for the modelling of construction noise impacts by the CoP Vol 2.
Environmental Protection (Noise) Policy 2019 (Qld)	Provides support to the operation of the EP Act by identifying environmental values to be enhanced or protected, stating acoustics quality objectives for enhancing or protecting environmental values and providing a framework for consistent, equitable and informed decisions about the acoustic environment.

Applicable criteria and potential mitigation measures are included within this document to adequately assess noise and vibration impacts associated with construction works. This report outlines the applicable criteria for the construction noise and vibration, operational road traffic noise and operational fixed infrastructure noise, and proposed mitigation measures.

2.2 Terms of Reference requirements

The noise and vibration section of the ToR (Part B, Section 11) has been reproduced in Table 2.2, alongside the relevant sections of this report which address these requirements.

Table 2.2 Terms of Reference requirements

Terms of Reference requirements				Addressed in report
Noise and vibration	Existing environment	11.118	Describe the existing noise and vibration environment that may be affected by the Project in the context of the environmental values.	Section 3
		11.119	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 and Appendix A
		11.120	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
	Impact assessment	11.121	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 and 6

Terms of Reference requirements				Addressed in report
		11.122	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: a) EPP (Noise) 2019, using recognised quality assured methods b) Environmentally Relevant Activities - Application requirements for activities with noise impacts (Guideline ESR/2015/1838) 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. d) Operational Noise – The Department of Transport and Main Roads Policy for Development on Land Affected by Environmental Emissions from Transport and Transport Infrastructure Versions 2, 10 May 2013 (Rail noise external criteria contained in Table 3 of this document) e) Operational vibration – British Standard BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings – Vibration sources other than blasting. British Standards Institution, London f) Operational Noise – The Department of Transport and Main Roads Policy for Development on Land Affected by Environmental Emissions from Transport and Transport Infrastructure Versions 2, 10 May 2013 (criteria contained in Table 6 of the document).	Sections 5 and 6, and Appendices C and D
		11.123	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 and 6
		11.124	Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the:	Refer sub-sections below.
			a) Activity's consistency with the objectives of documentation referenced in 11.122	Appendix P: Non-operational Noise and Vibration Technical Report, Sections 2 and 5.4
			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	Appendix P: Non-operational Noise and Vibration Technical Report, Section 7
			c) Potential impacts of any low-frequency (<200 Hz) noise emissions.	Appendix P: Non-operational Noise and Vibration Technical Report, Section 4.1.1

Terms of Reference requirements				Addressed in report
	Mitigation measures	11.125	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.	Sections 2.1 and 8
		11.126	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.	
		11.127	Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed.	
Hazard, health and safety	Climate	11.166	Describe the climate patterns with particular regard to discharges to water and air and the propagation of noise related to the project.	Section 3.3.3 Effect of climate patterns on the propagation of construction noise is described in accordance with the CoP Vol 2 in Chapter 15: Noise and Vibration. Construction noise emissions will persist for a period far shorter than the assessment period of changes of climate relative to the propagation of noise.

3 Existing noise environment

3.1 Site description

The noise and vibration study area for the Project is the area which falls within 2 km of the disturbance footprint in all directions, designated as part of the Project's design. The noise and vibration study area is shown in Figure 3.1. The land surrounding the Project is predominantly rural land. The Project crosses a number of local and private roads, creeks and privately-owned properties. There are several towns located along the noise and vibration study area including Calvert, Lanefield, Ebenezer, Peak Crossing, and Kagaru. In addition, there are a number of scattered rural residential properties. The Project is also near the Cunningham Highway, a connecting route to Warwick and western Queensland towns, and Ipswich-Boonah Road, a major connecting route between Ipswich and Boonah.

3.2 Sensitive receptors

Sensitive receptors applicable to the Project have been identified throughout the noise and vibration study area. The CoP Vol 2 outlines the sensitive land uses that could be potentially impacted by construction noise and vibration. Additionally, the EPP (Noise) defines sensitive receptors, which are covered by the CoP Vol 2 definitions.

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

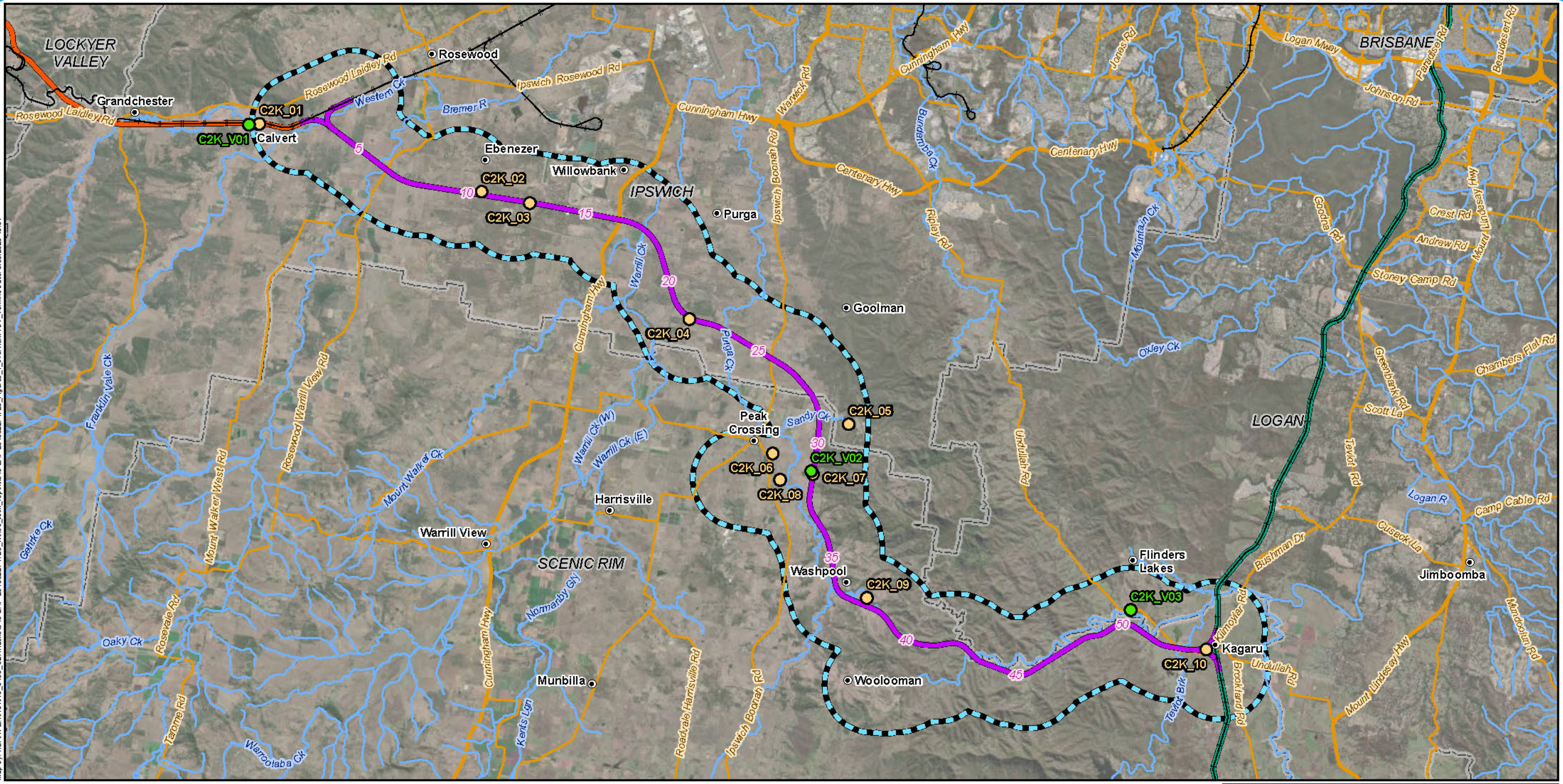
- A dwelling (detached or attached) including house, townhouse, unit, reformatory institution, caravan park or retirement village
- A library, child care centre, kindergarten, school, school playground, college, university, museum, art gallery or other educational institution, hospital, respite care 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 noise and vibration study area designated as part of the design was identified using a combination of land property information and investigation of detailed aerial imagery. All identified sensitive receptors within the noise and vibration study area is included in Appendix A.

A total of 906 sensitive receptors were found to be within the noise and vibration study area. Of these:

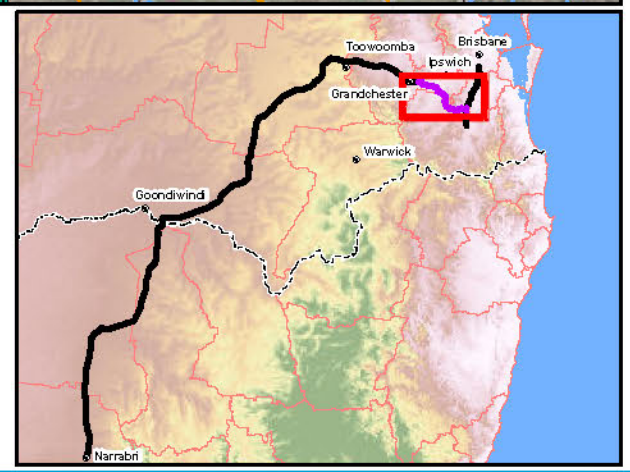
- Twelve sensitive receptors were found to be used for industrial purposes and are not classified as "noise sensitive" and have only been included within the vibration and blasting assessments
- Thirteen listed historic heritage structures were identified within the noise and vibration study area, six of which are also residential receptors. The remaining seven are unoccupied and therefore not noise sensitive and have only been included within the vibration and blasting assessments.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Vibration monitoring locations
- Noise montoring locations
- 5 Chainage (km)
- Localities
- Existing rail
- H2C project alignment
- C2K project alignment
- K2ARB project alignment
- Watercourses
- Major roads
- Minor roads
- Noise and vibration study area
- Local Government Areas



A3 scale: 1:175,000

0 1 2 3 4 5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 03/03/2020 Version: 1
Coordinate System: GDA 1994 MGA Zone 56

Calvert to Kagaru

Figure 3.1: Noise and vibration monitoring locations

3.3 Noise and vibration monitoring

Attended and unattended ambient noise monitoring was conducted at 10 locations within the noise and vibration study area in November 2018, shown in Figure 3.1. This included both long term monitoring and short term attended measurements. Noise monitoring locations were selected as representative of clusters of sensitive receptors, particularly those most at risk of being impacted by construction noise. Monitoring included both long term monitoring and short term attended measurements. The monitoring was conducted in accordance with the CoP Vol 2.

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 1 m 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 measured in 15 minute averaging periods.

The first 24 hours of noise monitoring and last 24 hours of noise monitoring additionally included attended measurements. One 15 minute attended measurement at each site over the first 24 hours and one 15 minute attended measurement at each site over the final 24 hours was undertaken.

Fifteen minute attended vibration measurements were conducted at each noise monitoring locations, using a handheld vibration monitor with an accelerometer. The monitoring was installed externally to the building with an accelerometer installed at ground level to measure background vibration levels. The accelerometer was mounted through the use of small ground stakes where possible in conjunction with sandbag overlaid weighing up to 20 kilograms (kg). Root mean square particle velocity and peak particle velocity (PPV) were measured in one-third octave bands.

The unattended noise measurements define the long-term noise environment throughout the noise and vibration study area and were used to determine the external construction noise limits for standard and non-standard hours as per CoP Vol 2. Attended noise measurements were carried out to provide additional information about the existing noise environment and the most significant noise sources.

Two portable weather stations were used to identify when and where meteorological influences may affect the measured noise levels. Each portable weather station measured the following:

- Temperature
- Humidity
- Rainfall
- Wind speed and direction.

Inclement weather that occurred throughout the monitoring period was excluded. Inclement weather is classified as any of the following occurring over an averaging period.

- Average wind speed over 5 m/s
- Any measurement of rainfall.

3.3.1 Noise instrumentation

Details of the equipment used for unattended long-term noise monitoring are presented in Table 3.1. The noise monitoring locations are shown in Figure 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 ID	Address	Start date	End date	Logger type	Serial number
C2K_01	30 Newcastle Street, Calvert, Queensland, 4340	19/11/2018	29/11/2018	01 dB DUO	12606
C2K_02[1]	84 Paynes Road, Ebenezer, Queensland, 4340	19/11/2018	28/11/2018	01 dB DUO	12602

Monitor ID	Address	Start date	End date	Logger type	Serial number
C2K_03	285-327 Paynes Road, Ebenezer, Queensland, 4340	19/11/2018	26/11/2018	01 dB DUO	12601
C2K_04	871 Middle Road, Purga, Queensland, 4306	20/11/2018	27/11/2018	Rion NL-52	001265386
C2K_05	310 Mount Flinders Road, Peak Crossing, Queensland, 4306	20/11/2018	27/11/2018	01 dB Cube	10824
C2K_06	63 McNeils Road, Peak Crossing, Queensland, 4306	20/11/2018	27/11/2018	01 dB DUO	12609
C2K_07	182 Dwyers Road, Peak Crossing, Queensland, 4306	20/11/2018	27/11/2018	Rion NL-52	00175550
C2K_08	1544 Ipswitch-Boonah Road, Peak Crossing, Queensland, 4306	20/11/2018	27/11/2018	01 dB DUO	12608
C2K_09[1]	581 Washpool Road, Washpool, Queensland, 4309	19/11/2018	28/11/2018	01 dB Cube	11107
C2K_10	738 Undullah Road, Kagaru, Queensland, 4285	21/11/2018	28/11/2018	01 dB Cube	12605

Table notes:

1 A portable weather station was used at this site

All acoustic instrumentation used for the assessment comply 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 ± 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). All calibration certificates have been included within Appendix B.

The sound level meters used to conduct attended noise measurements are presented in Table 3.2. Each item of equipment also has a NATA calibration certificate and met the Class 1 requirements for SLM. Attended measurements were conducted at the deployment and removal of each long-term noise logger.

Table 3.2 Attended measurement monitoring details

Monitor ID	Attended measurement 1 date	Logger type	Serial number	Attended measurement 2 date	Logger type	Serial number
C2K_01	19/11/2018	NTI-XA	A2A-09320-E0	29/11/2018	NTI-XA	A2A-09320-E0
C2K_02	19/11/2018	NTI-XA	A2A-09320-E0	28/11/2018	NTI-XA	A2A-09320-E0
C2K_03	19/11/2018	NTI-XA	A2A-09320-E0	26/11/2018	NTI-XA	A2A-09320-E0
C2K_04	20/11/2018	NTI-XA	A2A-09320-E0	27/11/2018	NTI-XA	A2A-09320-E0
C2K_05	20/11/2018	SVAN 957	27537	27/11/2018	SVAN 957	27537
C2K_06	20/11/2018	NTI-XA	A2A-09320-E0	27/11/2018	NTI-XA	A2A-09320-E0
C2K_07	20/11/2018	SVAN 957	27537	27/11/2018	SVAN 957	27537
C2K_08	20/11/2018	NTI-XA	A2A-09320-E0	27/11/2018	NTI-XA	A2A-09320-E0
C2K_09	19/11/2018	SVAN 957	27537	28/11/2018	SVAN 957	27537
C2K_10	21/11/2018	NTI-XA	A2A-09320-E0	28/11/2018	NTI-XA	A2A-09320-E0

3.3.2 Vibration instrumentation

Details of the equipment used for attended vibration monitoring are presented in Table 3.3.

Table 3.3 Vibration monitoring details

Location	Equipment type	Serial number	Calibration date
All vibration monitoring locations	Instatel Minimate Plus	BE14070	10/05/19
All vibration monitoring locations	Instatel Standard Triaxial Geophone	BT2091	10/05/19

3.3.3 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 1 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 acoustical 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 over each period of interest. 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 background levels determined over the entire monitoring duration for each period of interest. 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 B. A summary of the existing measured RBL noise levels is presented in Table 3.4.

Table 3.4 Existing background and ambient noise levels

Monitoring location	Rating background level, dB(A)		
	Day[1]	Evening[1]	Night[1]
C2K_01	35	32	27
C2K_02	33	31	23
C2K_03	33	28	23
C2K_04	32	33	25
C2K_05	39	32	22
C2K_06	34	39	35
C2K_07	29	29	22
C2K_08	35	31	23
C2K_09	35	25	<21
C2K_10	<21	<21	<21

Table notes:

1 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 10.00pm to 7.00am.

3.3.4 Weather monitoring results

All average wind speed measurements were below 5 m/s throughout the monitoring period, at both portable weather station locations. At both sites there were occasional, short periods of rainfall. Noise measurements gathered during these periods were omitted. Details of the weather monitoring results at each site can be found in Appendix B.

3.3.5 Attended noise monitoring results

Attended noise monitoring was conducted at all unattended monitoring locations between November 2018. Each measurement was conducted over a 15 minute period. Weather conditions were clear on the day of monitoring, with minimal wind unless stated otherwise in the summary of observations. The monitoring results from the attended measurements and the summary of observations are presented in Table 3.5.

Table 3.5 Attended noise monitoring results

Monitoring location	Date	Time	Summary of observations	$L_{Amax,15min}$, dB(A)	$L_{A10,15min}$, dB(A)	$L_{A90,15min}$, dB(A)	$L_{Aeq,15min}$, dB(A)
C2K_01	19/11/2018	16:30	▪ Cow 44 dB(A) ▪ Distant traffic 52 dB(A) ▪ Local car 42 dB(A) ▪ Birds 40 to 62 dB(A)	65	43	33	43
	29/11/2018	6:45	▪ Distant bark 44 dB(A) ▪ Motorbike 45 to 52 dB(A) ▪ Distant traffic 32 to 55 dB(A) ▪ Local car 42 dB(A) ▪ Birds 35 to 52 dB(A)	67	47	33	44
C2K_02	19/11/2018	12:15	▪ Bird 38 to 46 dB(A) ▪ Insect 30 to 34 dB(A) ▪ Wind gust 38 dB(A) ▪ Resident 45 dB(A) ▪ Aeroplane 40 dB(A)	53	37	29	35
	28/11/2018	10:00	▪ Wind gust 50 dB(A) ▪ Insect 42 dB(A) ▪ Truck local 62 dB(A)	62	51	42	48
C2K_03	19/11/2018	14:45	▪ Bird 36 to 66 dB(A), ▪ Wind gust 40 dB(A), ▪ Ambient distant traffic 45 to 43 dB(A)	65	45	36	43
	26/11/2018	11:45	▪ Wind Gust 46 to 60 dB(A) ▪ Car Local 42 to47 dB(A) ▪ Resident talking 60 dB(A) ▪ Aeroplane 52 dB(A) ▪ Ambient noise resident 40 to 55 dB(A)	78	49	38	48

Monitoring location	Date	Time	Summary of observations	$L_{Amax,15min}$, dB(A)	$L_{A10,15min}$, dB(A)	$L_{A90,15min}$, dB(A)	$L_{Aeq,15min}$, dB(A)
C2K_04	20/11/2018	14:15	▪ Ambient distant traffic 35 dB(A) ▪ Natural sources 36 to 38 dB(A) ▪ Car pass-by 47 to 55 dB(A) ▪ Wind gusts 52 dB(A) ▪ Insects 38 dB(A) ▪ Aeroplane 40 to 63 dB(A)	64	45	34	43
	27/11/2018	11:00	▪ Birds at 42 to 62 dB(A) ▪ Car pass-by 40 to 58 dB(A) ▪ Aeroplane 34 to 35 dB(A) ▪ Cow at 32 dB(A), ▪ Distant traffic 36 dB(A)	62	42	29	43
C2K_05	20/11/2018	10:45	▪ Bird 47 to53 dB(A) ▪ Insect 39 to 49 dB(A)	54	47	40	44
	27/11/2018	13:15	▪ Person dropping equipment 63 to 71 dB(A) ▪ Insect 47 dB(A)	71	53	48	51
C2K_06	20/11/2018	13:00	▪ Distant traffic 33 to 37 dB(A) ▪ Dog 35 to 48 dB(A) ▪ Bird 42 to 70 dB(A) ▪ Car 35 dB(A) ▪ Truck 38 dB(A) ▪ Natural sources 31dB(A)	68	48	34	47
	27/11/2018	12:30	▪ Distant traffic 34 to 44 dB(A) ▪ Dog 60 to 63 dB(A) ▪ Bird 55 to 68 dB(A) ▪ Car 39 to 56 dB(A) ▪ Truck 46 to 51 dB(A) ▪ Gust of wind 42 to 56 dB(A) ▪ Plane 50 to 57 dB(A) ▪ Cow 44 to 48 dB(A)	73	40	33	42
C2K_07	20/11/2018	14:15	▪ Aeroplane 49 to 62 dB(A) ▪ Bird 38 to 43 dB(A) ▪ Distant traffic 31 to 32 dB(A)	62	40	30	41
	27/11/2018	10:30	▪ Aeroplane 41 to 65 dB(A) ▪ Car 32 to 37 dB(A) ▪ Distant traffic 28 to 31 dB(A)	66	50	28	46

Monitoring location	Date	Time	Summary of observations	$L_{Amax,15min}$, dB(A)	$L_{A10,15min}$, dB(A)	$L_{A90,15min}$, dB(A)	$L_{Aeq,15min}$, dB(A)
C2K_08	20/11/2018	10:15	▪ Birds 38 to 62 dB(A) ▪ Trucks 42 to 46 dB(A) ▪ Distant Traffic 35 to 38 dB(A)	62	46	31	43
	27/11/2018	7:45	▪ Birds 39 to 48 dB(A) ▪ Resident noise 43 dB(A) ▪ Cars 33 to 43 dB(A)	49	41	31	38
C2K_09	19/11/2018	16:45	▪ Wind gust 42 to 45 dB(A) ▪ Bird 51 dB(A) ▪ Residents 57 dB(A) ▪ Natural sources 39 dB(A)	60	46	38	44
	28/11/2018	10:45	▪ Wind gust 44 to 45 dB(A) ▪ Bird 50 to 62 dB(A) ▪ Noise from resident 41 dB(A) ▪ Distant wind 40 dB(A)	63	51	41	47
C2K_10	21/11/2018	9:30	▪ Birds 36 to 48 dB(A) ▪ Trucks 46 to 58 dB(A) ▪ Aeroplane 44 to 46 dB(A) ▪ Natural sources 33 to 36 dB(A) ▪ Cars 33 dB(A) ▪ Wind gust 41 dB(A)	58	47	34	43
	28/11/2018	7:30	▪ Birds 36 to 63 dB(A) ▪ Cars 40 dB(A) ▪ Insects 40 dB(A) ▪ Local truck 51 dB(A) ▪ Aeroplane 47 to 50 dB(A), ▪ Resident 42 dB(A) ▪ Natural sources 37 to 40 dB(A)	63	47	38	45

3.3.6 Vibration monitoring results

Table 3.6 contains the vibration measurement site summary showing the PPV vibration levels from the monitoring period. Sources of existing background vibration include vehicle movements, wind gusts, and nearby fauna movements.

Table 3.6 Background vibration measurements

Site	Date	Start time	End time	PPV (mm/s)
C2K_V01	3/07/2019	2:31 PM	2:47 PM	0.21
C2K_V02	3/07/2019	1:09 PM	1:26 PM	0.15
C2K_V03	3/07/2019	11:22 AM	11:37 AM	0.12

4 Assessment criteria

4.1 Criteria

Noise and vibration criteria are specific to the type of source of noise or vibration. Noise criteria for different types of noise use various noise parameters as well as various limits. Each of the following categories of noise and vibration sources is assessed individually:

- External construction noise limits applied to the assessment of construction activities and construction sites
- Noise assessment criteria for construction traffic
- Vibration assessment standards for intensive vibration generating construction activities
- Vibration and overpressure standards for blasting activities
- Operational noise criteria for the fixed infrastructure associated with the Project
- Operational road traffic noise criteria for the proposed locations with road and rail interface.

The assessment of the above various sources is consistent with the ToR and the relevant noise and vibration legislation, policies and guidelines.

4.1.1 External construction airborne noise criteria

For dwellings (including short term accommodation such as hotels and motels), noise emissions associated with construction activities are to be assessed using the noise criteria in Table 4.1, adopted from the CoP Vol 2. Exceeding the upper limits is considered to cause significant annoyance, and the upper limits are used 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 limits 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 noise and vibration study area.

The CoP Vol 2 definitions of standard hours and non-standard hours is presented in Table 4.2**.**

Table 4.1 External construction noise criteria

Receptor period		**External noise level $L_{Aeq,\ adj,\ 15min}$[4,5], dB(A)**	
		Lower limit	**Upper limit**
Standard hours (CoP Vol 2)		RBL* + 10 [1,2,3]	75 where: RBL > 55
			70 where: 40 < RBL ≤ 55
			65 where: RBL ≤ 40
Non-Standard Hours (CoP Vol 2)	Evening	RBL + 5 [3]	RBL + 5
	Night-time		

Table notes:

*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

This single short event adjustment from table note 6 of 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 4.2 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 Saturday 8.00 am to 1.00 pm	Monday to Friday 9.00 am to 5.00 pm Saturday 9.00 am to 1.00 pm
Non-standard hours – day/evening	Monday to Friday 6.00 pm to 10.00 pm Saturday 1.00 pm to 10.00 pm 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 of Environment and Science 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	

Table 4.3 outlines the adjustment factors that should be applied to the analysis in order to consider noise characteristics such as low frequency noise, as per the CoP Vol 2.

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: ▪ 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz ▪ 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive ▪ 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	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. 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 seconds.

Factor	Assessment/ measurement	When to apply	Correction	Comments
Intermittent/ modulating noise	Measurement of difference between L_{A10} and L_{A90}, average difference between short term samples, or subjectively assessed	▪ Difference between L_{A10} and L_{A90} exceeds 5 dB repeatedly for a characteristic averaging period (for example, 10 seconds) for intermittent sources ▪ Average difference between measured L_{Aeq} levels exceeds 5 dB for a characteristic sampling frequency (for example, 10 Hz) for rapidly varying source ▪ Subjectively annoying for a combination not easily characterised.	5 dB	Adjustment to be applied for night-time only.
Maximum adjustment	Refer to individual modifying factors	Where two or more adjustment factors are applied to a noise course, the total adjustment may be no more than this value.	Maximum correction of 10 dB(A)	-

Table 4.1 was applied at each of the reference monitoring locations to obtain external construction noise criteria for the different work areas, shown in Table 4.4.

Table 4.4 External construction noise criteria

Monitor ID	CoP Vol 2 Work period[3]	Monitor level	External façade corrected noise level	
		RBL, L_{A90}, dB(A)	Construction $L_{Aeq,adj,15\ minute}$	
			Lower limit	Upper limit
C2K_01	Standard hours	35	50[1]	65
	Non-standard hours (evening)	32	45[1]	45[2]
	Non-standard hours (night-time)	27	45[1]	45[2]
C2K_02	Standard hours	33	50[1]	65
	Non-standard hours (evening)	31	45[1]	45[2]
	Non-standard hours (night-time)	23	45[1]	45[2]
C2K_03	Standard hours	33	50[1]	65
	Non-standard hours (evening)	29	45[1]	45[2]
	Non-standard hours (night-time)	23	45[1]	45[2]
C2K_04	Standard hours	32	50[1]	65
	Non-standard hours (evening)	33	45[1]	45[2]
	Non-standard hours (night-time)	25	45[1]	45[2]
C2K_05	Standard hours	39	50[1]	65
	Non-standard hours (evening)	32	45[1]	45[2]
	Non-standard hours (night-time)	22	45[1]	45[2]
C2K_06	Standard hours	34	50[1]	65
	Non-standard hours (evening)	39	45[1]	45[2]
	Non-standard hours (night-time)	35	45[1]	45[2]
C2K_07	Standard hours	29	50[1]	65
	Non-standard hours (evening)	29	45[1]	45[2]
	Non-standard hours (night-time)	22	45[1]	45[2]

Monitor ID	CoP Vol 2 Work period[3]	Monitor level	External façade corrected noise level	
		RBL, L_{A90}, dB(A)	Construction $L_{Aeq,adj,15\ minute}$	
			Lower limit	Upper limit
C2K_08	Standard hours	35	50[1]	65
	Non-standard hours (evening)	31	45[1]	45[2]
	Non-standard hours (night-time)	23	45[1]	45[2]
C2K_09	Standard hours	35	50[1]	65
	Non-standard hours (evening)	25	45[1]	45[2]
	Non-standard hours (night-time)	<21	45[1]	45[2]
C2K_10	Standard hours	<21	50[1]	65
	Non-standard hours (evening)	<21	45[1]	45[2]
	Non-standard hours (night-time)	<21	45[1]	45[2]

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 Work periods are defined as per CoP Vol 2 in Table 4.2

It should be noted that the minimum criteria for all CoP Vol 2 times of day have been reached at all monitoring locations. Therefore, the minimum external construction noise criteria (upper and lower limits) set by CoP Vol 2 have been adopted across the entire extent of the Project. These minimum criteria are summarised in Table 4.5.

Table 4.5 Noise and vibration study area construction CoP Vol 2 upper and lower limits

CoP Vol 2 Work Period[1]		External noise level $L_{Aeq,adj,15\ minute}$ dB(A)	
		Lower limit	Upper limit
Standard hours	Day	50	65
Non-standard hours	Evening	-	45
	Night	-	

Table notes:

1 Work periods are defined as per CoP Vol 2 in Table 4.2

4.1.2 Noise criteria for critical facilities

CoP Vol 2 defines critical facilities and internal noise criteria for them, which are to be met where reasonable and practicable, and which applies for the operational hours of the facility. Critical facilities are identified within Table 4.6 along with their criteria.

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
Court of law (court reporting and transcript areas, Judges' chambers)	40
Community buildings (libraries, places of worship)	45

Receptors were categorised using a combination of Queensland cadastral data and aerial imagery. No critical receptors were identified within the noise and vibration study area.

4.1.3 Construction road traffic noise criteria

Haulage/transportation associated with construction activities on public roads within the noise and vibration study area or beyond has the potential to create noise issues for existing sensitive receptors. CoP Vol 2 specifies the following criteria to limit traffic noise caused by construction traffic:

- Construction traffic should not increase the pre-construction traffic noise level $L_{A10,\ 1\ hour}$ 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 presented in Table 4.7.

Table 4.7 Construction ground-borne noise investigation limits

Building	Ground-borne noise limit	
	Work period	**L_{ASMax}, dB(A)**
Dwellings (including hotels and motels)	Standard hours[1]	40
	Non-standard hours – day/evening[1]	35
	Non-standard hours – night[1]	35
Commercial (offices)	While in use	40

Table notes:

1 Work periods are defined as per CoP Vol 2and shown in Table 4.2

4.2 Ground-borne vibration criteria

Ground-borne vibration criteria are defined in CoP Vol 2. The effects of ground-borne 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).

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

4.2.1 Human comfort

In order to minimise annoyance due to ground-borne construction vibration, CoP Vol 2 adopts the vibration levels that are presented in Table 4.8. 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]	1.0	2.0
	Non-standard hours – evening[1]	0.3	1.0
	Non-standard hours – night[1]	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:

1 Work periods are defined as per CoP Vol 2 and shown in Table 4.2

For this assessment, only criteria for "dwellings (including hotels and motels)", and "commercial (offices) and retail areas" (predominantly local stores in the noise and vibration study area) apply.

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 4150.3 provides recommended maximum levels of vibration that reduce the likelihood of building damage and are presented in Table 4.9. These have been adopted as short-term vibration criteria against building/structural damage.

Table 4.9 DIN 4150.3 Structural damage 'safe limits' for short-term building vibration

Group	Type of structure	PPV in mm/s		
		At foundation at a frequency of		
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz[1]
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 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.

The DIN 4150.3 limits listed in Table 4.10 have been adopted as long-term vibration criteria against building/structural damage.

Table 4.10 DIN 4150.3 Structural damage 'safe limits' for long-term building vibration

Group	Type of structure	PPV in mm/s of vibration in horizontal plane of highest floor, at all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	10
2	Dwellings and buildings of similar design and/or use (i.e. residential)	5
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under groups 1 or 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	2.5

'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 4.11.

Table 4.11 DIN 4150.3 guideline values for evaluating the effects of vibration on buried pipework

Line	Pipe material	Guideline values for peak particle velocity measured on the pipe in mm/s	
		Short-term vibration	Long-term vibration
1	Steel (including welded pipes)	100	50
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80	40
3	Masonry, plastic	50	25

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 environmental effects – airblast and ground vibration. The airblast and ground vibration produced may cause human discomfort and may have 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
- Australian Standard 2187.2-2006 Explosives - Storage and Use Part 2: Use of Explosives – Appendix J
- EP Act, including 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 and the CoP Vol 2. These criteria should be 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 considered and are summarised in Table 4.12.

Table 4.12 Blasting ground vibration criteria summary

Category	Human comfort	Structural damage[1]
Sensitive structures (e.g. residential, theatres, schools etc.)	5 mm/s for 95 per cent blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply[2]	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 The values above are less stringent than those in DIN 4150. This is because DIN 4150 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.

2 It should be noted that the human comfort limits should be based off the values presented above from the DEHP guideline as per the CoP Vol 2.

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 obtaining additional measurements on the structure itself. No such receptors have been identified within the noise and vibration study area as part of the EIS. Should structures with a particular sensitivity to vibration be identified, these should be addressed on a case by case basis.

4.3.2 Recommended hours and frequency of blasting activities

The CoP Vol 2 defines the working periods for blasting activities as follows:

- Blasting should generally only be permitted during the hours of 9:00 am to 5:00 pm Monday to Friday and Saturday 9:00 am to 1:00 pm
- Generally blasting is not to be conducted outside standard hours. Any blasting outside of standard hours must be approved by the Department of Environment and Science prior to blasting. It is noted that reduced limits may be required to be achieved.

4.4 Operational noise criteria

Operational railway noise and vibration criteria can be found in EIS Appendix Q: Operational Railway Noise and Vibration Technical Report.

4.4.1 Operational road traffic noise criteria

As the design includes a number of alterations to the road network, road works were categorised as per the definitions adopted from the CoP Vol 1. These definitions are provided in Table 4.13 and are acoustic terminology. Consequently, these categories may not align with those used in other reports.

Table 4.13 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. Also a new road is applicable 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 upgrading 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.

The assessed Project alterations to the existing road network are listed in Table 4.14. Private access and maintenance access roads are not assessed as part of the operational road traffic noise assessment.

Table 4.14 Project road changes

Road name	Approximate chainage (km)	Proposed treatment	CoP Vol 1 category
Hayes Road	4.40	Active level crossing,	Existing road upgrade
Mt Forbes Road	9.80	Grade separation – road over rail, within existing corridor	Existing road upgrade
Paynes Road	9.80	Realignment outside existing corridor	New Road
M Hines Road	12.00	Passive level crossing, within existing corridor	Existing road upgrade
Cunningham Highway	16.40	Grade separation – road over rail, within existing corridor	Existing road upgrade
Middle Road	21.80	Active level crossing, within existing corridor	Existing road upgrade
Ipswich Boonah Road	25.60	Grade separation – rail over road, within existing corridor	Existing road upgrade
Truloff Road	27.50	Realignment outside existing corridor	New Road

Road name	Approximate chainage (km)	Proposed treatment	CoP Vol 1 category
Mt Flinders Road	27.80	Grade separation – rail over road, within existing corridor	Existing road upgrade
Dwyers Road	32.00	Active level crossing, realignment outside existing corridor	New road
Washpool Road	34.00	Grade separation – rail over road, realignment outside existing corridor	New road
Wild Pig Creek Road Section 1	42.60	Grade separation – rail over road, realignment outside existing corridor	New road
Wild Pig Creek Road Section 2	45.60	Active level crossing, realignment inside existing corridor	Existing road upgrade
Wild Pig Creek Road Section 3	48.40	Realignment outside existing corridor	New road
Undullah Road Section 1	51.60	Grade separation – rail over road, realignment outside existing corridor	New road
Undullah Road Section 2	53.60	Grade separation – road over rail, realignment within existing corridor	Existing road upgrade

4.4.1.1 Operational road traffic noise criteria –new roads

The construction of seven new road sections is proposed within the noise and vibration study area. A desktop assessment approach has been implemented for each of the proposed road sections. The assessment has been completed in accordance with CoP Vol 1.

Table 4.15 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 1 m from the façade at a height of 1.5 m from FFL or mid window height, whichever is the higher. Outdoor educational and passive recreational areas are assessed in the free field. Note that due to the low existing noise levels throughout the noise and vibration study area shown in Section 3, the more stringent criteria of 60 L_{A10} (18h), dB(A) has been adopted for residential land uses.

Table 4.15 Road traffic assessment criteria for new roads (CoP Vol 1)

Category	Criteria		
	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 L_{A10} (18h), existing level > 55 L_{A10} (18h) 60 L_{A10} (18h), existing level ≤ 55 L_{A10} (18h)	58 L_{A10} (1h)	63 L_{A10} (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.

4.4.1.2 Operational road traffic noise criteria – road upgrades

The upgrade of nine road sections is proposed within the noise and vibration study area. A desktop assessment approach has been implemented for each of the proposed upgrades. The assessment has been completed in accordance with CoP Vol 1.

Table 4.16 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 1 m from the façade at a height of 1.5 m from finished floor level (FFL) or mid window height, whichever is the higher.

Table 4.16 Airborne noise criteria for upgraded roads

Description	Criteria		
	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 L_{A10} (18h)	65 L_{A10} (1h)	63 L_{A10} (12h)

4.4.2 Operational fixed infrastructure noise objectives

Noise impacts of the operation of fixed infrastructure included in the design have been assessed under EPP (Noise). Fixed infrastructure identified as part of the design includes:

- Tunnel ventilation fans for emergency and maintenance operations
- Pumps and pump stations
- Transformers, substations and generators.

The design does not currently identify any fixed infrastructure in the open route of the Project. Therefore, should any additional fixed infrastructure be identified during detailed design, operational noise impacts should be assessed, and mitigation designed to meet the EPP (Noise) acoustic quality objectives.

Safety systems have not been assessed as operational fixed infrastructure and are assessed in EIS Appendix Q: Operational Railway Noise and Vibration Technical Report. These noise sources include:

- Level crossing alarms
- Train horns.

As operation of fixed infrastructure can occur during any time of the day or night, the most onerous noise objectives for the night-time (10:00 pm to 7:00 am) have been utilised for the assessment. The following acoustic quality objectives from the EPP (Noise) have been used to assess fixed infrastructure noise impacts. These are shown in Table 4.17.

Table 4.17 Acoustic quality objectives (EPP (Noise))

Sensitive receptor	Internal noise level criterion		
	$L_{Aeq,1hr}$, dB(A)	$L_{A10,1hr}$, dB(A)	$L_{A1,1hr}$, dB(A)
Residential (indoors - night-time)	30	35	40

5 Construction noise and vibration assessment

5.1 Construction activities

Construction noise emissions for large linear infrastructure projects are complex due to a large number of construction activities, the distribution of sites across a large geographical area, and the transitory nature of many individual construction activities at particular locations.

Construction activities to be carried out as part of the Project are outlined in Table 5.1. The work has been grouped into distinct construction stages based on indicative proposed construction activities specific to the Project. Assumptions made in modelling construction activities are detailed in Section 5.2.

Table 5.1 Construction stages and proposed equipment

Construction stage	Activities	Plant and equipment
Site setup/laydown areas	▪ Establishment of site compounds/laydown areas, site facilities and camps ▪ Potential construction of water storage dams to harvest/store construction water ▪ Haul road and access roads construction ▪ Haul road maintenance ▪ Concrete batching	Grader, truck, dump truck, 40 t excavator, scraper, water cart, concrete batching
Earthworks	▪ Clearing and grubbing/topsoil stripping ▪ Cut to fill ▪ Import general fill ▪ Place and compact general fill ▪ Import structural fill ▪ Place structural fill	Dozer, 40 t excavator, trucks, scraper, water cart, front end loader, padfoot roller, compactor, grader, 15 t roller, mulcher[1]
Tunnel construction	▪ Excavation and primary lining ▪ Secondary lining and internal structure	Drill rig, excavator fitted with rock breaker, front end loader, forklift, dump truck, shotcrete machine and roadheader
Structures	▪ Substructure/foundations construction ▪ Pier construction ▪ Superstructure construction	40 t excavator, piling rig[2], concrete truck, crane
Drainage	▪ Install cross drainage	Backhoe, 30 t excavator, work truck (hiab), compactor, concrete truck, concrete pump, Franna crane
Rail civil works	▪ Capping material import ▪ Capping material placement ▪ Bottom ballast ▪ Sleeper installation ▪ Rail installation ▪ Top ballast ▪ Track tamping and regulating ▪ Flash-butt welding ▪ Rail stressing ▪ Rail grinding	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, welder, generator for welding and rail grinder
Road civil works	▪ Road works	Grader, 30 t excavator, compactor, water cart, trucks

Table notes:

1 The mulcher is expected to only typically operate during CoP Vol 2 standard working hours and as such two scenarios have been assessed to represent typical conditions during standard and non-standard hours.

2 Impact piling has been assumed as part of a worst-case assessment.

5.2 Noise modelling methodology

5.2.1 Airborne noise

Noise levels due to the construction activities shown in Table 5.1 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 suited to predicting noise propagation over large distances as it accounts for a range of atmospheric conditions that can significantly influence noise levels over larger distances. The CONCAWE method is recommended by CoP Vol 2 for the prediction of airborne construction noise.

The 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 equipment would be operating simultaneously, which is unlikely and is therefore a conservative assumption.
- Specific equipment locations are not known at this stage however the design provides areas for each construction activity. As such, equipment was assumed to be operating at the closest point to each receptor in these areas, in order to represent the worst-case scenario. The equipment could only operate at the closest point to each receptor for a limited period.
- All dwellings are modelled at two storeys, 4.6 m above ground level.

5.2.2 Airborne noise emission sources

Table 5.2 presents a summary of the typical sound power levels of the construction equipment to be used for each construction stage. 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.

For the noise assessment, the construction scenarios listed in Table 5.1 have been considered with an indicative construction duration which would be confirmed during detailed design. Recommendations to control noise are provided in Section 7. 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 detailed design, local site conditions and changes in work practices 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 modelling assessment.

This approach is used at this point in the assessment to ensure that identified impacts are conservative and adequate noise management and mitigation measures are considered early in the Project.

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
Compactor	**108**	98	106	107	100	105	96	94
Concrete pump	**110**	111	109	106	107	105	102	99
Concrete truck	**108**	111	102	94	97	98	106	88
Crane	**99**	96	99	96	90	94	94	83
Dozer	**108**	117	118	109	101	102	98	96
Dump truck	**115**	114	107	107	107	107	112	97
Excavator - 20T	**103**	100	99	102	101	97	94	91
Excavator - 30T	**103**	100	99	102	101	97	94	91
Excavator - 40T	**107**	113	106	105	105	101	99	96
Franna crane	**94**	94	95	88	89	90	89	78
Front end loader	**83**	88	81	77	80	79	76	71
Grader	**114**	116	115	111	107	112	106	102
Generator for welding	**101**	103	100	95	96	98	94	90
Mulcher	**125**	104	113	105	111	119	121	117
Padfoot roller	**109**	111	105	105	104	104	103	96
Piling rig[1]	**117**	110	110	110	117	111	106	103
Rail grinder[2]	**116**	114	108	106	105	109	111	110
Regulator	**116**	114	108	106	105	109	111	110
Roller - 15T	**101**	108	103	105	100	95	90	82
Scraper	**114**	116	115	111	107	112	106	102
Smooth drum roller	**101**	108	103	105	100	95	90	82
Tamper	**114**	116	115	111	107	112	106	102
Truck	**118**	127	123	115	114	112	111	105
Water cart	**116**	109	107	107	111	112	109	104
Welder	**101**	95	96	97	96	97	94	89
Work truck (hiab)	**107**	109	110	95	100	99	102	101

Table notes:

1 Impact piling has been assumed as part of a worst-case assessment
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

The locations of equipment is expected to change as the design develops, however, the model has used the most appropriate locations available at the time of this assessment. Construction plant were modelled as potentially operating anywhere within the disturbance footprint for the following construction activities:

- Earthworks
- Drainage
- Rail civil works.

The areas for laydown areas, structures and road civil works were also based on the constructability assessment as the activities are expected to occur within the disturbance footprint.

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 which are provided by CoP Vol 2 are summarised in Table 5.3.

Table 5.3 CoP Vol 2 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); it can be set to any value in-between to represent an average of soft and hard ground in the noise and vibration study area. A consistent ground absorption coefficient of 0.5 was applied throughout the noise and vibration study area. This was chosen following review of aerial imagery and assumptions of dryness of the ground.

5.3 Vibration assessment methodology

5.3.1 Ground-borne vibration – construction

Table E.1 of BS5228-2 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) which result in the highest vibration impact.

Table 5.4 Extract from BS 5228-2 Table E.1

Operation	Formula	Parameters	Parameters used
Percussive piling	$v_{res} \leq k_p \left[\frac{\sqrt{W}}{r^{1.3}}\right]$	V_{res}: predicted vibration level K_p: scaling factor W: nominal hammer energy x: distance measured along ground surface L: pile toe depth r: slope distance from pile toe $\left(\sqrt{L^2 + x^2}\right)$	K_p: 5 W: 85 000 J L: 27 m
Vibratory piling	$V_{res} = \frac{k_v}{x^{\delta}}$	V_{res}: predicted vibration level k_v: Scaling factor x: distance measured along ground surface δ: 1.3 (all operations), 1.2 (Start up and run down), 1.4 (steady state operation)	k_v: 266 δ: 1.2

Operation	Formula	Parameters	Parameters used
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_{res}: predicted vibration level k_t: Scaling factor n_d: number of drums A: maximum amplitude of drum vibration x: distance measured along ground surface L_d: vibrating drum width	k_t: 276 (5 per cent probability of predicted value being exceeded) L_d: 2.2 m A: 1.72 mm n_d: 2
Vibratory compactor (steady-state)	$V_{res} = k_s\sqrt{n_d}\left[\frac{A}{x+L_d}\right]^{1.5}$	V_{res}: predicted vibration level k_s: Scaling factor n_d: number of drums A: maximum amplitude of drum vibration x: distance measured along ground surface L_d: vibrating drum width	k_s: 177 (5 per cent probability of predicted value being exceeded) L_d: 0.75 m A: 1.72 mm n_d: 2

Therefore, the highest potential vibration impacts from construction activities at any given location will depend on its proximity to each of the construction activities.

5.3.2 Roadheader – tunnel construction

The roadheader source vibration levels have been derived from the Melbourne Metro Rail project[1], which provides PPV levels per octave (10 Hz – 500 Hz) at a distance of 5 m. The Melbourne Metro Rail project was selected as it is similar to the Project. As vibration propagates differently via different substrates, vibration levels were back-calculated to a distance of close proximity to the source, and repropagated through the ground type relevant to the Teviot Tunnel. The following equation (based on Amick (1999)) was used to predict propagation of vibration, PPV, through the ground at a distance x:

$$PPV_x = PPV_{ref}\left(\frac{d_{ref}}{d_x}\right)^n e^{-\alpha(d_x - d_{ref})}$$

where α is the material damping co-efficient, which is frequency dependent;

$$\alpha = \frac{\pi\eta f}{c}$$

The values used in the above equations are provided in Table 5.5.

Table 5.5 Variables used in the roadheader calculation

Symbol	Parameter	Value used (in rock)
PPV_{ref}	PPV at a reference distance	8 mm/s
d_{ref}	Reference distance of PPV	5 m
n	Geometric damping coefficient	1
η	Material loss factor	0.01
c	Longitudinal speed in the ground material	3,500 m/s

It has been assumed that the PPV values at each frequency all occur simultaneously resulting in a conservative PPV sum for the purpose of assessment against the nominated criteria.

[1] Melbourne Metro Rail Project Environment Effects Statement Inquiry and Advisory Committee – MMRA Technical Note #042, 19 August 2016.

EIS Appendix O: Groundwater Technical Report provides information of the ground type in which the Teviot Tunnel is proposed to be constructed, which is stated to be Koukandowie Formation. Based on this, it is assumed that vibration propagation through rock will apply to this assessment. For roadheader use in rock, it is assumed that the PPV will be 8 mm/s at 5 m, as per the Melbourne Metro Rail project. The predicted vibration propagation profile in shown in Figure 5.1 based on rock between the tunnel and the nearest sensitive receptors.

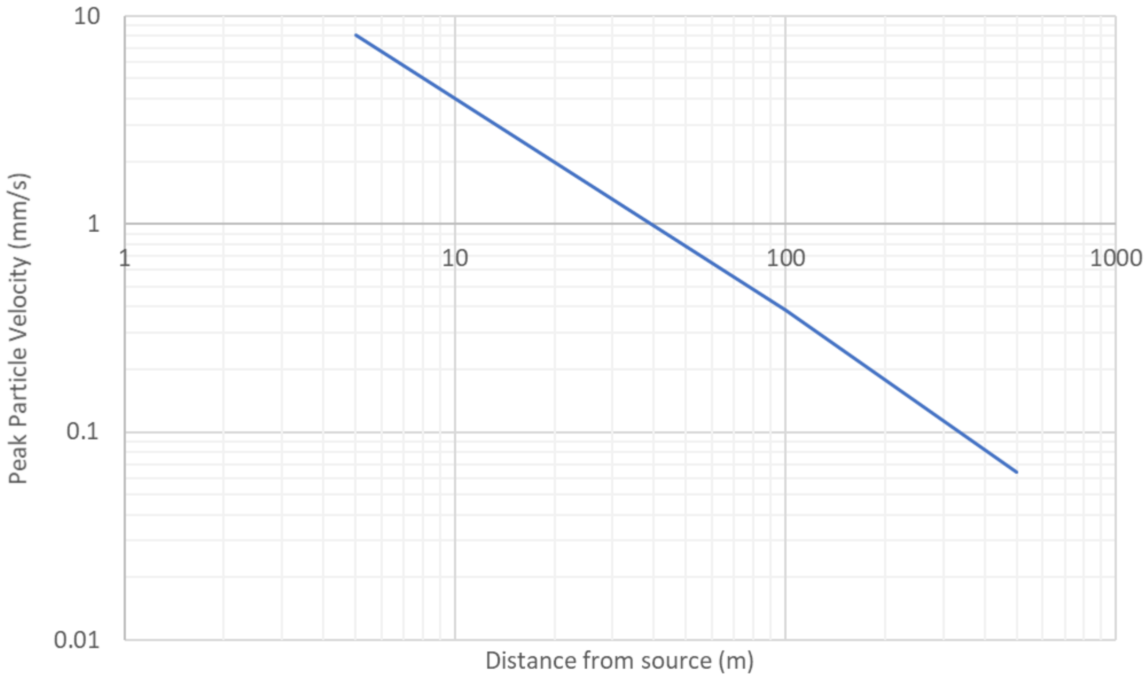


Figure 5.1 Propagation of road header peak particle velocity levels through rock

The (diagonal) distance between the source and the building foundation of each sensitive receptor is based on the following horizontal and vertical data for the tunnel:

- LiDAR elevation terrain contours at the sensitive receptor
- Tunnel outer edge
- Rail centreline (vertical and horizontal profile)
- Shortest horizontal distance between the sensitive receptor and rail centreline (typically perpendicular, with the exception of houses near the portals).

It is assumed that no other vibration intensive plant equipment will be used for these tunnelling works. Ground-borne vibration due to tunnelling is assumed to be long-term vibration as defined by DIN 4150.3.

5.3.3 Blasting due to tunnel construction

Vibration due to blasting has been calculated using AS 2187.2:2006[2], which states the following equation:

$$V = K_g \left(\frac{R}{\sqrt{Q}} \right)^{-B}$$

Where V is the PPV (mm/s), K_g is a site constant, R is distance between the charge and point of measurement (m), Q is maximum instantaneous charge (effect change mass per delay, kg) and B is the rock constant. AS2187 provides site constants when blasting is to be carried out to a free face in average field conditions (with a chance of 50 per cent exceedance). It was noted that the site constants provided in AS 2187 are not appropriate for the Project, as the AS2187 values may exceed the CoP Vol 2 blasting criteria. Both constants will need to be evaluated with test blasting on site. For the purpose of this assessment, a literature review has been conducted and more relevant site constants have been determined.

[2] Australian Standards: AS2187.2 - Explosives – Storage and Use – Use of Explosives, 2006

5.3.4 Ground-borne noise

Once the vibration velocity levels were predicted inside the building, a vibration-to-airborne noise correction as per Chapter 11 of FTA's Transit Noise and Vibration Impact Assessment[3] was used to predict the reradiated ground-borne noise levels. As the peak vibration values of the roadheader have been used as the source rather than RMS values, it is assumed that the predicted ground-borne noise levels are a reasonable approximation of the L_{ASMax} levels.

5.3.5 Building losses and corrections

Vibration velocity levels have been predicted at the foundation of each sensitive receptor using the methodology outlined in Section 5.3.2. Losses and corrections have then been applied based on the FTA's Transit Noise and Vibration Impact Assessment[4] and Melbourne Metro Rail Project[4] – Noise and Vibration, Appendix E: Operation: Vibration and ground-borne Noise from Rail. These are provided in Table 5.6. A minus 5 dB radiation correction was applied when converting vibration levels on a floor to ground-borne noise[2].

Table 5.6 Correction and losses due to buildings

Situation	Octave band centre frequencies, Hz Correction per octave, dBV (ref: 1 μ inch/s)					
	8	16	31.5	63	125	250
Building floor amplification [1]	6	6	6	5	4	3
Typical residential foundation loss [2]	0	- 4	- 5	- 5	- 4	- 3

Table notes:

1 The actual amplification will vary depending on the type of construction
2 As per Transit Noise and Vibration Impact Assessment, pg. 10-11, corresponding with wood frame houses which may be a conservative approach. The general rule is the heavier the building construction, the greater the coupling loss, therefore masonry construction will reduce vibration levels further.

5.4 Predicted impacts

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 5.7. Non-standard hours work has been conservatively assessed against the more stringent night-time criteria. Appendix C presents the L_{Aeq} noise level contours for the construction activities for individual properties.

Table 5.7 presents the external noise criteria and the number of sensitive receptors that exceed each limit for different construction activities. Both lower and upper criteria exceedances are included for standard and non-standard hours as per the CoP Vol 2. It should be noted that 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.

It is important to consider that 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 receptor 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.

[3] Transit Noise and Vibration Impact Assessment – Department of Transportation (Office of Planning and Environment, Federal Transit Authority), May 2006
[4] Melbourne Metro Rail Project – Noise and Vibration, Appendix E: Operation: Vibration and ground-borne Noise from Rail. Doc. Number: MMR-AJM-PWAA-RP-NN-008020

This construction noise assessment conservatively assumes that all plant will be operating continuously and simultaneously. However, this is unlikely to occur during construction. Particularly noisy activities, such as piling, are likely to persist for only a portion of the overall construction period. In addition, the predictions use the shortest separation distance to each sensitive receptor, however distances will vary between plant and sensitive receptors. For works that move along the rail alignment, rather than works located at a construction compound, noise exposure at each receptor is expected to reduce due to increases in distance loss as the works progress along the alignment.

This assessment predicts the level of impacts during the typical worst case 15-minute period of construction works. All items of plant proposed within the constructability assessment for key construction activities have been modelled to identify which sensitive receptors may be impacted. During the construction phase of the Project the plant operating at any one time will commonly be less than the number used within this assessment, resulting in a lower number of impacted sensitive receptors. The numbers of sensitive receptors in Table 5.7 predicted to exceed the construction will not occur during the entire construction phase; only during certain period of intensive works in proximity to each sensitive receptor.

The construction staging is indicative but conservative and is subject to change during detailed design.

Table 5.7 Predicted construction noise impacts

CoP Vol 2 Work Period	Limit	Number of sensitive receptors exceeding criterion					
		Drainage	Earthworks	Site setup/ laydown	Rail civil works	Road civil works	Structures
Standard hours	Upper: 65 dB(A)	89	159	40	120	43	22
	Lower: 50 dB(A)	285	507	213	394	225	239
Non-standard hours	45 dB(A)	438	781	358	723	402	541

Eighteen residential noise sensitive receptors are located within the disturbance footprint (the area within which construction equipment is expected to operate). It is anticipated that land within the disturbance footprint will either be permanently or temporarily required for the Project. The noise impact at receptors within the disturbance footprint has therefore not been assessed.

Measurements obtained of the existing environment highlight the low background levels and have resulted in a stringent criterion. The number of exceedances drops significantly between the lower and upper limit. A detailed breakdown of all sensitive receptors and their airborne noise impacts is shown in Appendix D.

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.

Recommendations to mitigate construction noise impacts have been provided in Section 8.

5.4.2 Construction road traffic noise impacts

Construction vehicle movements and existing traffic flows have been based on information derived from EIS Appendix U: Traffic Impact Assessment Technical Report. Construction traffic movements in this document 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 is the relevant peak hour traffic flows for both base volumes and additional construction traffic as part of the Project.

The construction traffic noise is predicted to exceed the criteria for 18 roads within the noise and vibration study area, with a maximum predicted increase of 12 dB(A). Table 5.8 presents the roads where the increase in the $L_{A10(1hr)}$ exceeds the CoP Vol 2 criteria. The predicted increase in $L_{A10(1hr)}$ for all roads is presented in Appendix D of this report. The $L_{A10(1hr)}$ stated are not predictions of impacts at receptors but are instead measures of road traffic noise emissions at a reference distance of 10 metres, corrected only for speed and percentage of heavy vehicles. Construction traffic may vary throughout the day and the results of this assessment should be confirmed during detailed design, based on detailed construction scheduling.

Table 5.8 Additional airborne noise levels from construction traffic per year

Road name	Road section	$L_{A\ 10,\ (1\ hr)}$, dB(A)											
		Level without development						Increase in level by development					
		2021	2022	2023	2024	2025	2026	2021	2022	2023	2024	2025	2026
Hayes Road	Full extent	54	54	54	55	55	55	1	5	3	3	3	1
Middle Road	Between Cunningham Highway and Bill Morrow Road	62	62	62	62	62	62	0	0	4	1	0	0
Reillys Road	Between Strongs Road and Rosewood Warrill View Road	50	50	50	50	50	50	0	8	8	7	8	0
Strongs Road	Between Coveney Road and Rileys Road	51	51	51	51	51	51	0	7	7	7	8	0
Kilmoylar Road	Between Lobb Street and Cunningham Highway	59	60	60	60	60	60	1	2	4	2	2	1
Undullah Road	Between Lane Road and Kuss Road	54	54	54	55	55	55	3	3	4	4	3	3
Undullah Road	Between LCC Council Boundary and Wyatt Road	54	54	54	55	55	55	3	5	7	4	4	2
Wyatt Road	Between Mount Lindesay Highway and LCC Council Boundary	54	54	54	55	55	55	3	5	7	4	4	2
Allan Creek Road	Between Kilmoylar Road and Undullah Road	62	62	62	62	63	63	0	2	5	4	2	0
Brookland Road	Between Allan Creek Road and Beaudesert Boonah Road	61	61	61	61	61	62	0	2	6	5	2	0
Kilmoylar Road	Between Beaudesert Boonah Road and Thiedke Road	60	61	61	61	61	61	1	2	3	1	1	1
Mutdapilly Churchbank Weir Road	Between ICC Council Boundary and Peak Crossing Churchbank Weir Road	56	56	56	57	57	57	0	7	7	0	0	0
Peak Crossing Churchbank Weir Road	Between Peak Crossing Churchbank Weir Road and Cunningham Highway	57	57	58	58	58	58	0	5	5	0	0	0
Undullah Road	Between Beaudesert Boonah Road and Allan Creek Road	54	54	54	55	55	55	3	3	4	4	3	3
Undullah Road	Between LCC Council Boundary and Brookland Road	54	54	54	55	55	55	3	6	12	7	5	3
Washpool Road	Between Kilmoylar Road and S of Brennans Dip Road	57	57	57	57	57	57	1	7	10	2	2	1

Road name	Road section	$L_{A\ 10,\ (1\ hr)}$, dB(A)											
		Level without development						Increase in level by development					
		2021	2022	2023	2024	2025	2026	2021	2022	2023	2024	2025	2026
Wild Pig Creek Road	Between Wyatt Road and Wild Pig Creek Road	53	53	54	54	54	54	3	6	8	5	5	3
Warrill View Peak Crossing Road	Between Pine Mountain Road and Cunningham Highway	61	61	61	62	62	62	0	5	4	0	0	0

For 18 roads intended to be used to carry construction traffic the maximum predicted increase in noise level is greater than 3.0 dB(A). A number of these roads are in rural locations and the existing base traffic volumes are low quantities. As such the initial airborne road traffic noise levels are low before the addition of construction traffic.

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 5.9. These are based on the formulae discussed in Section 5.3.

Table 5.9 Recommended minimum working distances for vibration intensive equipment

Plant Item	Predicted setback distance (m)							
	Human comfort			Building damage			Buried pipework	
	Lower limit (night) 0.3 mm/s PPV	Lower limit (day)/ upper limit (night) 1.0 mm/s PPV	Upper Limit (day) 2.0 mm/s PPV	Heritage structures 3 mm/s PPV	Dwellings 5.0 mm/s PPV	Industrial 20 mm/s PPV	Masonry, plastic or metal construction 50 mm/s PPV	Steel construction 100 mm/s PPV
Vibratory roller – vibration start up/ run down	330	130	80	55	40	10	< 10	< 5
Vibratory roller – steady state	200	90	60	40	30	10	< 10	< 5
Vibratory piling	290	110	60	40	30	< 10	< 5	< 5
Percussive piling	690	275	160	115	80	25	< 5	< 5

The lower night time vibration human comfort limit of 0.3 mm/s is predicted to be exceeded at the majority of residential receptors adjacent to the Project due to their relative distance to construction activities. However, it is expected that vibration intensive equipment will only rarely be operated during the night period defined by the CoP Vol 2.

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 8.

The prediction vibration limit to individual sensitive receptors has also been calculated and detailed results included in Appendix D. A summary of the total exceedances for each construction activity is shown in Table 5.10.

Table 5.10 Construction vibration exceedances

Activity	Number of sensitive receptors exceeding criterion				
	Human comfort – standard hours		Human comfort – non-standard hours		Structural limit
	Lower limit	Upper limit	Lower limit	Upper limit	
Site setup/laydown areas					
Vibratory roller – steady state vibration	0	0	3	0	0
Vibratory roller – vibration start up/run down	2	0	11	2	0

Activity	Number of sensitive receptors exceeding criterion				
	Human comfort – standard hours		Human comfort – non-standard hours		Structural limit
	Lower limit	Upper limit	Lower limit	Upper limit	
Structures					
Vibratory piling	0	0	13	0	0
Percussive piling	11	1	71	11	0
Earthworks/drainage/rail civil works					
Vibratory roller – steady state vibration	29	21	29	21	8
Vibratory roller – vibration start up/run down	38	27	38	27	13
Road civil works					
Vibratory roller – steady state vibration	13	9	13	9	4
Vibratory roller – vibration start up/run down	18	11	18	11	5

Currently, specific locations of works are not known, and vibration sources are represented as areas of works. Eighteen residential and one industrial vibration sensitive receptors are located within the disturbance footprint. It is anticipated that land within the disturbance footprint will either be permanently or temporarily required for the Project. The vibration impacts at receptors within the disturbance footprint have therefore not been assessed.

The vibration predictions in Table 5.10 are based on several coarse assumptions (discussed below) in the absence of final details on the construction equipment/processes, and as such are likely to be conservative:

- 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 5 mm/s vibration criterion has been adopted for 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 current design.

5.4.3.1 Historic heritage structures

Thirteen receptors were identified as being buildings of special value or significance as part of the cultural heritage assessment in EIS Appendix T: Non-Indigenous Heritage Technical Report. Six of these sensitive receptors are also occupied dwellings and have been assessed against both residential and heritage criteria. While these buildings are of historical value and may be particularly sensitive to ground vibration, some may not be sensitive. As a conservative approach, the heritage building structural damage criterion outlined in Table 4.9 is applied to these receptors. The minimum setback distances at which this criterion is predicted to be met are given in Table 5.11.

Table 5.11 Minimum setback distances for heritage structures from vibration intensive equipment

Plant Item	Predicted setback distance (m) Structural Damage Criterion 3.0mm/s PPV
Vibratory roller – vibration start up/run down	55
Vibratory roller – steady state	40
Vibratory piling	40
Percussive piling	115

The number of heritage structures predicted to exceed the heritage building criterion is given in Table 5.12. More detailed vibration impacts predicted for heritage buildings is given in Appendix D.

Table 5.12 Construction vibration exceedances – heritage structures

Activity	Number of exceedances of structural damage criterion
Site setup/laydown areas	
Vibratory roller – steady state vibration	1
Vibratory roller – vibration start up/run down	2
Structures	
Vibratory piling	1
Percussive piling	1
Earthworks/drainage/rail civil works	
Vibratory roller – steady state vibration	2
Vibratory roller – vibration start up/run down	2
Road civil works	
Vibratory roller – steady state vibration	0
Vibratory roller – vibration start up/run down	0

Currently, specific locations of works are not known, and vibration sources are represented as areas of works. Nine of the thirteen heritage vibration sensitive receptors are located in the disturbance footprint. These buildings may be permanently or temporarily required for the Project. The construction methodology near these receptors will need to be detailed on a case by case basis. These receptors have not been included in Table 5.12.

5.4.4 Construction blasting impacts

Locations requiring blasting throughout the disturbance footprint are yet to be confirmed. As such the maximum permissible charge weight to meet the criteria outlined in Section 4.3 is shown in Table 5.13. The maximum permissible charge weight has been calculated for indicative setback distances for sensitive receptors. Once the location of blasting is known, a detailed blasting assessment can be finalised. The below information is based on a worse case assumption of a confined blast and geotechnical parameters for good vibration transmission. A more detailed assessment for the blasting required during the tunnelling works of the Project is provided in Section 5.4.5.5.

Table 5.13 Charge mass ranges for set distances

Distance to sensitive receptor	Number of receptors	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	1	N/A – Specific blast design required or blasting not feasible at these distances.			
200 to 400 m	2	45	175	<1	<5
400 to 800 m	2	180	710	<1	30
800 to 1,600 m	22	720	>2,000	<5	250

5.4.4.1 Historic heritage structures

Thirteen receptors were identified as being buildings of special value or significance, determined as part of the cultural heritage assessment in the EIS Appendix T: Non-indigenous Heritage Technical Report. Six of these sensitive receptors are also occupied dwellings and have been assessed against both residential and heritage criteria. Each heritage receptor has the potential to be particularly sensitive to vibration. For this reason, the maximum permissible charge weight to meet the heritage building criteria outlined in Section 4.3 has been calculated for indicative setback distances in Table 5.14 and for each receptor in Appendix D. A detailed blasting assessment can be completed once blasting locations have been finalised through detailed design. Further works such as structural surveys of heritage receptors to individually determine their sensitivity to vibration are recommended in Section 8.1.2. The below information is based on a worst case assumption of a confined blast and geotechnical parameters for good vibration transmission.

Table 5.14 Charge mass ranges for set distances for heritage buildings

Distance to sensitive receptor	Number of receptors	Maximum permissible charge weight (kg)
Receptor within blasting area of works	2	N/A – specific blast design required or blasting not feasible at these distances.
0 to 200 m	1	
200 to 400 m	0	14
400 to 800 m	0	57
800 to 1,600 m	0	230

Currently, specific blasting locations are not known, and blasting airblast overpressure and vibration sources are represented as areas of works. Of the 13 heritage receptors, two are located in the blasting areas of works with an additional heritage receptor within 200 m of blasting areas. The construction methodology near these receptors will need to be detailed on a case-by-case basis once specific blasting locations are known. The remaining ten heritage vibration receptors are located more than 1,600 m away from the potential blasting locations.

5.4.5 Roadheader vibration and ground-borne noise predictions

Vibration and ground-borne noise due to the operation of the roadheader have been calculated using the methodology summarised in Section 5.3. The predicted vibration impacts at the three sensitive receptors nearest the tunnel and assessment against the criteria for damage and human comfort are presented in Figure 5.2 and Figure 5.3. Dotted lines represent the relevant criteria; receptor dots are coloured by the criteria exceeded those dots. As the upper limit of human comfort for the evening and night period is the same as the lower limit of human comfort during the day period, any compliance with the former will result in compliance with the latter. Predicted vibration levels at residential locations are presented in Appendix E.

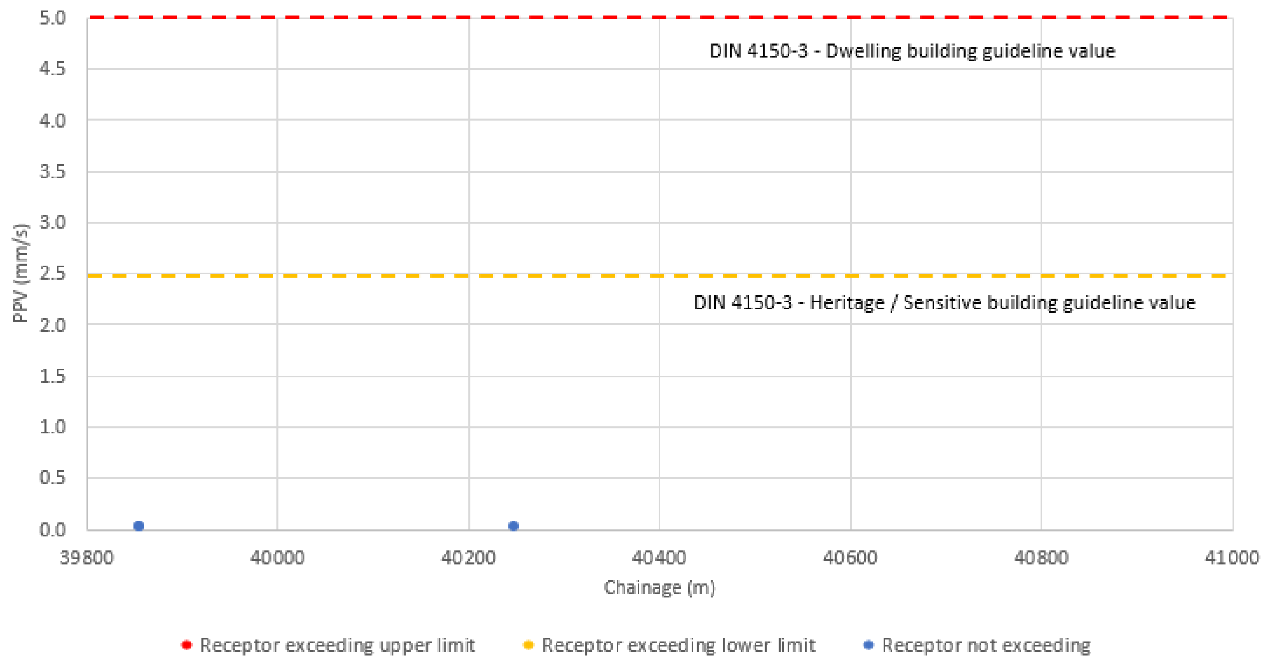


Figure 5.2 **Predicted roadheader PPV (mm/s) at the sensitive receptors along the tunnel alignment and the long-term DIN 4150-3 damage guideline values**

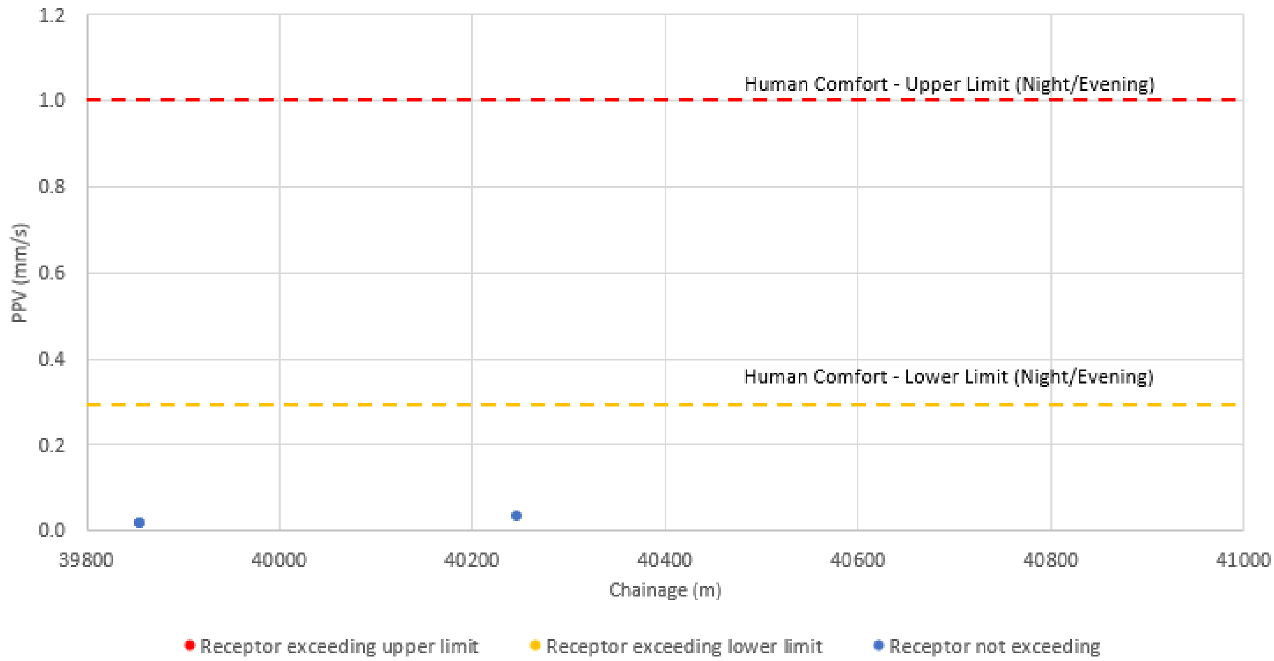


Figure 5.3 **Predicted roadheader PPV (mm/s) at sensitive receptors along the tunnel alignment and the DTMR CoP Vol 2 Human Comfort vibration criteria**

The predicted ground-borne noise levels at the sensitive receptors in the vicinity of the tunnel are presented in Figure 5.4. Standard hours and non-standard hours are in reference to the times denoted in Table 4.7. Compliance is predicted to occur when ground-borne noise from construction is predicted to be less than 35 dB(A) L_{ASMax} inside a habitable room. Predicted ground-borne noise levels at residential locations are presented in Appendix E.

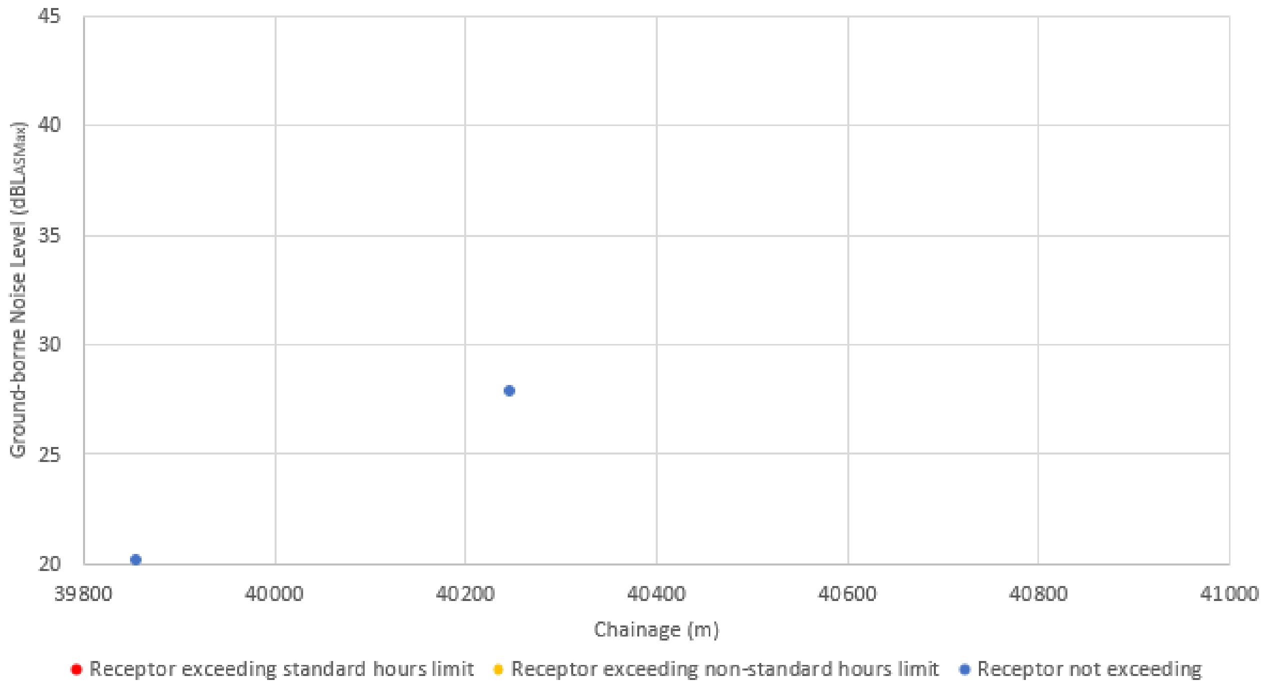


Figure 5.4 Predicted roadheader ground-borne noise level (dBL_{ASMax}) at sensitive receptors along the tunnel alignment against the DTMR CoP Vol criteria, rounded to the nearest integer

The predictions undertaken are based on conservative assumptions i.e. propagation through rock, no impedance changes at below-ground formation change, foundation types and use of peak velocity values to determine L_{ASMax} noise levels.

5.4.5.1 Building damage

The vibration levels predicted at the foundations of sensitive receptors were well below the criterion for heritage and sensitive buildings (2.5 mm/s) for damage due to vibration, outlined in Table 4.10. This criterion applies to the vibration at the highest floor level, however it was assumed that the receptors assessed were single storey dwellings, as is typical of residences in the noise and vibration study area, and that the vibration impacts at the foundations are also representative of the vibration impacts at the highest floor level. This is a conservative approach as vibration impacts are typically greatest at the lowest floor level. This is contrary to noise impacts, which are typically greatest at the highest floor level.

5.4.5.2 Human comfort

Vibration levels predicted on the ground floor slab or floors of buildings were found to comply with the lower limit for dwellings during non-standard working hours criterion, adopted from the CoP Vol 2, and listed in Table 4.8. The criterion for human comfort is 0.3 mm/s.

5.4.5.3 Underground infrastructure

It is currently not known if utility owners have specific vibration limits which apply to gas or water pipes. Preliminary consultation with utility owners should be undertaken as part of detailed design to determine any specific vibration limits. Consequently, compliance against the 25 mm/s criterion adopted from DIN 4150.3 and listed in Table 4.11 has been assessed. This is the most conservative criterion for underground infrastructure specified by DIN 4150.3, applicable to masonry or plastic infrastructure impacted by long term vibration. Compliance with this criterion is predicted when the roadheader is at least 5 m from the pipework. Vibration measurements should be undertaken on site to confirm that these predictions are representative of the vibration levels on site.

It is recommended that the minimum setback distance of 5 m be observed between the roadheader and all buried services.

The results of vibration predictions are less accurate when construction equipment is within 5 m of a vibration-sensitive item. Consequently, the construction team will need to undertake vibration monitoring when working within 5 m of infrastructure to assess whether the vibration from the works meet the criteria.

5.4.5.4 Ground-borne construction noise impacts

Ground-borne noise due to the roadheader has not been predicted to exceed the ground-borne noise criteria defined in the CoP Vol. 2 at any residence. This is because the distance between the alignment and sensitive receptors is approximately 930 m.

5.4.5.5 Blasting vibration impacts – tunnel construction

Vibration due to blasting is predicted based upon several variables, with the site constant and instantaneous charge size (in kg) the dominant variables in the prediction model. The site-specific constants for the noise and vibration study area are not known at this stage. Consequently, a literature review of site constants for similar Projects has been conducted.

It was found that most blasting assessments state that no more five per cent of blasts should exceed the relevant assessment's PPV criteria. The site constants in AS2187.2 have a 50 per cent chance of exceedance and therefore are not considered to be appropriate. A range of site constants were assessed against a range of instantaneous charge sizes and are presented in Table 5.15. The predicted PPV levels at various distances for different site constants and charge sizes are presented in Figure 5.5.

Table 5.15 Instantaneous charge size (kg) and site constants

Plot shading in Figure 5.5	Instantaneous charge size (kg)	Site constant (K_g)	Source of site constant
Red	500	1,140	AS2187.2
		3,099	Avg. from literature search quoting no more than 5 per cent of blasts should exceed assessment's criterion
		6,210	Maximum site constant from literature search
Blue	100	1,140	AS2187.2
		3,099	Avg. from literature search quoting no more than 5 per cent of blasts should exceed assessment's criterion
		6,210	Maximum site constant from literature search
Green	10	1,140	AS2187.2
		3,099	Avg. from literature search quoting no more than 5 per cent of blasts should exceed assessment's criterion
		6,210	Maximum site constant from literature search
Yellow	1	1,140	AS2187.2
		3,099	Avg. from literature search quoting no more than 5 per cent of blasts should exceed assessment's criterion
		6,210	Maximum site constant from literature search

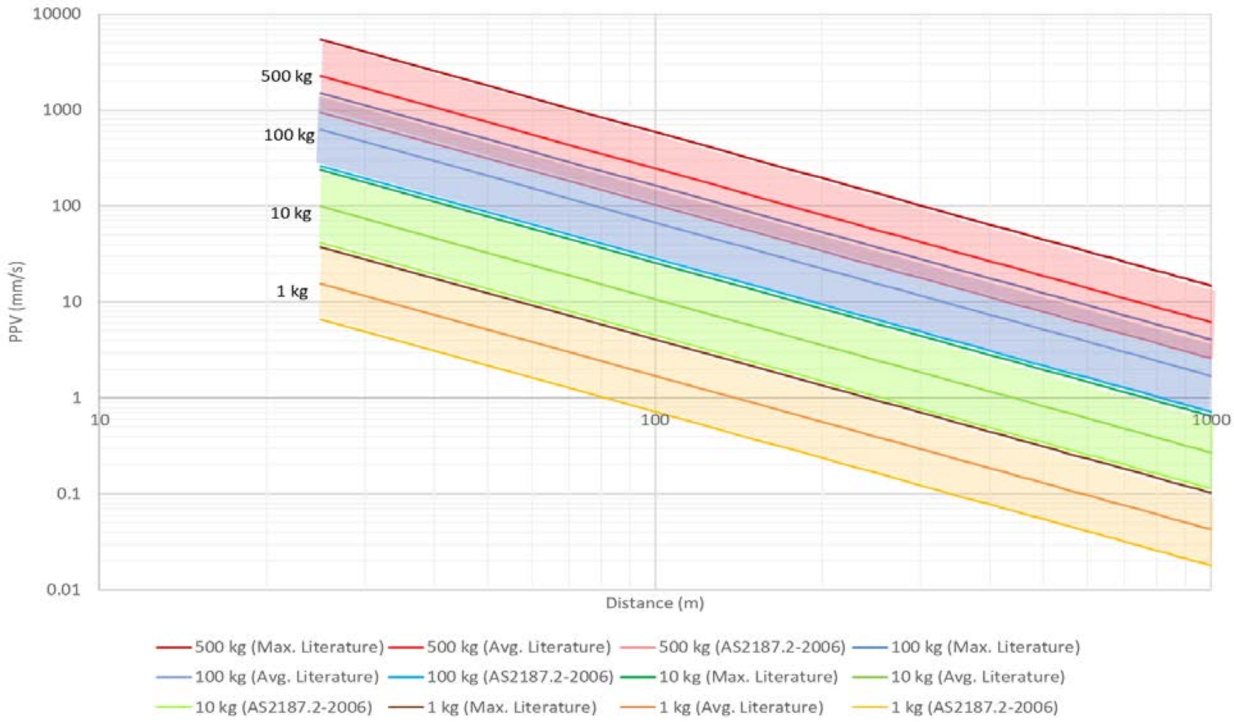


Figure 5.5 Predicted PPV (mm/s) at a distance (m) based on instantaneous charge size and site constants

Figure 5.5 shows a significant range in PPV values when using different site constants and charge sizes. Because of this large range in predicted PPV, small scale site-specific blast testing should occur before major blasting works to determine the “true” site constants in order to understand the potential impacts.

The closest sensitive receptor is approximately 930 m from the outer dimensions of the tunnel, therefore it is likely that suitable charge sizes will be able to be determined which comply with the CoP Vol. 2 criteria.

6 Operational noise assessment

6.1 Operational fixed infrastructure

Noise impacts of the operation of fixed infrastructure included in the design have been assessed under EPP (Noise). Fixed infrastructure identified as part of the design includes:

- Tunnel ventilation fans for emergency and maintenance operations
- Pumps and pump stations
- Transformers, substations and generators.

The design does not currently identify any fixed infrastructure in the open route of the Project. Therefore, should any additional fixed infrastructure be identified during detailed design, operational noise impacts should be assessed, and mitigation designed to meet the EPP (Noise) acoustic quality objectives.

Safety systems have not been assessed as operational fixed infrastructure and are assessed in EIS Appendix Q: Operational Railway Noise and Vibration Technical Report. These noise sources include:

- Level crossing alarms
- Train horns.

6.1.1 Methodology

6.1.1.1 Assessment approach

The following approach was used to assess airborne noise due to operation of fixed infrastructure associated with the tunnel:

- Identification of closest sensitive receptor and occupancy type
- Derivation of empirical sound power level of noise sources based on specifications from the tunnel engineers
- Prediction of airborne noise levels at the sensitive receptors
- Comparison of the predicted internal airborne noise levels with the acoustic quality objectives
- Development of acoustic mitigation options to meet the environmental noise objectives
- Identification of residual operational fixed infrastructure noise impacts, detailed in Section 8.3.

To predict the noise levels inside a property:

- Noise levels due to simultaneous operation of the fan systems were predicted at the façade of the nearest noise sensitive property
- 7 dB was subtracted from the predicted value, corresponding to the indicative outside to inside noise reduction of an open window, resulting in the internal noise level.

Ancillary fixed infrastructure noise sources other than tunnel ventilation fans, such as pumps and transformers, will be located at the eastern and western tunnel portals for the Project. While noise from these sources are not yet known, nominal mitigation strategies (such as attenuators, solid barriers, enclosures etc) would be implemented and shall be designed to meet the EPP (Noise) acoustic quality objectives at noise sensitive receptors.

6.1.1.2 Operational scenario

The following operational scenario is included in the predictions:

- Maintenance operations: includes two jet fans together at the western and eastern end of the tunnel, and one Longitudinal Egress Passage (LEP) fan each end of the tunnel. These fans will run for 100 per cent of the time over a 1-hour period. It was assumed that all fans will run at full duty during maintenance operations.

6.1.1.3 Identification of receptors

For the tunnel, a single noise sensitive receptor was identified (RES0806, refer Appendix A of this report), which is approximately 1 km from the tunnel portals. This property is located between both portals, therefore only the closest portal was used in the predictions. Other receptors are more than 1.5 km from the noise sources. It follows that if the EPP (Noise) acoustic quality objectives are met at the nearest receptor, that they will also be met at all receptors.

6.1.1.4 Prediction methodology

Calculations of fan noise emissions were undertaken using the methodology in ISO 9613-2[5], which is used to predict the equivalent continuous octave-band sound pressure level at a specified distance away (SPL_d) (based upon downwind favourable meteorological conditions for propagation).

6.1.1.5 Limitations and assumptions

The following limitations and assumptions apply:

- It is assumed that because the fixed infrastructure will be operating simultaneously at a steady-state, meeting the continuous $L_{Aeq,1hr}$ EPP (Noise) acoustic quality objective will also mean meeting the $L_{A10,1hr}$ and $L_{A1,1hr}$ acoustic quality objectives.
- As fans are yet to be selected, fan sound power levels have been empirically derived and may vary from final plant selection noise levels. Noise associated with the final fan selections will need to be assessed for compliance with the environmental noise objectives.
- Terrain, topography and screening effects have not been considered in the assessment. This is a conservative assumption.
- Attenuators for the site are to be custom made and data for these attenuators is not readily available. Indicative insertion loss and pressure drops have therefore been derived based on extrapolation of “off-the-shelf” attenuator data.
- Specific ductwork has not been finalised as part of the design. The locations of jet fans in the tunnel have therefore been assessed as at the portals. This is a conservative approach as additional ductwork is expected to provide some attenuation.
- It is assumed that “beating” between the simultaneous use of the jet fans does not occur. If there is a risk of occurrence then this will need to be addressed.
- Additional fixed infrastructure, such as transformers, is yet to be selected, as the design at the time of assessment was at schematic design. As the design progresses noise from fixed infrastructure should be assessed against the EPP noise objectives.

[5] ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

6.1.2 Predictions

The jet fan sound power level (SWL) was based on manufacturer data[6], and the SWLs for the LEP fans[7] were empirically derived. The SWLs of the fans are provided in Table 6.1.

Table 6.1 Sound power levels of indicative fans

Fan	Octave band centre frequency, Hz Sound power level, dB								Total SWL dBA
	63	125	250	500	1k	2k	4k	8k	
Jet fan	87	101	93	90	90	91	80	75	96
LEP	94	94	98	95	91	89	86	86	97

Predicted noise levels at the noise sensitive locations are presented in Table 6.2, and mapped in Appendix F.

Table 6.2 Predicted noise level at the closest noise sensitive receptor

Scenario	Jet fan operation location	Receptor	Internal noise criterion $L_{Aeq,1hr}$, dB	Predicted internal noise level $L_{Aeq,1hr}$, dB
Maintenance	East and West portal	RES0806	30	26

With the previously defined sound power levels, the EPP (Noise) acoustic quality objectives are predicted to be met at all sensitive receptors. Once fans are selected, if sound power levels differ from those in Table 6.1 then they will need to be reassessed. Selected fans will need to be free of tonality.

6.2 Operational road traffic noise assessment

An operational road traffic noise assessment has been undertaken to a 10-year design horizon, and in accordance with the CoP Vol 1.

6.2.1 Operational road traffic noise assessment – new roads

In assessing the potential noise impacts of the seven new road sections (as discussed in Section 4.4), a desktop assessment has been implemented, taking into consideration the nearest sensitive receptors to the proposed works, as well as the realignment distance to predict the change in noise levels brought about by the realignment of the road closer to residents.

The predicted façade corrected $L_{A10\ (18\ hour)}$ does not exceed the criterion at the nearest residential receptor for all proposed new roads. The predicted façade corrected $L_{A10\ (18\ hour)}$ for each receptor is presented in Table 6.3.

[6] Axijet – Jet Fans for Tunnel Ventilation - Sales Catalogue 50 Hz
[7] ASHRAE Handbook

Table 6.3 Predicted operational road traffic noise – proposed roads

Location	Existing distance to nearest receptor (m)	2019 Façade Corrected $L_{A10, 18\ hour}$ (dB(A))	New alignment – distance to nearest receptor (m)	New alignment – 2035 Façade Corrected $L_{A10, 18\ hour}$ (dB(A))
Paynes Road	50	57	25	61
Truloff Road	738	43	738	45
Dwyers Road	33	51	33	52
Washpool Road[1]	80	49	80	51
Wild Pig Creek Road Section 1	2229	38	2194	40
Wild Pig Creek Road Section 3	450	57	450	59
Undullah Road Section 1	450	38	210	43

Table note:

1 Where multiple changes are to be made to one road segment, the worst-case impact has been assessed

6.2.2 Operational road traffic noise assessment – upgraded roads

In assessing the potential noise impacts of the nine road sections to be upgraded as part of the Project (as discussed in Section 4.4), a desktop assessment has been implemented, taking into consideration the nearest sensitive receptors to the proposed works to predict the change in noise levels brought about by the road upgrade.

The predicted façade corrected $L_{A10\ (18\ hour)}$ exceeds the criterion at residential receptor RES0411, adjacent to the proposed upgrade of Ipswich Boonah Road. The predicted façade corrected $L_{A10\ (18\ hour)}$ for each receptor is presented in Table 6.4. These predicted impacts are based on the design and conservative assumptions. These findings should be revisited during detailed design.

Table 6.4 Predicted operational road traffic noise – re-aligned roads

Location	Distance to nearest receptor (m)	2035 Façade corrected $L_{A10, 18\ hour}$ (dB(A))
Hayes Road	90	48[1]
Mt Forbes Road	40	64[1]
M Hines Road	40	62[1]
Cunningham Highway	80	65
Middle Road	30	63
Ipswich Boonah Road	80	69
Mt Flinders Road	355	47
Wild Pig Creek Road Section 2	155	55
Undullah Road Section 2	110	58

Table notes:

1 Assumed heavy vehicle percentage of 15 per cent.

7 Cumulative impacts

Table 7.1 details other major ‘State significant’ or ‘strategic’ projects which may be constructed simultaneously with the Project and within close proximity to contribute to cumulative noise levels at sensitive receptors potentially affected by the Project. Other projects identified and assessed in Chapter 22: Cumulative Impacts of the EIS have not been considered for noise and vibration due to their distances from the Project. It is assumed that these other projects will meet their legislative requirements. It is therefore unlikely that these projects will materially contribute to the noise environment such that impacts are greater than those predicted in Section 5.4.

Table 7.1 Summary of cumulative impacts to be addressed

Project and Proponent	Location	Description	EIS status	Relationship to C2K
Helidon to Calvert (H2C) – (ARTC)	Helidon to Calvert	47 km single-track dual-gauge freight railway as part of the Inland Rail Program	Draft EIS being prepared by proponent	Potential overlap of construction of H2C and construction of C2K
Kagaru to Acacia Ridge and Bromelton (K2ARB) – (ARTC)	Acacia Ridge to Bromelton	49 km of existing track to be upgraded enabling double-stacking capacity as part of the Inland Rail Program	Proponent has lodged initial advice statement to the Office of the Coordinator-General	Potential overlap of construction of K2ARB and construction of C2K

Simultaneous noise from construction works of H2C and K2ARB has the potential to increase noise levels at nearby sensitive receptors affected by noise from this Project. The likelihood of cumulative impacts from other sections of the Inland Rail Program are reduced by the linear progression of construction along the alignment. Due to the modelling technique used for the Project which has assessed the worst-case construction scenarios and L_{Amax} levels to sensitive receptors, the noise levels due to cumulative impacts presented should not significantly increase the predicted levels.

The cumulative impact of noise would be managed as far as possible to ensure that the potential for adverse impacts at sensitive receptors is minimised. In addition, any overlap of construction works is likely to be for a limited period due to the linear nature of rail project construction.

Existing sources of noise have been considered and accounted for by noise monitoring of the existing environment and the application of criteria under the CoP Vol 2.

8 Mitigation measures

8.1 Initial mitigation

8.1.1 Construction noise and vibration initial mitigation

The mitigation measures and controls presented in Table 8.1 have been factored into the Project's design. They have been applied prior to the prediction of construction noise and vibration impacts detailed in Section 5.4.

Table 8.1 Initial construction noise and vibration mitigation measures

Action	Mitigation measure
Project design	The Project should be designed and constructed with the aim of achieving construction noise and vibration criteria adopted by the CoP Vol 2 and summarised in Section 3.3.6. For example, track features such as crossing loops, crossovers, turnouts, and rail joints should be avoided near vibration sensitive structures where practicable.
Construction noise and vibration assessment	Where it is found that standard mitigation measures are not sufficient to reduce noise and vibration impacts to acceptable levels, additional mitigation measures should be investigated and implemented.
Communication	Local residents/ stakeholders should be provided with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts during construction.
	The ARTC Community Engagement Team or construction contractor are to provide a community liaison phone number and permanent site contact so that noise and/or vibration related complaints or inquiries can be received and addressed in a timely manner.

8.1.2 Operational noise and vibration initial mitigation

The mitigation measures and controls presented in Table 8.2 have been factored into the design for the Project. They have been applied prior to the prediction of operational noise and vibration impacts detailed in Section 6.

Table 8.2 Initial operational noise mitigation measures

Aspect	Mitigation measure
Project design	The Project should be designed and constructed with the aim of achieving the operational noise criteria adopted from the CoP Vol 1 in the case of operational road traffic noise and environmental noise objectives adopted from EPP (Noise).
Operational noise assessment	Where it is found that standard mitigation measures are not sufficient to reduce operational noise impacts to acceptable levels, additional mitigation measures should be investigated and implemented.
Communication	Local residents/stakeholders should be provided with sufficient information to enable them to understand the likely nature, extent and duration of operational noise impacts during construction.
	The ARTC Community Engagement Team or construction contractor are to provide a community liaison phone number and permanent site contact so that noise related complaints or inquiries can be received and addressed in a timely manner.

8.2 Impact assessment

As detailed in Section 5.4, construction noise and vibration impacts are expected to exceed the limits established in Section 3.3.6, in accordance with the ToR. Appendix C presents the typical worst-case $L_{Aeq,\,15\,min}$ noise level contours for the construction activities for individual properties. To mitigate the predicted construction noise and vibration impacts, the proposed mitigation measures in Table 8.3 are recommended.

When evaluating the feasibility of mitigation measures, it should be taken into consideration that most noise and vibration receptors within the noise and vibration study area are residences in low-density areas. This is particularly true of receptors closest to the Project. Higher-density towns such as Calvert and Peak Crossing are typically further from the Project. Noise and vibration sensitive receptors are mapped in Appendix A. The results of the operational road traffic noise assessment in Section 6.2 show that the predicted noise impacts of the operation of the section of Ipswich Boonah road to be upgraded exceeds the criterion specified by the CoP Vol 1. These predicted impacts are based on the design and conservative assumptions. These findings should be revisited during detailed design. Where impacts are predicted to exceed the CoP Vol 1 criteria, the mitigation measures in Table 8.3 are recommended: This segment not close to built-up areas with many noise sensitive receptors. As such, noise barriers constructed to mitigate operational road traffic noise impacts are likely to be infeasible. However, this conclusion should be reviewed during detailed design of the Project.

The results of the operational fixed infrastructure noise assessment in Section 6.1.2 show that the predicted noise levels due to operational fixed infrastructure as a part of the Project comply with the noise criteria for sensitive receptors. Predicted noise levels at the noise sensitive locations are mapped in Appendix F. At this stage mitigation is not required. Compliance may need to be revisited during detailed design.

Table 8.3 Proposed construction noise and vibration mitigation measures

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Noise and vibration impacts on sensitive receptors	Avoid/minimise impacts on nearby sensitive receptors during detailed design. Update the construction noise and vibration assessment to reflect/inform the final location of construction sites, construction activities and construction scheduling to inform the development of the Noise and Vibration Sub-plan to achieve the performance criteria and inform Construction Noise and Vibration Management Plans.
	Operational railway noise and vibration impacts on sensitive receptors	Review and if necessary, update the operational noise and vibration assessment to reflect/inform the detailed design, including incorporation of potential noise or vibration treatments. The vibration assessment will include consideration of: ▪ Buildings/structures that will remain in close proximity to the Project works ▪ Other vibration sensitive receptors (including buildings/ structures of heritage value). The vibration assessment will identify building condition survey requirements at vibration sensitive receptors which are expected to exceed the structural damage vibration limits given by DIN 4150.3 and recommended by the CoP Vol 2. The following treatments are to be considered as part of detailed design: ▪ Source controls – mitigations applied to the railway infrastructure to control the emission of noise and vibration at its source. Such measures included; rail dampers, track lubrication (for control of curving noise), identification of rollingstock causing discrete high noise events or lower noise emission alarm bells ▪ Pathway controls – measures to impede and limit the propagation of railway noise to the sensitive receptors and typically constructed within the rail corridor. Measures can include; railway noise barriers, low height noise barriers or earth mounding. ▪ Receptor controls – measures to mitigate noise and vibration levels or manage potential noise and vibration impacts at the sensitive receptor properties and land-uses. Measures can include; architectural acoustic treatment of property, property construction/relocation, upgrades to existing property fencing or negotiated agreement with property owners.
	Operational road traffic noise impacts on sensitive receptors	Review/update the operational road traffic noise to reflect/inform the detailed design, including incorporation of potential noise treatments. The following mitigation measures are to be considered as part of detailed design where operational road traffic noise impacts are predicted to exceed the appropriate CoP Vol 1 road traffic noise limit based on the detailed design: ▪ Pavement surface treatment ▪ Provision of acoustic façade treatments to affected sensitive receptors ▪ Noise barriers in the form of a landscaped earth mound and/or a noise fence.
Pre-construction	Noise and vibration impacts on sensitive receptors	Develop and implement a Construction Noise and Vibration Management Pan. The Construction Noise and Vibration Management Plan will include: ▪ Location of sensitive receptors in proximity to the disturbance footprint ▪ Requirements for pre-construction dilapidation surveys and/ or vibration monitoring at vibration sensitive receptors during construction ▪ Specific management measures for activities that could exceed the construction noise and vibration criteria at a sensitive receptor. ▪ Notification process within the community engagement plan (including who to contact in the event of a complaint) to advise of significant works with potential for noise nuisance or vibration at sensitive receptors. Noise management measures may include controlling noise and vibration at the source, controlling noise and vibration on the source to receptor transmission path and controlling noise and vibration at the sensitive receptor. Practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on sensitive receptors.

Delivery phase	Aspect	Proposed mitigation measures
		Any other measures necessary to comply with conditions of approval or regulatory requirements. Where it is found that existing mitigation measures are not sufficient to reduce noise and vibration impacts to acceptable levels, additional mitigation measures will be investigated and implemented, including consultation with affected sensitive receptors.
Construction and Commissioning	Noise and vibration impacts on sensitive receptors	Sensitive receptors identified in the Construction Noise and Vibration Management Plan, as well as residents within at least 2 km of the disturbance footprint and other relevant stakeholders are to be provided with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts during construction. Sensitive receptors with the potential to be affected by exceedances of noise goals will be notified prior to the commencement of relevant works. Construction progress and upcoming activities will be regularly communicated to local residents/stakeholders, particularly when noisy or vibration generating activities are planned, such as vibratory compaction and piling.
	Damage to buildings and structures	Building condition surveys will be undertaken for vibration sensitive receptors identified as potentially exposed to vibration impacts from the Project works during the detailed design phase modelling and assessment. Surveys are to take place prior to commencement and on completion of vibration generating works (such as pile-driving). Following such surveys, more accurate data may be used to assess the impacts to vibration sensitive receptors. If, during detailed design and construction methodology assessments, vibration impacts are predicted to exceed the criteria at a vibration sensitive receptor the following mitigation must be undertaken: ▪ Consultation with the owner of the structure to determine the sensitivity of the structure to construction vibration. A more appropriate criteria to be applied at the location may be agreed upon as a result. ▪ Baseline vibration monitoring is to be undertaken prior to the activity commencing and monitored throughout the activity to assess compliance with vibration limits set as part of the Construction Noise and Vibration Management Plan for the relevant receptor. Vibration monitoring results are to be assessed and used to refine vibration predictions and management measures as applicable, such as developing and enforcing exclusion zones around the sensitive structure or implementing remediation measures. Where feasible, modify the construction methodology to reduce the predicted vibration impacts. This could include: ▪ Using smaller equipment, such as a handheld jackhammer instead of a rock breaker ▪ Changing the construction methodology.
	Damage to buildings and structures	Vibration monitoring will be undertaken at locations where the potential for building/structural damage risk has been identified during the detailed design and is warranted. This includes vibration sensitive receptors at which vibration impacts are expected to exceed the structural damage criteria recommended by DIN 4150.3 and recommended by the CoP Vol 2. Vibration monitoring will be undertaken by a suitably qualified professional, in accordance with the CoP Vol 2.
	Noise impacts on sensitive receptors	Where practicable and feasible, noise monitoring will be undertaken at noise sensitive receptors where the potential for noise impacts to exceed the criteria in EIS Chapter 23: Outline Environmental Management Plan, Table 23.13 (refer EIS Chapter 23: Outline Environmental Management Plan), has been identified. Noise and/or vibration monitoring will also be undertaken in response to valid noise or vibration complaints.
	Noise impacts on sensitive receptors – hours of work	Project works will be undertaken in accordance with the hours of work in Table 23.4 (refer EIS Chapter 23: Outline Environmental Management Plan), and as per advice to stakeholders and sensitive receptors regarding permitted out of hours activities.

Delivery phase	Aspect	Proposed mitigation measures
	Noise impacts on sensitive receptors – staff	Staff training is to be undertaken so that unnecessary sources of noise are avoided. Training must enforce that: ▪ Unnecessary shouting or loud stereos/radios on site are not tolerated ▪ Materials are not to be dropped from height ▪ Metal items are not thrown ▪ Doors/gates are not slammed ▪ Vehicle radios and engines are to be turned off or volume lowered wherever possible.
	Noise and vibration impacts on sensitive receptors – selection of construction equipment near sensitive receptors	Quieter and non-vibratory construction equipment will be selected for use near sensitive receptors, where feasible and reasonable. This is particularly important for any non-standard/out of hours construction activities where sensitive receptors are nearby. This is also particularly important for loud and/or vibration-intensive plant such as mulchers and piling rigs. Appropriately sized equipment is to be selected for the task, such as vibratory compactors and rock excavation equipment. For example, a 22-tonne excavator is expected to operate 8 dB(A) quieter than a 40-tonne excavator, based on equipment noise emissions given by BS5228.1.
	Noise and vibration impacts on sensitive receptors – selection of construction methods near sensitive receptors	Where practicable, alternative construction methods will be adopted to reduce the noise and vibration impacts in the vicinity of sensitive receptors, such as: ▪ Using damped tips on rock-breakers where appropriate ▪ Using rock saws instead of blasting ▪ During clearing, using excavators with grabs and rake attachments instead of chainsaws; and mulching cleared material at locations away from sensitive receptors ▪ Avoiding onsite fabrication work where possible ▪ 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 ▪ When piling, avoiding dynamic compaction using large tamping weights near sensitive and critical receptors where possible ▪ Reducing energy per blow when piling (consider first whether this may result in prolonged exposure with no realised reduction in community disturbance).
	Noise and vibration impacts on sensitive receptors - blasting	Where blasting impacts are expected to exceed the vibration goals, the following measures are to be implemented where feasible and reasonable: ▪ Reducing the charge size by use of delays and reduced charge masses ▪ Ensuring adequate blast confinement to minimise the amount of overpressure ▪ Avoiding secondary blasting where possible; the use of rock breakers or drop hammers may be an acceptable alternative ▪ Avoiding blasting during heavy cloud cover or during strong winds blowing towards sensitive receptors ▪ Establishing a blasting timetable through community consultation for example, blasts times negotiated with surrounding sensitive receptors.

Delivery phase	Aspect	Proposed mitigation measures
	Noise and vibration impacts on sensitive receptors – during hours of construction	Where feasible and reasonable, 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. Vibration-intensive stationary plant located near sensitive receptors will be isolated with resilient mounts. Noise-emitting plant and equipment, construction compounds laydown areas will be orientated away from sensitive receptors where feasible and reasonable. Equipment will be operated in the correct manner and correctly maintained including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components and repair of leakages in compressed air lines. Construction plant, vehicles and machinery will be maintained and operated in accordance with manufacturer's instructions to minimise noise and vibration emissions. When piling, the pile and rig are to be carefully aligned, and cable slap and chain clink minimised.
	Noise and vibration impacts on sensitive receptors – mechanical plant management	All mechanical plant near sensitive receptors will be modified to reduce noise by practical means, such as: ▪ Internal combustion engines are fitted with a suitable muffler in good repair, operating as per the manufacturer's specifications, as a minimum ▪ Pneumatic tools are fitted with an effective silencer on their air exhaust port, where feasible and practicable ▪ Aggregate bins and chutes are lined with a rubber material, to dampen the vibration of the structure ▪ When piling, acoustic damping are provided to sheet steel piles to reduce vibration and resonance ▪ When piling, resilient pads are used between pile and hammerhead. Care is to be taken when selecting a resilient pad as energy is transferred to the pad in the form of heat.
	Noise impacts on sensitive receptors – stationary noise sources	Stationary noise sources near noise sensitive receptors will be shielded or enclosed where feasible and reasonable. Acoustic shielding must also be considered where works are expected to occur close to sensitive receptors for lengthy periods.
	Noise and vibration impacts on sensitive receptors – shielding of noise emitting plant	Where feasible, structures and noise-emitting plant will be located such that the structures provide some shielding to any nearby receptors. Structures include: ▪ Temporary site buildings such as sheds ▪ Materials stockpiles ▪ Fencing ▪ Storage/shipping containers. Where vibration impacts at sensitive receptors are expected to exceed the structural damage goals, and where reasonable and safe to do so, cut-off trenches to interrupt the direct transmission path of vibrations between source and receptors will be provided.
	Noise impacts on sensitive receptors	Non-tonal reversing beepers (or an equivalent mechanism) be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.

Delivery phase	Aspect	Proposed mitigation measures
	Noise impacts on sensitive receptors – delivery of materials	Site access points and roads will be sited as far as is practicable from sensitive receptors. Acoustic shielding will be considered if loading/unloading areas are close to sensitive receptors. Delivery vehicles will be fitted with straps rather than chains where feasible. Off-site truck parking areas, if required, will be located away from residences and will be nominated where practicable. The drop height of materials will be minimised, for example, while loading and unloading vehicles or in storage areas. Reversing movements of vehicles are to be minimised to reduce the use of reversing alarms. Where practicable, sites are to be designed such that delivery vehicles are able to drive through the site and not be required to reverse.
	Noise impacts on sensitive receptors – construction traffic	Where reasonable and feasible, unsealed areas will be regularly graded and potholes filled in sealed access roads and hardstand areas to reduce noise from construction vehicles. Where practicable, night time construction traffic will be redirected away from noise sensitive receptors, in accordance with the Construction Traffic Management Plan. Appropriate construction traffic speed limits will be established and managed near noise sensitive receptors.
Operation	Noise and vibration impacts on sensitive receptors- operation	The operational railway noise and vibration levels shall be verified through a program of noise and vibration monitoring once the Project is operational. The monitoring program would be undertaken within the initial 6 months post commencement of railway operations (train movements) on the Project. ARTC will investigate where monitored operational noise and/or vibration levels at sensitive receptors are confirmed to be above the railway noise and vibration criteria.

8.3 Residual impact mitigation

Across all construction activities, 65 per cent of exceedances of the upper standard hours noise limit under the CoP Vol 2 are within 10 dB(A) of the limit, as are 63 per cent of exceedances of the evening non-standard hours noise limit. Of the construction noise mitigation measures recommended in Section 8.1.2, those which can be quantified can be expected to provide between 4 and 11 dB(A) attenuation. The remaining approximate 45 per cent of exceedances are not expected to be feasibly mitigated to below the appropriate limit by physical attenuation alone. Where further mitigation is also similarly infeasible or unreasonable, residual exceedances may need to be managed. As with mitigation, management of residual impacts should be undertaken in consultation with the community and affected residents.

Specific management of residual impacts should be determined during detailed design, following the development of a construction Noise and Vibration Sub-plan. As with the application of mitigation, management of residual impacts should be considered in consultation with affected occupants.

Residual exceedances can be expected where noise and vibration impacts are unavoidable and significant after all reasonable and practicable mitigation measures are implemented. Currently these residual impacts would be addressed through respite, temporary relocation of affected receptors and the provision of architectural treatments.

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.

Temporary relocation involves the voluntary relocation of impacted occupants for short periods of time where all reasonable and practicable measures and respite periods are implemented and further mitigation is impractical. Examples of temporary relocation may involve the offer of an alternative activity or accommodation.

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 should primarily focus on those elements.

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

Operational road traffic and fixed infrastructure noise impacts will persist and will be mitigated to meet the relevant criteria. Residual operational noise levels may result in minor increases in background noise levels for a limited number of receptors and are considered acceptable.

9 Conclusion

9.1 Construction noise

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 exceedances of both the lower and upper external noise limits within the noise and vibration study area. The number of exceedances varies with the time of day and the construction activity. The greatest construction noise impact is that of earthworks occurring during non-standard hours, which is predicted to result in exceedances at 781 sensitive receptors within the noise and vibration study area. The magnitude and number of exceedances are detailed for each period of the day and each construction activity in Section 5.4. Appendix C presents the typical worst-case $L_{Aeq,\ 15\ min}$ noise level contours for the construction activities for individual properties

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.

Prior to relevant works commencing, a Noise and Vibration Sub-plan would be developed as part of the CEMP, developed in response to detailed construction planning and detailed design. Where it is predicted that noise or vibration impacts will exceed the criteria, then reasonable and feasible mitigation measures will be developed in consultation with adversely affected sensitive receptors.

The final number, degree and nature of these measures would be selected by the contractor and be largely dependent on the construction strategy and work carried out.

9.2 Construction road traffic noise

For 18 roads intended to be used to carry construction traffic the maximum predicted increase in noise level is greater than the criteria. Details of these exceedances are given in Section 5.4.2. These roads are primarily in rural locations and the existing base traffic volumes quantities are low. As such the initial airborne road traffic noise levels are low before the addition of construction traffic. Mitigation measures outlined in Section 8 should be applied to these 18 roads expected to exceed the criteria.

9.3 Construction vibration

Minimum working distances for vibration intensive construction work have been predicted for human comfort and structural damage limits in Section 5.4.3. Exceedances of the construction vibration criteria adopted from CoP Vol 2 have been predicted at a number of sensitive receptors. Specific measures to mitigate vibration have been outlined in Section 8.1.2, in addition to the standard mitigation measures detailed in Section 8.1.1.

9.4 Blasting

Maximum charge mass amounts based on indicative setback distances of sensitive structures and heritage buildings are presented in Section 5.4.4. This type of assessment has been completed in the absences of detailed information for the required blasting works as part of the Project. A more detailed assessment of blasting works associated with the tunnel construction is presented in Section 5.3.3. Additional assessments incorporating site conditions will need to be completed during future stages of the Project to ensure safe charge mass amounts are used. Mitigation measures are recommended in Section 8.1.2.

9.5 Operational road traffic noise

A desktop assessment of 7 new road sections and 9 road section upgrades was undertaken in order to predict the potential noise impacts associated with each road alteration. These road sections were assessed against relevant criteria from 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 have not been considered.

The operation of the Ipswich Boonah Road section proposed to be upgraded is predicted to result in one exceedance of the CoP Vol 1 criteria at residential receptor RES0411. These predicted impacts are based on the design and conservative assumptions. These findings should be revisited during detailed design.

9.6 Operational fixed infrastructure noise

Noise from fixed infrastructure has been assessed for the emergency and maintenance operations of the tunnel ventilation. Based on empirically derived fan sound data, the EPP (Noise) acoustic quality objectives are predicted to be achieved at all sensitive receptors. Predicted noise levels at the noise sensitive locations are presented in Table 6.2, and mapped in Appendix F.

10 References

Amick, H (1999). *Frequency-dependent soil propagation model,* proceedings of the SPIE Conference on Current Development in Vibration Control for Optomechanical Systems, Denver, Colorado, July 20, 1999.

Australian and New Zealand Environment Conservation Council (1990). Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, Sydney: ANZEC.

Australian Standards (1989). AS 3671-1987 – Acoustics – Road traffic noise intrusion – Building siting and construction, Sydney: Standards Australia.

Australian Standards (1997). AS 1055.1-1997 – Acoustics – Description and measurement of environmental noise, Part 1: General procedures, Sydney: Standards Australia.

Australian Standards (2004). AS IEC 61672.1-2004 – Electroacoustics – Sound level meters – Specifications, Sydney, Standards Australia.

Australian Standards (2006). AS 2187.2-2006 – Explosives – Storage and Use Part 2: Use of Explosives – Appendix J, Sydney: Standards Australia

British Standards (2009). BS5228-1:2009 - Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, British Standards, London, UK

British Standards (2009). BS 5228-2:2009 – Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 2 Vibration, British Standards, London, UK

CONCAWE (1981). the propagation of noise from petroleum and petrochemical complexes to neighbouring communities, report no. 4/81, CONCAWE

Department of Environment and Heritage Protection (2016). Guideline – Noise and Vibration from Blasting, Queensland Government.

Department of Environment and Science (2019). Guideline – Application requirements for activities with noise impacts, Queensland Government.

Department of Transport and Main Roads (2015). Transport Noise Management: *Code of Practice* Volume 2, Queensland Government.

Department of Transport and Main Roads (2013), Road Traffic Noise Management: Code of Practice Volume 1, Queensland Government.

Deutsches Institut für Normung (1999). DIN 4150: Part 3 1999 Structural Vibration in Buildings - Effects on Structures, Berlin: DIN.

Melbourne Metro Rail Project Environment Effects Statement Inquiry and Advisory Committee (2016). MMRA Technical Note #042, 19 August 2016

APPENDIX

P

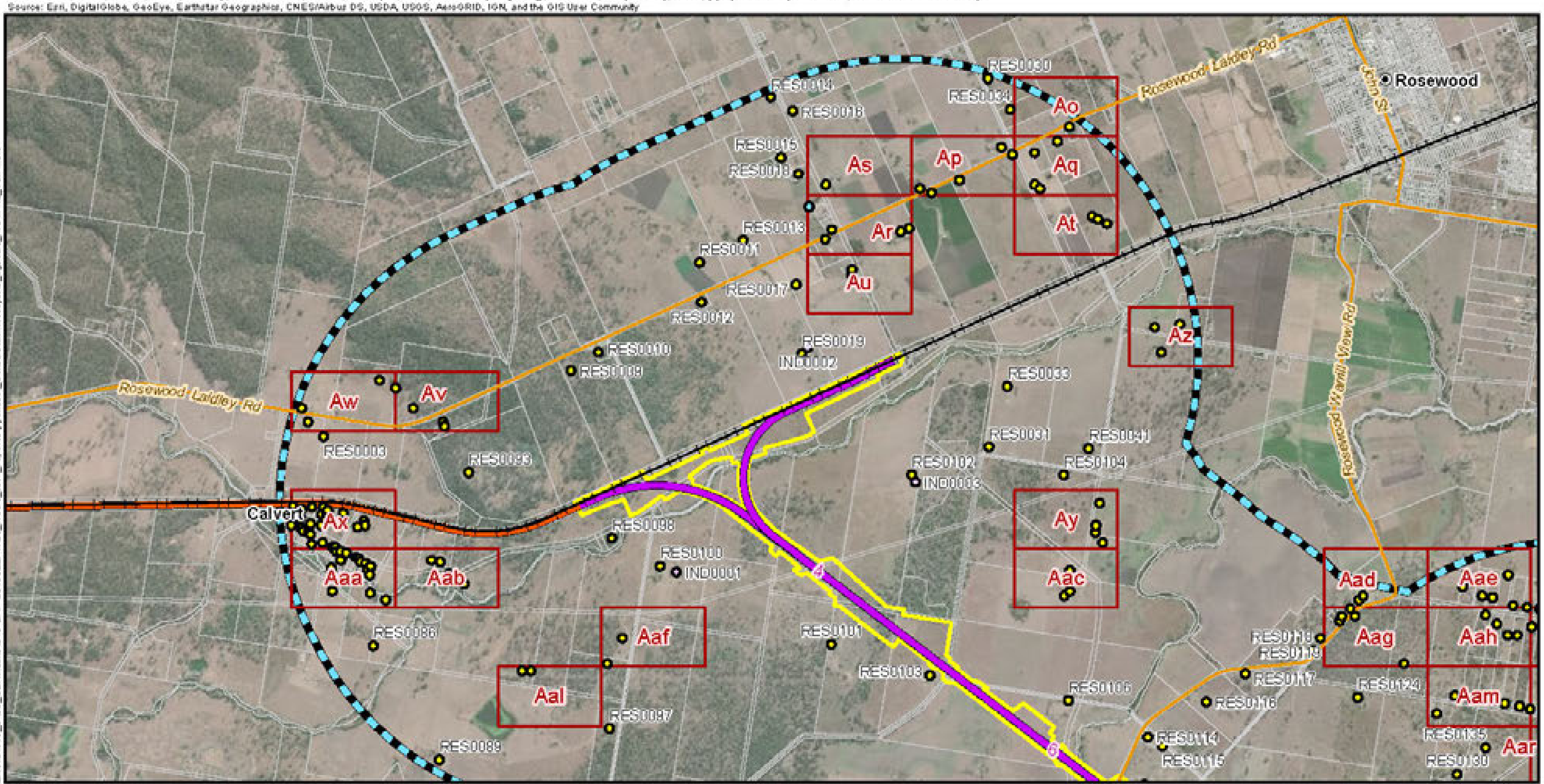
Non-operational Noise and Vibration Technical Report

Appendix A Noise and vibration sensitive receptors

CALVERT TO KAGARU ENVIRONMENTAL IMPACT STATEMENT

IR_1381

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

5	Chainage (km)
	Localities
	Existing rail
	H2C project alignment
	C2K project alignment
	Minor roads
	EIS disturbance footprint
	Noise and vibration study area
	Cadastre
	Areas mapped separately

Sensitive receptors

- Community Retail
- Industrial
- Residential

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

Future Freight

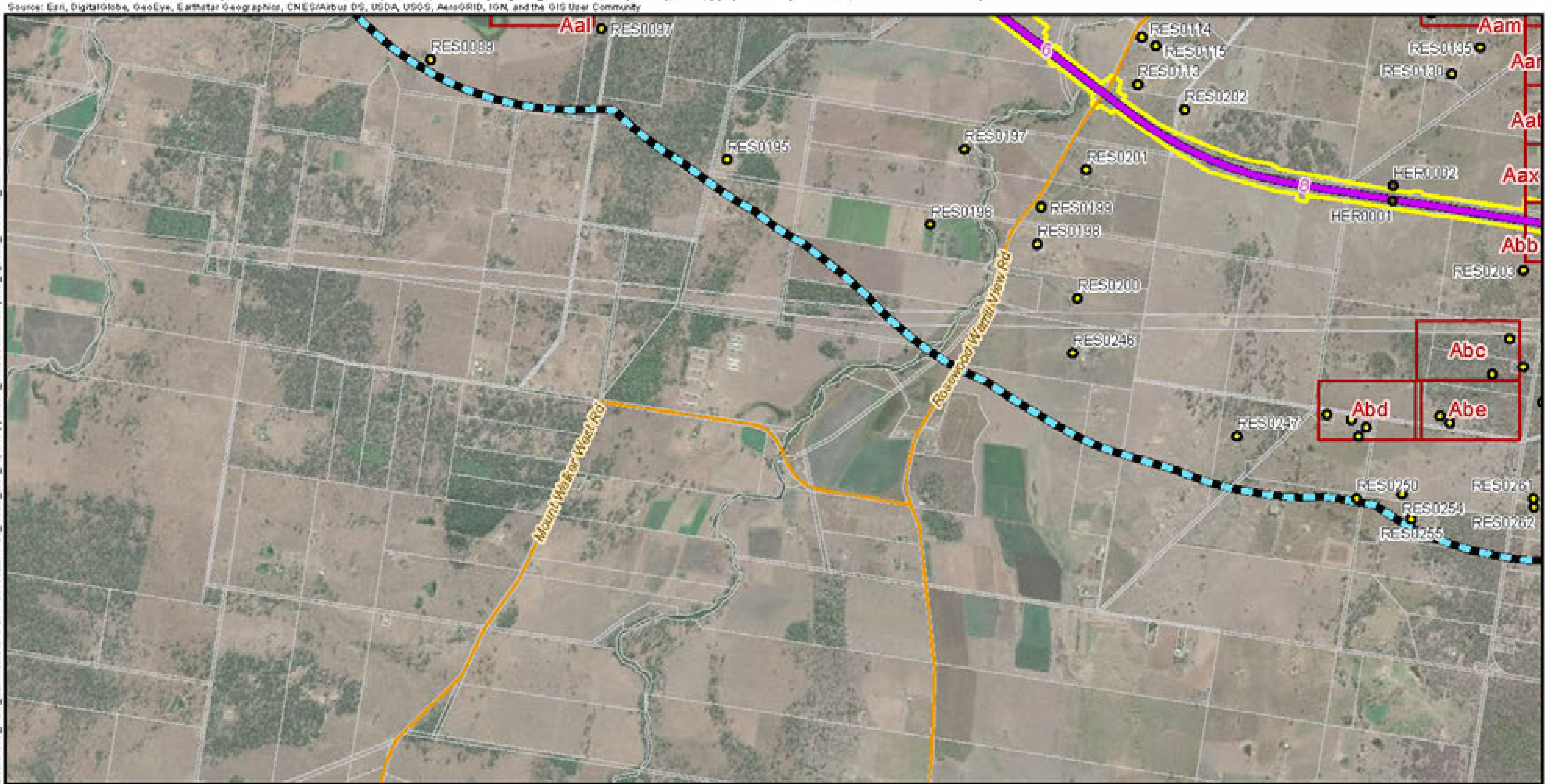
Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aa: Noise and vibration sensitive receptors

Map by: CSN/CW/RB/GN Date: 5/03/2020 08:25

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



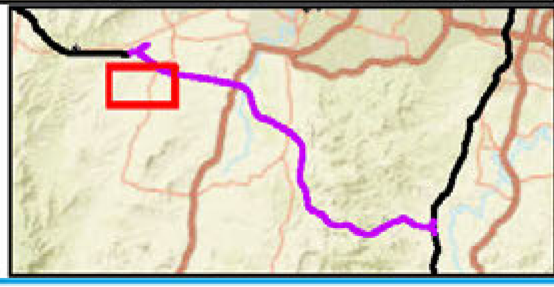
Map by: CSN/CW/RB/GN Date: 5/03/2020 08:25
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_Upgrade_FF\Vol4_Ver7.mxd

Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Heritage
- Residential



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

Future Freight

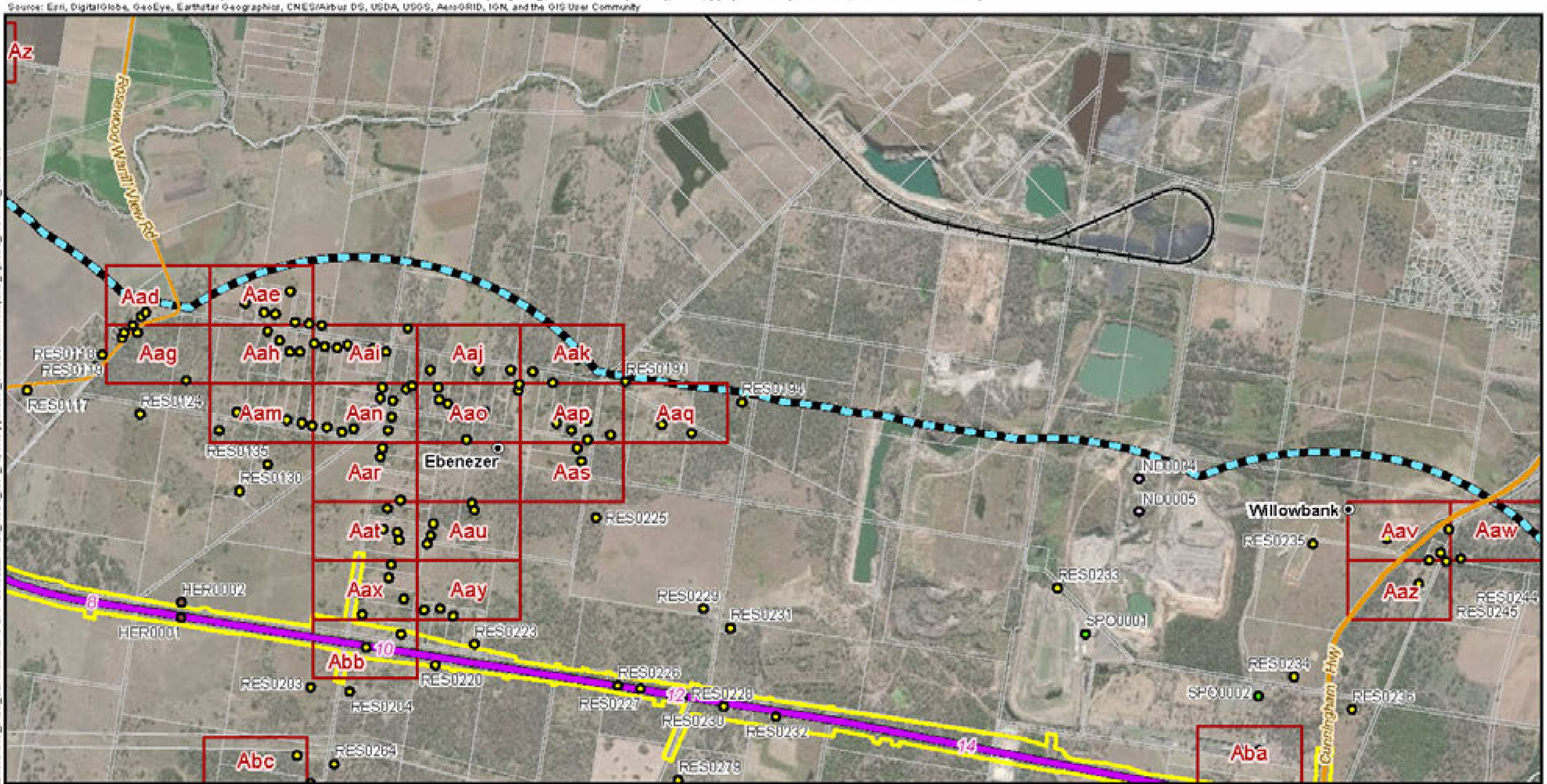
Date: 05/03/2020 Version: 7

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ab: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



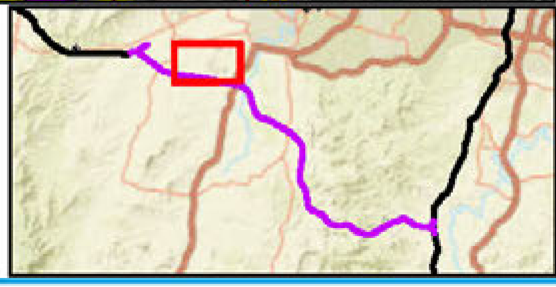
Map by: CSN/DWR/BGN Date: 5/03/2020 08:25
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_Inground_FFJV\v4L_Ver7.mxd

Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Major roads
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Community Retail
- Heritage
- Industrial
- Residential
- Sporting Facility



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

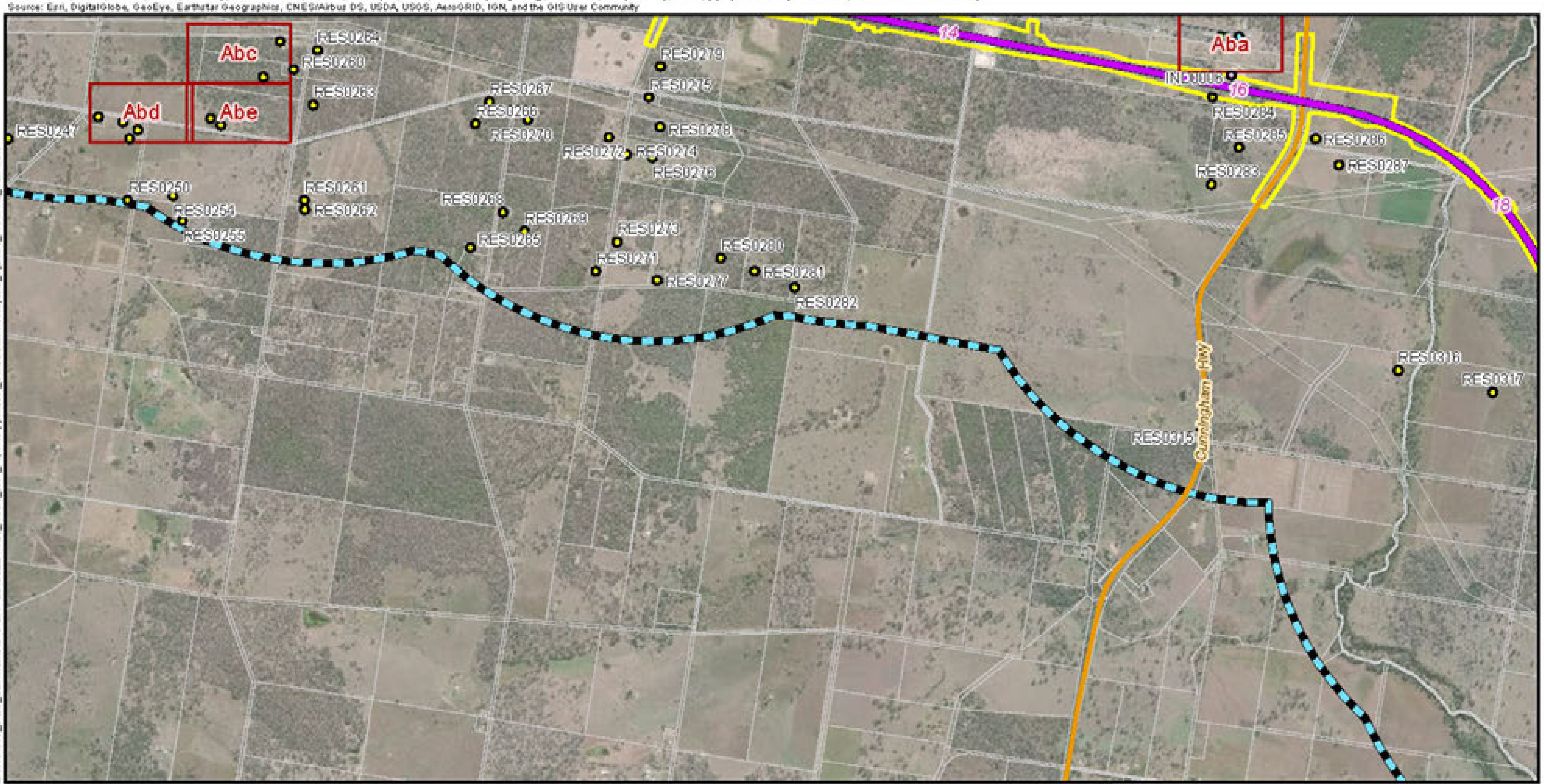
Future Freight

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ac: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 08:25
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_Ingrade_FF\Vista_Ver7.mxd

Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Major roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Community Retail
- Industrial
- Residential
- Sporting Facility

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

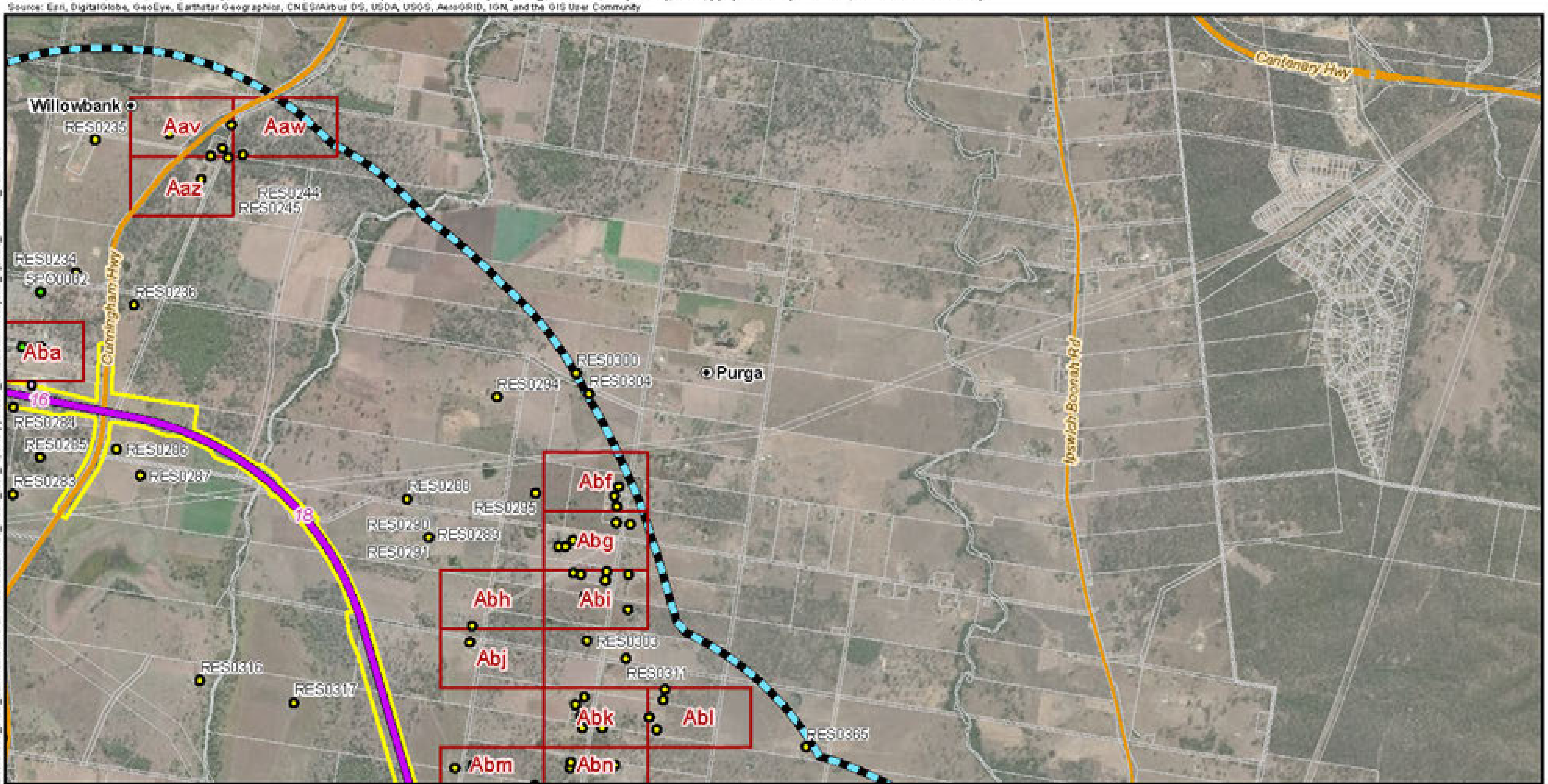
Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ad: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



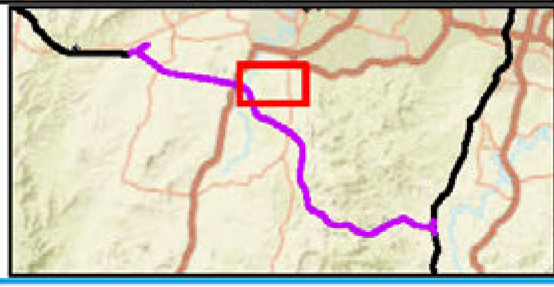
Map by: CSNCW/RB/GN Date: 5/03/2020 08:25

Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Major roads
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Community Retail
- Industrial
- Residential
- Sporting Facility



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

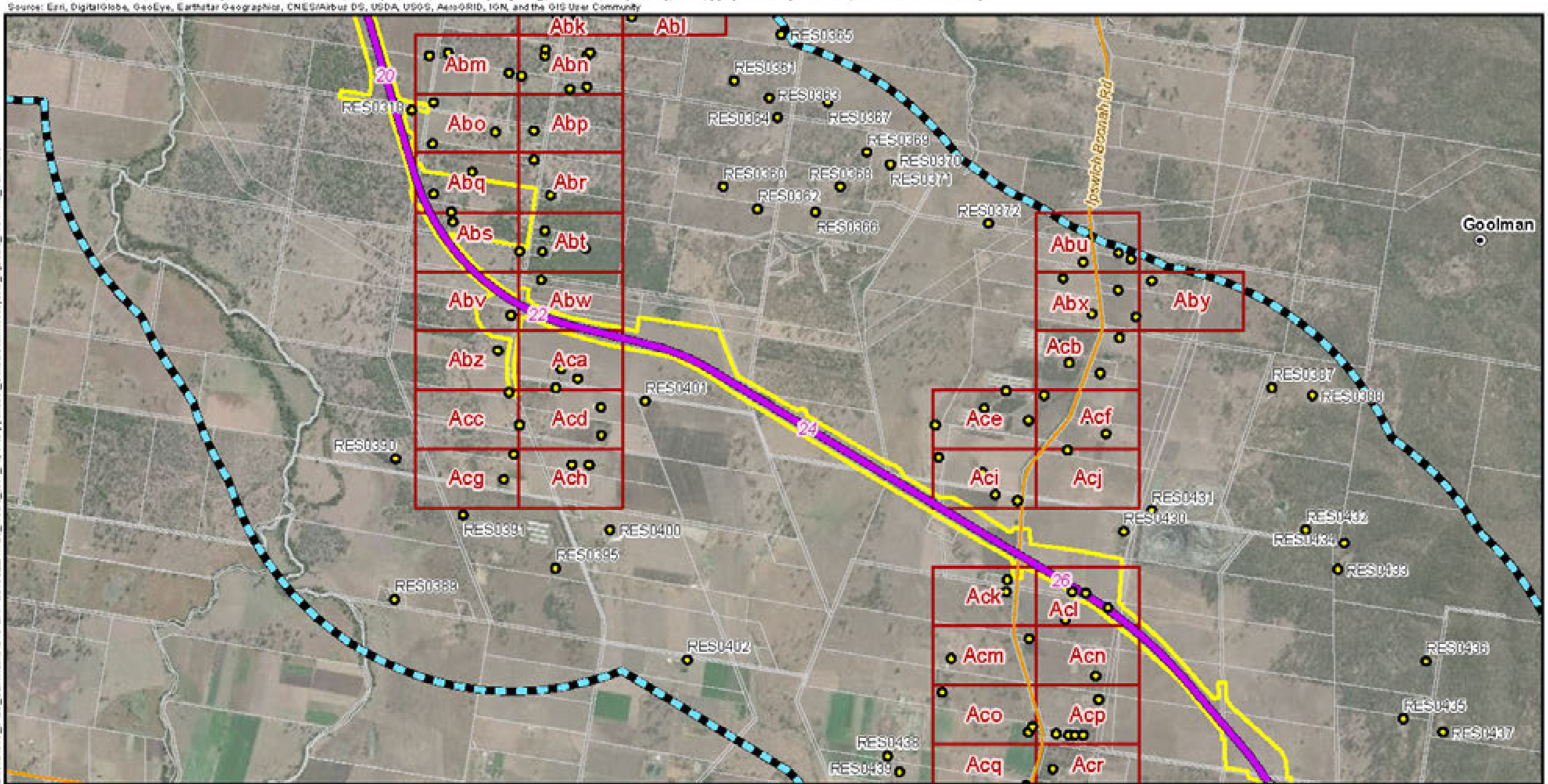
Future Freight

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

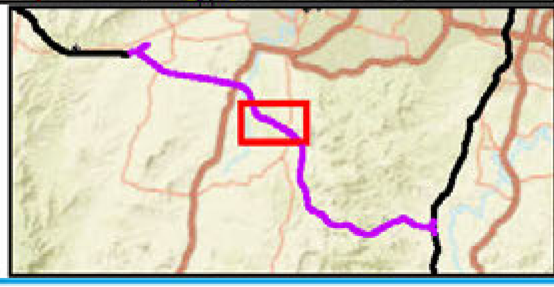
Appendix Ae: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

5 Chainage (km)	EIS disturbance footprint	**Sensitive receptors**
Localities	Noise and vibration study area	Residential
Existing rail	Cadastre	
C2K project alignment	Areas mapped separately	
Minor roads		



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

Future Freight

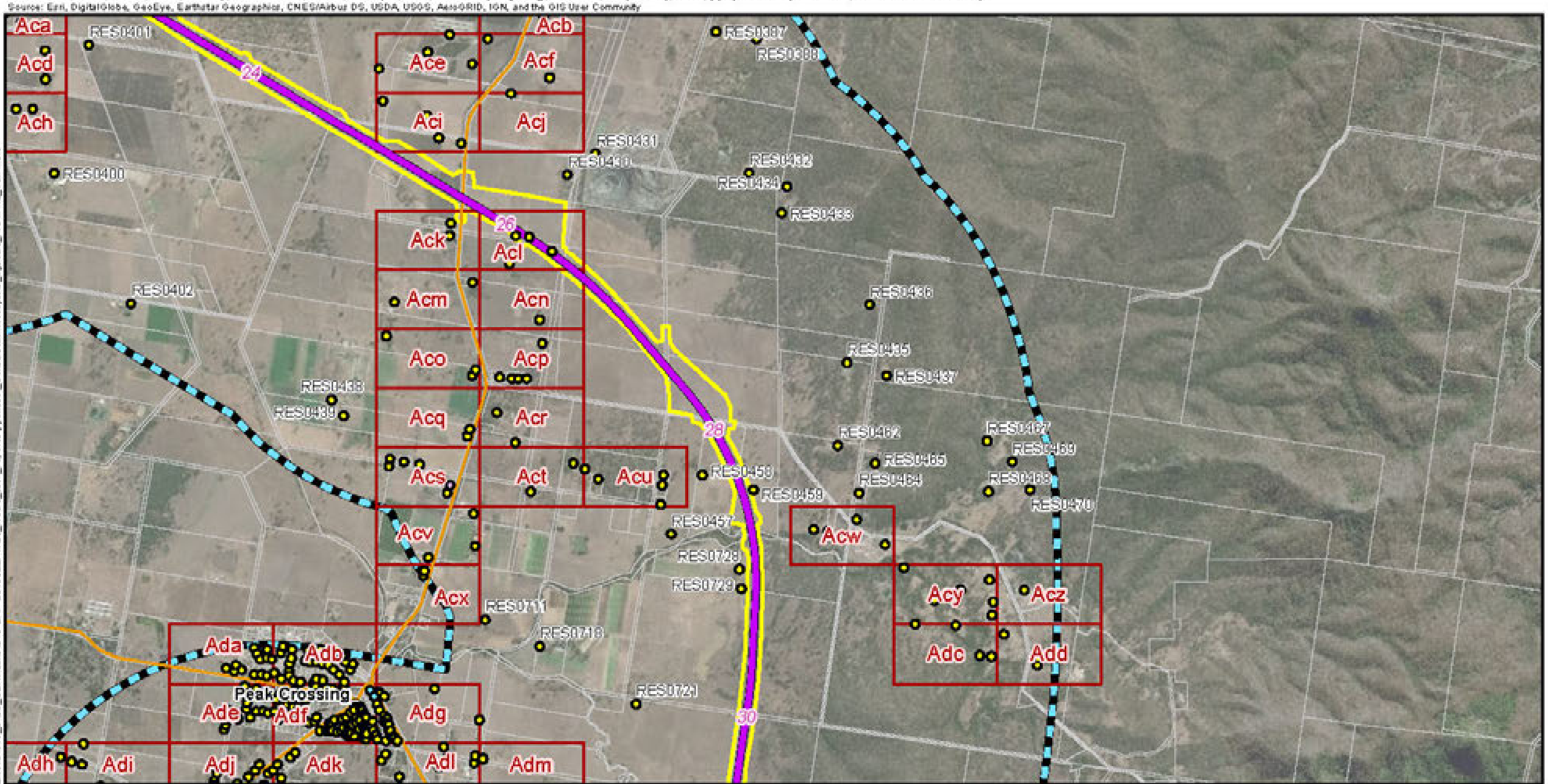
Date: 05/03/2020 Version: 7

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Af: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Community Retail
- Industrial
- Residential

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

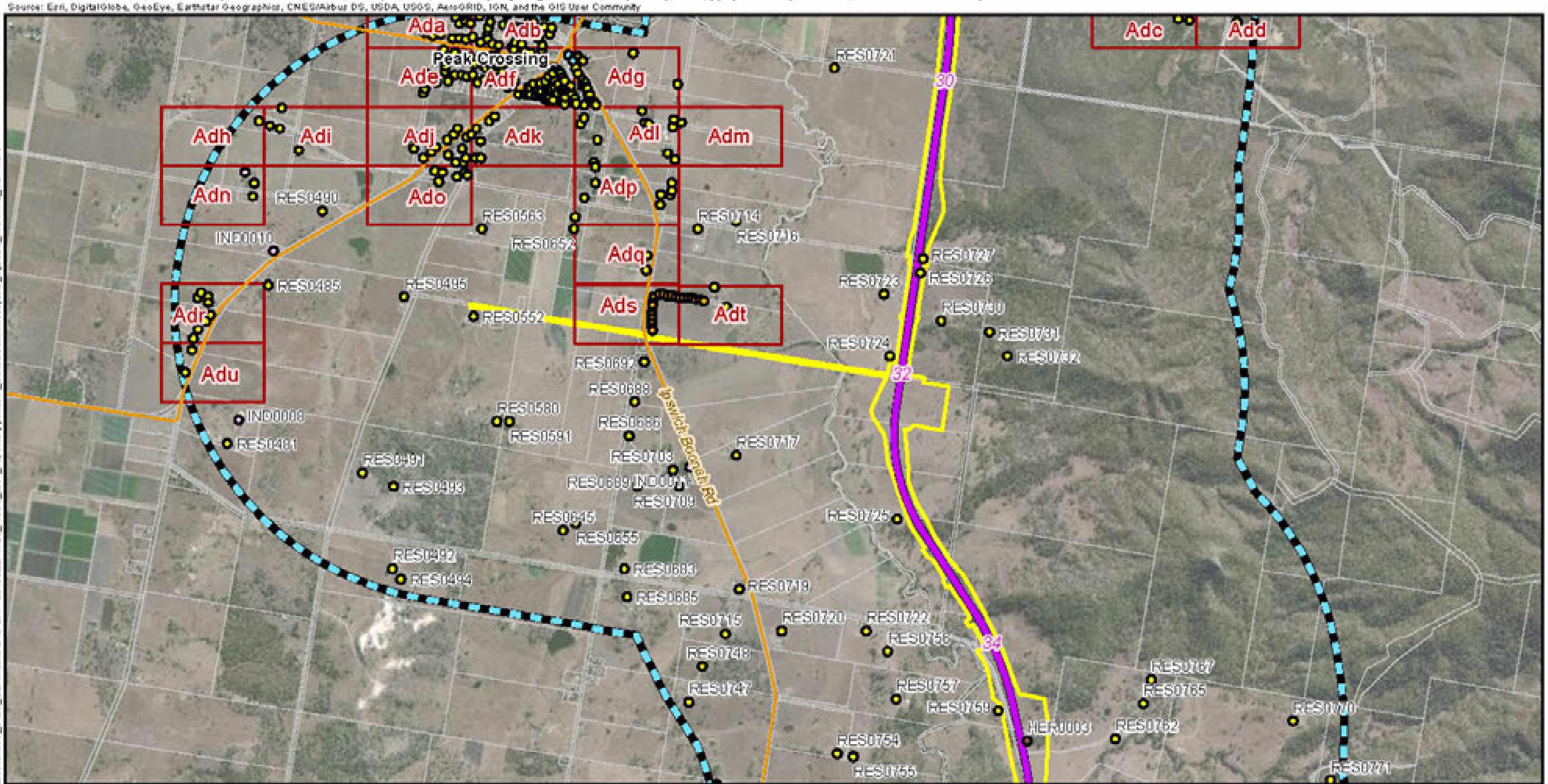
Future Freight
Integrating Community Development and Engineering

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ag: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Community Retail
- Heritage
- Hotel/Motel
- Industrial
- Residential

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

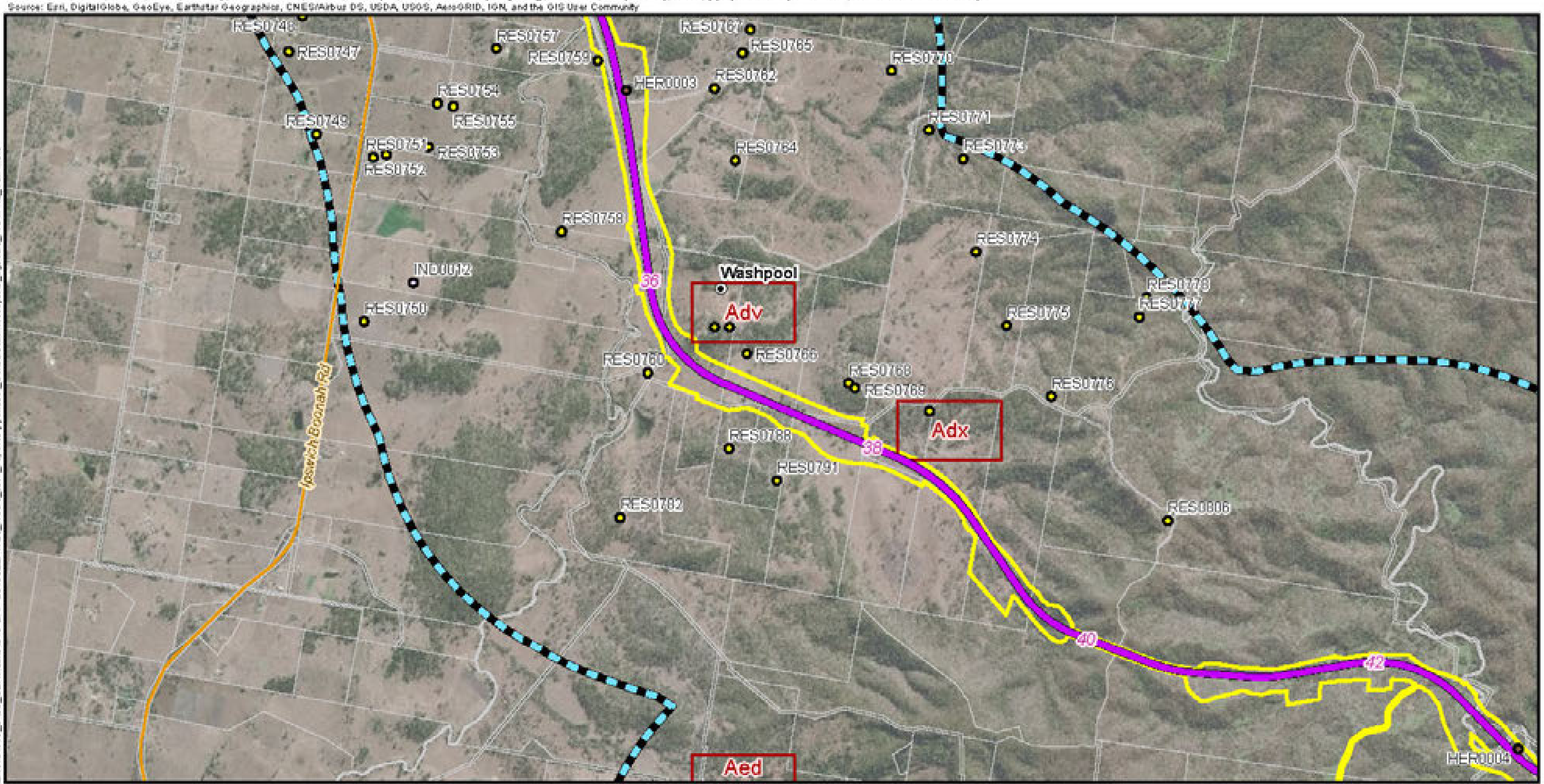
Future Freight

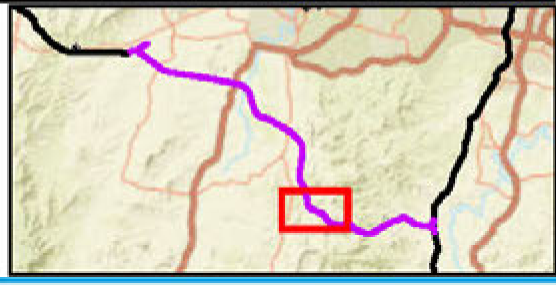
Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ah: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

5	Chainage (km)		EIS disturbance footprint
	Localities		Noise and vibration study area
	Existing rail		Cadastre
	C2K project alignment		Areas mapped separately
	Minor roads		

Sensitive receptors
- Heritage
- Industrial
- Residential

Note that due to topography constraints and the realignment of Wild Pig Creek Road and to minimise impacts on Dugandan Creek, there is a small area not within the disturbance footprint between Chainage 42 and 44.

A4 scale: 1:40,000

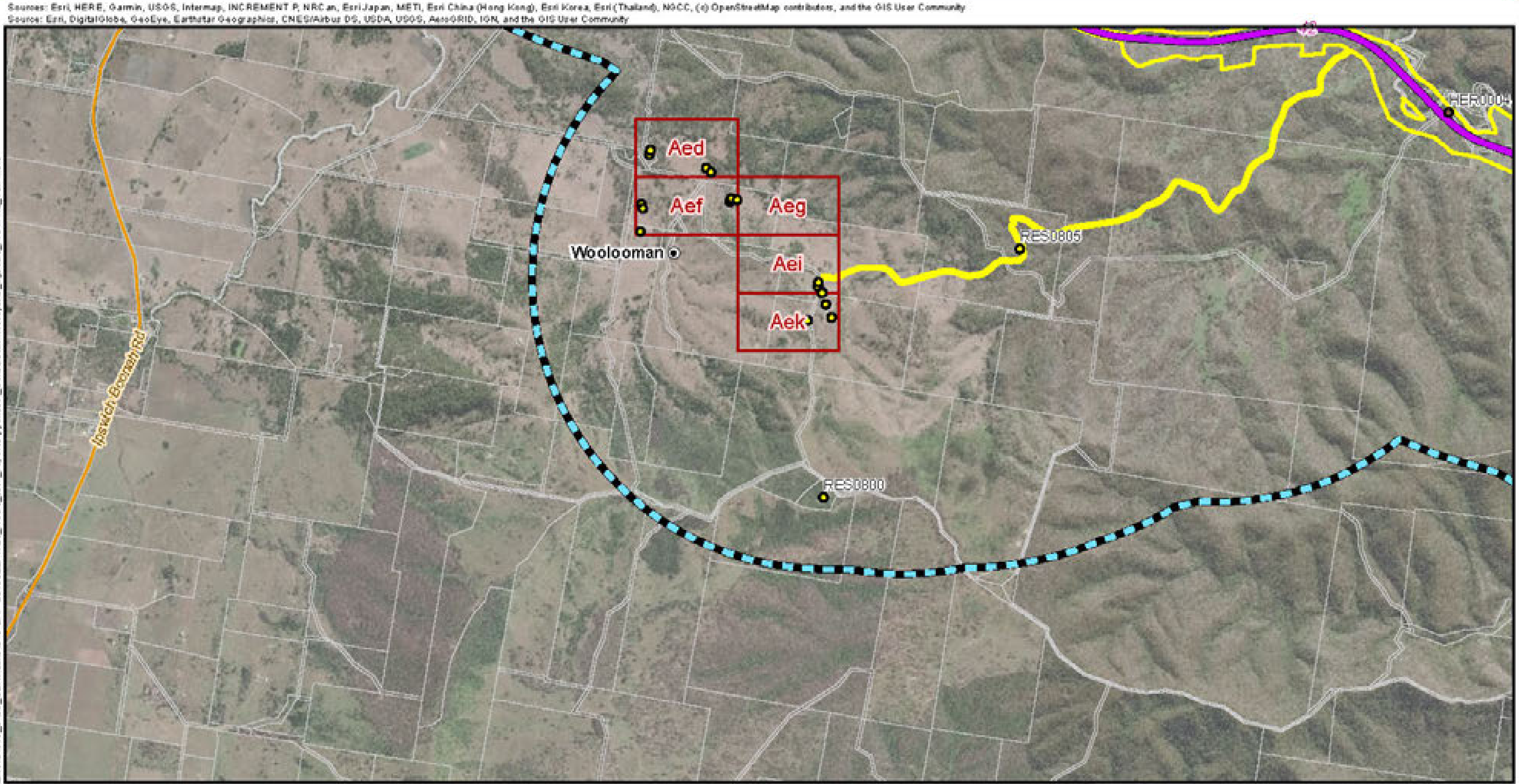
0 0.5 1 1.5 2 2.5 km

Future Freight

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ai: Noise and vibration sensitive receptors



Legend

5 Chainage (km)	EIS disturbance footprint	**Sensitive receptors**
Localities	Noise and vibration study area	Heritage
Existing rail	Cadastre	Residential
C2K project alignment	Areas mapped separately	
Minor roads		

Note that due to topography constraints and the realignment of Wild Pig Creek Road and to minimise impacts on Dugandan Creek, there is a small area not within the disturbance footprint between Chainage 42 and 44.

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

Future Freight

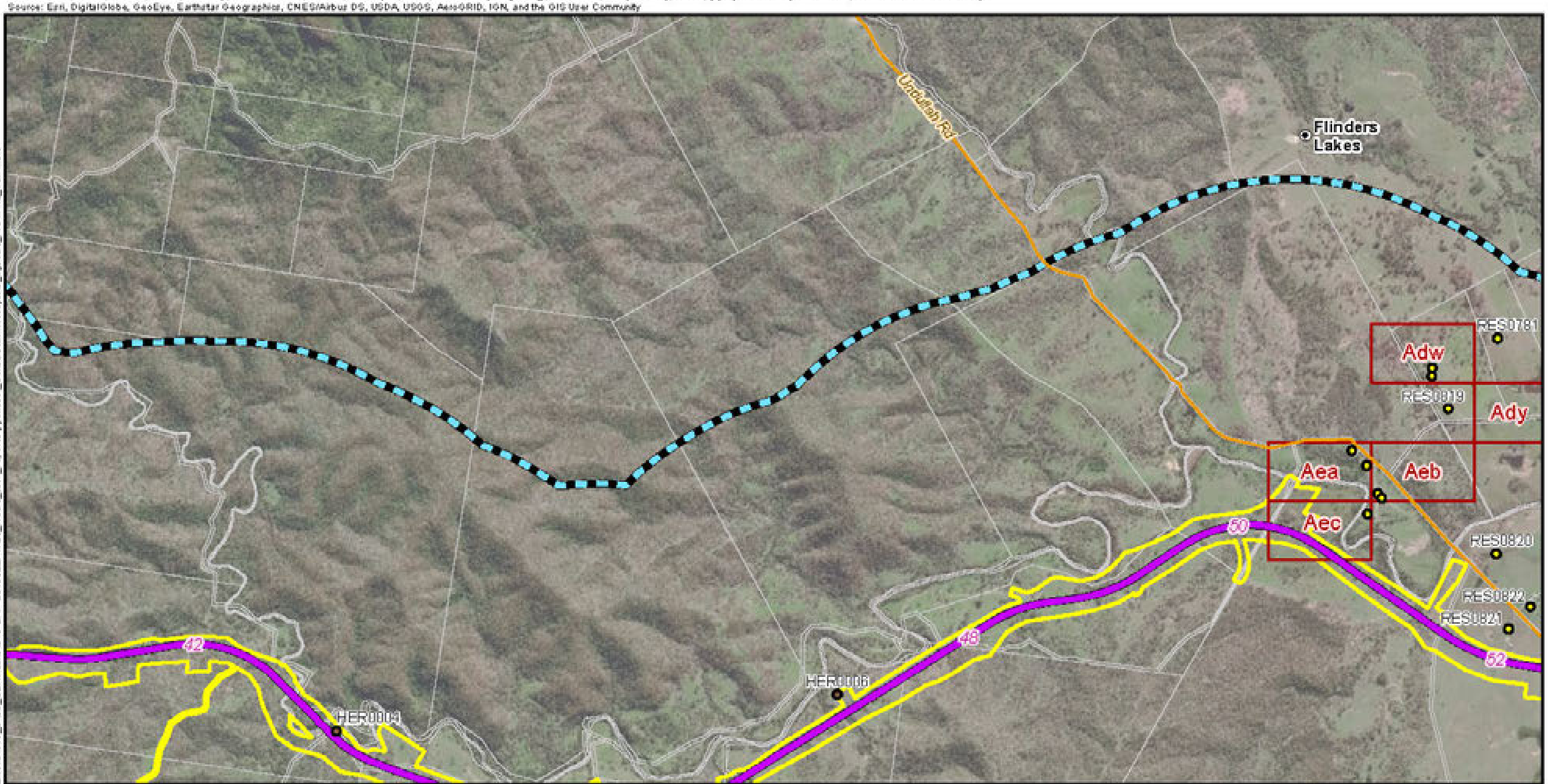
Date: 05/03/2020 Version: 7

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aj: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 08:25

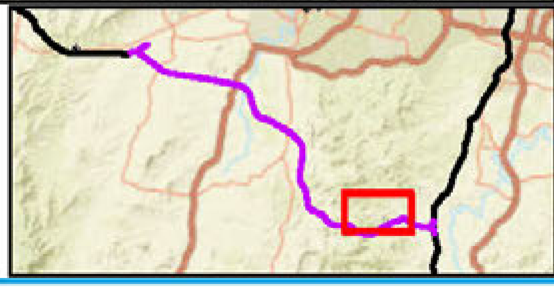
Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Heritage
- Residential

Note that due to topography constraints and the realignment of Wild Pig Creek Road and to minimise impacts on Dugandan Creek, there is a small area not within the disturbance footprint between Chainage 42 and 44.



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

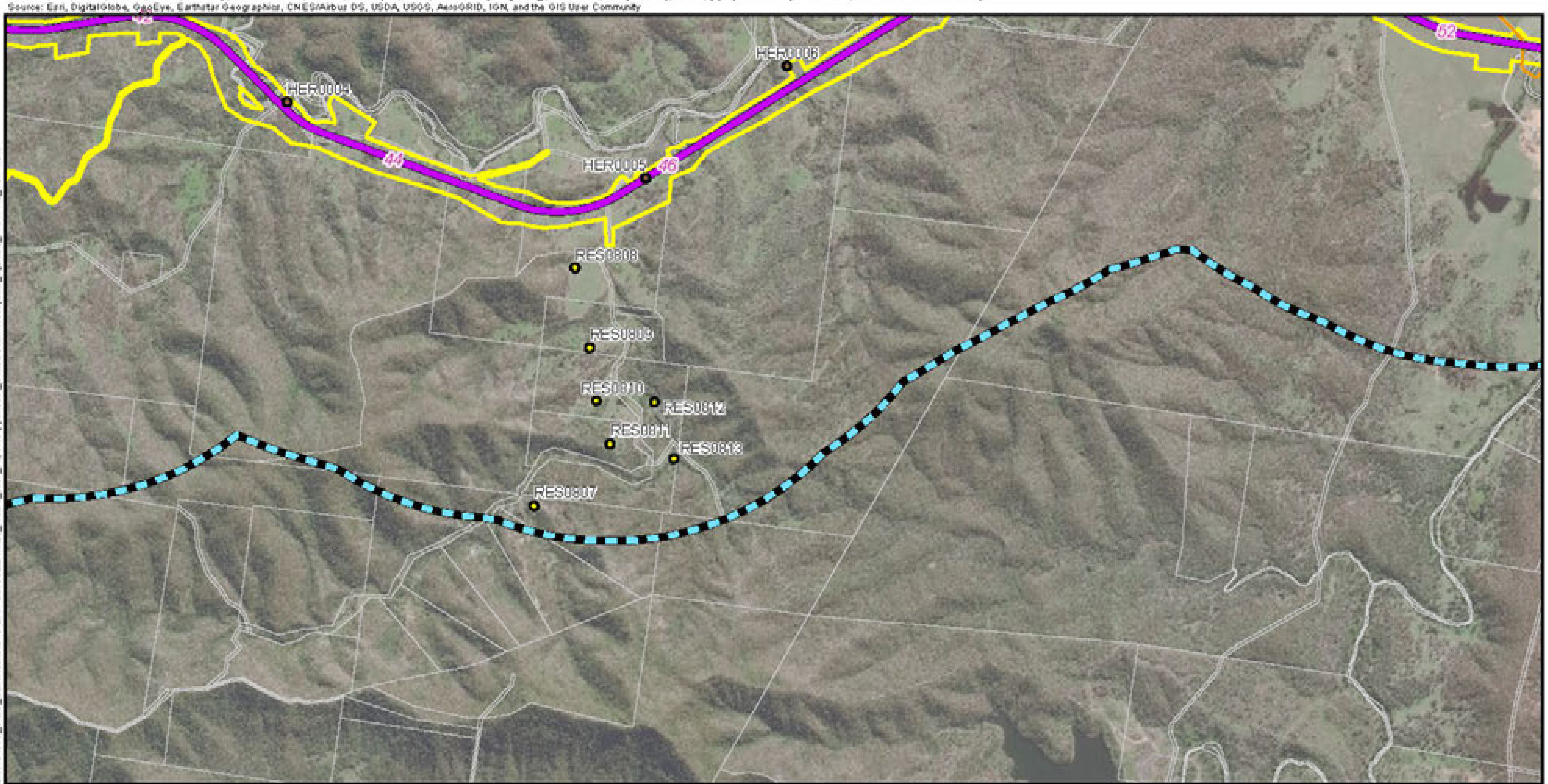
Future Freight

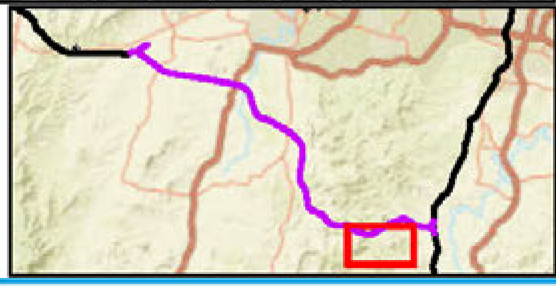
Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ak: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Heritage
- Residential

Note that due to topography constraints and the realignment of Wild Pig Creek Road and to minimise impacts on Dugandan Creek, there is a small area not within the disturbance footprint between Chainage 42 and 44.

A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

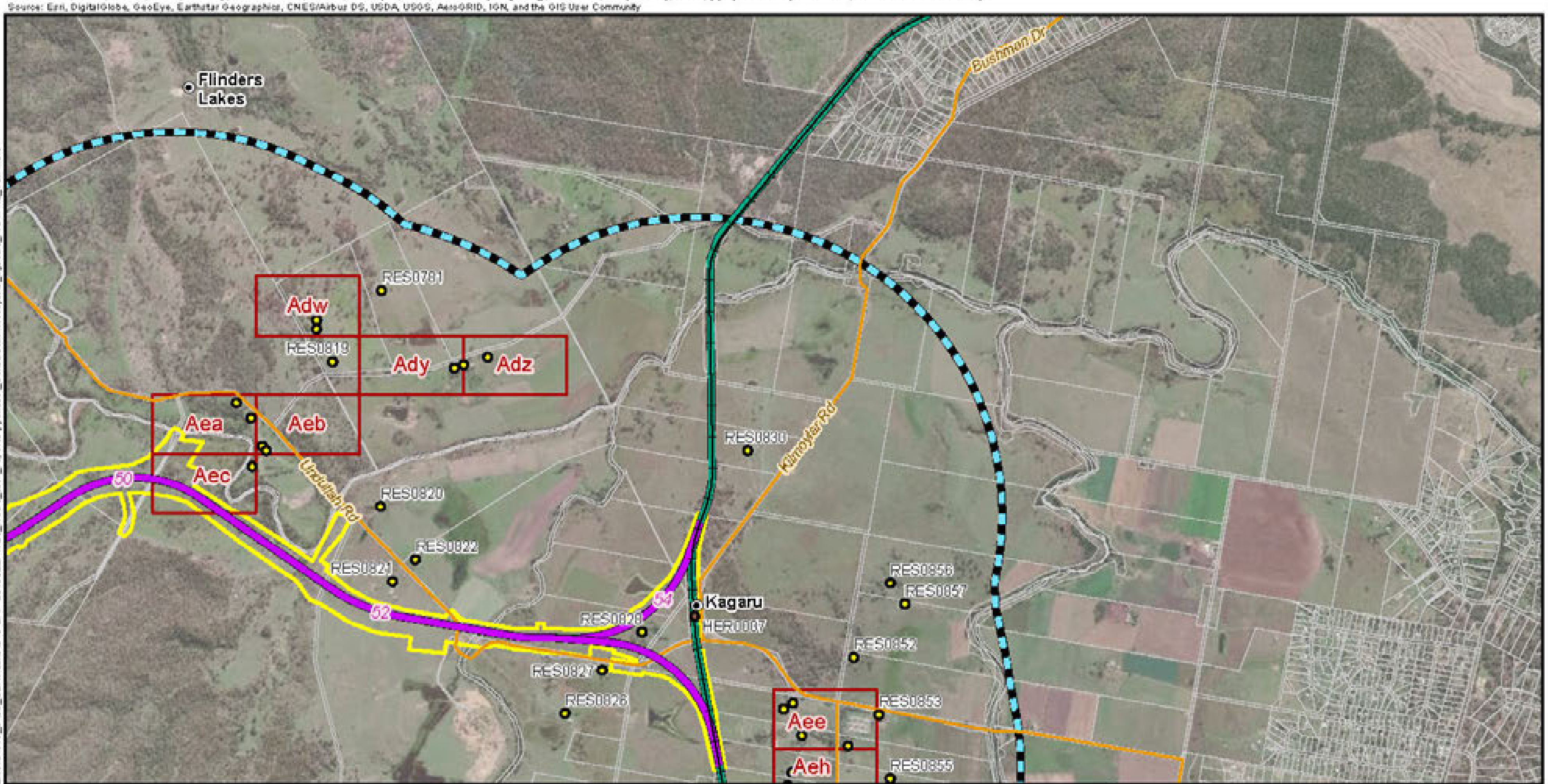
Future Freight

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

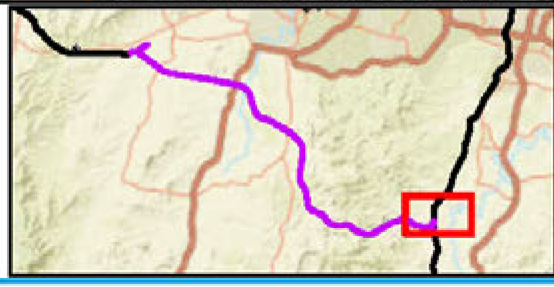


Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- K2ARB project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Heritage
- Residential



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

Future Freight

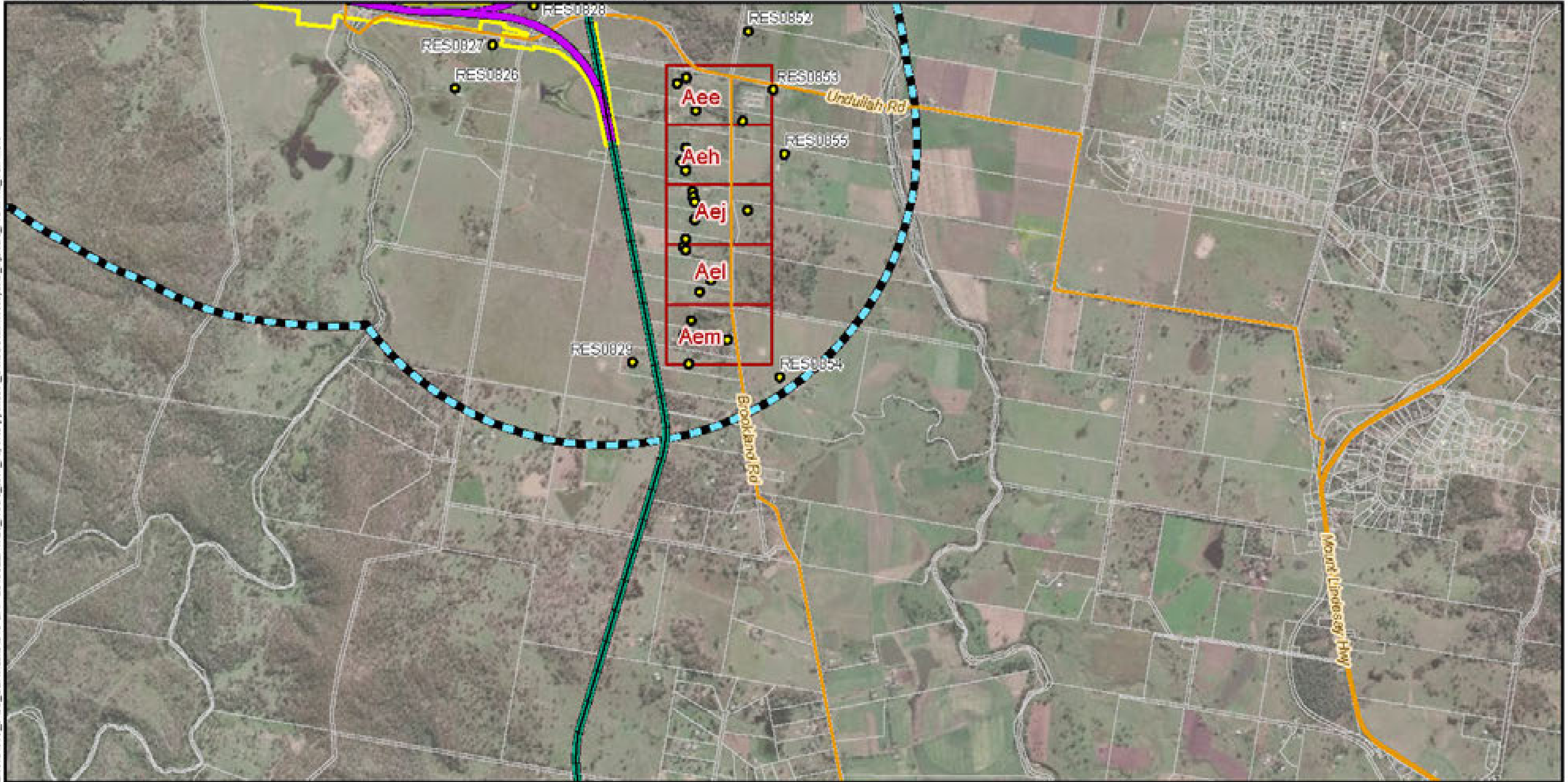
Date: 05/03/2020 Version: 7

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Am: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



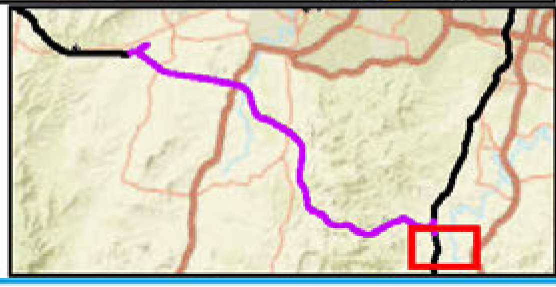
Map by: CSN/CW/RB/GN Date: 5/03/2020 08:25
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_Ingrade_FF\V4\4_Ver7.mxd

Legend

- 5 Chainage (km)
- Localities
- Existing rail
- C2K project alignment
- K2ARB project alignment
- Major roads
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre
- Areas mapped separately

Sensitive receptors

- Residential



A4 scale: 1:40,000

0 0.5 1 1.5 2 2.5 km

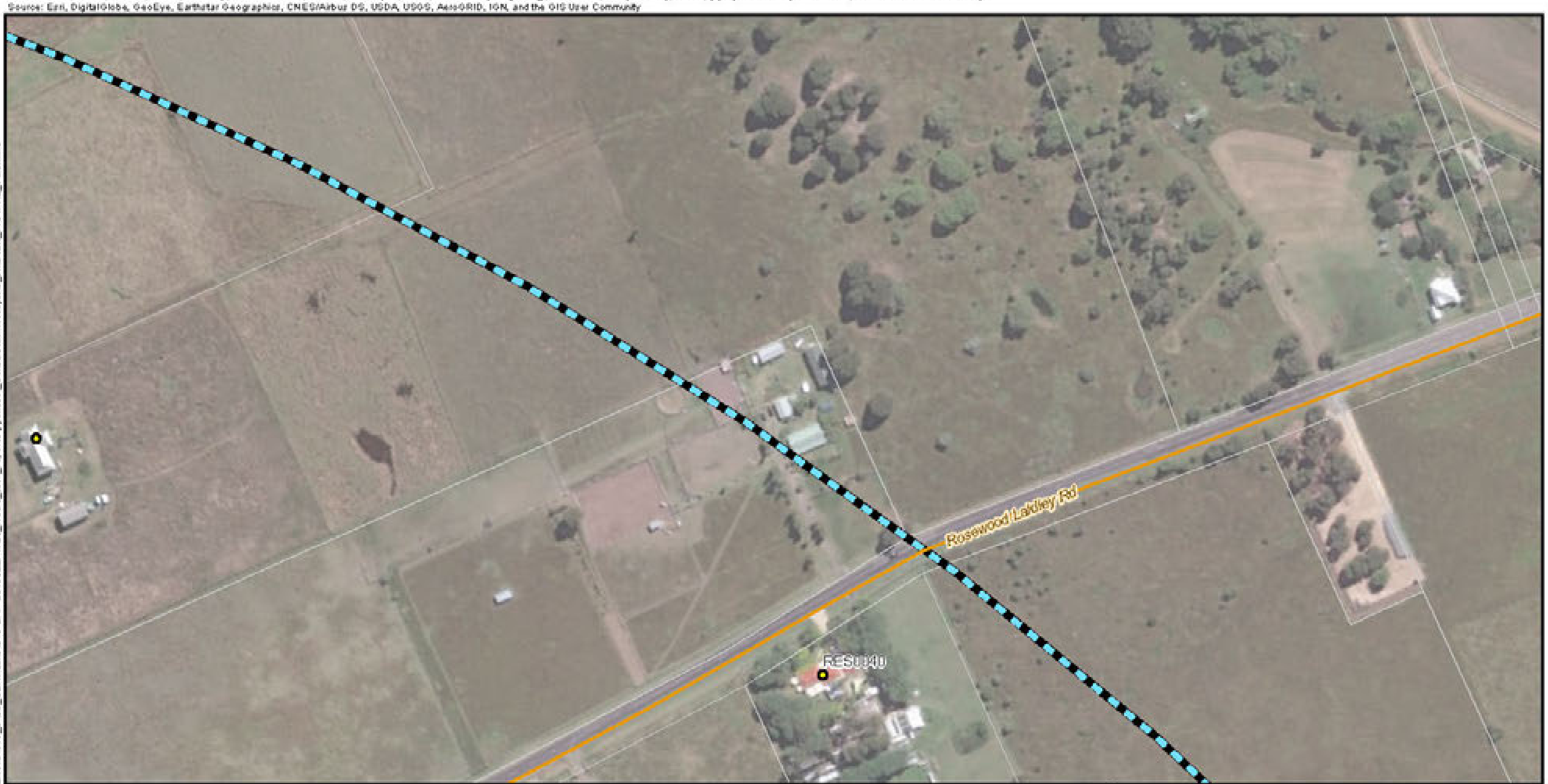
Future Freight
Integrating Community Development and Engineering

Date: 05/03/2020 Version: 7
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix An: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

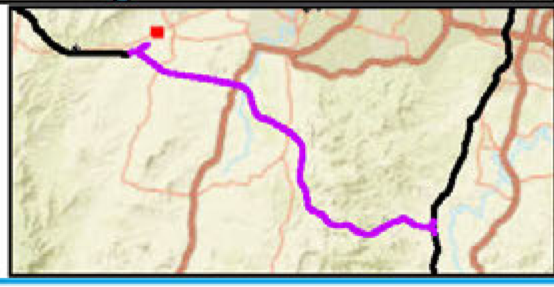
Minor roads

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

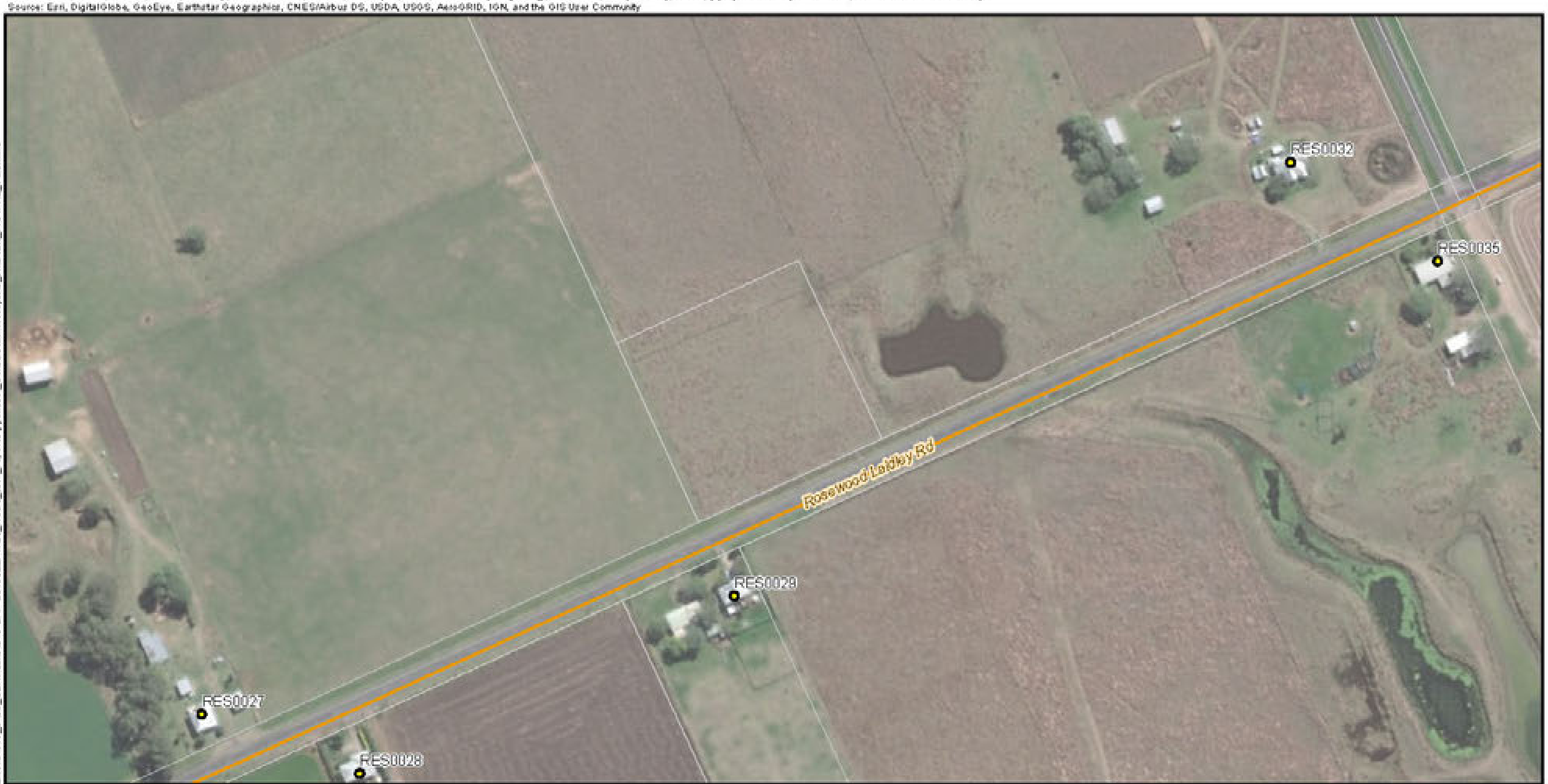
Date: 05/03/2020 Version: 6

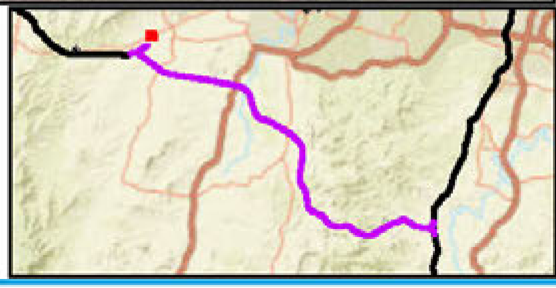
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ao: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

Minor roads

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

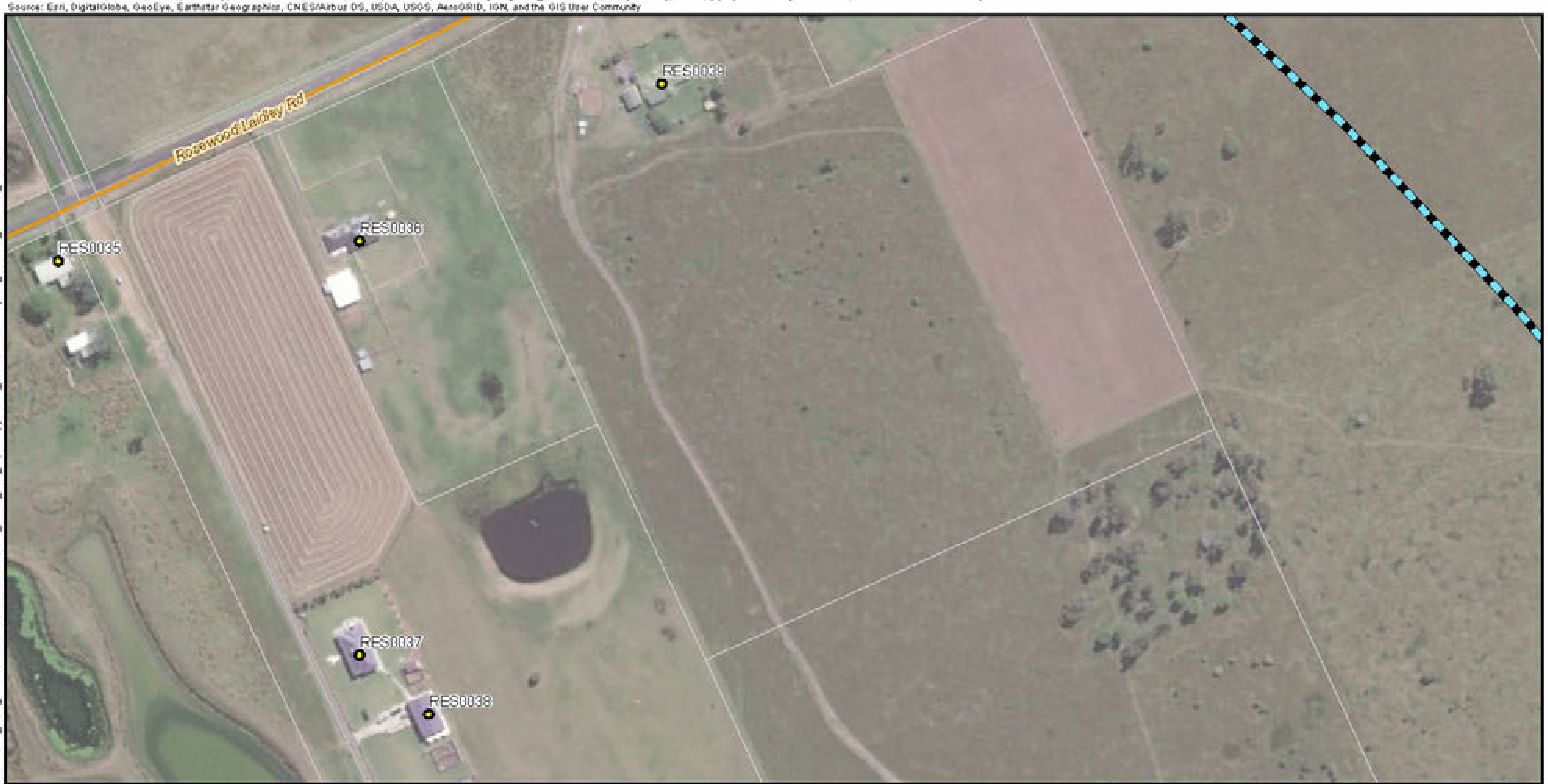
Date: 05/03/2020 Version: 6

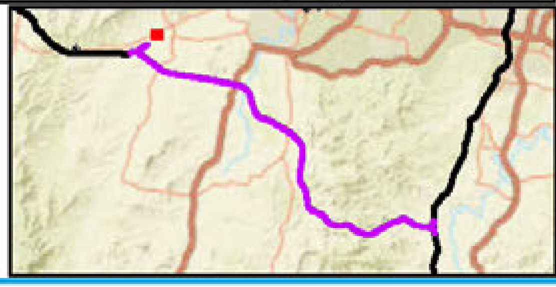
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ap: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

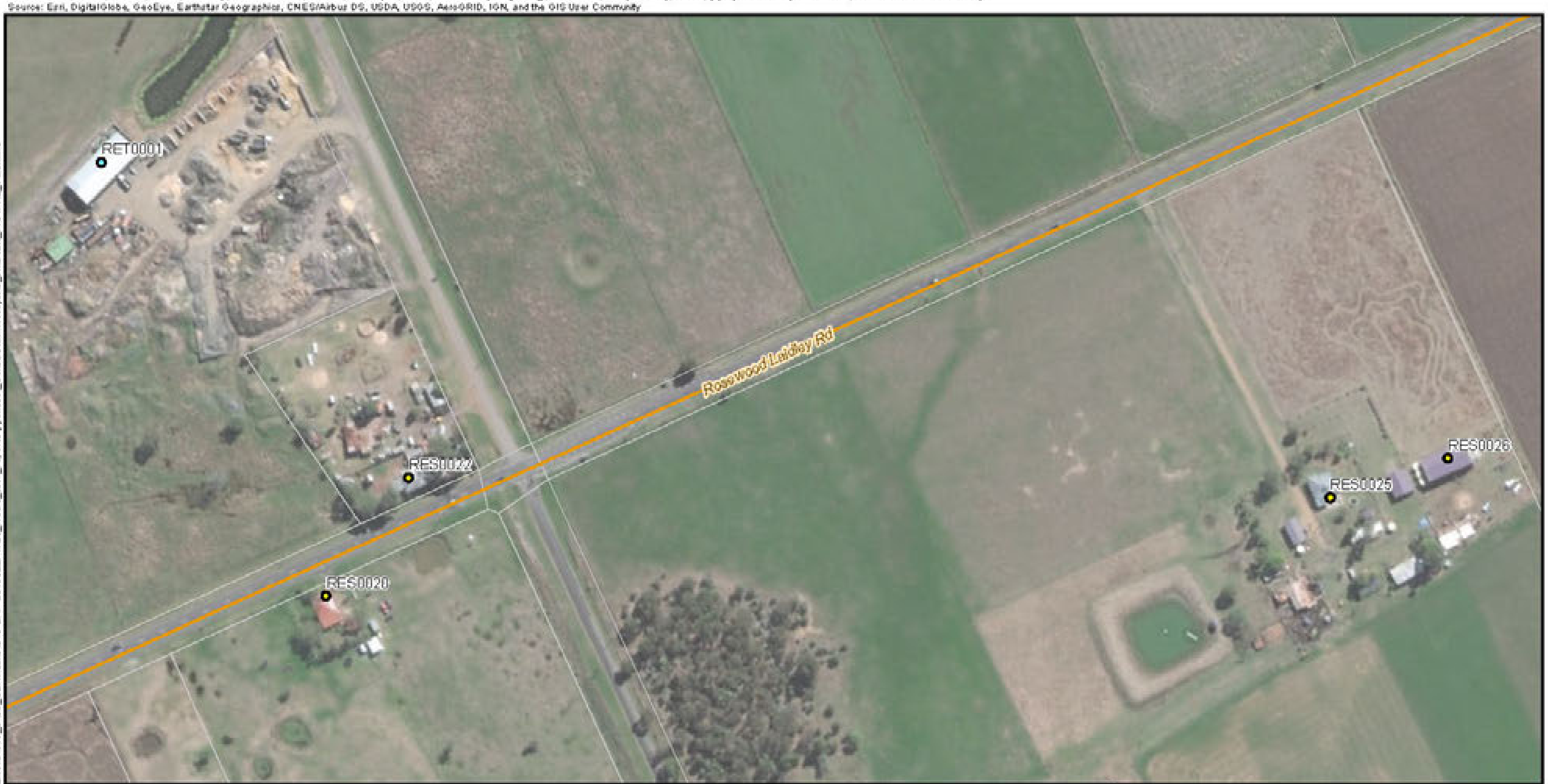
0 25 50 75 100 125 Meters

Future Freight

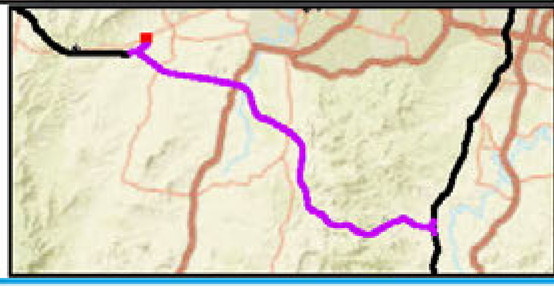
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aq: Noise and vibration sensitive receptors



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAR_Ver6.mxd



Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Community Retail
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

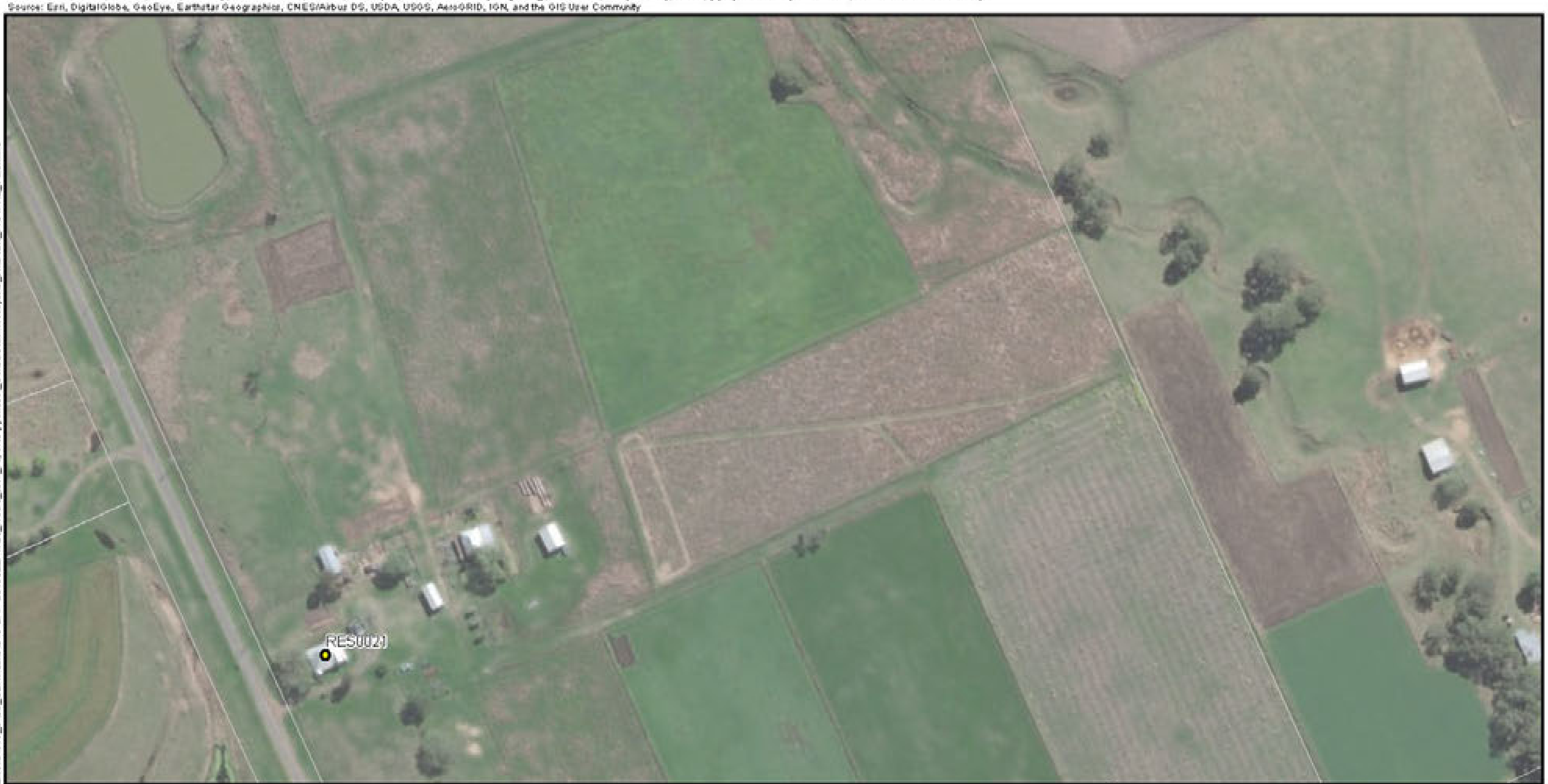
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ar: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV_Ver6.mxd

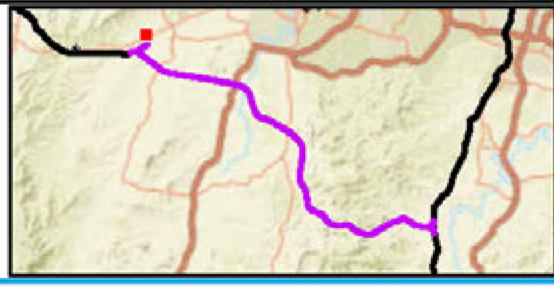
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

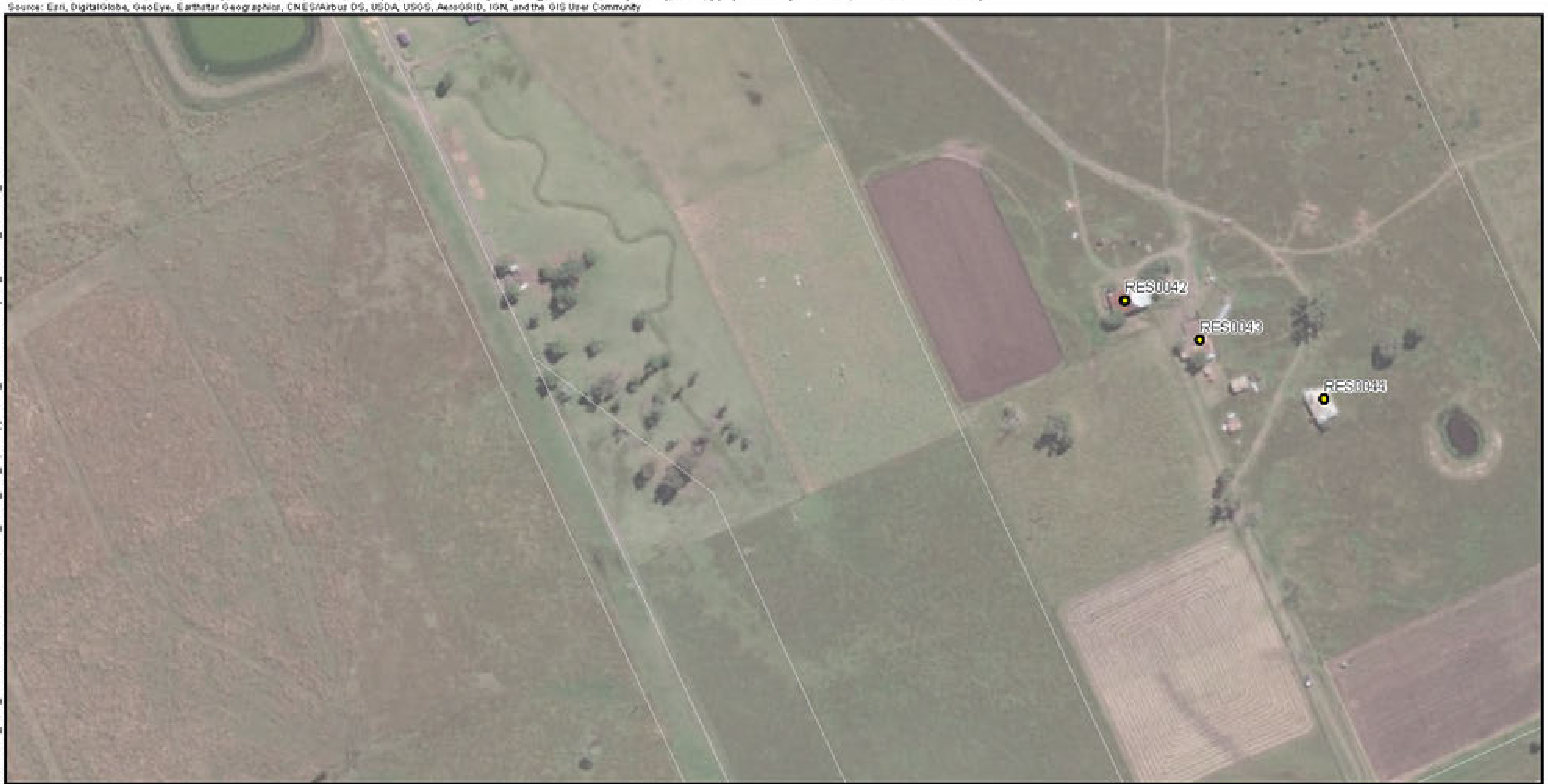
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix As: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

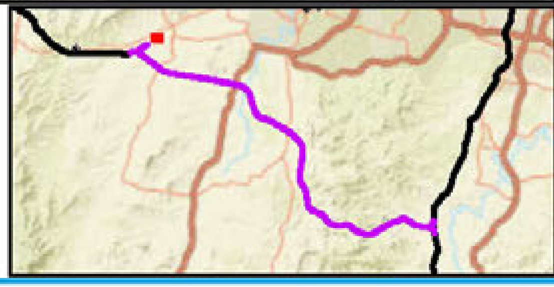
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix At: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\JAAL_Ver6.mxd

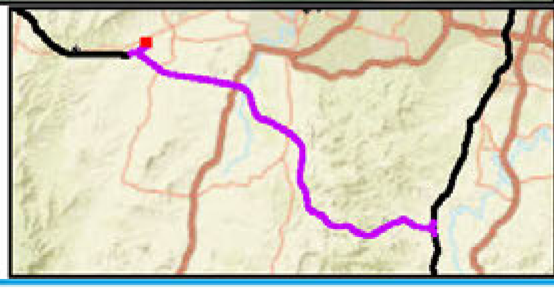
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

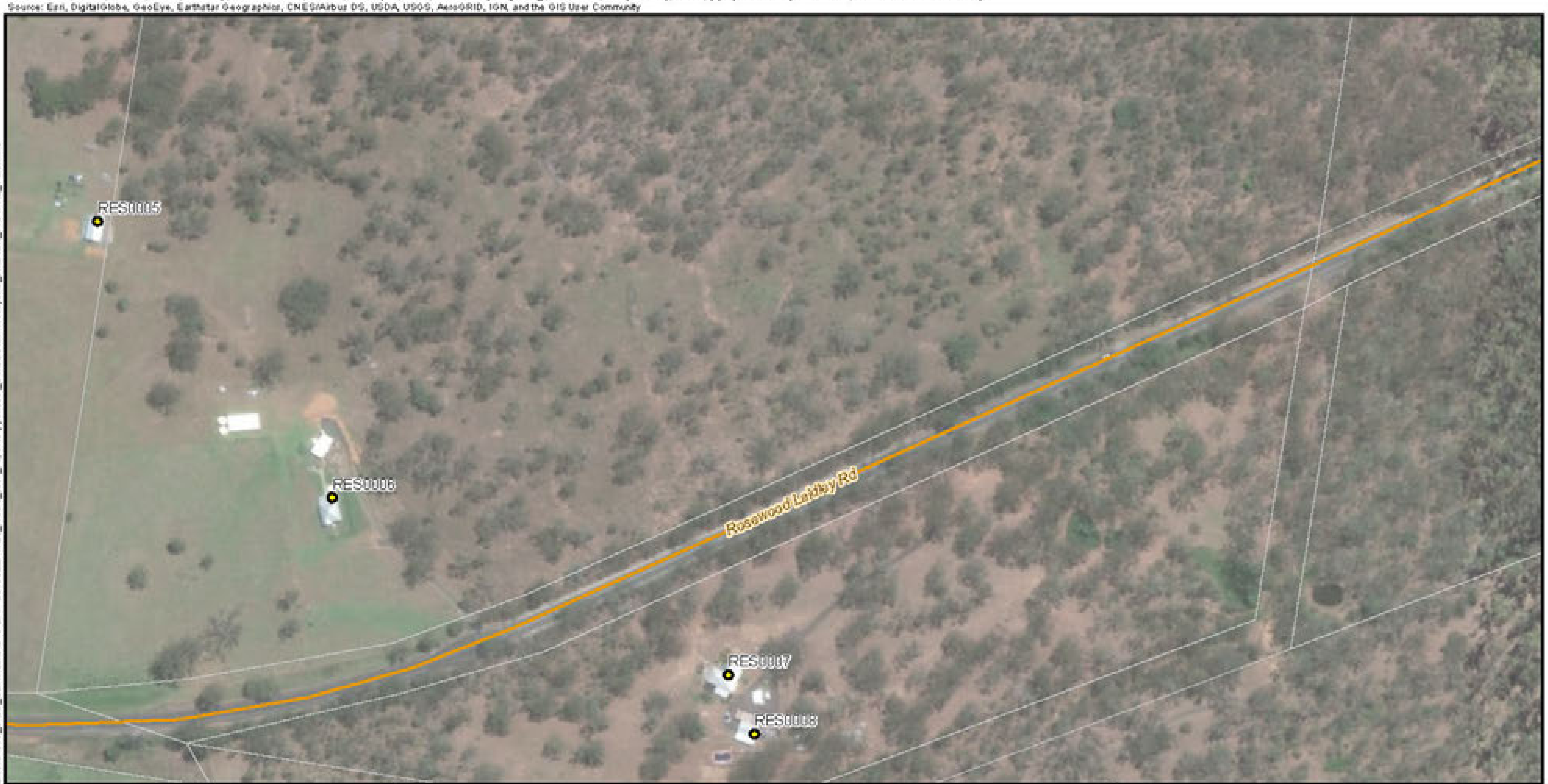
Future Freight
Integrating Community Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Au: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



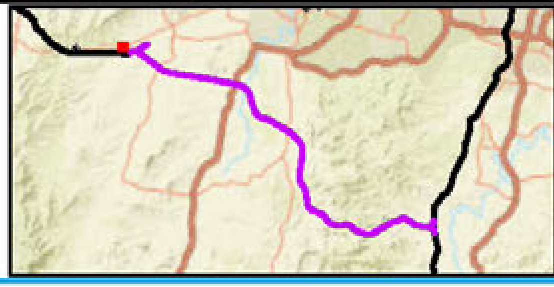
Map by: CSNCWRB/GN Date: 5/03/2020 09:14

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

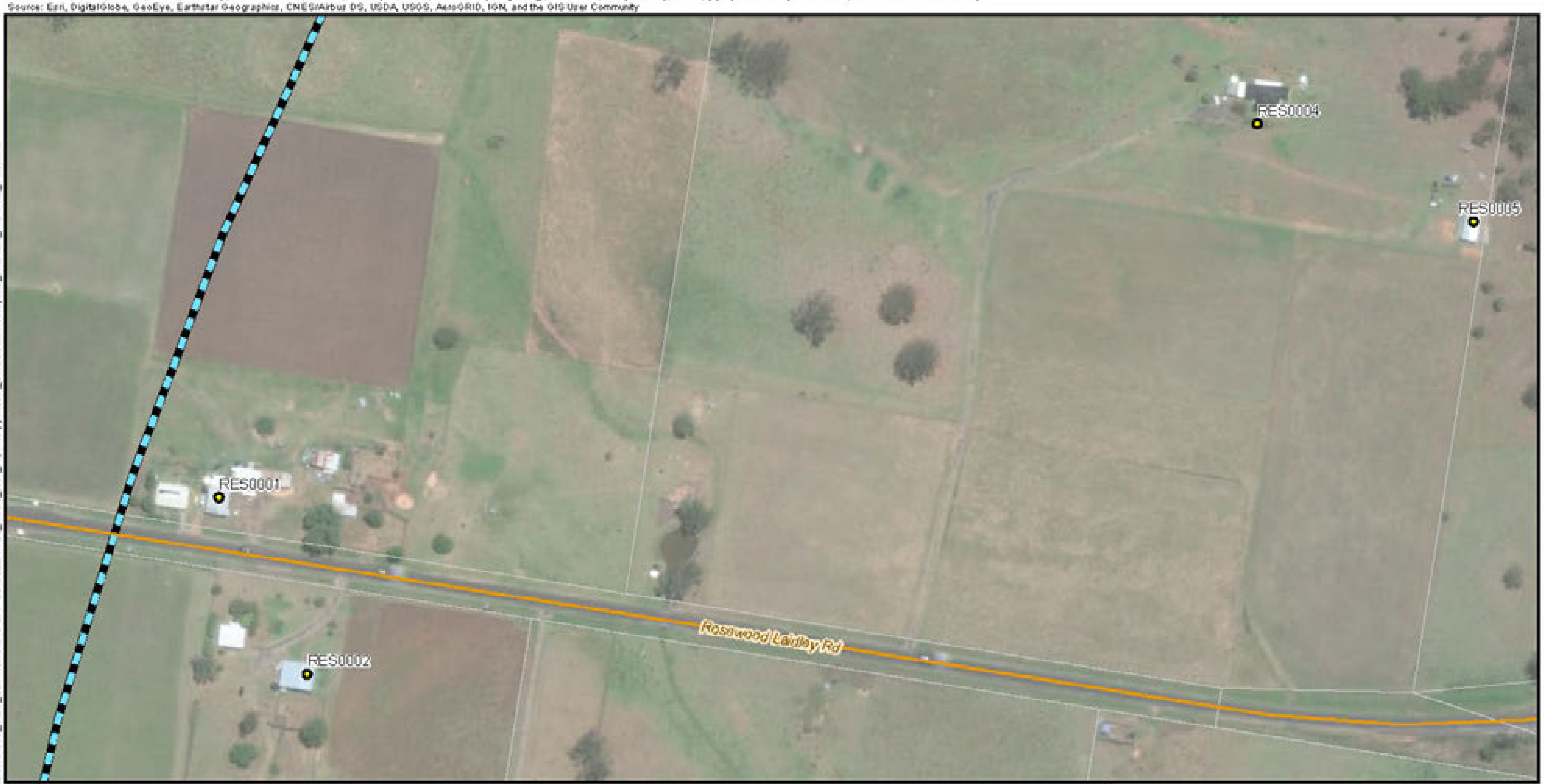
Date: 05/03/2020 Version: 6

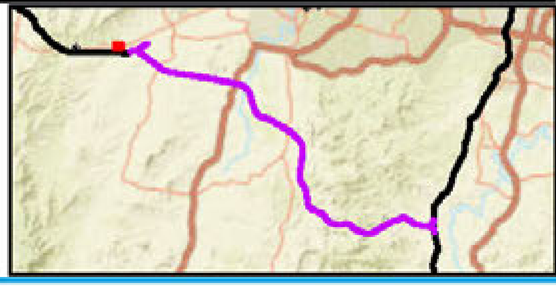
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Av: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

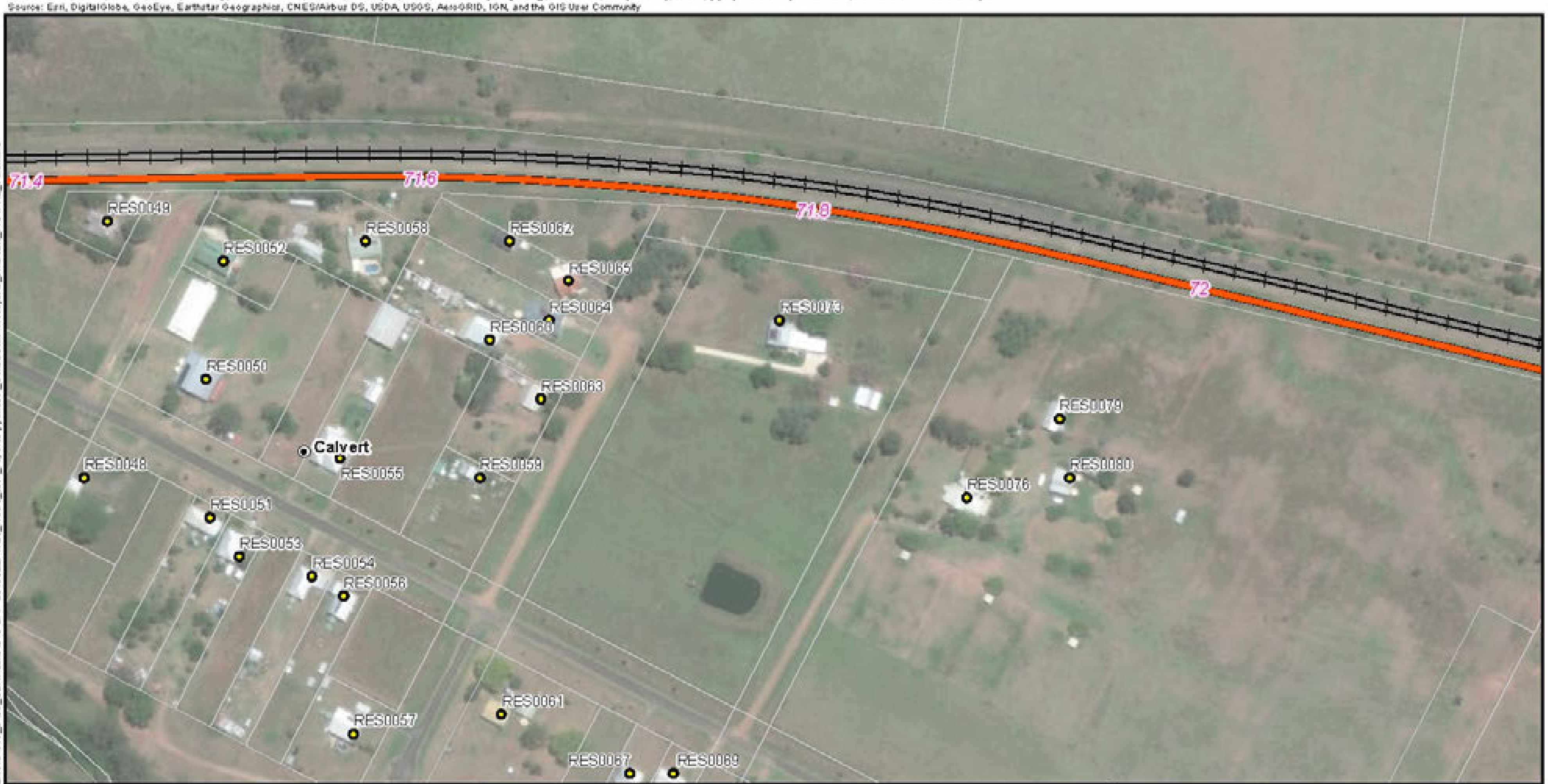
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aw: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



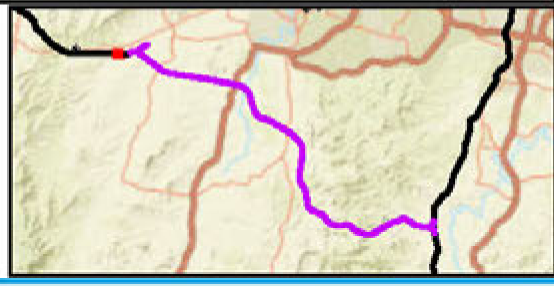
Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

- Localities
- Existing rail
- H2C project alignment
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ax: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AL_Ver6.mxd

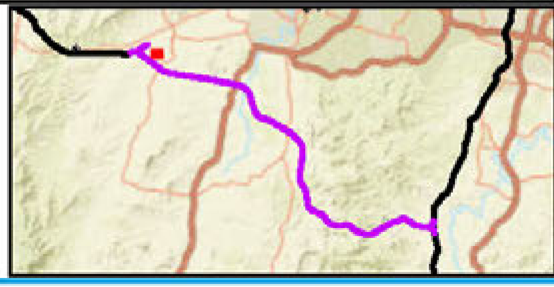
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight — Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ay: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\Al_Ver6.mxd

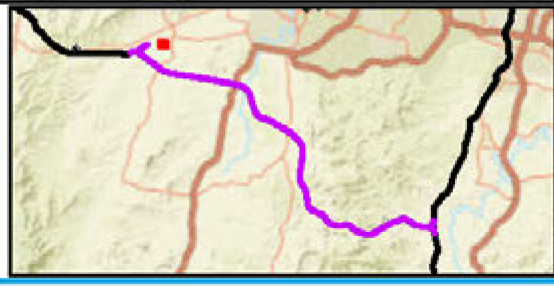
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Az: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

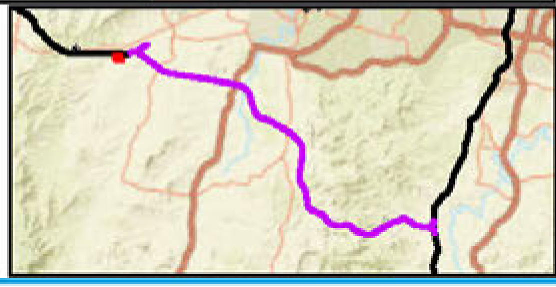
Map by: CSNCW/RB/GN Date: 5/03/2020 09:14

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

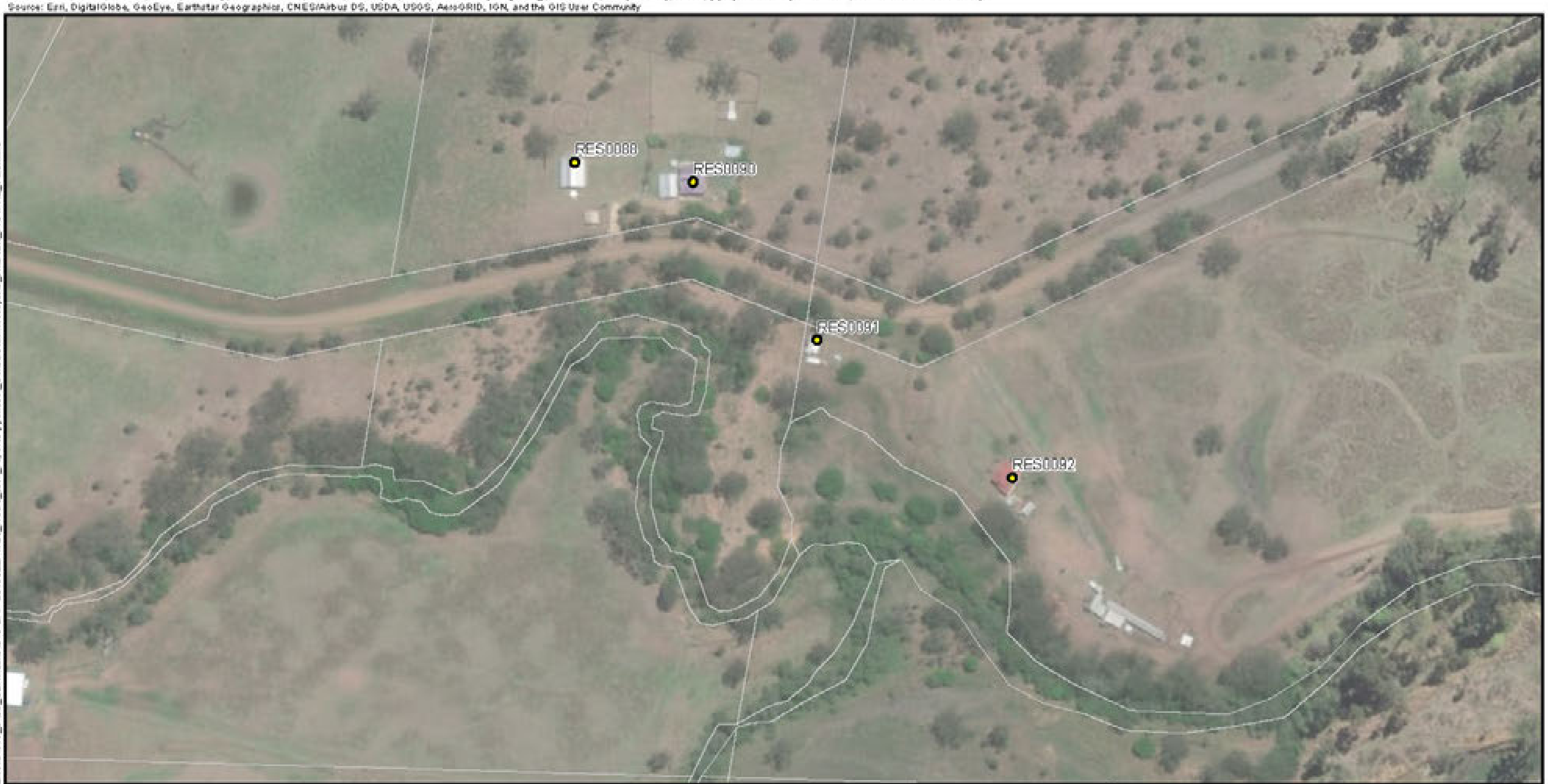
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

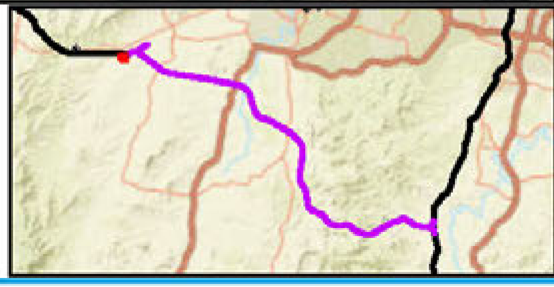
CALVERT TO KAGARU

Appendix Aaa: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14



Legend

Noise and vibration study area
Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

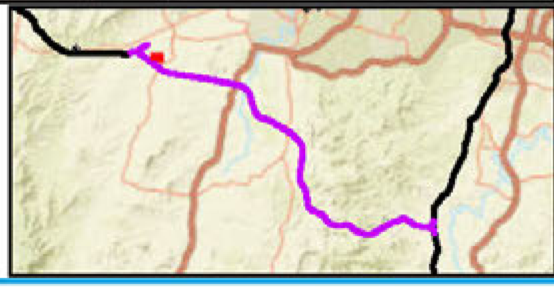
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aab: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

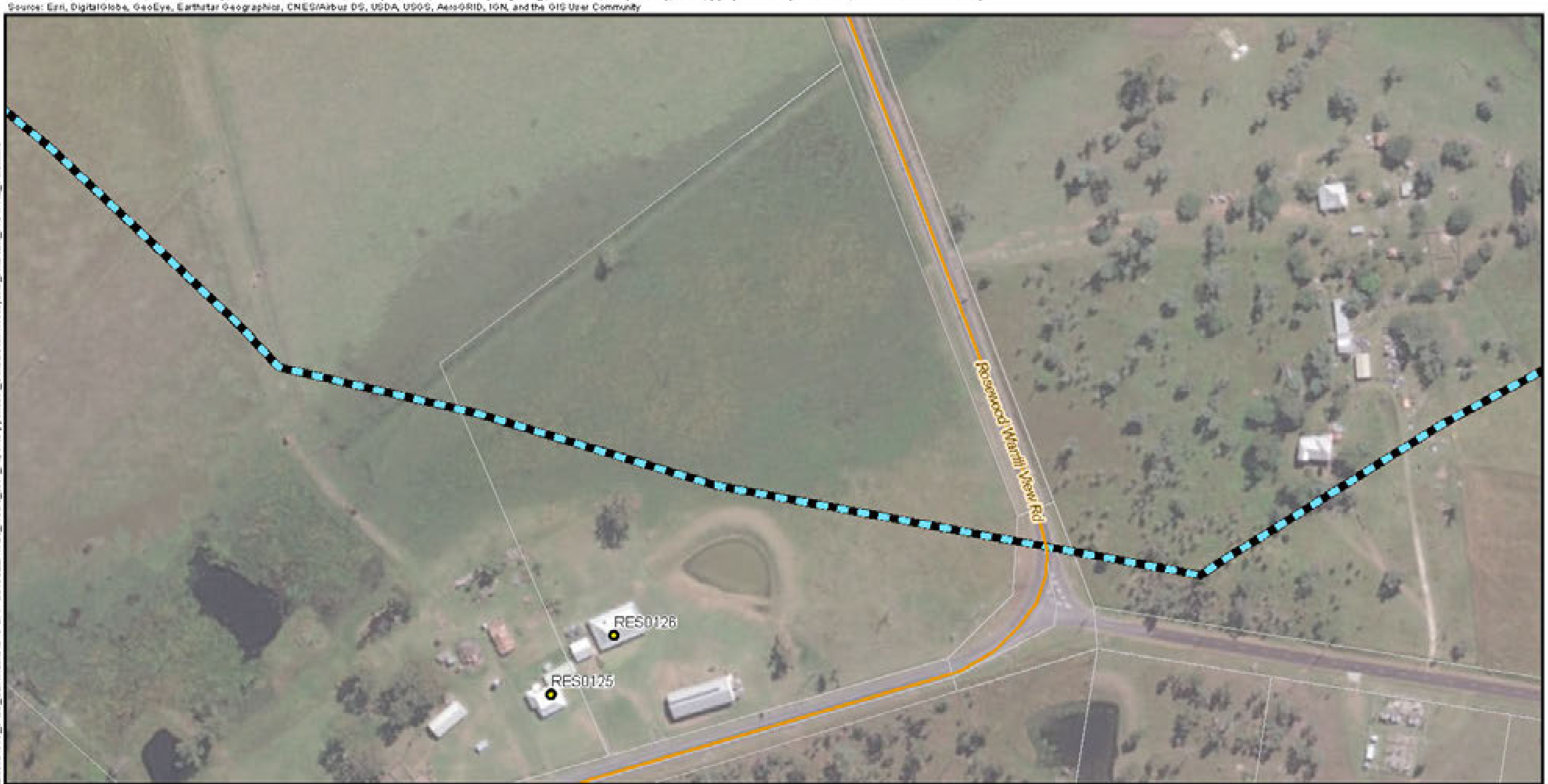
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aac: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJVA4L_Ver6.mxd

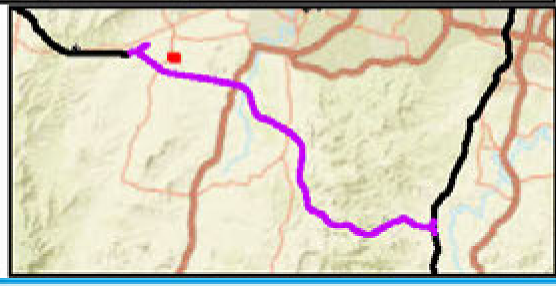


Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

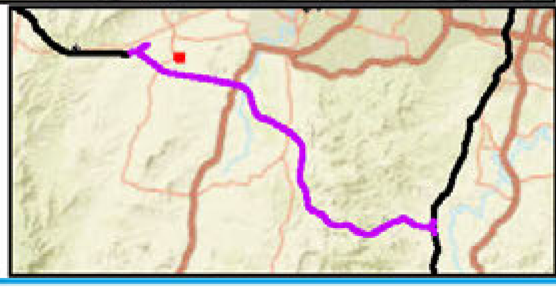
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aad: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aae: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

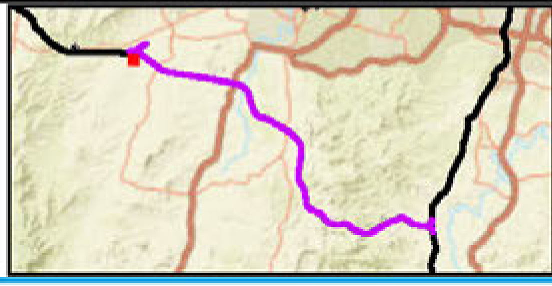
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

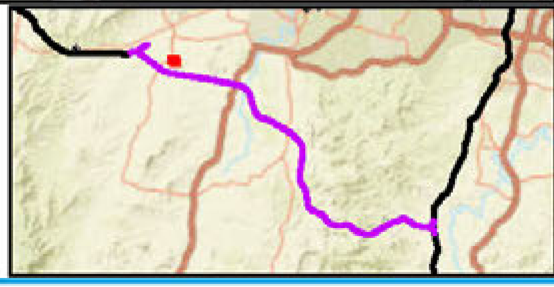
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aaf: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix\A_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aag: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

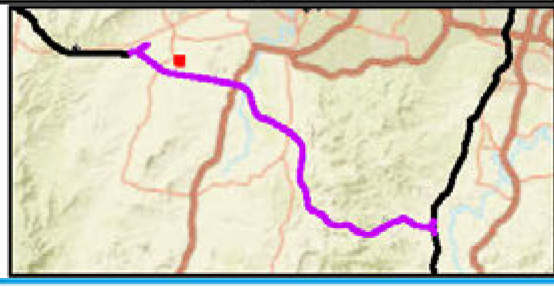
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

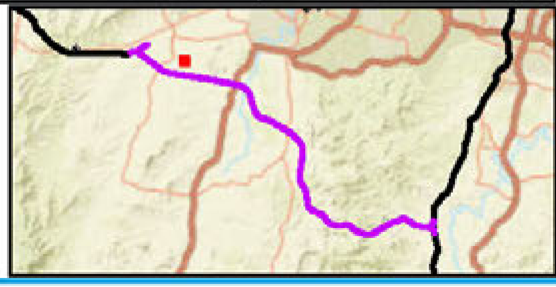
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aah: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

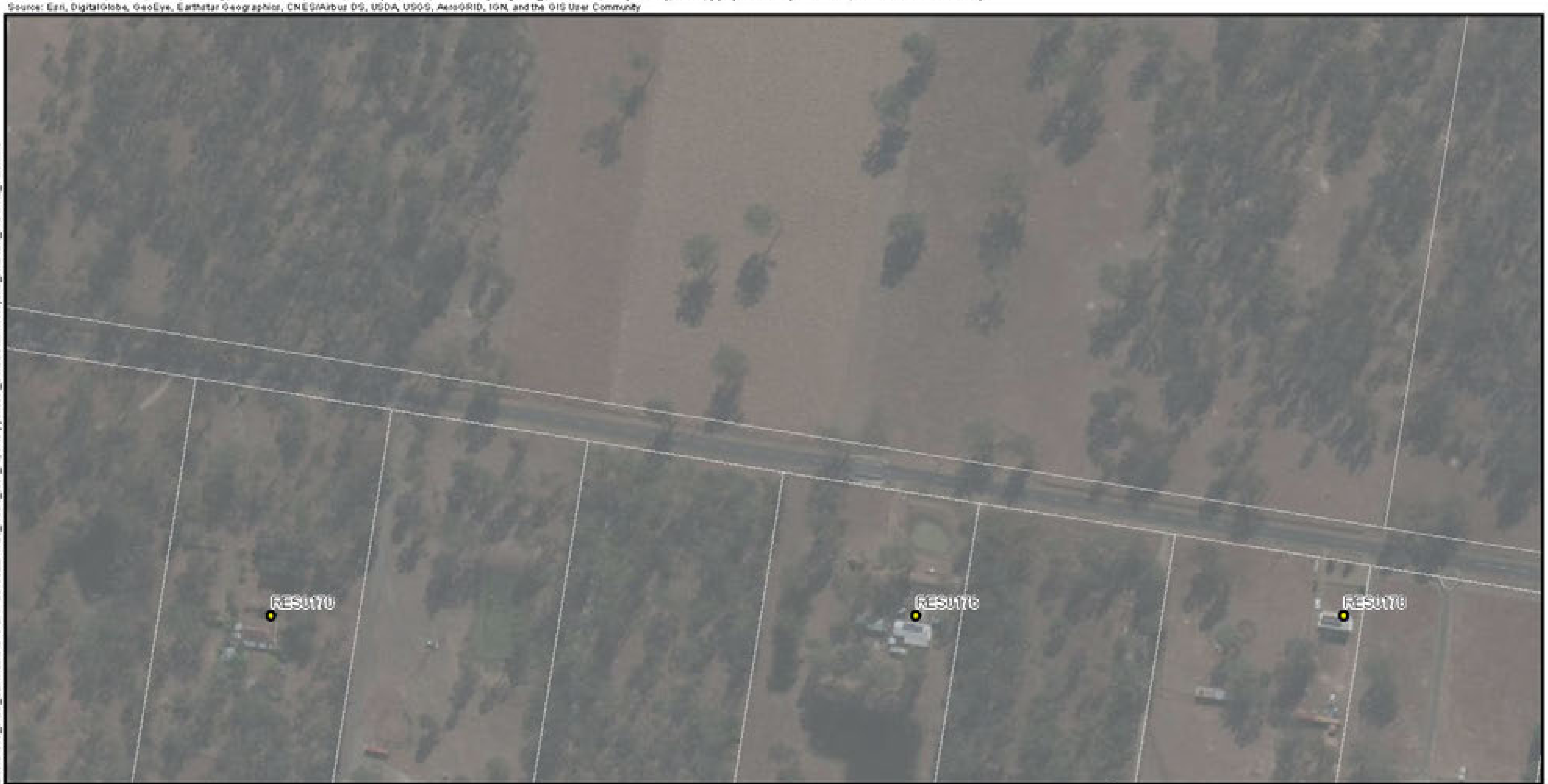
Future Freight

Date: 05/03/2020 Version: 6

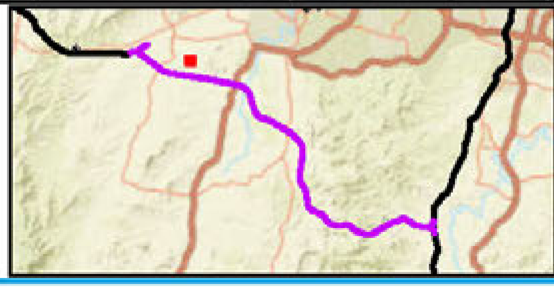
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aai: Noise and vibration sensitive receptors



Map by: CSN CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community Development and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aaj: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAK_Ver6.mxd

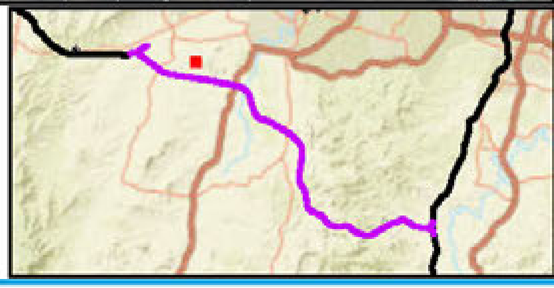
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aak: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAI_Ver6.mxd

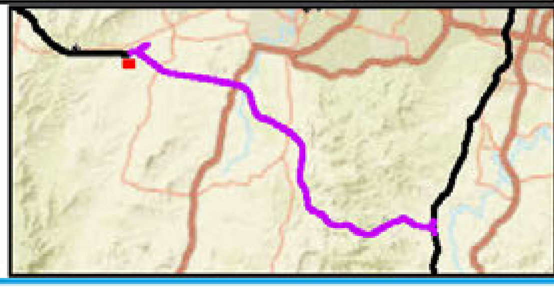
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AaI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_Construction\Receptors_smlscale_FFJV\A4L_Ver6.mxd

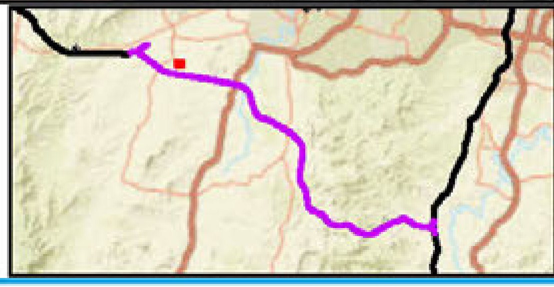
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

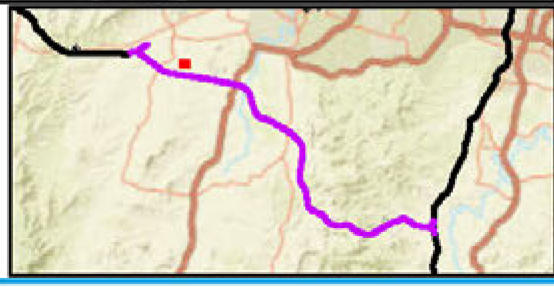
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aam: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aan: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAI_Ver6.mxd

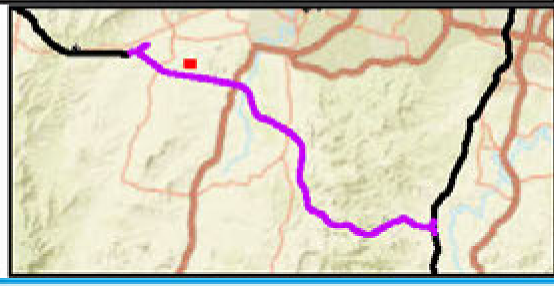
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aao: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

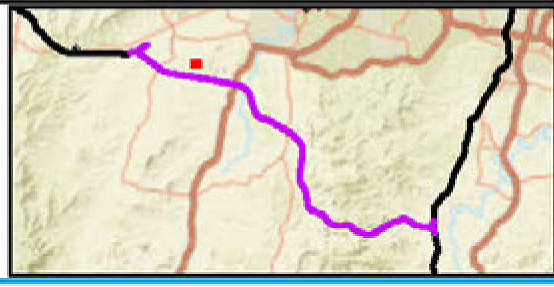
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FF_VAHL_Ver6.mxd

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

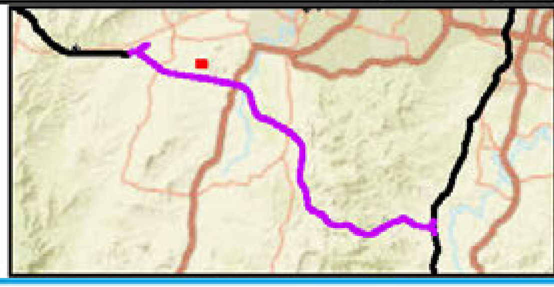
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aap: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

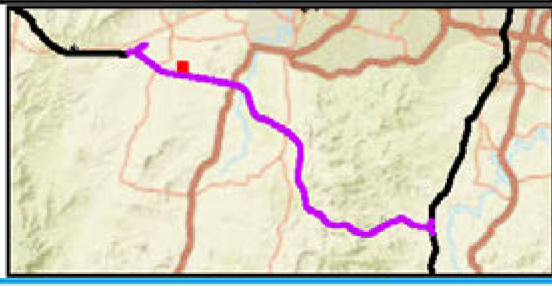
Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aaq: Noise and vibration sensitive receptors



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aar: Noise and vibration sensitive receptors

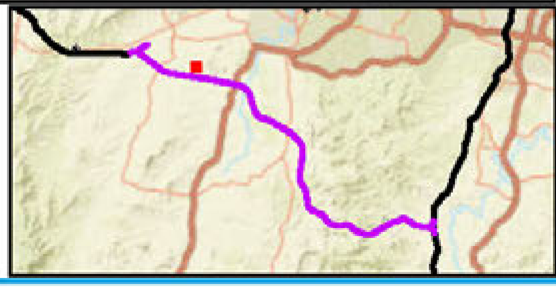
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

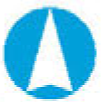
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJVAW_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential





A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aas: Noise and vibration sensitive receptors

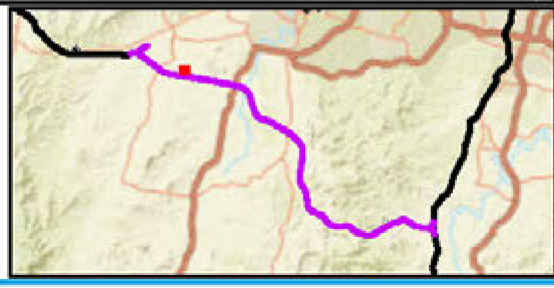
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aat: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCWRB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJVAM_Ver6.mxd

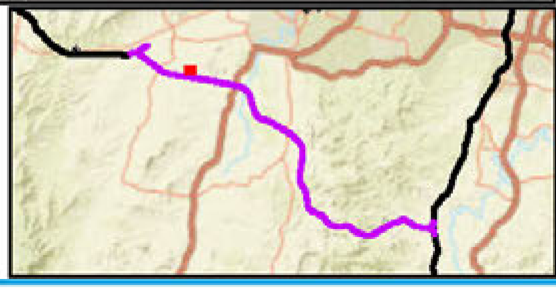
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aau: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

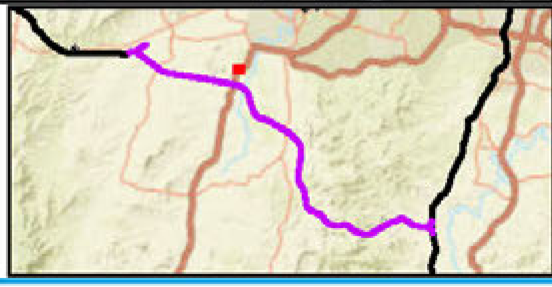
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV/A4L_Ver6.mxd

Legend

- Localities
- Major roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

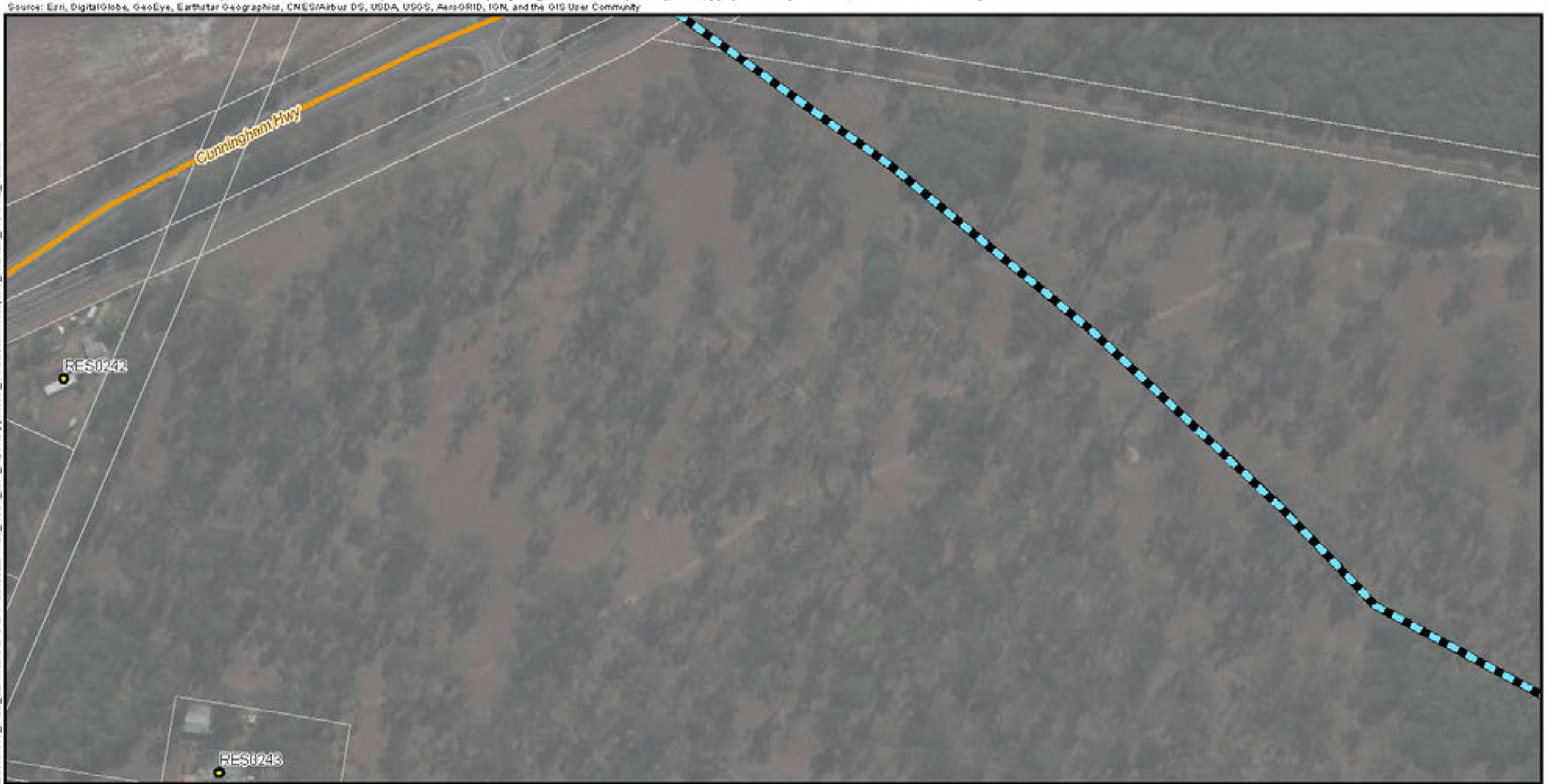
Future Freight
Integrating Community Connections and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aav: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

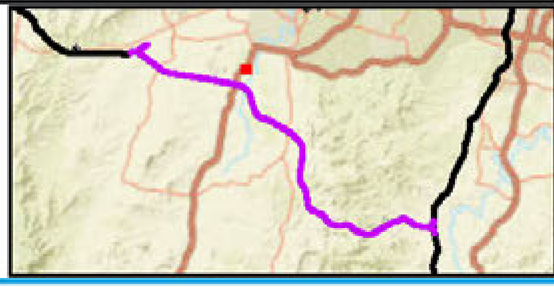


Map by: CSNCW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smllscale_FFJV\A4L_Ver6.mxd

Legend

Major roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aaw: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14

Legend

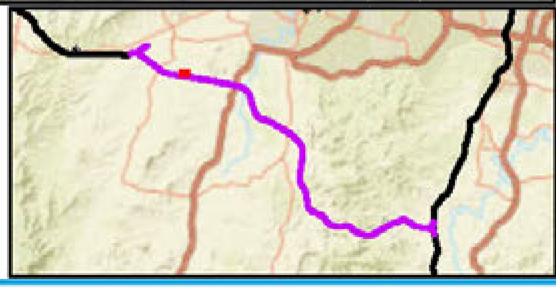
EIS disturbance footprint

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aax: Noise and vibration sensitive receptors

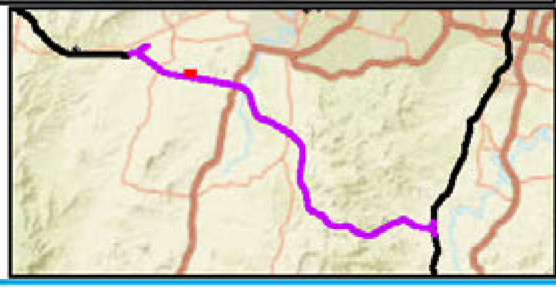
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aay: Noise and vibration sensitive receptors

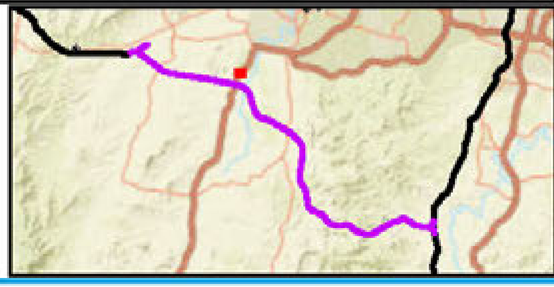
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJV\AA_Ver6.mxd

Legend

Major roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

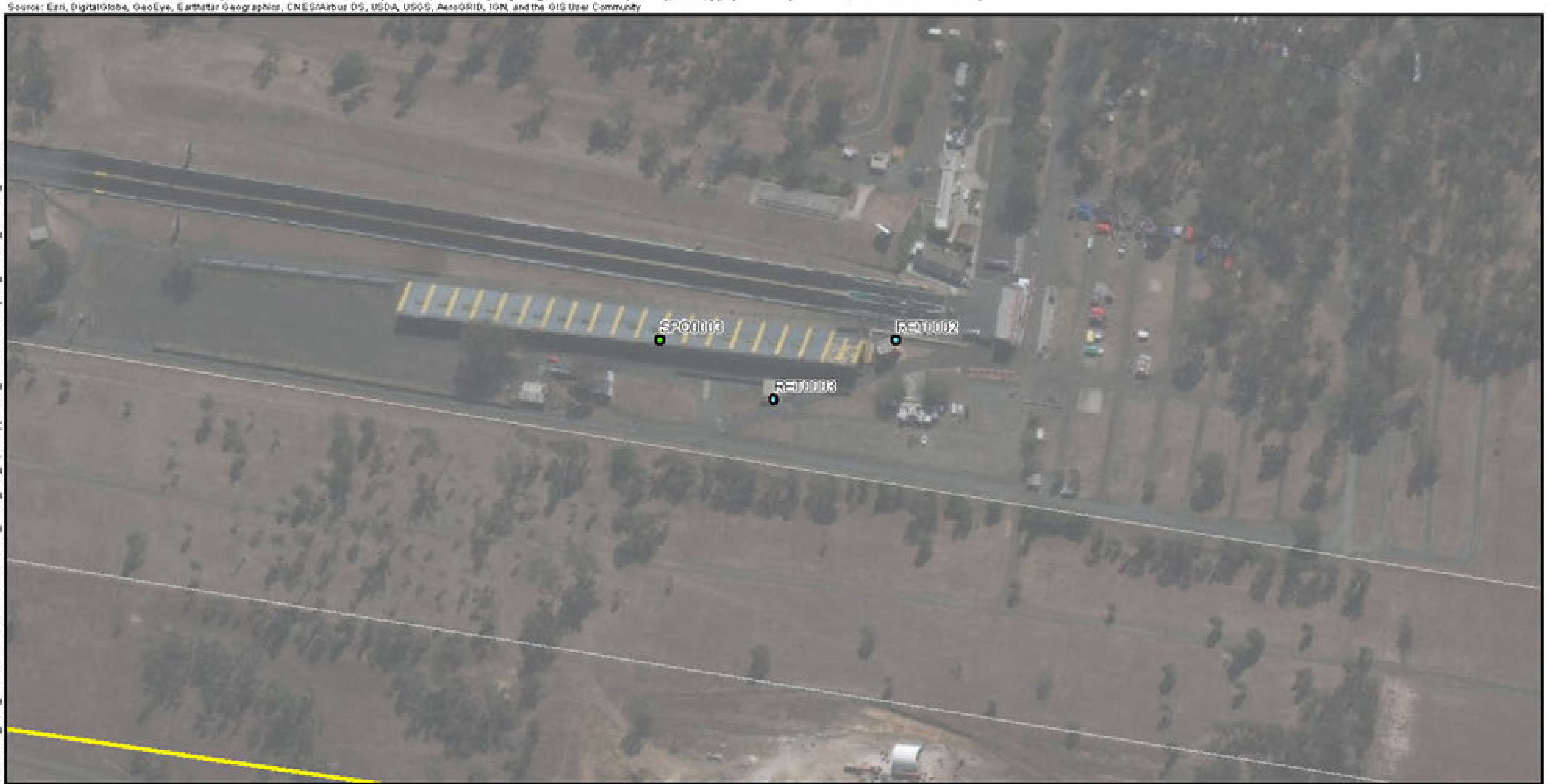
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aaz: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

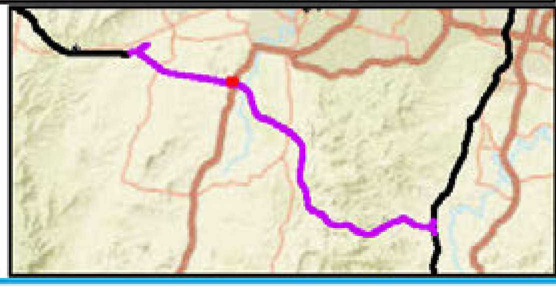


Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Community Retail
- Sporting Facility



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

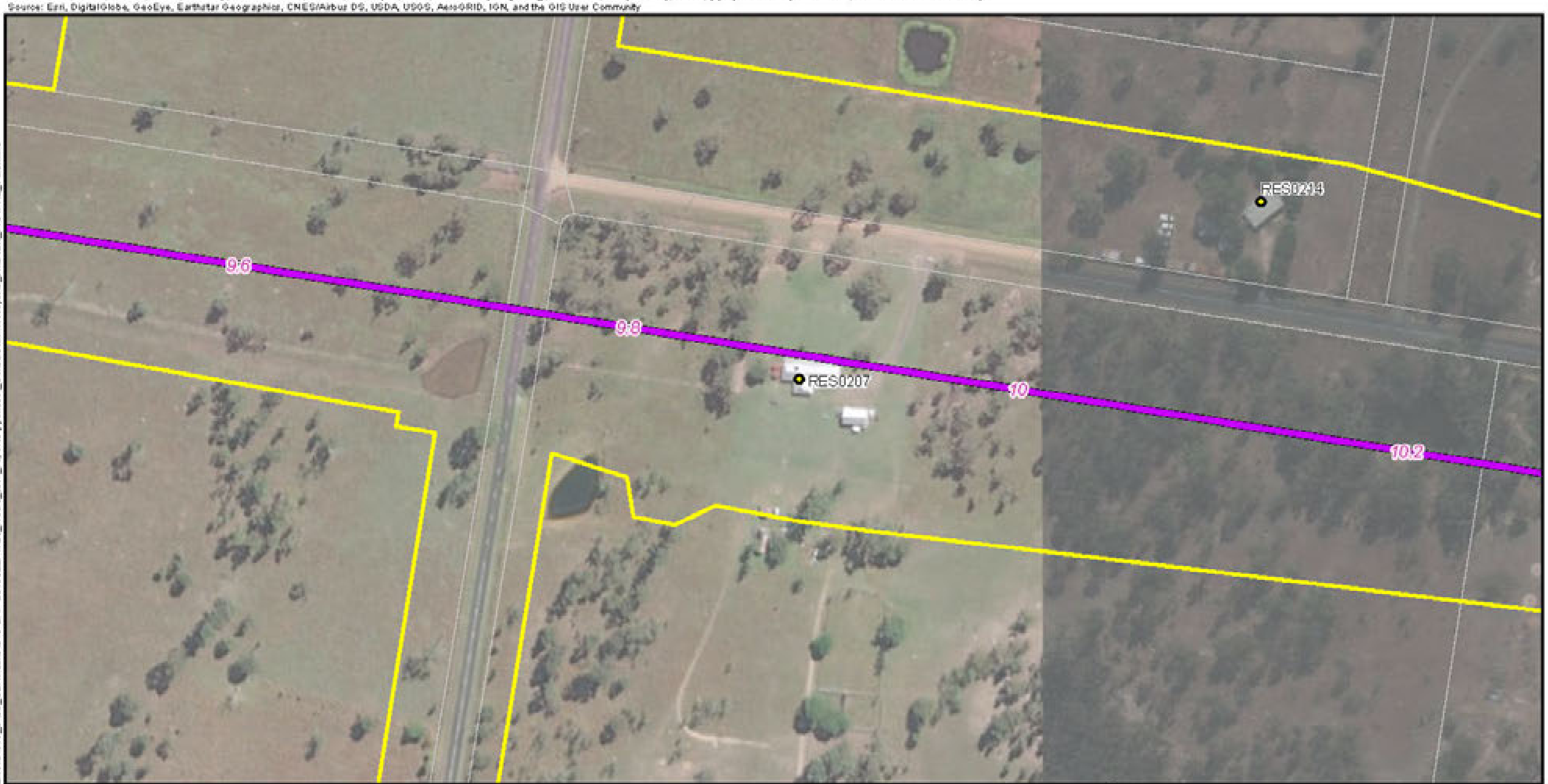
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aba: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\A4L_Ver6.mxd

Legend

C2K project alignment

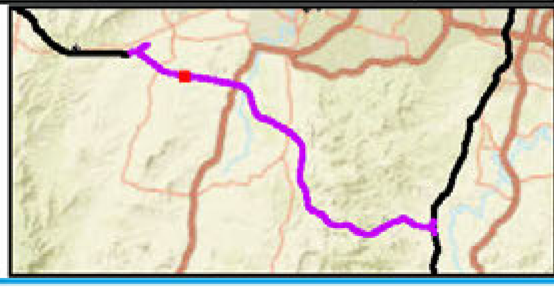
EIS disturbance footprint

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abb: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

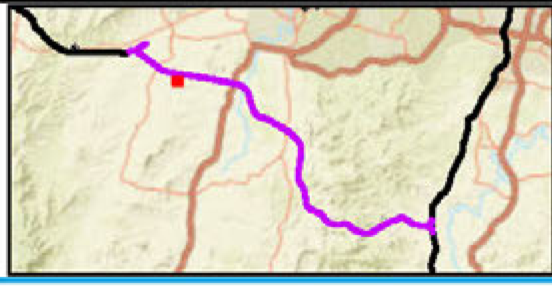
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abc: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

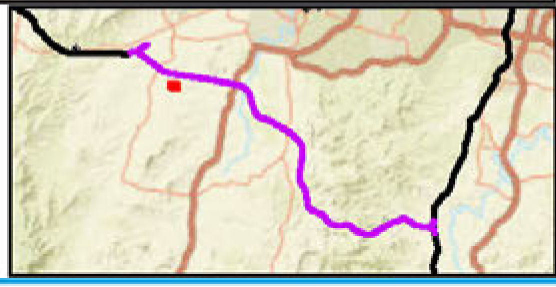
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abd: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

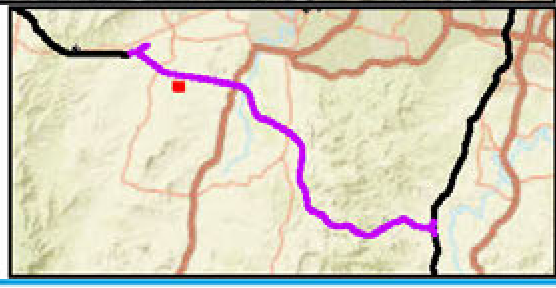
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

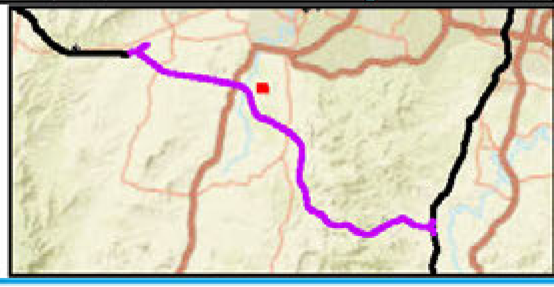
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abe: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

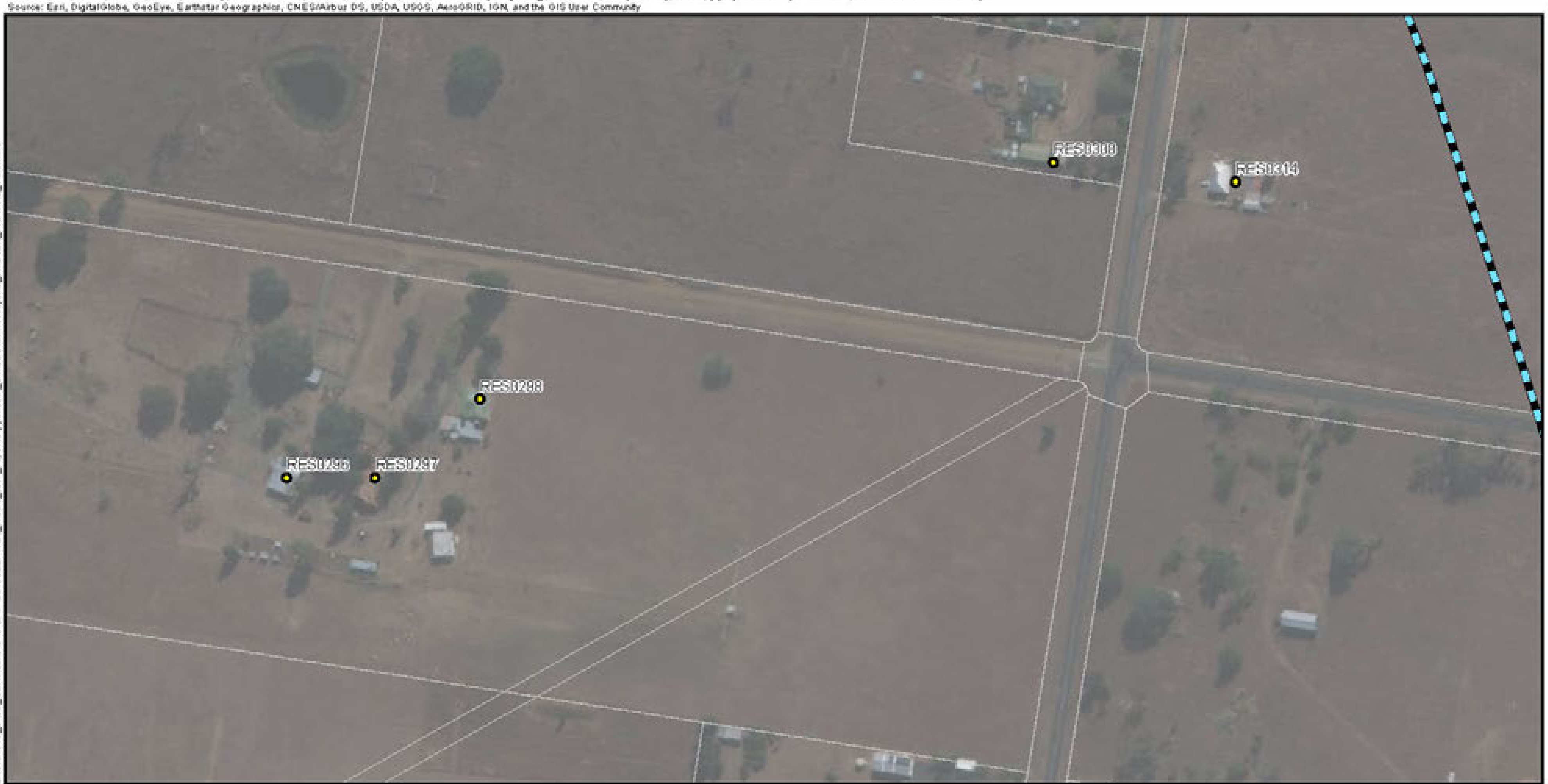
Future Freight

Date: 05/03/2020 Version: 6

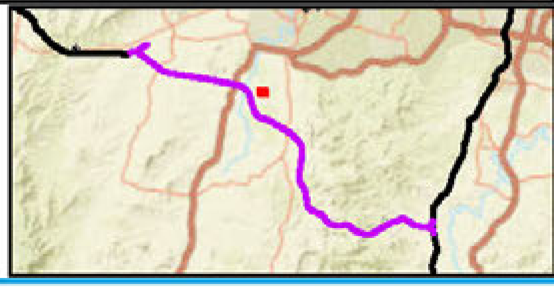
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abf: Noise and vibration sensitive receptors



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AA_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

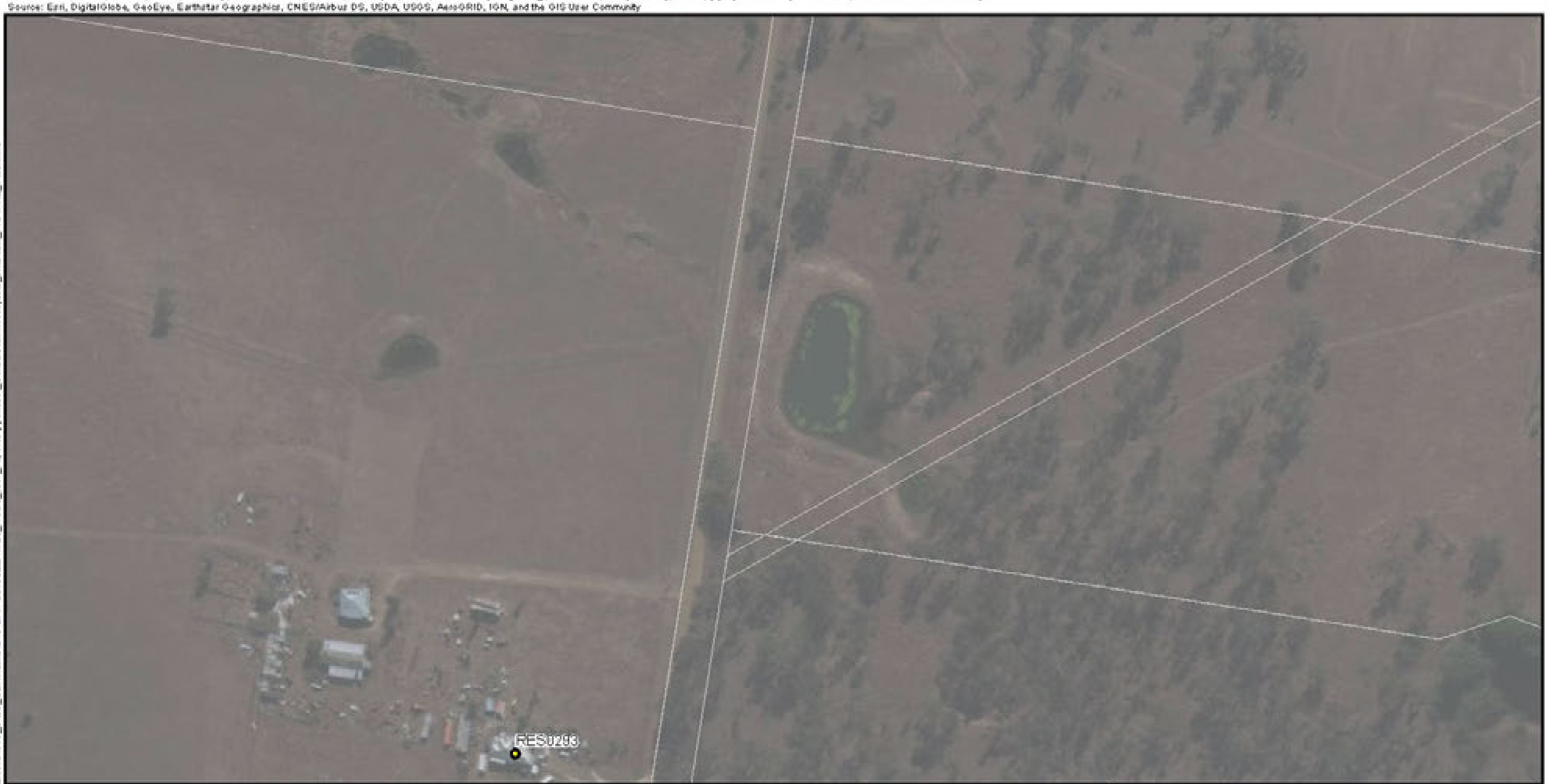
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abg: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV4AL_Ver6.mxd

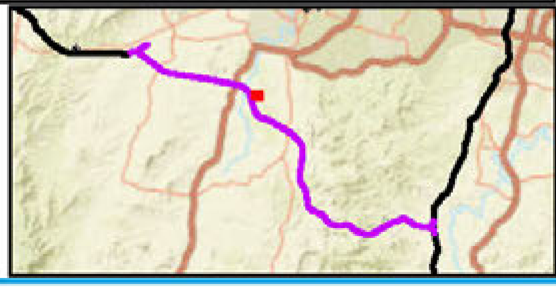
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

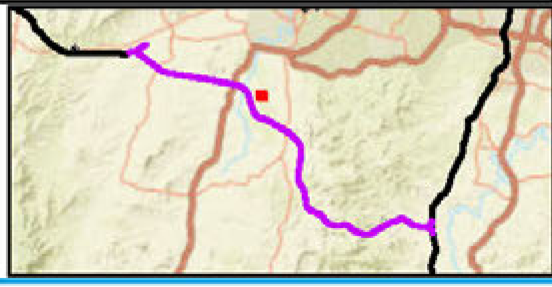
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abh: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abi: Noise and vibration sensitive receptors

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJVAAL_Ver6.mxd

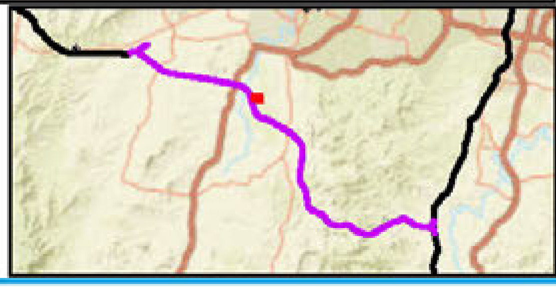
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abj: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AL_Ver6.mxd

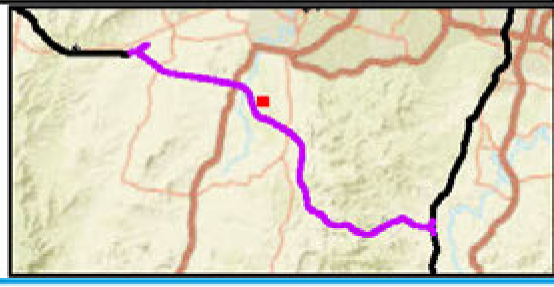
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abk: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AbI_Ver6.mxd

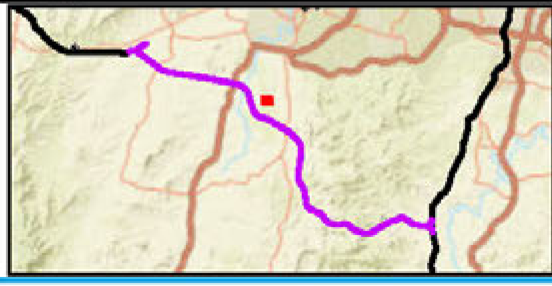
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AbI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAAL_Ver6.mxd

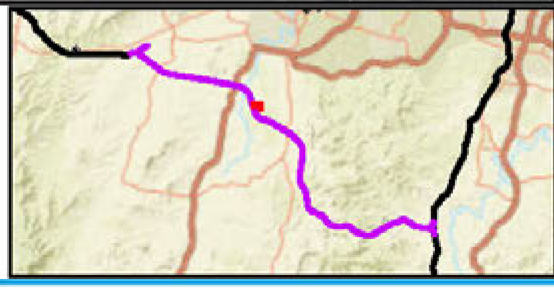
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

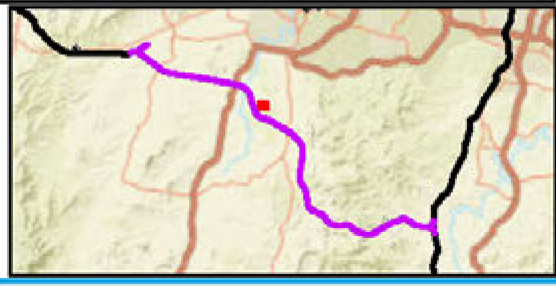
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abm: Noise and vibration sensitive receptors

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abn: Noise and vibration sensitive receptors

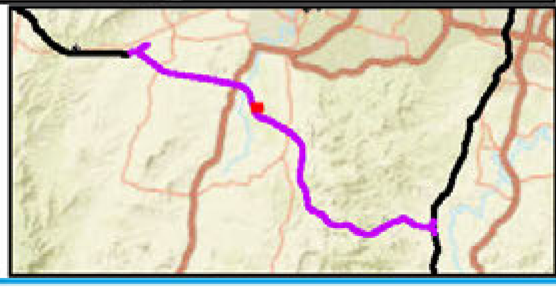
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

EIS disturbance footprint
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abo: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

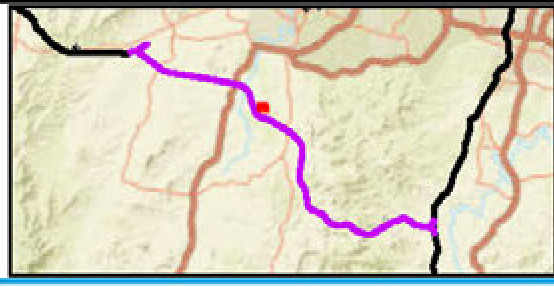
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

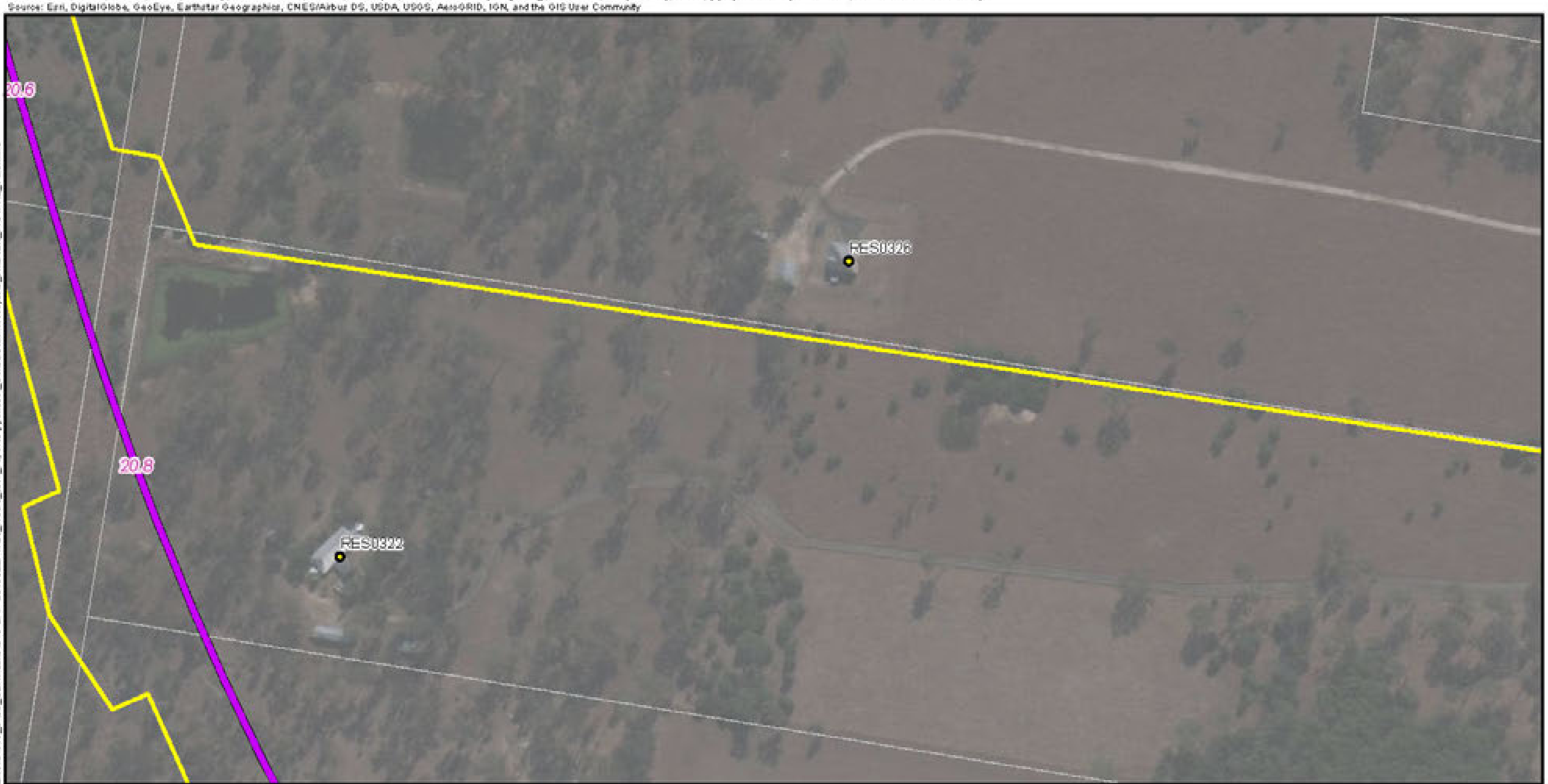
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abp: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

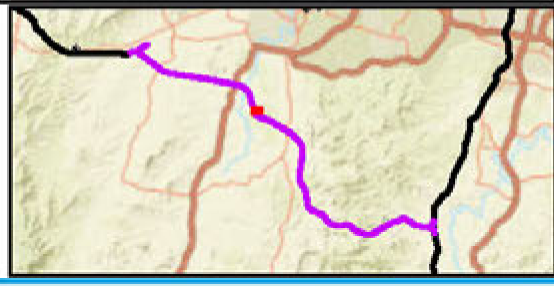


Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abq: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

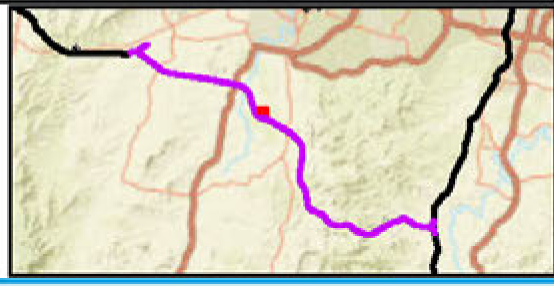
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\Ar4_Ver6.mxd

Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

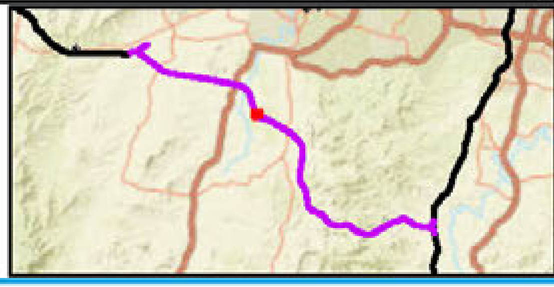
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abr: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abs: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\A4L_Ver6.mxd

Legend

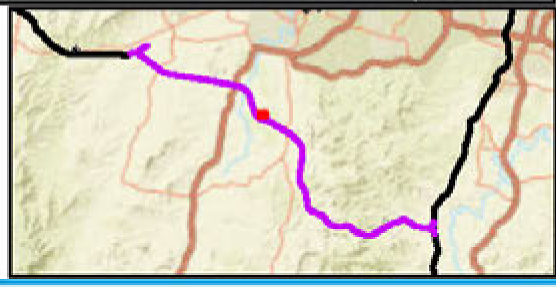
EIS disturbance footprint

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abt: Noise and vibration sensitive receptors

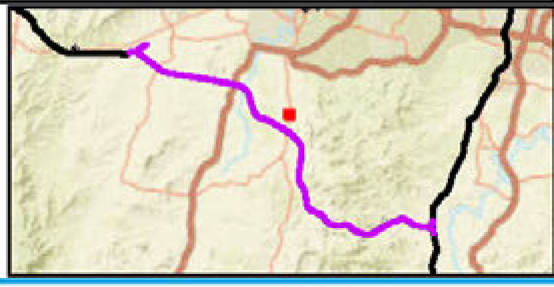
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

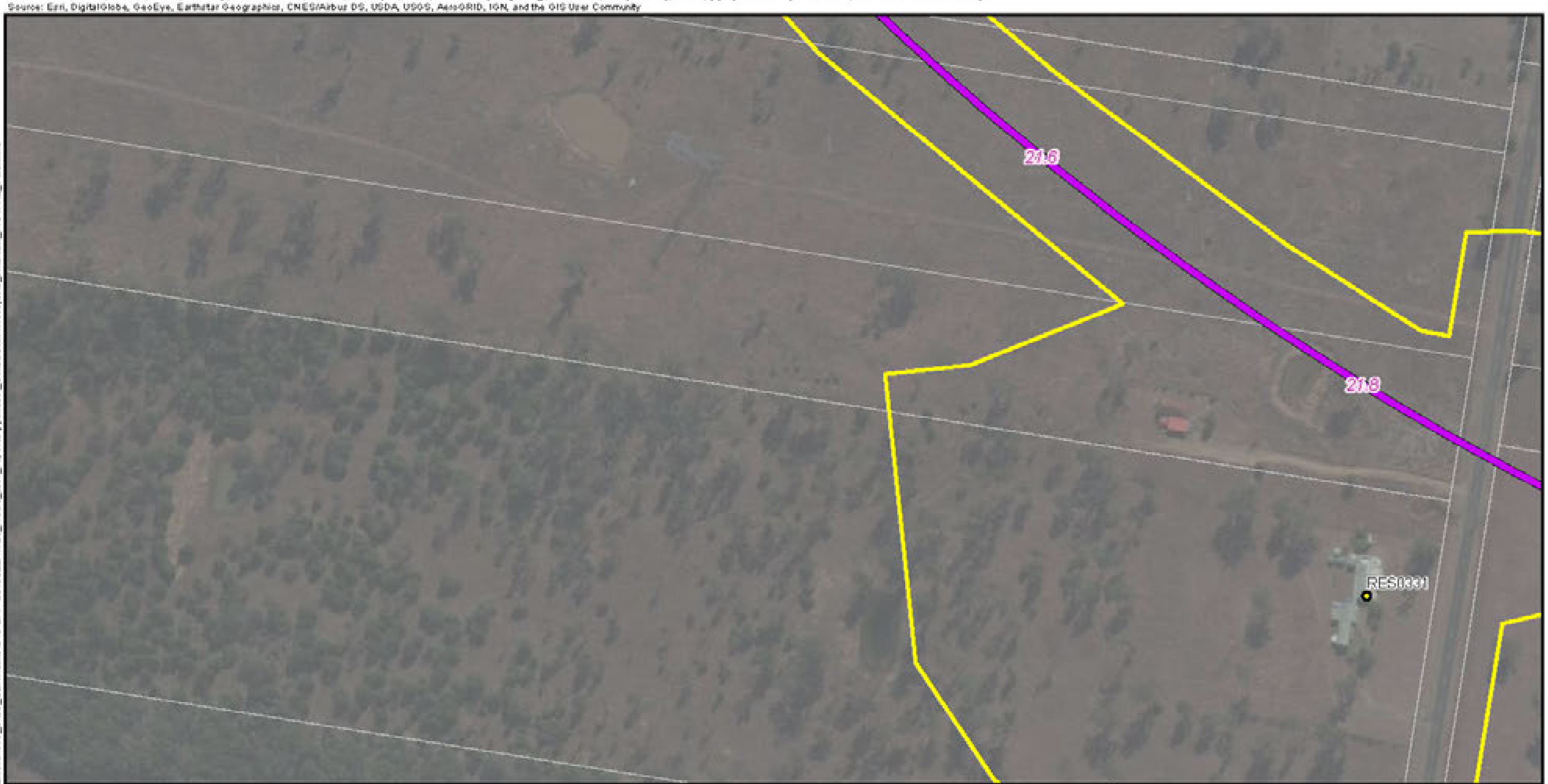
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abu: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

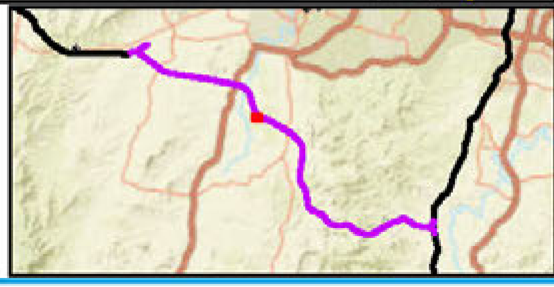


Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

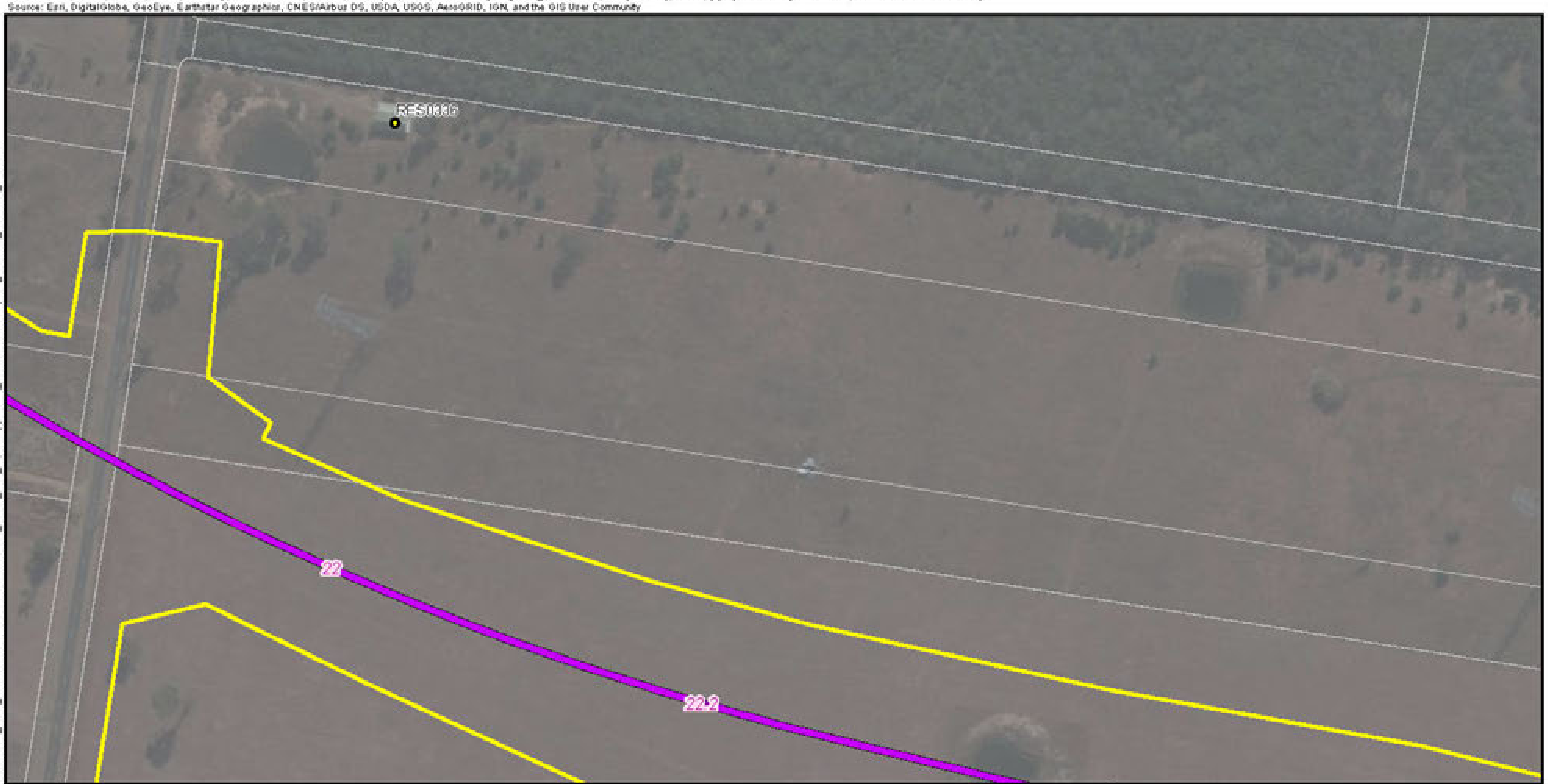
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abv: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



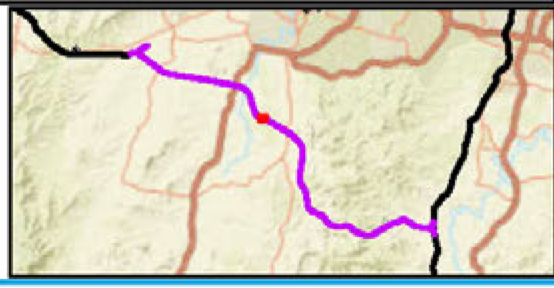
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\A4L_Ver6.mxd

Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

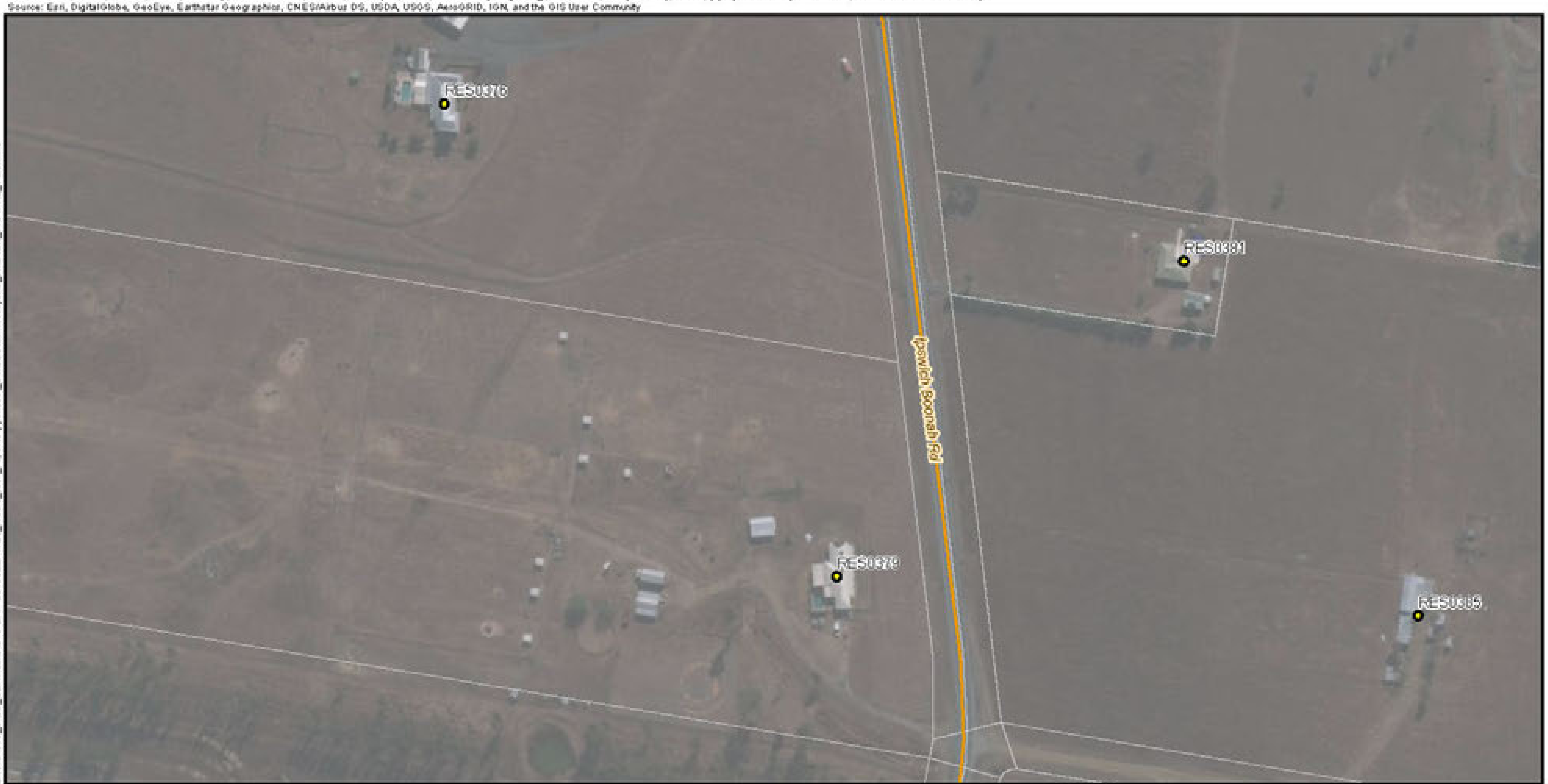
Date: 05/03/2020 Version: 6

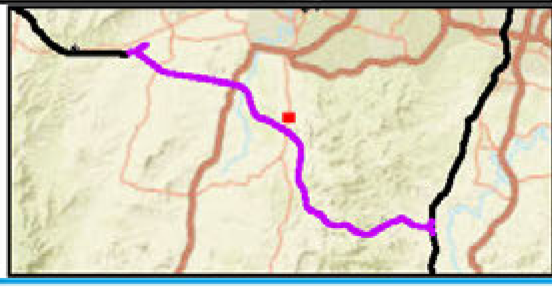
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abw: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

Minor roads

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abx: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

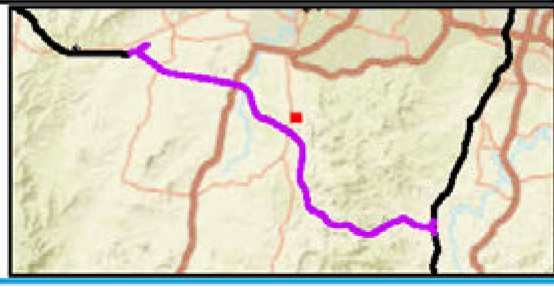
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aby: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

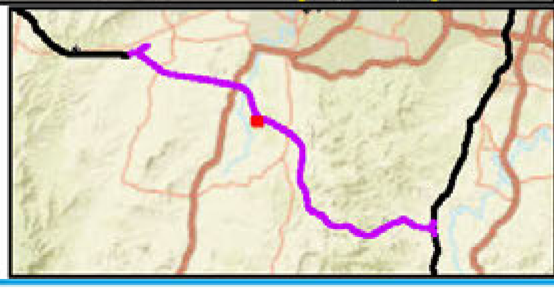
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Abz: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

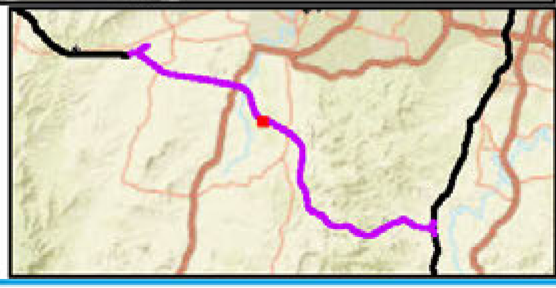
Map by: CSN/CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\AAL_Ver6.mxd

Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

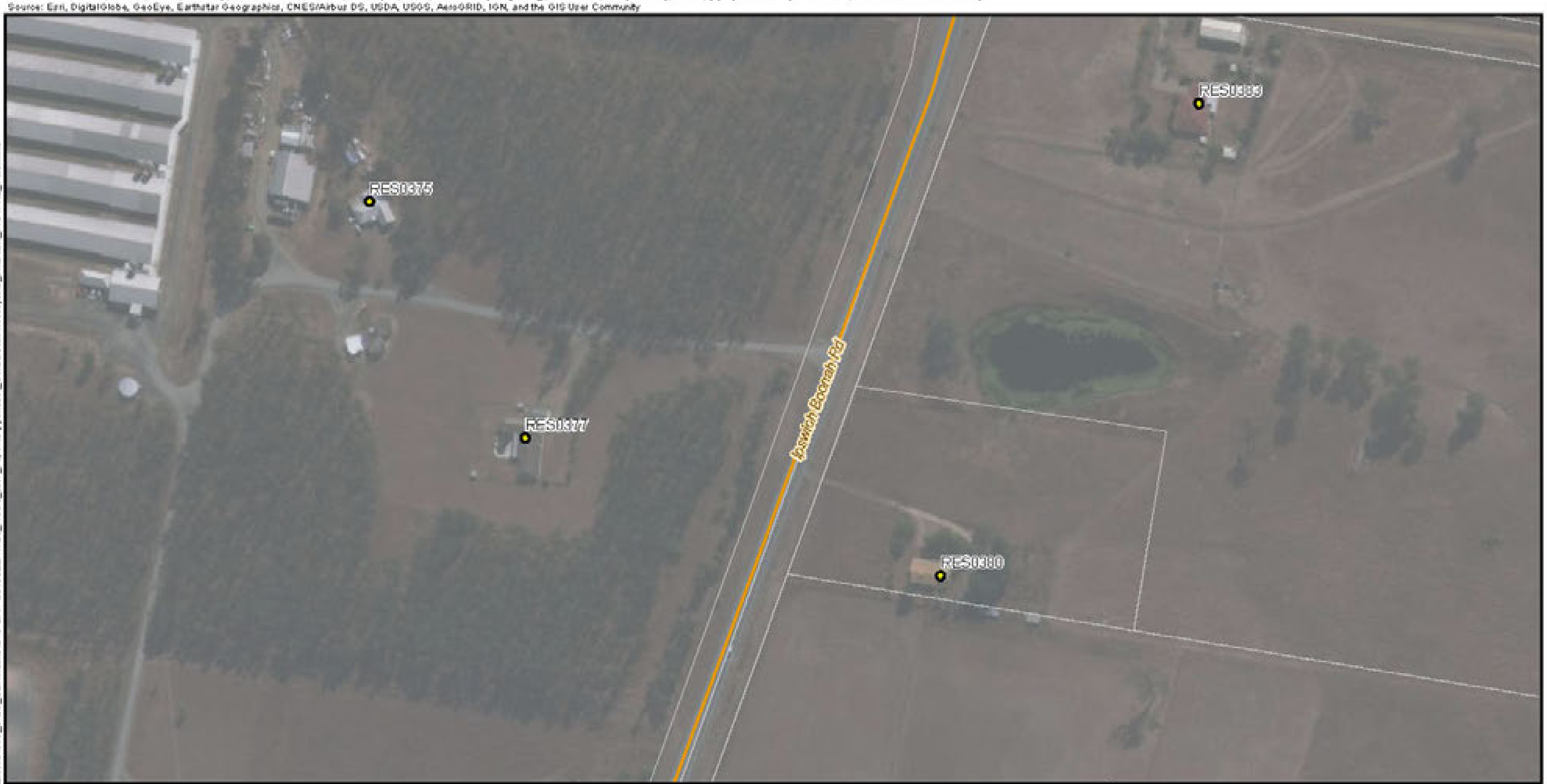
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

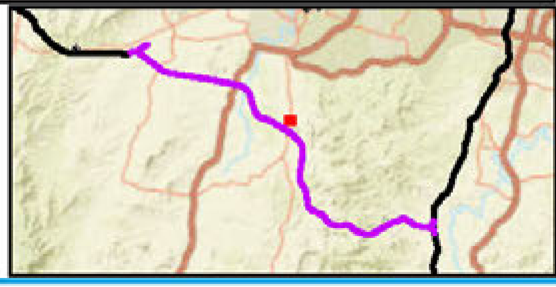
CALVERT TO KAGARU

Appendix Aca: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd





Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acb: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

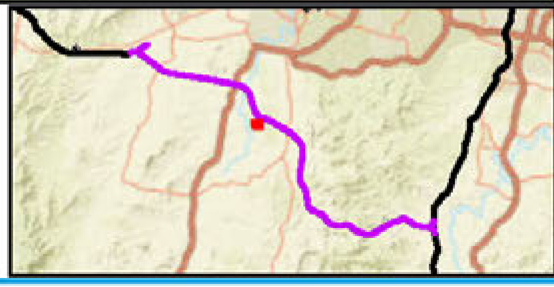
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJVA4L_Ver6.mxd

Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acc: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\VAWL_Ver6.mxd

Legend

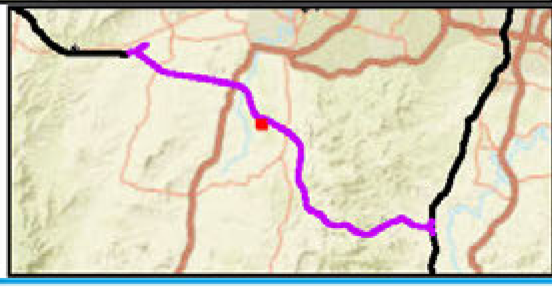
EIS disturbance footprint

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acd: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14

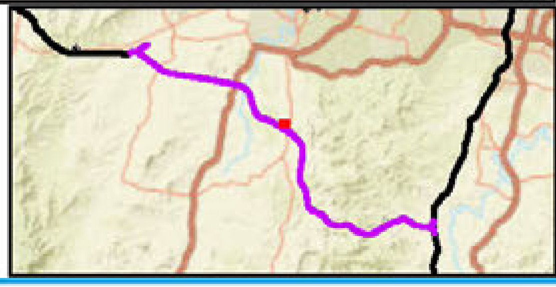
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

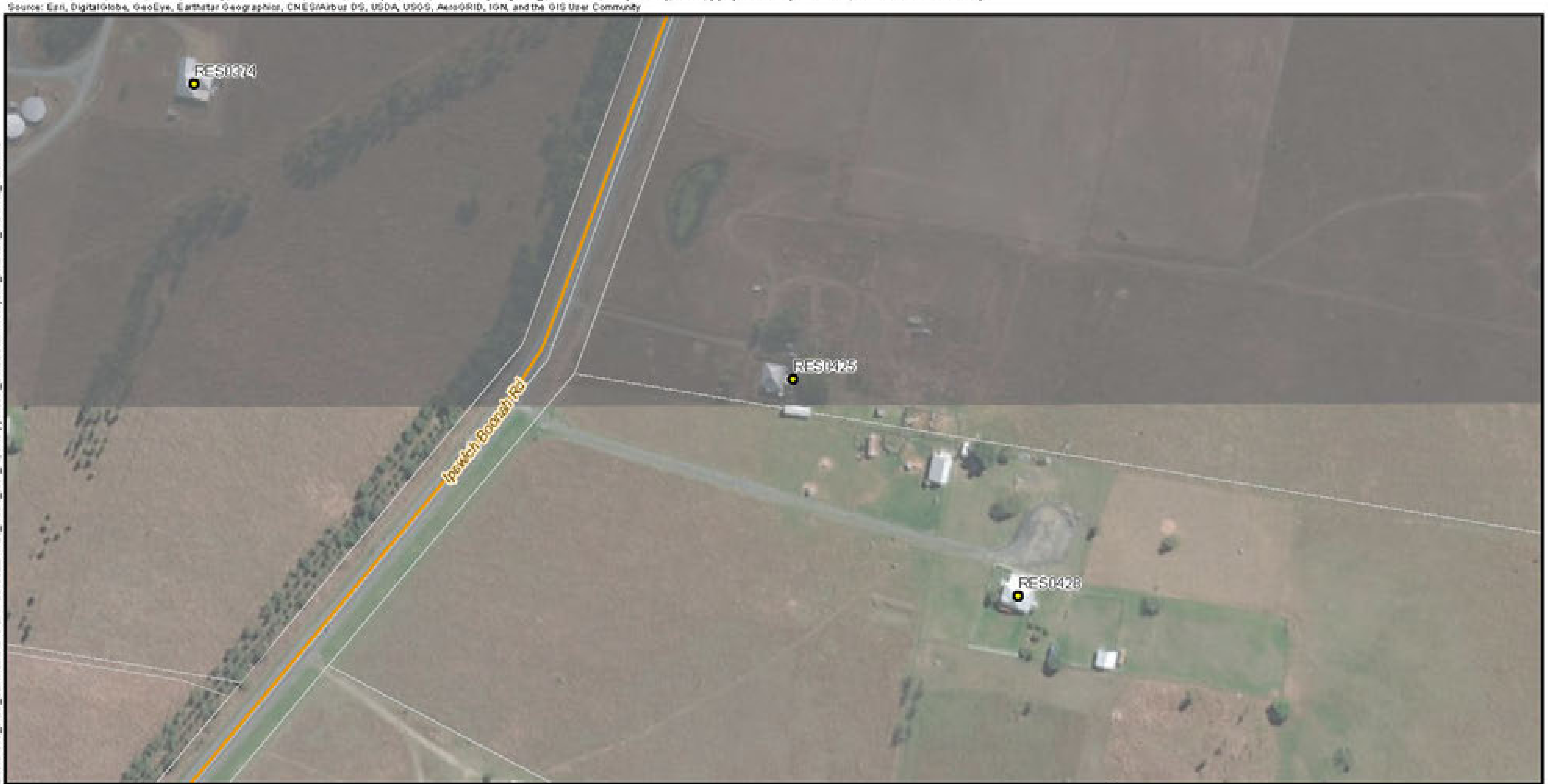
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ace: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



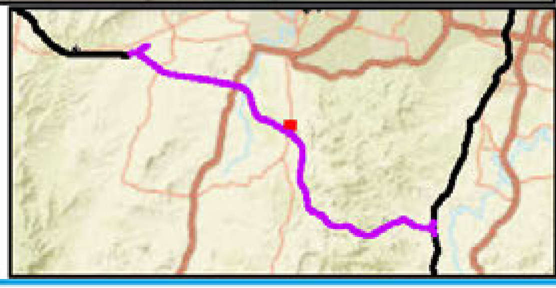
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\JVAML_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acf: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJVAAL_Ver6.mxd

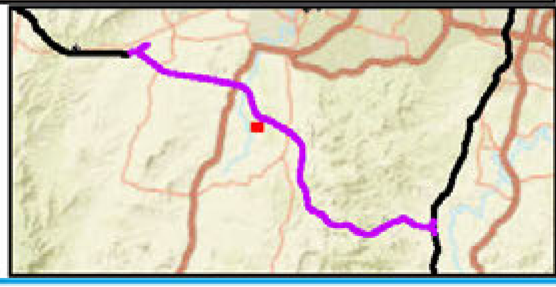
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

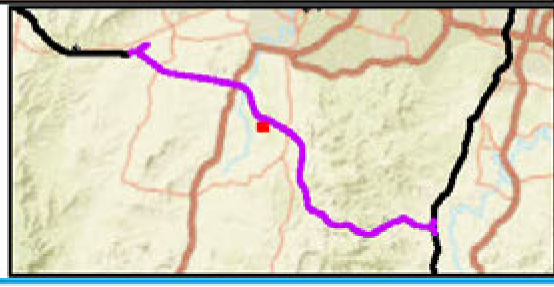
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acg: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ach: Noise and vibration sensitive receptors

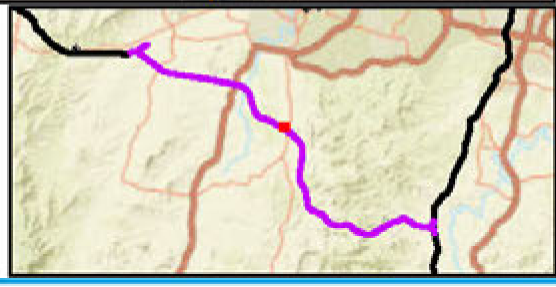
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

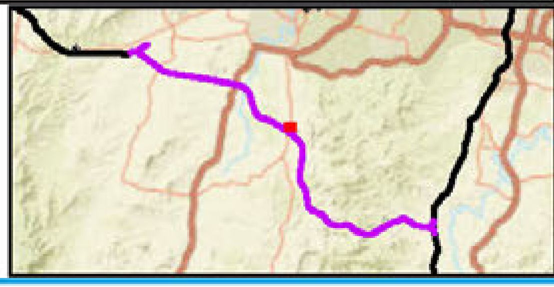
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aci: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF_VAR_Ver6.mxd



Legend

Minor roads

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

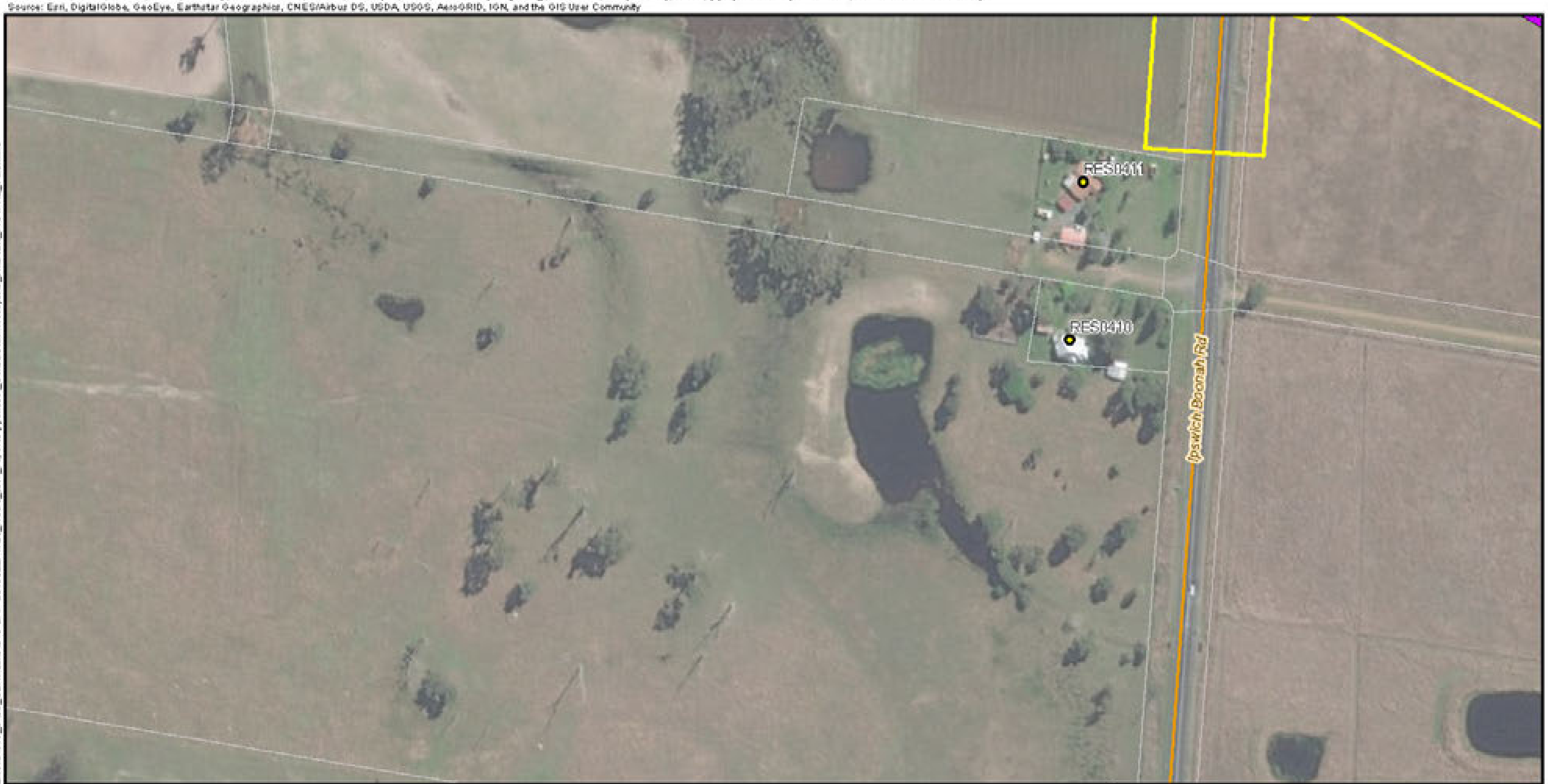
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acj: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

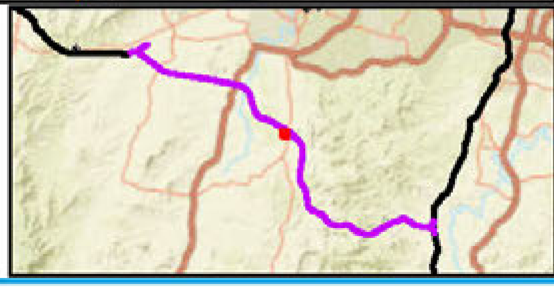


Legend

- C2K project alignment
- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

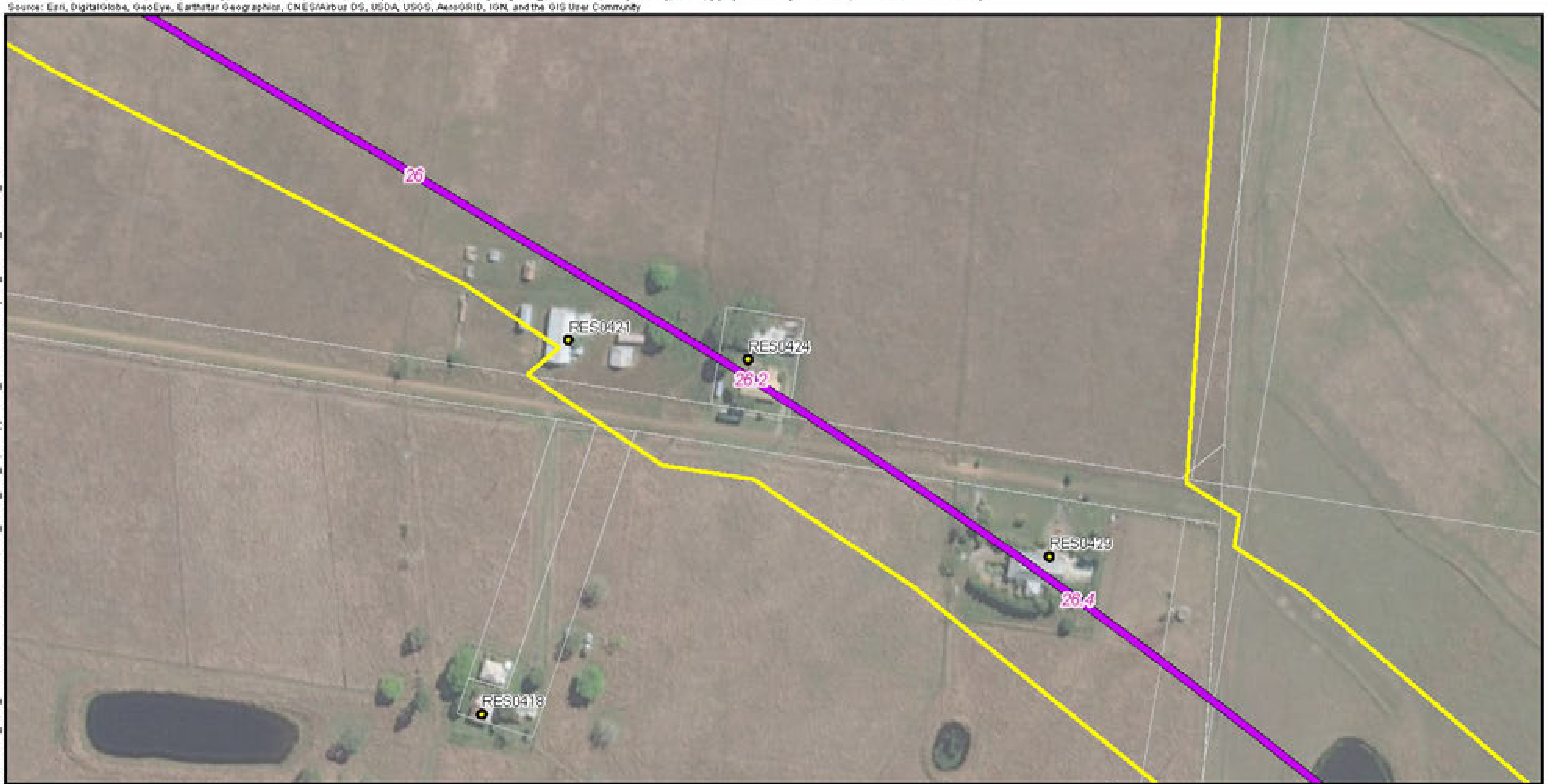
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ack: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

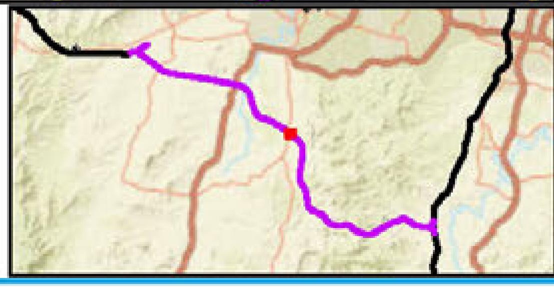


Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

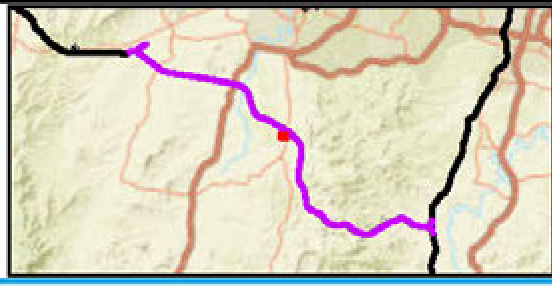
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AcI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acm: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

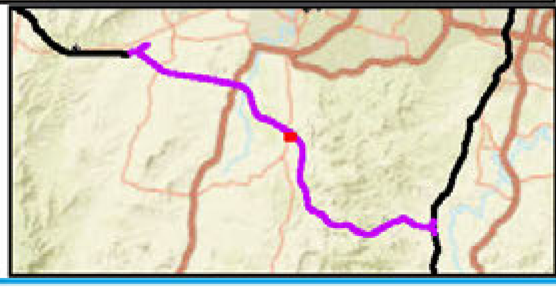
Map by: CSN CW/RB/GN Date: 5/03/2020 09:14

Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acn: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

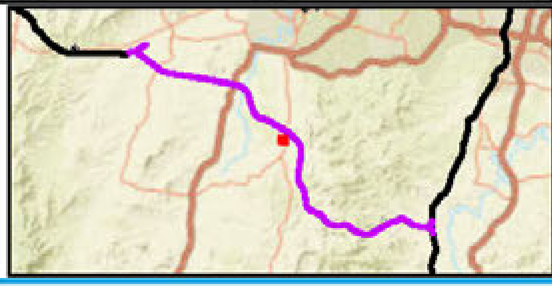
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

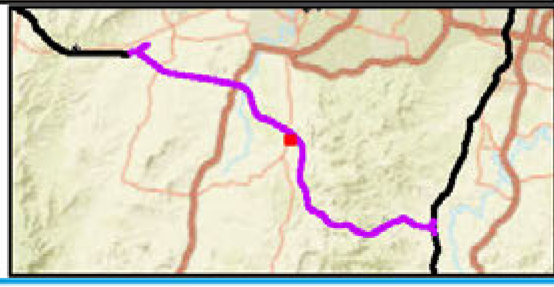
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aco: Noise and vibration sensitive receptors

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14



Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acp: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

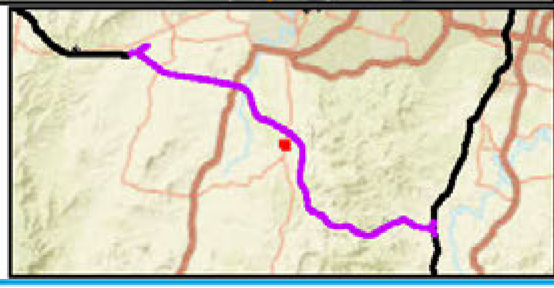
Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AAL_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community Engineering and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acq: Noise and vibration sensitive receptors

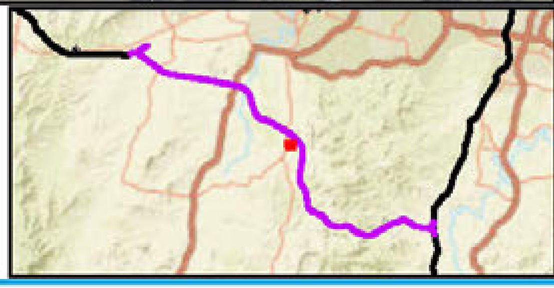
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acr: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

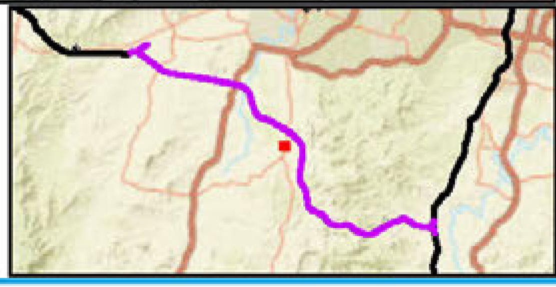
Map by: CSN/CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJV\All_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Industrial
- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

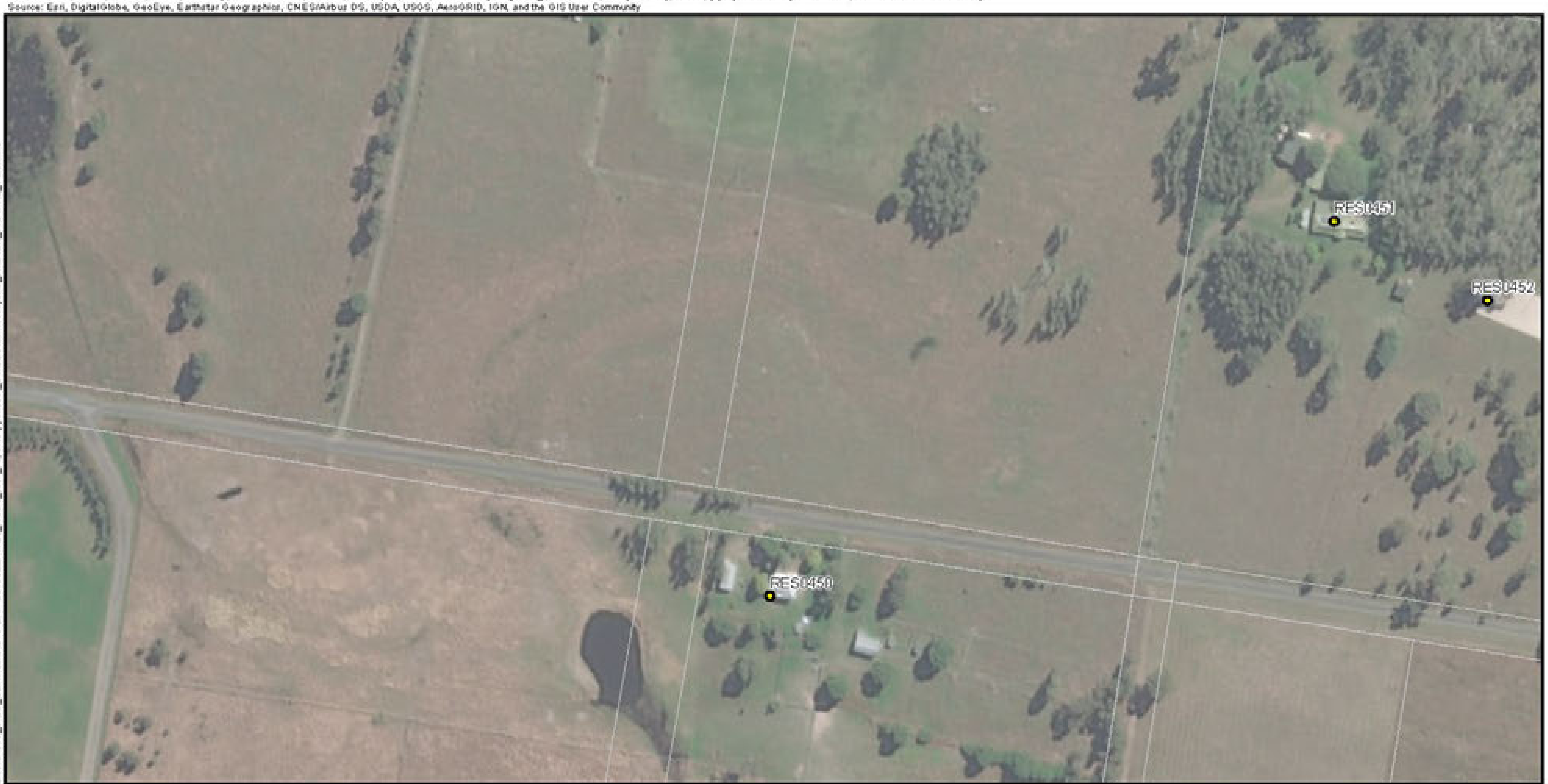
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

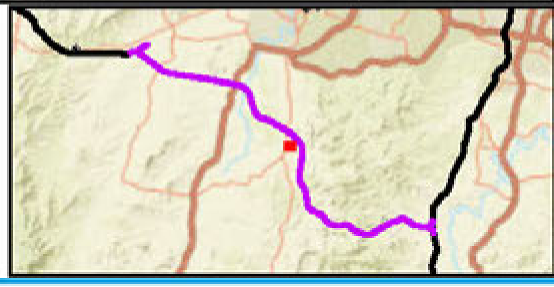
CALVERT TO KAGARU

Appendix Acs: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSNCW/RB/GN Date: 5/03/2020 09:14



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

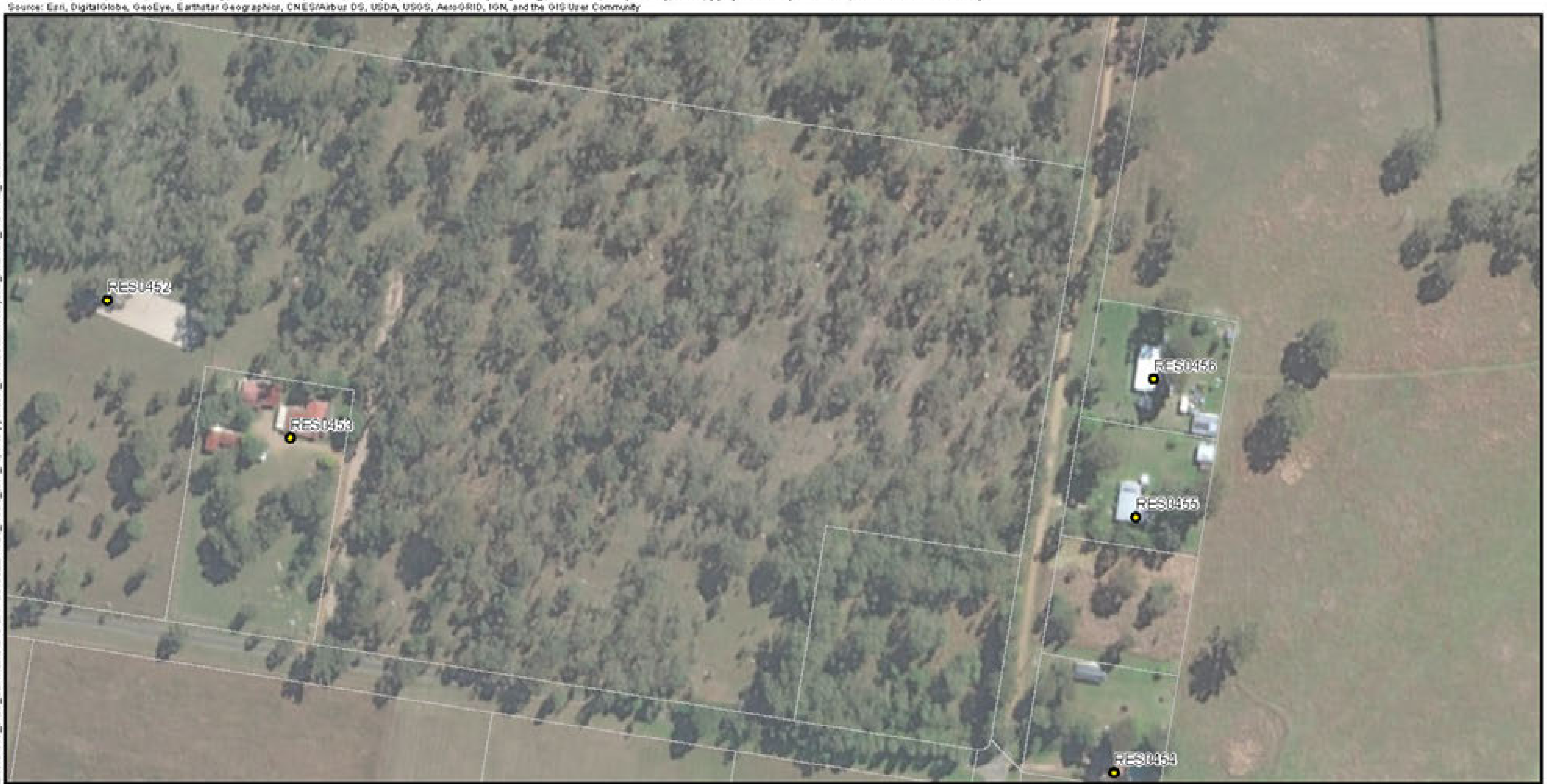
Date: 05/03/2020 Version: 6

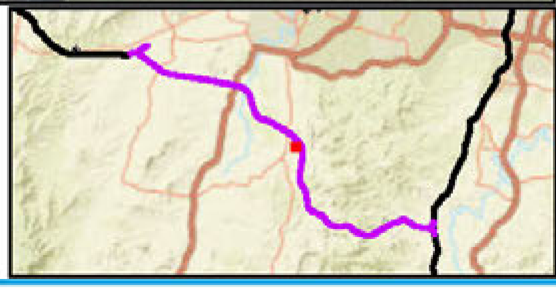
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Act: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

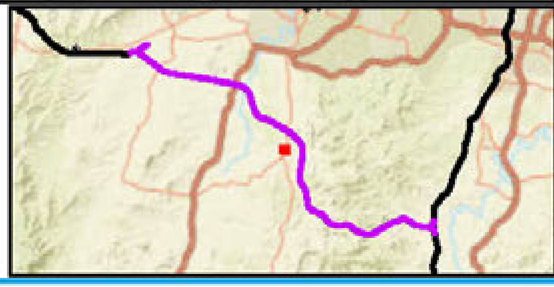
Appendix Acu: Noise and vibration sensitive receptors

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

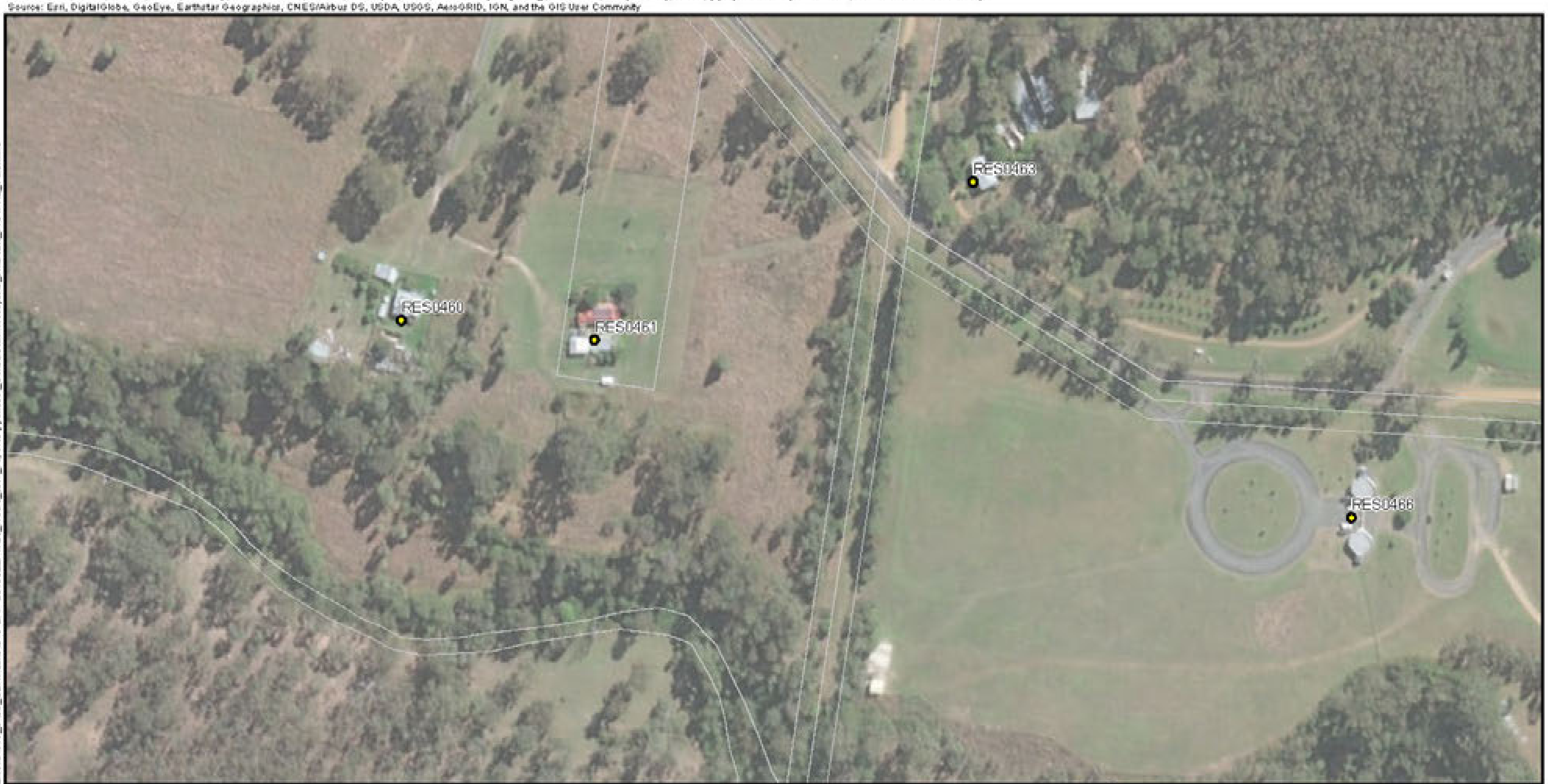
0 25 50 75 100 125 Meters

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acv: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



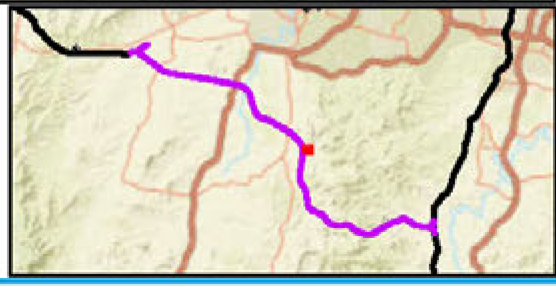
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

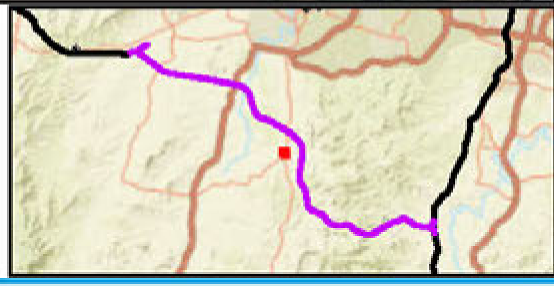
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acw: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix\A_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd



Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acx: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

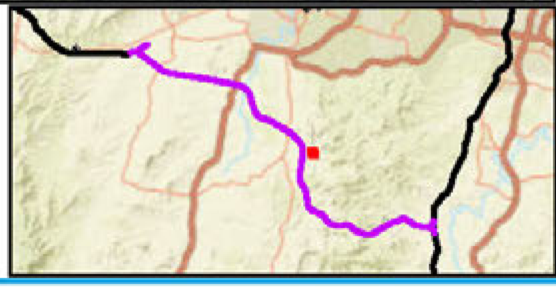
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

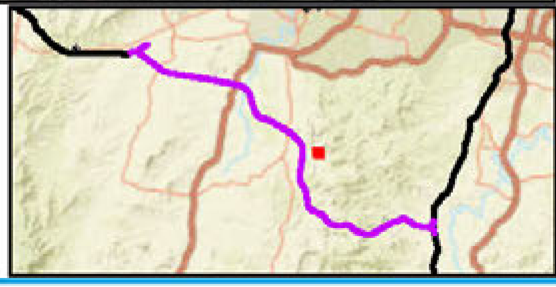
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acy: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\All_Ver6.mxd



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

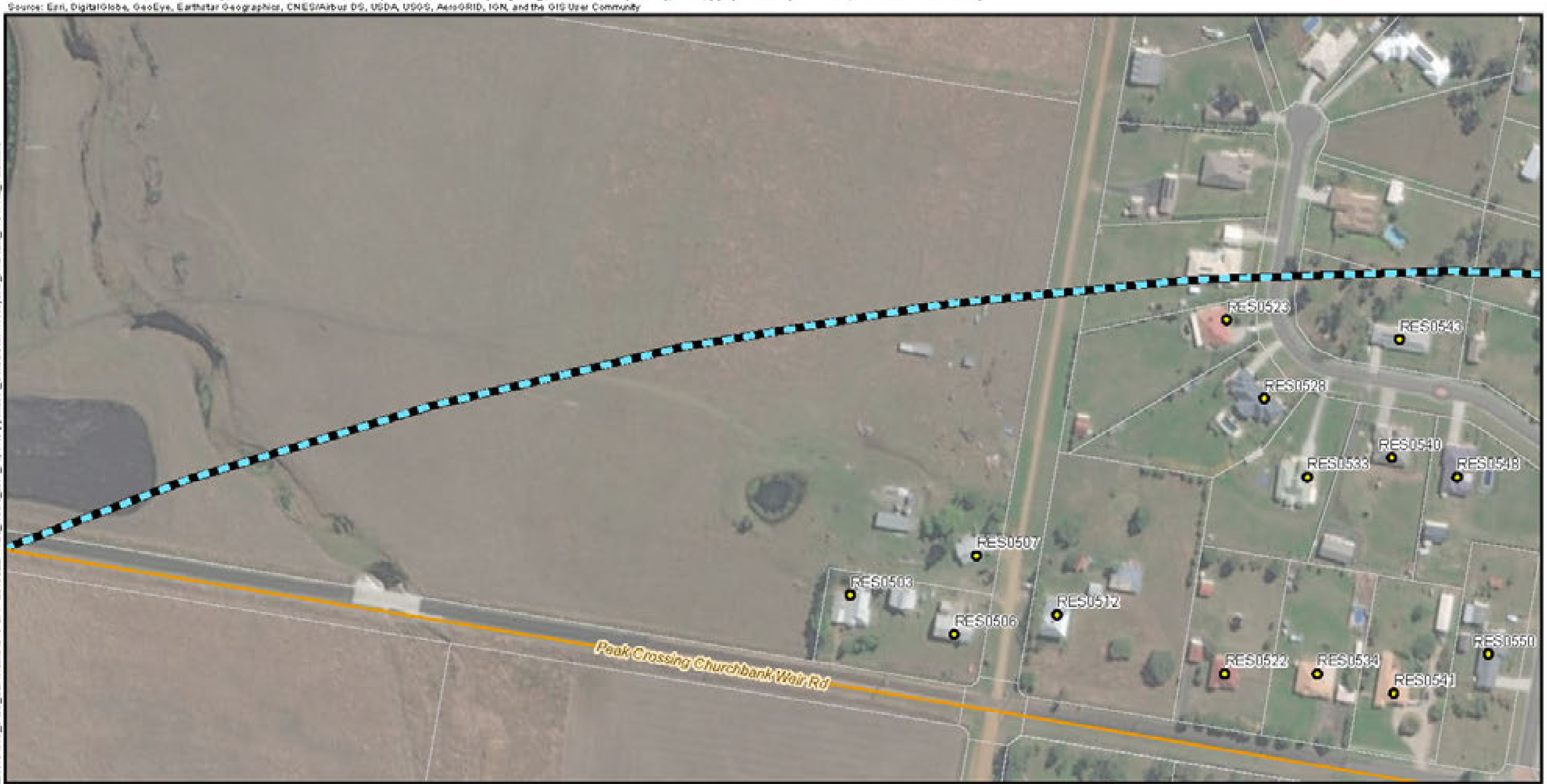
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Acz: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



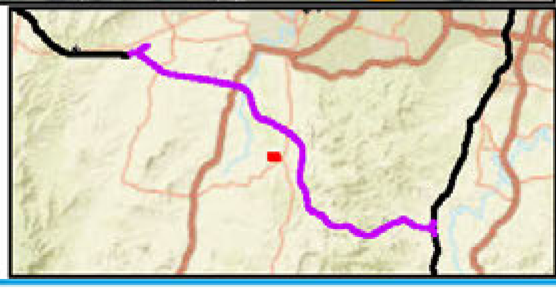
Map by: CSNCWRB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

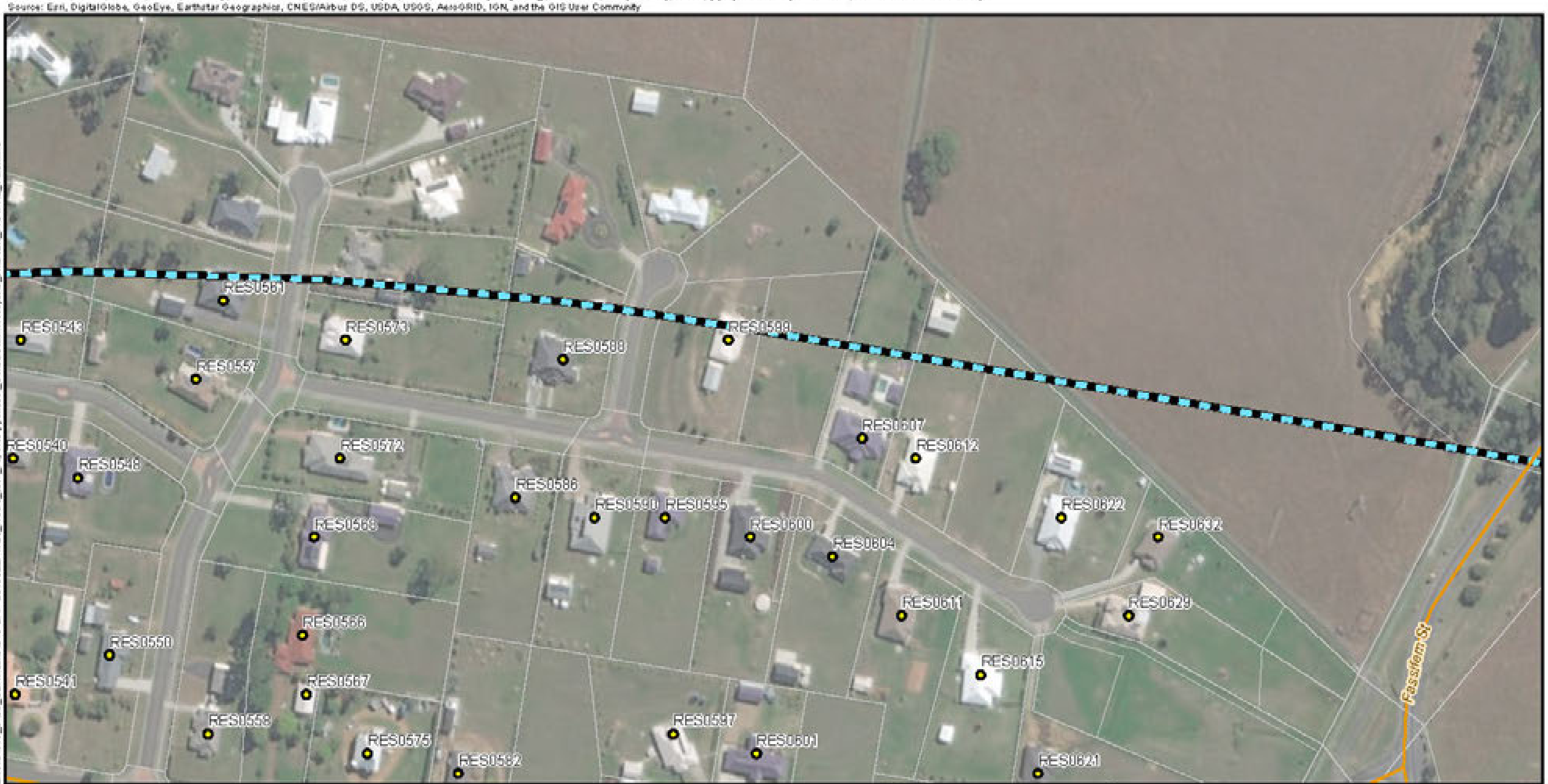
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ada: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



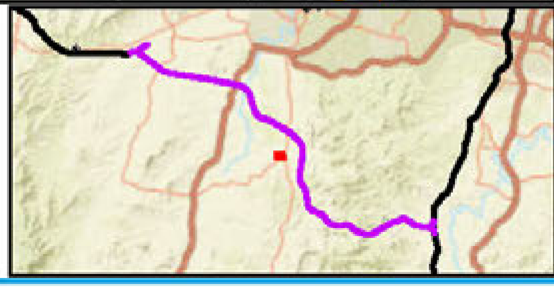
Map by: CSN/CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AHL_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adb: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

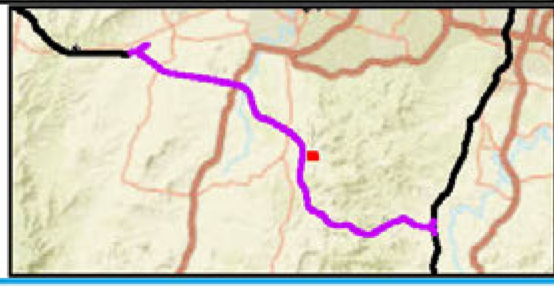
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adc: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

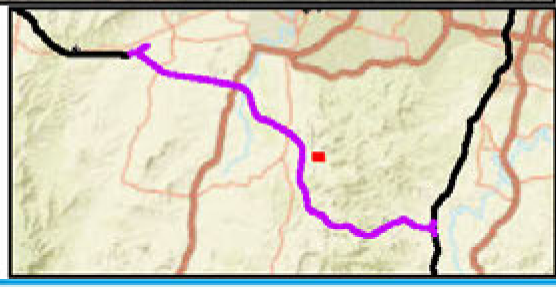
Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Integrating Community Development and Engineering

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Add: Noise and vibration sensitive receptors

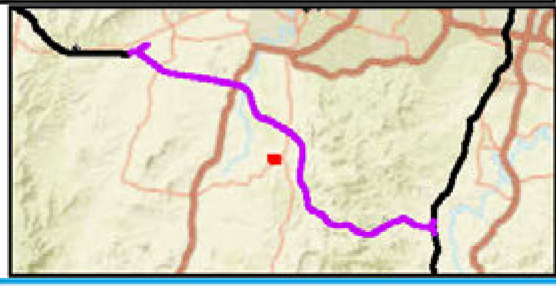
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ade: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

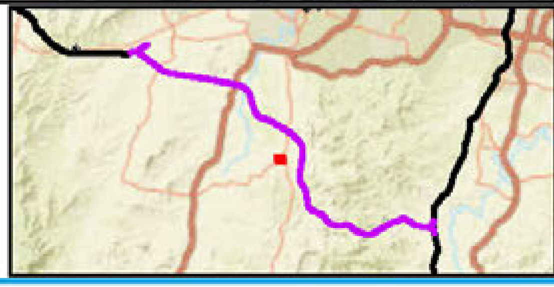
Map by: CSNCWR/B/ON Date: 5/03/2020 09:14

Legend

- Localities
- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Community Retail
- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

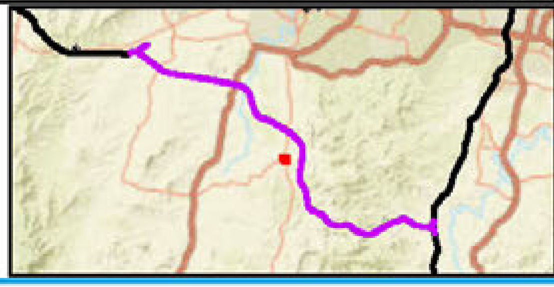
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adf: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Community Retail
- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adg: Noise and vibration sensitive receptors

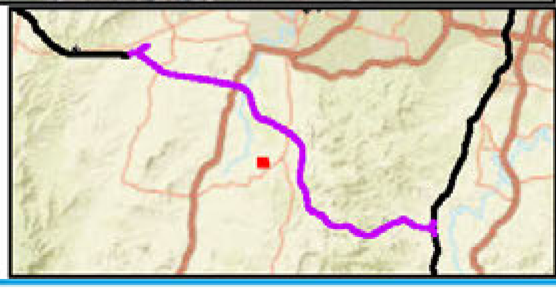
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV4AL_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

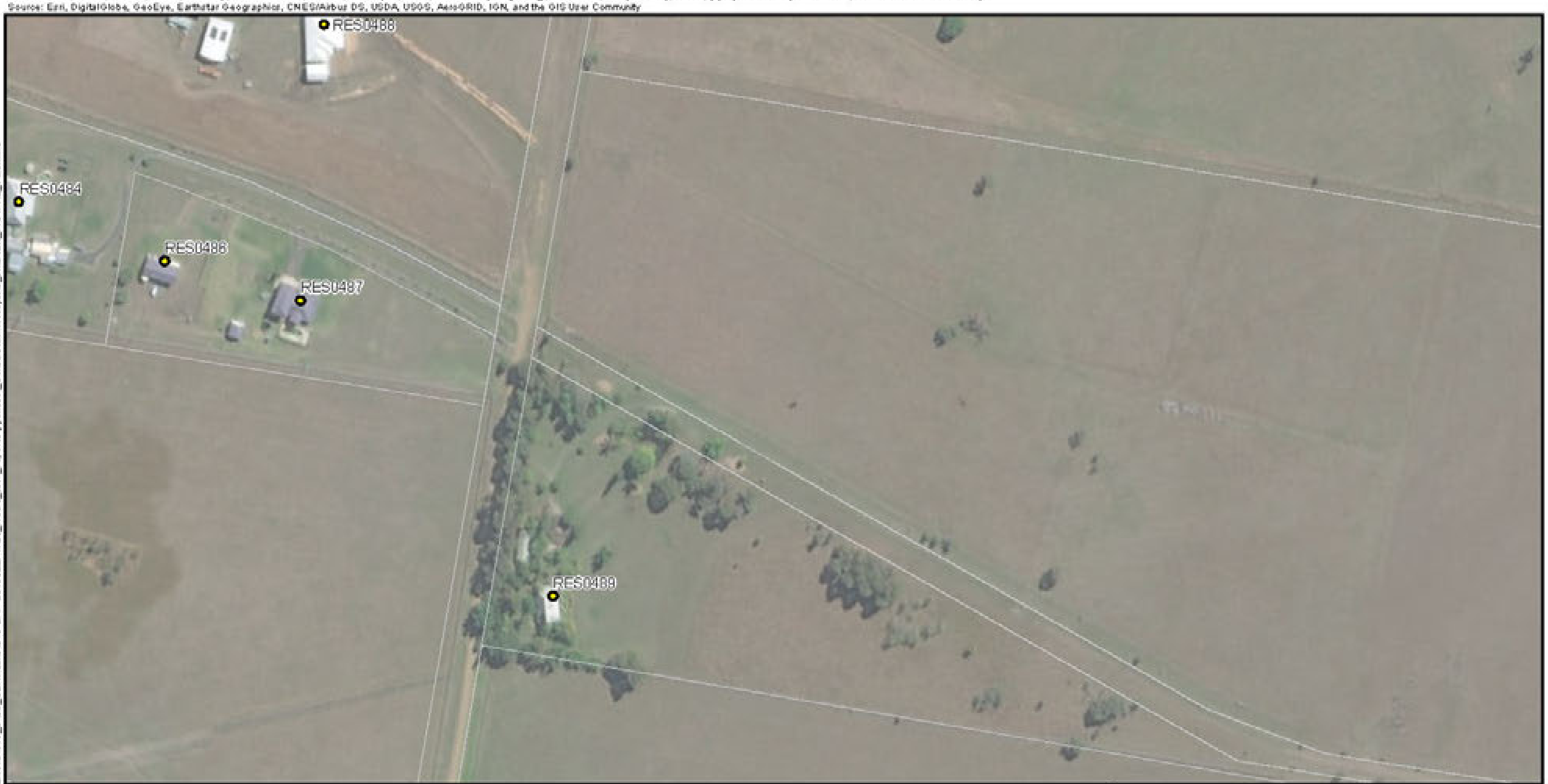
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adh: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: CSN CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJVAAL_Ver6.mxd

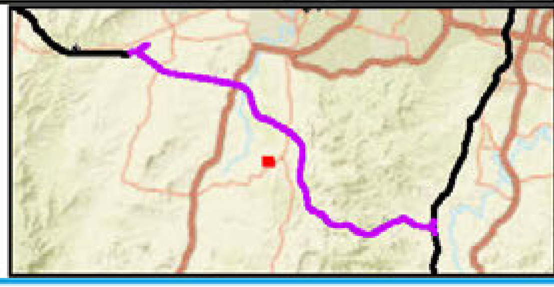
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adi: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

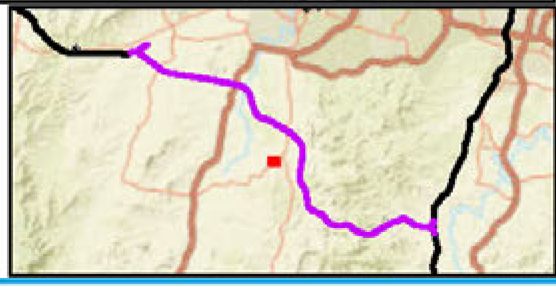
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adj: Noise and vibration sensitive receptors

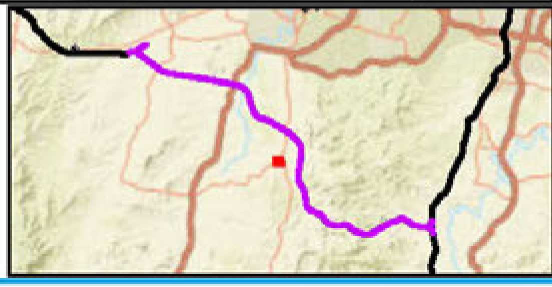
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix\A_ConstructionReceptors_smlscale_FFJVA4L_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community Development and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adk: Noise and vibration sensitive receptors

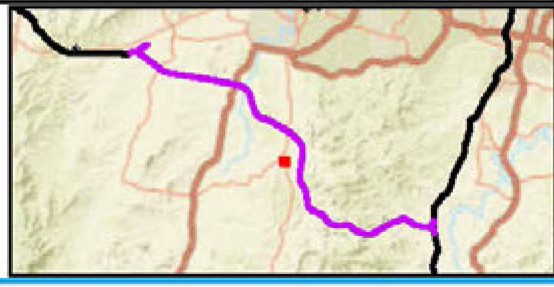
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSNCW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV_A4L_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000
0 25 50 75 100 125 Meters

Future Freight
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AdI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\AppendixA_ConstructionReceptors_smlscale_FFJV\AIL_Ver6.mxd

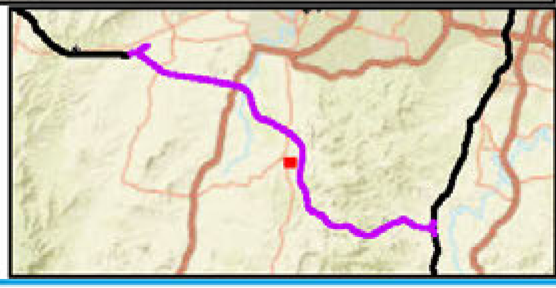
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

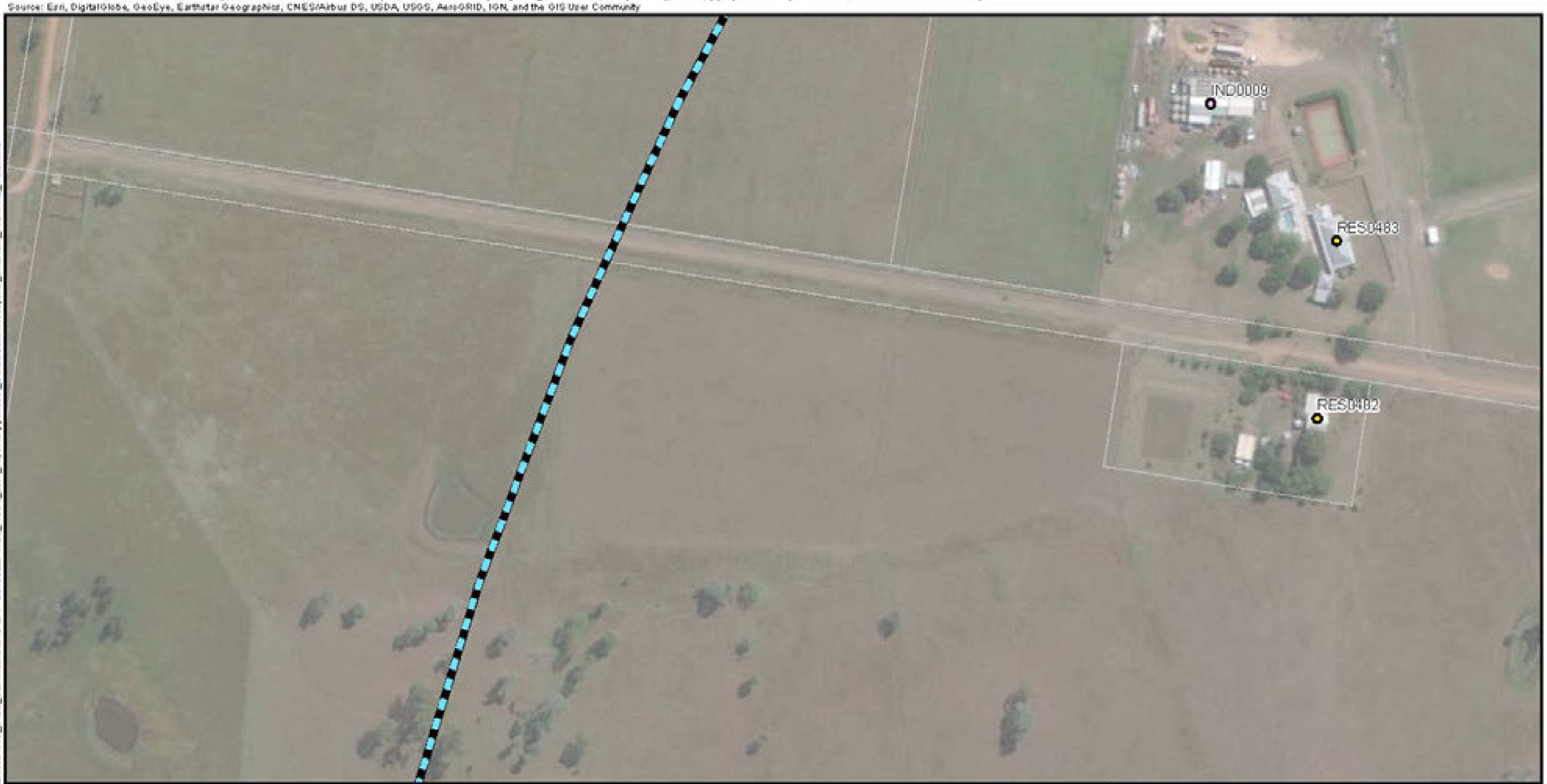
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adm: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



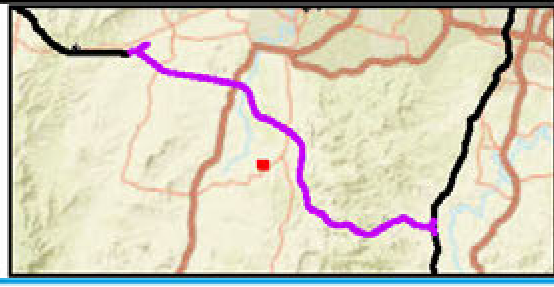
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\AAL_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors

- Industrial
- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

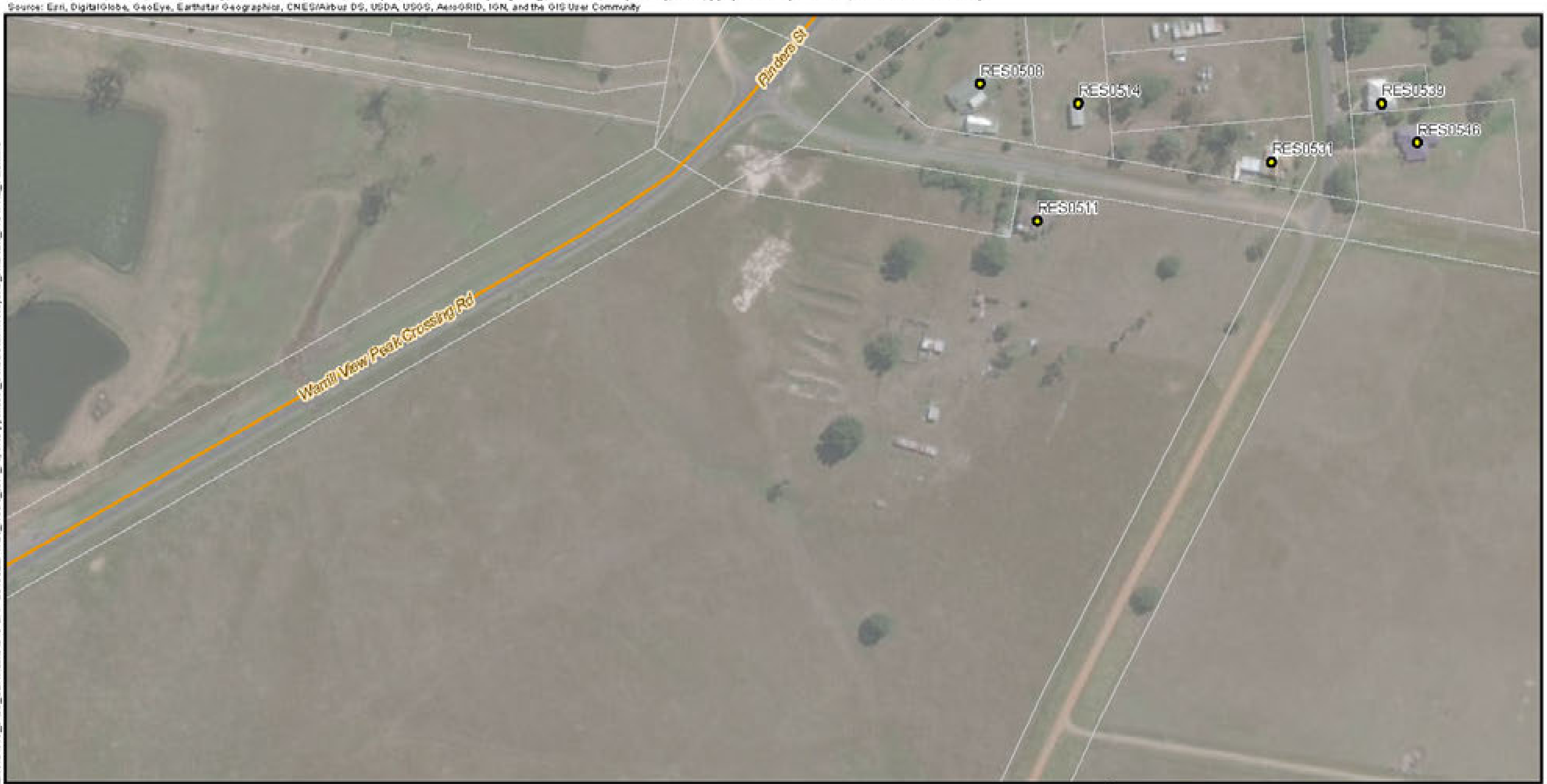
Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adn: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

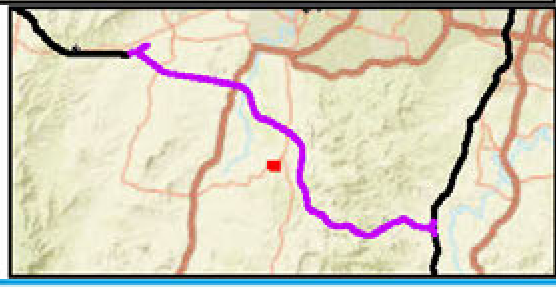


Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

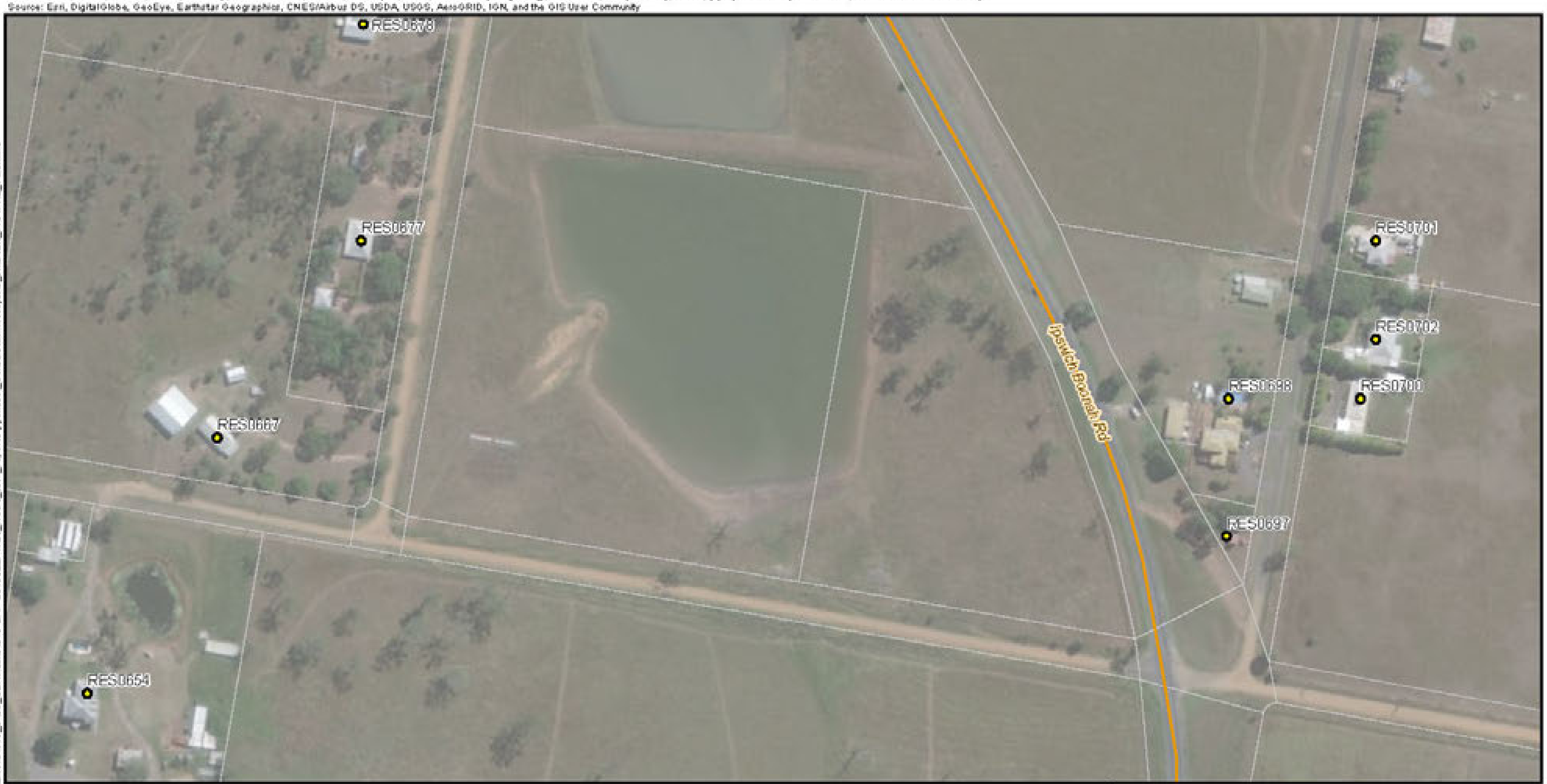
Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ado: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

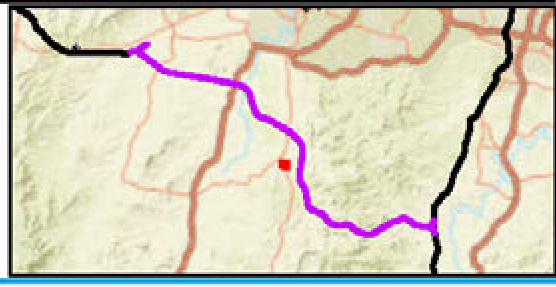


Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV4K_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

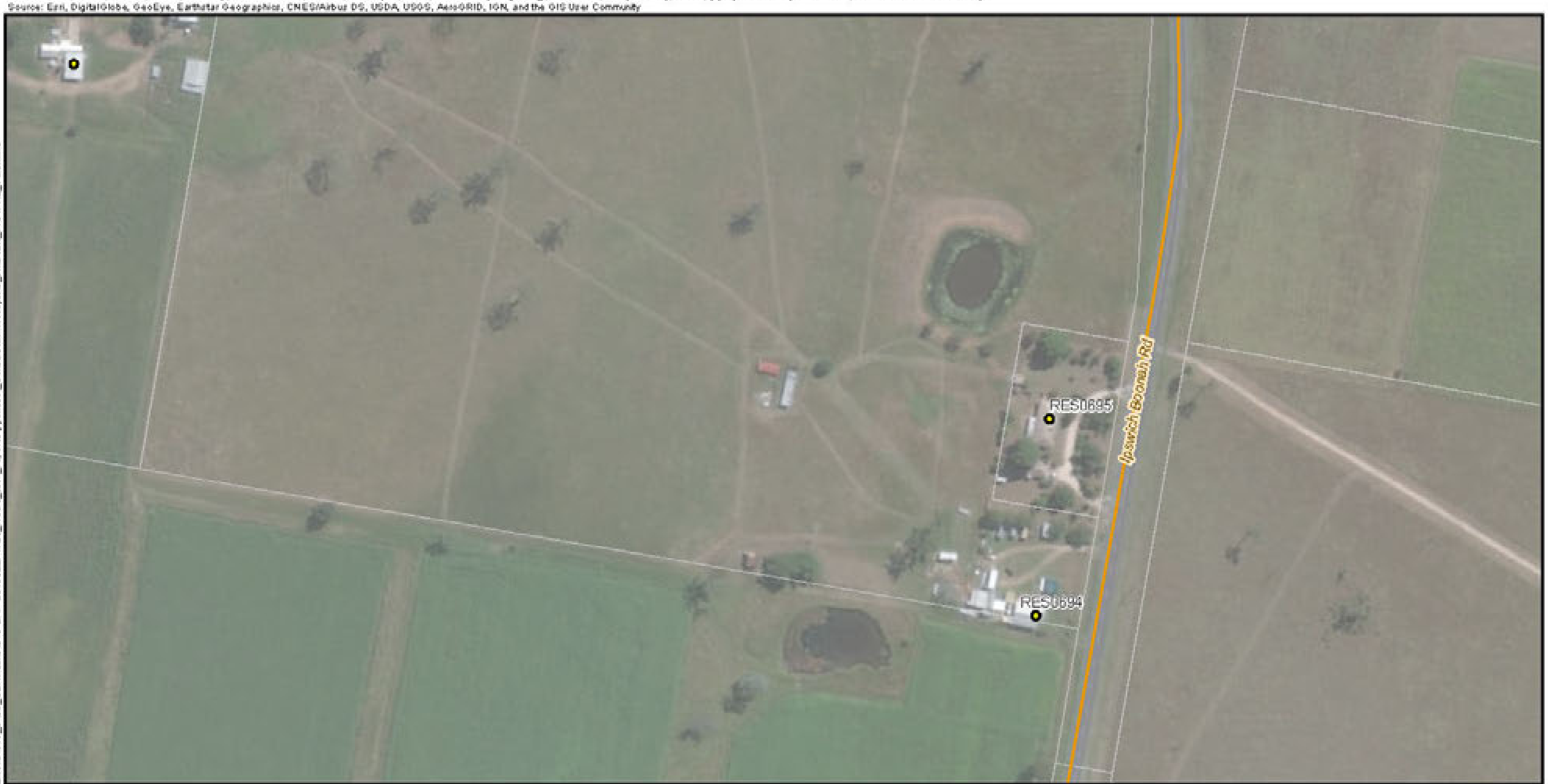
Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adp: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



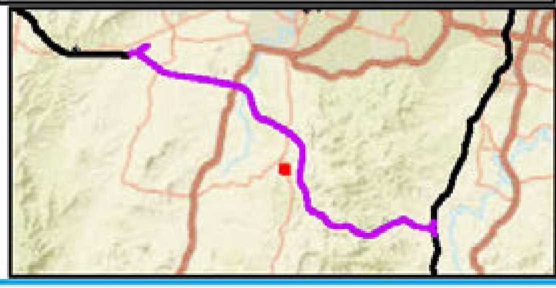
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

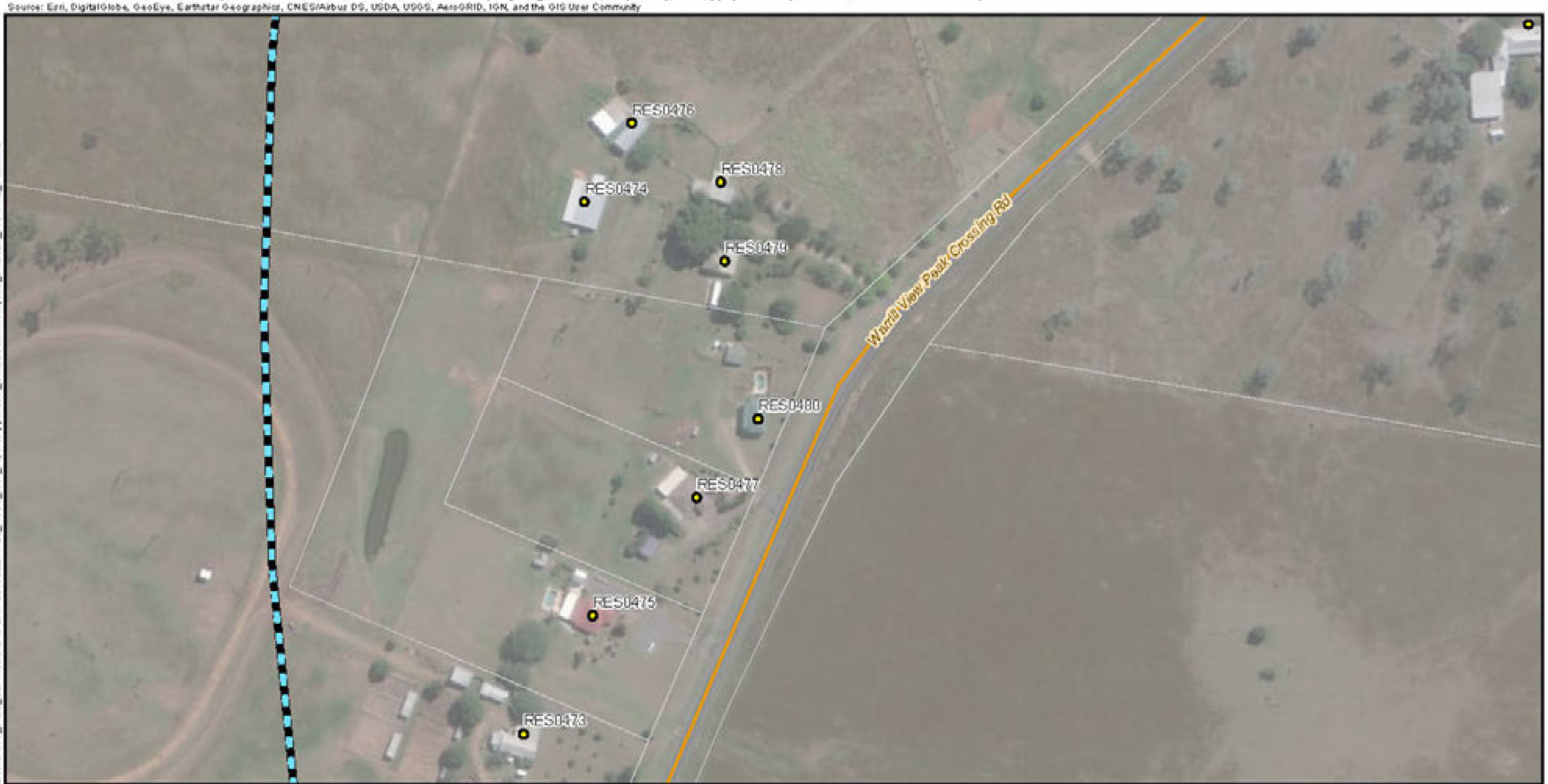
Future Freight

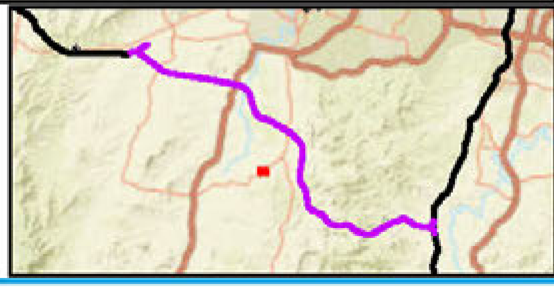
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adq: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adr: Noise and vibration sensitive receptors

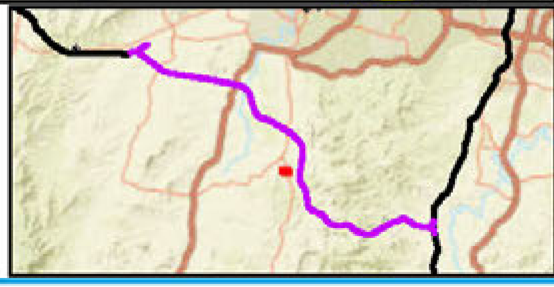
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Minor roads
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Hotel/Motel



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ads: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

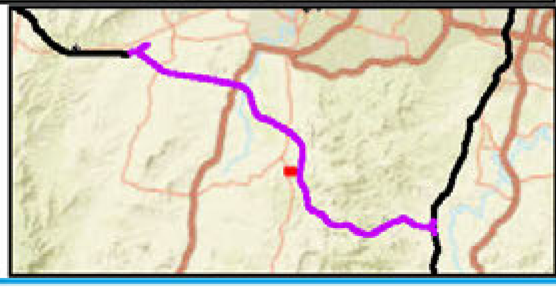
Map by: CSN CW/RB/GN Date: 5/03/2020 09:14

Legend

- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Hotel/Motel
- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

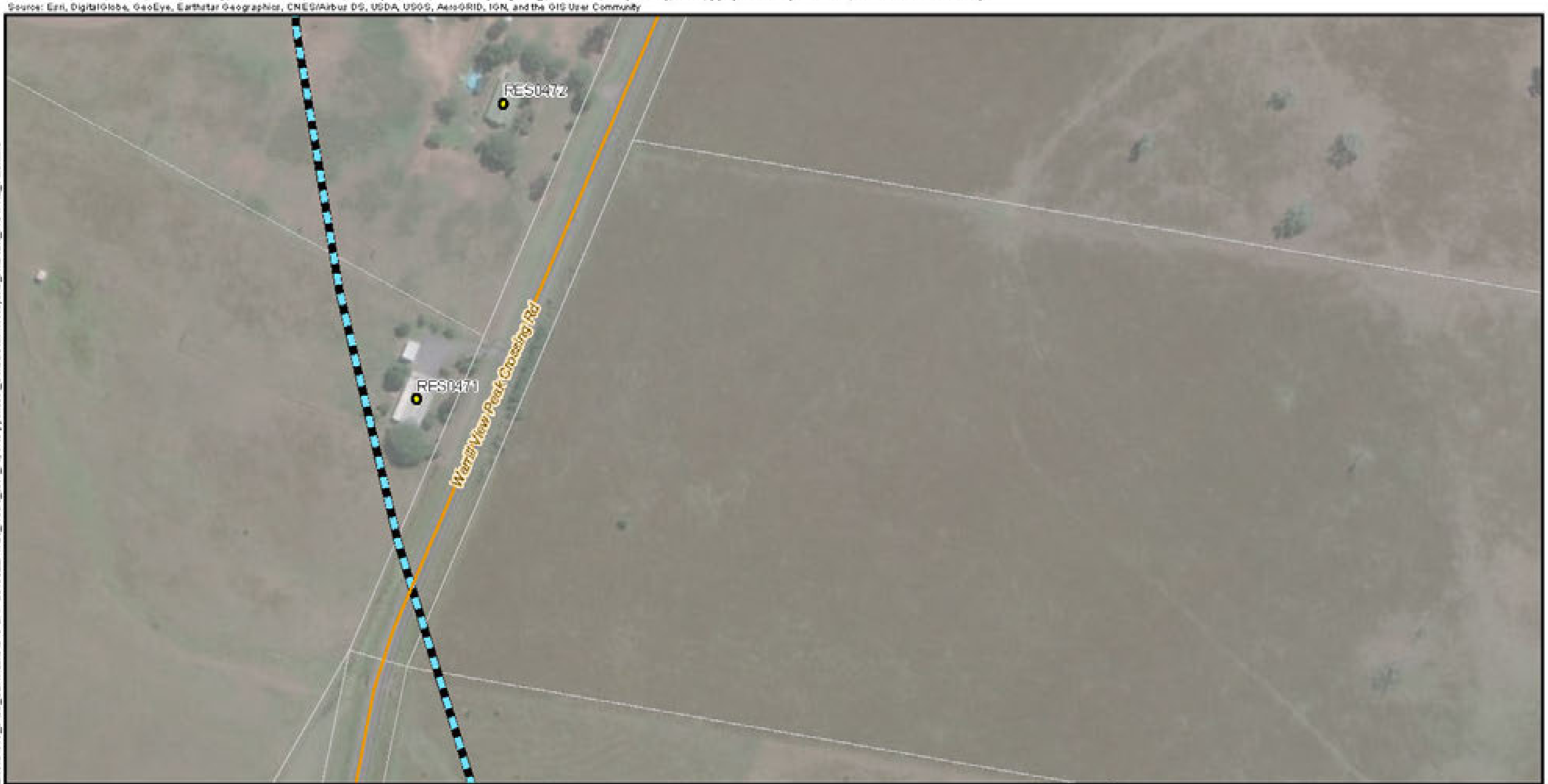
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adt: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

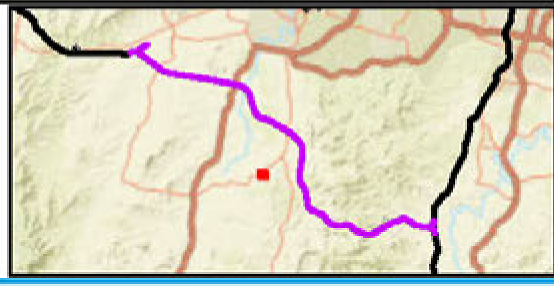


Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

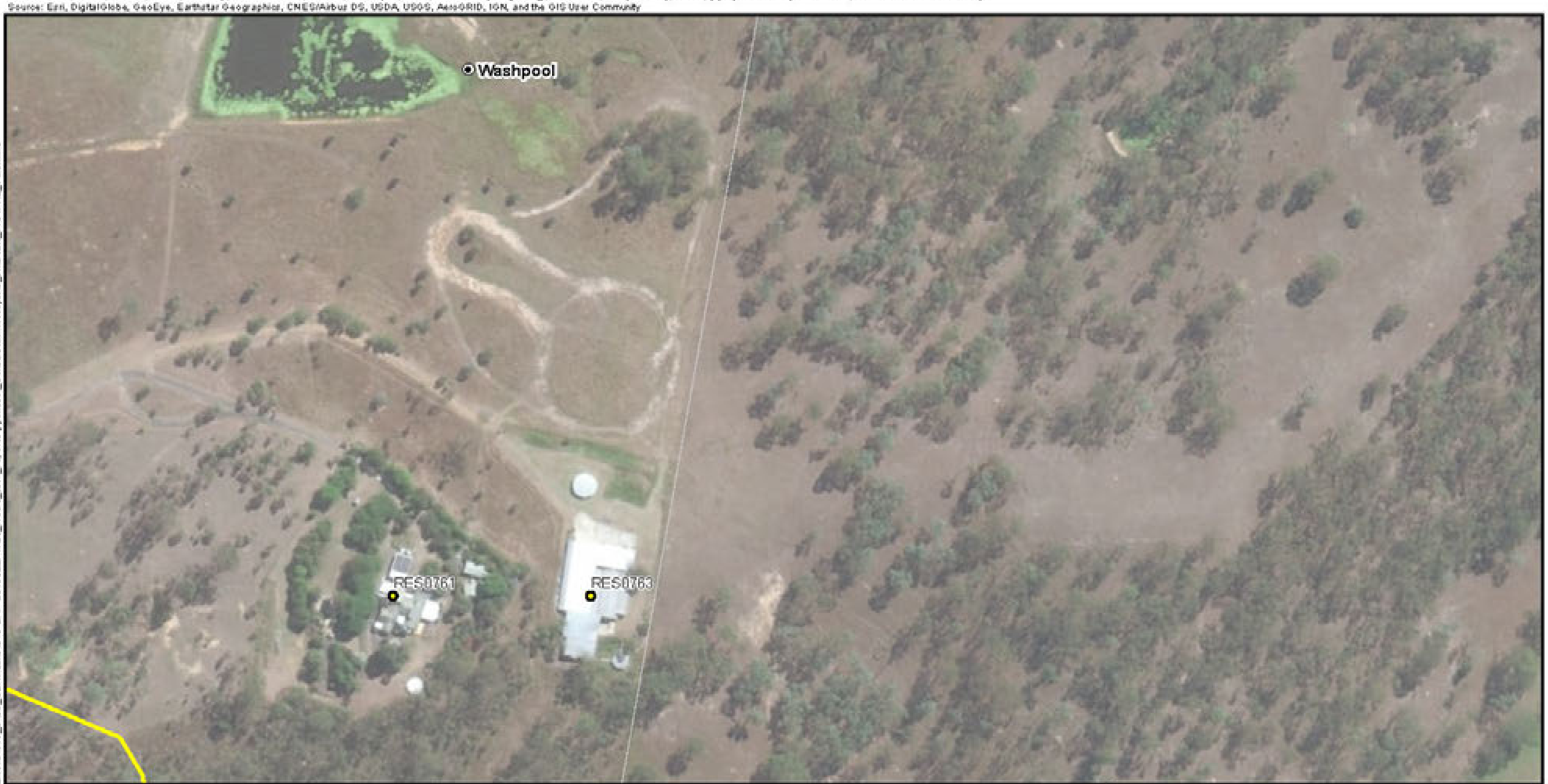
Date: 05/03/2020 Version: 6

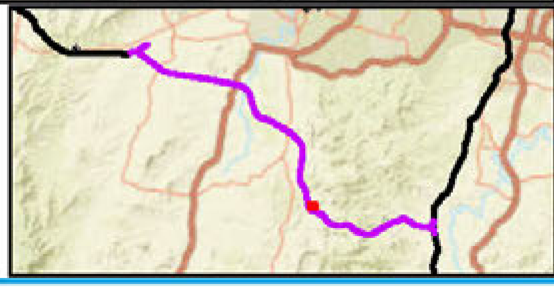
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adu: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





Legend

- ◉ Localities
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

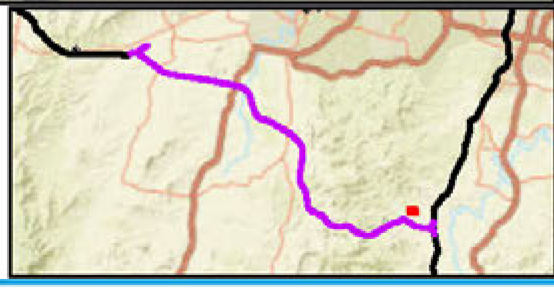
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adv: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14



Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

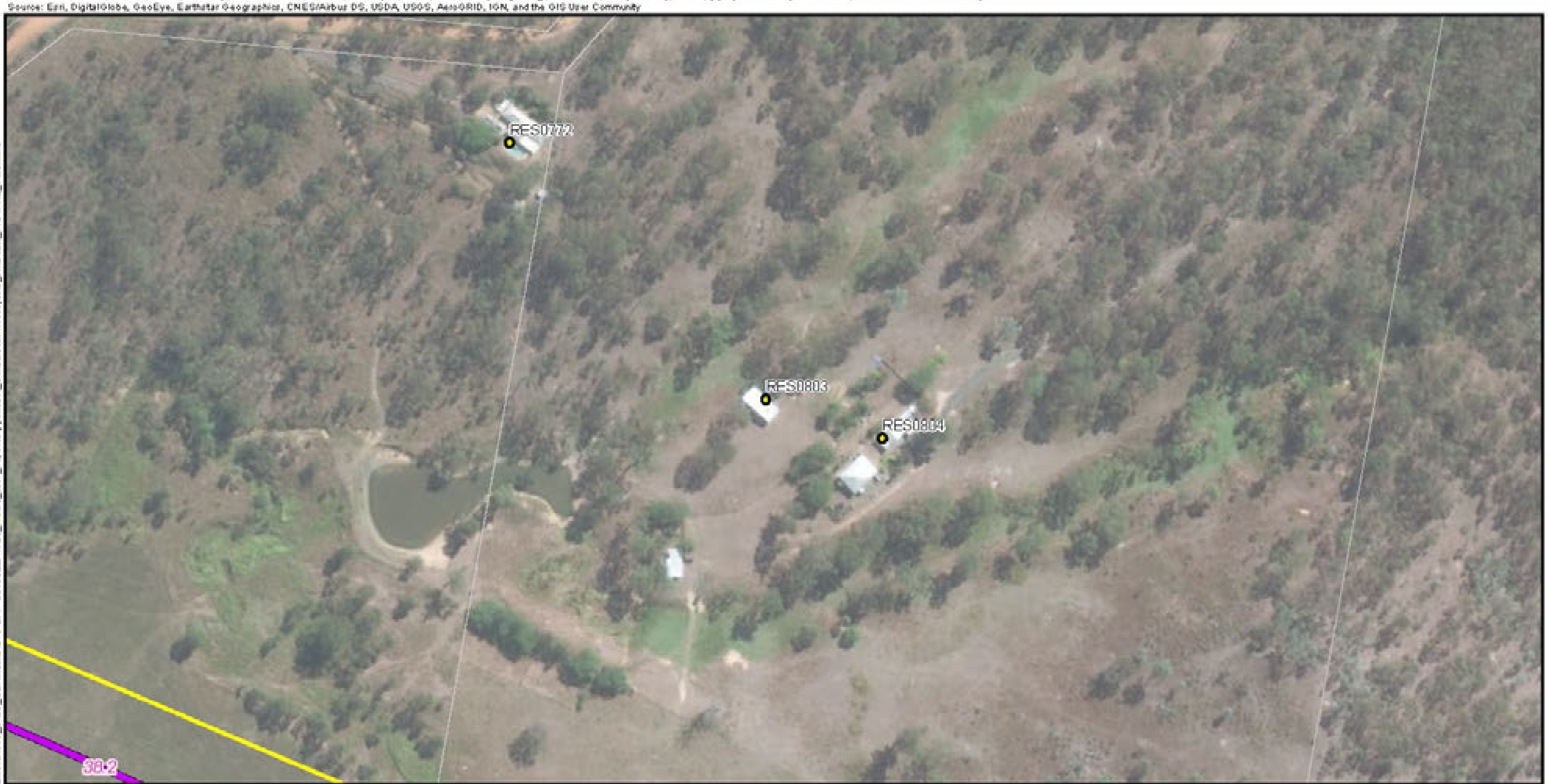
Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adw: Noise and vibration sensitive receptors



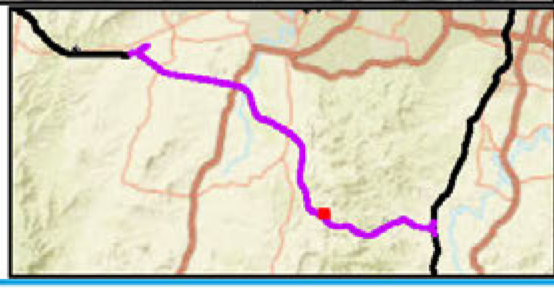
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

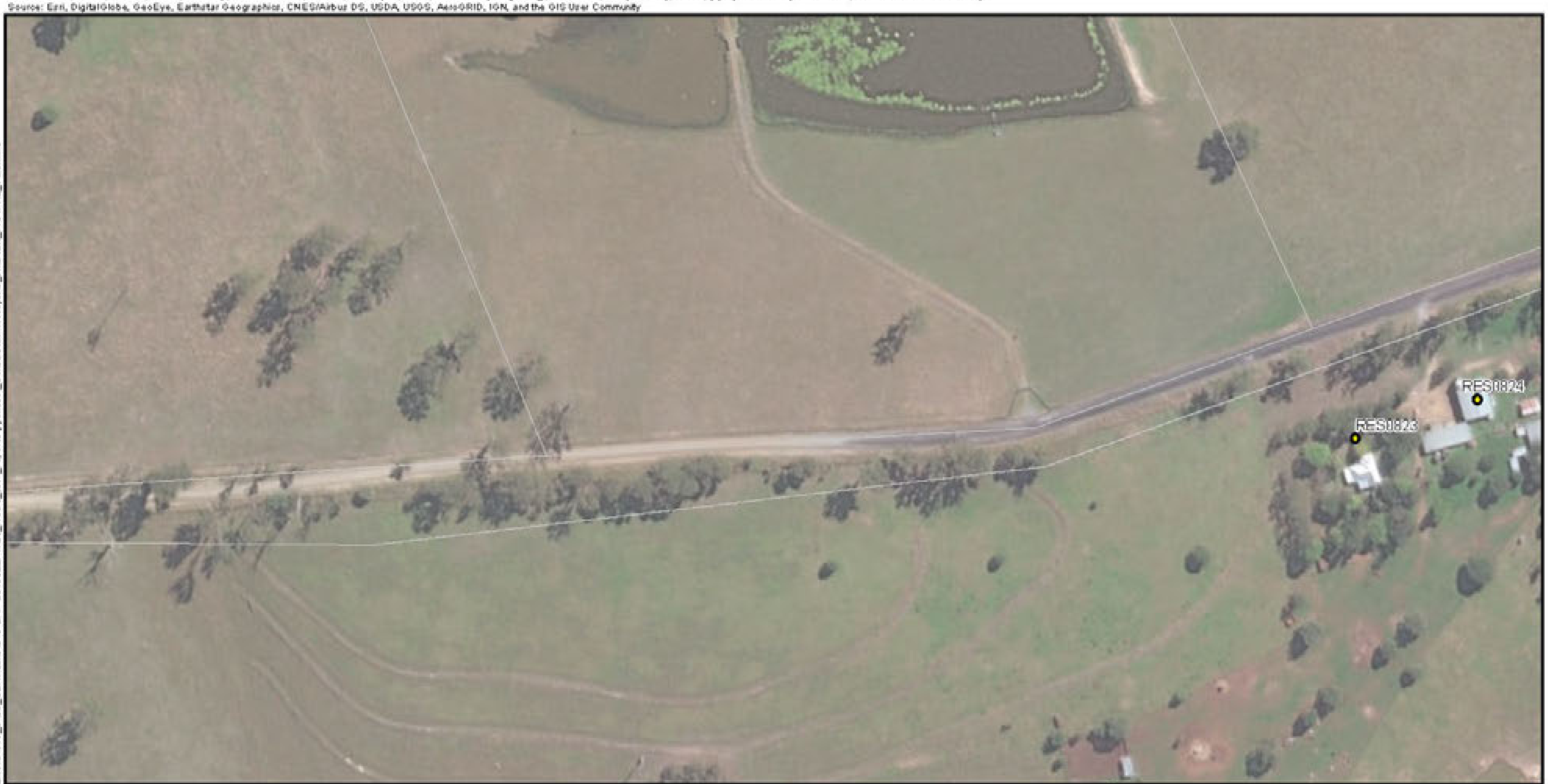
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adx: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



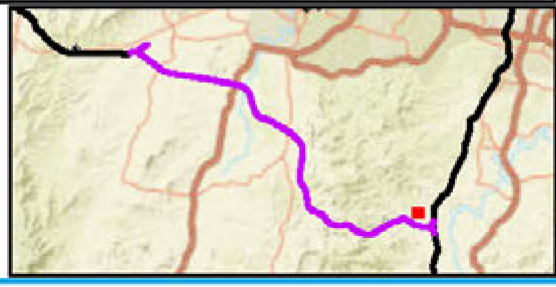
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\JVAIL_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Ady: Noise and vibration sensitive receptors

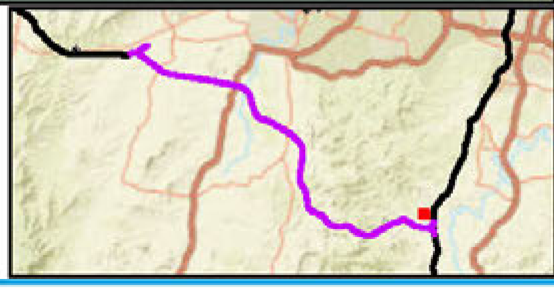
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF\A4L_Ver6.mxd

Legend

Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Adz: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

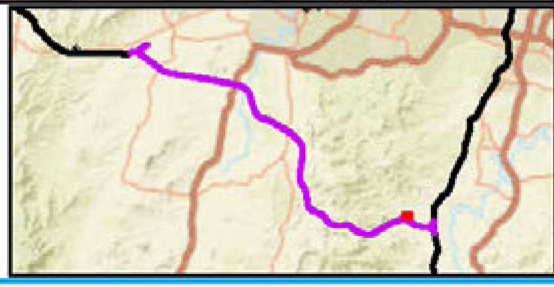
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FF_JVAIL_Ver6.mxd

Legend

Minor roads
EIS disturbance footprint
Noise and vibration study area
Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aea: Noise and vibration sensitive receptors

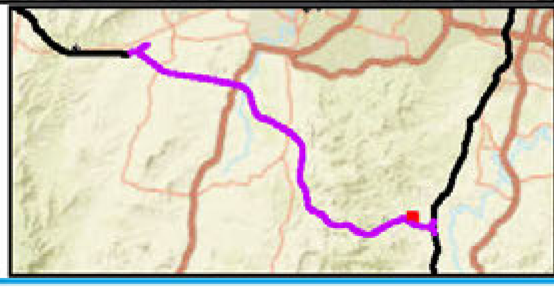
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aeb: Noise and vibration sensitive receptors

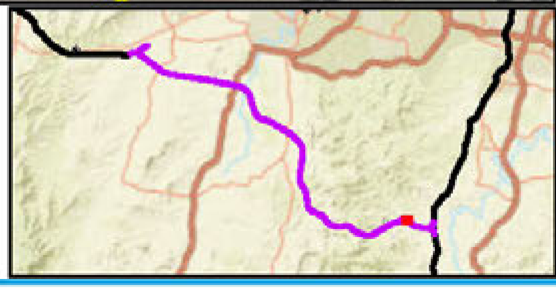
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- C2K project alignment
- EIS disturbance footprint
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

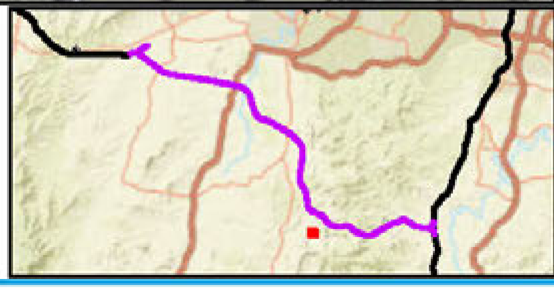
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aec: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14



Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aed: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV_Ver6.mxd

Legend

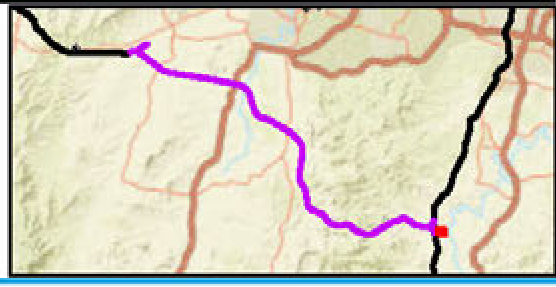
Minor roads

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aee: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

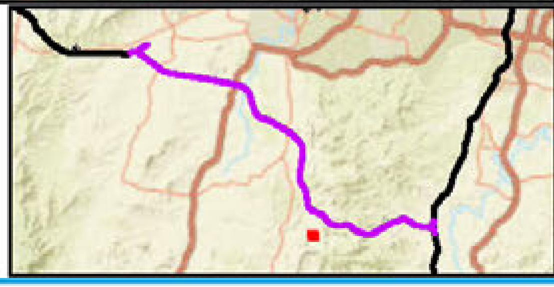
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aef: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

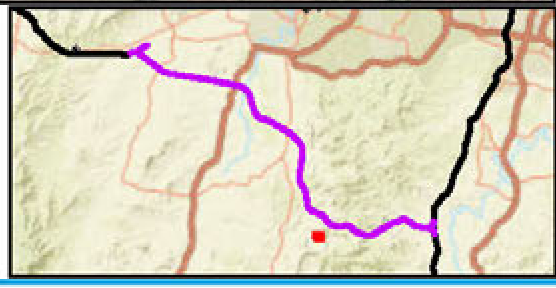
Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

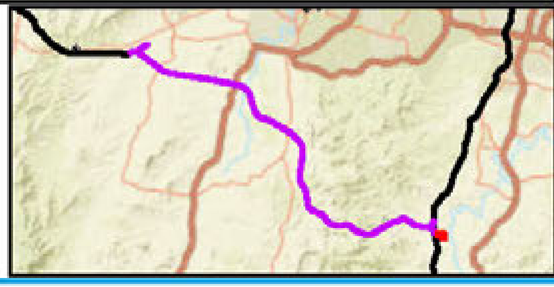
Appendix Aeg: Noise and vibration sensitive receptors

Map by: CSN/CW/RB/ON Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix_ConstructionReceptors_smlscale_FFJV\A4L_Ver6.mxd

Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors
Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight
Integrating Community, Environment and Engineering

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aeh: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14

Legend

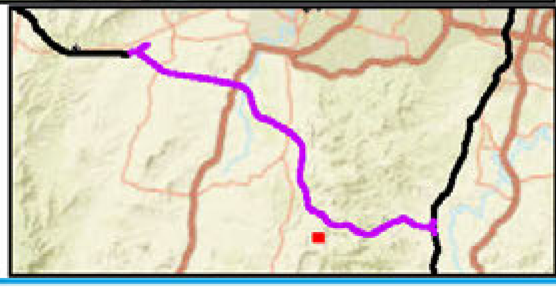
EIS disturbance footprint

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

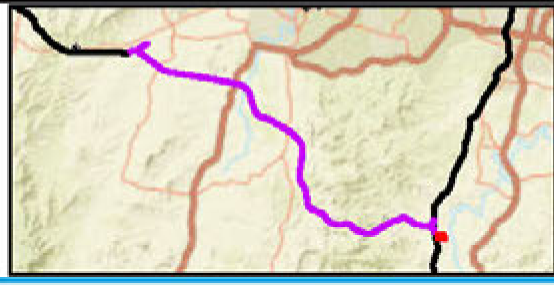
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aei: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN CW/RB/GN Date: 5/03/2020 09:14



Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aej: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: CSN/CW/RB/GN Date: 5/03/2020 09:14
Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201902271720_Noise_tech_report\Appendix\A_ConstructionReceptors_smlscale_FFJV4AL_Ver6.mxd

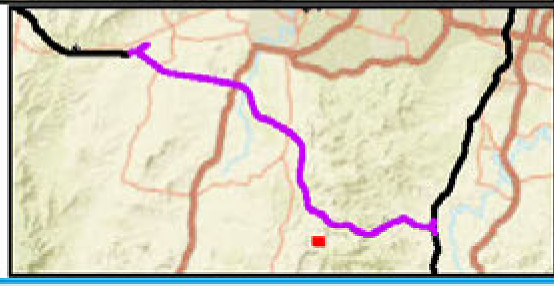
Legend

Noise and vibration study area

Cadastre

Sensitive receptors

Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aek: Noise and vibration sensitive receptors

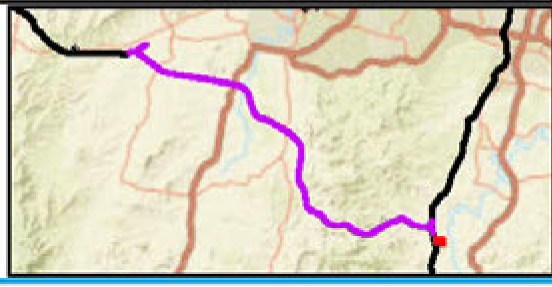
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Minor roads
- Noise and vibration study area
- Cadastre

Sensitive receptors

- Residential



A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

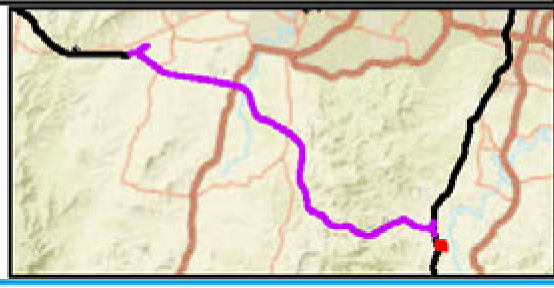
Date: 05/03/2020 Version: 6

Coordinate system: MGA56

CALVERT TO KAGARU

Appendix AeI: Noise and vibration sensitive receptors

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

Minor roads
Noise and vibration study area
Cadastre

Sensitive receptors

Residential

A4 scale: 1:3,000

0 25 50 75 100 125 Meters

Future Freight

Date: 05/03/2020 Version: 6
Coordinate system: MGA56

CALVERT TO KAGARU

Appendix Aem: Noise and vibration sensitive receptors