

CHAPTER 12

Air Quality

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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12. Air Quality

12.1 Scope of chapter

This chapter describes the air quality components of the Inland Rail—Border to Gowrie Project (the Project) with the objective of ensuring the Project is planned, designed, constructed and operated in a manner that protects environmental values of air. This chapter describes the existing environment, potential impacts and mitigation measures associated with the Project. Potential impacts are derived from reviews of relevant legislation, existing information (including from existing emitters and meteorological and air quality monitoring data) and a qualitative and quantitative assessment of the Project construction and operations stage.

This chapter addresses the 'Air' section of the Terms of Reference (ToR), inclusive of ToR items 11.127 to 11.138. This chapter has been updated in accordance with additional information requested by the Coordinator-General following the public notification of the draft Environmental Impact Statement (EIS) in 2021.

This chapter should be read in conjunction with the following technical appendices to the revised draft EIS: Appendix R: Air Quality Technical Report and Appendix AD: Borrow Pits: Supporting Technical Information.

12.2 Regulatory environment

The policies, standards and guidelines relevant to air quality in the context of the Project are summarised in Table 12-1. In Queensland, the environmental impacts of air emissions are primarily regulated under the *Environmental Protection Act 1994* (Qld) (EP Act) and subordinate legislation, including the *Environmental Protection Regulation 2019* (Qld). Discussion on the broader applicability of the EP Act and *Environmental Protection Regulation 2019* is presented in Chapter 3: Legislation and Project Approvals Process.

TABLE 12-1 POLICIES, STANDARDS AND GUIDELINES APPLICABLE TO THE ASSESSMENT OF AIR QUALITY

Policy, standard or guideline	Relevance to the Project
<i>National Environment Protection (Ambient Air Quality) Measure 2021</i> (Cth)	This National Environment Protection Measure (NEPM) establishes national standards for six major air pollutants in Australia, specifically: particulate matter less than 10 micrometres in diameter (PM ₁₀); particulate matter less than 2.5 micrometres in diameter (PM _{2.5}); nitrogen dioxide (NO ₂); carbon monoxide (CO); ozone (O ₃); and sulphur dioxide (SO ₂). The standards are not intended to be applied as impact assessment criteria for individual projects. The six pollutants are covered by the <i>Environmental Protection (Air) Policy 2019</i> (Qld) (EPP (Air)).
<i>National Environment Protection (Air Toxics) Measure 2004</i> (Cth)	This NEPM prescribes standards for five air pollutants (air toxics), specifically benzene, formaldehyde and benzo(a)pyrene as a marker for polycyclic aromatic hydrocarbons (PAH), toluene, and xylenes. The measure intends to improve the information base regarding ambient air toxics within the Australian environment in order to facilitate the development of standards. The standards prescribed are not intended to be applied as impact assessment criteria for individual projects. The five pollutants covered by the legislation are covered by the EPP (Air).
<i>Environmental Protection (Air) Policy 2019</i> (Qld) (EPP (Air))	Policy measure instrument established pursuant to the EP Act intended to protect or enhance the statutory environmental values of the air environment by setting pollutant-specific air quality objectives.
<i>Guideline ESR/2015/1840: Application requirements for activities with impacts to air</i> , version 5, 2023 (Department of Environment and Science (DES), 2023b)	Queensland Government guideline on assessment and information requirements for applications for activities with impacts to air, for assessments with relevant environmentally relevant activities (ERAs).
<i>Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales</i> (New South Wales (NSW) Environmental Protection Agency (EPA), 2022)	Prescribes assessment methods for modelling and impact assessment for air quality in NSW. This guideline is referred to by DES (2023), now the Department of Environment, Science and Innovation (DESI) as the guiding document for air dispersion modelling. Despite being written for NSW, it provides some guidance which is appropriate for impact assessments undertaken in Queensland.
<i>Development Affected by Environmental Emissions from Transport Policy Version 4</i> (Department of Transport and Main Roads (DTMR), 2017b)	Outlines the DTMR policy position on the development of land affected by environmental emissions (noise, vibration, air emissions and particles and light) from linear transport operations and infrastructure. The document identifies potential air quality impacts from freight rail and presents air quality criteria for new sensitive developments. The document does not prescribe assessment methodology requirements that are relevant to this AQIA.
<i>Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for Modeling and Assessments in NSW, Australia'</i> (Barclay & Scire, 2011)	This document provides guidance on the selection of CALPUFF model variables when establishing a model for assessing air pollutants. The document is written for integration with the guideline from NSW EPA (2022) and provides some guidance that is appropriate for impact assessments undertaken in Queensland.

Policy, standard or guideline	Relevance to the Project
<i>Guidance on the assessment of dust from demolition and construction</i> (United Kingdom Institute of Air Quality Management (UK IAQM), 2014).	This document provides a four-step risk-based assessment method for dust emissions associated with demolition, including land clearing and earth moving, and construction activities. The qualitative impact assessment methodology of the construction works stage of the Project has been based on this document.
<i>Air Quality Planning Scheme Policy (AQPSP)</i> (Brisbane City Council (BCC), 2014)	This document provides guidance on assessment methodologies and air quality goals for air quality assessments undertaken for projects in the BCC local government area (LGA). Despite only being strictly applicable within the BCC LGA, the policy provides a robust methodology for air quality assessments and is used widely in Queensland. The assessment methodology adopted for the Project has been guided by this policy. Air quality goals from the policy have also been adopted for the Project for pollutant species not covered by the EPP (Air).
<i>Air – EIS information guideline</i> (DES, 2022f)	Guideline providing advice to proponents in relation to air emissions when preparing an EIS. This guideline has been used to guide the methodology of this AQIA.
<i>Road Traffic Air Quality Management Manual (RTAQMM)</i> (DTMR, 2014a)	This document provides DTMR's guidance on road traffic air quality impact assessment and planning methodologies for road projects. This guidance has been considered in the assessment, noting that the manual does not include recommendations for rail projects.

12.2.1 Environmental values and air quality goals

The EPP (Air) was prepared by the Queensland Government to fulfil the objectives of the EP Act in relation to the air environment. Air quality objectives are provided in the EPP (Air) as indicators for identifying environmental values of the air environment that are required to be enhanced or protected. The EPP (Air) objectives are intended to be progressively achieved over the long-term. The air quality objectives in the EPP (Air) do not apply to workplaces with respect to workplace health and safety, as this is covered by the workplace exposure standards set by SafeWork Australia.

The EPP (Air) recommends different strategies to control emissions for different types of activities, including:

- ▶ Identifying environmental values to be enhanced or protected
- ▶ Stating indicators and air quality objectives for enhancing or protecting the environmental values
- ▶ Providing a framework for making consistent, equitable and informed decisions about the air environment.

The environmental values to be enhanced or protected under the EPP (Air) are the qualities of the air environment that are conducive to protecting the:

- ▶ Health and biodiversity of ecosystems
- ▶ Human health and wellbeing
- ▶ Aesthetics of the environment, including the appearance of buildings, structures and other property
- ▶ Agricultural use of the environment.

The air quality objectives from the EPP (Air) relevant to the Project have been adopted as air quality goals for the AQIA. The air quality goals adopted for the Project, including those taken from the EPP (Air), are shown in Table 12-2.

No dust deposition objectives are prescribed in the EPP (Air); however, DESI commonly includes a deposition rate goal of 120 milligrams per square metre per day (mg/m²/day) in environmental authorities, averaged over one month. This limit is based on research into community complaints for coal-related projects. Although it is not a legislative requirement, this deposition limit is frequently used in Queensland (DES, 2023b) and is considered to be an appropriate criterion.

Where air quality goals for identified pollutants are not within the EPP (Air), goals have been sourced from the *Approved methods for the modelling and assessment of air pollutants in NSW* (NSW EPA, 2022) and the BCC AQ PSP (BCC, 2014). Both of these documents are considered to be robust guidance policies for AQIAs and are considered appropriate for application in the assessment for the Project.

The environmental values listed in Table 12-2 that are being protected by each air quality goal have been taken from the EPP (Air). The environmental values protected by these air quality goals are:

- ▶ Health and wellbeing
- ▶ Protection of the aesthetic environment
- ▶ Health and biodiversity of ecosystems.

With respect to the environmental value of health and biodiversity of ecosystems, the only air pollutant of concern for the Project for which the EPP (Air) prescribes an air quality goal is NO₂ (Table 12-2). As discussed in Table 12-2, NO₂ has the potential to damage plants. Other pollutants that have goals to protect the health and biodiversity of ecosystems include fluoride, O₃ and SO₂. Fluoride, O₃ and SO₂ also have goals to protect agriculture; however, fluoride, O₃ and SO₂ are not pollutants of concern for the Project and therefore the impact of these pollutants on the health and biodiversity of ecosystems and on agriculture does not require consideration.

In addition to NO₂, deposited dust is also considered to have the potential to impact on agricultural crops and livestock, through the inhibition of plant growth or impairment of livestock development.

Research on vegetation response to dust deposition impact (Doley, 2003) has shown that, for sunny conditions, a dust deposition rate of up to 15 grams per metres squared per month (g/m²/month) (or 500 mg/m²/day) is unlikely to have a detectable effect on crop growth. It is not until a deposition rate of up to 30 g/m²/month (or 1,000 mg/m²/day) that there is a measurable reduction in crop growth under overcast conditions. Livestock research on dairy cows (Andrews & Skriskandarajah, 1992) has shown that a dust deposition rate of up to 120 g/m²/month (or 4,000 mg/m²/day) does not influence the amount of feed cattle eat or the amount of milk produced. These dust deposition levels have been considered in the assessment of the operations stage of the Project, to assess the potential for impact to agriculture.

Discussion of background air quality for the Project is provided in Section 12.3.

TABLE 12-2 ADOPTED AIR QUALITY GOALS

Pollutant	Air quality goal (µg/m ³)	Averaging period	Environmental value	Source
NO ₂	250	1 hour ¹	Health and wellbeing	EPP (Air)
	62	Annual	Health and wellbeing	EPP (Air)
	33	Annual	Health and biodiversity of ecosystems	EPP (Air)
TSP	90	Annual	Health and wellbeing	EPP (Air)
PM ₁₀	50	24 hours	Health and wellbeing	EPP (Air)
	25	Annual	Health and wellbeing	EPP (Air)
PM _{2.5}	25	24 hours	Health and wellbeing	EPP (Air)
	8	Annual	Health and wellbeing	EPP (Air)
Arsenic and compounds (measured as the total metal content in PM ₁₀)	6 ng/m ³	Annual	Health and wellbeing	EPP (Air)
Cadmium and compounds (measured as the total metal content in PM ₁₀)	5 ng/m ³	Annual	Health and wellbeing	EPP (Air)
Lead and compounds (measured as the total metal content in TSP)	0.5	Annual	Health and wellbeing	EPP (Air)
Nickel and compounds (measured as the total metal content in PM ₁₀)	22 ng/m ³	Annual	Health and wellbeing	EPP (Air)
Chromium (III) compounds (as PM ₁₀)	9	1 hour	-	NSW EPA
Chromium (VI) compounds (as PM ₁₀)	0.1	1 hour	Screening health risk assessment	BCC AQPSP
	0.01	Annual	Screening health risk assessment	BCC AQPSP
1,3-butadiene	2.4	1 hour	Health and wellbeing	EPP (Air)
Benzene	5.4	Annual	Health and wellbeing	EPP (Air)
Toluene	1,100	30 minutes	Protecting aesthetic environment	EPP (Air)
	4,100	24 hours	Health and wellbeing	EPP (Air)
	400	Annual	Health and wellbeing	EPP (Air)
Xylenes	1,200	24 hours	Health and wellbeing	EPP (Air)
	950	Annual	Health and wellbeing	EPP (Air)
Benzo(a)pyrene (as a marker for polycyclic aromatic hydrocarbons)	0.3 ng/m ³	Annual	Health and wellbeing	EPP (Air)
Polychlorinated dioxins and furans	3.0 x 10 ⁻⁰⁸	Annual	Screening health risk assessment	BCC AQPSP
Dust deposition	120 mg/m ² /day	Monthly ²	Nuisance	DES 2021

Table notes:

µg/m³ micrograms per cubic metre

ng/m³ nanograms per cubic metre

mg/m²/day milligram per square metre per day

¹ Not to be exceeded more than one day per year

² Not legislative, DESI recommended Project goal to reduce likelihood of complaints. The dust deposition goal is a daily deposition average calculated using the deposition level predicted at a modelled receptor over an averaging period of one month.

12.3 Methodology

The AQIA methodology for the Project has included the following key elements:

- ▶ Qualitative impact assessment of the construction works stage
- ▶ Primarily quantitative impact assessment of the operations stage, with minor emissions sources assessed qualitatively
- ▶ Identification of potential mitigation measures
- ▶ Assessment of the residual impact with the inclusion of the identified mitigation measures.

Stakeholder and community engagement identified that impacts to tank water quality were of concern and therefore the AQIA has included assessment of potential pollutants in water tanks against drinking water guidelines. Dust generation during construction and operation have also been key matters raised by stakeholders and the community, which has helped to inform the development of mitigation measures for both construction and operation. This includes consideration of both onsite construction activities, and the movement of construction vehicles and equipment to and within the works areas.

Detailed assessment of the commissioning stage of the Project has not been undertaken, as air emissions during this stage are expected to be insignificant and are considered unlikely to generate nuisance or risk exceedance of the Project's air quality goals. Further discussion of the commissioning stage is provided in Appendix R: Air Quality Technical Report.

The methodology used to assess air impacts for the construction works and operations stages of the Project is described in this section. The AQIA was completed based on methodologies and guidance presented in the following documents (described in Table 12-1):

- ▶ *Application requirements for activities with impacts to air* (DES, 2023b)
- ▶ *Approved methods for the modelling and assessment of air pollutants in New South Wales* (NSW EPA, 2022)
- ▶ *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for Modelling and Assessments in NSW, Australia'* (Barclay & Scire, 2011)
- ▶ *Guidance on the assessment of dust from demolition and construction*, (UK IAQM, 2014).

Further information about the impact assessment methodology is provided in Appendix R: Air Quality Technical Report.

12.3.1 Project air emissions

Based on a review of expected activities, applicable National Pollutant Inventory (NPI) emission estimation manuals, and EIS literature for similar rail projects, the air pollutants expected to be generated during the construction works and operations stages of the Project are listed in Table 12-3.

During the construction works stage, particulate matter deposited as total suspended particulates (TSP) (referred to as dust deposition) and airborne concentrations of particulate matter less than 10 micrometres in diameter (PM₁₀) will be of primary concern. These pollutants can be emitted in significant quantities by construction activity and have the potential for nuisance and human health impacts if not correctly managed (UK IAQM, 2014). For construction activities, particulate matter less than 2.5 micrometres in diameter (PM_{2.5}) is typically emitted in minor quantities from mechanical sources and is more predominant from combustion point sources (i.e. combustion engines). Point source emissions of combustion gases (e.g. oxides of nitrogen (NO_x), and carbon monoxide (CO)) and PM_{2.5} from diesel construction vehicles and mobile plant, will be significantly lower than particulate emissions from construction activities. Point source emissions of combustion gases and PM_{2.5} are considered unlikely to result in exceedance of air quality goals or cause nuisance to sensitive receptors; therefore, they have not been assessed for the construction works stage.

In addition to construction dust, odour and volatile organic compounds (VOCs) will be emitted as fugitive emissions from fuel tanks located at laydown areas.

Air emissions during the commissioning stage of the Project are anticipated to be minor and are expected to be limited to point source combustion engine emissions from transport vehicles and train locomotives, and limited fugitive dust emissions from vehicle travel on unsealed roads.

The primary source of air pollution during the operation of the Project will be point source locomotive engine exhaust. The gaseous pollutants contained in the exhaust are produced as a product of diesel combustion and include NO_x, PM₁₀, PM_{2.5}, VOCs, and PAHs.

A detailed description of each pollutant is provided in Appendix R: Air Quality Technical Report.

TABLE 12-3 POLLUTANTS CONSIDERED DURING THE AIR QUALITY ASSESSMENT

Pollutant	Description ^a
TSP	TSP refers to airborne particles ranging from 0.1 micrometres (µm) to 100 µm in diameter. TSP is primarily associated with aesthetic impacts, including impacts resulting from dust deposition; however, TSP can cause health impacts when inhaled; if the particles contain toxic materials (such as lead, cadmium, zinc), toxic effects can occur from inhalation of the dust.
PM ₁₀	Particulate matter less than 10 µm in diameter. Exposure to particulate matter has been linked to a variety of adverse health effects such as respiratory problems
PM _{2.5}	Particulate matter less than 2.5 µm in diameter. Exposure to particulate matter has been linked to a variety of adverse health effects such as respiratory problems. Fine particles (PM _{2.5}) can travel further into the human respiratory system than coarser particle sizes.
NO _x	NO _x describes a mixture of nitric oxide (NO) and nitrogen dioxide (NO ₂). NO _x is colourless at low concentrations but has an odour. There are no air quality criteria for NO, and therefore NO has not been considered individually in the AQIA for impacts to environmental values, but NO _x has been considered for the assessment of NO ₂ .
NO ₂	NO ₂ is a brownish gas with a pungent odour. Nitrogen dioxide can cause damage to the human respiratory tract, increasing a person's susceptibility to respiratory infections and asthma. Sensitive populations, such as the elderly, children, and people with pre-existing health conditions are most susceptible to the adverse effects of NO ₂ exposure. Excess levels of NO ₂ can also cause death in plants and damage the leaves of agricultural crops.
CO	CO is a colourless, odourless gas formed when substances containing carbon (such as petrol, gas, coal, and wood) are burned with an insufficient supply of air. Concentrations of CO normally present near to transport sources (e.g. road traffic, freight rail) are typically well below air quality goals and are unlikely to cause ill effects. Due to the low likelihood of significant impact, CO has not been considered in this assessment.
Volatile organic compounds	VOCs are carbon-based chemicals that readily evaporate at room temperature, including xylene, toluene and benzene. VOC species are harmful to human health, with the health impacts specific to the individual compound and nature of exposure.
Sulphur dioxide (SO ₂)	SO ₂ is a colourless gas with a sharp, irritating odour. The AQIA assumes low sulphur content fuel as per the requirements of the <i>Fuel Quality Standards Act 2000</i> (Cth) and the <i>Fuel Quality Standard (Automotive Diesel) Determination 2019</i> (Cth). The regulation of low sulphur content fuel in Australia has significantly decreased the generation and concentrations of SO ₂ near transport sources. Due to the low likelihood of significant impact, SO ₂ has not been considered in this assessment.
PAHs	PAHs are a group of over 100 chemicals, which are formed through the incomplete combustion of organic materials, such as petrol or diesel. Exposure to these chemicals can cause a range of adverse reactions, including irritation of the eyes, nose and throat and skin.
Trace metals including arsenic, cadmium, lead, nickel and chromium VI	Heavy metals such as cadmium, lead, and mercury are common air pollutants that are typically emitted from industrial activities and fuel combustion. Exposure to heavy metals can result in a range of health impacts, including kidney and bone damage, developmental and neurobehavioral disorders, elevated blood pressure and potentially even lung cancer.
Ozone (O ₃)	O ₃ is not emitted directly from fuel combustion but, rather, is a secondary pollutant formed via chemical reaction of other pollutant species in the local atmosphere. Assessment of the formation of ozone and other secondary pollutants has not been considered in this assessment.
Odour	Odour emissions can be either a single compound or a mixture of compounds that have the potential to affect environmental amenity and cause nuisance.
Fluoride	Emissions of fluoride primarily originate from industrial processes, such as the manufacture of glass or bricks, and not through the combustion of fuel (e.g. diesel locomotives). Significant emissions of fluoride are not anticipated for the Project.

Table note:

- a. The descriptions provided in Table 12-3 have been derived from the information provided on the Department of Climate Change, Energy, the Environment and Water National Pollutant Inventory website (dcceew.gov.au/environment/protection/npi) and the NSW Department of Planning and Environment website (environment.nsw.gov.au).

12.3.2 Construction works impact assessment

Construction emissions for large linear infrastructure projects are complex due to the 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. As such, the potential construction air quality impacts associated with the Project were assessed by describing the nature of proposed works, plant and equipment, potential emissions sources, and the expected magnitude of construction dust emissions.

Potential dust impacts on surrounding sensitive receptors were determined through a qualitative risk assessment, based on information provided at the time of writing. Sensitive receptors located within 1 km of the alignment were considered in the assessment; this includes the two temporary non-resident workforce accommodation facilities for the Project. Further quantitative assessment of potential dust deposition at sensitive receptors from construction activity will be completed in future stages (prior to construction) when more detailed construction information is available.

The main pollutant of concern during the construction works stage is particulates, predominantly airborne PM₁₀ and deposited dust (TSP). PM_{2.5}, a pollutant generated predominantly by combustion sources, is generally generated in negligible quantities by construction activities and equipment and has therefore not been assessed. Gaseous emissions from diesel construction vehicles will be significantly lower than particulate emissions from construction activities and are unlikely to result in exceedance of air quality goals or significant impact to environmental values and therefore have not been assessed in detail; however, mitigation measures for these sources have been identified to minimise the potential for impact on sensitive receptors.

The assessment methodology used for the construction works stage is the UK IAQM *Guidance on the assessment of dust from demolition and construction*, (2014). The IAQM process is a four-step risk-based assessment of dust emissions associated with demolition, earthworks (including land clearing and earth moving), construction activities and vehicle movements. The assessment steps are as follows:

- ▶ Step 1—screening assessment: assess distance from receptors to active construction areas
- ▶ Step 2—dust risk assessment: assess the dust emission magnitude (scale of activity) of the identified sources, determine the sensitivity of the surrounding area, and determine the risk of impacts if no mitigation is implemented
- ▶ Step 3—management strategies: identify the mitigation measures required to minimise the risk of impacts to sensitive receptors
- ▶ Step 4—reassessment: review the potential for residual impacts post-mitigation.

Construction impacts from blasting have also been assessed qualitatively considering the EPA Victoria guideline *Recommended separation distances for industrial residual air emissions* (Victorian EPA, 2013), which provides guidance on suitable separation distances between mining and extractive activities (that undertake blasting) and neighbouring sensitive receptors. The EPA Victoria guideline has been used in the absence of Queensland-specific guidance. The EPA Victoria guideline is commonly applied for air quality assessments in Queensland and interstate and is considered appropriate for the assessment. The EPA Victoria guideline has also been used for the assessment of potential impacts from sewage treatment for non-resident workforce accommodation facilities (Section 12.5.1.2).

A breakdown of each step and the associated findings of the dust impact assessment is provided in Section 12.5.1.

The construction impact assessment covers construction along the Project alignment as well as operations of the Turallin facility and the Whetstone Material Distribution Centre (MDC), which are discussed in Sections 12.5.1.3 and 12.5.1.4. Further discussion and assessment of the Whetstone MDC is presented in Appendix AE: Whetstone Material Distribution Centre: Supporting Technical Information.

In addition to construction dust, odour and VOCs will be emitted from fuel tanks located at laydown areas. Impacts from fuel storage have been assessed in Section 12.5.1.5.

The impact of construction dust, odour and VOC emissions on ecological receptors has not been considered, as there are no air quality goals (Table 12-2) for particulate matter (e.g. PM₁₀ and TSP), odour or VOCs for the protection of the health and biodiversity of ecosystems.

Detailed dispersion modelling of construction is not typically undertaken, as construction activities are difficult to forecast accurately, and emissions are typically well controlled by standard construction dust mitigation practices. The qualitative assessment method applied for the assessment of construction-works stage impacts is considered appropriate for the Project at this time and is consistent with industry standard methodology. It is noted that further quantitative assessment of potential dust deposition at sensitive receptors resulting from construction activity will be completed in future stages (prior to construction) when more detailed construction information is available.

12.3.3 Operations stage impact assessment

This section outlines the approach taken to the modelling and assessment of the operations stage of the Project, including:

- ▶ Emissions inventory and assessment assumptions, including potential cumulative emission sources
- ▶ The dispersion modelling methodology, including:
 - ▶ software packages
 - ▶ meteorological data
 - ▶ scenarios assessed and model inputs
- ▶ The method for the assessment of impacts to tank water quality
- ▶ The method for the assessment of agricultural freight odour.

12.3.3.1 Emissions inventory

An emissions inventory has been developed to quantify emissions from the diesel locomotives that may operate on the Project, based on the engine types, rail traffic quantities and locomotive speeds for the forecast train services. The key pollutants of interest included in the emissions inventory for diesel locomotives are TSP, PM₁₀, PM_{2.5} and NO₂.

To assess emissions from potential worst-case operations, the assessment of operations-stage impacts has considered forecast peak train volumes for the year 2040, as shown in Table 12-4. Forecast typical train volumes are also provided in Table 12-4 for comparison.

For the purpose of developing the infrastructure for Inland Rail, ARTC developed a train plan to translate the predicted tonnage profile expected on Inland Rail from the 2015 Business Case into an outline train number and frequency. The information was validated in the Inland Rail operation train model. This train plan forms the basis for the development of a future working timetable. The daily train volumes for the various route sections have been calculated. The typical and peak weekly train volumes for the Project alignment have been forecast for the year 2040.

Table 12-4 shows that the forecast for typical train movements (136 trains per week) is significantly fewer than the forecast for peak train movements (174 trains per week). The peak train numbers represent the design capacity of the individual rail section, while the typical train numbers represent the modelled train numbers for each year. Air emissions as a result of the operation of the Project are directly related to the volume of trains; therefore, a lower number of trains will result in a lower rate of pollutant emissions to air. Emission rates for both typical and peak train movement scenarios have been calculated; however, dispersion modelling has only been undertaken for peak train movements, as this operational scenario has the greater potential to result in air quality impacts.

TABLE 12-4 WEEKLY TYPICAL AND PEAK TRAIN MOVEMENTS BY SERVICE

Train type/description	Number of trains per week —typical movements			Number of trains per week —peak movements		
	NR Class ¹	SCT/LDP Class ²	Class 82 ³	NR Class ¹	SCT/LDP Class ²	Class 82 ³
MB Express (Bromelton)	12	-	-	14	-	-
MB Express (Acacia Ridge)	12	-	-	14	-	-
MB Superfreighter (Bromelton)	-	32	-	-	40	-
MB Superfreighter (Acacia Ridge)	-	6	-	-	8	-
GB Superfreighter (Bromelton)	-	16	-	-	22	-
GB Superfreighter (Acacia Ridge)	-	8	-	-	10	-
Narrabri – PoB Grain	-	-	18	-	-	24
Yelarbon – PoB Grain	-	-	18	-	-	24
Narrabri – PoB Export Continuation	-	-	10	-	-	12
Yelarbon – PoB Cotton	-	-	4	-	-	6
Total		136			174	

Table notes:

1. UGL National Rail Class locomotive
2. Downer EDI SCT/LDP Class locomotive
3. Downer EDI 82 Class locomotive

PoB = Port of Brisbane
MB = Melbourne to Brisbane
GB = Goobang to Brisbane

Diesel locomotive emissions

Emissions factors have been sourced from emissions testing completed on locomotives by the NSW EPA and rated emission standards published by the United States Environmental Protection Agency (US EPA). The US EPA emission factors are the most accurate source of available emissions data for the locomotives and are considered appropriate for use in the assessment. Table 12-5 presents the referenced emissions factors on a grams per kilowatt hour basis (g/kWh).

TABLE 12-5 LOCOMOTIVE EMISSIONS FACTORS

Locomotive	NR Class ²		SCT/LDP ³	82 Class ⁴
	Cycle weighted	Idling		
Locomotive Max Power in kilowatts (kW)			3,350	2,425
Rated Emission Standard	US EPA – Tier 0	-	US EPA – Tier 1	US EPA – Tier 0
Total Particulates (g/kWh)	0.101	1.09	0.60	0.8
NO _x (g/kWh)	16.6	43.7	9.92	12.74
Total Hydrocarbons (THC) ¹ (g/kWh)	0.519	4.66	0.74	1.34
CO (g/kWh)	1.117	7.63	2.95	6.71
Source	<i>Technical Highlights: Emission Factors for Locomotives</i> (US EPA, 2009)		<i>Diesel Locomotive, Fuel Efficiency & Emission Testing</i> or NSW EPA (ABMARC, 2016) (NR121 & 93 Class)	
			<i>Technical Highlights: Emission Factors for Locomotives</i> (US EPA, 2009)	

Table notes:

1. VOCs are a subset of THC. For this assessment 100% of THC emissions are assumed to be VOCs
2. UGL National Rail Class locomotive
3. Downer EDI SCT/LDP Class locomotive
4. Downer EDI 82 Class locomotive

Table 12-6 summarises the operating mode percentages of maximum engine power used for each engine notch setting to calculate average duty cycle power ratings.

To determine the time spent at each engine notch setting, data from United States rail operations was used to provide a basis for average duty cycle power ratings. Table 12-7 presents US EPA data from Ireson, Germer, and Schmid (2005), which represents duty cycle data for line haul diesel locomotives in the United States. The line haul data presented is the result of analysis of 63 linehaul trains and 2,475 operational hours.

TABLE 12-6 ADOPTED NOTCH SETTING AND OPERATING MODE POWER RATING PERCENTAGES

Notch setting or operating mode	Adopted percentage of maximum engine power	Source
Idle	2.3%	Casadei & Maggioni (2016)
Dynamic Braking	3.6%	StarCrest Consulting Group (2008)
Notch 1	4.8%	Spiryagin et al. (2015)
Notch 2	10.0%	
Notch 3	24.1%	
Notch 4	34.3%	
Notch 5	45.4%	
Notch 6	66.0%	
Notch 7	87.1%	
Notch 8	100.0%	

TABLE 12-7 DUTY-CYCLES FOR LINE HAUL LOCOMOTIVES IN THE UNITED STATES (PERCENTAGE TIME IN NOTCH)

Notch setting/operating mode	Line haul
Idle	38.0%
Dynamic braking	12.5%
Notch 1	6.5%
Notch 2	6.5%
Notch 3	5.2%
Notch 4	4.4%
Notch 5	3.8%
Notch 6	3.9%
Notch 7	3.0%
Notch 8	16.2%

Average hourly power consumption rates have been calculated for each locomotive type using the adopted notch power ratings and duty cycle information presented in Table 12-6 and Table 12-7. The calculated average hourly power consumption rates in addition to the maximum and continuous idling power consumption rates at crossing loops for each locomotive are presented in Table 12-8.

TABLE 12-8 LOCOMOTIVE POWER USAGE

Power	NR Class ¹	SCT/LDP ²	Class 82 ³
Max power (kWh)	2,917	3,350	2,425
Calculated duty cycle (kWh)	823	945	684
Continuous idle (kWh)	68	78	56

Table notes:

1. UGL National Rail Class locomotive
2. Downer EDI SCT/LDP Class locomotive
3. Downer EDI 82 Class locomotive

Table 12-9 presents the maximum design line speed for the Project alignment in kilometres per hour (km/hr) and the estimated average line speed that has been used to estimate train travel emissions. The average line speed has been estimated assuming that the average travel speed is 75 per cent of the maximum design speed. Changes in grade along the Project alignment have not been considered when estimating emissions from locomotives, with engine load determined based on the power consumption for each locomotive, as presented in Table 12-8.

TABLE 12-9 LOCOMOTIVE TRAVEL SPEEDS

Power	Direction of travel	NR Class ¹	SCT/LDP ²	Class 82 ³
Maximum line speed (km/hr)	North	115	115	80
	South	115	115	80
Average line speed (km/hr)	North	86	86	60
	South	86	86	60

Table notes:

1. UGL National Rail Class locomotive
2. Downer EDI SCT/LDP Class locomotive
3. Downer EDI 82 Class locomotive

To determine continuous idling emissions, it was assumed that three NR-class locomotives would idle for periods up to or greater than one hour. The idling emission rates were therefore derived from the hourly idling locomotive power usage presented in Table 12-8, and the locomotive emission factors presented in Table 12-5.

The derived emission rates for typical and peak train movements are presented in Table 12-10. Only peak train movements were modelled and assessed as emission rates due to typical train movements being lower; therefore, associated impacts for typical train movements would also be lower. Table 12-10 also presents the emission rates for locomotives idling at crossing loops. The methodology for the assessment of emissions from the crossing loops (short-term and long-term averages) is explained in Section 12.3.

TABLE 12-10 DERIVED POLLUTANT DIESEL COMBUSTION EMISSION RATES

Pollutant	Total Project emissions (g/m/s)—typical movements	Total Project emissions (g/m/s)—peak movements	Short-term average idling emissions (g/s) (per locomotive)	Long-term average idling emissions (g/s) (per locomotive)
NO _x	6.91 x 10 ⁻⁵	8.88 x 10 ⁻⁵	0.824	0.2060
TSP	4.30 x 10 ⁻⁶	5.52 x 10 ⁻⁶	0.021	0.0051
PM ₁₀	4.19 x 10 ⁻⁶	5.38 x 10 ⁻⁶	0.020	0.0050
PM _{2.5}	4.03 x 10 ⁻⁶	5.17 x 10 ⁻⁶	0.019	0.0048
Total VOCs	6.68 x 10 ⁻⁶	1.01 x 10 ⁻⁵	0.088	0.0220

Table notes:

a Explanation of the scenarios modelled (long term and short term) for the assessment of emissions from the crossing loops is provided in Section 12.3

g/s = grams per second

g/m/s = grams per metre per second

Where emission factors for specific pollutants of concern were not available, emission factors from the *Emission estimation technique manual for Railway yard operations* (Department of the Environment, Water, Heritage and the Arts, 2008) and the *EMEP/EEA air pollutant emission inventory guidebook 2016* (European Monitoring and Evaluation Programme (EMEP)/European Environment Agency (EEA)) (EMEP/EEA, 2016) were used.

12.3.3.2 Cumulative impacts and modelled cumulative sources

The AQIA for the Project requires assessment of the background air quality and the cumulative impact of emissions from the Project in combination with emissions from existing and future sources (which will be operational at the same time as the Project). The following existing emission sources have been included in the dispersion modelling for the AQIA:

- ▶ Commodore Mine and Millmerran Power Station
- ▶ Gore Highway and Warrego Highway
- ▶ Existing non-Project rail sources.

Commodore Mine and Millmerran Power Station

The Commodore Mine and Millmerran Power Station are existing emission sources (as identified in Section 12.4.3) in the AQIA area. Due to distance from the air quality monitoring stations considered in the assessment, emissions from the Commodore Mine and Millmerran Power Station will not be represented in the background concentrations adopted and therefore these emissions sources have been included in the dispersion model developed for the assessment. To include emissions from these sources in the dispersion modelling, NPI emissions data for each of the sources has been reviewed.

Table 12-11 provides a summary of the reported emissions for the Commodore Mine and Millmerran Power Station for the reporting years of 2012/2013 to 2020/2021, which are the most recent available years at the time of the assessment.

It is widely understood that the emissions estimation techniques for mining activities presented in the NPI guidance documents have significant uncertainty when compared with actual dust emissions. Several studies have sought to reduce the uncertainty in emissions estimates of PM₁₀ and PM_{2.5} by developing new emission factors for mining activities in Australia (Roddis et al., 2015; Laing et al., 2015; Roddis et al., 2013; Richardson, Putland & Verran, 2015; Richardson, 2013); however, these developed emissions factors have not been adopted by the NPI and, instead, the NPI emissions manuals reference estimation techniques developed by the US EPA for United States coal mines (1998), which generally yield over estimations of emissions from Australian coal mines.

Table 12-11 shows that there is significant variation in reported emissions for both the Commodore Mine and Millmerran Power Station. There is limited information available from the NPI website to explain the variations in reported yearly emissions for each source. Furthermore, it is noted that the Commodore Mine is the sole source of thermal coal for the Millmerran Power Station; therefore, it could be expected that emission values between the sources would correlate.

TABLE 12-11 REPORTED NATIONAL POLLUTANT INVENTORY EMISSIONS FOR COMMODORE MINE AND MILLMERRAN POWER STATION

Facility	Reporting year	PM ₁₀ (kg)	PM _{2.5} (kg)	NO _x (kg)
Commodore Mine	2020/2021	950,000	67,000	1,000,000
	2019/2020	950,000	67,000	1,000,000
	2018/2019	880,000	71,000	1,100,000
	2017/2018	720,000	59,000	910,000
	2016/2017	605,023	53,656	820,240
	2015/2016	668,215	21,709	309,773
	2014/2015	668,389	21,812	313,853
	2013/2014	337,005	1,228	242,784
	2012/2013	277,999	1,101	241,433
Millmerran Power Station	2020/2021	770,000	440,000	9,700,000
	2019/2020	760,000	430,000	14,000,000
	2018/2019	170,000	42,000	9,400,000
	2017/2018	100,000	25,000	9,000,000
	2016/2017	91,520	11,441	8,891,295
	2015/2016	183,830	91,570	9,491,277
	2014/2015	54,159	50	12,614,517
	2013/2014	80,200	37,900	14,500,000
	2012/2013	90,566	33,000	18,130,000

Table notes:

NPI 2019/2020 reporting year data shown in **bold** was used in the assessment as described in the text below.

During the preparation and execution of modelling for the assessment, the most recent NPI data available was for the 2019/2020 reporting year (shown in bold in Table 12-11), and this data was used for the modelling for the mine and power station.

However, since the completion of the modelling, but prior to the preparation of this report, reporting data for the year 2020/2021 was published. Table 12-11 allows for comparison between the 2019/2020 and 2020/2021 reporting years, summarised as follows:

- ▶ Reported emissions for Commodore Mine are identical between the 2019/2020 and 2020/2021 reporting years
- ▶ Reported emissions for 2020/2021 for the Millmerran Power Station are approximately:
 - ▶ 30 per cent lower than 2019/2020 NO_x emissions
 - ▶ 1.3 per cent higher than 2019/2020 PM₁₀ emissions
 - ▶ 2.3 per cent higher than 2019/2020 PM_{2.5} emissions.

Overall, the difference between the 2019/2020 and 2020/2021 emissions data is considered minor, with the exception of NO_x emissions from the power station, which are significantly (30 per cent) higher in 2019/2020. As a result, emissions data for 2019/2020 is considered appropriate for use in the assessment.

Emission rates used in the initial modelling for these sources were calculated by averaging total emissions for the selected year (2019/2020) evenly over the year (365 days). Table 12-12 presents the modelled emission rates for Commodore Mine and Millmerran Power Station for each pollutant.

TABLE 12-12 NATIONAL POLLUTANT INVENTORY EMISSIONS FOR COMMODORE MINE AND MILLMERRAN POWER STATION

Cumulative source	Emissions	PM ₁₀	PM _{2.5}	NO _x
Commodore Mine	NPI reported emissions in kilograms per annum (kg/annum)	950,000	67,000	1,000,000
	Total modelled emission rate (g/s)	30.1	2.1	31.7
Millmerran Power Station	NPI reported emissions (kg/annum)	760,000	430,000	14,000,000
	Total modelled emission rate (g/s)	24.4	13.6	443.9

Initially, emissions from the Commodore Mine and Millmerran Power Station were modelled using the emission values presented in Table 12-12. The predicted cumulative PM₁₀ 24-hour concentrations (Commodore Mine emissions, Millmerran Power Station emissions and adopted background concentrations) are presented in Figure 12-1 for receptor 438, which represents the closest modelled receptor (within 50 m) to the Millmerran air quality monitoring station (AQMS). Analysis of the modelling results identified that the mine, which is a ground-level source, is the greater contributor to predicted ground level concentrations. Emissions from the power station contribute significantly less and were identified to have limited influence on ground-level concentrations due to the elevated release height of the emission source at the power station (200 m tall stacks).

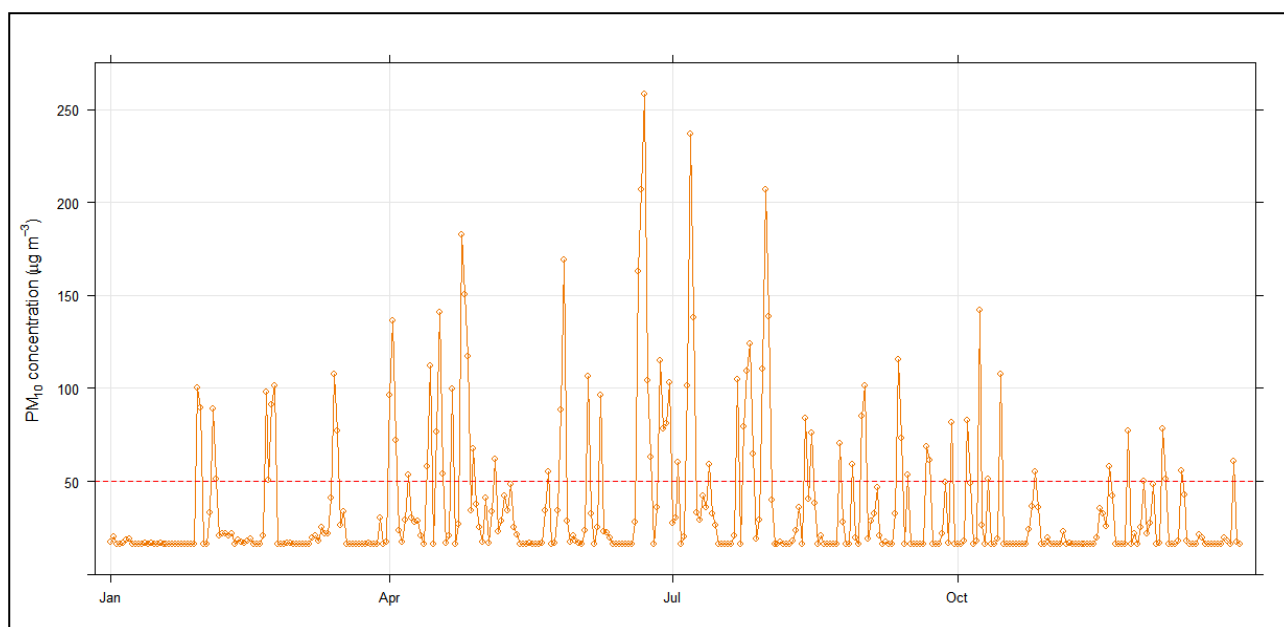


FIGURE 12-1 PREDICTED PM₁₀ 24 HOUR AVERAGE CONCENTRATIONS (µG/M3) FOR SENSITIVE RECEPTOR 438 MODELLED WITH 2019/2020 NPI REPORTED EMISSIONS FROM COMMODORE MINE AND MILLMERRAN POWER STATION

The corresponding measured PM₁₀ 24-hour concentrations from the Millmerran AQMS for the 12-month monitoring period from 1 April 2021 to 31 March 2022 inclusive is presented in Figure 12-2. Figure 12-2 shows that measured 24-hour PM₁₀ concentrations are generally well below the air quality goal of 50 µg/m³ and that background concentrations near the mine and power station are not elevated. Additional information on the Millmerran AQMS data is presented in Appendix R: Air Quality Technical Report.

The data capture rate for the Millmerran AQMS for PM₁₀ was 87 per cent over the monitoring period, above the target capture rate of 75 per cent for air quality monitoring (National Environment Protection Council, 2001). As a result, monitoring data is available throughout the year, with the exception of data gaps in 2021 in early June, August, September, November and December, as shown in Figure 12-12. These data gaps are due to minor equipment faults, inability to access the AQMS due to COVID-19 restrictions (August and September 2021) and sustained periods of rainfall, which made access to the AQMS unsafe (November and December 2021). Data gaps in monitoring campaigns are common for air quality monitoring, and the Millmerran AQMS data gaps are not considered significant.

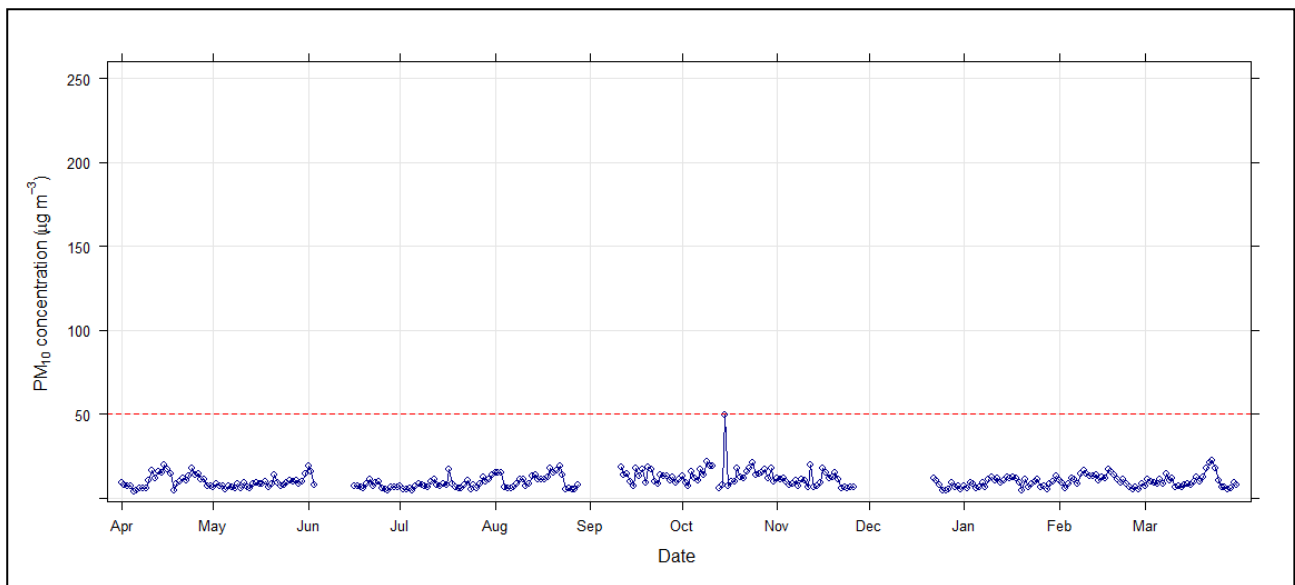


FIGURE 12-2 MILLMERRAN AIR QUALITY MONITORING STATION MEASURED PM₁₀ 24 HOUR AVERAGE CONCENTRATIONS (µG/M³) FOR 2021

Comparison of the modelled results (Figure 12-1) against the Millmerran AQMS monitoring data (Figure 12-2) indicates significant differences, with predicted concentrations at receptor 438 being orders of magnitude greater than the concentrations measured at Millmerran AQMS. Figure 12-1 shows that the predicted maximum 24 hour PM₁₀ concentration is in excess of 250 µg/m³, with over 50 exceedances of the PM₁₀ 24 hour goal of 50 µg/m³ (shown as a red dotted line in Figure 12-1 and Figure 12-2) predicted for the modelled year. Conversely, the monitoring results show a maximum 24-hour PM₁₀ concentration of 49 µg/m³, with concentrations mostly between 10 and 20 µg/m³.

It is also highlighted that the peak 24-hour concentration measured at the Millmerran AQMS on 15 October 2021 (49 µg/m³) was the result of a regional dust storm experienced throughout southern Queensland. Further discussion of the evidence of this dust storm on regional air quality is provided in Appendix R: Air Quality Technical Report.

The second highest measured 24-hour PM₁₀ concentration (i.e. the highest concentration which cannot be attributed to a regional event) at the Millmerran AQMS was 22 µg/m³, measured in both October 2021 and March 2022. In comparison to the modelling results (Figure 12-1), a 24-hour concentration of 22 µg/m³ represents less than 10 per cent of the highest modelled result (in excess of 250 µg/m³). Based on the comparison of modelling and monitoring data, and the acknowledged uncertainty in the accuracy of emissions estimation techniques for mining activities, the NPI reported emissions quantities are expected to be a significant overestimate of actual emissions from the Commodore Mine and Millmerran Power Station.

Commodore Mine and Millmerran Power Station each operate under an Environmental Authority (EA) (EA EPML00841513 for Commodore Mine, and EA ENRE00296005 for Millmerran Power Station) issued under the EP Act, which prescribe conditions regarding air quality and emissions to air. In addition, the EA for Commodore Mine states that they must take all reasonable and feasible avoidance measures so that particulate matter emissions generated do not exceed the following levels at sensitive receptors:

- ▶ Deposited dust: 120 mg/m²/day averaged over one month (no allowable exceedances per year)
- ▶ PM₁₀: 50 µg/m³ over a 24-hour averaging time (no allowable exceedances per year).

As it is part of their continual operating commitments (via the EA), it is reasonable to assume that the mine (which is a ground level source and the greatest contributor to ground level concentrations) is not exceeding these limits and that the modelled exceedance for PM₁₀ is a result of the uncertainties and conservativeness in the NPI emissions estimation techniques. This assumption is further strengthened by the recent air quality monitoring results from the Millmerran AQMS, which do not show measured exceedances of the PM₁₀ 24-hour goal (50 µg/m³) over a 12-month monitoring period.

Therefore, to provide a more accurate estimation of local air quality in the area near the Commodore Mine, modelled particulate emissions from the mine (TSP, PM₁₀ and PM_{2.5} only) have been scaled so that peak modelled results (considering emissions from the mine, power station and adopted background) match the peak monitored 24-hour concentration (excluding the regional event on 15 October 2021) of 22 µg/m³ at the modelled receptor most affected by emissions from the mine (receptor 435). The scaled particulate emission rates for the mine have been used when assessing the cumulative impact of the Project.

Emissions of NO_x from the mine have not been scaled as no monitoring data is available for NO_x/NO₂. National Pollutant Inventory reported emissions of NO_x (Table 12-11) for Commodore Mine for 2019/2020 are higher than average for the most recent nine years of reporting, and therefore the use of this emissions data provides a conservative assessment. Due to the release height of the emission source modelled (200-m tall stacks), emissions from the power station have limited impact at ground level and power station emissions have not been scaled from those presented in Table 12-11.

Gore Highway and Warrego Highway

Several roads and highways intersect or run parallel to the alignment of the Project. A review of all roads and highways in the AQIA area found the most significant in terms of traffic volumes are the Gore Highway and Warrego Highway.

As road vehicles emit the same pollutant species as those that are of concern for the Project, these highways have been included within the model developed for the assessment to allow for an assessment of cumulative air quality impacts.

The locations of the modelled sections of the Gore Highway and Warrego Highway are presented in Appendix R: Air Quality Technical Report.

Pollutant species emitted from road traffic on these two highways include NO_x, PM₁₀, PM_{2.5} and TVOCs. Emissions of these pollutants on the Gore Highway and Warrego Highway have been represented within the modelling assessment, using the following methodology:

- ▶ Existing traffic volumes for the Gore Highway and Warrego Highway were obtained for the year 2022
- ▶ The annual average daily traffic (AADT) volume for the year of assessment (2040) was calculated using traffic growth rates for each road section as adopted for Appendix AA: Traffic Impact Assessment
- ▶ Emissions for each modelled highway segment were calculated using DTMR road vehicle emission factors. Diurnal variation in emissions was determined based on hourly traffic count data.
- ▶ Sections of the highways that are located within 2 km of the Project alignment have been included in the model
- ▶ PM_{2.5} emissions factors are assumed to be equivalent to the calculated PM₁₀ emission factors, as the majority of particulate matter emissions are anticipated to be within the PM_{2.5} size fraction.

Table 12-13 presents the 2022 AADT and the calculated AADT for 2040, based on the growth rate for each section. Further discussion of assessment of the Gore Highway and Warrego Highway is provided in Appendix R: Air Quality Technical Report.

TABLE 12-13 BASE AND MODELLED TRAFFIC VOLUMES FOR THE GORE HIGHWAY AND WARREGO HIGHWAY

Section	Growth rate	AADT	
		2022	2040
Gore Highway Section 1 (northern-most section, south of Pittsworth to north of Southbrook) (both directions)	3.52%	6,057	11,292
Gore Highway Section 2 (middle section, through Brookstead) (both directions)	3.17%	3,236	5,670
Gore Highway Section 3 (southern-most section, south of Millmerran Leyburn Road) (both directions)	3.17%	3,236	5,670
Warrego Highway (southbound)	1.19%	6,755	8,356
Warrego Highway (northbound)	1.19%	6,998	8,656

The methodology for estimating and modelling emissions from the Warrego Highway and Gore Highway represents a conservative approach and is likely to over-predict pollutant concentrations from traffic on these roads.

In addition to the Gore Highway and Warrego Highway, the Cunningham Highway is also located within the AQIA area and intersects with the Project alignment at Yelarbon; however, the forecast AADT volume for the Cunningham Highway for 2040 is 1,592 vehicles (total for both directions of travel), which is significantly lower than the forecast volumes for the Gore Highway and Warrego Highway and is considered to be a low traffic volume overall. On the basis that traffic volumes on the Cunningham Highway will be low, the risk of cumulative impacts, including emissions from this road, is low; therefore, the Cunningham Highway has not been included in the modelling for the assessment. As noted in Section 12.4.3, the contribution from local traffic on minor roads is represented by the adopted background concentrations.

Other rail sources

In addition to the Commodore Mine, Millmerran Power Station, Gore Highway and Warrego Highway, the following emission sources have also been included in the dispersion modelling:

- ▶ NS2B Project (Inland Rail)
- ▶ G2H Project (Inland Rail)
- ▶ West Moreton System (existing rail line west of the junction between the Project and the G2H section of Inland Rail).

One kilometre (km) of the NS2B project and G2H project rail sources, and 3.5 km of the Queensland Rail (QR) West Moreton Line (near alignment chainage (Ch) 207.0 km) have been included in the dispersion modelling at their respective ends of the Project to ensure that cumulative air quality impacts are assessed. The emission rates used for modelling were calculated based on train numbers, locomotive type and freight type for each section. Modelled emission rates are presented in Table 12-14. Emission calculation details for these background rail sources are provided in Appendix R: Air Quality Technical Report.

TABLE 12-14 MODELLED EMISSION RATES FOR BACKGROUND RAIL SOURCES

Pollutant	Modelled emission rate (g/m/s)		
	G2H Project	West Moreton Line	NS2B Project
NO _x	1.84×10^{-4}	7.78×10^{-5}	8.88×10^{-5}
TSP	5.83×10^{-5}	5.17×10^{-5}	5.52×10^{-6}
PM ₁₀	3.37×10^{-5}	2.72×10^{-5}	5.38×10^{-6}
PM _{2.5}	1.26×10^{-5}	6.38×10^{-6}	5.17×10^{-6}
TVOC	2.81×10^{-5}	1.62×10^{-5}	1.01×10^{-5}

Other existing rail lines near the Project alignment have not been modelled. Rail traffic volume data for other existing rail lines (i.e. the QR South Western Line and Millmerran Branch Line near Ch 30 km, 45 km and 162 km) were analysed for the years 2016 to 2018. Existing monthly traffic volumes for these rail lines ranged from less than one train per week to up to six trains per week. Compared with the 174 trains per week (peak) that have been assessed for the Project alignment in the AQIA, these volumes represent a very small percentage (i.e. 0.6 to 3.6 per cent) of the overall modelled rail traffic. As such, it is considered that inclusion of these rail sources would not result in an observable change to predicted cumulative results; therefore, these existing rail lines have not been included in the AQIA.

In addition to the NPI sources (Commodore Mine and Millmerran Power Station), major highways, and the adjoining rail lines, other local emission sources will include ERAs, local commercial and industrial uses and vehicle traffic on minor roads. It is expected that emissions from ERAs, local commercial and industrial uses and other vehicle traffic will be adequately represented by the assumed background concentrations, as these activities emit significantly lower quantities of pollutants than the major polluters, which have been assessed in detail.

12.3.3.3 Modelling methodology

The air dispersion modelling conducted for this assessment was based on a modelling approach using The Air Pollution Model (TAPM) as a meteorological pre-processor to the air dispersion model CALPUFF.

The data that was available for this Project and a discussion of the data processing methodologies that were required in order to implement CALPUFF are discussed in the following sections. The modelling was undertaken in accordance with relevant guidance documents and appropriate literature (NSW EPA, 2022; Barclay & Scire, 2011).

Figure 12-3 presents the modelling methodology undertaken for the AQIA.

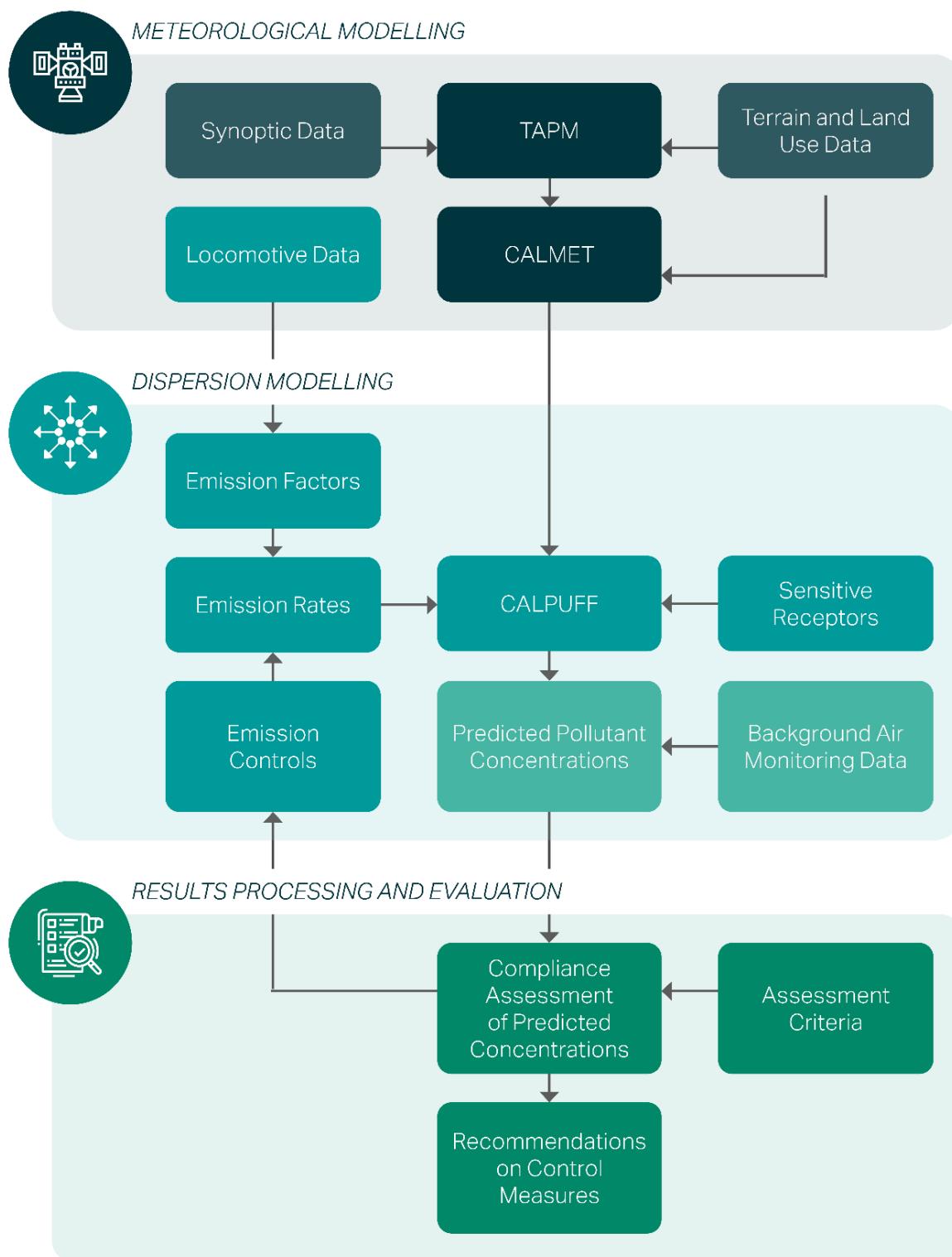


FIGURE 12-3 DIAGRAMMATIC REPRESENTATION OF THE CALPUFF MODELLING METHODOLOGY

CALPUFF

The CALPUFF suite of programs, including meteorological (CALMET), dispersion (CALPUFF) and post-processing modules (CALPOST), is an advanced non-steady-state modelling system designed for meteorological and air quality modelling. DESI does not require the use of any particular dispersion model (e.g. CALPUFF or AERMOD models); however, within DES (2023) reference is made to the NSW EPA guidance document. CALPUFF is appropriate in applications involving complex terrain, non-steady-state conditions, in areas where coastal effects may occur, and/or when there are high frequencies of stable or calm meteorological conditions (Barclay & Scire, 2011). As many of these features are present in the AQIA area, the CALPUFF model is preferred over Gaussian models, such as AERMOD or AUSPLUME, which perform poorly in the aforementioned conditions.

Meteorological data

The meteorological data used in the dispersion model are of fundamental importance, as this data drives the predictions of the transport and dispersion of the air pollutants in the atmosphere. The most critical parameters are:

- ▶ Wind direction, which determines the initial direction of transport of pollutants from their sources
- ▶ Wind speed, which dilutes the plume in the direction of transport and determines the travel time from source to receiver
- ▶ Atmospheric turbulence, which indicates the dispersive ability of the atmosphere.

Prognostic meteorological data generated by TAPM for the year 2013 were used in this assessment. Further information regarding meteorological data and the selection of 2013 as the modelling year is presented in Appendix R: Air Quality Technical Report.

Consideration of climate change influence on meteorological modelling data

Climate change has the potential to influence wind conditions, atmospheric stability, mixing height and other meteorological factors important to the dispersion of ground-released pollution; however, as described in NSW EPA (2022), site-representative meteorological data is to be based on long-term historical meteorological data (presented in Section 12.3); therefore, the potential influence of future altered conditions due to climate change has not been considered in this assessment.

Crossing loops

Locomotive diesel emissions from crossing loops have been modelled as follows:

- ▶ Emissions have been modelled from locomotives idling on the crossing loops. Travel around the crossing loops has not been modelled.
- ▶ When operational, freight trains could enter a crossing loop from either direction; therefore, idling locomotives could be located at either end of the crossing loop. To replicate this, emissions sources (point sources) representing idling locomotives have been modelled at either end of the crossing loops.
- ▶ Three point sources were positioned at each end of the crossing loop (representing three locomotives) based on maximum number of locomotives of any train type. Overall, a total of six point sources were modelled per crossing loop.
- ▶ Two different approaches (hereafter referred to as versions) have been assessed for crossing loops to accurately consider emissions and allow for assessment against both short and long-term averaging periods:
 - ▶ short-term (one hour average): continuous idling of six NR Class locomotives assumed to occur every hour of the year
 - ▶ long-term (24-hour and annual averages): idling of six NR Class locomotives assumed to occur six hours per day (25 per cent of a 24-hour period).
- ▶ The locomotive point sources have been located on the top and in the centre of 'buildings' included in the model, to account for the influence of downwash caused by the structure of the locomotives.

Modelling scenarios

Peak train volumes have been considered in the assessment. Modelling of emissions from train travel along the Project alignment has been undertaken assuming an even volume of train travel per day (e.g. daily train volumes and train emissions from travel along the alignment have been modelled based on the weekly train volumes divided by seven).

Two different versions (short-term and long-term) have been run to enable accurate assessment of emissions from the crossing loops against both short-term and long-term air quality goals (Section 12.2.1).

The model predictions from the short-term version have been used to assess compliance against the short-term goals (one hour, 24 hour), with the model predictions from the long-term version used to assess compliance against annual average goals.

12.3.3.4 Tank water quality

In rural and remote Australia where reticulated water supply is not always available, the use of domestic rainwater tanks is common practice. Rainfall is collected from roof run-off and, where installed, is most commonly used as the primary source of household drinking water (enHealth, 2010). Rainwater stored in tanks has the potential to be contaminated by chemical, physical and microbial sources, and become a hazard to human health. Industrial and traffic emissions have the potential to be a source of chemical contamination through their atmospheric deposition onto rooves where water is collected (Gunawardena, 2012).

The potential for the operation of the Project to impact tank water quality collected via roof catchments has been investigated. Using the emissions inventory developed for assessment of impacts to air quality, dust deposition modelling was also completed using CALPUFF to determine the impact of diesel locomotive emissions on tank water quality. The methodology for predicting the potential impact to tank water quality is summarised as follows:

- ▶ Rainwater collection systems can have first flush devices, which take the first water captured by rooves and divert it for disposal rather than collection in a water tank. First flush systems were not assumed to be installed for any of the receptors considered.
- ▶ Annual average dust deposition rates were predicted for every receptor in the AQIA study area for peak and typical train operations. Every receptor was assumed to have a water tank, and the roof area (collection area) for each receptor was assumed to be 200 m².
- ▶ It was assumed that all deposited dust at each receptor (200 m² roof area) was collected by a 10,000 litre (L) rainwater tank that was 10 per cent full, resulting in a receiving water volume of 1,000 L. This conservative assumption allows for periods where there may be prolonged periods of drought and short rainfall events that wash deposited pollutants into rainwater tanks.
- ▶ The goals used for the assessment of impacts to water quality were taken from the National Water Quality Management Strategy *Australian Drinking Water Guidelines* (Cth) (National Health and Medical Research Council (NHMRC) and National Resource Management Ministerial Council (NRMMC), 2011), which provides guideline water concentrations for arsenic, cadmium, lead, nickel and chromium VI, which are all metals.
- ▶ The concentration of metals in water tanks was determined by taking the predicted annual average dust deposition level (e.g. 2 mg/m²), multiplying it by the assumed roof area (200 m²) to determine total mass (e.g. 400 mg), and then speciating the predicted dust deposition level into metal concentrations using the diesel locomotive emission factors (Appendix R: Air Quality Technical Report)
- ▶ The predicted water concentrations for each species were then assessed against the goals prescribed by the *Australian Drinking Water Guidelines* (2011) (Section 12.2).

The methodology applied is described for water tanks; however, it is also conservatively applicable for assessment of impacts to water quality for dams, noting that the ratio of the surface area (roof area) to water volumes (e.g. 1,000 L for a tank) would be significantly lower than assumed for the assessment of impacts to tank water quality.

The *Australian Drinking Water Guidelines* (2011) present guideline values on allowable contaminants within drinking water, such as from rainwater tanks. Table 12-15 presents the drinking water criteria for the pollutants of interest.

TABLE 12-15 DRINKING WATER QUALITY GUIDELINES

Pollutant	Guideline value (mg/m3)	Environmental value	Source
Arsenic	0.01	Health	(NHMRC & NRMMC, 2011)
Cadmium	0.002	Health	
Lead	0.01	Health	
Nickel	0.02	Health	
Chromium as Cr (VI)	0.05	Health	

12.3.3.5 Agricultural freight odour

To assess the nuisance impacts that may arise from agricultural freight trains, a qualitative assessment utilising FIDOL factors has been undertaken to determine the likelihood of odour nuisance. The following factors, described using the acronym FIDOL, are accepted by DESI, *Odour Impact Assessment from Developments* (Department of Environment and Heritage Protection, 2013a) as being important dimensions of odour nuisance:

- ▶ Frequency (F): How often an individual is exposed to the odour
- ▶ Intensity (I): The strength of the odour
- ▶ Duration (D): The length of exposure
- ▶ Offensiveness (O): The offensiveness or intrinsic character, known as the hedonic tone of the odour, may be pleasant, neutral, or unpleasant
- ▶ Location (L): The type of land use, nature of human activities and sensitivity of the receiving community in the vicinity of an odour source.

12.4 Existing environment

The existing environmental values of the air environment that may be affected by the Project are described in this section. Aspects of the existing environment relevant to this assessment include:

- ▶ Meteorological conditions and climate
- ▶ Existing air quality, including regional and local sources of air pollution (natural and anthropogenic) that emit similar air pollutants as those being assessed. Existing concentrations of pollutants of concern for the Project have been adopted as background concentrations to ensure a cumulative assessment of air quality impacts
- ▶ Terrain and land use

In addition to discussion of existing air quality and meteorological conditions, this section also introduces and presents the locations of sensitive receptors that have been considered in assessing the impacts of the Project on the environmental values of the air environment.

For the purposes of the AQIA, the impact assessment area (AQIA area) refers to the air environment and location of identified sensitive receptors within 1 km of the Project alignment.

12.4.1 Meteorology and climate

The Project is located in the Darling Downs and spans across the Toowoomba and Goondiwindi LGAs. The Darling Downs generally experiences a sub-tropical climate with distinct wet and dry seasons.

The Bureau of Meteorology (BoM) operates a network of monitoring stations around Australia that have long-term climatic data available for analysis. Several air quality stations operated in South East Queensland by DESI also record meteorological data; however, none of the DESI monitoring stations are located in areas that allow for the collection of data that would be representative of the Project. The nearest DESI monitoring station is more than 150 km to the west of the Project. All monitoring stations to the east of the Project are near the coast of Queensland or below the Great Dividing Range and are therefore not representative of the climate in the AQIA area.

The Project spans 217.48 km, and local meteorological conditions are expected to vary across this distance, especially at areas further inland and/or away from notable terrain features. The two BoM-operated Oakey Aero and Inglewood Forest stations are considered to provide an appropriate regional coverage of climatic conditions. Another BoM-operated station located at the Toowoomba Wellcamp Airport is located nearer to the Project than the Oakey Aero and Inglewood Forest stations; however, the data from this station is not publicly available at the time of this AQIA. Climate data from the Oakey Aero station is expected to be similar to that obtained at the Toowoomba Wellcamp Airport station.

Details of the meteorological monitoring stations selected for use in the AQIA are provided in Table 12-16. The locations of the BoM meteorological monitoring stations are shown in Figure 12-4.

TABLE 12-16 LOCATION OF METEOROLOGICAL MONITORING STATIONS

Operator	Name	Coordinates	Distance from Project (closest point, km)	Direction from Project	Period operational	Elevation (m)
BoM	Oakey Aero	-27.40, 151.74	13.1	North-west	1973 to Present	406
BoM	Inglewood Forest	-28.37, 150.95	7.0	North-west	2000 to 2014	379

Figure 12-4: Locations of meteorological and air quality monitoring stations

- 5 Chainage (km)
- Localities
- Narrabri to North Star alignment
- North Star to NSW/QLD border alignment
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Helidon to Calvert alignment
- Calvert to Kagaru alignment
- Kagaru to Acacia Ridge/Bromelton alignment
- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- NSW/QLD border

- BoM monitoring station
- DES monitoring station
- FFJV monitoring station
- Dust deposition monitoring locations

Coordinate System: GDA 1994 MGA Zone 56

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Date: 08/01/2025
Author: FFJV GIS
Data Sources: FFJV

Paper: A4
Scale: 1:1,400,000

12.4.1.1 Temperature

Mean minimum and maximum temperatures have been collected from the two selected BoM stations and are shown in Table 12-17. Temperatures recorded at the two stations are very similar: the annual mean minimum temperature only higher by 1.6°C at Inglewood Forest, and the annual mean maximum is 1.1°C higher at Inglewood Forest.

In winter (June, July and August), mean minimum temperatures are slightly lower at Oakey (4.2°C, 2.9°C and 3.6°C, respectively) than at Inglewood Forest (6.7°C, 5.6°C and 6.9°C). Mean maximum temperatures for winter are almost identical between the two sites.

In summer (December, January and February), mean minimum temperatures are higher at Inglewood Forest (17.7°C to 18.7°C) than at Oakey (16.7°C to 17.9°C). The mean maximum temperatures are also higher at Inglewood Forest (31.5°C to 33.2°C) than at Oakey (30.3°C to 31.0°C).

Overall, temperatures measured at the two stations and those expected across the AQIA area are consistent with a warm sub-tropical climate.

TABLE 12-17 MEAN MINIMUM (BLUE) AND MAXIMUM (RED) MONTHLY TEMPERATURES FOR BUREAU OF METEOROLOGY MONITORING STATIONS

Station	Mean minimum and maximum temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Oakey Aero ¹	31.0	30.1	28.7	25.9	22.3	19.1	18.7	20.5	24.0	26.7	28.8	30.3	25.5
	17.9	17.7	15.8	11.8	7.8	4.2	2.9	3.6	7.3	11.4	14.5	16.7	11.0
Inglewood Forest ²	33.2	32.2	30.4	27.3	22.4	19.0	18.6	21.0	25.3	28.0	30.1	31.5	26.6
	18.7	18.0	16.2	13.1	8.8	6.7	5.6	6.9	10.6	13.1	15.9	17.7	12.6

Table notes:

1. Mean maximum and minimum temperature values have been calculated based on data from 1973 to 2019 (BoM, 2019)
2. Mean maximum and minimum temperature values have been calculated based on data from 2000 to 2013 (BoM, 2019)

12.4.1.2 Rainfall

Mean rainfall values have been collected from the two nominated BoM stations and are presented in Table 12-18. A wet season (summer) and a dry season (winter) are experienced by the region annually, although the distinction is not as pronounced as along the coast.

Table 12-18 shows that for both monitoring stations, approximately 40 per cent of average annual rainfall occurs during the three months of summer, with significantly less rainfall recorded during winter months.

TABLE 12-18 MEAN MONTHLY AND ANNUAL RAINFALL FOR SELECTED BUREAU OF METEOROLOGY MONITORING STATIONS

Station	Mean rainfall (millimetres (mm))												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Oakey Aero ¹	77.7	78.2	51.1	29.9	39.5	30.0	28.8	25.7	31.0	57.7	75.2	91.8	618.2
Inglewood Forest ²	72.3	54.5	63.5	27.4	28.6	33.3	28.7	24.3	34.0	49.7	79.9	97.3	620.0

Table notes:

1. Mean rainfall values have been calculated based on data from 1970 to 2019 (BoM, 2019)
2. Mean rainfall values have been calculated based on data from 2000 to 2013 (BoM, 2019)

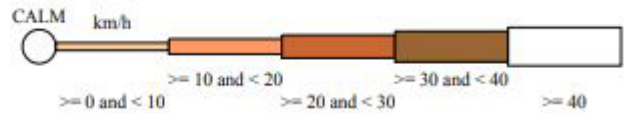
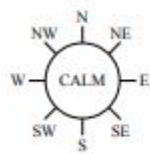
12.4.1.3 Wind speed and direction

Long-term annual wind roses for morning and afternoon conditions at the Oakey Aero and Inglewood Forest BoM stations were available for review. The 9.00 am and 3.00 pm annual wind roses for Oakey Aero and Inglewood Forest stations are presented in Figure 12-5.

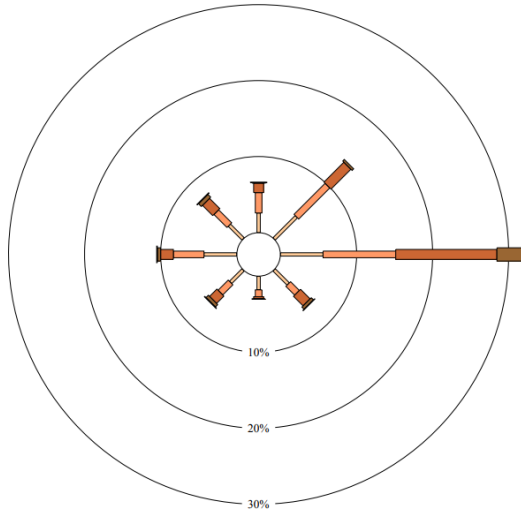
Morning winds at the Oakey Aero location blow predominantly from the east and north-east and are low-to-moderate strength when not calm. Calm conditions represent 14 per cent of 9.00 am wind observations.

Wind conditions at the Inglewood Forest station location are overall lighter than those observed at Oakey Aero station. Morning winds are most frequently from the north, north-east and east, and generally of low speed, with almost no calms (1 per cent). Afternoon winds are slightly stronger and blow mostly from the south-west and west.

Overall, analysis of the annual wind roses for the two stations indicates that wind speed and direction is influenced on the local scale by terrain and land use. Terrain and land use are discussed further in Section 12.4.4. The wind roses for both stations do not show any sea breezes or valley drainage flow affecting wind speed and direction at the large scale.

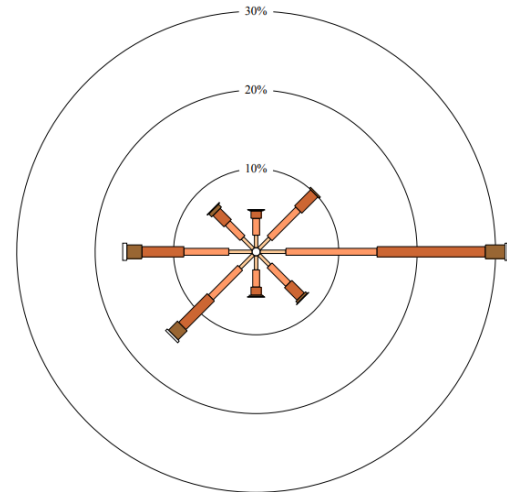


9 am
15175 Total Observations
Calm 14%



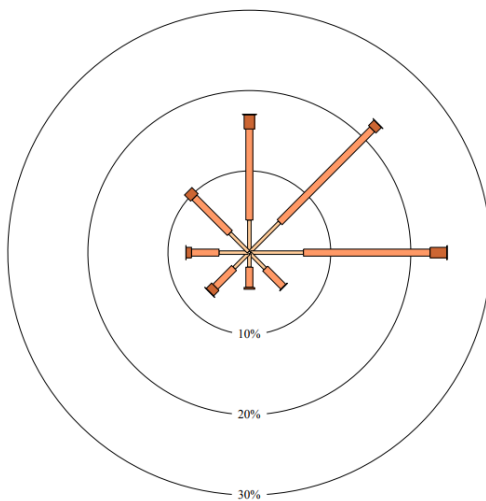
Annual 9.00 am wind rose at Oakey Aero¹

3 pm
14574 Total Observations
Calm 3%



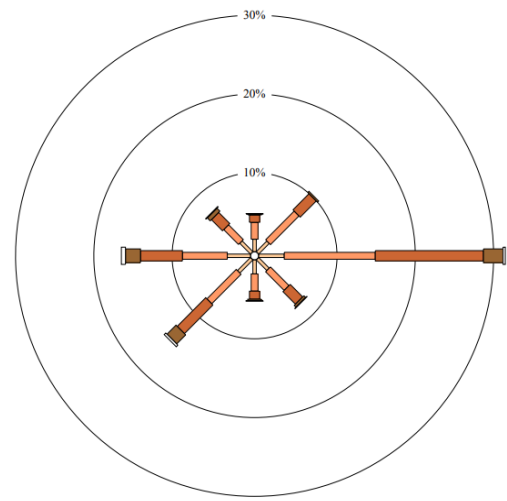
Annual 3.00 pm wind rose at Oakey Aero¹

9 am
4951 Total Observations
Calm 1%



Annual 9.00 am wind rose at Inglewood Forest²

3 pm
14574 Total Observations
Calm 3%



Annual 3.00 pm wind rose at Inglewood Forest²



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FIGURE 12-5 WIND ROSES FOR BUREAU OF METEOROLOGY MONITORING STATIONS OAKEY AERO AND INGLEWOOD FOREST

Figure notes:

1. Annual wind rose of wind direction versus wind speed based on observations from 1973 to 2018
2. Annual wind rose of wind direction versus wind speed based on observations from 2000 to 2014

12.4.1.4 Atmospheric stability

Stability is a measure of the convective properties of a parcel of air. Stable conditions occur when convective processes are low, while unstable conditions are associated with stronger convective processes, which are associated with potentially rapid changes in temperature. Stable atmospheres occur when a parcel of air is cooler than the surrounding environment, so the parcel of air (and any pollution within it) sinks. Conversely, unstable atmospheres occur when a parcel of air is warmer than the surrounding environment, making the parcel of air buoyant and, subsequently, leading to the parcel of air rising.

Stability is commonly explained using Pasquill-Gifford A – F stability class designations. Classes A, B and C represent unstable conditions, with Class A representing very unstable conditions and Class C representing slightly unstable conditions. Class D stability corresponds to neutral conditions, which are typical during overcast days and nights. Classes E and F correspond to slightly stable and stable conditions, respectively, which occur at night.

Meteorological modelling for the assessment has been undertaken using CALMET, with the alignment represented by three CALMET modelling domains, referred to as the northern, central and southern domains. The location of the CALMET modelling domains is provided in Appendix R: Air Quality Technical Report.

Stability class data extracted from the three CALMET domains has been analysed. Figure 12-6 to Figure 12-8 show stability classes for the three domains by time of day. As expected, the stability classes indicate stable conditions during the night hours and neutral and unstable conditions during the day. Figure 12-9 to Figure 12-11 show stability classes in relation to wind speed for the three domains. As expected, stable conditions are more prevalent with lower wind speeds.

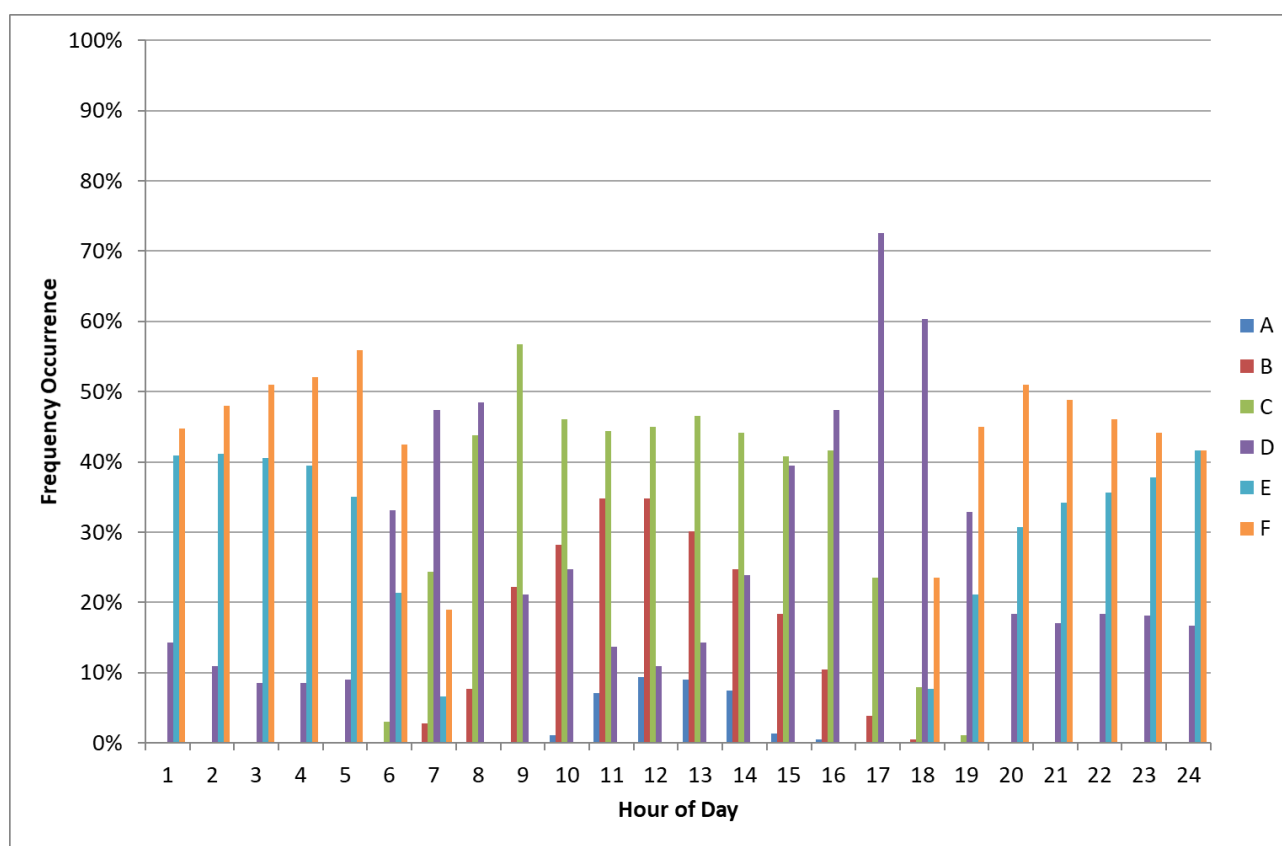


FIGURE 12-6 HOURLY STABILITY CLASS FREQUENCY FOR NORTHERN DOMAIN

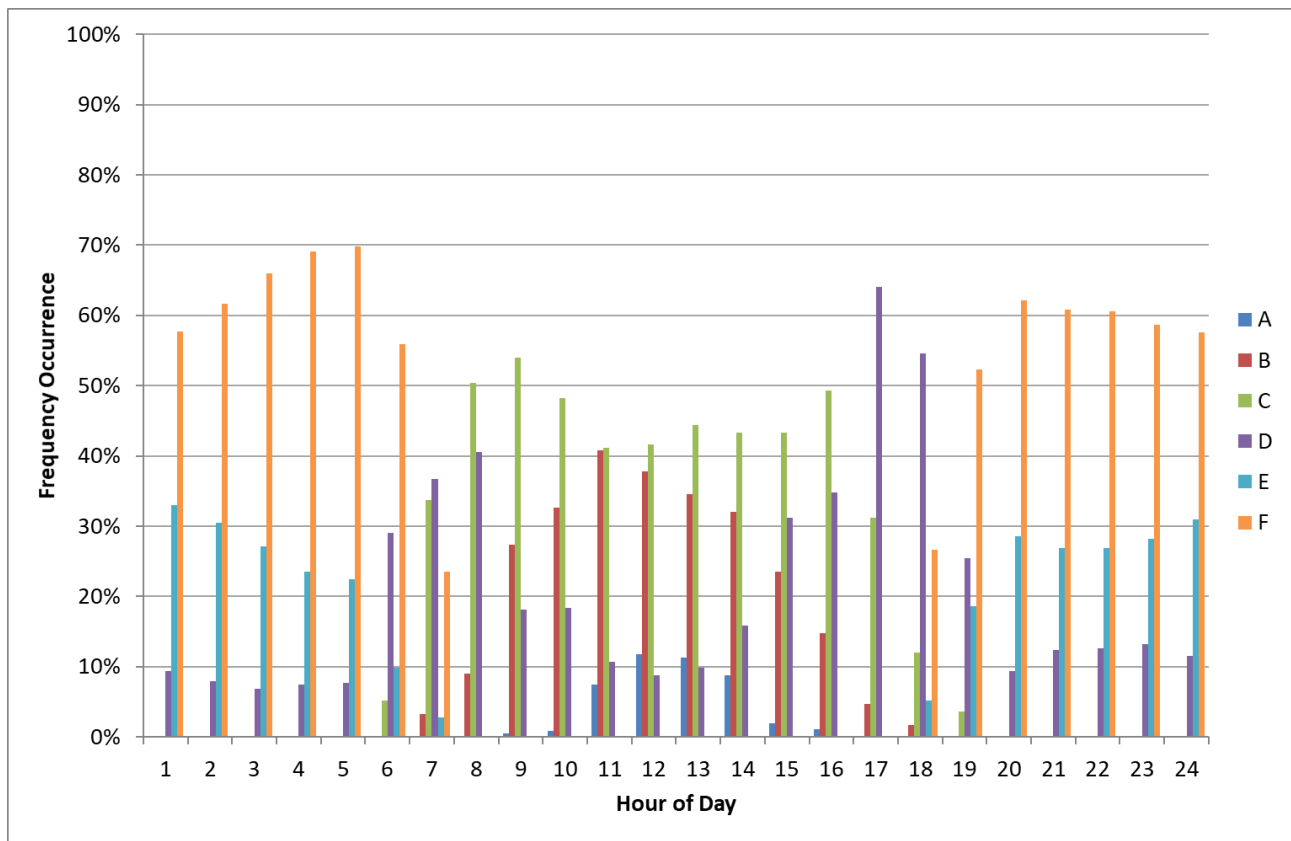


FIGURE 12-7 HOURLY STABILITY CLASS FREQUENCY FOR CENTRAL DOMAIN

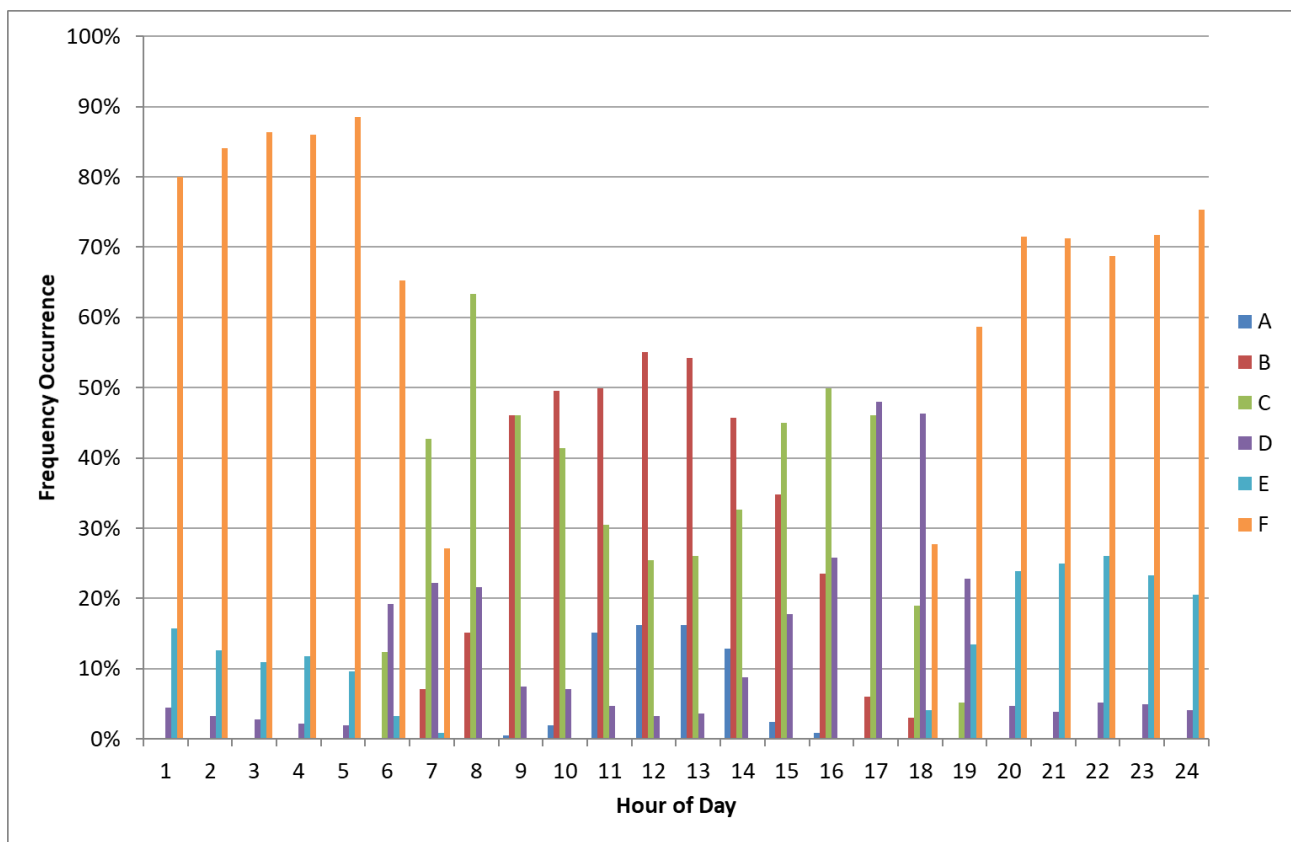


FIGURE 12-8 HOURLY STABILITY CLASS FREQUENCY FOR SOUTHERN DOMAIN

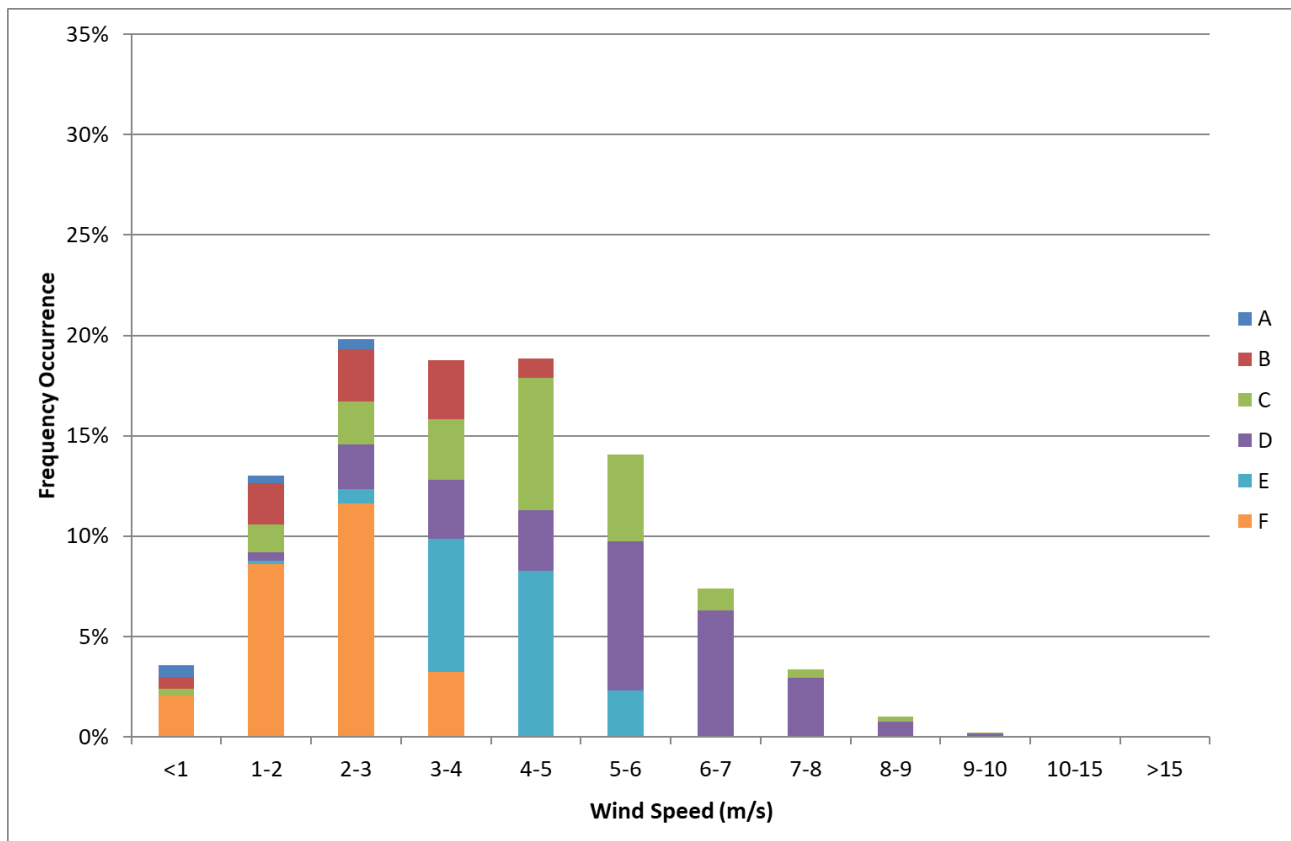


FIGURE 12-9 STABILITY CLASS FREQUENCY BY WIND SPEED FOR NORTHERN DOMAIN

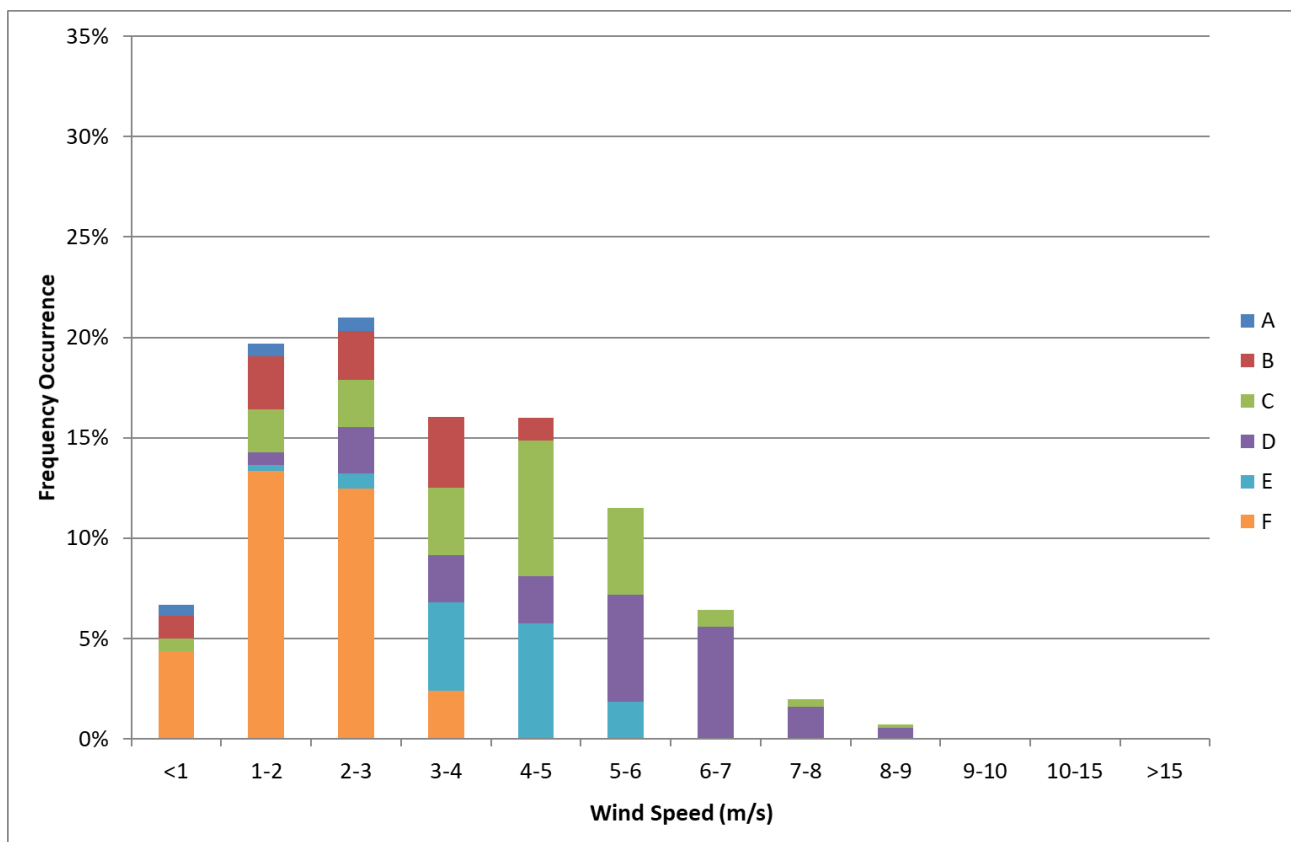


FIGURE 12-10 STABILITY CLASS FREQUENCY BY WIND SPEED FOR CENTRAL DOMAIN

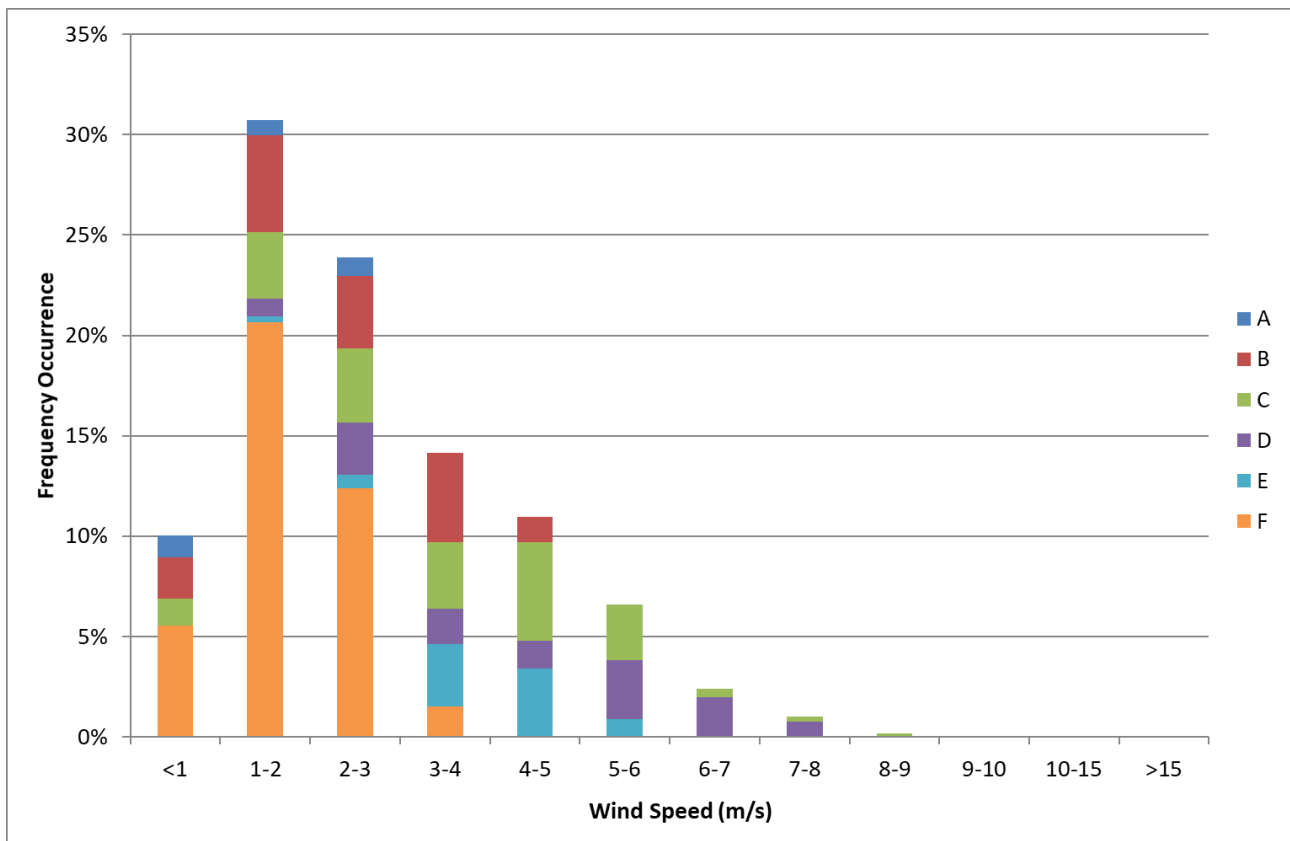


FIGURE 12-11 STABILITY CLASS FREQUENCY BY WIND SPEED FOR SOUTHERN DOMAIN

12.4.1.5 Mixing height

The planetary boundary layer is the lowest part of the atmosphere and is directly influenced by the Earth's surface. This layer can range between 100 to 2,000 metres (m) above ground level. The height of this layer above ground level is referred to as the mixing height.

The mixing height is estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50 m. Figure 12-12 to Figure 12-14 present average mixing height by hour of day across the meteorological dataset, as generated by CALMET. These results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during night time. In addition, peak mixing heights are consistent with typical ranges.

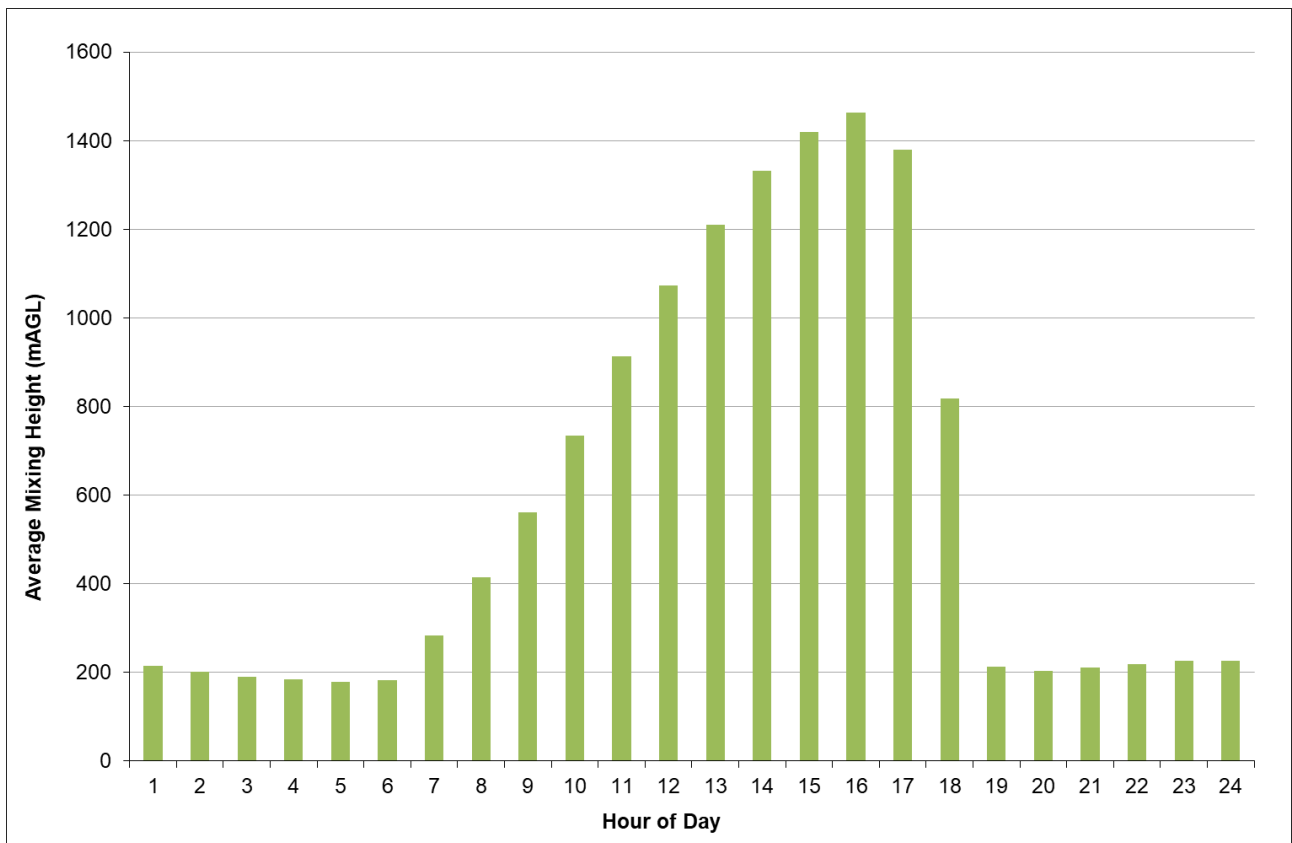


FIGURE 12-12 AVERAGE MIXING HEIGHT BY HOUR OF DAY FOR NORTHERN DOMAIN

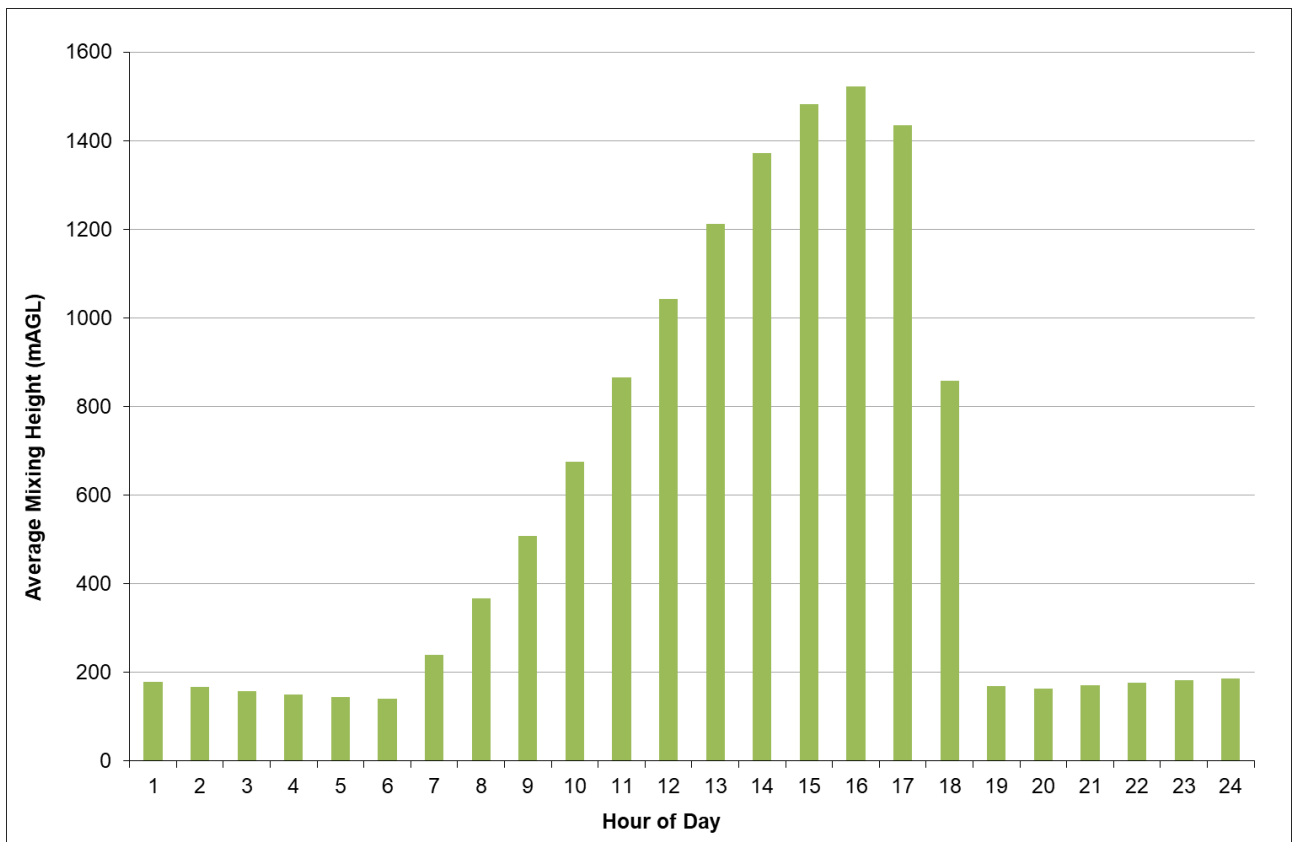


FIGURE 12-13 AVERAGE MIXING HEIGHT BY HOUR OF DAY FOR CENTRAL DOMAIN

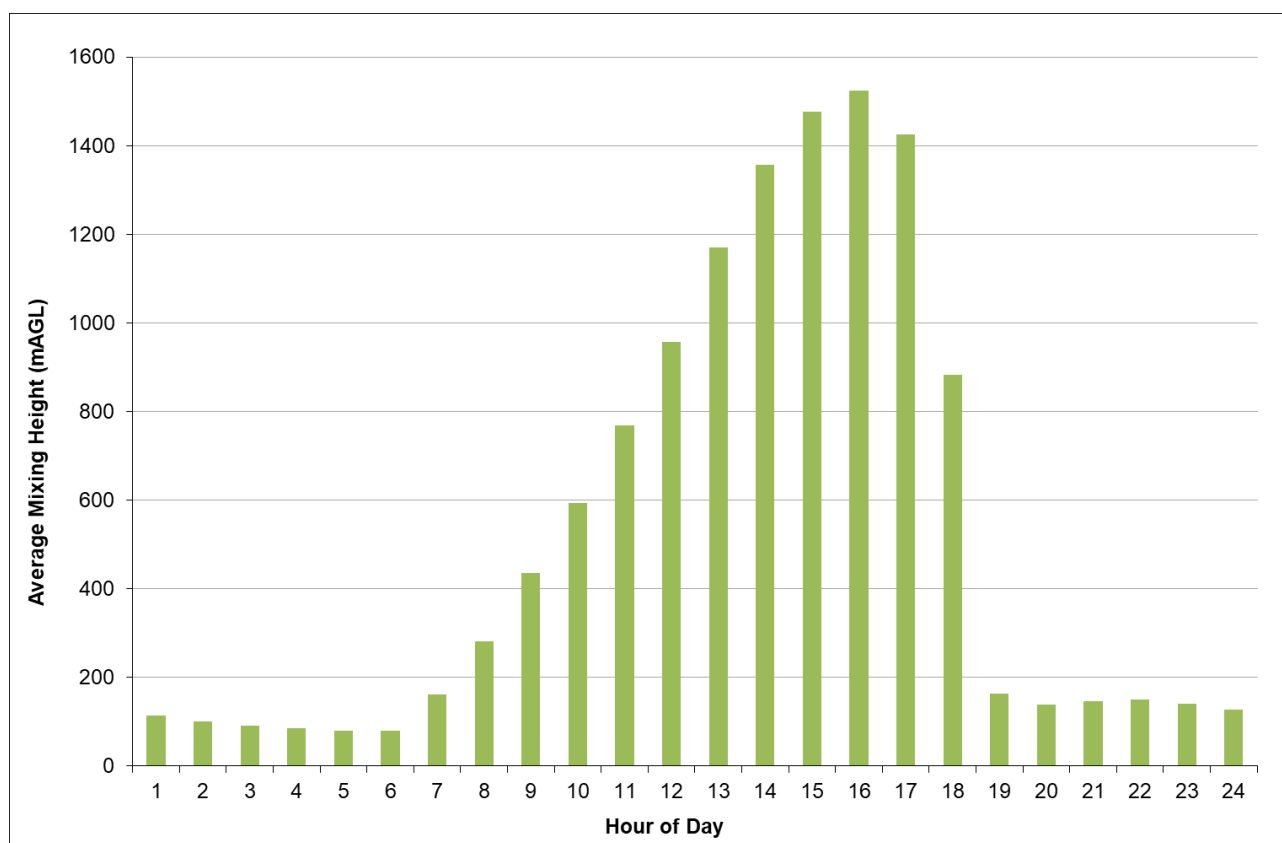


FIGURE 12-14 AVERAGE MIXING HEIGHT BY HOUR OF DAY FOR SOUTHERN DOMAIN

12.4.1.6 El Niño–Southern Oscillation

For Australia, the El Niño–Southern Oscillation (ENSO) has the strongest effect on year-to-year climate variability in Australia, mostly affecting rainfall and temperature. El Niño incidences represent periods of unusually warm Pacific Ocean conditions along the western coast of South America, which frequently present as high rainfall events in South America and drought conditions for Australia. Conversely, La Niña periods represent cooler ocean surface temperatures along the western coast of South America and increase the likelihood of drought conditions locally and high rainfall periods in Australia.

The Southern Oscillation Index, Oceanic Niño Index, and Multivariate ENSO Index are measures that can indicate episodes of El Niño and La Niña. Due to differences in methodology, each of these indices can have slightly differing results; however, utilising the Southern Oscillation Index, Oceanic Niño Index, and Multivariate ENSO Index measures for ENSO, concurrence can be seen on which years represent periods of El Niño or La Niña. The three indices show that the year 2013 was relatively neutral in terms of ENSO and this year has been selected as the meteorological year for the assessment. Appendix R: Air Quality Technical Report includes further detail on the analysis of the ENSO measurement indices and justification of selecting 2013 as the meteorological year for the assessment.

12.4.2 Background air quality

An air quality monitoring program was undertaken for the AQIA for the Project, which included monitoring of PM₁₀ and PM_{2.5}. Two AQMSs were established near the alignment. The Inland Rail AQMS was established in 2018 at a private property located off Draper Road, Charlton (Lot 29, SP294200), immediately adjacent to the northern end of the Project. The Millmerran AQMS was established in March 2021 on a privately owned property associated with Millmerran Power Station and in close proximity to the Commodore Mine. The locations of the two AQMSs are shown in Figure 12-4.

The Inland Rail AQMS is located approximately 200 m to the south of the existing QR Western Line. Measured concentrations at the station are influenced by emissions from existing freight rail traffic operating on the QR network. Due to the influence of freight rail emissions on measured concentrations, the Inland Rail AQMS represents a conservative estimate of background air quality. PM₁₀ and PM_{2.5} monitoring data is available from the Inland Rail AQMS from 21 July 2018 to 31 October 2021.

PM₁₀ and PM_{2.5} monitoring data is available from the Millmerran AQMS for the period from 1 April 2021 to 31 March 2022. Monitoring data from the Millmerran AQMS has been used to determine ambient air quality in the area near the Commodore Mine and the Millmerran Power Station, which are existing air emission sources, for use in the AQIA.

Background concentrations for other pollutants of interest not monitored at either AQMS have been estimated using monitoring data available from AQMSs operated by DESI. The DESI has an ambient monitoring network across Queensland that monitors for controlled pollutants in areas with large population bases or heavy industry adjacent to residential areas. To determine appropriate baseline levels of each pollutant, recent data from the operational stations closest to the alignment was reviewed.

The nearest historic DESI monitoring station to the Project was located at Jondaryan, 40 km north-west of Toowoomba. This station operated between March 2014 to April 2015. When operational, its purpose was to serve as a peak monitoring station, and it was positioned in a location near a significant local pollution source. This station is not considered suitable to provide representative background concentrations for the AQIA area and therefore has not been considered further.

A further four monitoring stations are present in south-west Queensland at Hopeland, Miles Airport, Burncluth, and Condamine. Although no exceedances of ambient air quality goals were found at these monitoring sites, it was concluded in the Commonwealth Scientific and Industrial Research Organisation's (CSIRO's) Gas Industry Social and Environmental Research Alliance investigation by Lawson et al., (2018) that coal seam gas activities are a likely contributor to the local air shed in this region. As the area surrounding the Project has no coal seam gas activity, monitoring data from these stations is not considered an accurate representation of the background air environment for the Project and data from these stations has not been used in this assessment.

A DES monitoring station was previously located in North Toowoomba; however, this station ceased operation in 2010 and its data is not considered representative of current conditions in the AQIA area.

The nearest operational and representative DESI monitoring station to the Project is located at Mutdapilly, approximately 90 km to the east. Not all pollutants of interest are measured at the Mutdapilly station; therefore, data from the Springwood DES station was also reviewed. Springwood is the only DES station in south-east Queensland that provides measurements of air toxics (VOCs) such as benzene and toluene; therefore, this station represents the best available monitoring station for these pollutants for use in the AQIA.

The details of the stations considered for review including pollutants monitored are presented in Table 12-19, with the location of these stations shown in Figure 12-4.

TABLE 12-19 MONITORING STATIONS CONSIDERED IN THE AIR QUALITY IMPACT ASSESSMENT

Station name	Location relative to alignment	Pollutants monitored
Mutdapilly	90 km to east	NO _x and O ₃
Springwood	135 km to east-northeast, in the grounds of a high school	NO _x , O ₃ , SO ₂ , PM ₁₀ , PM _{2.5} and air toxics (organic pollutants, (e.g. benzene, toluene))
Inland Rail AQMS	<0.1 km to the south, at a residential dwelling located off Draper Road, Charlton (Lot 29, SP294200)	PM ₁₀ and PM _{2.5}
Millmerran AQMS	0.4 km to the north, at a residential dwelling located off Millmerran Inglewood Road, Millmerran (Lot 1, RP193091) (approximately 1 km north of the Commodore Mine)	PM ₁₀ , PM _{2.5}

DES does not measure dust deposition rates; however, a three-month deposited dust monitoring program was conducted for the Inland Rail Program in 2016. The Yelarbon to Gowrie section was a previous alignment option, which has been replaced by the Project alignment. The monitoring was conducted at four sites and in accordance with Australian Standard (AS)/New Zealand Standard (NZS) 3580.10.1:2003 *Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method*. The locations of the four sites are shown in Figure 12-4.

The highest measured rate of 50 mg/m²/day (reported as total insoluble solids) (measured at Site 3 during May/June 2016) has been adopted as the background concentration for the AQIA. The monitoring locations represent rural areas with agricultural sources in the surrounding area, similar to the Project alignment. For the urban areas of the Project alignment this may result in conservative estimates of dust deposition rates; however, for the purposes of this AQIA the data collected at these monitoring locations is deemed appropriate.

Existing concentrations of pollutants of concern for the Project have been adopted as background concentrations to ensure a cumulative assessment of air quality impacts. Table 12-20 summarises the existing environment background concentrations adopted for the AQIA.

The *Application requirements for activities with impacts to air* (DES, 2023b) does not prescribe a methodology for adopting background concentrations; however, the BCC AQPSP (2014) does provide a method, which has been adopted for the AQIA. The BCC AQPSP is a technical document that is widely used throughout Queensland regardless of the type of project or the rural or urban setting of the assessment area. For AQIAs, the BCC AQPSP prescribes that the 70th percentile of measured concentrations should be used for the assessment of pollutant species with short-term air quality goals (1 hour and 24 hour). The 70th percentile method is recommended for impact assessment for all project types, including transport (rail and road) projects. The BCC AQPSP does not prescribe the use of other percentiles.

In accordance with the BCC AQPSP, the 70th percentile concentration has been used as the adopted background concentration for assessment of the 24-hour average goals for PM₁₀, PM_{2.5}, toluene and xylene, and for the assessment of the 1-hour average goal for toluene. It is highlighted that although the BCC AQPSP is the guidance set for a predominantly urban area (such as Brisbane), The 70th percentile approach is appropriate for rural areas, as the 70th percentile concentration is calculated based on monitoring data from a representative location or a location that is conservative for the study area (e.g. Springwood).

Further information and discussion regarding air quality monitoring data is provided in Appendix R: Air Quality Technical Report.

TABLE 12-20 SUMMARY OF ADOPTED EXISTING POLLUTANT CONCENTRATION AND DUST DEPOSITION LEVELS

Pollutant	Averaging time and statistic	Air quality goal (µg/m ³)	Adopted background concentration (µg/m ³)	Monitoring location
Deposited Dust	30 days, maximum	120 mg/m ² /day	50 mg/m ² /day	4 locations along the Project alignment (Yelarbon to Gowrie Preliminary Environmental Assessment)
NO ₂ ^a	1 hour, maximum	250	57.5	Mutdapilly
	Annual average	62	7.8	
TSP	Annual average	90	31.0 ^b	Inland Rail AQMS
PM ₁₀	24 hours, 70th percentile	50	16.2	
	Annual average	25	12.4	
PM _{2.5}	24 hours, 70th percentile	25	6.8	
	Annual average	8	5.6	
Benzene	Annual average	5.4	5.2	Springwood ^c
Toluene	1 hour, 70 th percentile	1,100	23	
	24 hours, 70 th percentile	4,100	21.7	
	Annual average	400	18.5	
Xylenes	24 hours, 70 th percentile	1,200	50.3	
	Annual average	950	34.1	

Table notes:

- Assessment of NO₂ cumulative concentrations was determined through the Ozone Limiting Method.
- Calculated from annual PM₁₀ concentrations measured at Inland Rail AQMS using a ratio of 2.5 which is based on a PM₁₀:TSP ratio of 0.4 as reported by the Australian Coal Association Research Program (1999)
- Due to the differing nature of the land-use (urban) surrounding the Springwood station, the adopted concentrations from the Springwood station are considered a conservative estimate of background concentrations for toluene, xylenes and benzene.

The assimilative capacity of the receiving air environment can be quantified through the difference between the adopted background concentrations and the air goals defined in Table 12-2. For most pollutants and averaging times, the background concentrations represent less than half of the air quality goal, indicating a moderate assimilative capacity of the receiving environment. Pollutants that show lower levels of assimilative capacity include the following:

- ▶ PM_{2.5} 5.6 µg/m³ annual average, representing 70 per cent of the 8 µg/m³ air quality goal
- ▶ Benzene 5.2 µg/m³ annual average, representing 96 per cent of the 5.4 µg/m³ air quality goal.

12.4.3 Existing emission sources

The NPI (Department of Agriculture, Water and the Environment, 2021) is regulated by the Australian Government. The purpose of the NPI is to track pollution sources across Australia and ensure that the community has access to information about the emission and transfer of toxic substances that may affect them locally. All major polluters are required by the Commonwealth Government to submit annual reports of their emissions to air. The NPI has emission estimates for 93 toxic substances and the source and location of these emissions. These substances have been identified as important due to their possible effect on human health and the environment. The data comes from facilities such as mines, power stations and factories, as well as other sources. NPI data tends to be a conservative estimate of industry emissions for sites like quarries and mines due to the broad and generalised assumptions made during the emission estimations.

An NPI search conducted for the AQIA area shows eight facilities are required to report emissions annually. A description of each existing emission source and its approximate distance from the Project alignment is described in Table 12-21.

TABLE 12-21 NPI LISTED FACILITIES IN THE AQIA AREA

Facility name	Industry	Distance from the Project alignment (km)	Direction from Project alignment
Commodore Mine	Coal mining	<1	East
Millmerran Power Station	Power generation	4.5	South-east
Sapphire Feedlot	Sheep, beef cattle and grain farming	<1	South
Yarranbrook Feedlot	Sheep, beef cattle and grain farming	<1	North-west
Doug Hall Enterprises	Poultry farming	<1	West
Pittsworth	Poultry farming	1.6	South
Inghams TF3 Breeder Farm Toowoomba	Poultry farming	4.0	East
Boral Asphalt Charlton	Hot mix asphalt manufacturing	3.6	South-east

Pollutant emissions of concern for the Commodore Mine and Millmerran Power Station include particulate matter and NO_x. Due to the distance from the AQMSs considered in the assessment, it is unlikely that emissions from the Commodore Mine and Millmerran Power Station are represented in the background concentrations adopted. Based on this, emissions from the mine and power station have been included in the dispersion model developed for the assessment to assess the cumulative impact of the Project. Further discussion on the inclusion of the mine and power station in the assessment is provided in Section 12.5.

The primary pollutant of concern for the feedlots and poultry farms is ammonia, which is the only pollutant reported to the NPI by these facilities. Ammonia is not a pollutant of concern for the Project and emissions from these four facilities were not considered further in the assessment.

Boral Asphalt Charlton is 3.6 km to the south-east of the Project alignment and reports emissions of particulate matter, total VOCs, CO, NO_x, and SO₂ to the NPI. Emissions of all pollutants other than total VOCs are relatively minor and are not considered likely to contribute to a cumulative impact at sensitive receptors near the Project. There is the possibility of minor concentrations of VOCs from the asphalt plant reaching sensitive receptors near the Project; however, these concentrations are likely to be well below those measured at the DES Springwood monitoring station, which is influenced by large volumes of traffic emissions. Inclusion of the Springwood background values is considered conservative and the Boral emissions were not included in the model on this basis.

In addition to these operational cumulative NPI regulated sources, the following emission sources have been included in the dispersion model for the assessment due to their potential to contribute to cumulative air quality impacts at receptors in the AQIA area:

- ▶ North Star to NSW/QLD Border project (NS2B) (Inland Rail)
- ▶ Gowrie to Helidon project (G2H) (Inland Rail)
- ▶ West Moreton System (existing rail line west of the junction between the Project and the G2H section of Inland Rail)
- ▶ Gore Highway and Warrego Highway for lengths that intersect or run parallel to the alignment.

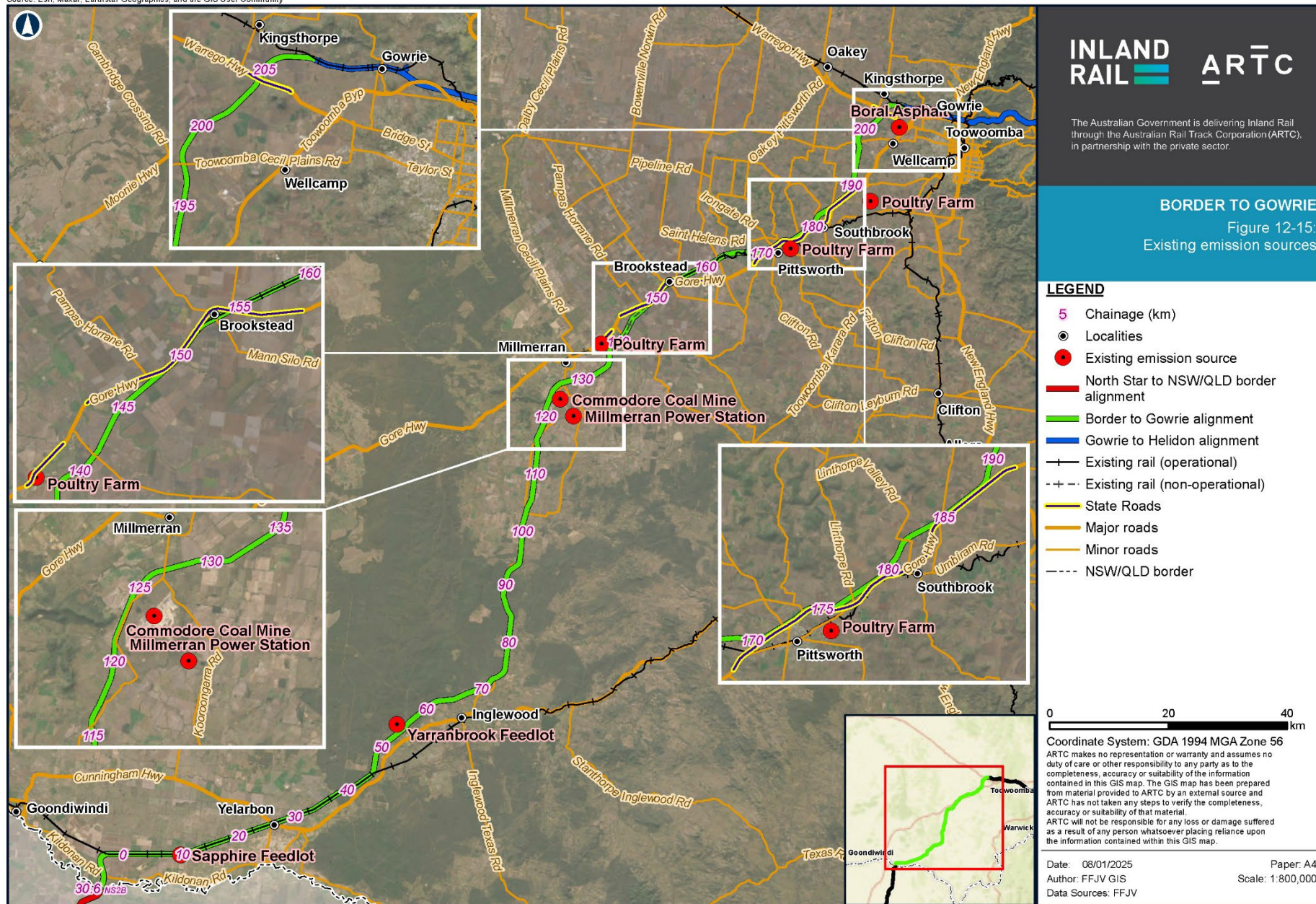
Emissions from other local anthropogenic and non-anthropogenic sources such as local traffic, wind-blown dust, have not been modelled individually but are assumed to be adequately represented by the assumed background concentrations presented in Section 12.4.2.

12.4.4 Terrain and land use

Terrain features and land use can influence meteorological conditions on both a local and regional scale. There are five distinctive regions within the AQIA area:

- ▶ Low-lying alluvial floodplains of the Macintyre River (typically 200.0 m Australian height datum (AHD) to 250.0 m AHD)
- ▶ Forested sandstone hills of the Macintyre Brook catchment (typically 250.0 m AHD to 350.0 m AHD)
- ▶ Undulating grazing lands and peaks near Millmerran (typically 300.0 m AHD to 650.0 m AHD)
- ▶ Broad cultivated alluvial plains of the Condamine River (typically 300.0 m AHD to 350.0 m AHD)
- ▶ Basaltic uplands and isolated peaks of the Toowoomba plateau (typically 325.0 m AHD to 700.0 m AHD).

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
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The landscape surrounding the Project is typically a sparsely settled rural landscape characterised by generally flat irrigated and non-irrigated croplands and undulating pastures, interspersed by a network of vegetated watercourses associated with the Dumaresq, Macintyre and Condamine Rivers and set against a backdrop of forested low hills and isolated volcanic peaks. It is, for the most part, a highly modified landscape as a result of historical clearing practices for agriculture and grazing, the establishment of linear infrastructure (railways, highways and powerlines) and other development activity (e.g. Commodore Mine, Toowoomba Wellcamp Airport and surrounds). Several small townships exist within 5 km of the Project alignment—these include Yelarbon, Inglewood, Millmerran, Brookstead, Pittsworth, Southbrook, Kingsthorpe and Gowrie.

The influence of terrain on wind flows and dispersion has been considered in the meteorological modelling undertaken for the assessment, as discussed in Section 12.3. The effect of land use on surface roughness and dispersion has also been included in the meteorological model developed for the AQIA study area. The height of the train emission source included in the model was based on the revised reference design elevations for the alignment.

12.4.5 Sensitive receptors

12.4.5.1 Selection of receptors

Sensitive air quality receptors in the AQIA area were identified as per the DES guideline (2022f). As per this guideline, a sensitive receptor can include the following:

- ▶ A dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises
- ▶ A motel, hotel or hostel
- ▶ A kindergarten, school, university or other educational institution
- ▶ A medical centre or hospital
- ▶ A protected area under the *Nature Conservation Act 1992* (Qld), the *Marine Parks Act 2004* (Qld) or a World Heritage Area
- ▶ A public park or garden
- ▶ A place used as a workplace including an office for business or commercial purposes.

Indigenous Heritage sites have not been included in the assessment as sensitive receptors as they do not fall within the air quality definition of a sensitive receptor; however, assessment of Indigenous heritage will be managed in accordance with a relevant approved Indigenous Cultural Heritage Management Plan developed with the relevant Aboriginal Party in accordance with the indigenous cultural heritage duty of care requirements under the *Aboriginal Cultural Heritage Act 2003* (Qld), to determine appropriate mitigation measures during the construction works and operations stages of the Project for these sites.

The DES (2023) definition for sensitive receptors includes areas protected under the *Nature Conservation Act 1992* (Qld) or the *Marine Parks Act 2004* (Qld), or World Heritage Areas. There are no World Heritage Areas or areas protected under the *Nature Conservation Act 1992* (Qld) or the *Marine Parks Act 2004* (Qld) located within the AQIA area.

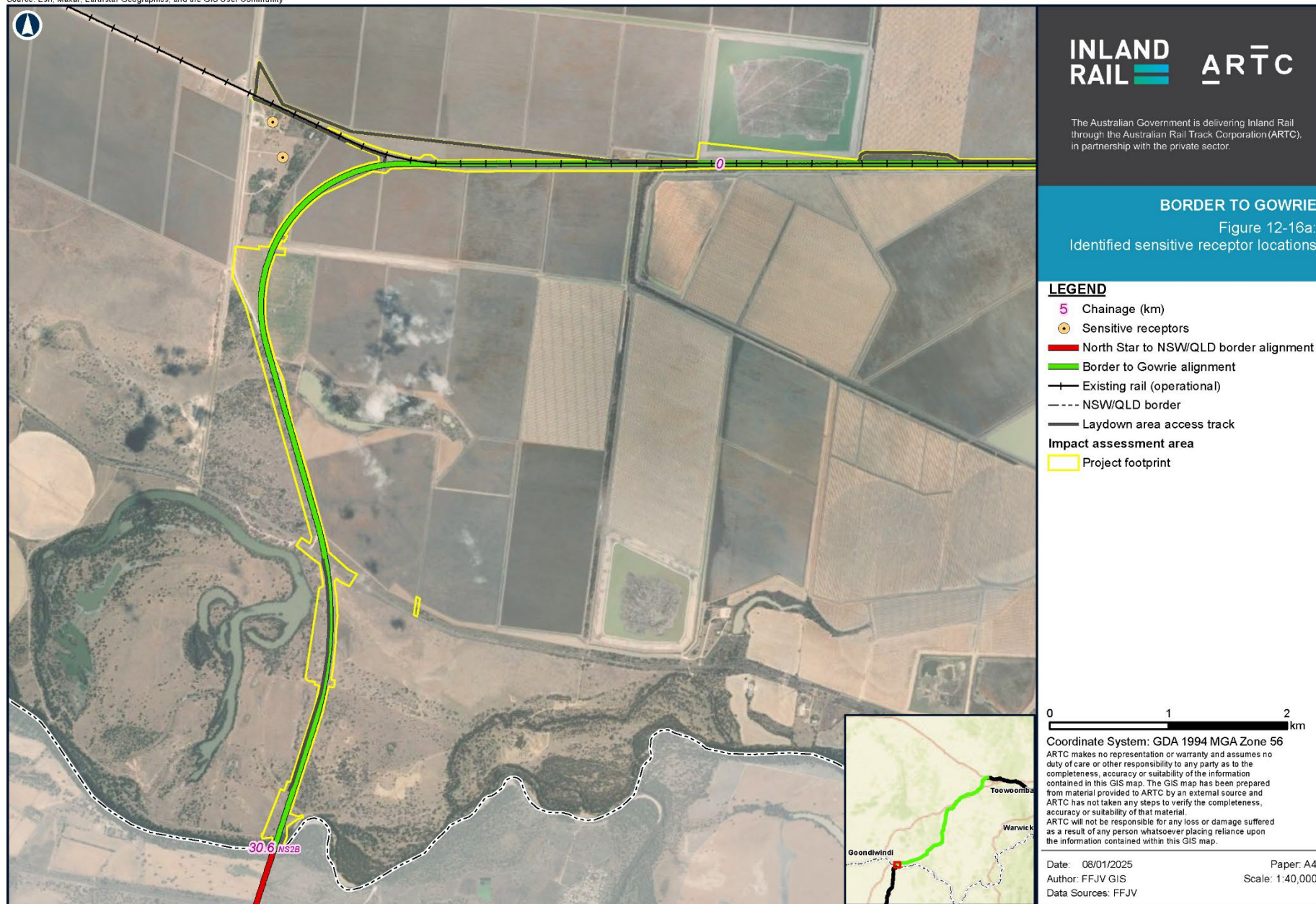
In addition to the DES (2023) definition for a sensitive receptor, DES (2022) states that ‘remnant and regrowth ecosystems of all types’ may be affected by the dispersal of air contaminants and should be considered. The impact of NO₂ on ecosystems, including remnant and regrowth ecosystems, has been investigated through the assessment of predicted annual average NO₂ concentrations against the EPP (Air) annual average goal for NO₂ set for the protection of the health and biodiversity of ecosystems (33 µg/m³) (Table 12-2).

Due to the large area that could be considered sensitive under the definition of ‘remnant and regrowth ecosystems of all types’, individual discrete sensitive receptor points have not been included for ecological receptors (remnant and regrowth ecosystems). Rather, the assessment of potential impacts to ecological receptors has been undertaken via review of annual average NO₂ concentration contour plots, generated by processing of model predictions at a grid of receptors included in the model covering the AQIA study area.

The primary sensitive receptor types of interest for the AQIA are rural and semi-rural dwellings, although other sensitive receptor types are present (e.g. schools). Surfaces that lead to potable water tanks in the vicinity of the Project are also considered sensitive receptors.

Figure 12-16 shows the location of sensitive receptors considered for the AQIA. The sensitive receptors were identified via a desktop review of aerial imagery and no site verification was undertaken. Only sensitive receptors within the AQIA area (within 1 km of the Project alignment centreline) were included in the modelling for the operations stage impact assessment. Appendix R: Air Quality Technical Report provides further detailed figures presenting receptor locations. It is noted that the sensitive receptors considered for air quality may be different to the sensitive receptors considered for other environmental disciplines (e.g. environmental noise) due to the definition and classification (e.g. inhabitable or habitable) of the receptors identified.

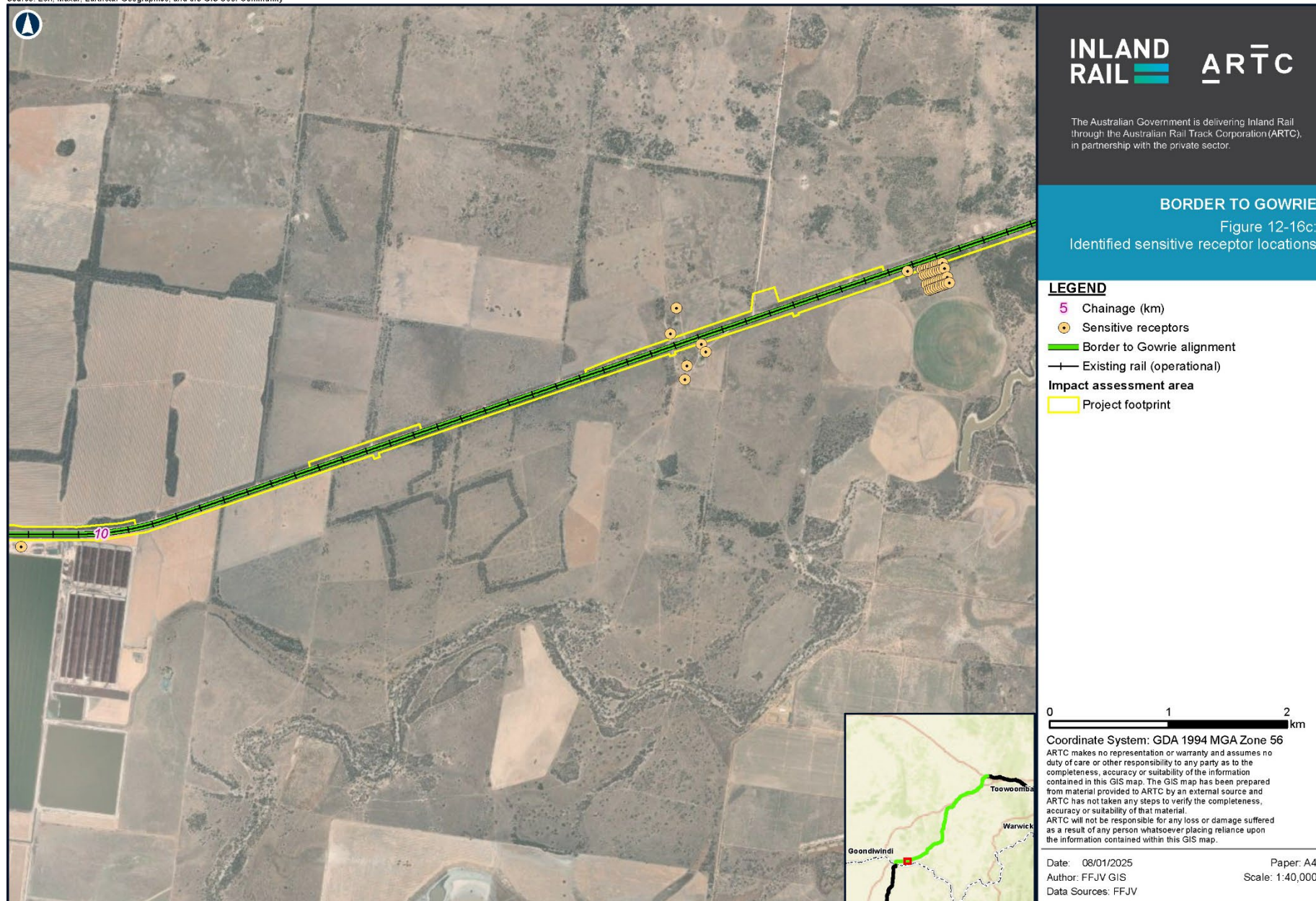
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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



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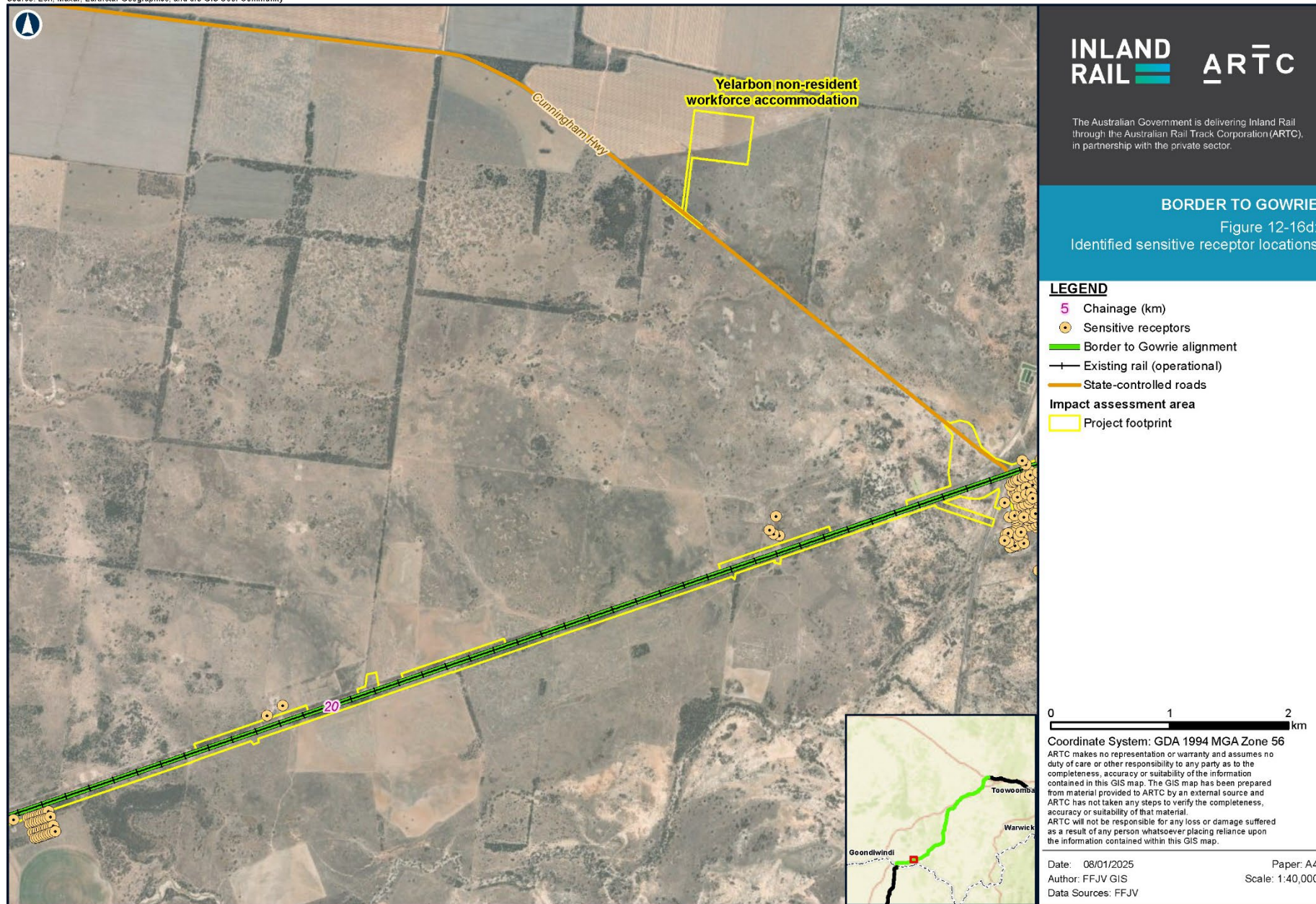


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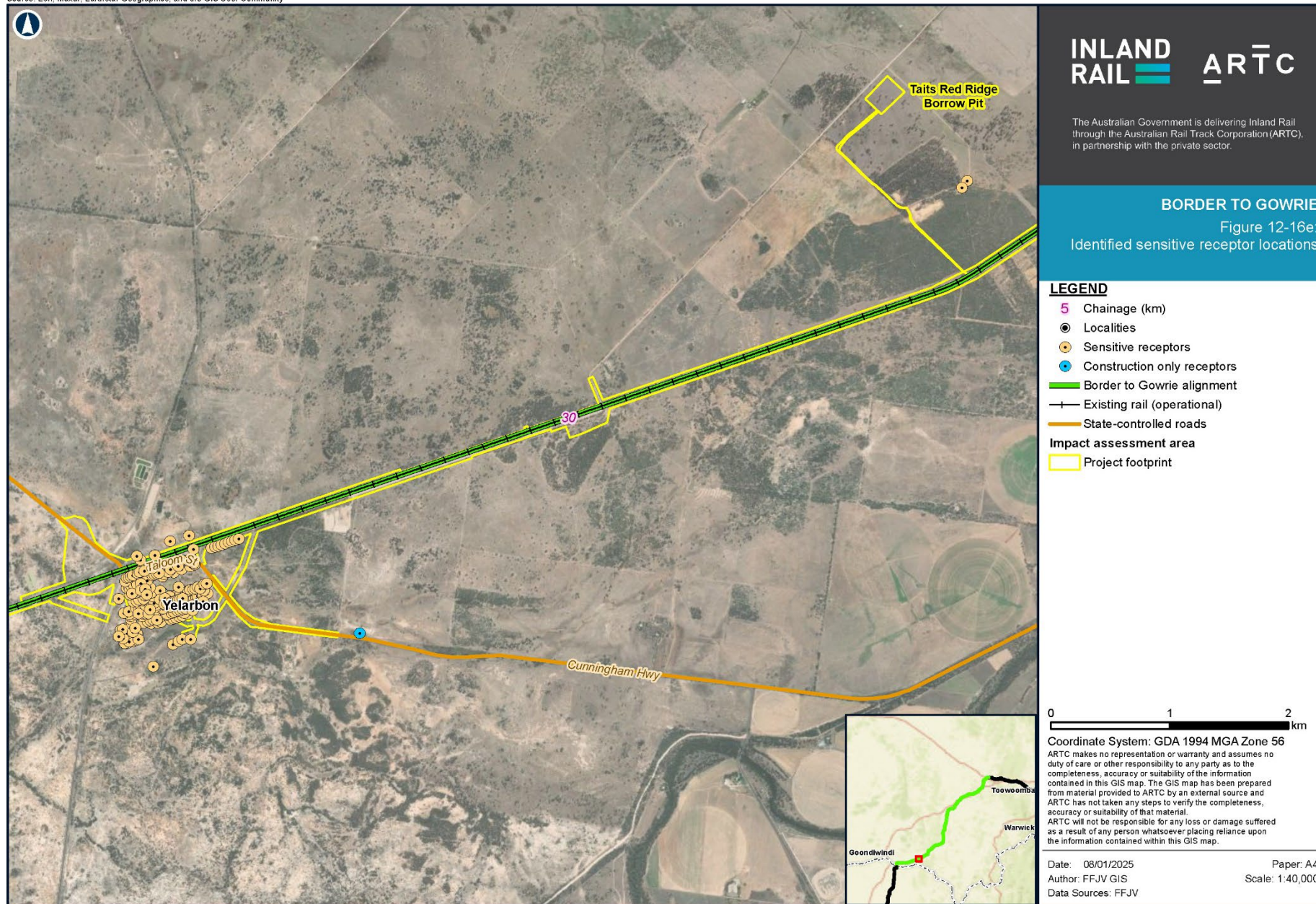
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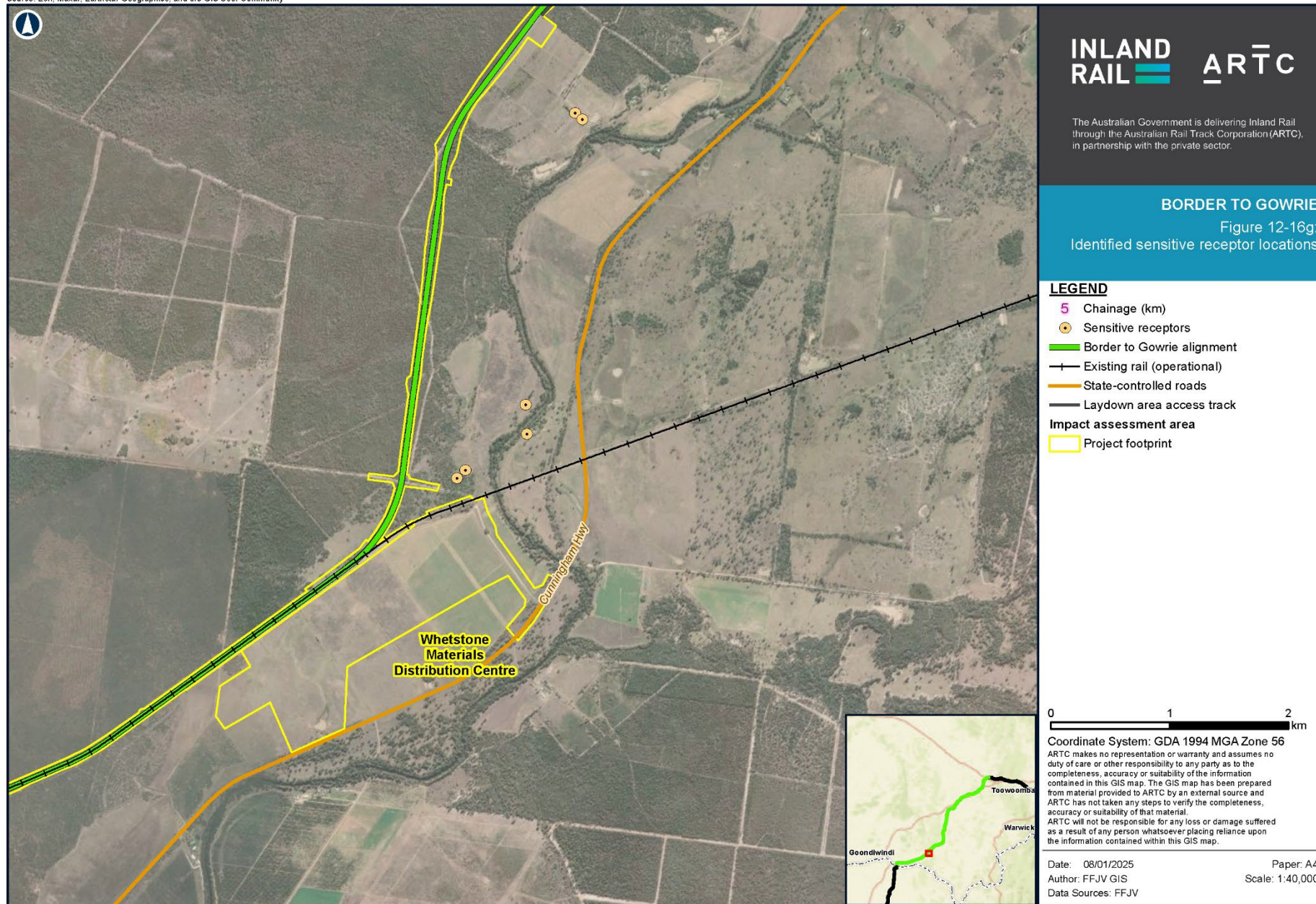
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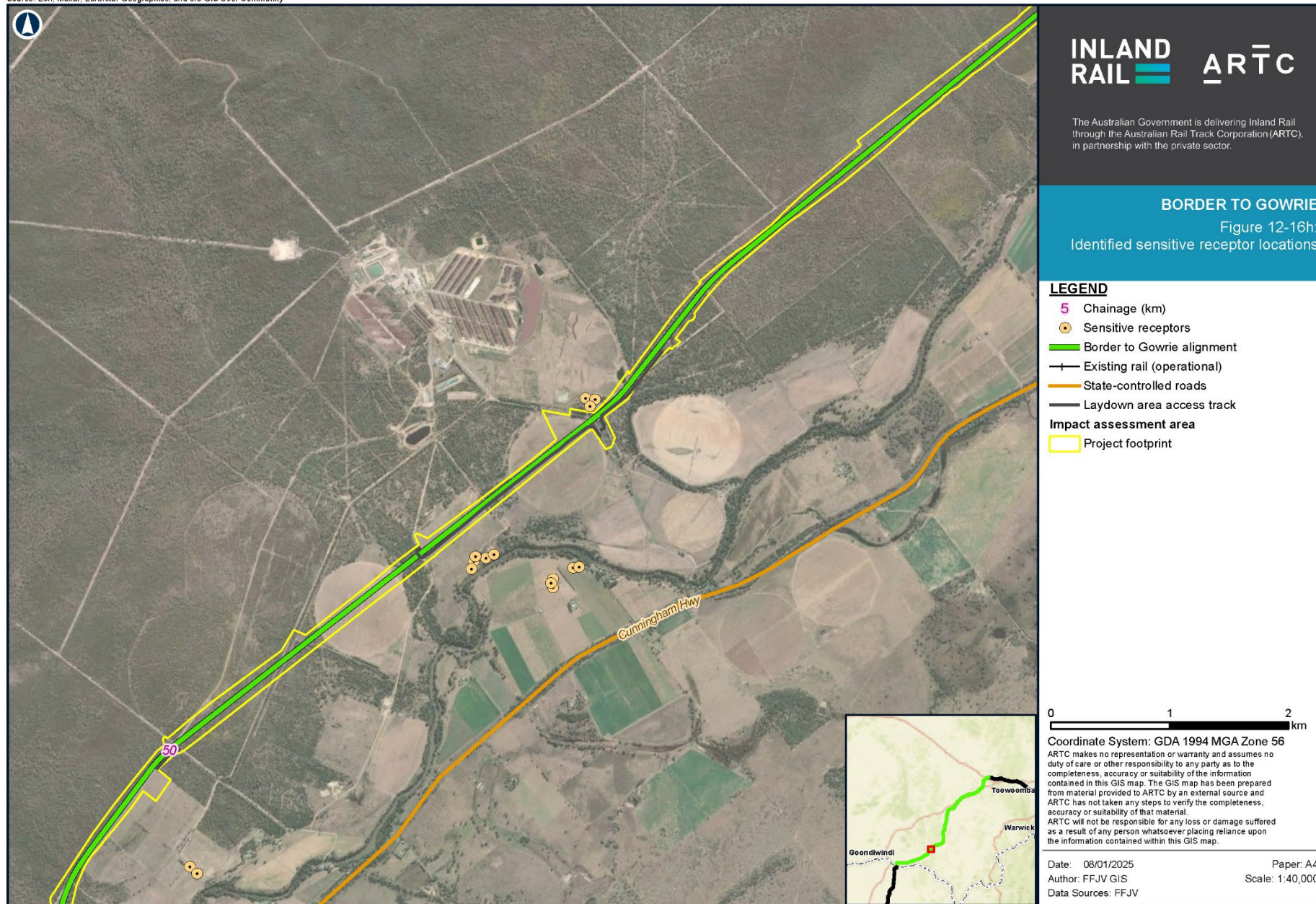
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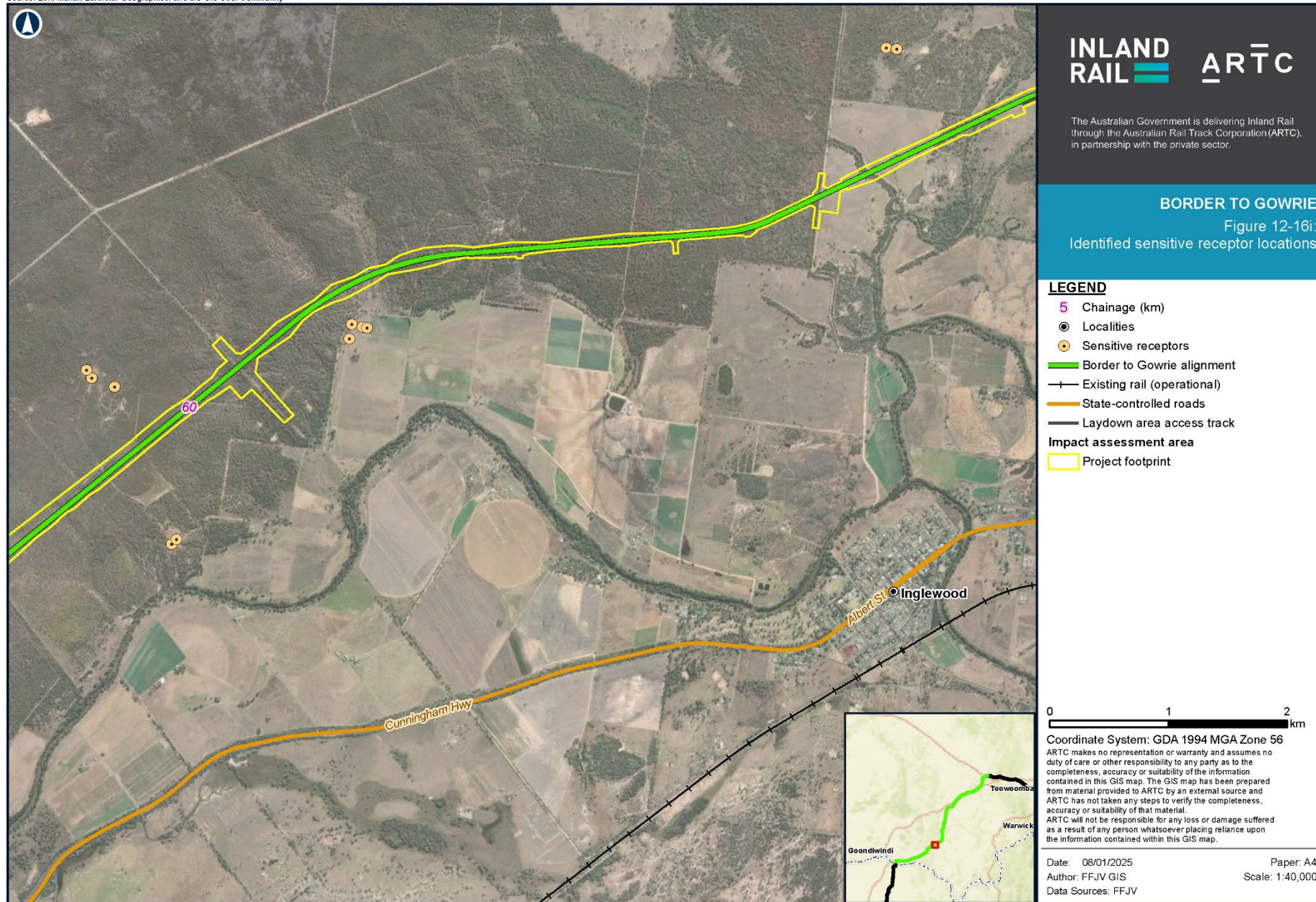


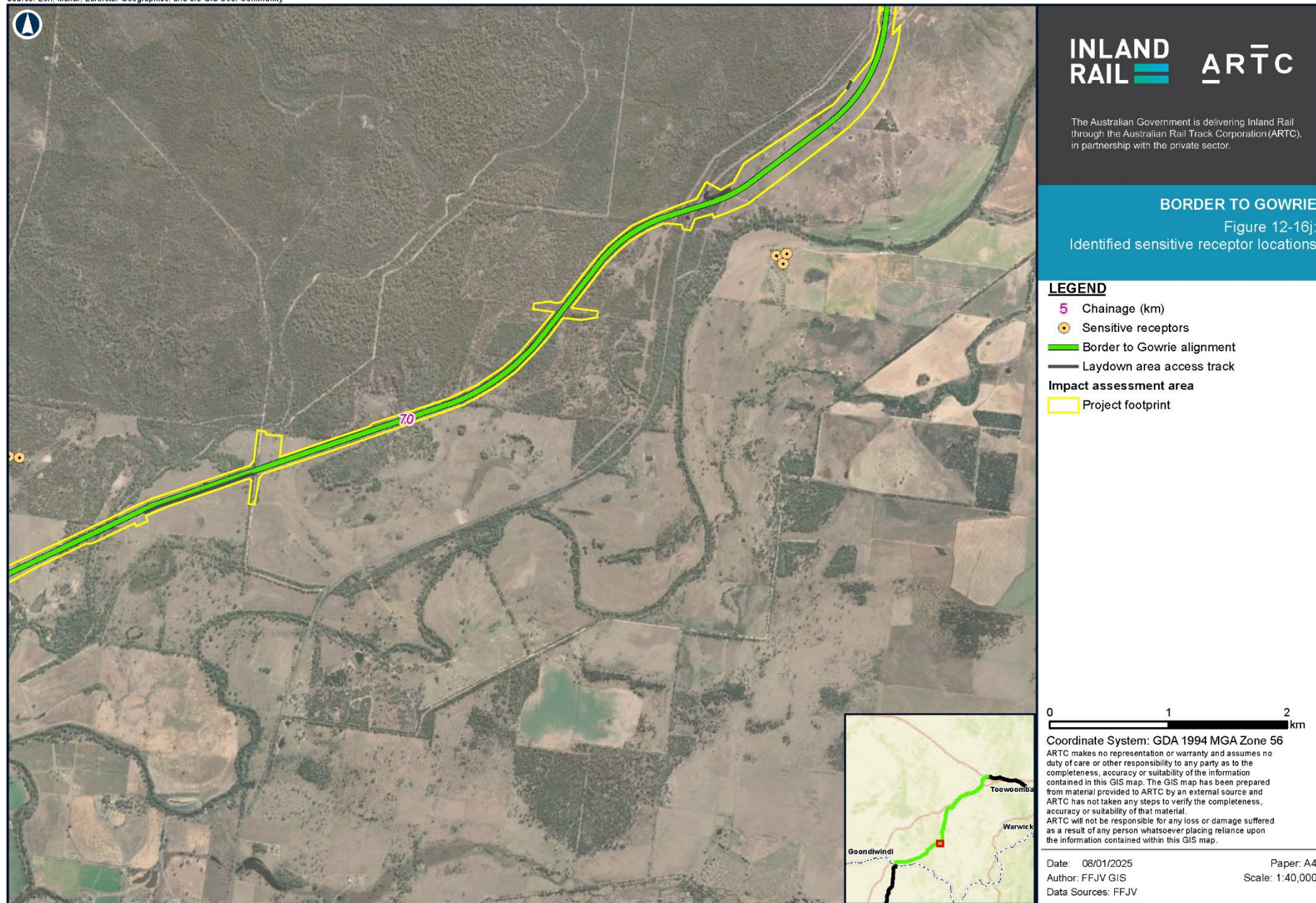


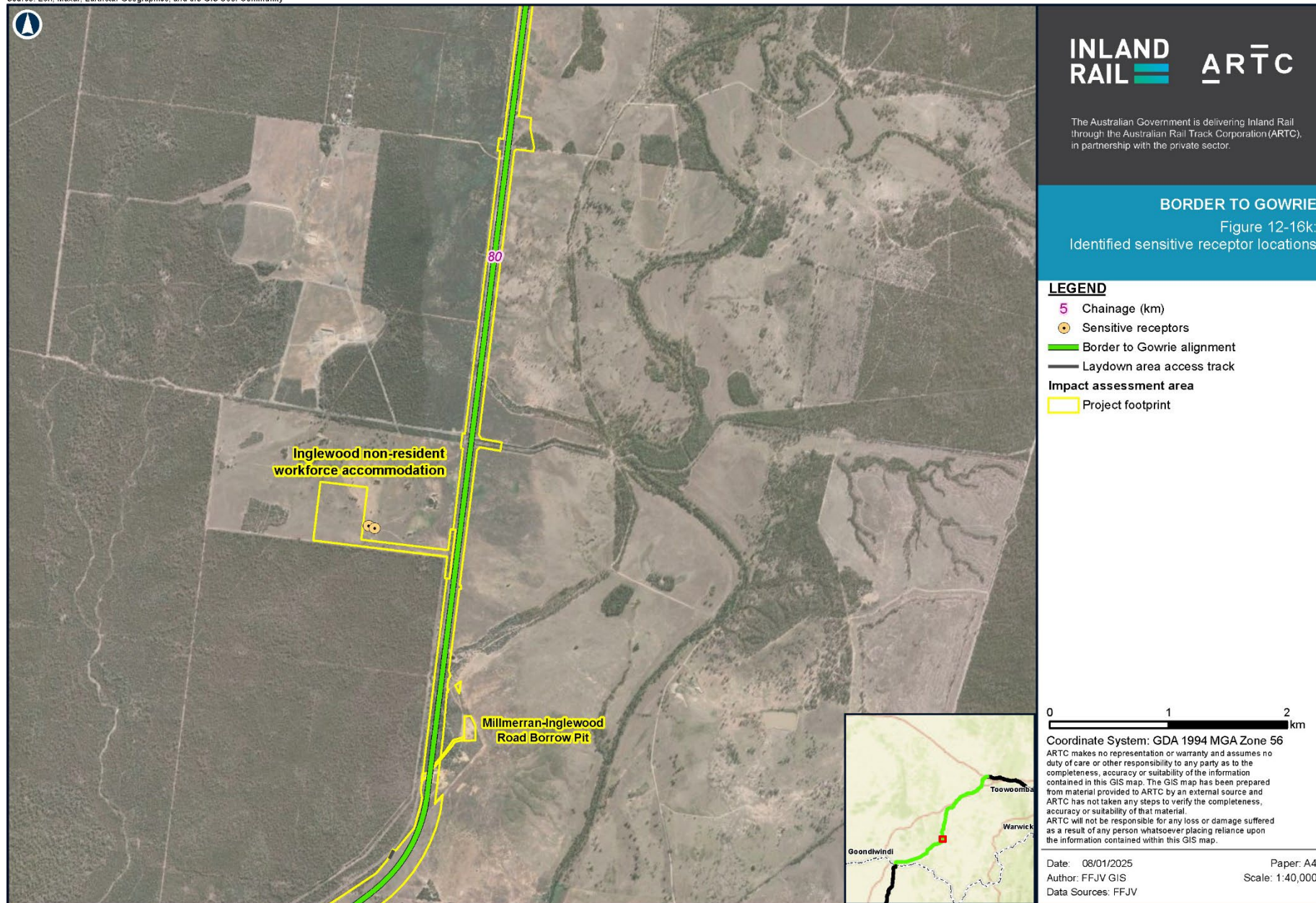
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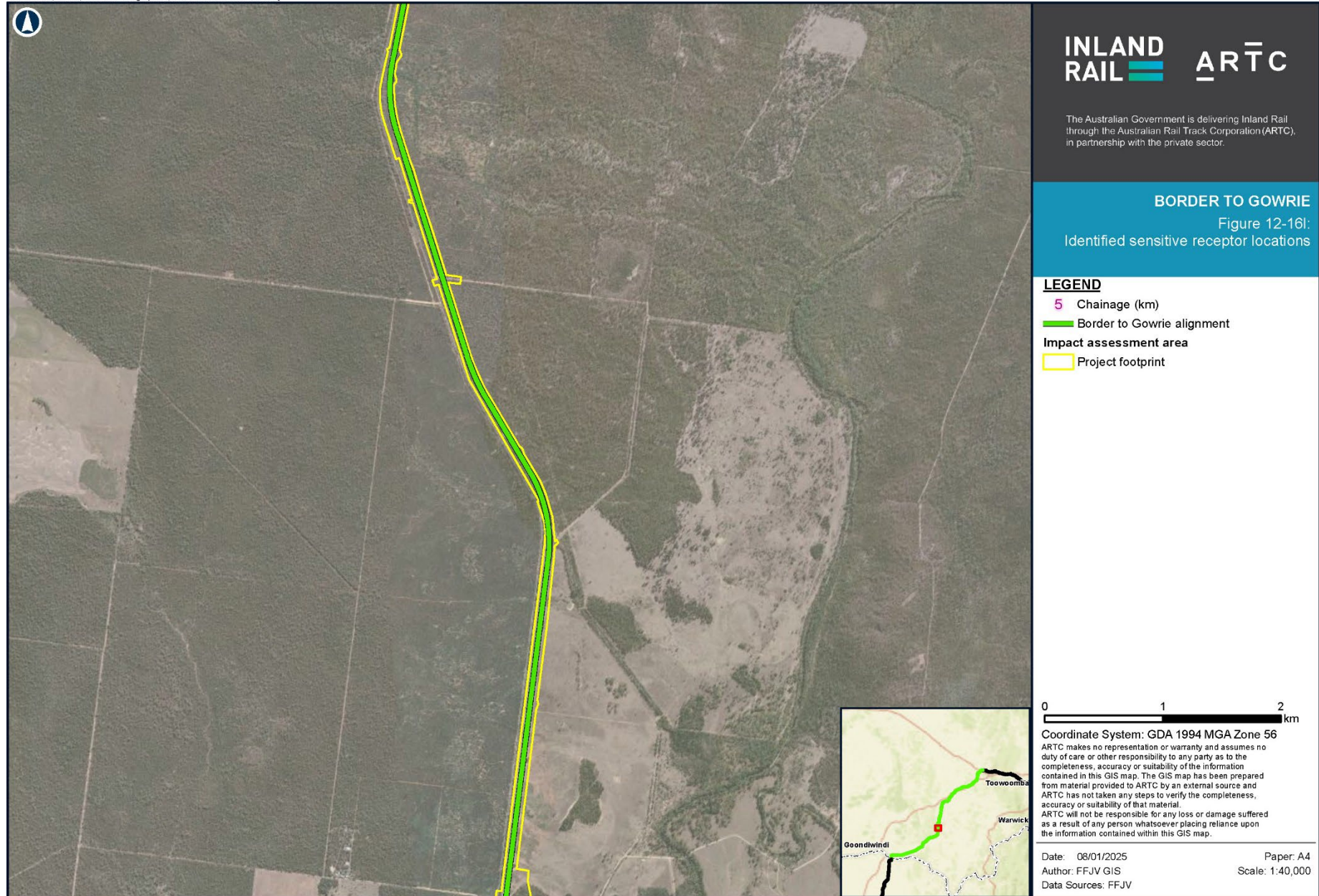




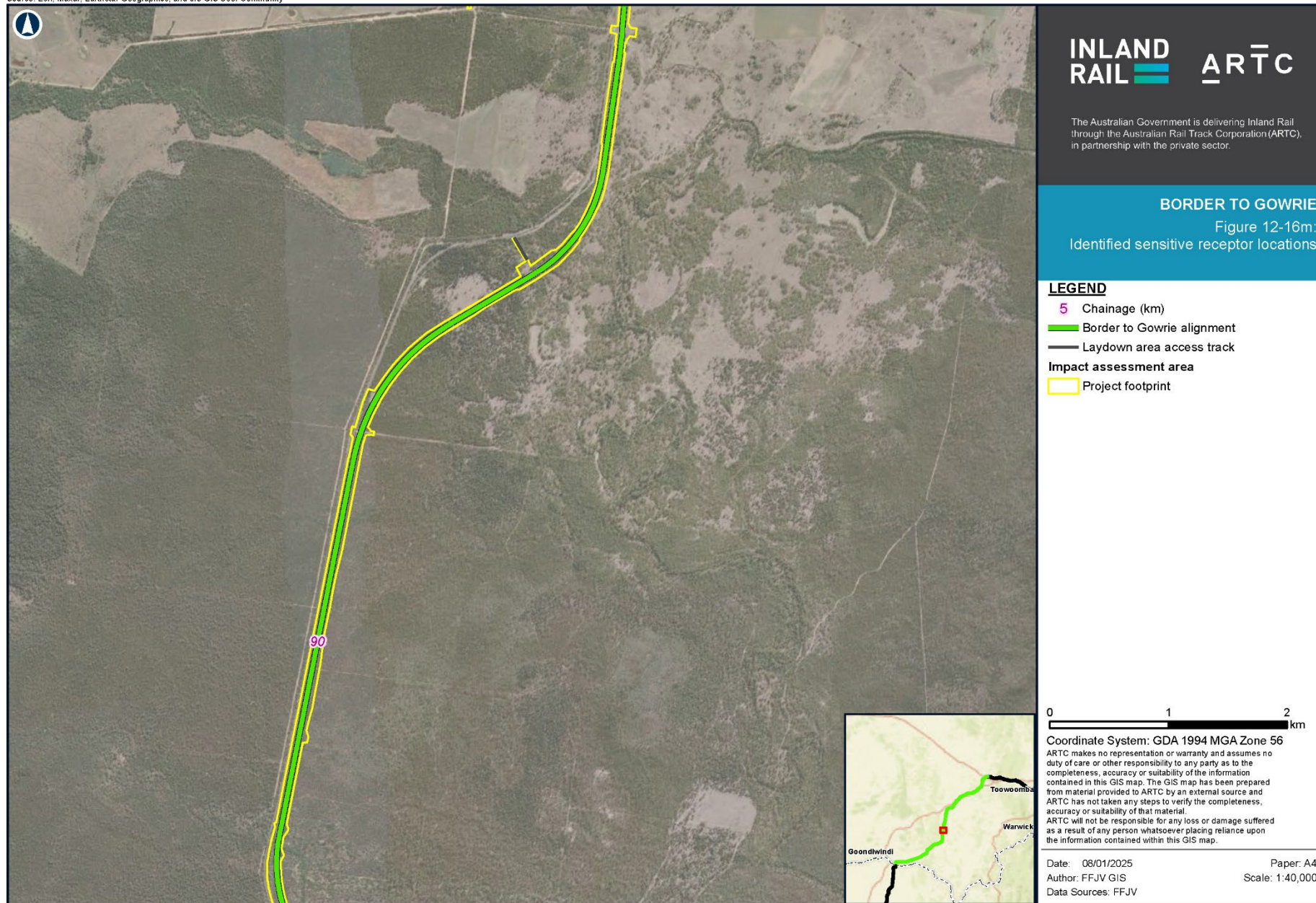








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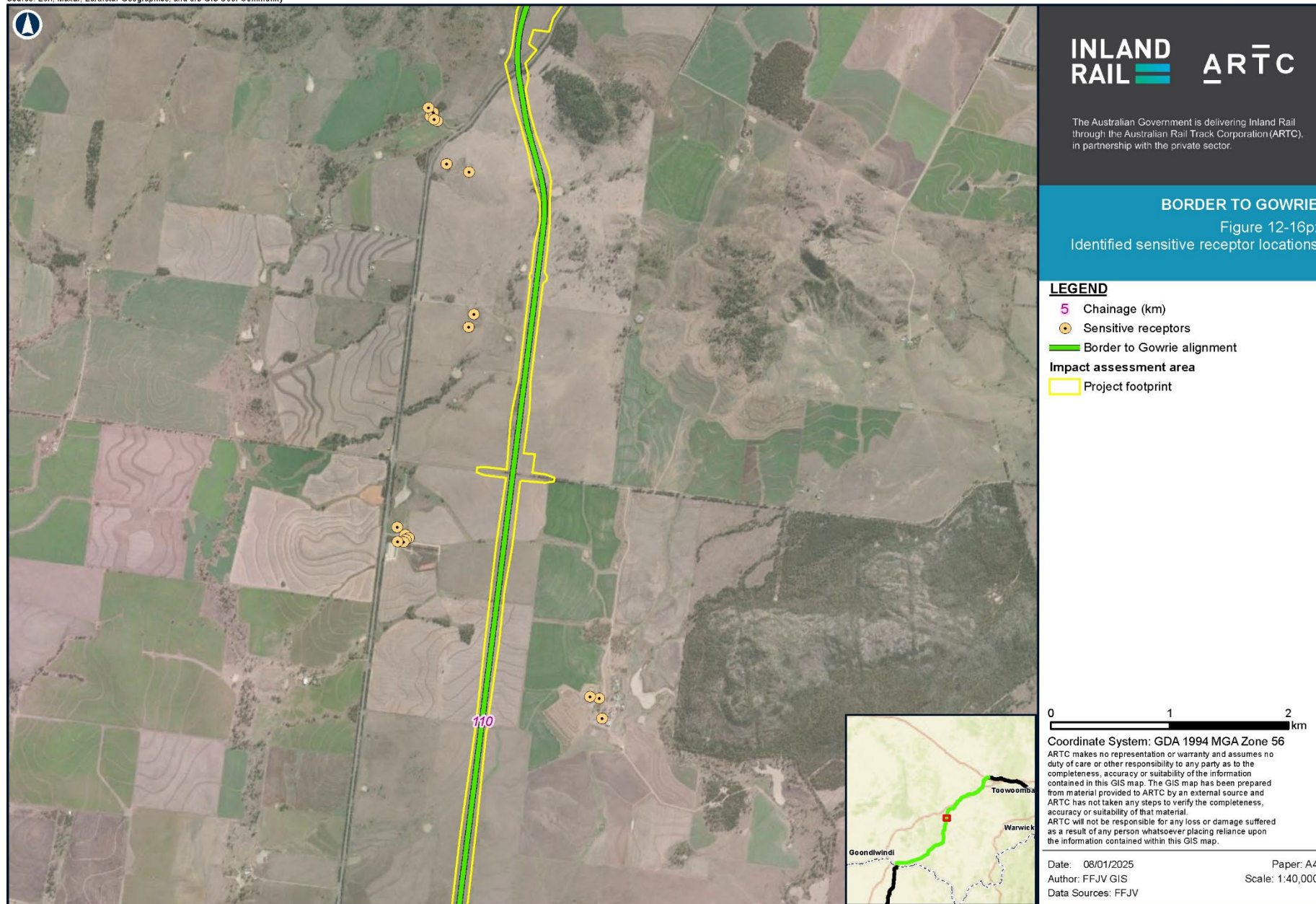


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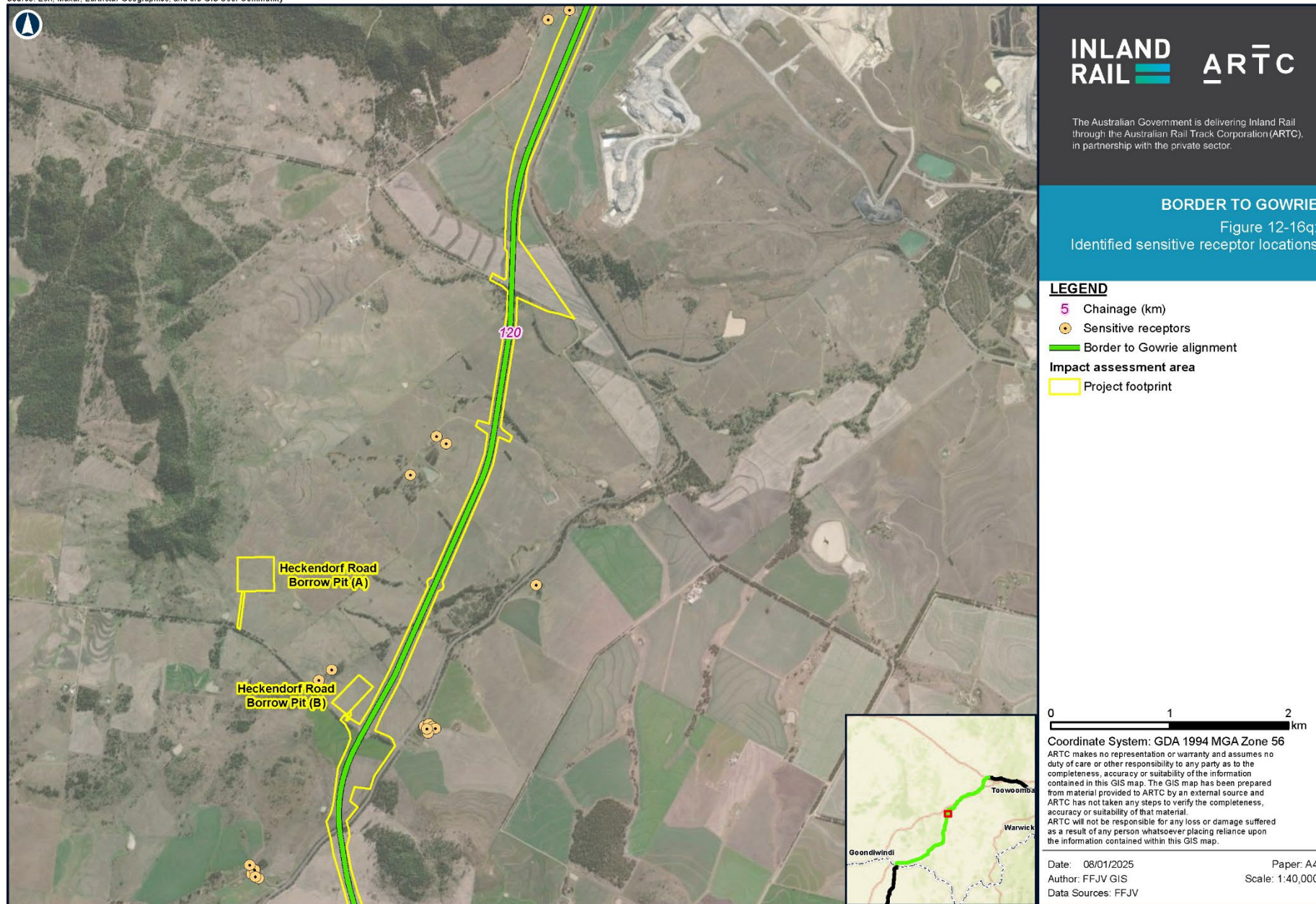
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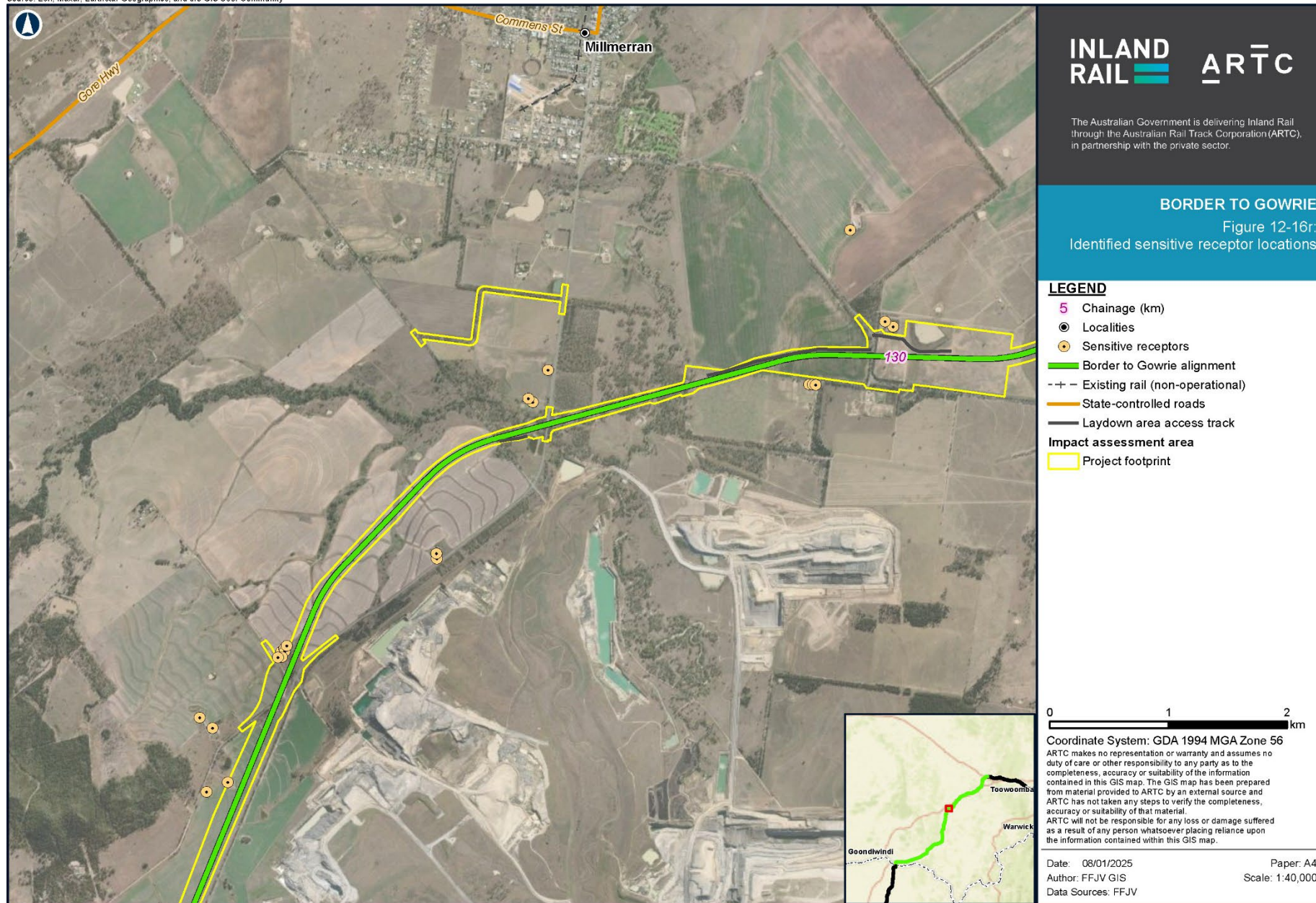
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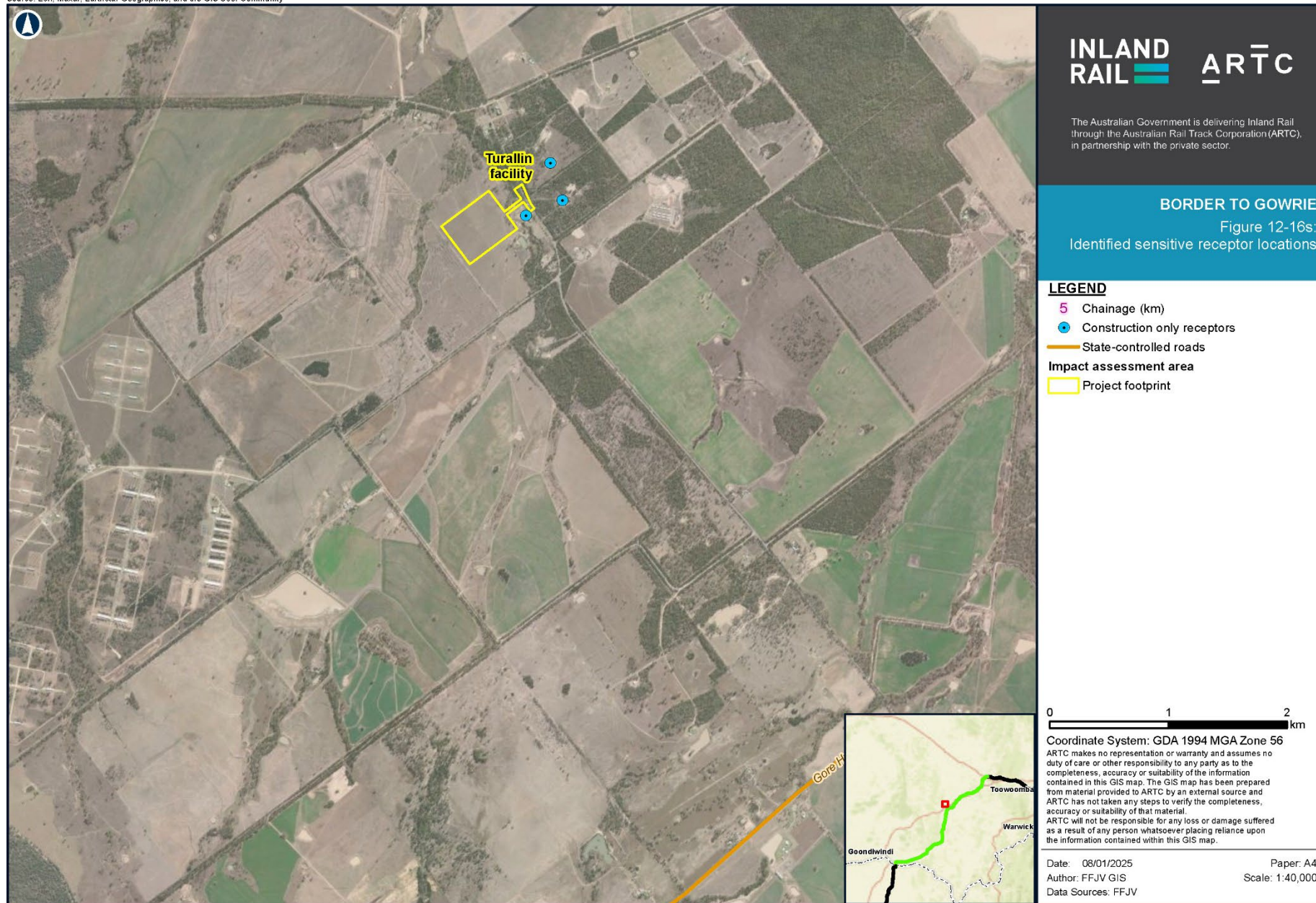


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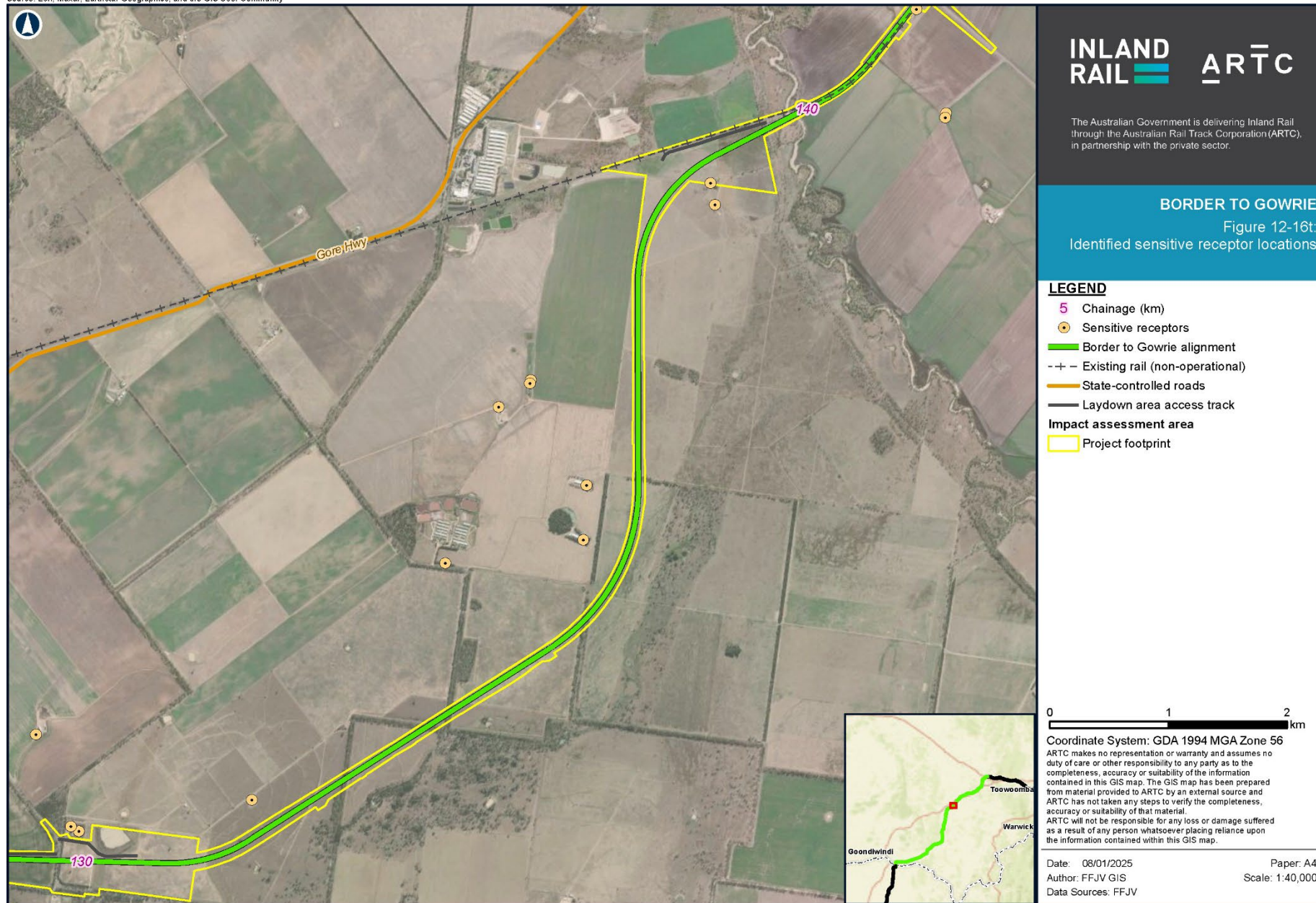
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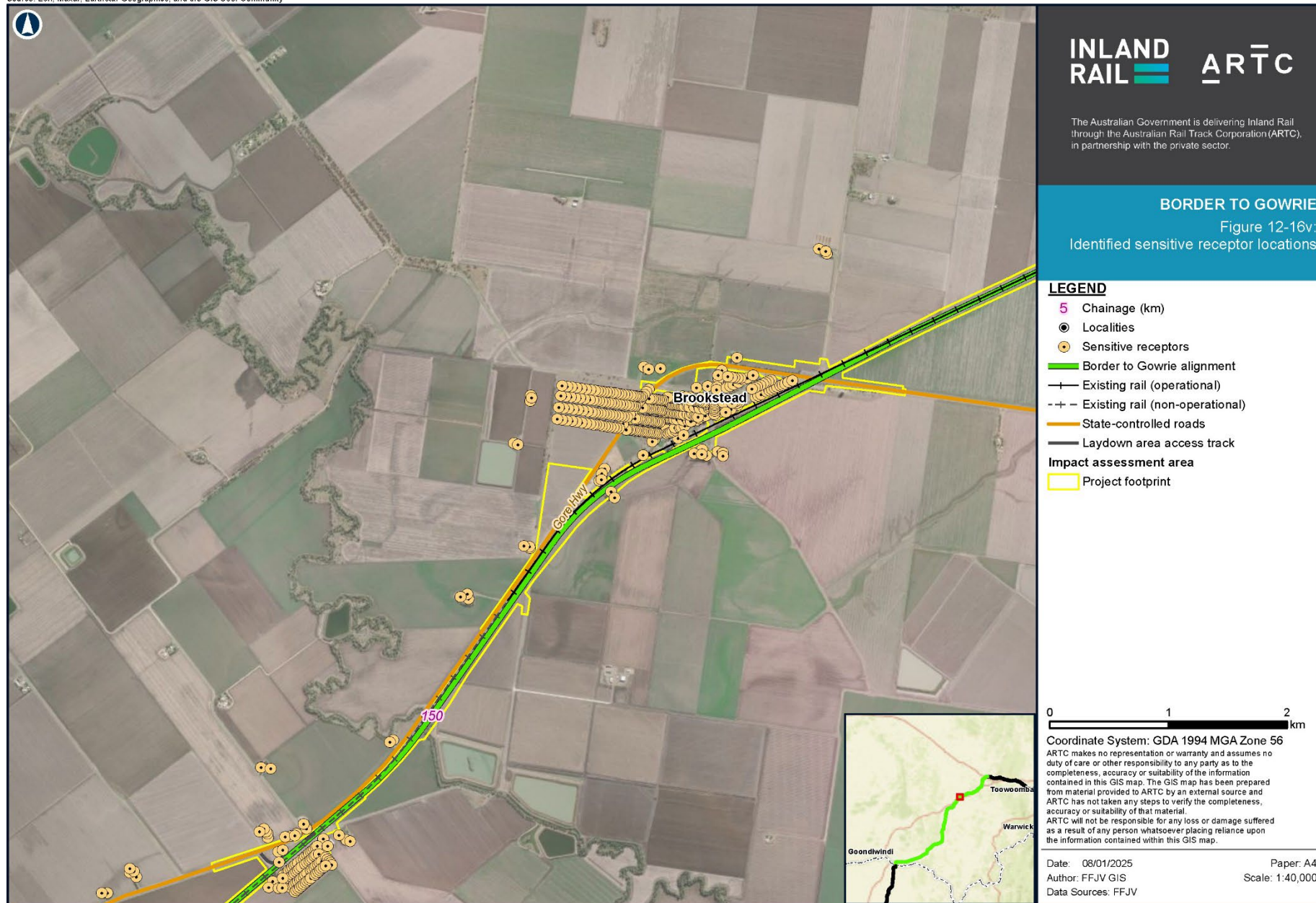
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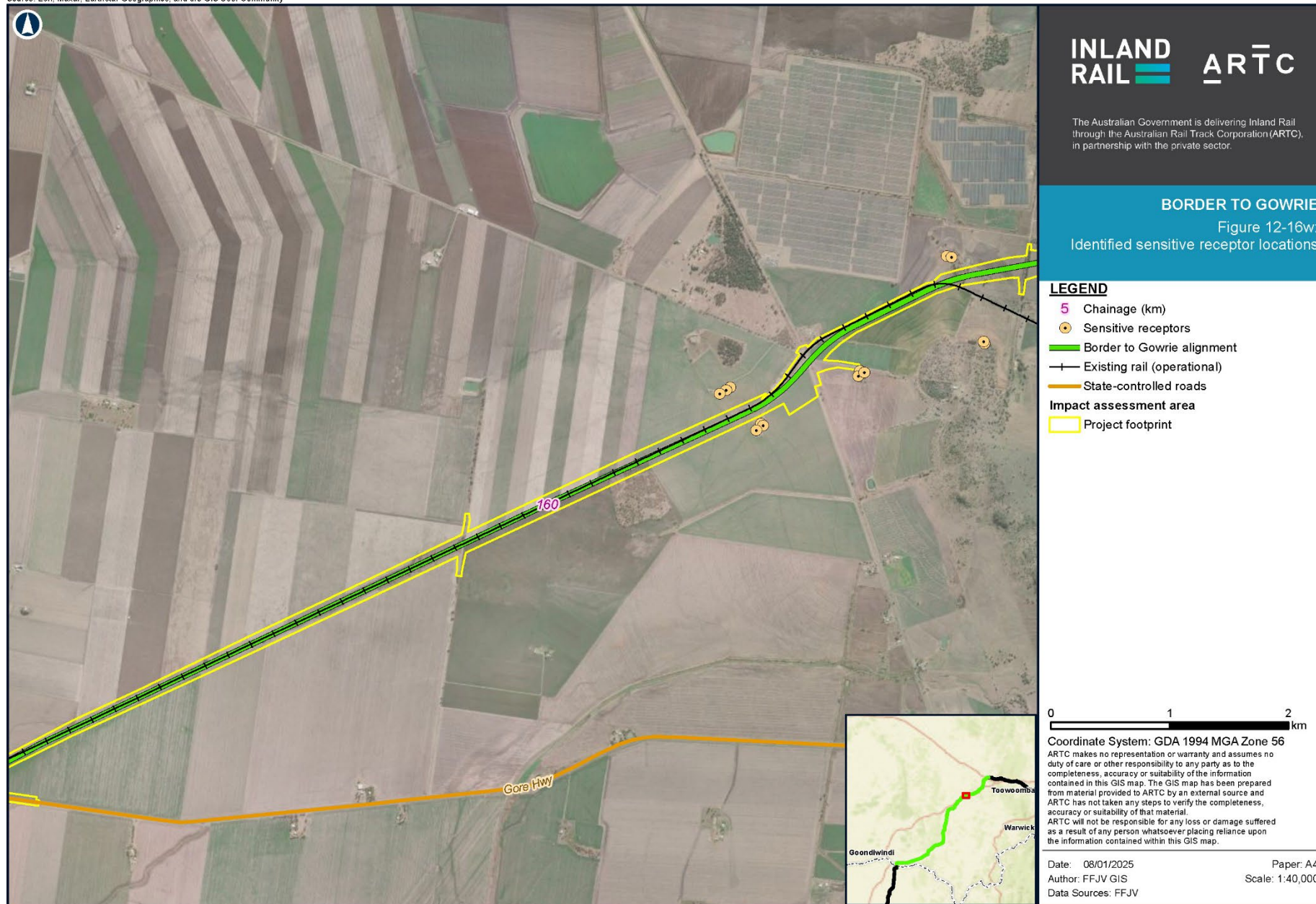


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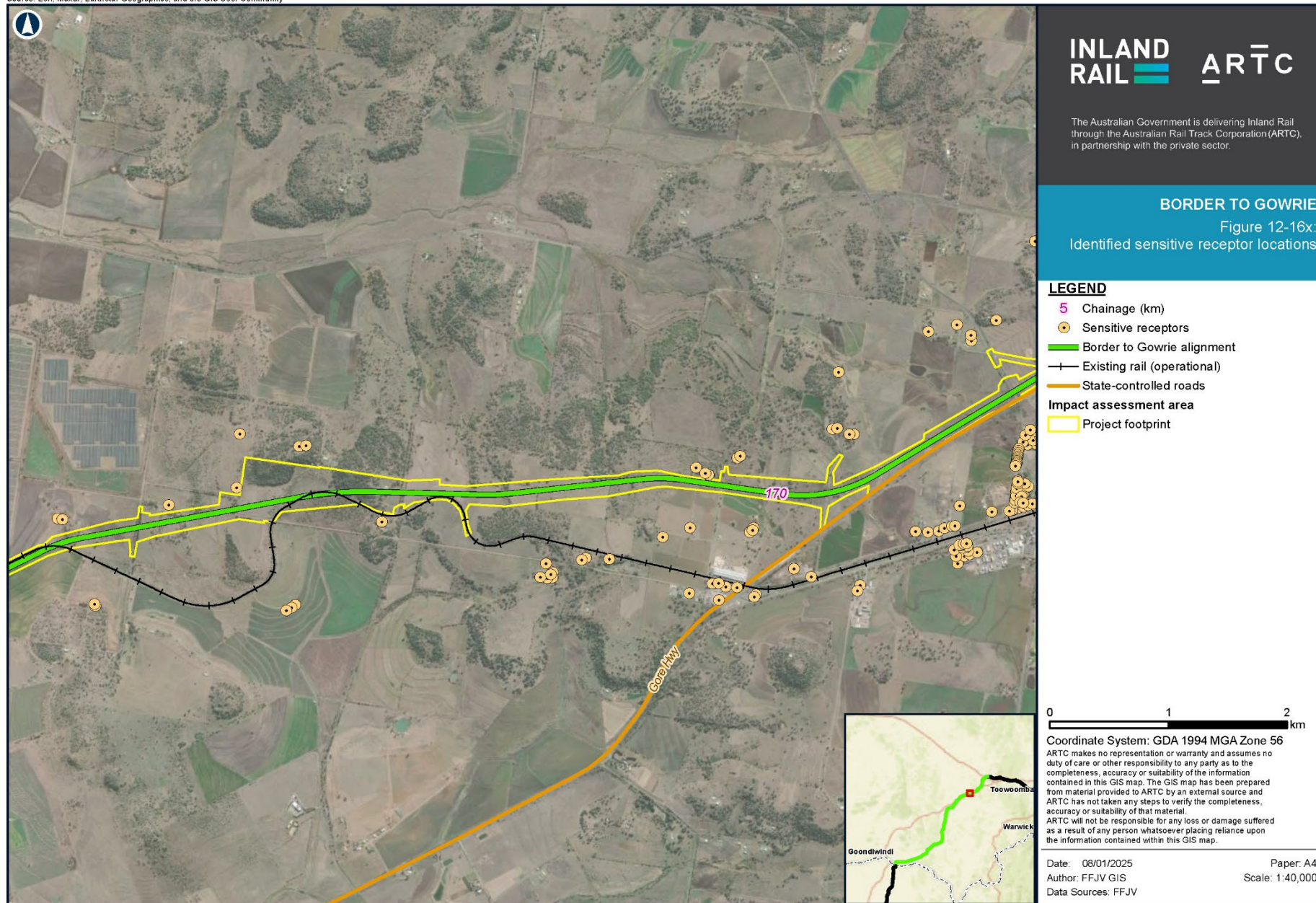




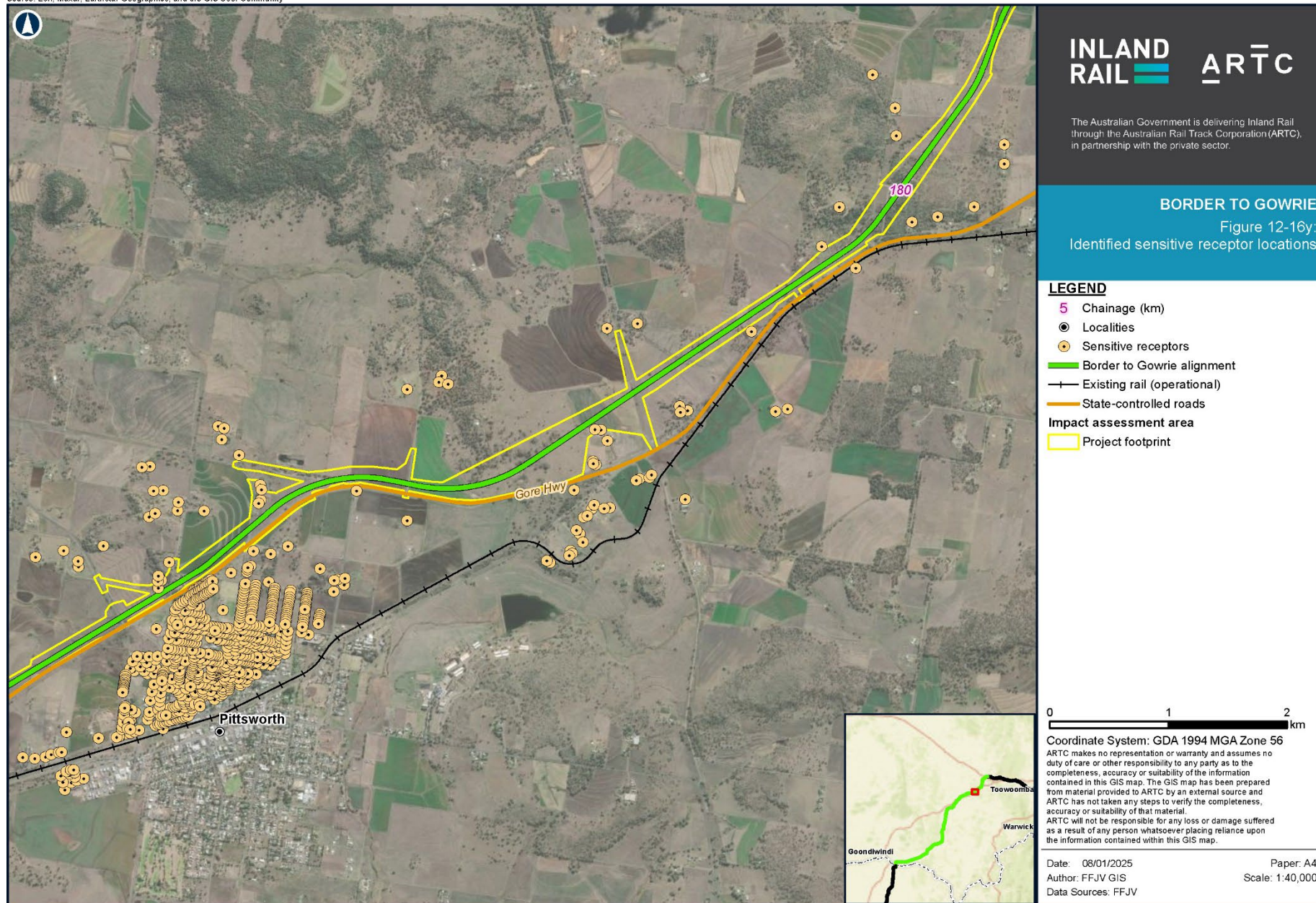
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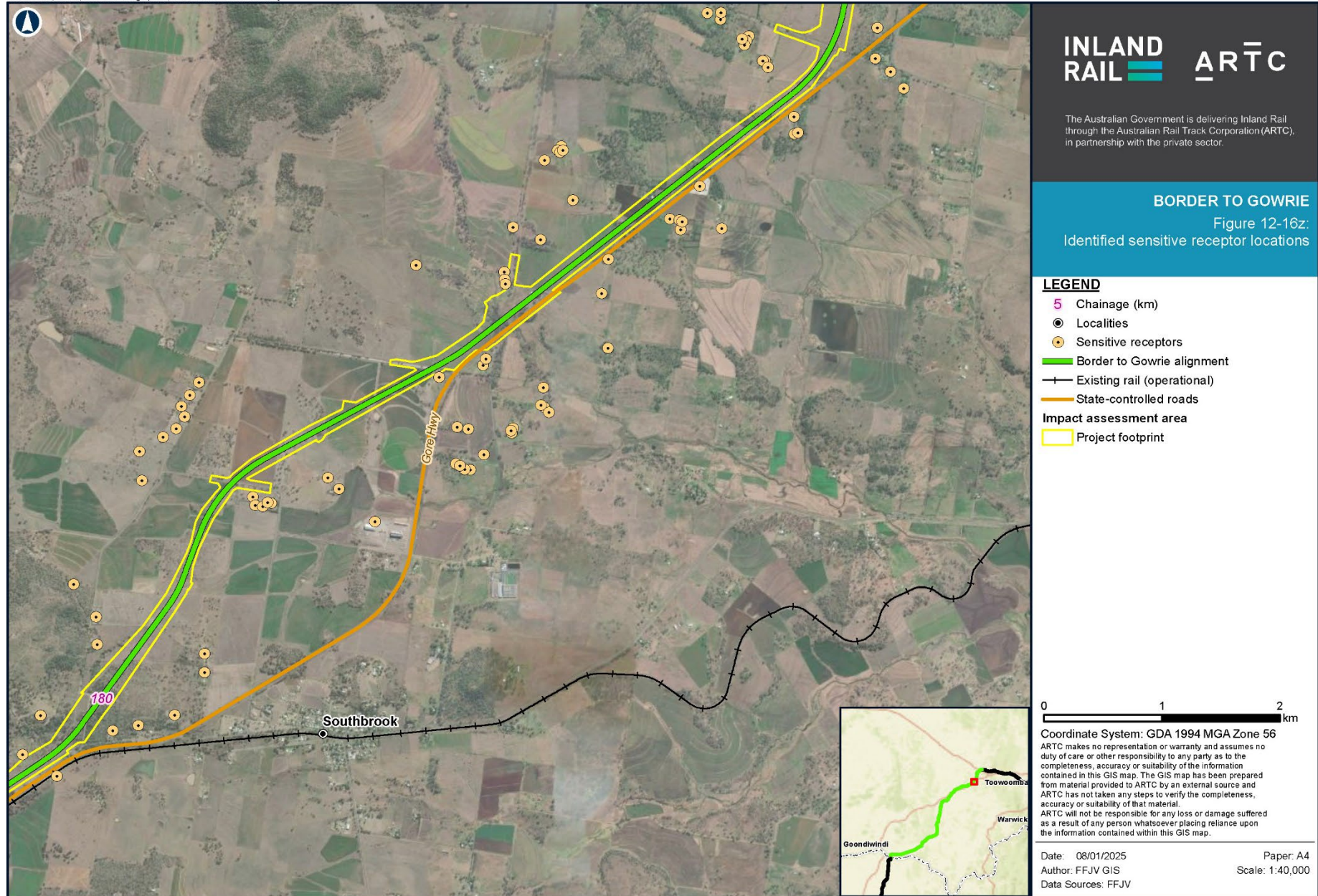
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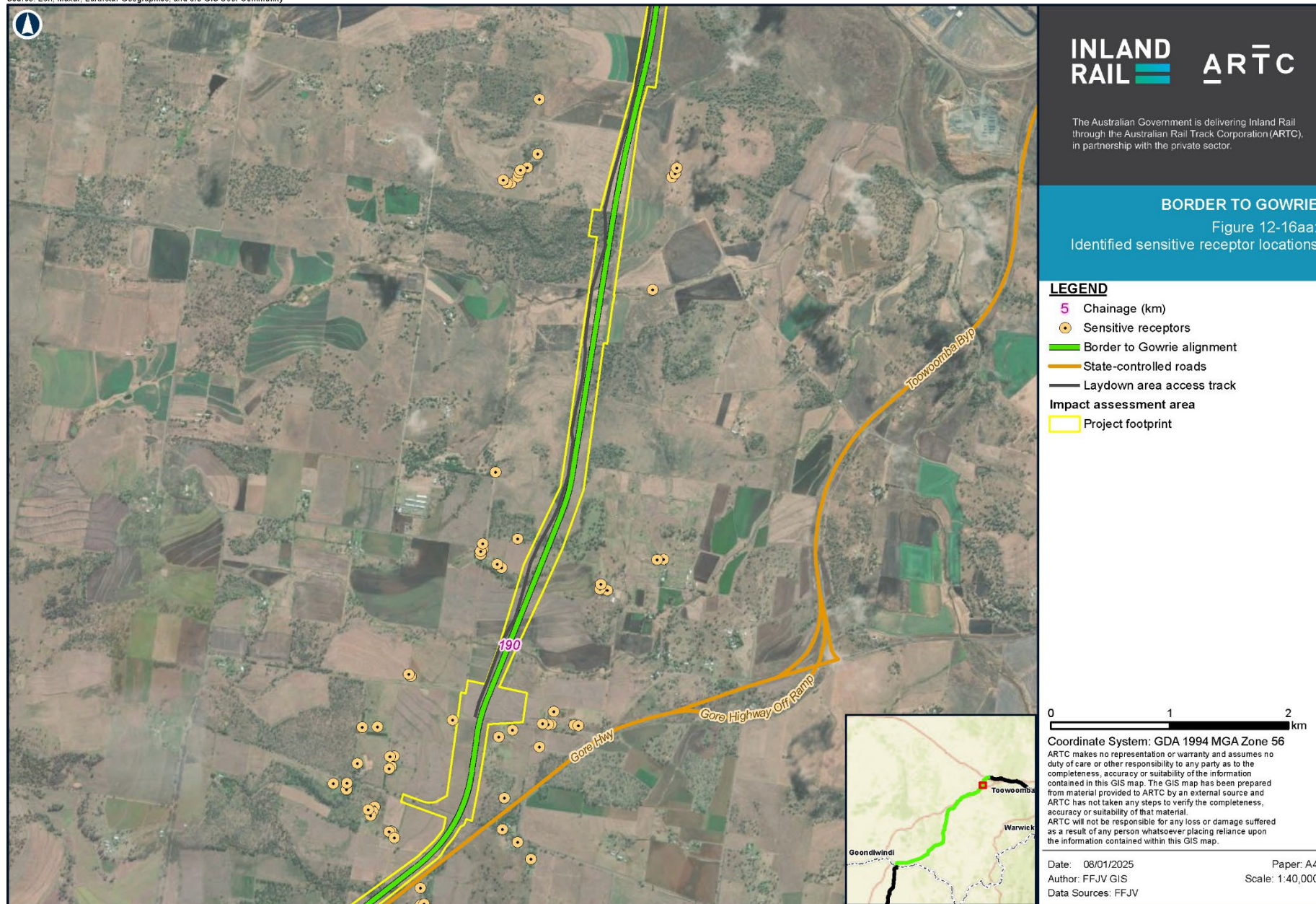
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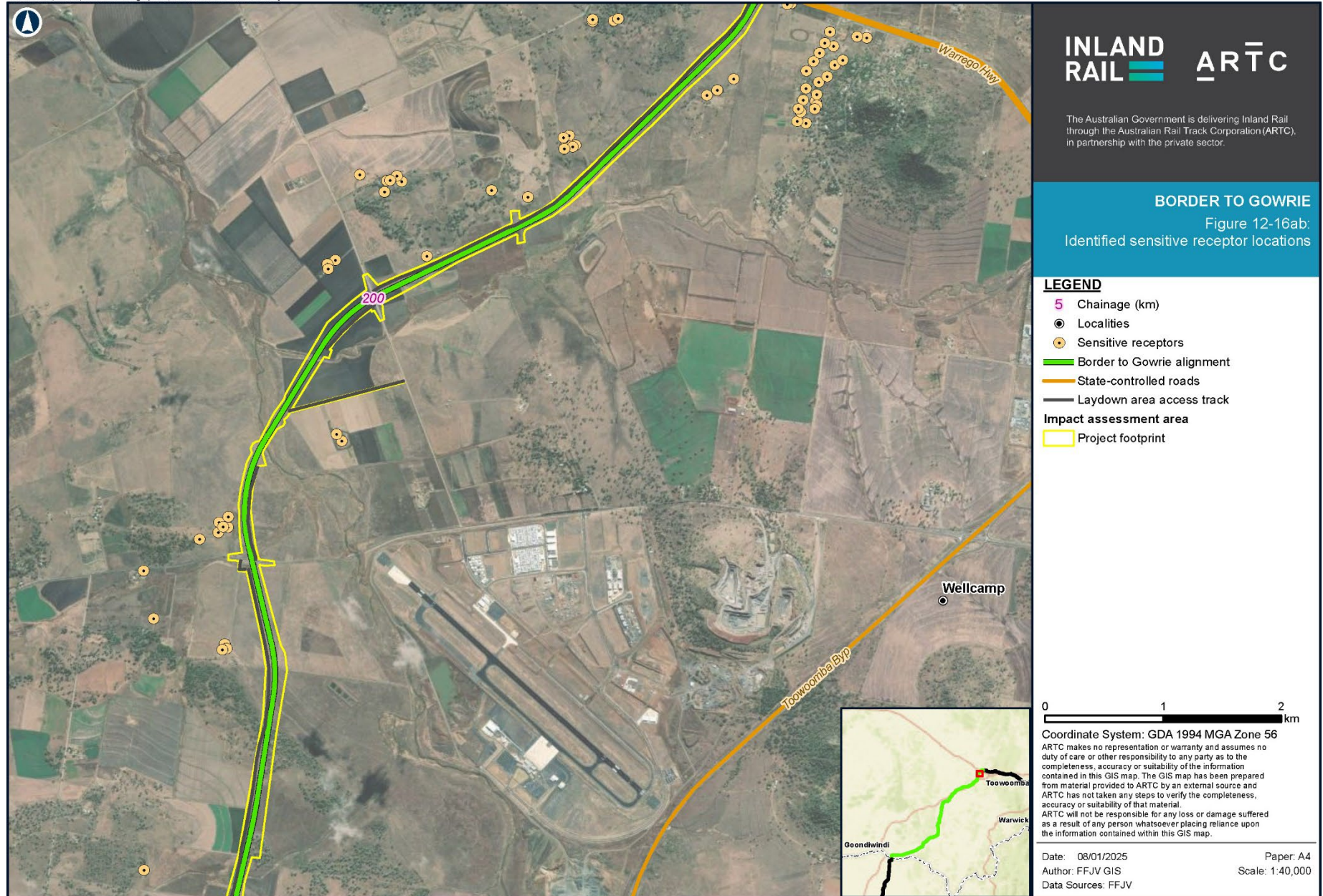
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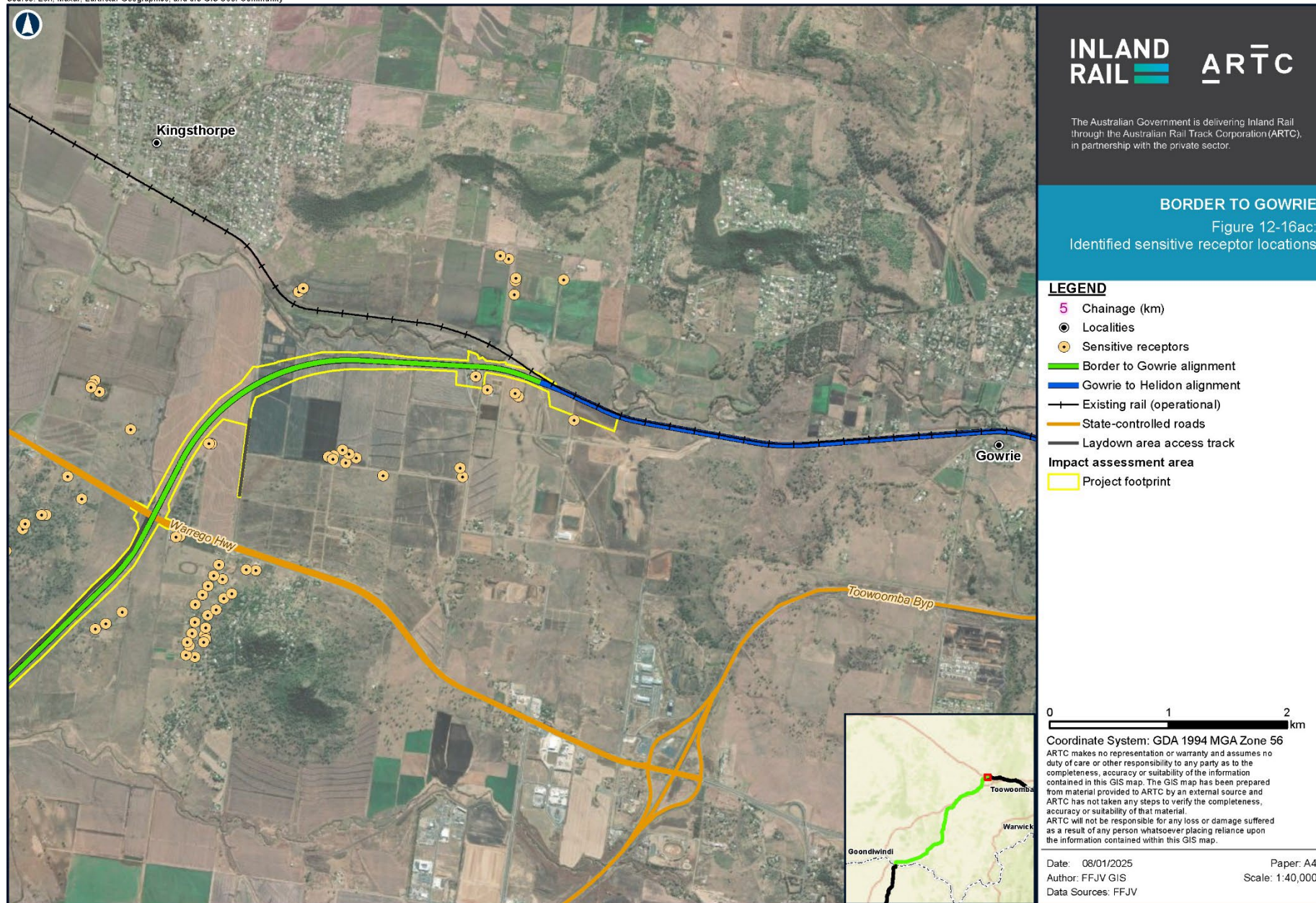
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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Map by: GN/JA/TM/AWS Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_ARTC_Fig12-16_SensitiveR_v11.mxd Date: 8/01/2025 09:25

Approved developments (e.g. residential sub-divisions) that may in future become sensitive receptor locations have also been considered and included within the AQIA. Identification of these potential future receptors was completed through a desktop review of current cadastral boundaries and, where clear undeveloped sub-divisions are present, these lots have been included as sensitive receptor locations. Additionally, the spatial data from the Queensland Government *Broadhectare (residential land supply) study* was referenced to identify further areas that in future may be residentially developed (Queensland Treasury, 2012a; 2012b).

In addition to existing sensitive receptors, two non-resident workforce accommodation sites have been included in the temporary footprint to accommodate the Project construction workforce requirements, one at Inglewood and another at Yelarbon. A third non-resident workforce accommodation site will be required in the Millmerran area and feasibility assessments will be undertaken to identify the optimal location for the site. The location for a Millmerran workforce accommodation has not been included in the revised draft EIS. The site selection and due diligence associated with locating a Millmerran workforce accommodation will be undertaken during the detailed design stage.

The Yelarbon and Inglewood non-resident workforce accommodation facilities will be occupied during the construction of the Project and therefore have been included as sensitive receptors for the construction works stage impact assessment. Non-resident workforce accommodation will not be occupied during the operation of the Project and therefore are not considered in the operations stage impact assessment. The number of sensitive receptors estimated in this assessment, 1,948 in total, are based on information provided to date and may change as the Project progresses. Due to the large-scale nature of the Project, it has been assumed that receptors within the temporary footprint will not be occupied during construction works and have therefore not been considered further.

12.4.5.2 Modelled receptor height

Discrete receptor points have been included for sensitive receptors and have been modelled at ground level (0 m above ground) as per the requirements of DES (2023). In addition to the discrete receptors, grids of receptors have been included in the modelling (at a height of 0 m above ground) to facilitate the generation of concentration contours.

It is standard (air quality) industry practice to represent predicted impacts at sensitive receptors at ground level and to determine ground level concentrations. This is stated in several State government air quality modelling guidelines in addition to the DES guideline, including in NSW EPA (2022), the South Australia (SA) EPA *Ambient air quality assessment* (SA EPA, 2016), and the EPA Victoria *Guideline for Assessing and Minimising Air Pollution in Victoria* (Victorian EPA, 2022).

It is noted that guidance documents such as the DTMR RTAQMM (2014) include reference to assessing air quality at a receptor height of 1.8 m above ground. Although road and rail projects are similar (linear infrastructure) with respect to air emissions, the RTAQMM is only strictly applicable for the assessment of air quality impacts from State-controlled road-related projects. It is also noted that the RTAQMM is not definitive in the use of 1.8 m as a receptor height, rather, it advises that a receptor height of 1.8 m is an acceptable assumption.

Experience with air quality dispersion modelling has shown that the difference in predicted concentration levels between receptors at 0 m and small heights above ground level (e.g. 1.8 m as advised by the RTAQMM) is minor in magnitude and generally insignificant with respect to the outcomes of an AQIA. This is due to the atmospheric layer near the ground level typically being well mixed. The absence of sensitivity to small changes in height is different to other similar environmental disciplines, which use predictive modelling (e.g. environmental noise) where height above ground has a more significant impact due to the strong influence of line of sight and travel path distance.

Additionally, dust deposition can only be predicted at receptor points located at ground level (0 m above ground). A key assumption of air pollutant dispersion models (both Gaussian and Lagrangian puff models, such as AERMOD and CALPUFF) is the mass depletion of pollutants (such as dust) in the model surface layer next to the ground surface. Should the conditions for deposition of air pollutants while present in this surface layer be met (e.g. sufficient residence time within the surface layer for particles to settle out of suspension), air pollutants are deposited and consequently depleted from within the model and are no longer available for dispersion. As such, air pollutant dispersion models cannot predict deposition onto a surface (e.g. the ground) if the surface does not exist in the model at the assessed height.

As deposition cannot be predicted at heights above ground level, and as the difference in predicted concentration levels between receptors at 0 m and small heights above ground level is not expected to be significant, all sensitive receptor heights in the model have been set at 0 m above ground. This receptor height has been used for the prediction of pollutant concentrations, dust deposition rates (amenity impacts) and for the assessment of impacts to tank water quality (deposition on residential rooves which led to water tanks), as discussed in Section 12.5.

Similar to concentration, the difference in deposition between 0 m and roof level (e.g. 3.5 m) is not expected to be significant; therefore, predicting deposition at 0 m for the assessment of impacts to tank water quality is considered appropriate and is expected to provide a robust assessment of potential impacts.

12.5 Potential air quality impacts

The following sections summarise the potential air quality impacts that may arise as a result of the construction works and operations stages of the Project.

12.5.1 Construction works

The highest proportion of construction emissions are generated by mechanical activity (e.g. material movement or mobile equipment activity), which typically generate coarser particulate emissions (PM₁₀ and TSP). Airborne PM₁₀ and deposited dust (TSP) are the main pollutants of concern for construction activities and these pollutant species are the focus of the assessment for construction dust.

In addition to construction dust, odour will be emitted from the sewage treatment plants required for non-resident workforce accommodation. The assessment of odour from these facilities is presented in Section 12.5.1.2.

No other significant pollutant emissions (excluding dust, odour and VOCs) are anticipated from the construction works stage of the Project.

12.5.1.1 Construction dust

A qualitative impact assessment of construction dust was completed using a four-step process to assess dust impacts.

Step 1—Screening assessment

The IAQM method recommends further assessment of dust impacts for construction activities where sensitive receptors are located closer than:

- ▶ 350 m from the boundary of the site
- ▶ 50 m from the route used by construction vehicles on public roads that are located up to 500 m from the site entrance.

There are 1,948 sensitive receptors identified within the AQIA area. Of these, 1,944 are sensitive receptors that have the potential to be impacted during the operations stage. Four receptors are located greater than 1 km from the Project alignment and therefore are not at risk of being impacted by the operations stage but have been included in assessment of the construction works stage due to being within 350 m of the temporary footprint.

The separation distances from the Project for the identified receptors are summarised in Table 12-22. The two non-resident workforce accommodation facilities for the Project are included in this summary.

The temporary footprint for the Project, including the location of laydown areas and the two non-resident workforce accommodation facilities is shown in Figure 12-16.

TABLE 12-22 SUMMARY OF SENSITIVE RECEPTORS

Distance from construction element (m)	Number of sensitive receptors			
	Access tracks	Laydown areas	Temporary footprint	Permanent footprint
< 1	0	3	24	14
1 to 20	0	10	102	94
21 to 50	1	9	127	121
51 to 100	6	69	262	254
101 to 350	99	462	578	551
>350	1,842	1,395	855	914
Total				1948

As there are receptors located within 350 m of the Project footprint, further assessment of construction impacts is required.

The number of sensitive receptors identified in this assessment is current at the time of assessment and minor variations to the number of sensitive receptors may occur as the Project progresses. The extent of property impacts will be confirmed prior to the commencement of the construction works stage, in consultation with property owners.

Step 2—Dust risk assessment

Step 2 in the IAQM is a risk assessment tool designed to appraise the potential for dust impacts due to unmitigated dust emissions from a construction project. The key components of the risk assessment are defining the dust emission magnitudes (Step 2A), the surrounding area sensitivity (Step 2B), and then combining these in a risk matrix (Step 2C) to determine an overall risk of dust impacts.

Step 2A—Dust emission magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken and other considerations such as the scale of works required and the types of material being used. Detailed explanation of the methodology is provided in Appendix R: Air Quality Technical Report.

Justification and the factors used in determining the magnitudes are presented in Table 12-23. Multiple work fronts will be active at any one time along the alignment.

TABLE 12-23 CONSTRUCTION ACTIVITIES AND DUST EMISSION MAGNITUDE JUSTIFICATION

Activity	Potential dust emission magnitude	Justification
Demolition	Small	▶ Existing buildings likely to be demolished, all assumed to be small homesteads ▶ Buildings assumed to be primarily of low dust potential material (wood/cladding). Materials to be confirmed prior to demolition ▶ Total building volume presently unknown although assumed to be <10,000 m³ ▶ Minimal demolition for realignment of existing roads—to be confirmed in the detailed design stage of the Project.
Earthworks	Large	▶ Multiple work fronts at any one time along the alignment ▶ Vegetation clearing along the proposed alignment corridor for new access tracks and laydown areas will occur where necessary—no known quantities at this stage. Clearing is staged to limit size of disturbance area at any one time ▶ Topsoil along the entire alignment (217.48 km) will be stripped (approximate depth of 0.21 m) and stockpiled. Wherever possible and appropriate, material will be reused within Project footprint ▶ 78 laydown areas along the alignment, with the ability to provide locations for excavation stockpiling. Stockpiles to be located as close as possible to the excavation source ▶ Total cut of 11,458,700 m³ and total fill of 12,678,300 m³ ▶ Utility relocations—more information to be provided in the detailed design stage ▶ Earthworks material likely to be dusty especially during dry season. Soil types along corridor location are detailed in Appendix J: Soil Assessment Report ▶ Blasting, ripping and digging of material required between select chainages along the alignment ▶ Mobile plant used for earthworks is expected to include dozers, excavators, scrapers, mulchers, rollers, graders, drilling rigs front end loaders, water carts and haul vehicles.
Construction	Large	▶ Construction period of approximately four years, with multiple work fronts at any one time along the alignment ▶ Installation of approximately 217.48 km of railway utilising steel rail, sleepers, ballast and concrete. Concrete and ballast present high dust risk ▶ Construction of 37 new bridge structures—steel material low dust risk but concrete high dust risk ▶ Temporary site offices and parking facilities likely to be constructed at each laydown area ▶ Construction of 16 fuel storage facilities: four approximately <20,000 L, and 12 approximately <10,000 L ▶ Laydown areas to also include temporary parking facilities for construction workers ▶ Construction of welding facilities at Whetstone MDC ▶ Construction of temporary and permanent fencing—total lengths to be determined during the detailed design stage ▶ Mobile plant used for the construction of structures is expected to include excavators, piling rigs, concrete trucks and concrete pumps, cranes, backhoes, compactors, dozers, graders, rollers, front end loaders, ballast train, rail tamper and regulator, water carts and haul vehicles.
Track-out	Large	▶ Multiple work fronts at any one time along alignment ▶ High amount of daily vehicle movements expected per work site (both light and heavy vehicles) ▶ Movement of ballast from sources, and between laydown area and ballast handling facility via 18 tonne dump trucks ▶ Movement of spoil by registered road trucks ▶ Total length of unpaved road/access tracks unknown until design is finalised but will be >100 m due to the size of the Project

Step 2B—Sensitivity of surrounding area

The IAQM methodology allows the sensitivity of an area to dust deposition and human health impacts due to particulate matter to be classified as high, medium, or low. The classifications are determined according to matrix tables provided in the IAQM guidance document. Individual matrix tables for dust deposition and human health impacts are provided. Factors used in the matrix tables to determine the sensitivity of the surrounding area are described as follows:

- ▶ Receptor sensitivity (for individual receptors in the area):
 - ▶ high sensitivity—locations where members of the public are likely to be exposed for eight hours or more in a day. For example, private residences, hospitals, schools, or aged care homes
 - ▶ medium sensitivity—places of work where exposure is likely to be eight hours or more in a day
 - ▶ low sensitivity—locations where exposure is transient (i.e. one or two hours maximum e.g. parks, footpaths, shopping streets, playing fields).
- ▶ Ambient annual mean PM₁₀ concentrations (only applicable to the human health impact matrix)
- ▶ Number of receptors in the area
- ▶ Proximity of receptors to dust sources.

Table 12-24 details the IAQM guidance sensitivity levels from dust deposition effects on people and property. As detailed in Step 1, the total number of receptors identified in the impact assessment area is 1,948. All 1,948 receptors are classified as high sensitivity. Of the 1,948 receptors:

- ▶ 1,093 are located within 350 m of a construction dust source (temporary area)
- ▶ 515 of the 1,093 are located within 100 m
- ▶ 253 of the 1,093 receptors are within 50 m
- ▶ 126 of the 1,093 receptors are within 20 m
- ▶ 24 of the 1,093 receptors are located within the bounds of the construction area (0 m separation distance).

Assessing the sensitivity level to dust deposition effects from the Project using the IAQM guidance, the sensitivity is determined to be 'High' as there are more than 100 receptors located within 20 m of active construction areas; however, the length of the Project is 217.48 km and the density of receptors near active construction areas is much less than a standard construction site in an urban area. Based on the land use of the AQIA area, a rating of 'High' for sensitivity to dust deposition is considered overly conservative, and a rating of 'Medium' is considered more appropriate. A rating of 'Medium' has been used for the sensitivity of receptors to dust deposition impacts. This approach is consistent with the IAQM guidance, which recommends the use of professional judgement in the assessment of sensitivity.

TABLE 12-24 IAQM SURROUNDING AREA SENSITIVITY TO DUST DEPOSITION IMPACTS

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20 m	<50 m	<100 m	<350 m
High	>100	High	High	Medium	Low
	10 to 100	High	Medium	Low	Low

A modified version of the IAQM guidance for assessing the sensitivity of an area to human health impacts is shown in Table 12-25. For high and medium sensitivity receptors, the IAQM methods consider the existing background concentrations of PM₁₀ (as an annual average) experienced in the area of interest (e.g. AQIA area). The IAQM method effectively considers the assimilative capacity of the environment through consideration of background concentrations.

As the UK objectives for PM₁₀ goals differ from the ambient air quality goals adopted for use in this assessment (EPP (Air) objectives), the annual mean concentration categories used in the assessment (Table 12-25) have been modified from those presented in the IAQM method. This approach is consistent with the IAQM guidance, which notes that in using the tables to define the sensitivity of an area, professional judgement may be used to determine alternative sensitivity categories.

TABLE 12-25 SURROUNDING AREA SENSITIVITY TO HUMAN HEALTH IMPACTS

Receptor sensitivity ^a	Annual mean PM ₁₀ concentration ^b	Number of receptors	Distance from the source (m)				
			<20 m	<50 m	<100 m	<250 m	<350 m
High	> 25 µg/m ³	> 100	High	High	High	Medium	Low
		10 to 100	High	High	Medium	Low	Low
		1 to 10	High	Medium	Low	Low	Low
	21 to 25 µg/m ³	> 100	High	High	Medium	Low	Low
		10 to 100	High	Medium	Low	Low	Low
		1 to 10	High	Medium	Low	Low	Low
	17 to 21 µg/m ³	> 100	High	Medium	Low	Low	Low
		10 to 100	High	Medium	Low	Low	Low
		1 to 10	Medium	Low	Low	Low	Low
	< 17 µg/m ³	> 100	Medium	Low	Low	Low	Low
		10 to 100	Low	Low	Low	Low	Low
		1 to 10	Low	Low	Low	Low	Low

Table notes:

a A relevant subset of the source table (UK IAQM, 2014) has been reproduced, for receptor sensitivity of 'High' only

b The annual mean PM₁₀ concentration categories have been modified from the IAQM guidance to adjust for assessment of a site in Queensland.

As detailed in Section 12.4.2, the background annual average PM₁₀ concentration from the Inland Rail AQMS adopted for the AQIA area for the assessment is 12.4 µg/m³.

Table 12-25 provides the modified IAQM guidance sensitivity levels for human health impacts for four annual mean PM₁₀ background categories. The background annual average PM₁₀ concentration of 12.4 µg/m³ falls within the below 17 µg/m³ category.

There are greater than 100 high sensitivity receptors within 20 m of the Project's temporary footprint; therefore, based on the IAQM risk matrix, the sensitivity of the AQIA area to human health impacts is considered to be 'Medium'.

Step 2C—Unmitigated risks of impacts

The dust emission magnitudes for each activity as determined in Step 2A were combined with the sensitivity of the AQIA area (Table 12-24 and Table 12-25) to determine the risk of construction dust air quality impacts, with no mitigation applied. The risk of impacts for each activity is assessed according to the IAQM risk matrix for each activity, which is presented in Table 12-26. The 'without mitigation' dust risk impacts for each activity are summarised in Table 12-27.

TABLE 12-26 IAQM RISK MATRIX

Activity	Surrounding area sensitivity	Dust emission magnitude		
		Large	Medium	Small
Demolition	High	High risk	Medium risk	Medium risk
	Medium	High risk	Medium risk	Low risk
	Low	Medium risk	Low risk	Negligible
Earthworks	High	High risk	Medium risk	Low risk
	Medium	Medium risk	Medium risk	Low risk
	Low	Low risk	Low risk	Negligible
Construction	High	High risk	Medium risk	Low risk
	Medium	Medium risk	Medium risk	Low risk
	Low	Low risk	Low risk	Negligible
Track-out	High	High risk	Medium risk	Low risk
	Medium	Medium risk	Low risk	Negligible
	Low	Low risk	Low risk	Negligible

TABLE 12-27 WITHOUT MITIGATION DUST RISK IMPACTS FOR PROJECT CONSTRUCTION ACTIVITIES

Activity	Demolition	Earthworks	Construction	Track-out
Scale of Activity (IAQM Table 4)	Small	Large	Large	Large
Dust deposition	Low	Medium	Medium	Medium
Human health	Low	Medium	Medium	Medium

The result of the qualitative air quality risk assessment shows that the unmitigated air emissions from the construction of the Project poses a 'Low' to 'Medium' risk of impact to human health and to amenity from dust deposition.

Step 3—Management strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. The IAQM guidance states that a high or medium-level risk rating means that suitable management measures will need to be implemented during construction to reduce the risk of significant impacts.

A Construction Environmental Management Plan (CEMP) will be developed to mitigate and manage potential impacts during construction, as detailed in Chapter 24: Draft Outline Environmental Management Plan. The implementation of approved site-specific and in-principle management measures, as listed in Section 12.6.3, is expected to result in minimal risk of dust impacts on surrounding receptors.

Step 4—Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from a proposed development.

Mitigation measures proposed to mitigate construction impacts are presented in Table 12-36. An assessment of the residual risk of impact from construction with the implementation of the proposed mitigation measures is presented in Table 12-37.

12.5.1.2 Non-resident workforce accommodation facilities

Construction personnel who do not live within a safely commutable distance to the Project will be housed in two temporary non-resident workforce accommodation facilities, located at Yelarbon and Inglewood. Each accommodation facility will have capacity to accommodate a minimum of 300 beds. The average occupancy of the non-resident workforce accommodation facilities outside of the peak period will be approximately 150 people per facility.

It is anticipated that each non-resident workforce accommodation facility will be self-contained, including the provision of on-site temporary package sewage treatment plants. Sewage treatment plants with a capacity of 300 equivalent persons (EP) will be required to service each non-resident workforce accommodation facility. Odour impacts are possible even from small scale sewage treatment plants, such as those proposed.

The EPA Victoria guideline *Recommended separation distances for industrial residual air emissions* (Victorian EPA, 2013) provides guidance on suitable separations distances between wastewater treatment facilities and neighbouring sensitive receptors. Table 12-28 presents the calculation methods and derived separation distances for a 300 EP sewage treatment plant.

TABLE 12-28 SEPARATION DISTANCES FOR SEWAGE

Type of installation	EPA Victoria separation distance equation	Separation distance for 300 EP sewage treatment plant (m)
Mechanical/biological wastewater plants	$10 n^{1/3}$	67
Aerobic pondage systems	$5 n^{1/2}$	87
Facultative ponds	$10 n^{1/2}$	173

Table notes:
n = equivalent population

Mechanical or biological wastewater treatment systems are likely to be used and therefore a minimum separation distance of 67 m will be maintained from neighbouring sensitive receptors to minimise odour impacts.

If the capacity of the accommodation facilities is required to change, the method described in this section can be used to determine the required separation distance to minimise the risk of odour impacts.

12.5.1.3 Whetstone Material Distribution Centre

The Whetstone MDC will be temporarily established along the alignment, between Inglewood and Yelarbon, to support the construction of the Project and reduce the need for road transportation. Once the Project is fully constructed, the Whetstone MDC will be progressively decommissioned.

The operation of the Whetstone MDC will involve the following works and activities:

- ▶ Material handling and distribution for both site-won and imported material
- ▶ Internal rail track construction
- ▶ Site offices and facilities
- ▶ Rollingstock provisioning and maintenance facilities
- ▶ Hardstand area for material stockpiling
- ▶ Ballast unloading facilities
- ▶ Rail welding facility and generators.

To facilitate the operation of the Whetstone MDC, upgrade of the Whetstone access road and Cunningham Highway intersection (e.g. turning lanes) will be undertaken.

Sensitive receptors within a 350 m buffer of the Whetstone MDC are included in the construction dust assessment in Section 12.5.1.1.

The location of the Whetstone MDC is shown in Figure 12-16.

12.5.1.4 Turallin facility

A facility will be established near the township of Turallin to support the construction of the Project. The Turallin facility is located over 10 km from the Project alignment and is shown in Figure 12-16.

The facility will be utilised for a laydown area, a training facility, or native plant nursery and traditional land management training facility (proposed land use subject to ongoing negotiations between the Australian Rail Track Corporation (ARTC) and landowners).

For the purposes of the construction dust assessment, it has been assumed that the facility will be used as a laydown area, which is the use with the highest potential for dust generation. Sensitive receptors within a 350 m buffer of the facility and are included in the construction dust assessment in Section 12.5.1.1.

This approach is considered to provide a conservative assessment of potential impacts as the separation distance between the Turallin facility and the Project alignment means that the risk of cumulative construction dust impacts is negligible.

12.5.1.5 Tank fuel storage

Fuel tank storage locations are proposed at 16 laydown areas along the Project site during the construction of the Project. Table 12-29 presents the construction laydown areas that will include diesel fuel storage areas, the storage volumes proposed, and distance from the laydown area to the closest identified sensitive receptor.

For the largest fuel storage tanks of 20,000 L, the distance to the closest receptor is approximately 120 m, while for the smaller tanks of 10,000 L, the distance to the closest receptor is 15 m.

EPA Victoria (2013) provides guidance on separation distances for the storage of petroleum products (100 m for floating roof tanks, and 250 m for fixed roof tanks); however, this guidance is for tanks exceeding 2,000 tonnes, which is far greater than the size of the tanks proposed for the Project.

TABLE 12-29 FUEL TANK STORAGE LOCATIONS

Construction area ID	Chainage (km)	Location	Fuel storage proposed (L)	Distance from boundary of temporary footprint to closest sensitive receptor
NS2B-LDN035.6	35.6	Eukabilla Road	20,000	800 m
B2G-LDN006.3	6.2	Yelarbon-Kurumbul Road	10,000	15 m
B2G-LDN025.9	25.9	Yelarbon- south)	10,000	95 m
B2G-LDN025.9	25.8	Yelarbon (north)		90 m
Whetstone MDC	44.8	Whetstone Access and Cunningham Highway	20,000	150 m
B2G-LDN054.2	54.3	Cremascos Road	10,000	160 m
B2G-LDN074.0	74.2	Millmerran-Inglewood Road	10,000	680 m
B2G-LDN081.0	81.1	Wongavale Yugibar Road	10,000	3.45 km
B2G-LDN104.5	104.6	Partons Road	10,000	385 m
B2G-LDN116.0	116.2	Heckendorf Road	20,000	120 m
Turallin facility	127.0	Turallin Road	10,000	50 m
B2G-LDN161.0	162.3	Yarralea Road	20,000	250 m
B2G-LDN175.5	176.9	Linthorpe Road	10,000	95 m
B2G-LDN188.2	189.5	Athol School Road	10,000	80 m
B2G-LDN192.3	193.6	via Athol Road	10,000	575 m
B2G-LDN206.3	207.6	Leesons Road	10,000	70 m

Due to the lack of applicable policy by Toowoomba Regional Council (TRC) and Goondiwindi Regional Council (GRC), guidelines from other councils within Queensland have been applied for the AQIA. The BCC Service Station Code within the Brisbane City Plan 2014 provides performance outcomes and acceptable outcomes for service stations to ensure that service station developments are located at sufficient distances from sensitive uses to maintain amenity, health and wellbeing. The current version of the Service Station Code is Version 28 (v28), released 1 September 2023. It provides minimum separation distances for service stations with the inclusion of Stage 1 vapour, which is not considered appropriate for small fuel storage tanks as proposed for the Project.

Version 19 of the Service Station Code (released 1 May 2020) included separation distances for service stations (based on annual throughput) without vapour recovery technology. Acceptable Outcome AO7.2 of Version 19 stated that for service stations with an annual fuel throughput of less than 1.2 ML, the acceptable separation distance is 10 m, whilst for service stations with annual fuel throughput of between 1.2 to 9 ML, the accepted distance is 50 m.

Although this version of the Service Station Code is superseded, it is still considered appropriate to use in the assessment of separation distances for fuel storage. The Service Station Code specifically excludes diesel from the definition of fuel. However, diesel is less volatile than petrol and other motor spirits and therefore the application of the separation distances from the Service Station Code to fuel storage areas for the Project represents a conservative assessment.

To exceed an annual throughput of 9 ML, the 20,000 L tanks would need to be refilled more than once per day (450 times per year), while the 10,000 L tanks would need to be refilled more than twice per day (900 times per year). It is considered improbable that this volume of diesel will be consumed, and it is expected that annual fuel throughput will be considerably less than 9 ML per tank.

It is proposed that at minimum, fuel tanks would be located at least 50 m from the nearest sensitive receptor, but separation distances would be maximised as far as practical within site restrictions. Compliance with Australian Standard AS 1940:2017 - *The storage and handling of flammable and combustible liquids* (Standards Australia, 2017a), and a minimum separation distance of 50 m is expected to result in negligible impacts to sensitive receptors.

All construction areas except for B2G-LDN006.3 have a separation distance from the nearest boundary to the closest receptor of greater than 50 m; however, the dimensions of B2G-LDN006.3 are approximately 300 m x 27 m, and therefore the tank can be located at a position that is further than 50 m from the nearest receptor within this construction area.

In the event that the location of the fuel storage tanks needs to be altered, a minimum separation distance of 50 m would be adhered to in order to minimise the risk of significant impacts to air quality from fugitive emissions.

12.5.1.6 Concrete batching plant

Two concrete batching facilities are required for the construction works stage of the Project. Two location options have been identified for the siting of the plant, laydown areas B2G-LDN150.5 (Dieckmann Road) and BNG-LDN138.5 (Hall Road), located on the Gore Highway immediately north and south of the Condamine River floodplain, respectively.

Concrete batching plants have the potential to impact local air quality primarily through emissions of dust associated with the handling of cement, aggregate, sand, and other input materials.

Recommended separation distances for concrete batching plants are provided in the SA EPA *Air & Water Quality Guideline – Concrete batching* (SA EPA, 2016). For batching plants, the SA EPA guideline recommends a minimum separation distance from housing or other activities of 100 m. In addition, SA EPA (2016) also states the following:

If a mobile batch plant is used for the preparation of concrete, the plant must not be positioned closer than 50 m to an environmentally sensitive location. In addition, where possible a buffer zone of 100 m from any township, municipality or residential dwelling should be provided when batching concrete.

If located at B2G-LDN150.5, the temporary batching plant would be located to the south-west of the Vary Agricultural Services (VAS) business, located at 92 Ware Street, Brookstead. VAS is an agricultural business which undertakes storage and transport of food (e.g. grain), and fertiliser products.

VAS has been included in the construction dust risk assessment (sensitive receptor 213); however, additional assessment has been undertaken for VAS to investigate potential impacts from the batching plant.

The dimensions of B2G-LDN150.5 are approximately 700 m long (north to south) by 360 m wide (east to west) at its widest point (triangle shaped laydown area). The separation distance from the boundary of B2G-LDN150.5 to the boundary of the VAS site is approximately 50 m, with the separation distance from the boundary of B2G-LDN150.5 to the nearest façade of the VAS storage building being approximately 100 m.

To minimise the potential for impacts, the temporary batching plant at B2G-LDN150.5 will be located as far as practical from the VAS site boundary and achieve a minimum boundary to boundary separation distance of 100 m. Based on the size of B2G-LDN150.5, it is expected that this separation distance will be readily achievable.

The separation distance from the boundary of B2G-LDN138.5 to the nearest sensitive receptor is 230 m; therefore, if the temporary batching plant were located at B2G-LDN138.5, the recommended minimum separation distance of 100 m will be met.

In addition to this minimum separation distance, additional mitigation measures to minimise the potential for impacts from the batching plant are provided in Table 12-36.

In the event that the location of the batching plant needs to be altered, a minimum separation distance of 100 m would be adhered to in order to minimise the risk of significant impacts to air quality from batching plant emissions.

12.5.1.7 Blasting

Blasting is proposed for the construction of certain sections of the alignment as identified by the chainage range in Table 12-30. Blasting will generate dust, which has the potential to impact sensitive receptors. Blasting will also result in fugitive gas emissions. Gaseous emissions from blasting are generated in lower magnitudes than dust and pose a lower risk of impact. During construction, ARTC will assess risks from blasting in two stages:

- ▶ Stage 1: ARTC will undertake an initial appraisal and provide 'in principle' approval to blast in proximity to infrastructure
- ▶ Stage 2: Detailed assessment and approval.

Assessment of the potential for dust impacts from blasting has been undertaken considering the EPA Victoria guideline *Recommended separation distances for industrial residual air emissions* (Victorian EPA, 2013). The EPA Victoria guideline does not specifically include blasting for construction but does include a recommended separation distance of 500 m for quarries that undertake blasting, which is considered an appropriate surrogate. Chainages along the alignment where blasting is required are presented in Table 12-30. Table 12-30 also identifies sensitive receptors that are located within 500 m of these blast areas.

Table 12-30 shows that of the 1,948 receptors considered in the construction dust assessment, 30 receptors are located within 500 m of proposed blasting areas.

TABLE 12-30 ALIGNMENT CHAINAGES WHERE BLASTING IS REQUIRED

Chainage	Number of receptors within 500 m ¹	Direction from the blast area
Ch 165.3 km to Ch 168.6 km	1	South
	4	North to West
Ch 176.1 km to Ch 176.6 km	3	East
	4	South-east
Ch 178.8 km to Ch 180.5 km	4	North to West
	3	South to East
Ch 186.5 km to Ch 186.9 km	5	South-east
Ch 190.2 km to Ch 191.6 km	3	West
Ch 193.5 km to Ch 194.6 km	3	East

Table note:

1. Receptors within 500m of blasting areas are identified individually in Appendix R: Air Quality Technical Report

Based on the EPA Victoria guideline, dust emissions from blasting have the potential to impact sensitive receptors. It is proposed that the risk assessments undertaken for blasting would include consideration of the potential impact to air quality at sensitive receptors.

To minimise the risk of impact to sensitive receptors, it is proposed that blasting is limited, where possible, when the prevailing wind direction is likely to transport dust emissions towards sensitive receptors within 500 m. For example, for the blasting area between Ch 165.3 km to Ch 168.6 km, blasting should be avoided if the prevailing wind direction is blowing to the south (e.g. northerly wind), as this wind would transport dust towards the nearest receptor. This approach to blasting will also minimise the risk of impacts to sensitive receptors as a result of fugitive gas emissions. Blasting during periods of high wind speeds (>36 km/hr) would be avoided where practical, as per the CEMP (Chapter 24: Draft Outline Environmental Management Plan).

Where there are sensitive receptors within 500 m in most directions, such as the blasting area between Ch 178.8 km to Ch 180.5 km, it may not be possible to identify a wind direction that blows away from all receptors. In this case, care should be taken to avoid blasting while winds are blowing in the direction of the closest receptors to the blast location. In addition, blasting during light winds (< 5 km/hr) that would limit the dispersion of pollutants should be avoided where possible.

12.5.2 Operations

The following sections outline the results of the assessment of the operations stage, including for impacts to human receptors, drinking water, ecological receptors and agricultural uses.

12.5.2.1 Air quality impacts to human receptors

The results of the dispersion modelling are presented in this section according to the increments presented in Table 12-31.

TABLE 12-31 MODELLING INCREMENT DESCRIPTIONS

Increments	Description
Project only contribution	Represents the predicted concentrations from modelled Project locomotive emissions. Different versions of the model have been run to accurately assess emissions from the crossing loops as discussed in Section 12.3.3.3
Background concentration	Adopted background concentrations as per Section 12.4.2
Project only contribution + background concentration	The summation the Project only contribution and background concentration
Non-Project contribution	The modelled non-Project cumulative emission sources adjacent to the alignment, which include the Commodore Mine and Millmerran Power Station, sections of the Gore Highway and Warrego Highway, and existing non-Project rail sources such as the NS2B and G2H Inland Rail lines, and the West Moreton System
Non-Project contribution + background concentration	The summation of the non-Project contribution and background concentration
Total cumulative concentration	The cumulative concentration from Project only contribution, non-Project contribution, and background concentration

Table 12-32 presents the highest total cumulative ground level concentrations at the worst impacted sensitive receptor for each pollutant assessed for peak operation train volumes (year 2040). The predicted concentrations have been compared against the relevant air quality goals (Section 12.2.1). The air quality goals adopted for the assessment are prescribed to protect the environmental values of health and wellbeing, the aesthetic environment (which includes avoiding nuisance) and the health and biodiversity of ecosystems.

The results in Table 12-32 show that the total cumulative ground level concentrations at the worst impacted sensitive receptor are below the air quality goals for all pollutants and all averaging periods. Therefore, compliance has been predicted at all modelled sensitive receptors for all pollutants and all averaging periods for peak operational train volumes.

The assessment has considered background air quality and existing emission sources in the prediction of cumulative concentration and deposition levels at sensitive receptors and has therefore considered the assimilative capacity of the air environment in determining the impact of the Project. Based on the results of the modelling, the operation of the Project is not expected to significantly adversely impact environmental values of the air environment.

Table 12-32 also presents the predicted Project-only contribution at the worst affected receptor. Table 12-32 shows that the Project-only contribution at the worst affected receptor is lower than the adopted background concentration (where a background concentration is available) for all pollutant species, with the exception of 24-hour average PM_{2.5}. Further discussion of the Project contribution for receptors near the Commodore Mine and Millmerran Power Station is provided later in this section.

The assessment of operations-stage impacts has considered peak train numbers in the year 2040 (Section 12.3.3). As typical train numbers will be lower than peak volumes, predicted concentrations and dust deposition levels, and the impact to sensitive receptors, would be reduced for the typical number of train movements.

Predicted pollutant concentration contours are presented in Figure 12-18 to Figure 12-20. Figure 12-20 presents the cumulative NO₂ annual average pollutant concentration contours (including all non-Project sources) for comparison against the air quality goal (33 µg/m³) set for the protection of the health and biodiversity of ecosystems. Further discussion of ecological impacts is provided in Section 12.5.2.3.

Risk of impacts near Commodore Mine and Millmerran Power Station

As discussed in Section 12.4, emissions from the Commodore Mine and Millmerran Power Station have been modelled considering monitoring data obtained from the Millmerran AQMS, located to the north of these existing emission sources. This approach allows for assessment of cumulative air quality impacts.

In addition to modelling emissions from the mine and power station, further evaluation of the risk of impacts to sensitive receptors near the mine and power station has been undertaken by reviewing Project-only contributions.

The pollutant species and averaging periods of most concern for receptors near the mine and power station are 24-hour averages of PM₁₀ and PM_{2.5}. Project-only contributions for the modelled receptor worst affected (for 24-hour averages) by PM₁₀ and PM_{2.5} emissions from the mine and power station have been evaluated. The predicted maximum 24-hour Project contributions at this worst affected receptor are:

- ▶ 24-hour PM₁₀: 0.021 µg/m³
- ▶ 24-hour PM_{2.5}: 0.020 µg/m³.

These maximum predicted Project contributions for 24-hour PM₁₀ and PM_{2.5} concentrations represent less than 1 per cent of the respective air quality goals (50 µg/m³ for PM₁₀, 25 µg/m³ for PM_{2.5}).

Due to the minor contribution to particulate matter concentrations, the risk of exceedances of particulate matter goals at sensitive receptors near Commodore Mine and Millmerran Power Station as a result of Project emissions is considered to be low.

TABLE 12-32 HIGHEST PREDICTED GROUND LEVEL CONCENTRATIONS AT SENSITIVE RECEPTORS FOR PEAK OPERATIONAL TRAIN VOLUMES

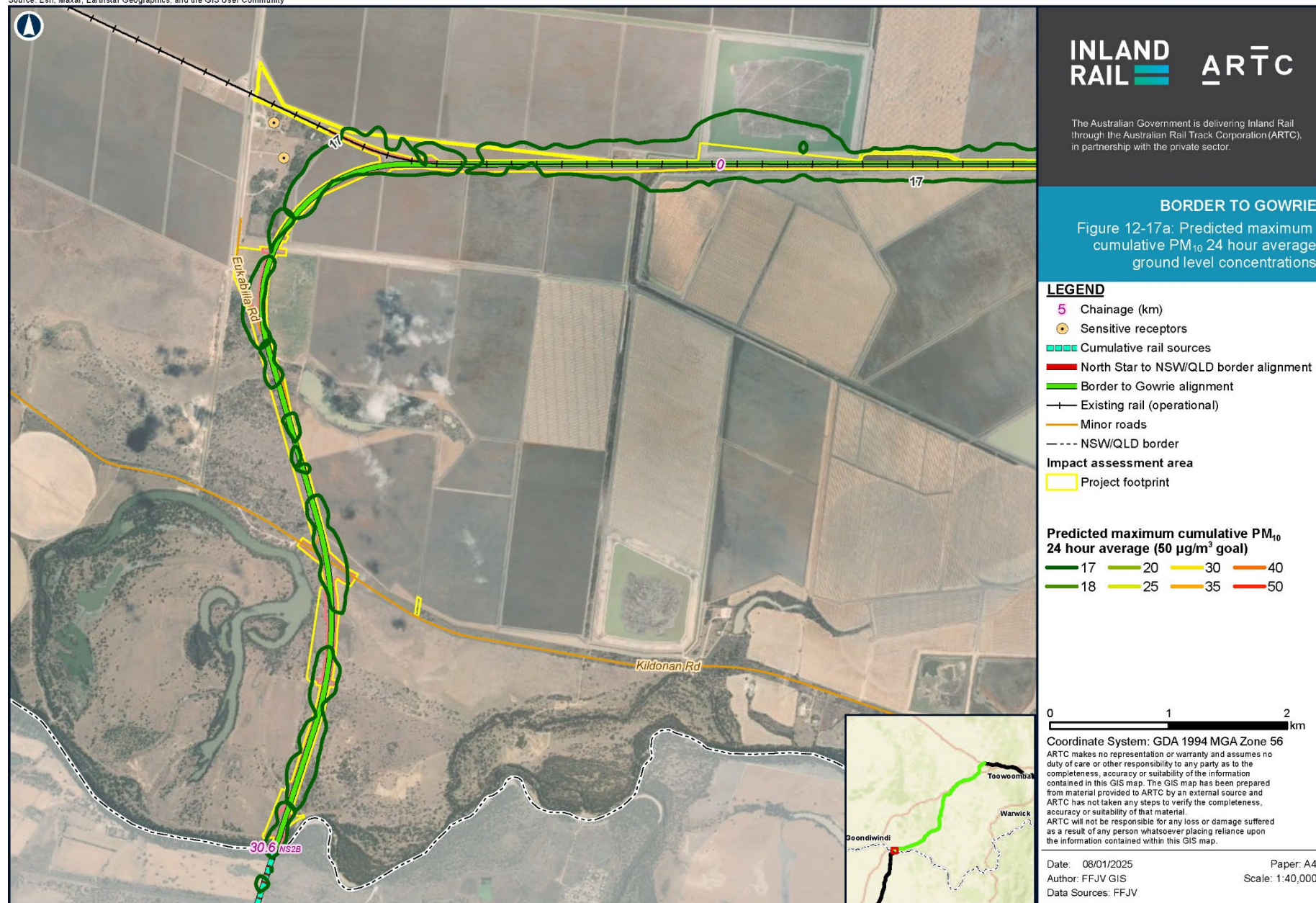
Pollutant	Average period	Highest predicted ground level pollutant concentration at identified sensitive receptor locations					Air quality goal (Section 12.2.1)	Units
		Project only contribution at worst affected receptor (A)	Background concentration (B)	Project only contribution + Background concentration (A + B)	Non-Project contribution (C)	Total cumulative concentration at worst affected (cumulative) receptor (A + B + C) ^{d,e}		
TSP	Annual average	1.1	31.0	32.1	9.0	40.0	90	µg/m ³
Deposited dust	30 day, maximum	0.01	50.0	50.0	0.1	50.1	120	mg/m ² /day
PM ₁₀	24 hour, maximum	7.5	16.2	23.7	26.3	42.5	50	µg/m ³
	Annual average	0.6	12.4	13.0	3.1	15.5	25	µg/m ³
PM _{2.5}	24 hour, maximum	7.1	6.8	13.9	3.4	13.9	25	µg/m ³
	Annual average	0.4	5.6	6.0	0.6	6.3	8	µg/m ³
NO ₂	1 hour, maximum	- ^a	57.5 ^a	- ^a	- ^a	167.0 ^a	250	µg/m ³
	Annual average	- ^a	7.8 ^a	- ^a	- ^a	25.3 ^a	62	µg/m ³
Arsenic and compounds	Annual average	4.3 x 10 ⁻⁵	-b.	-b.	-c.	-b.	6	ng/m ³
Cadmium and compounds	Annual average	0.004	-b.	-b.	-c.	-b.	5	ng/m ³
Chromium III and compounds	1 hour, maximum	0.0006	-b.	-b.	-c.	-b.	9	µg/m ³
Chromium VI and compounds	1 hour, maximum	0.0006	-b.	-b.	-c.	-b.	0.1	µg/m ³
	Annual average	2.1 x 10 ⁻⁵	-b.	-b.	-c.	-b.	0.01	µg/m ³
Lead and compounds	Annual average	3.6 x 10 ⁻⁷	-b.	-b.	-c.	-b.	0.5	µg/m ³
Nickel and compounds	Annual average	0.05	-b.	-b.	-c.	-b.	22	ng/m ³
Dioxins and furans	Annual average	1.8 x 10 ⁻¹¹	-b.	-b.	-c.	-b.	3 x 10 ⁻⁰⁸	µg/m ³
Polycyclic aromatic hydrocarbon (as benzo[a]pyrene)	Annual average	0.006	-b.	-b.	-c.	-b.	0.3	ng/m ³
1,3-butadiene	1 hour, maximum	0.05	-b.	-b.	-c.	-b.	2.4	µg/m ³

Pollutant	Average period	Highest predicted ground level pollutant concentration at identified sensitive receptor locations					Air quality goal (Section 12.2.1)	Units
		Project only contribution at worst affected receptor (A)	Background concentration (B)	Project only contribution + Background concentration (A + B)	Non-Project contribution (C)	Total cumulative concentration at worst affected (cumulative) receptor (A + B + C) ^{d,e}		
Benzene	Annual average	0.0006	5.2	5.2	0.002	5.2	5.4	µg/m ³
Toluene	30 minute, maximum ^e	0.006	23.0	23.0	0.006	23.0	1,100	µg/m ³
	24 hour, maximum	0.003	21.7	21.7	0.002	21.7	4,100	µg/m ³
	Annual average	9.1 x 10 ⁻⁵	18.5	18.7	0.0003	18.7	400	µg/m ³
Xylenes	24 hour, maximum	0.5	50.3	50.8	0.2	50.8	1,100	µg/m ³
	Annual average	0.01	34.1	34.1	0.04	34.2	950	µg/m ³

Table notes:

- a The Ozone Limiting Method was used to determine NO₂ concentrations. The Ozone Limiting Method is complex as it uses modelled hourly NO_x concentrations and hourly varying background NO₂ and O₃ monitoring data from the Mutdapilly DES monitoring station for 2013. Due to the complexity of this process the emission sources included in the model, including cumulative sources, were modelled in the same model run and were not modelled individually. As a result, the individual contribution from Project and non-Project sources cannot be determined, however, based on the location of the worst affected receptors the predominant source at the worst affected receptors presented in Table 12-32 is the Project and the Warrego Highway
- b No background monitoring data is available for this modelled pollutant
- c Compound not emitted by modelled non-Project emission sources, and therefore nil value is presented
- d The highest Project only contribution (A) and the highest non-Project contribution (C) may be predicted at different receptors and therefore the total cumulative concentrations does not necessarily equal the sum of the values A, B and C presented in this table
- e Worst affected receptors are visually identified in Appendix R: Air Quality Technical Report

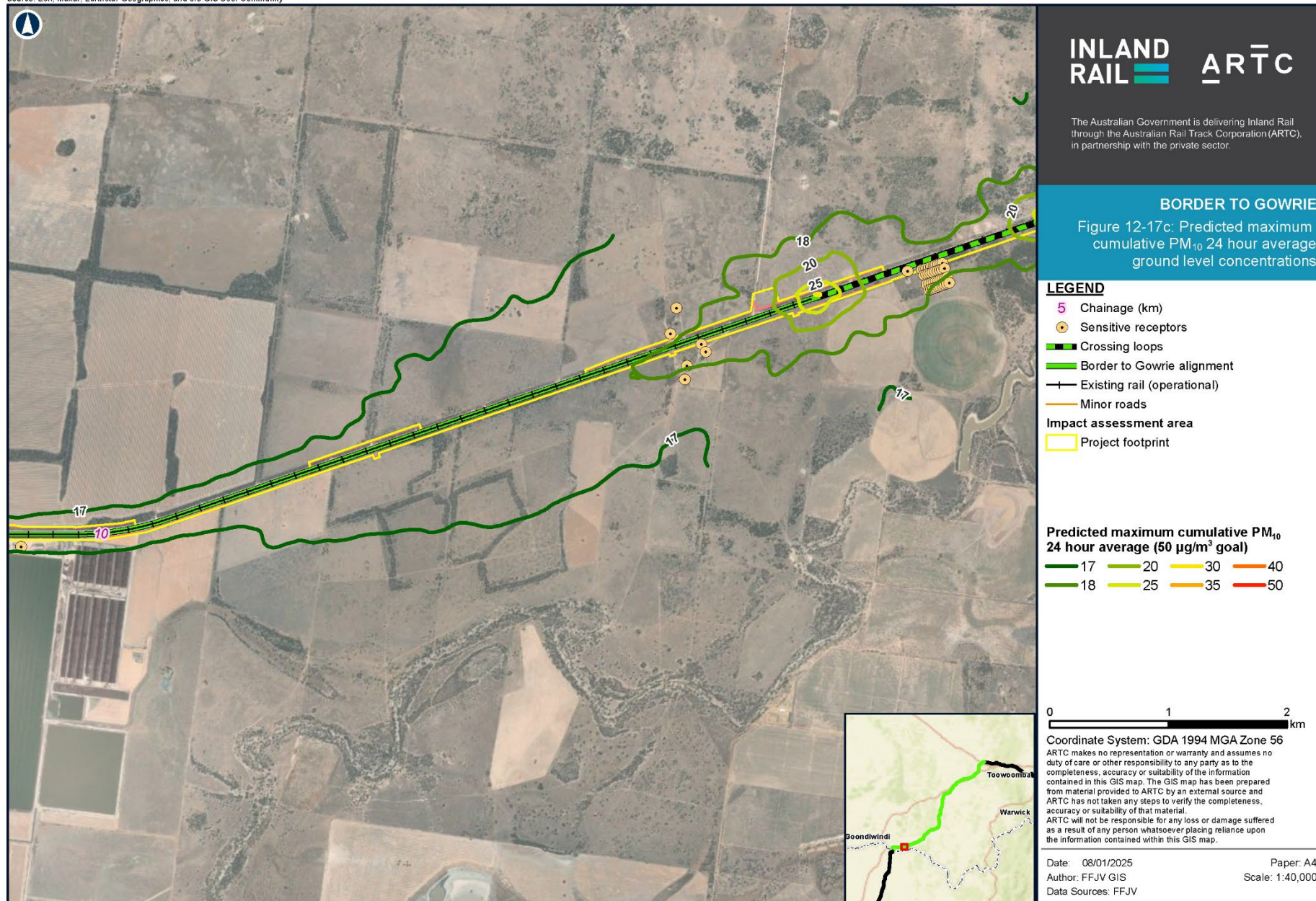
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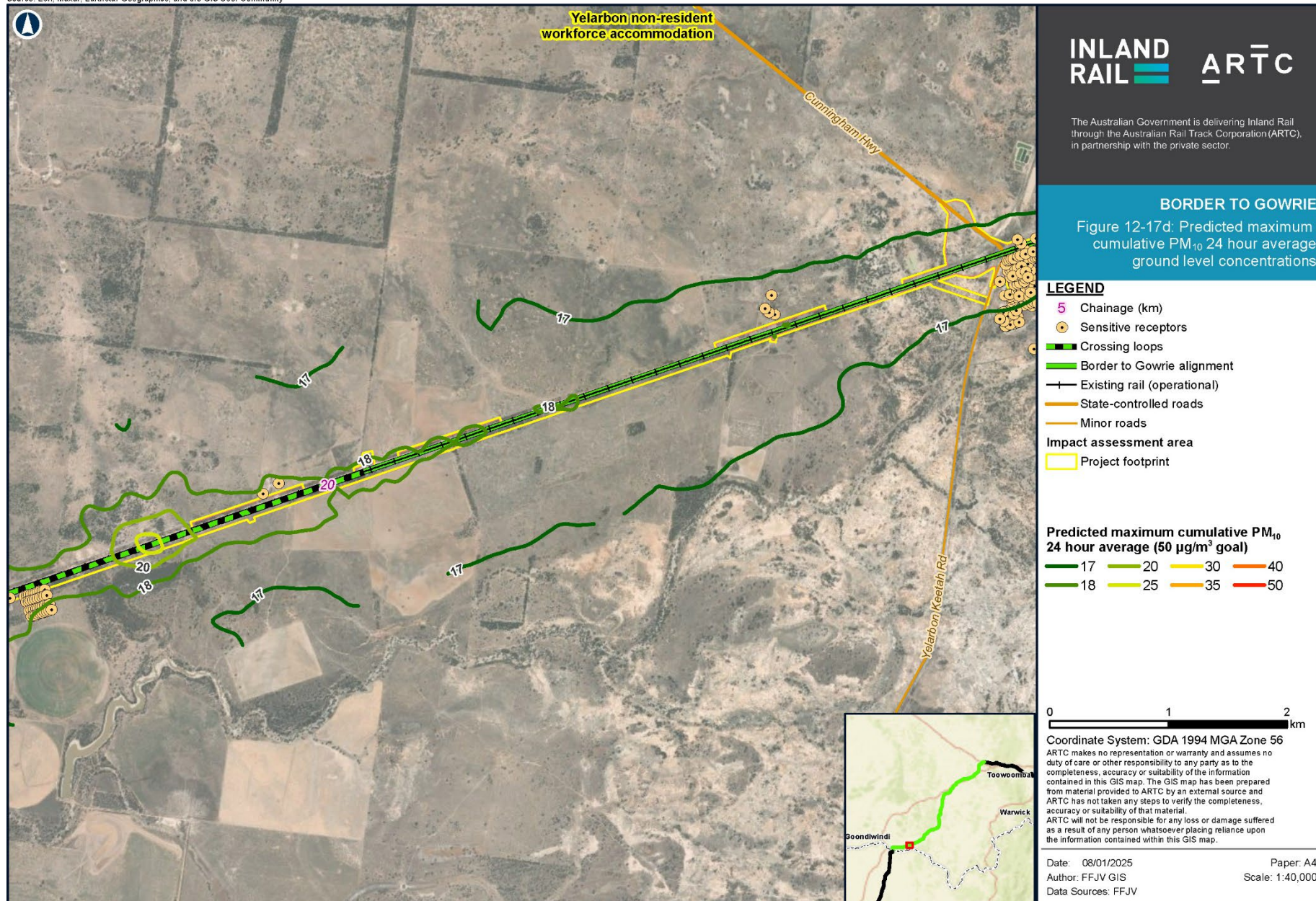


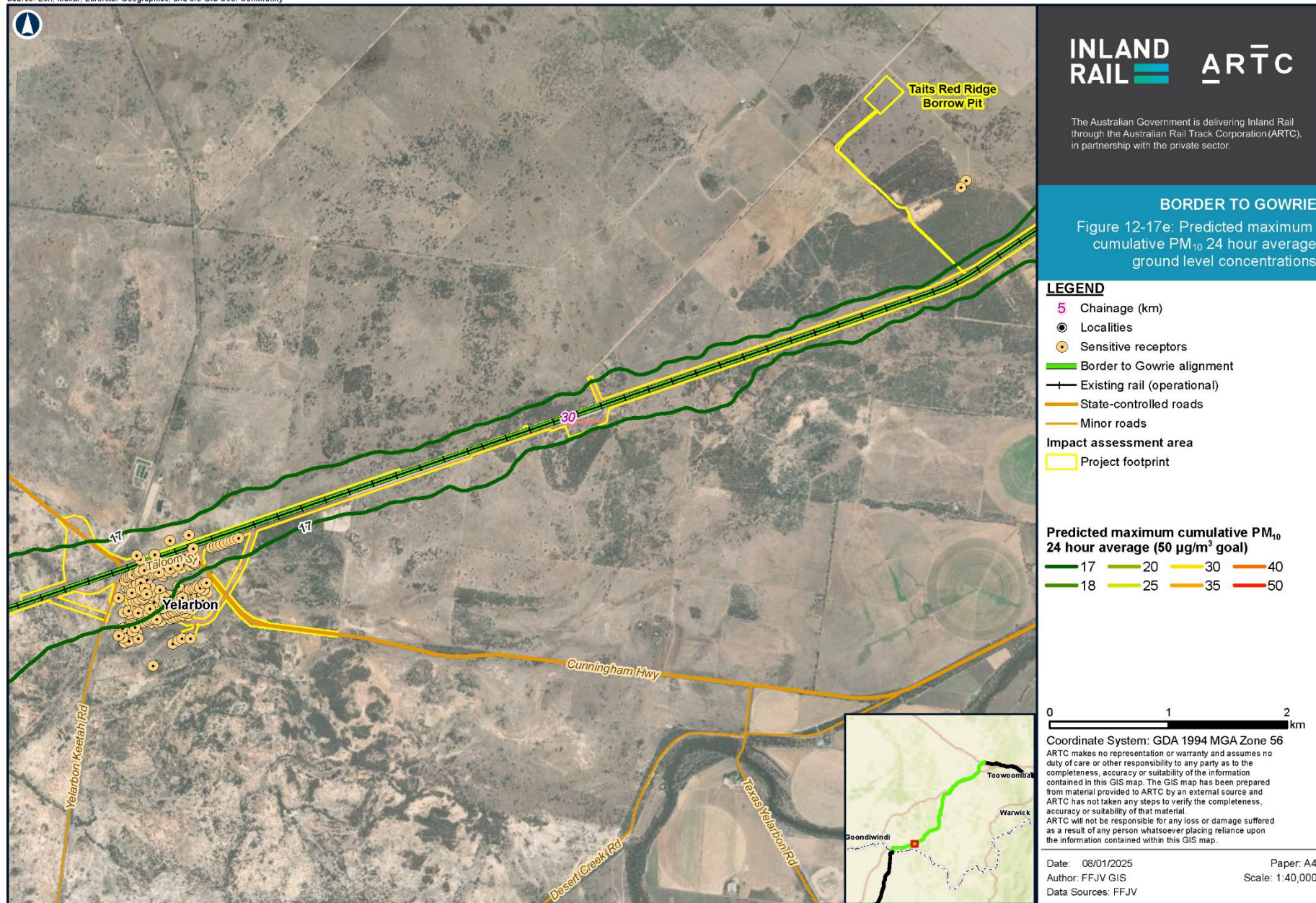
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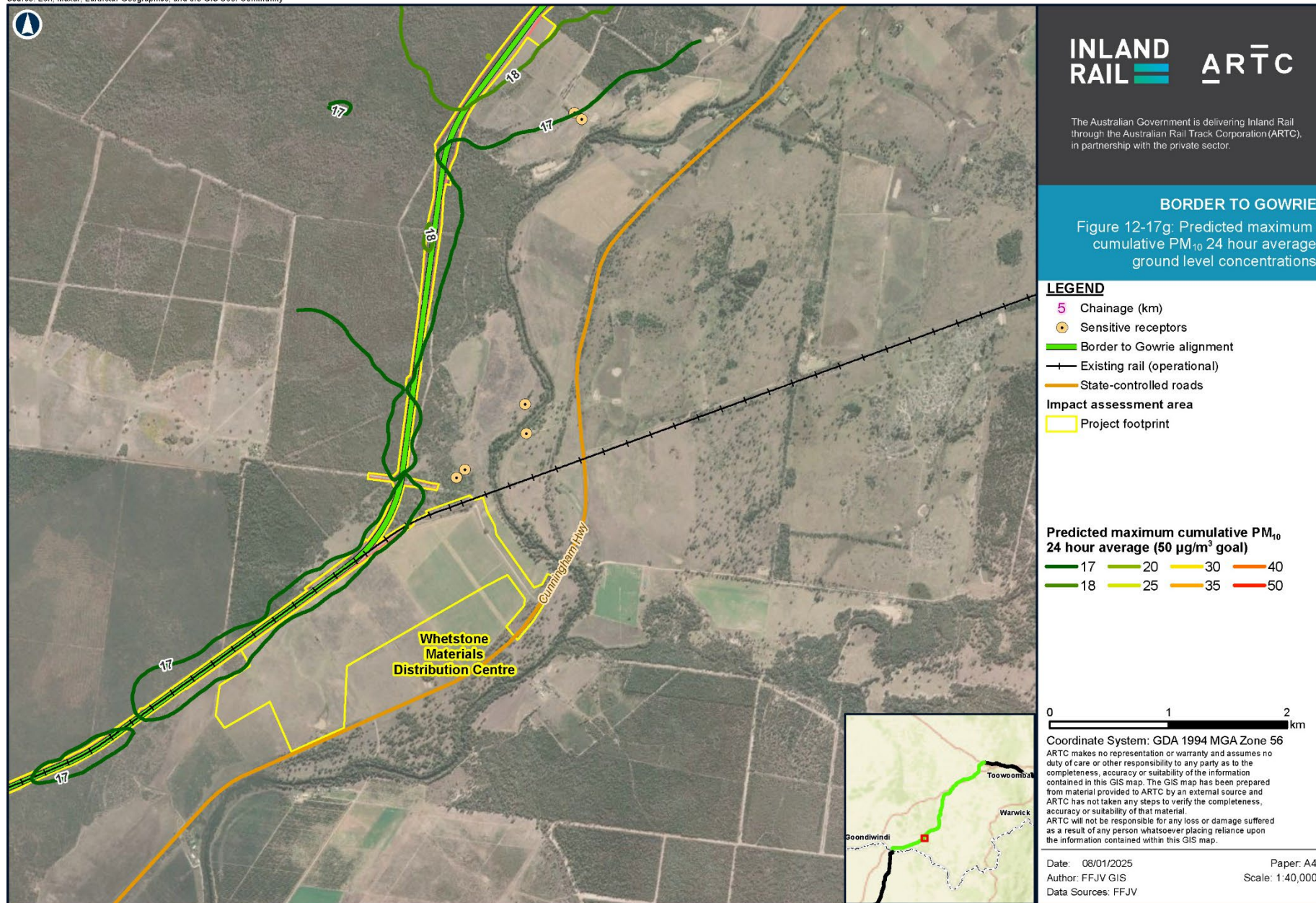
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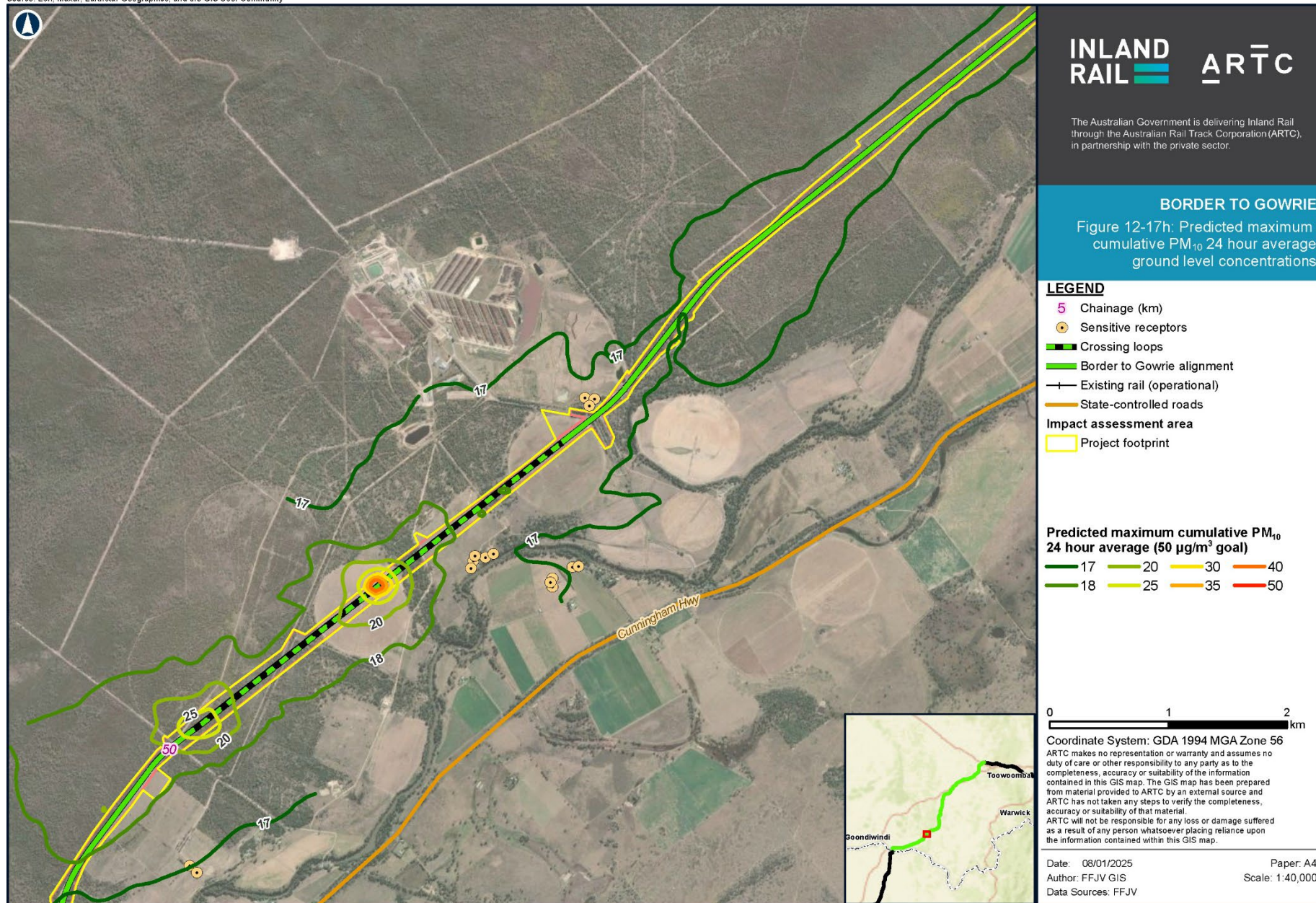


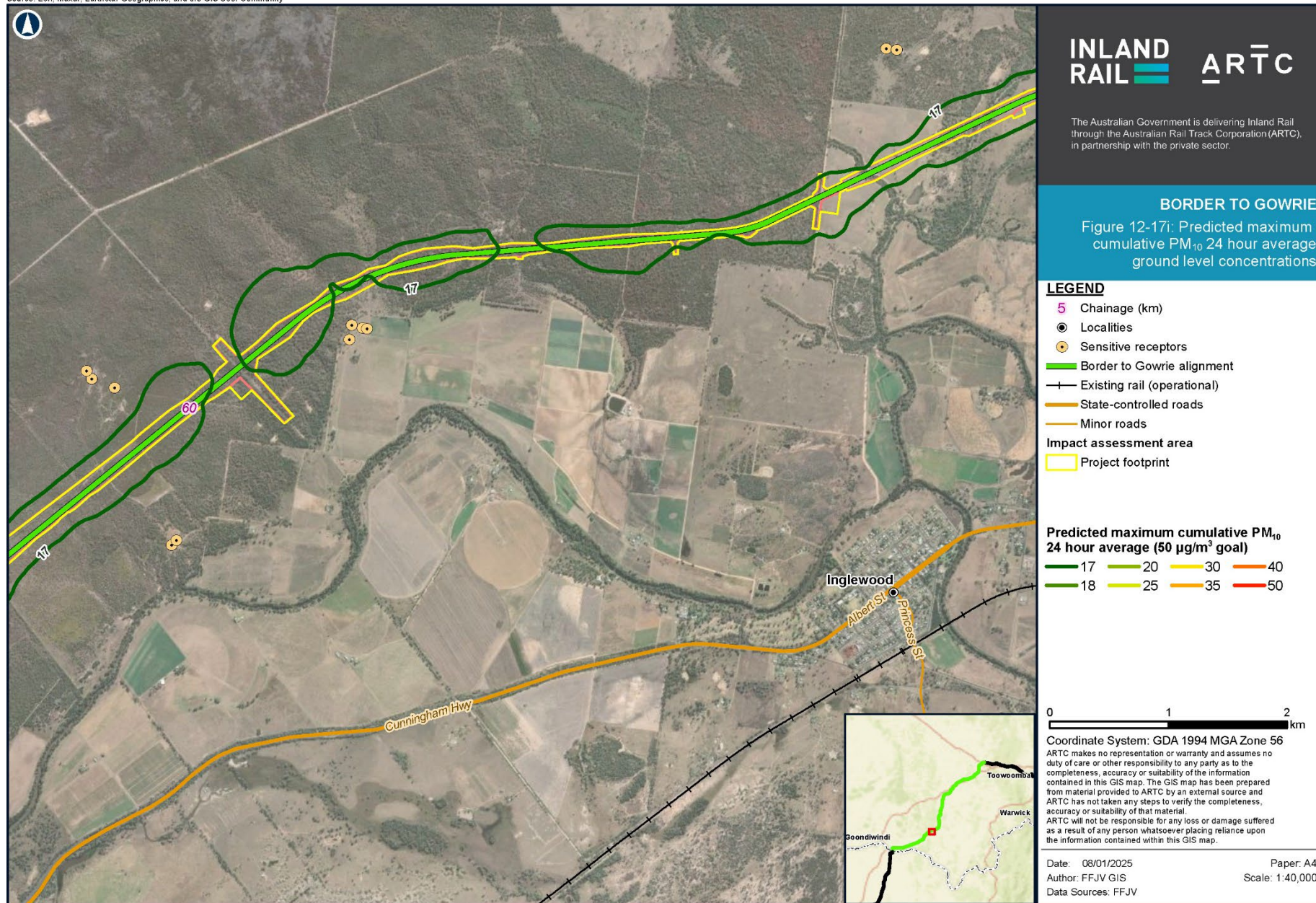


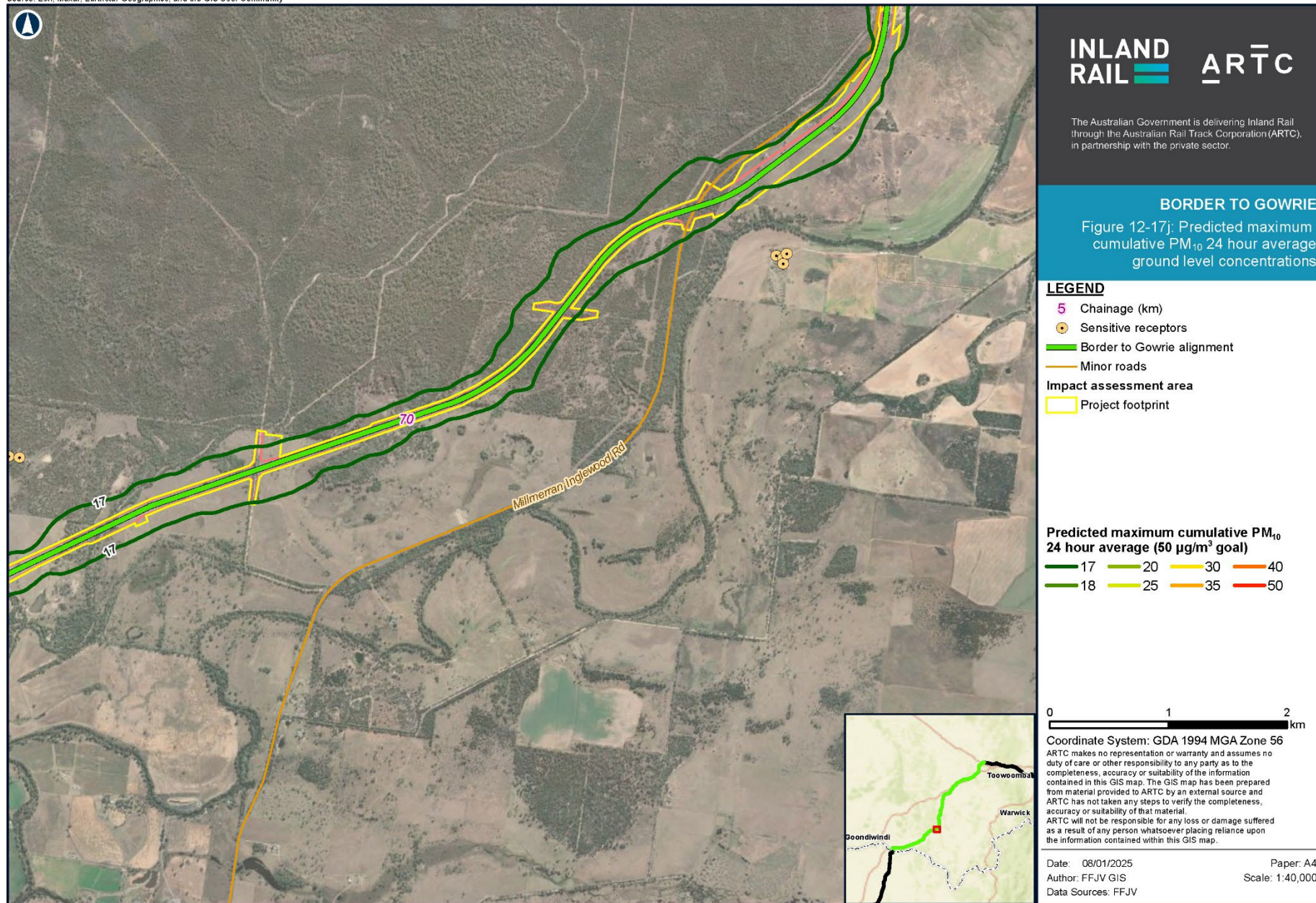


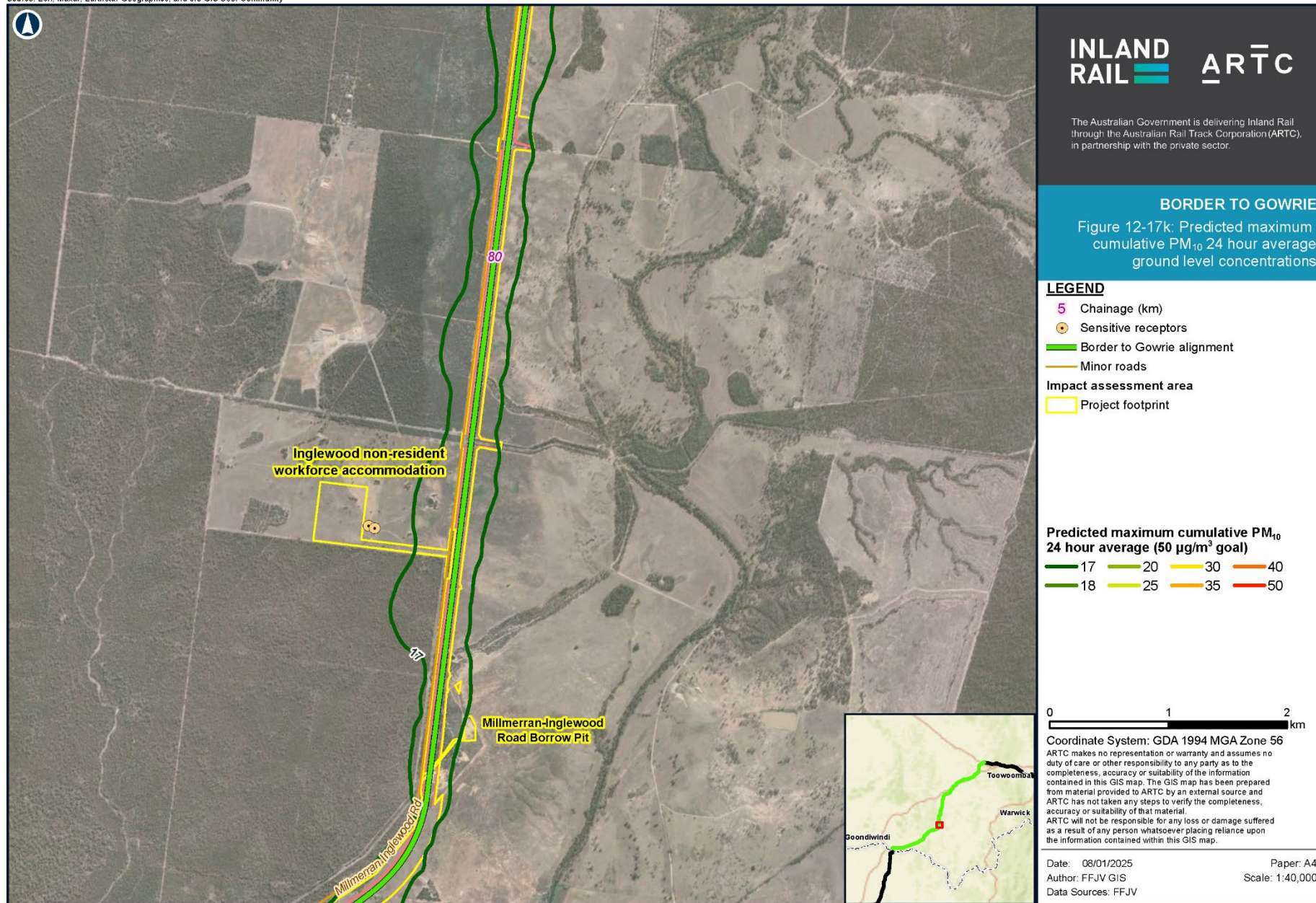




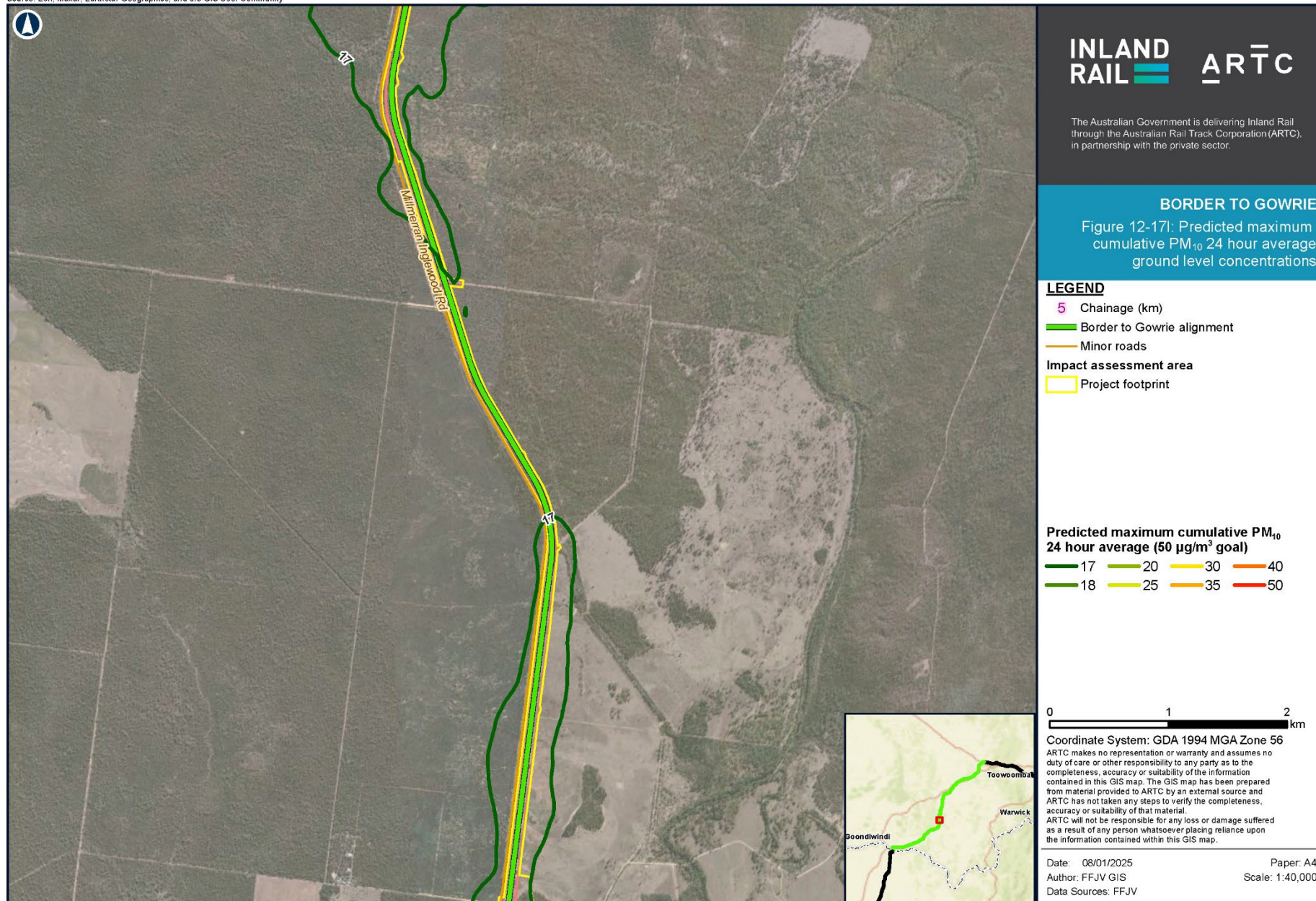


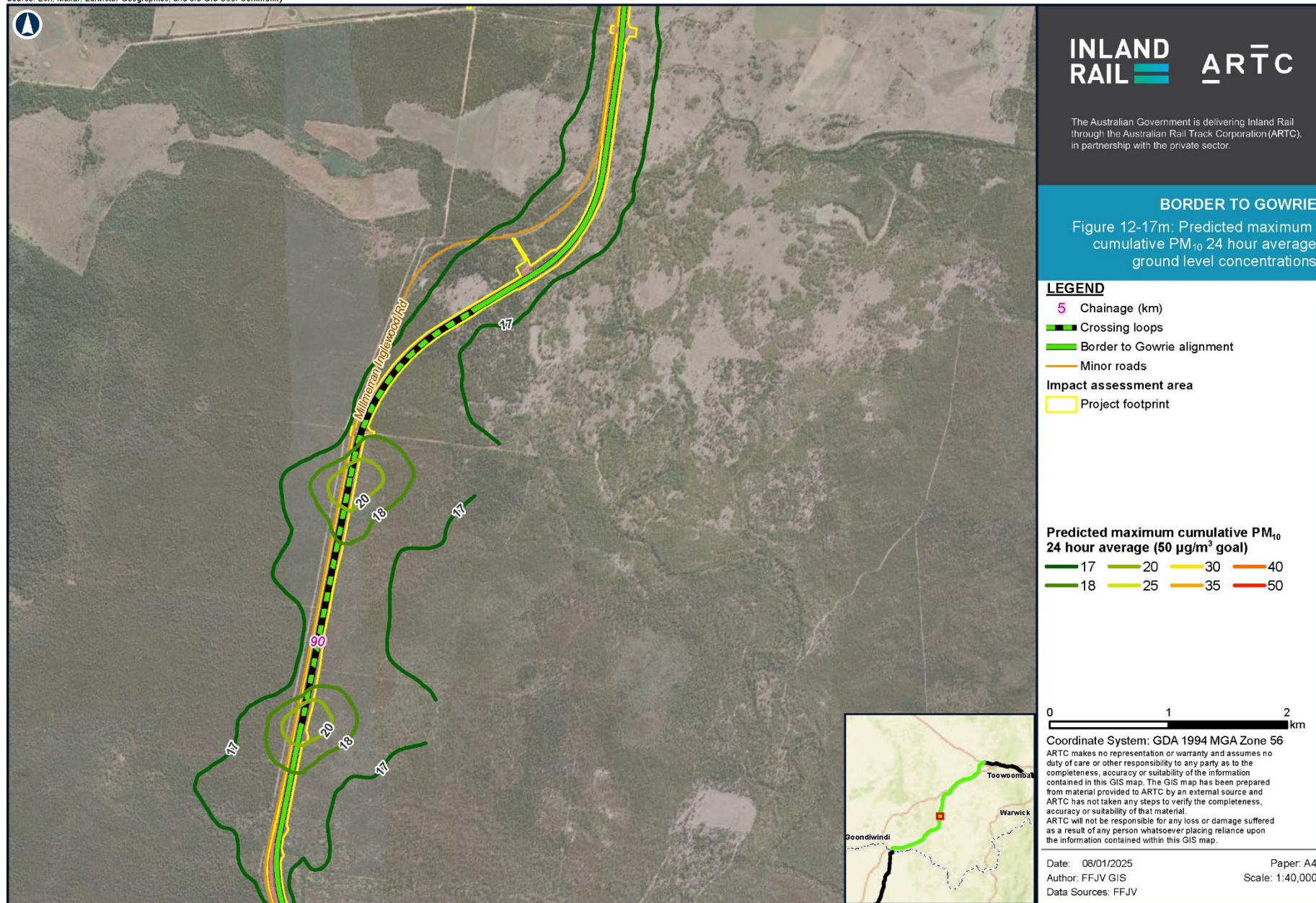


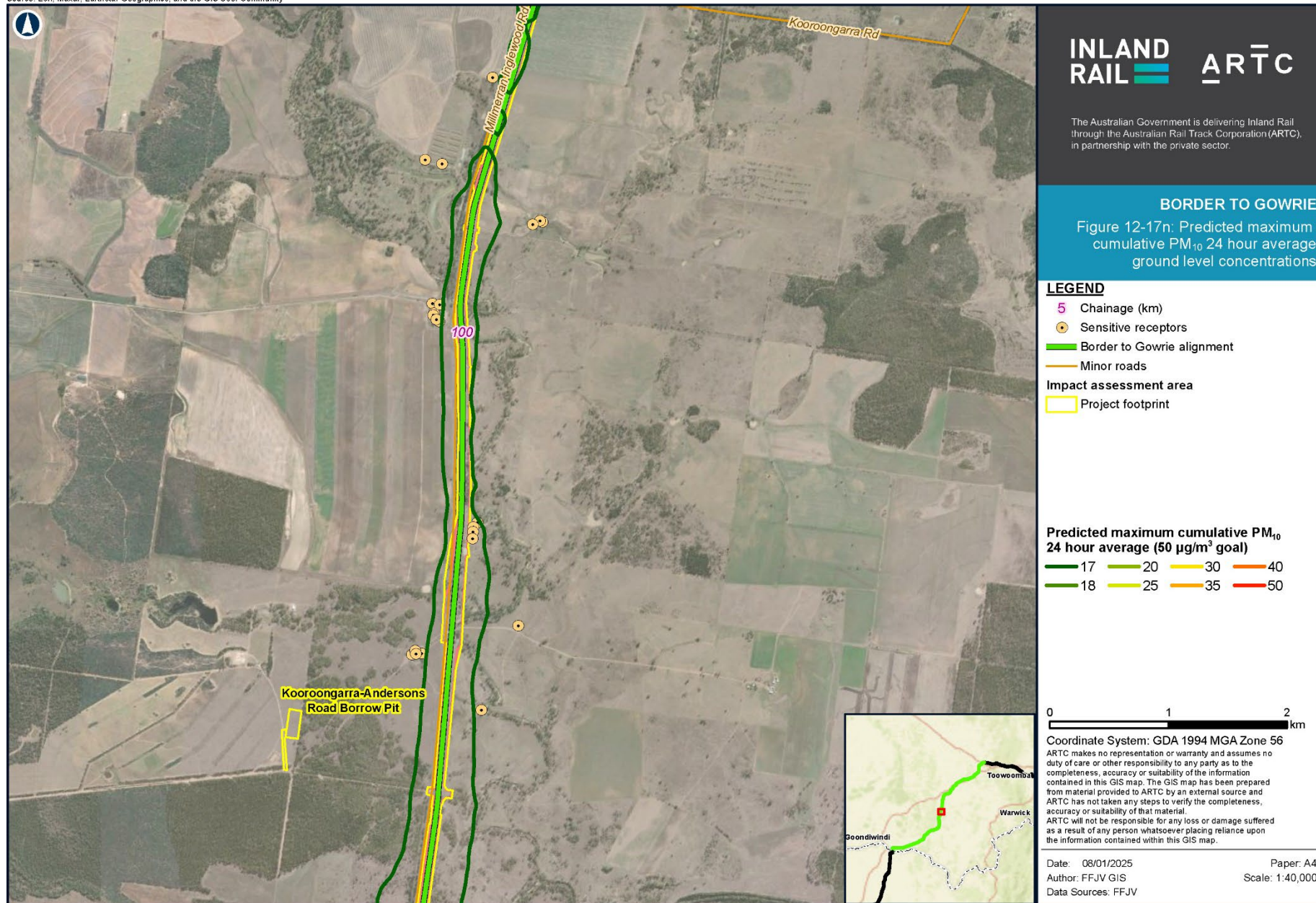


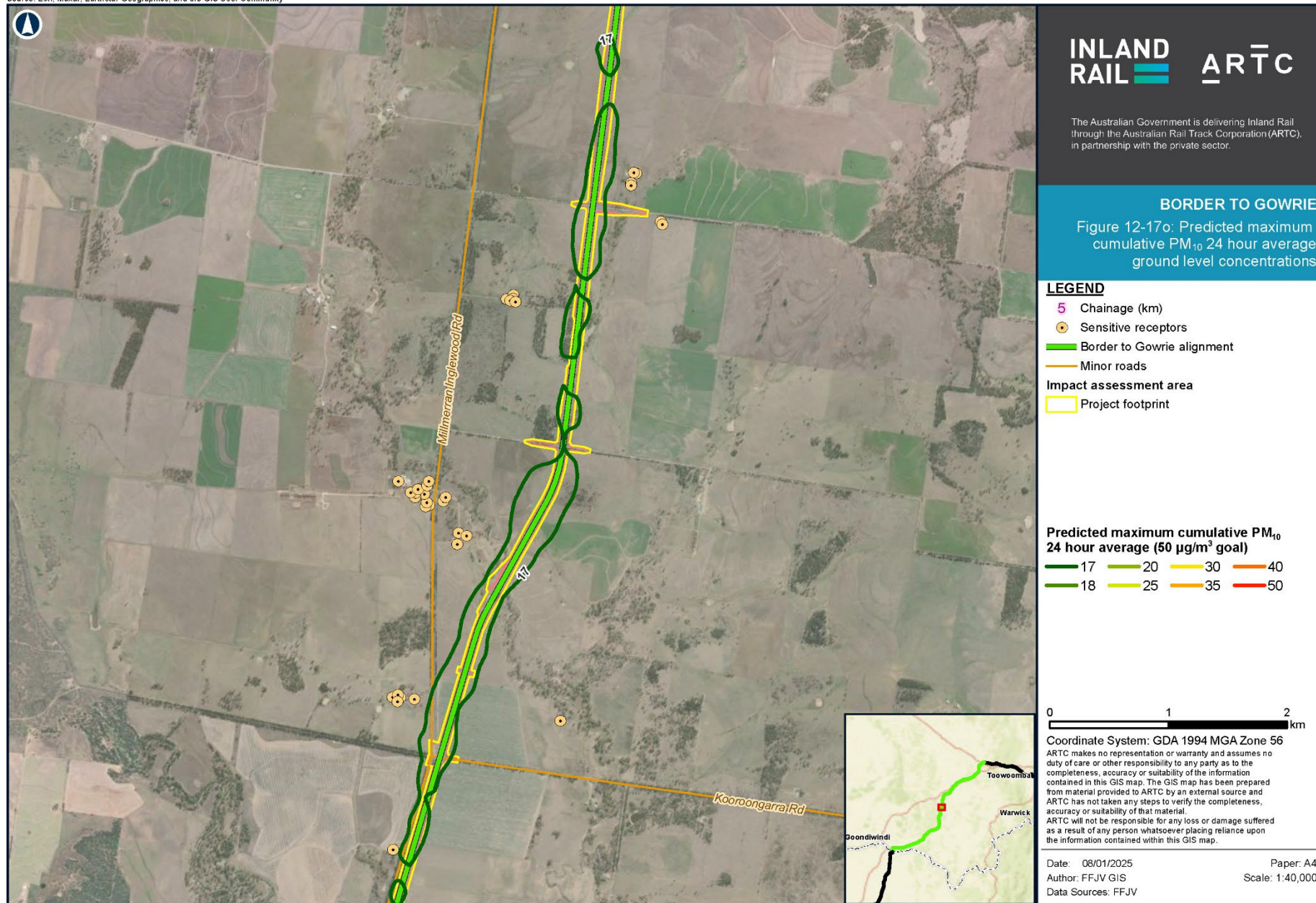


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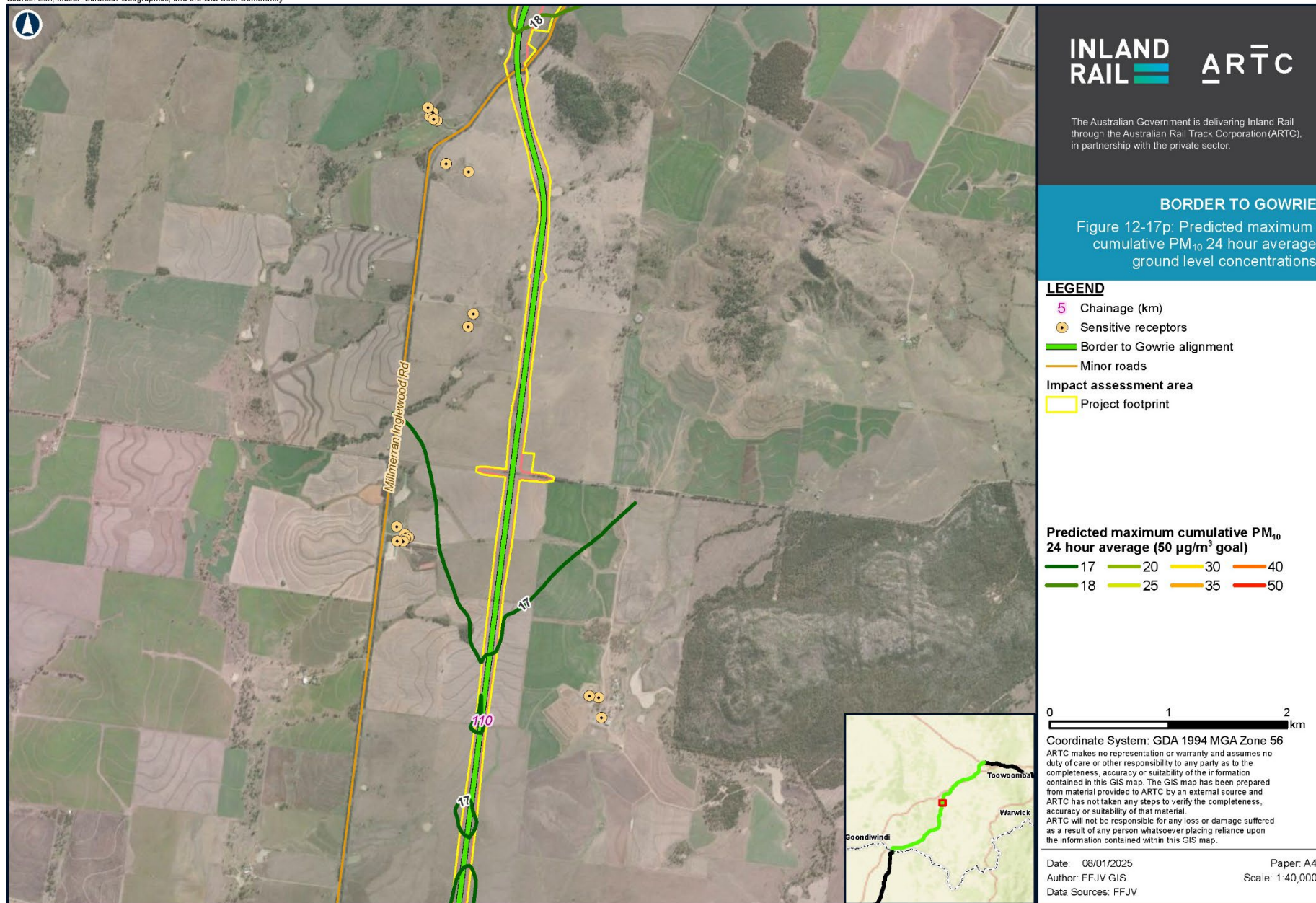




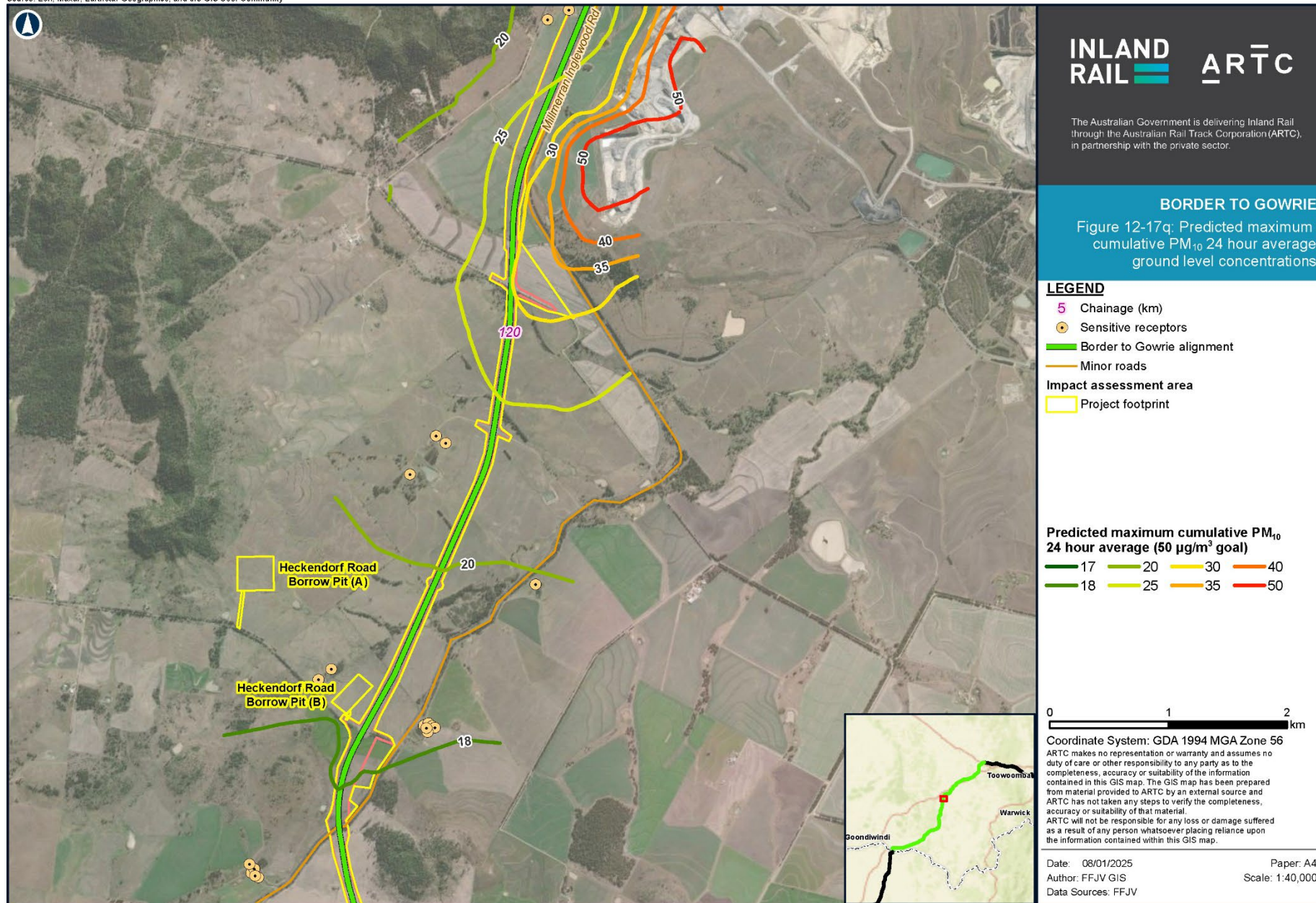


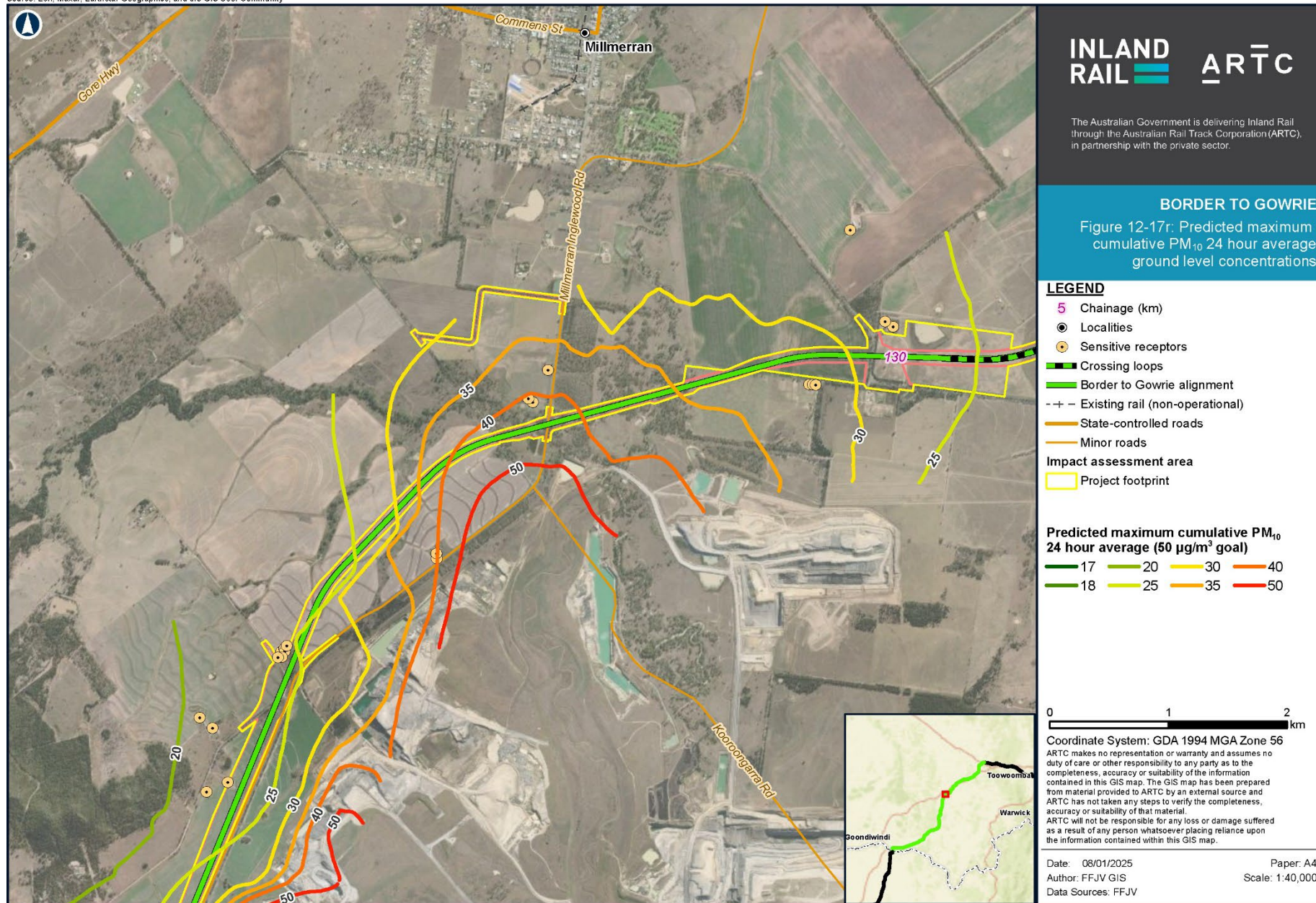


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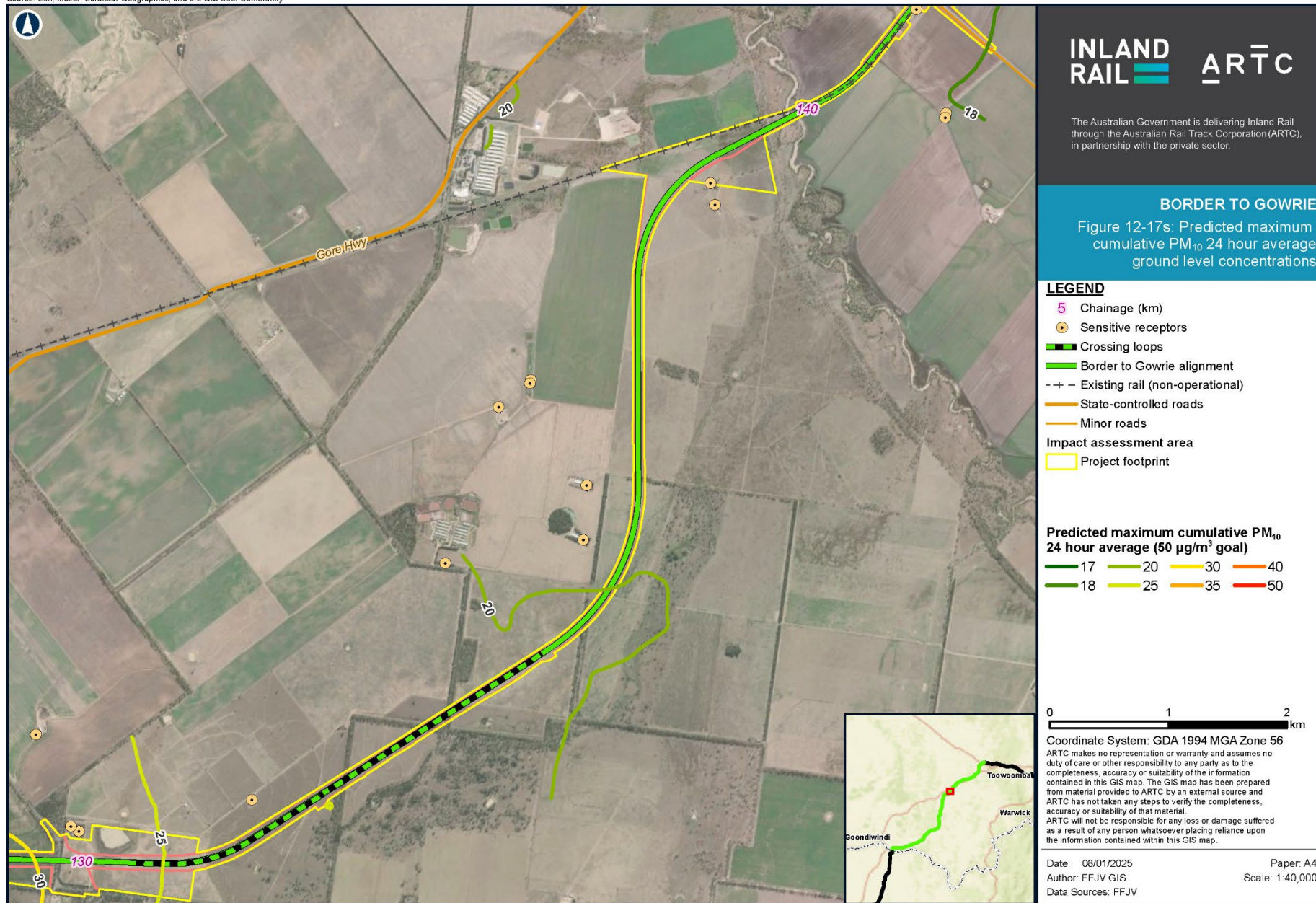


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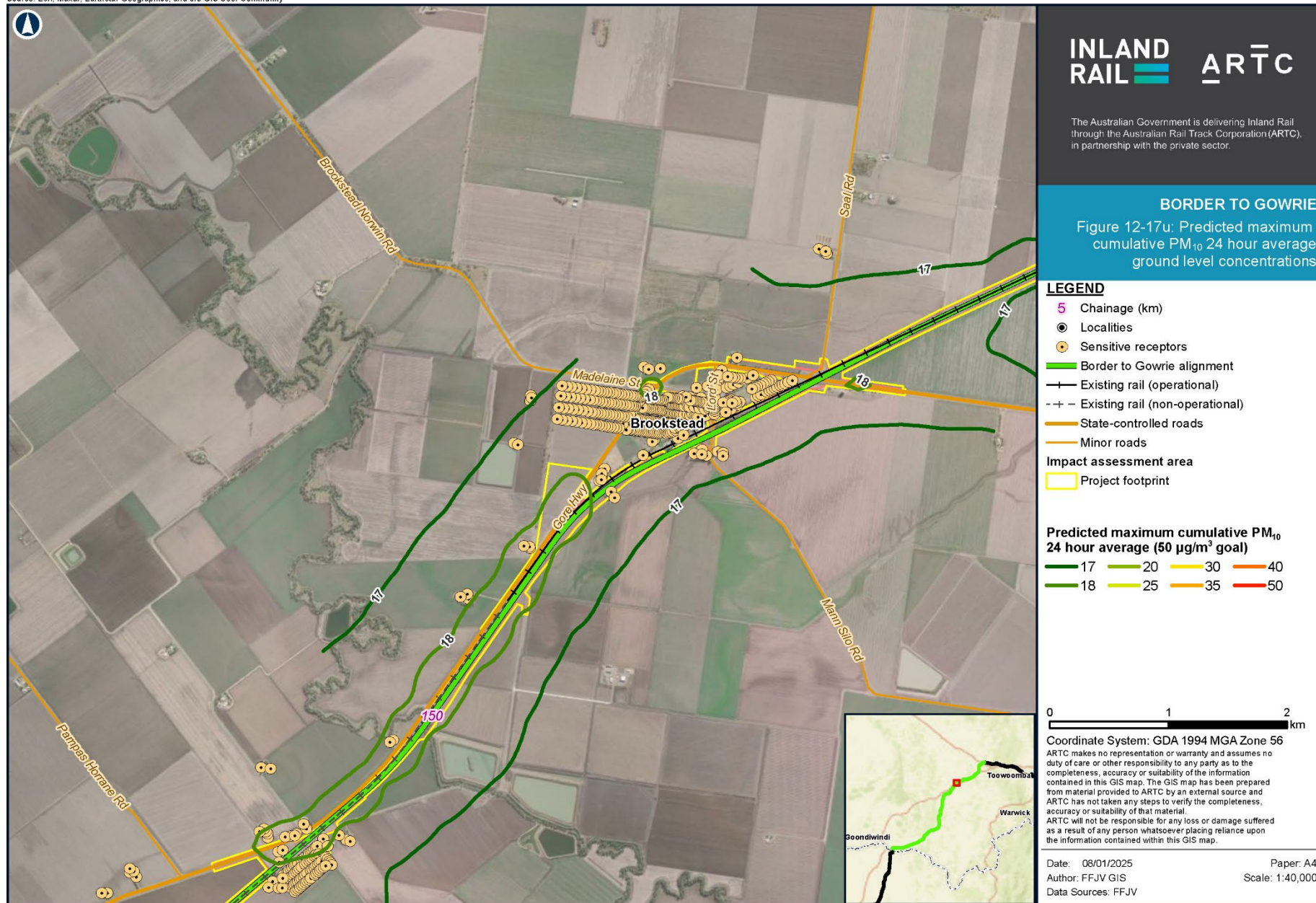


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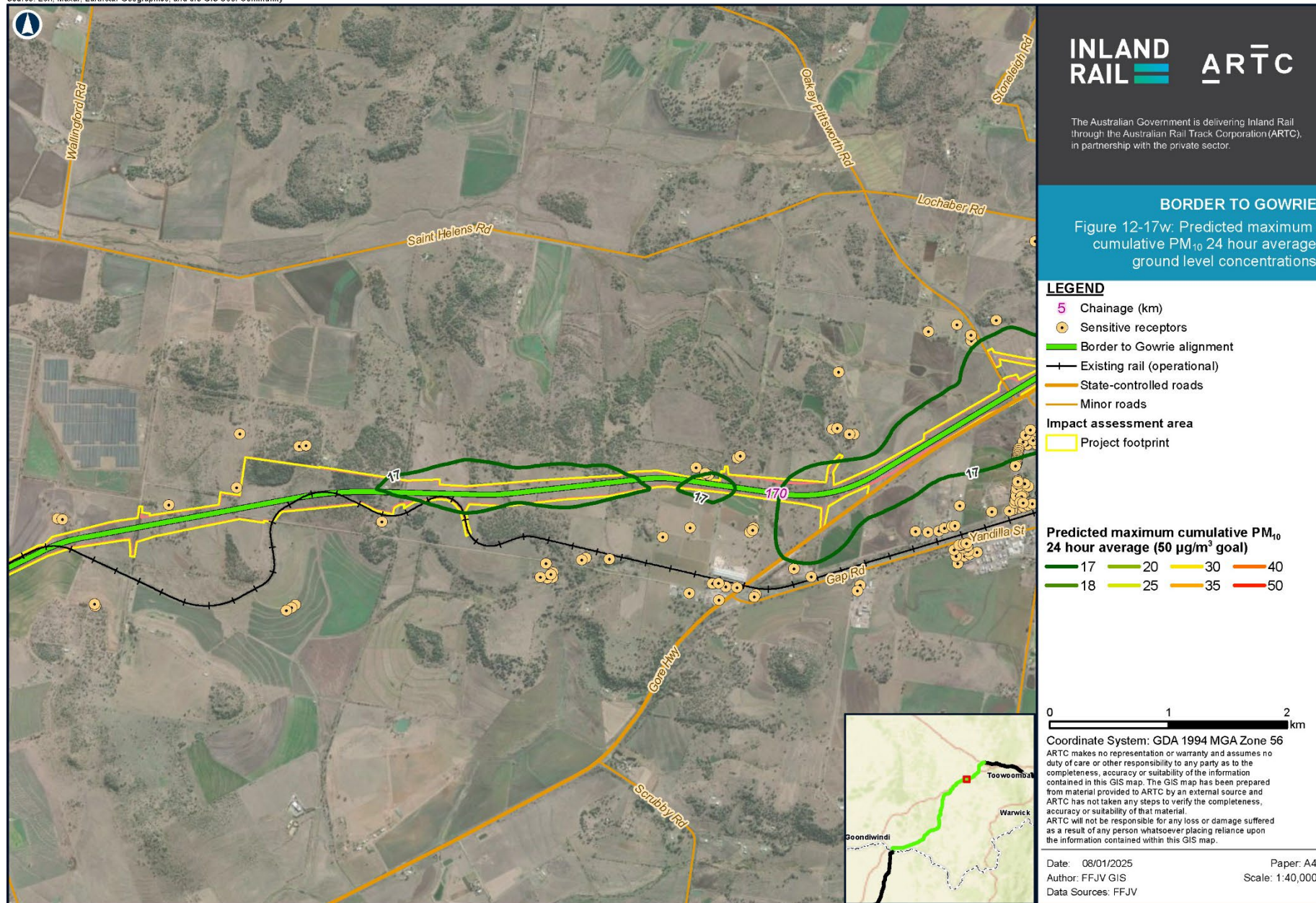
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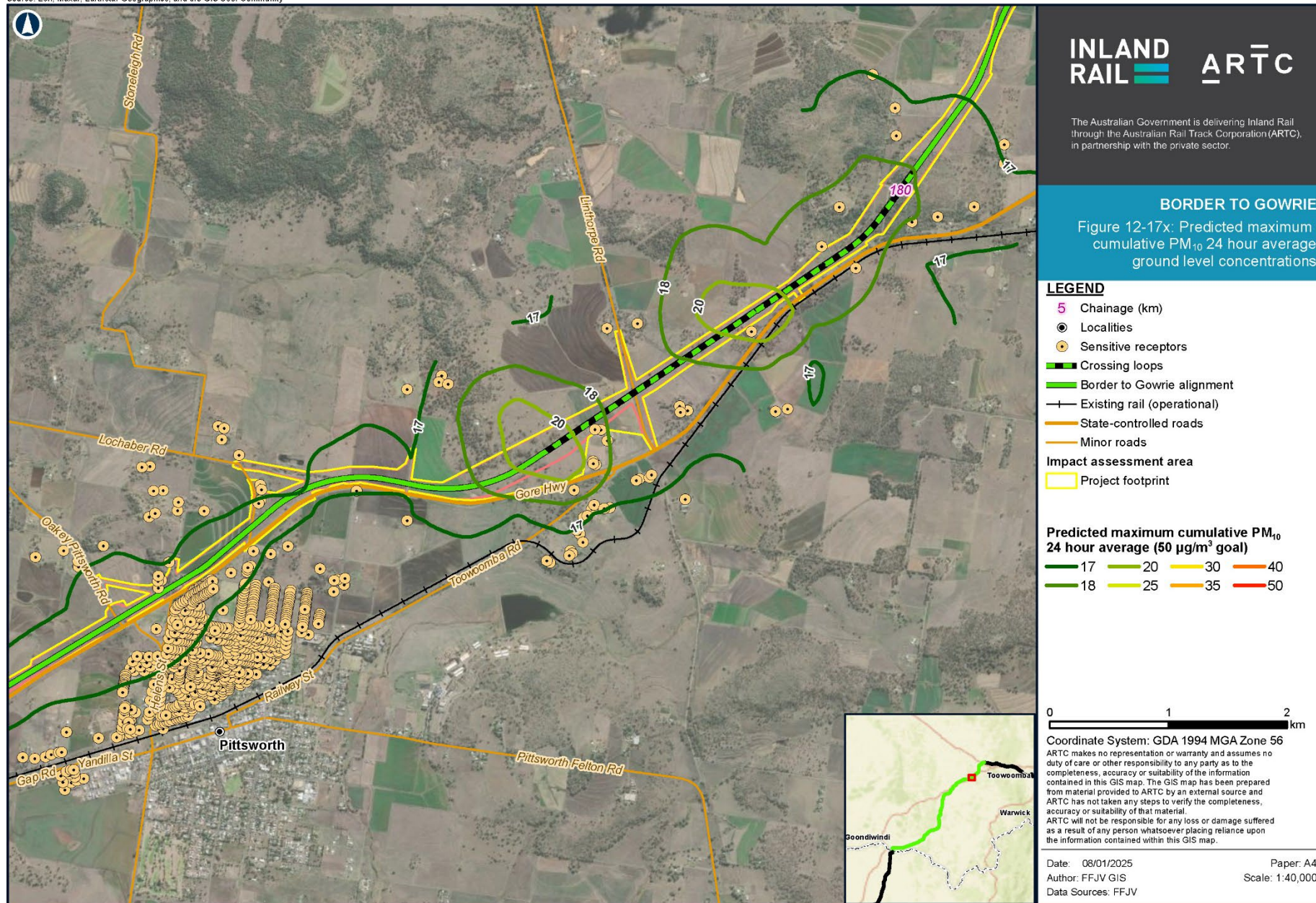




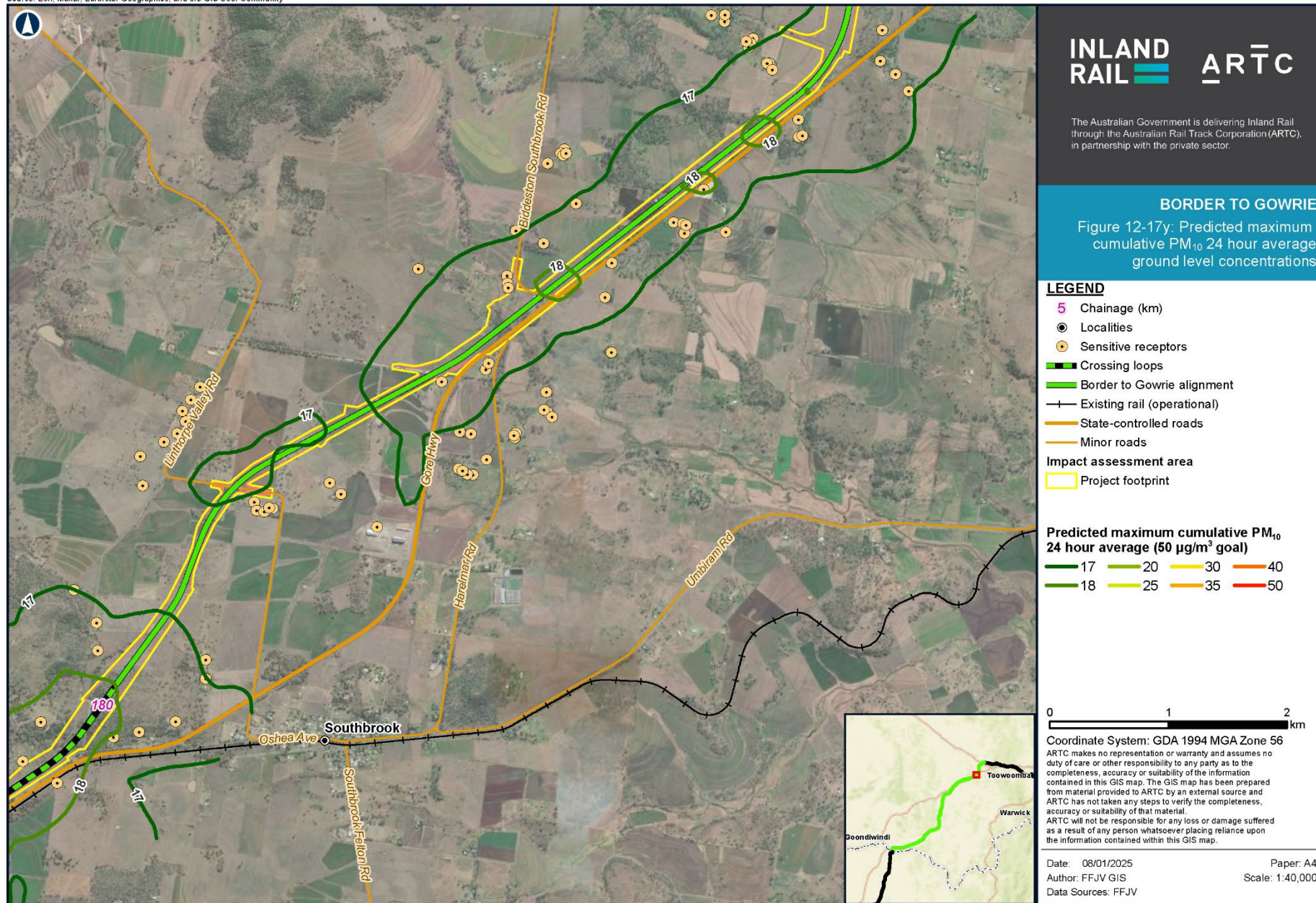
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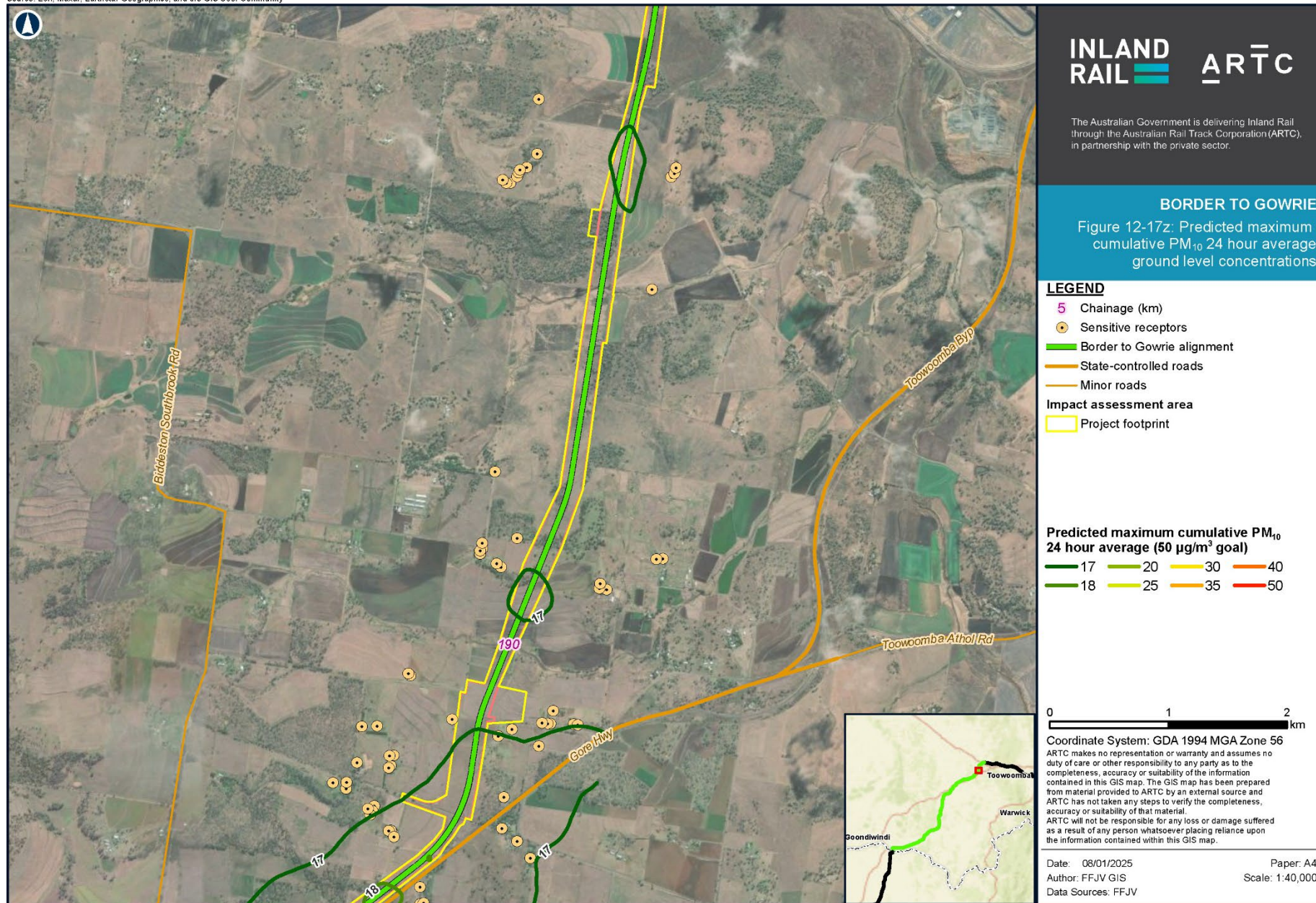
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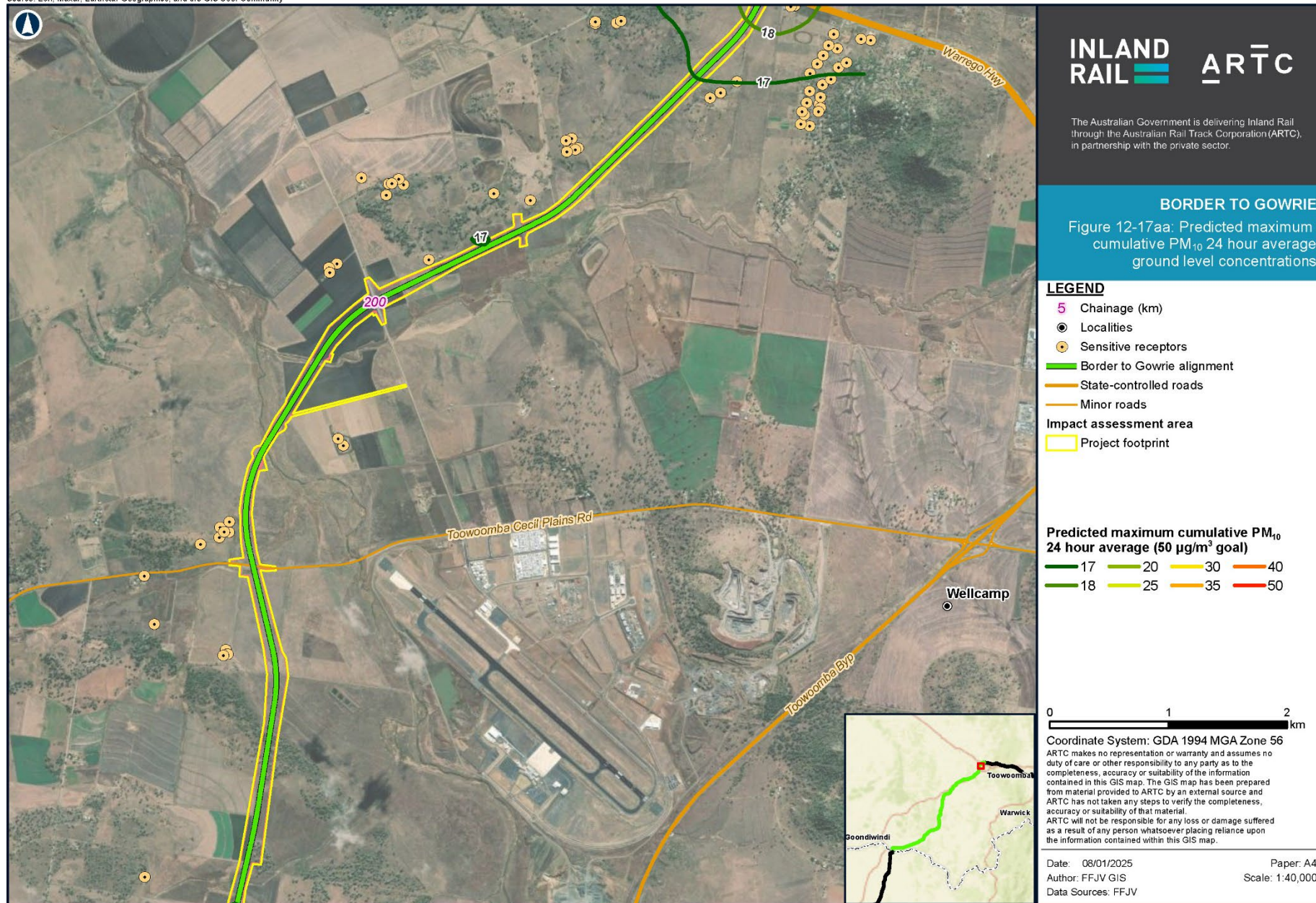
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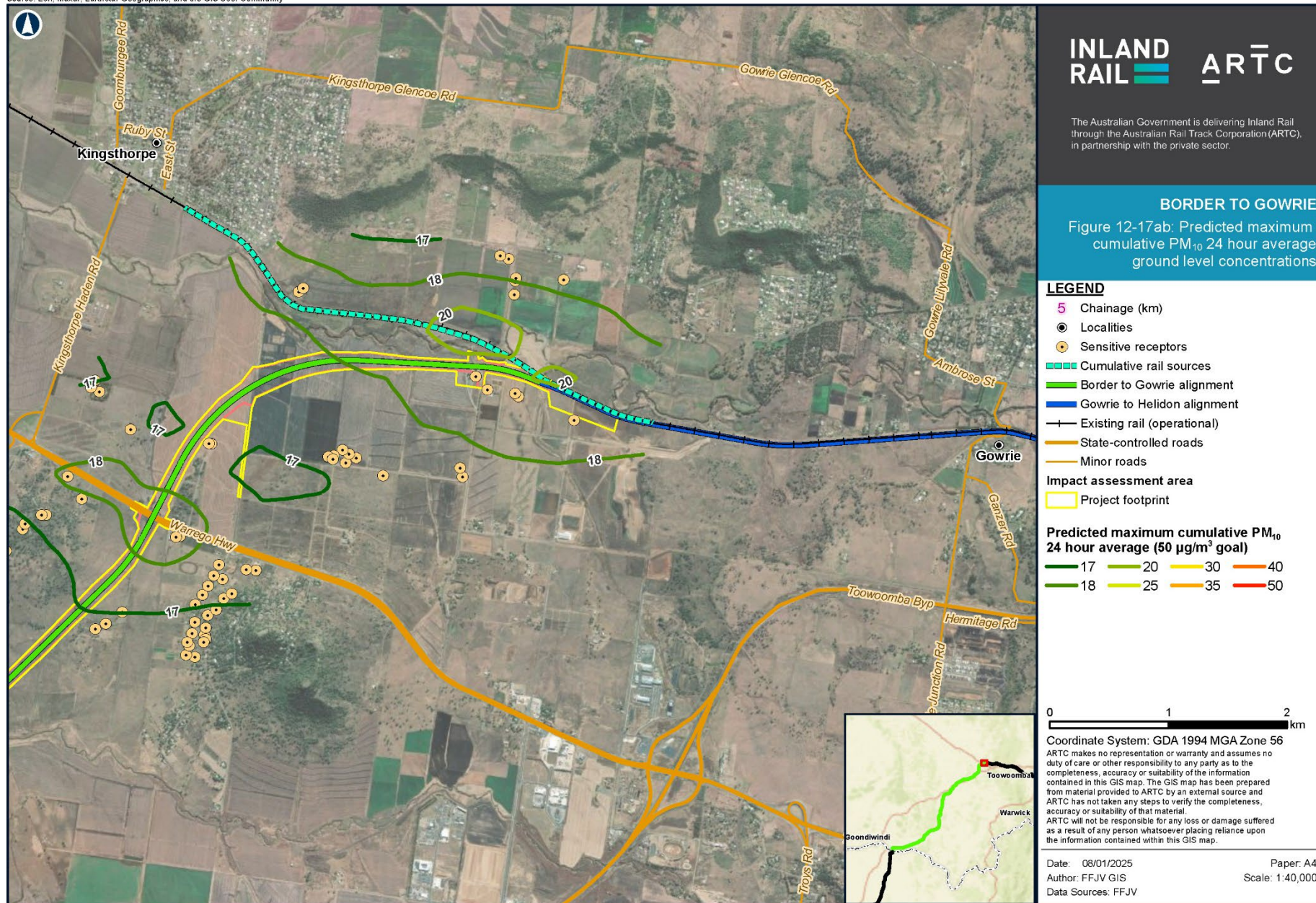


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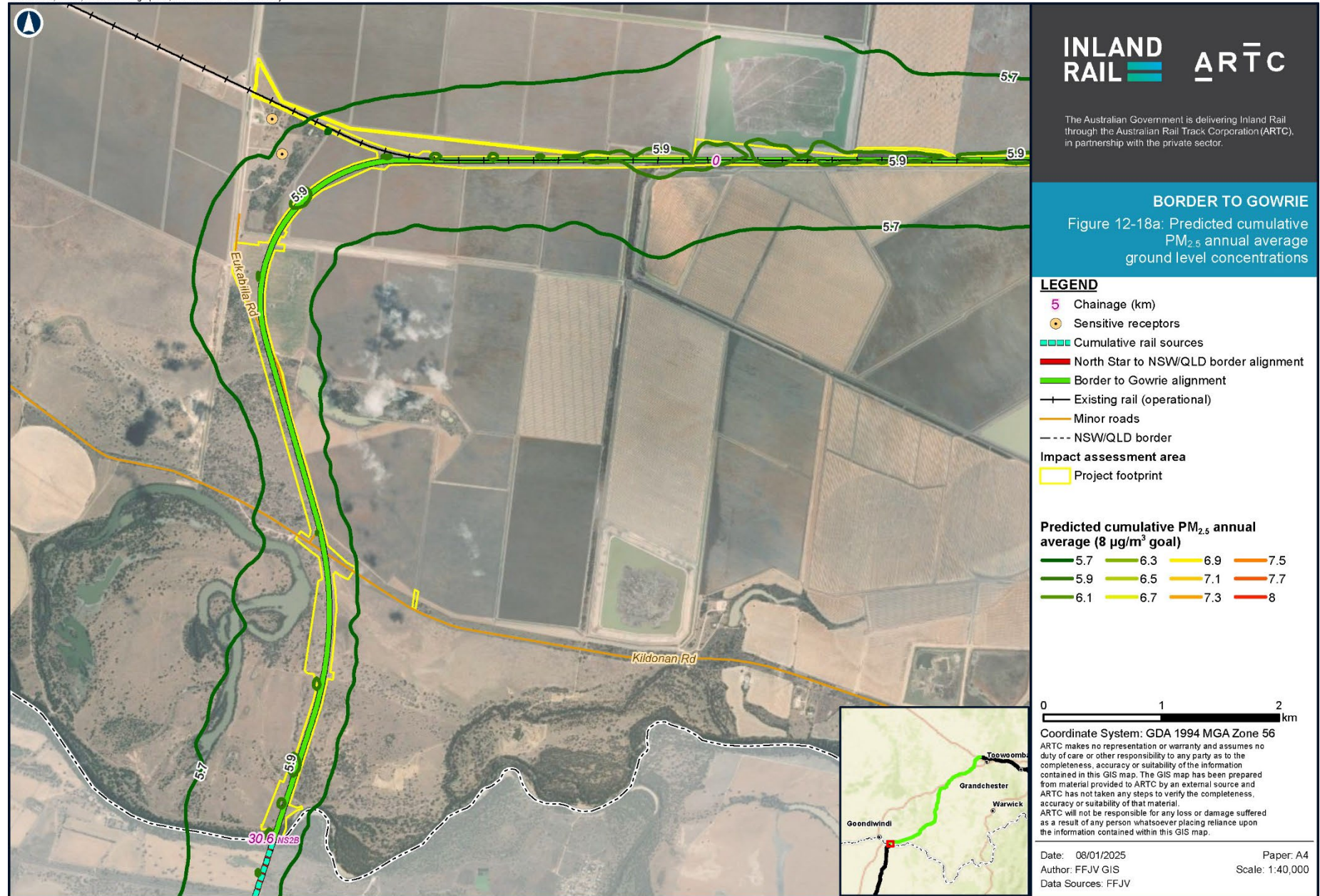
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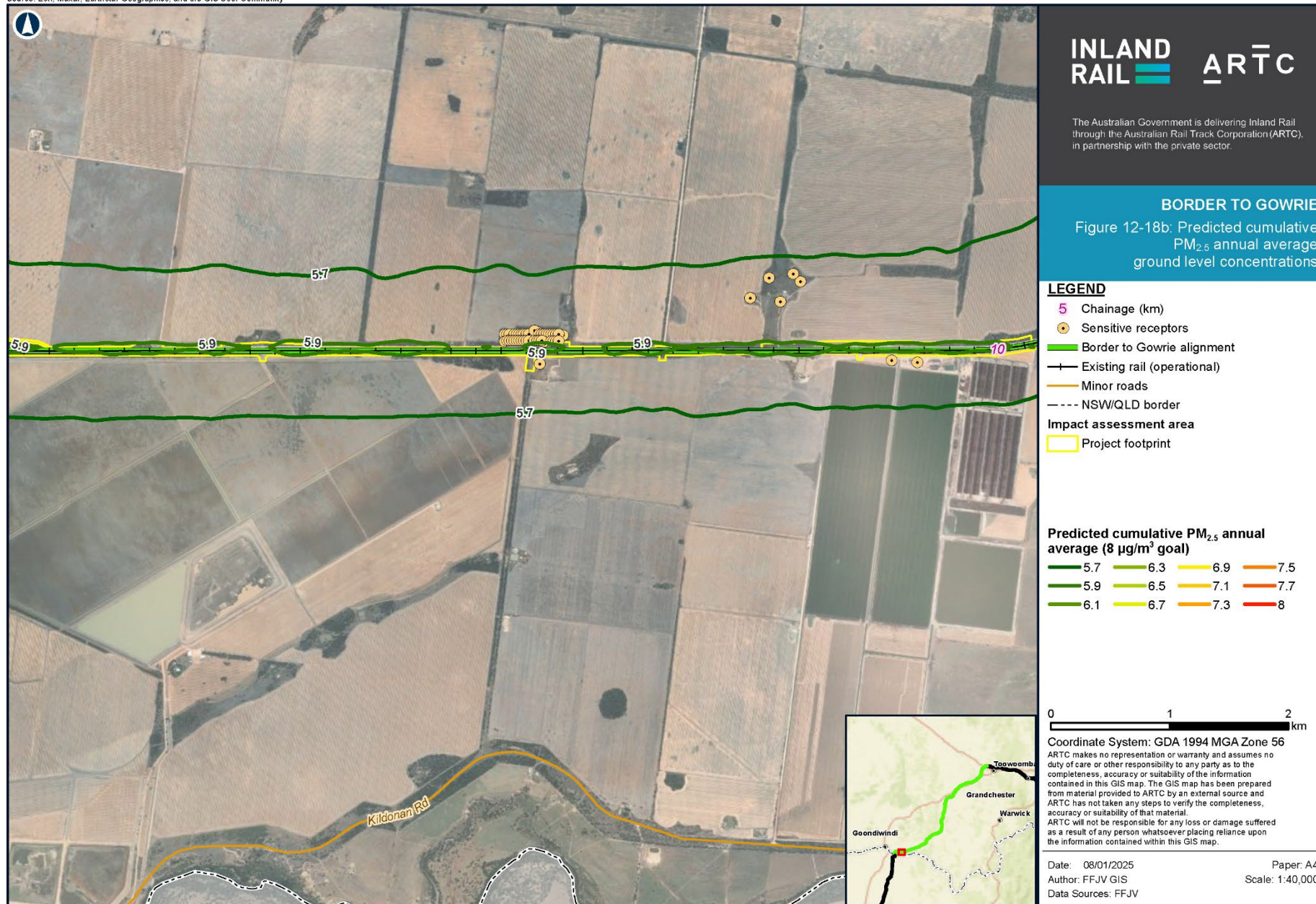


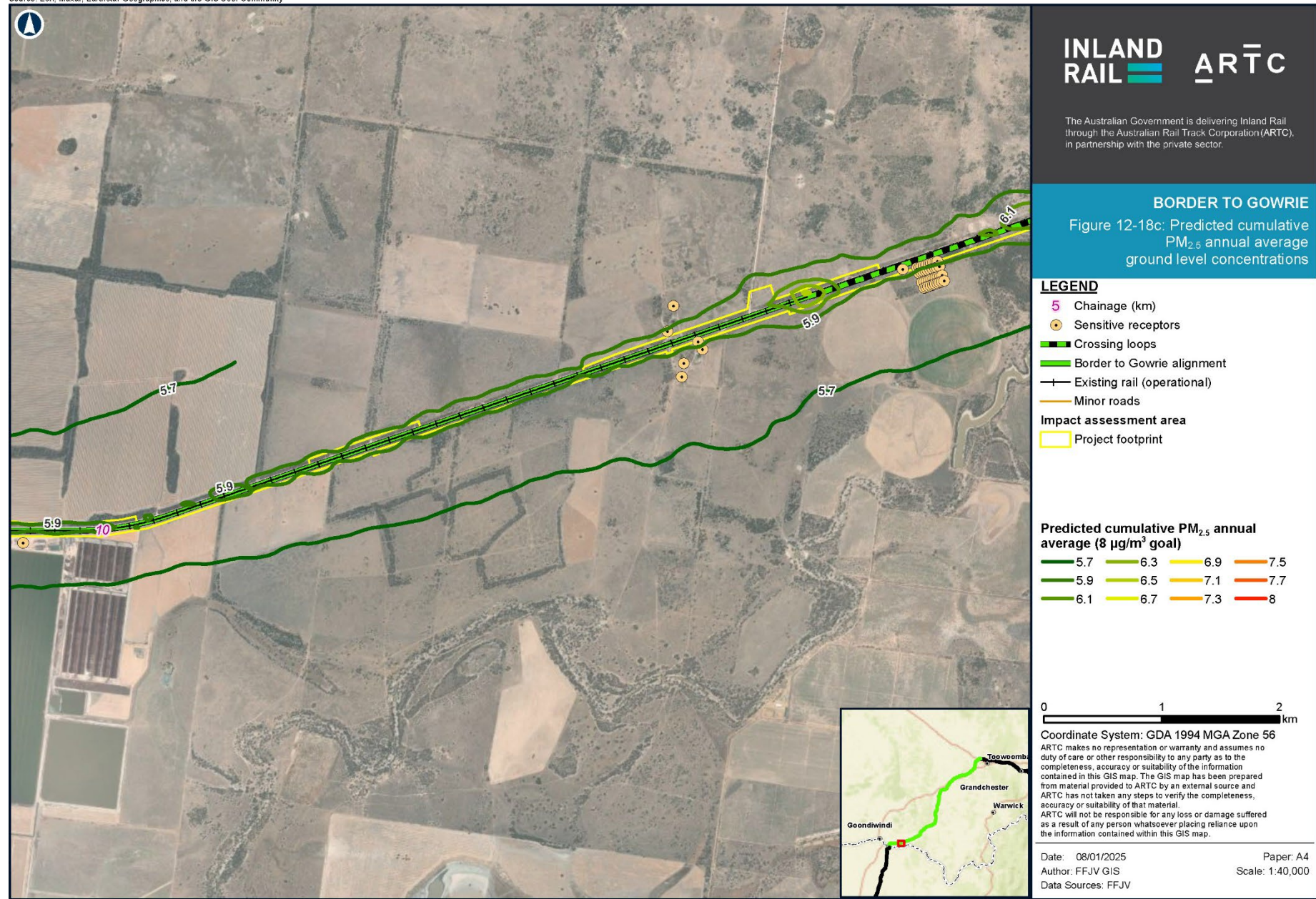
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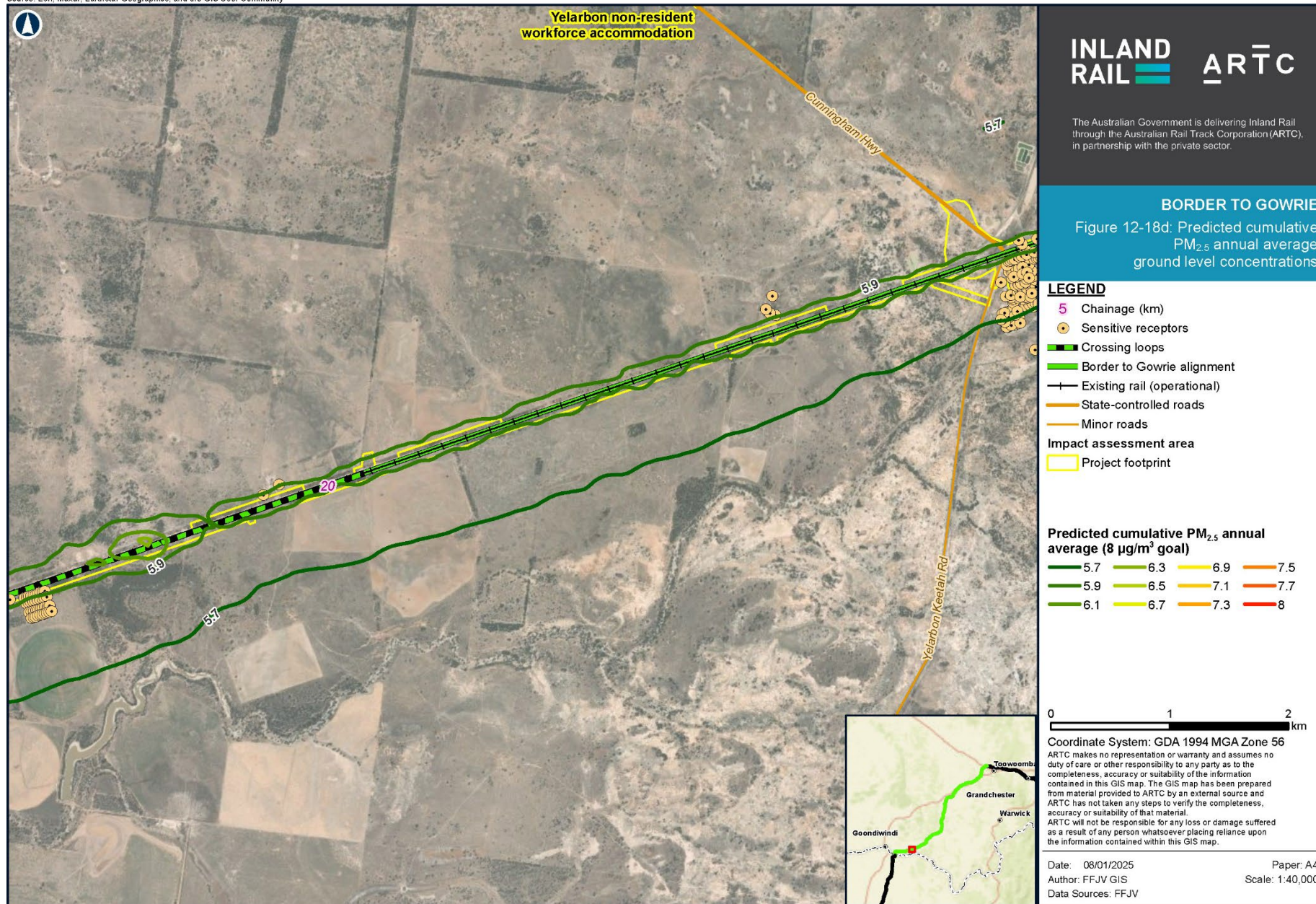
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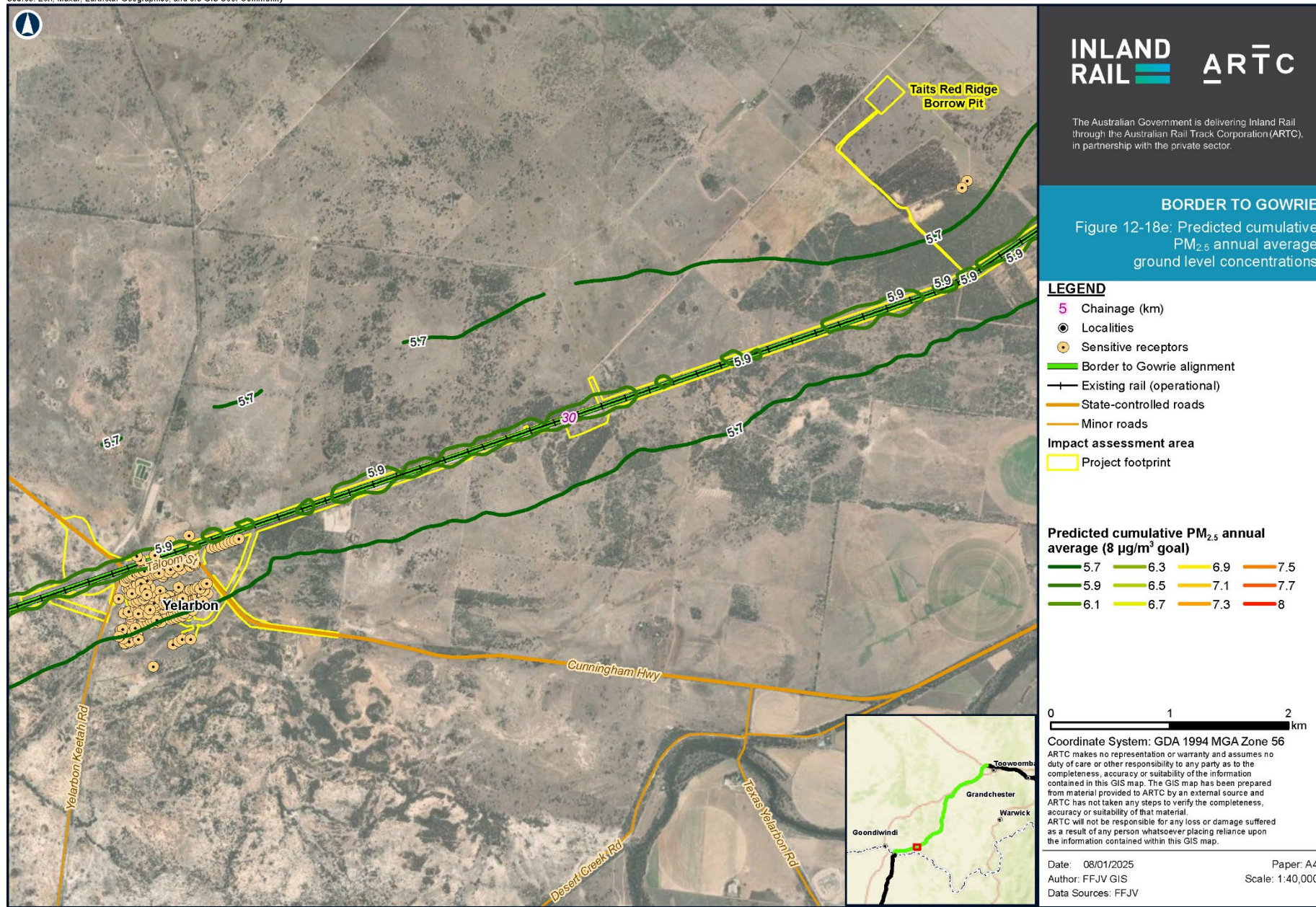
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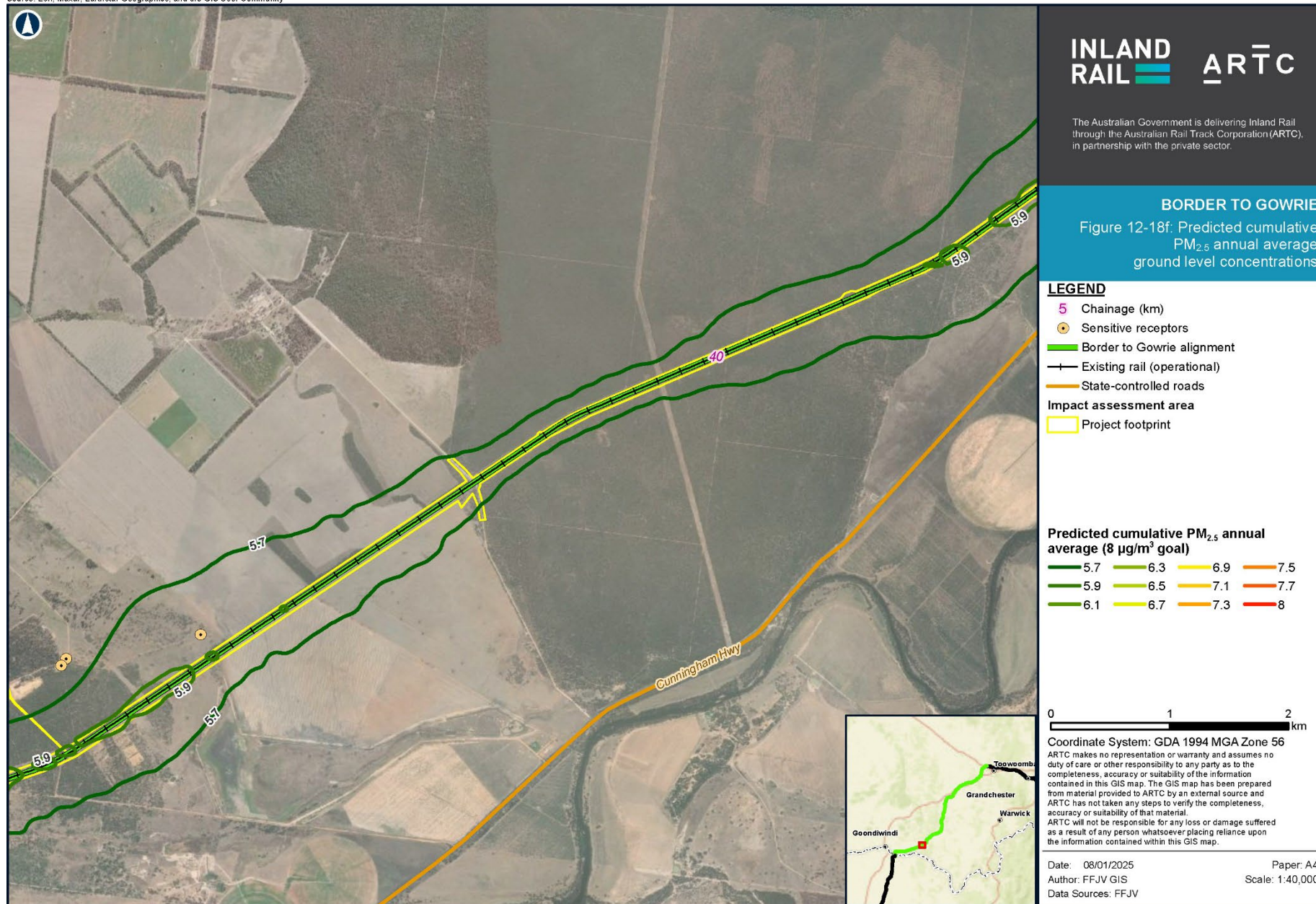




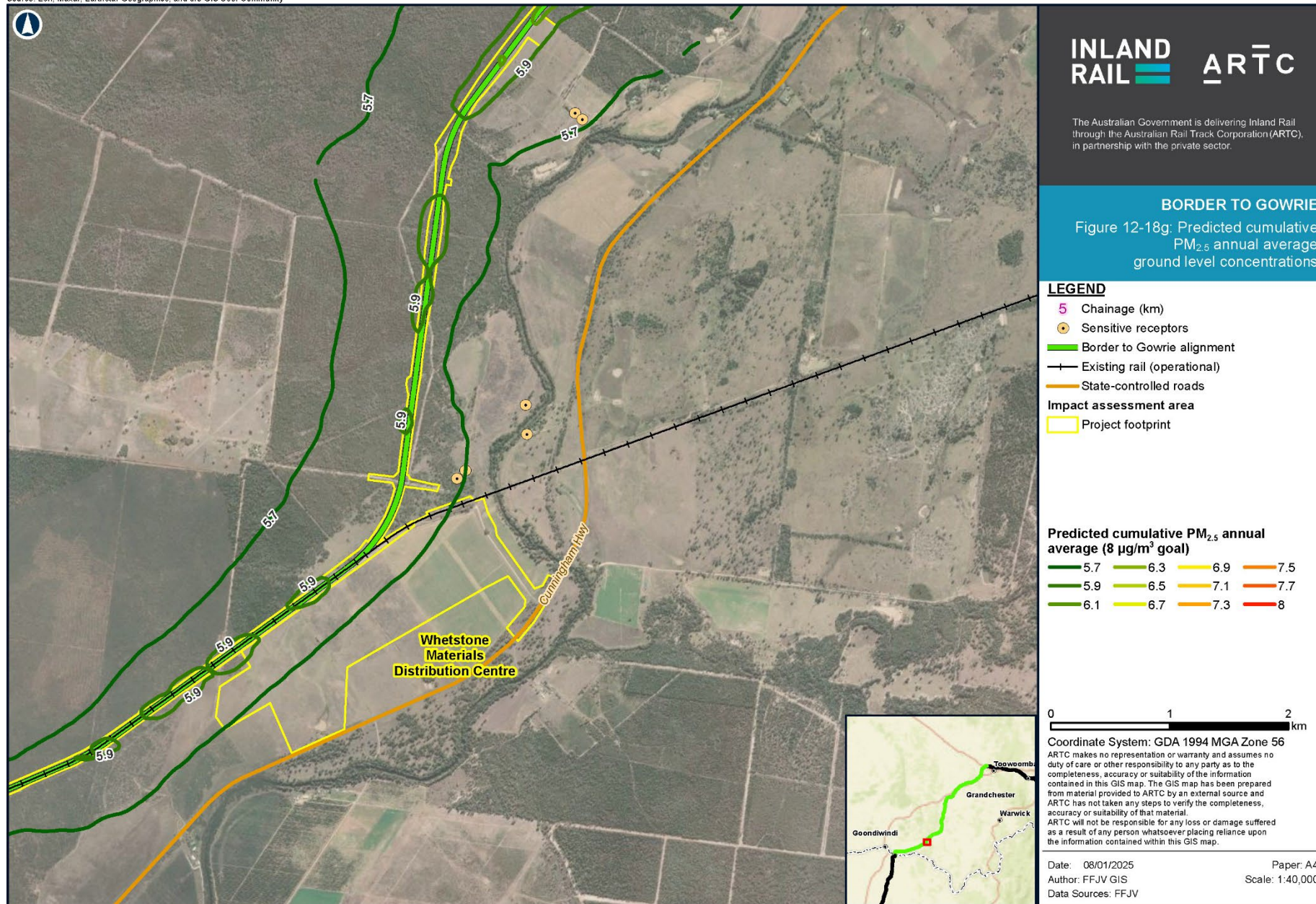


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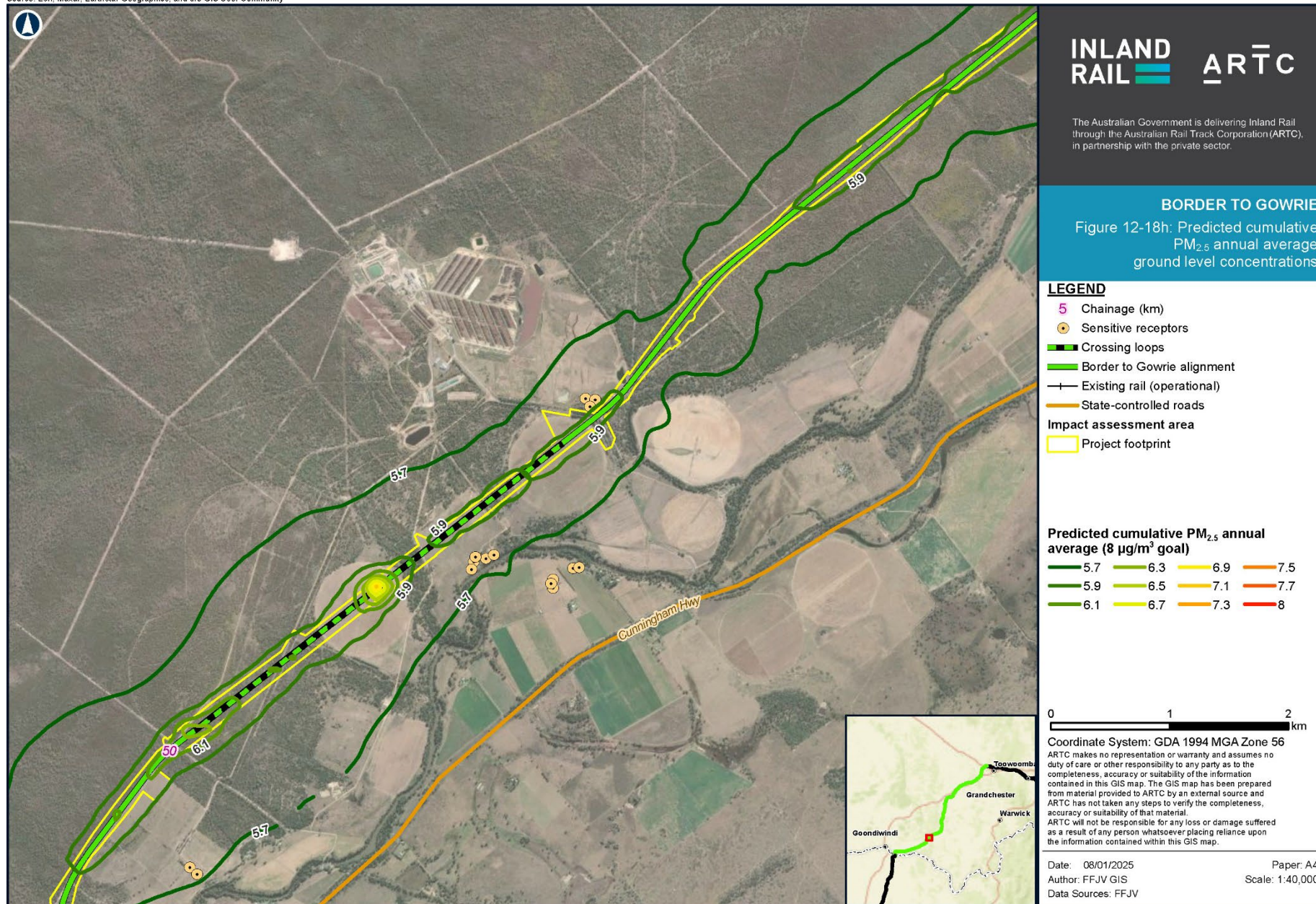




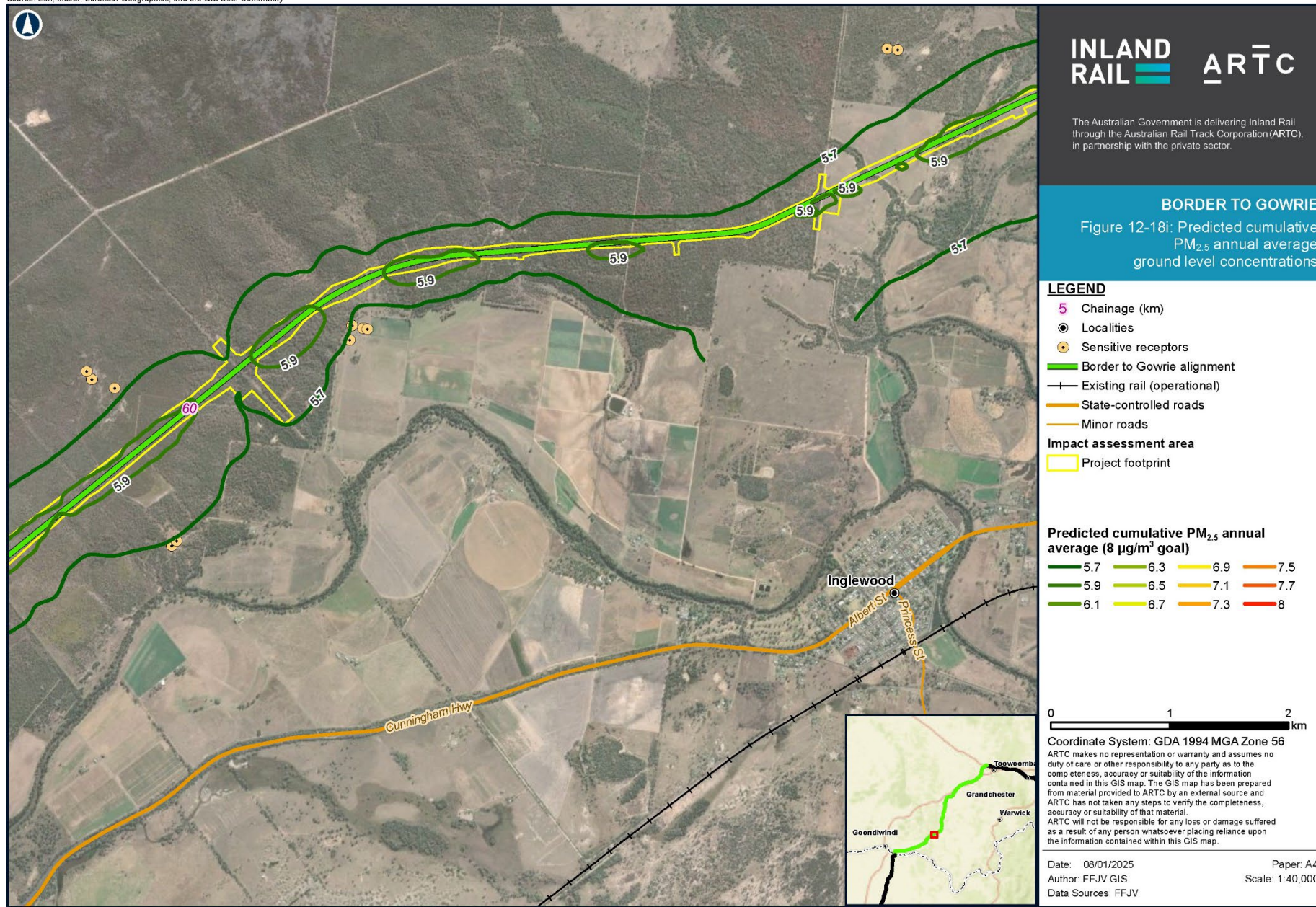
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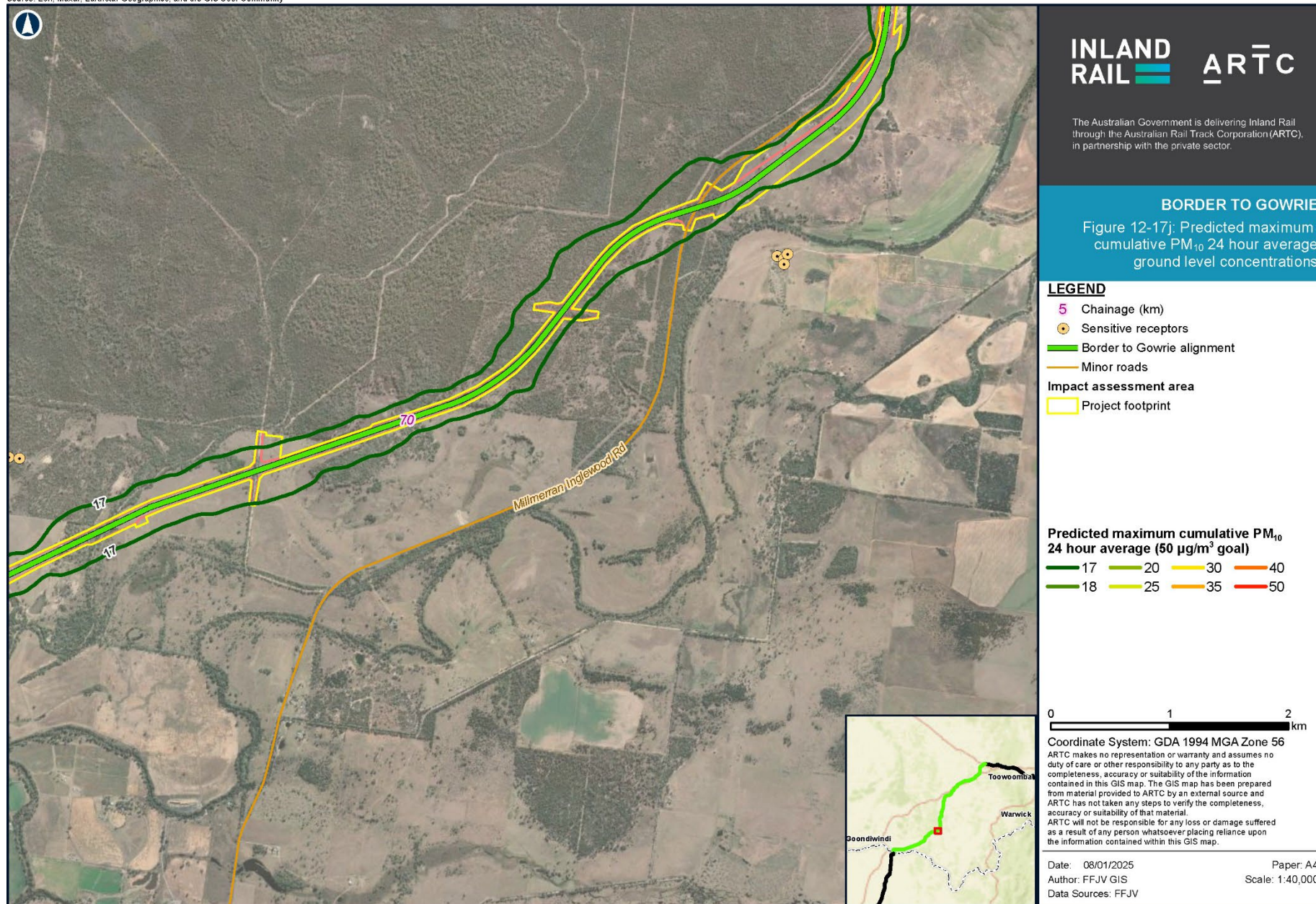


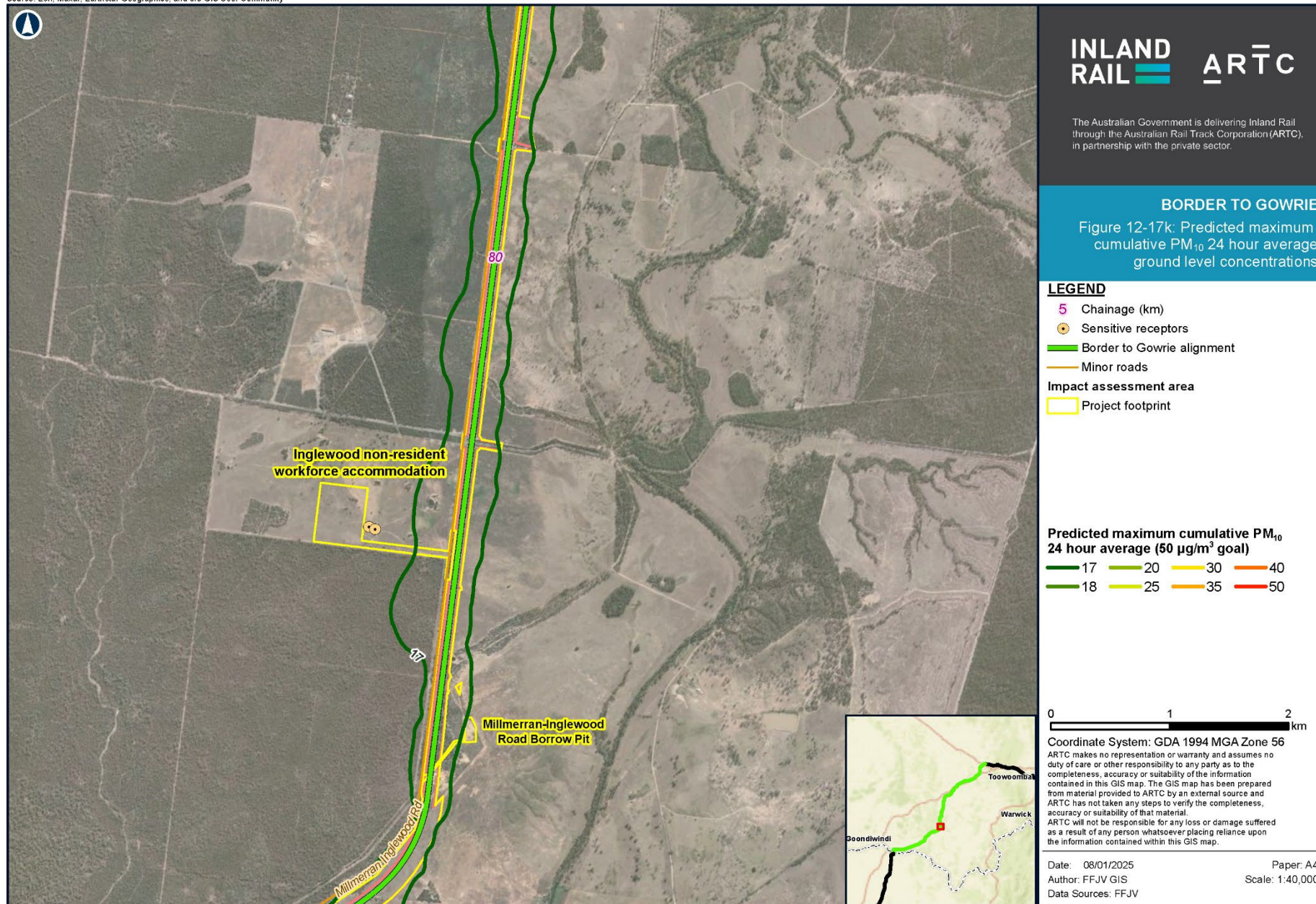
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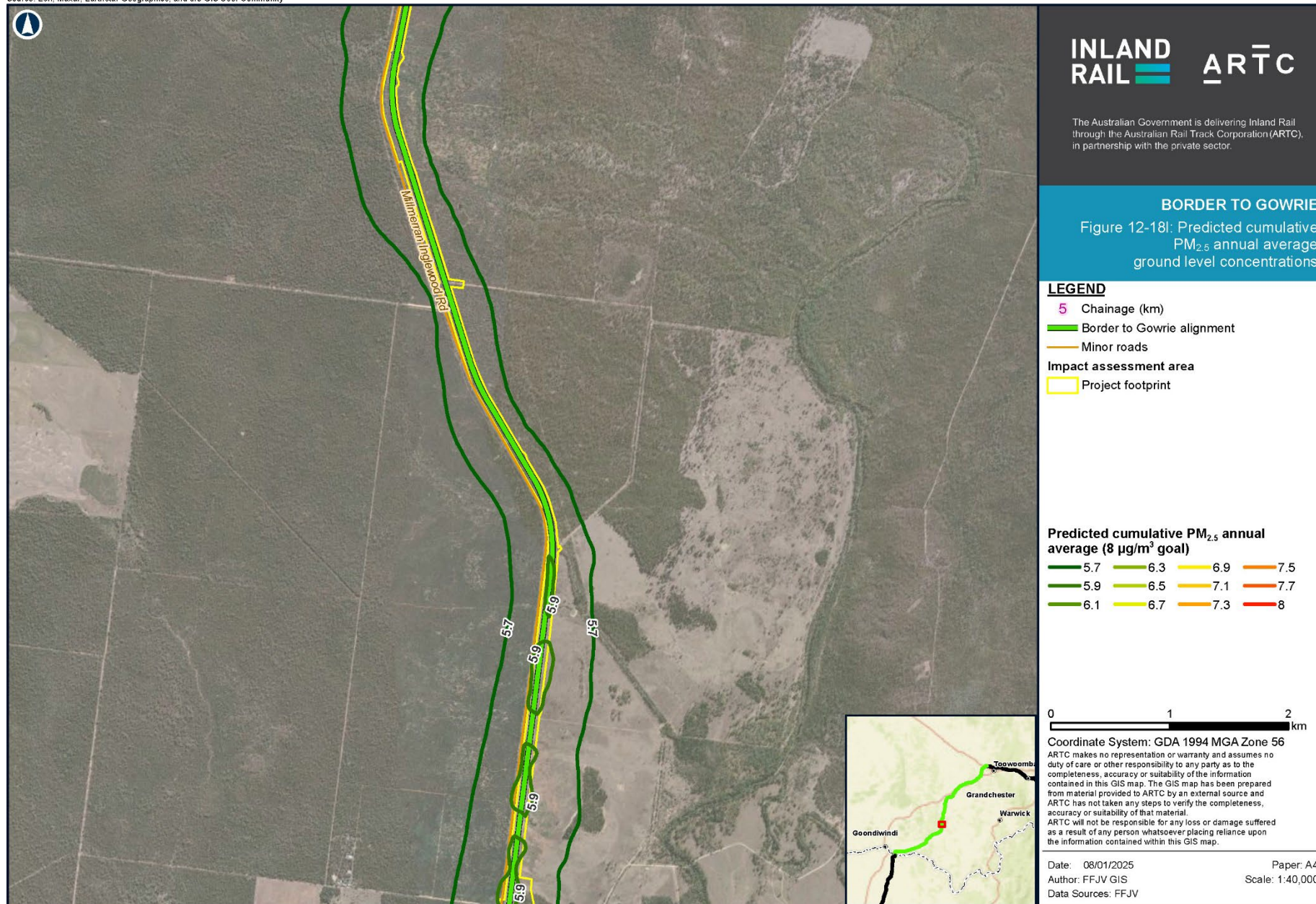


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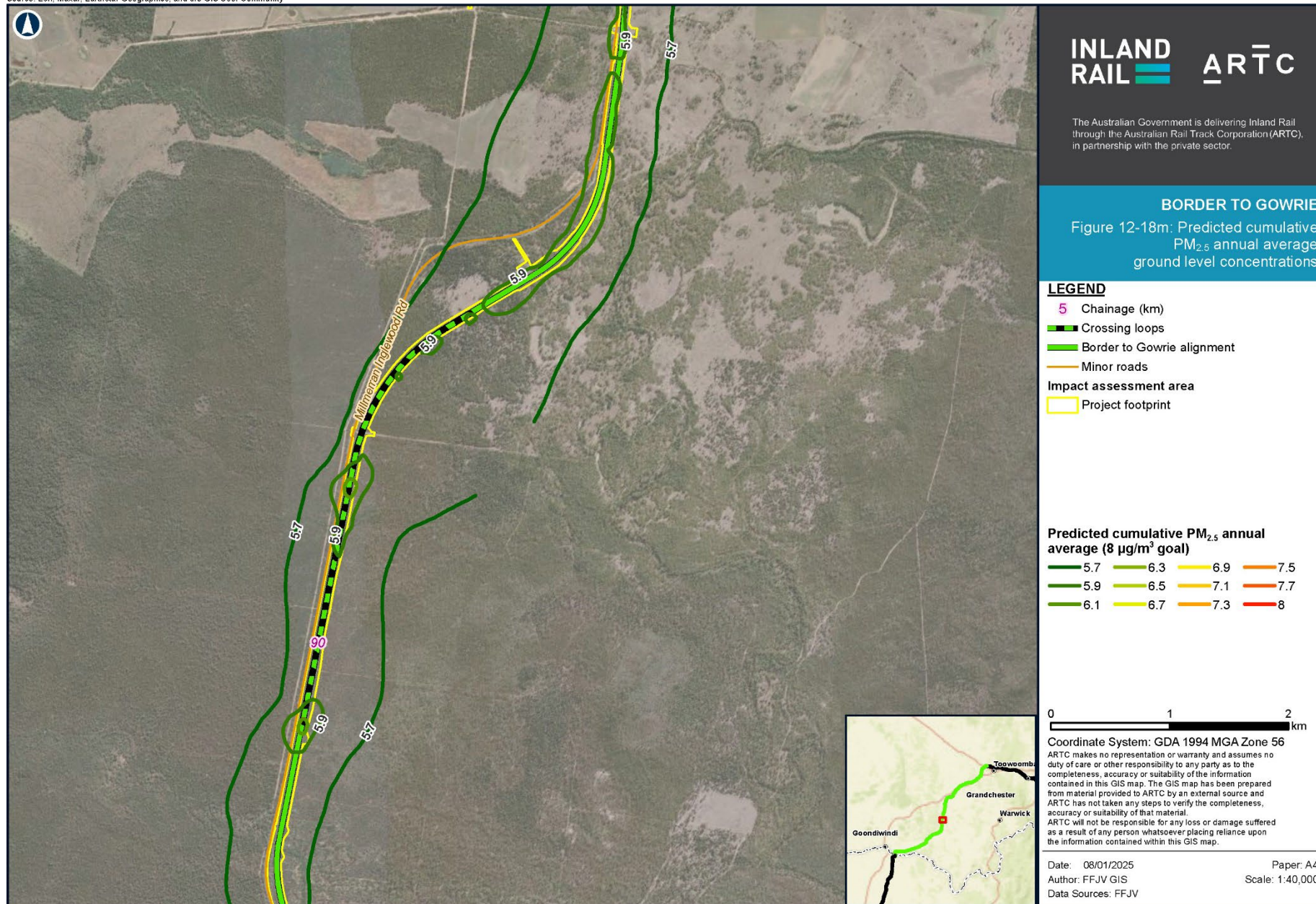
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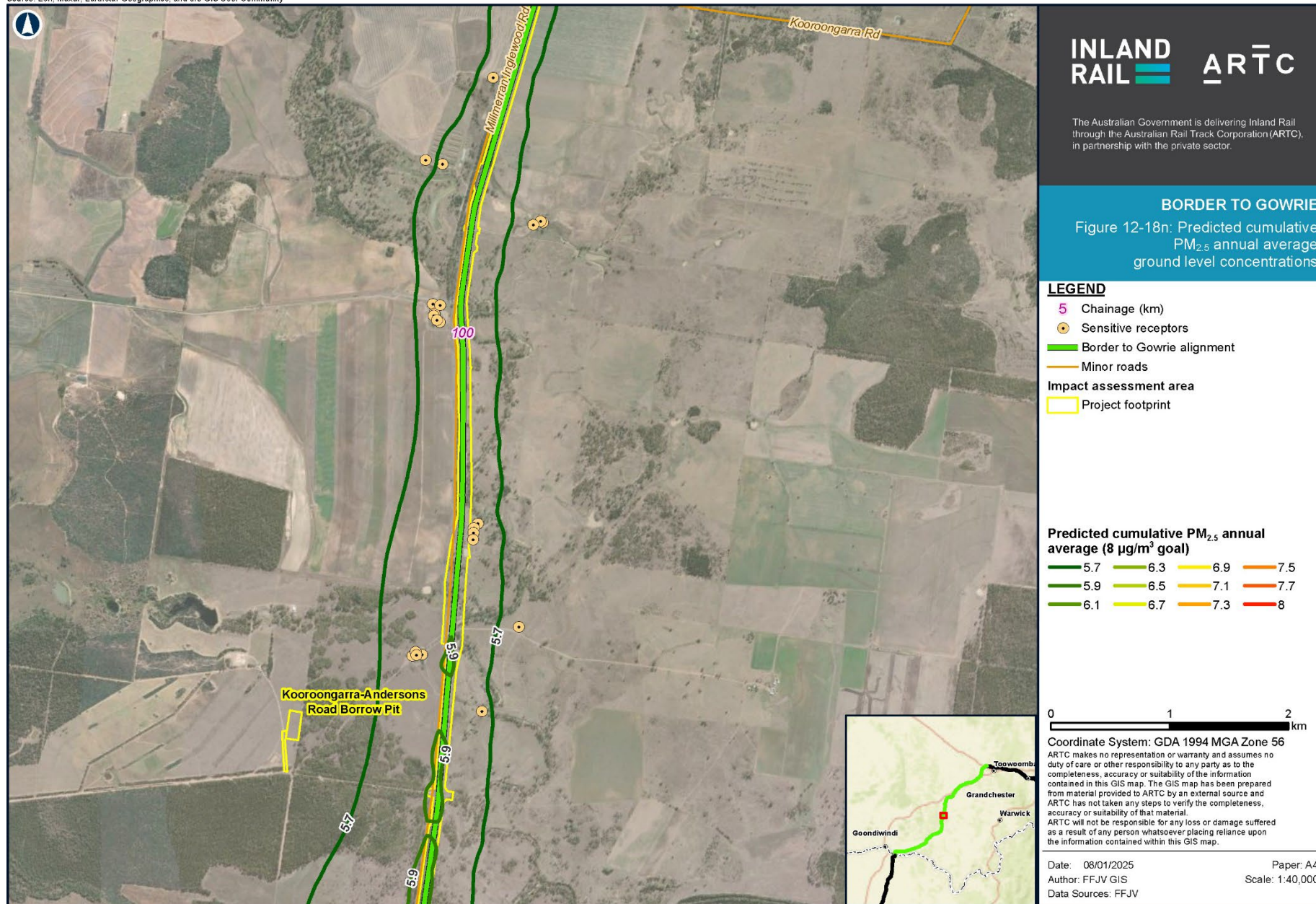




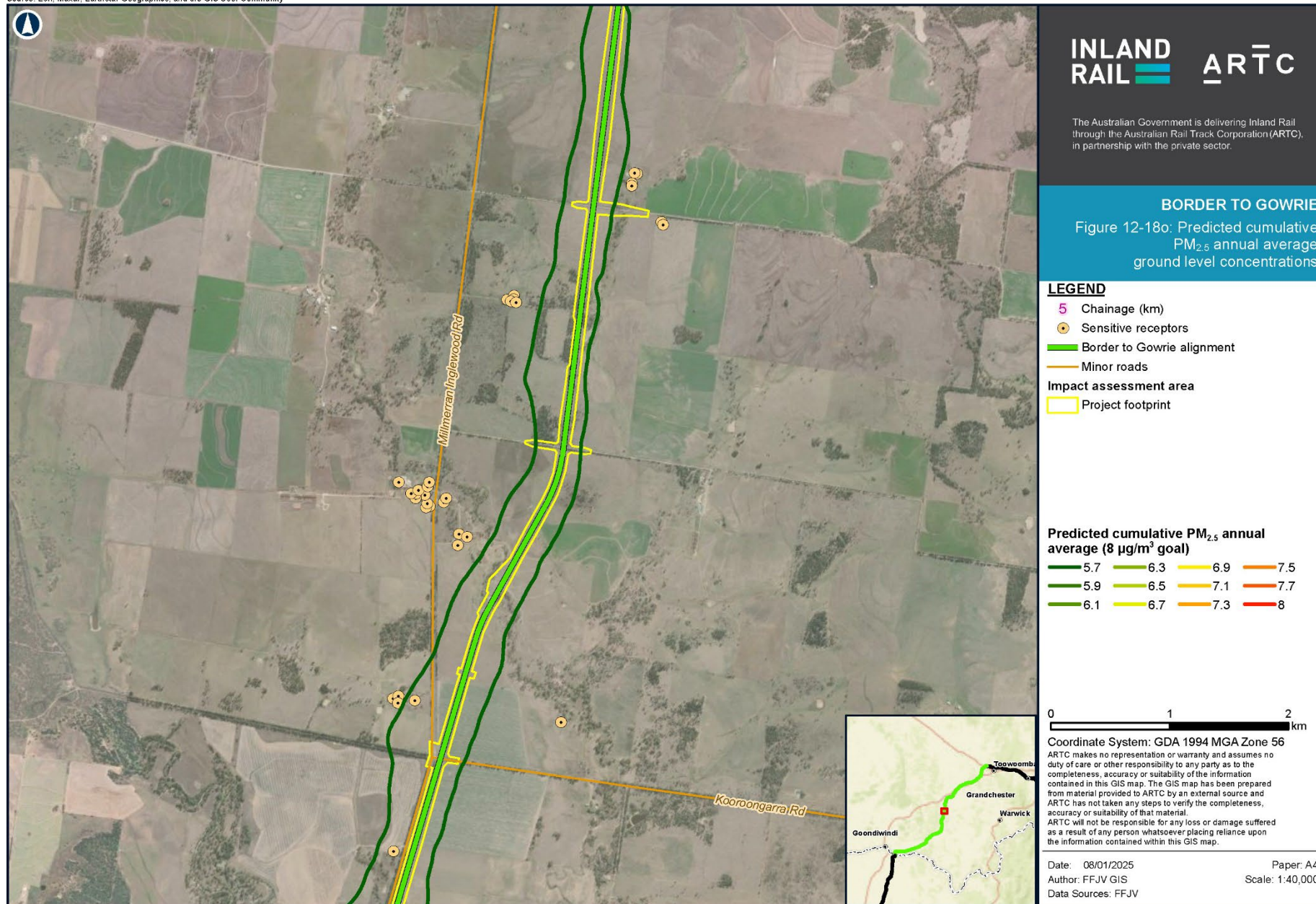


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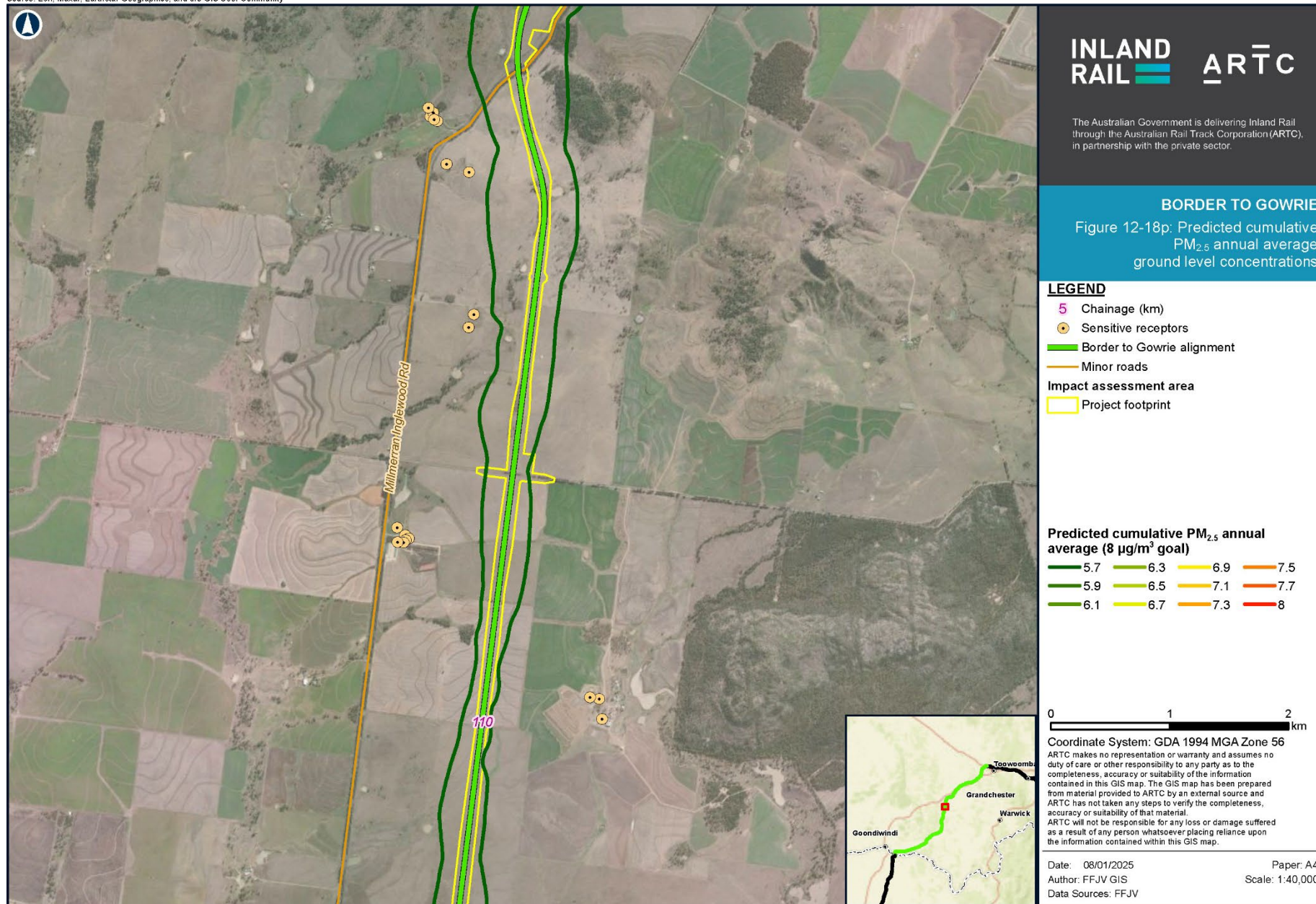


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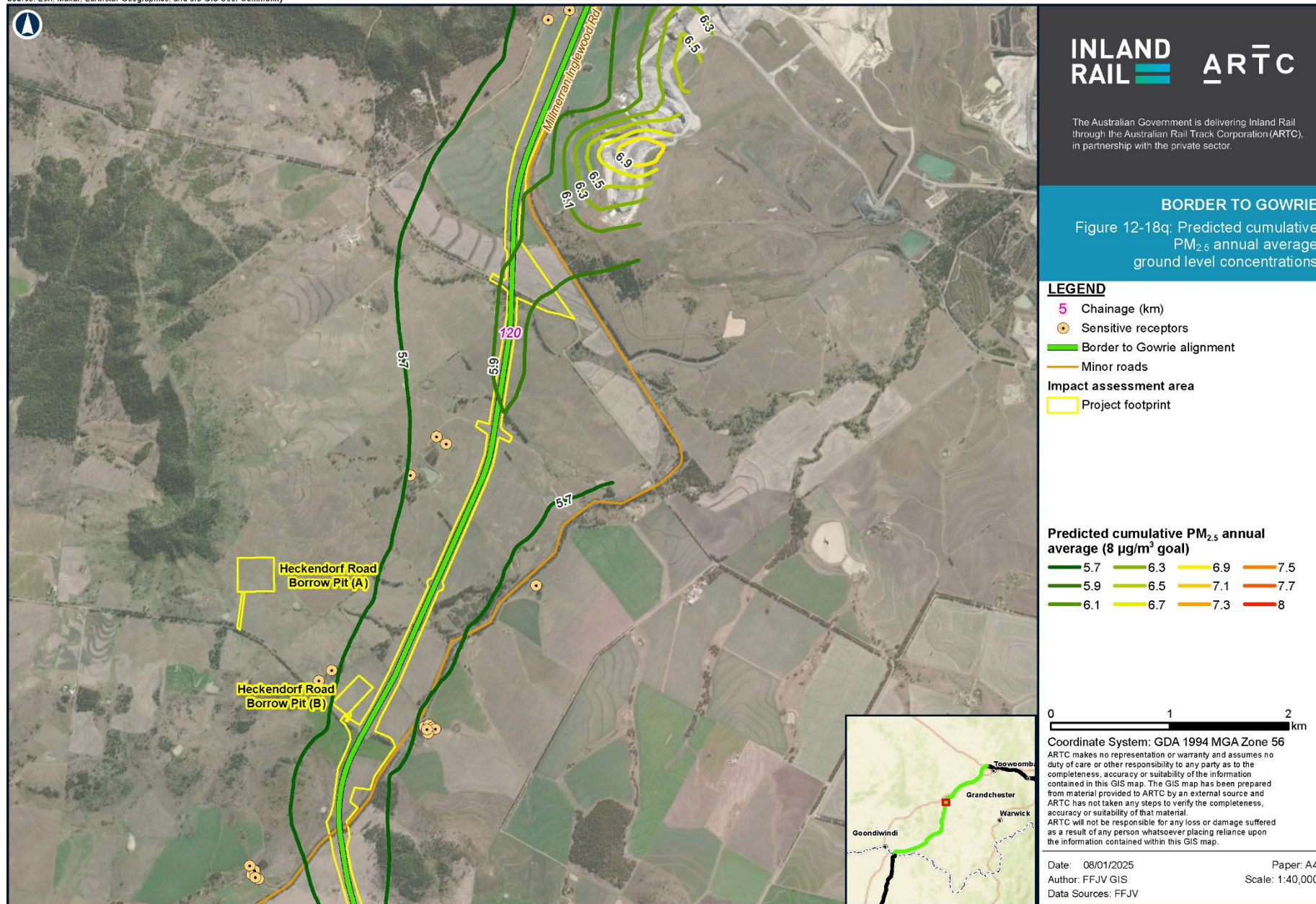


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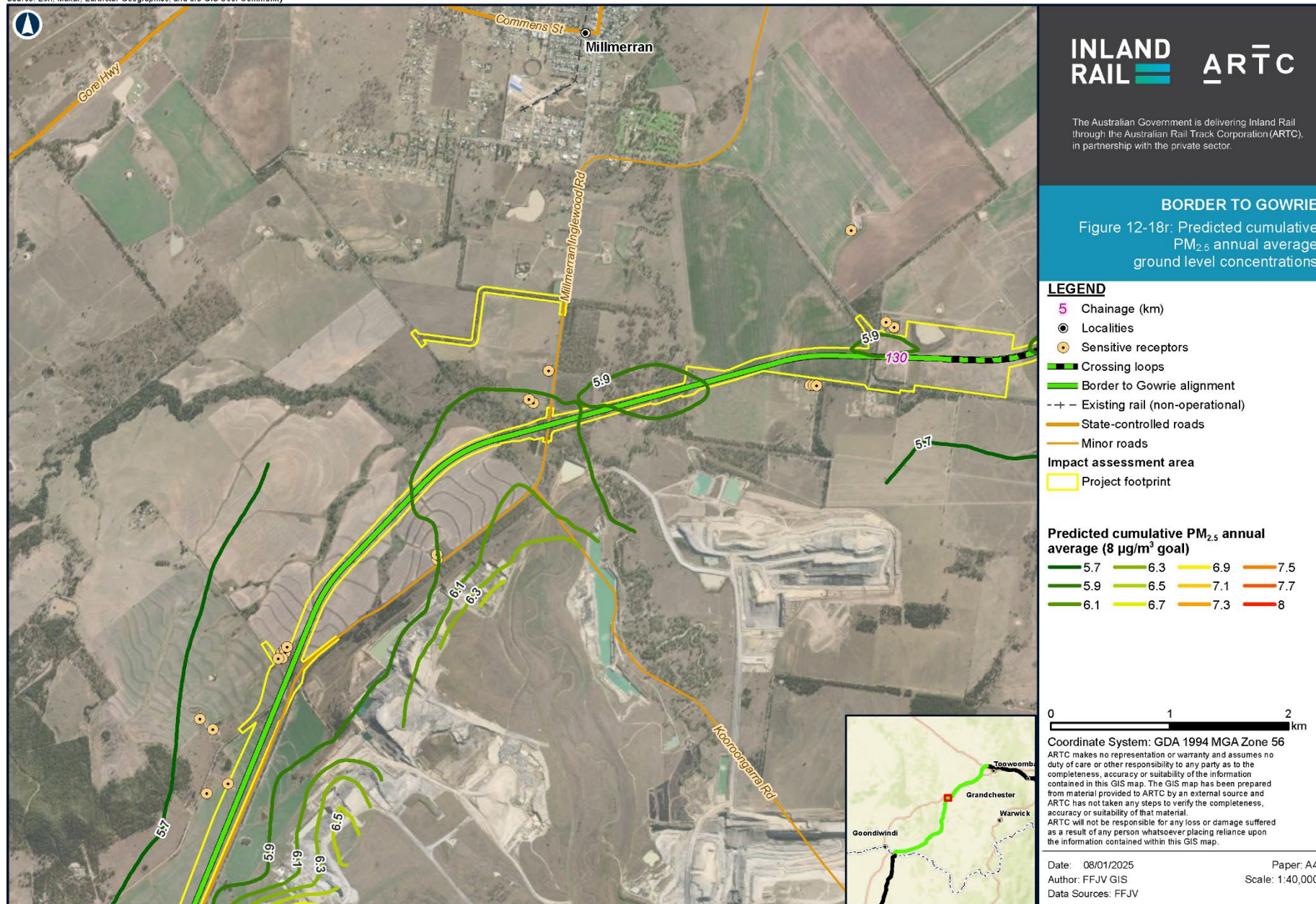
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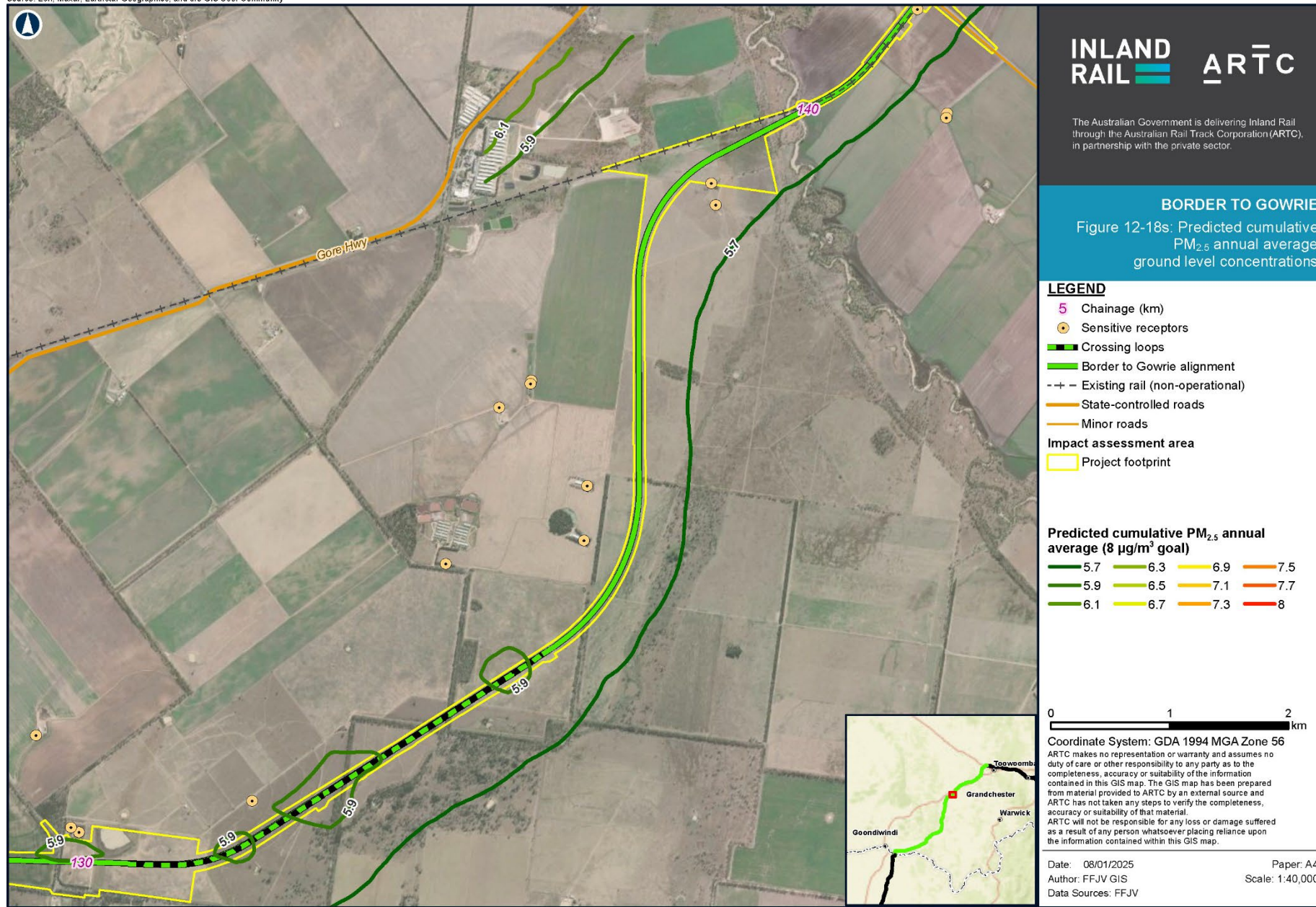


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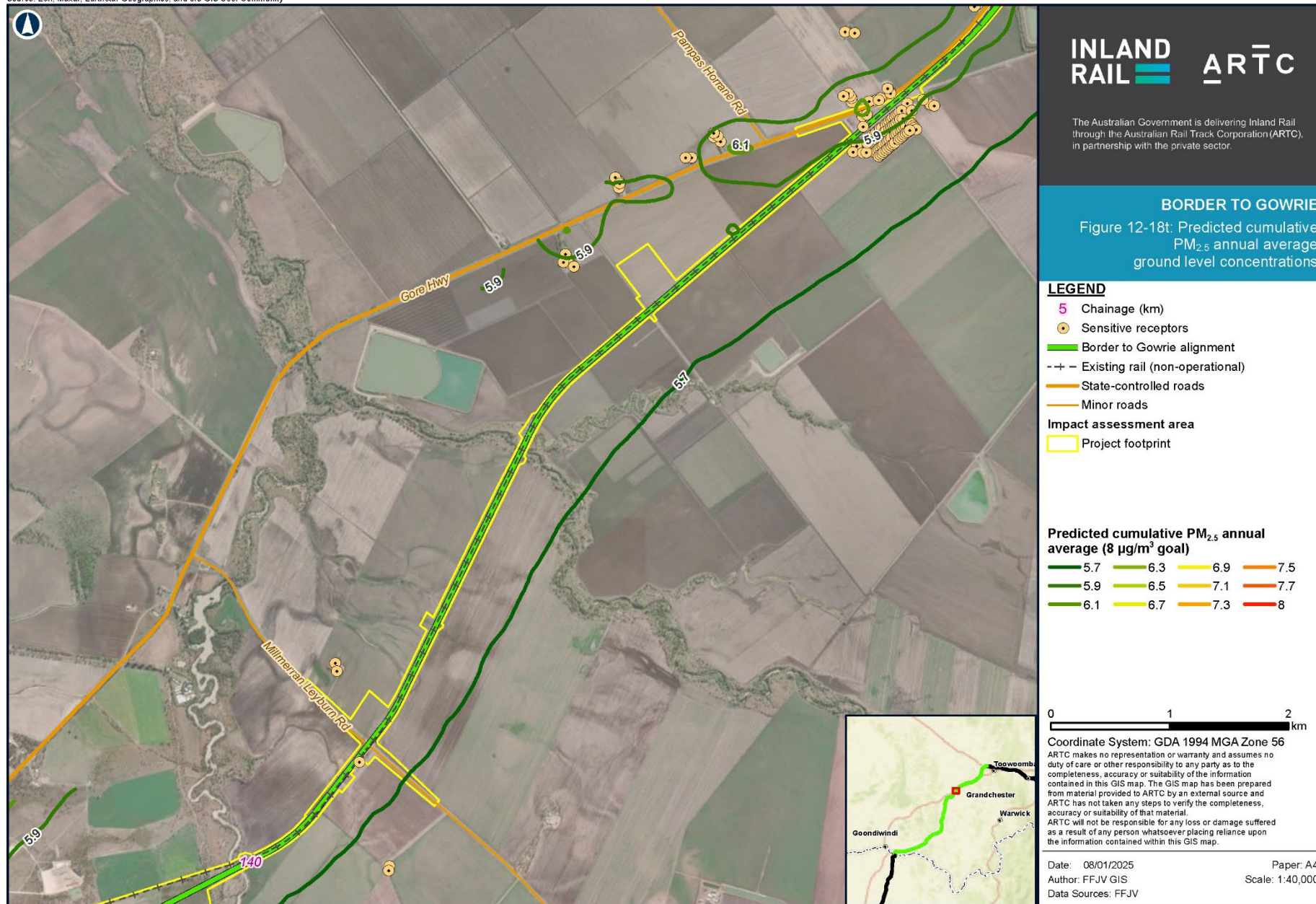


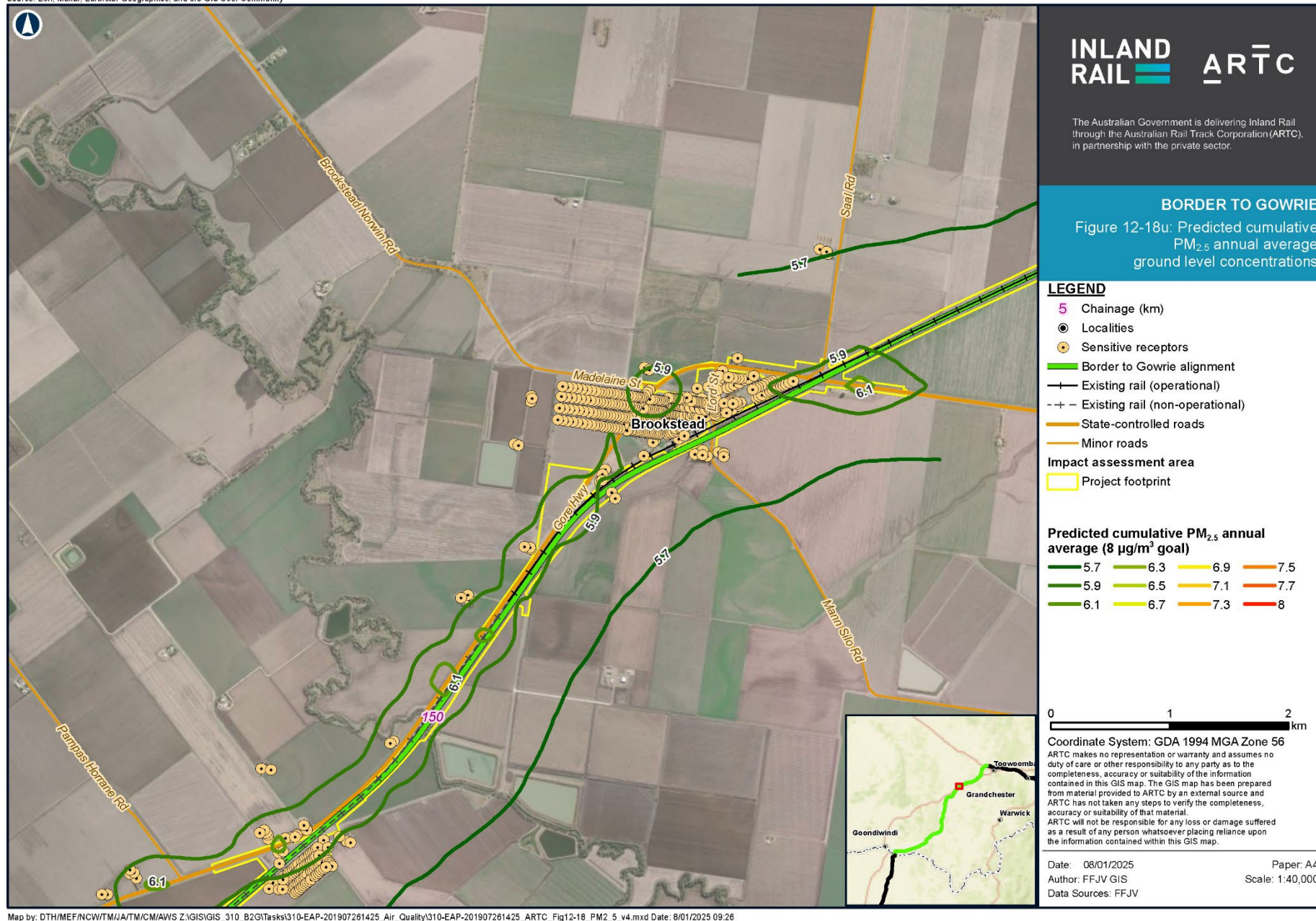
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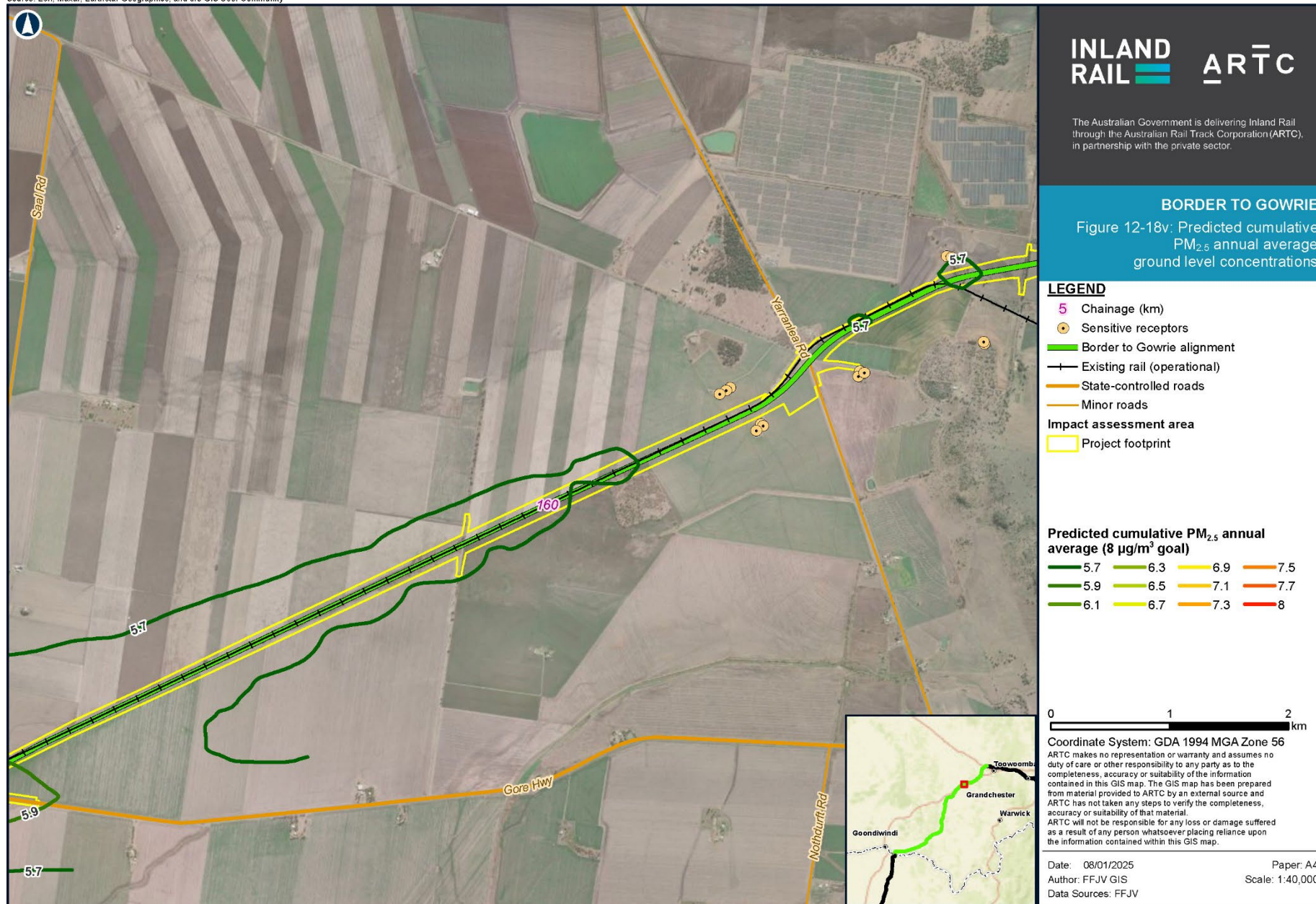


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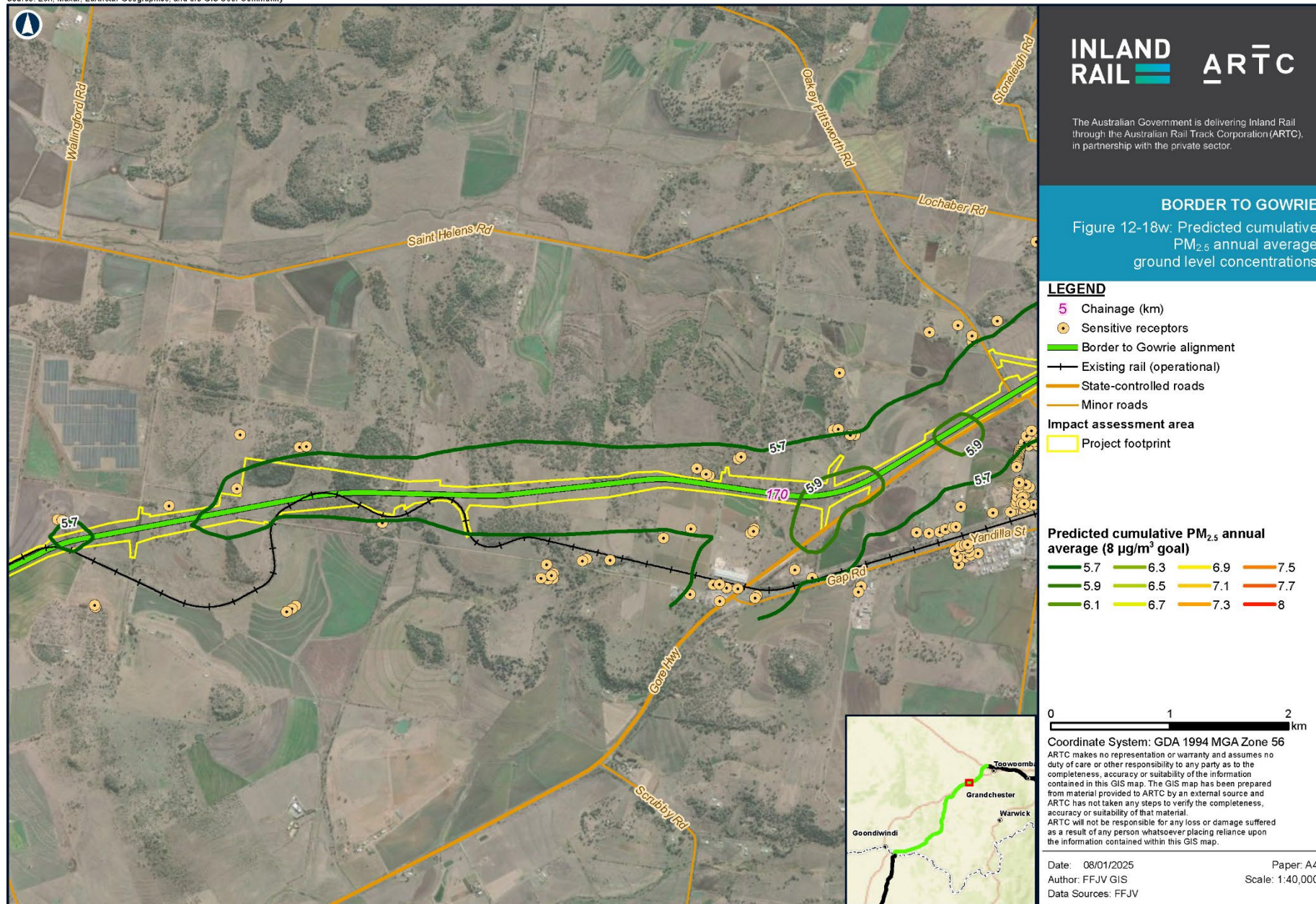


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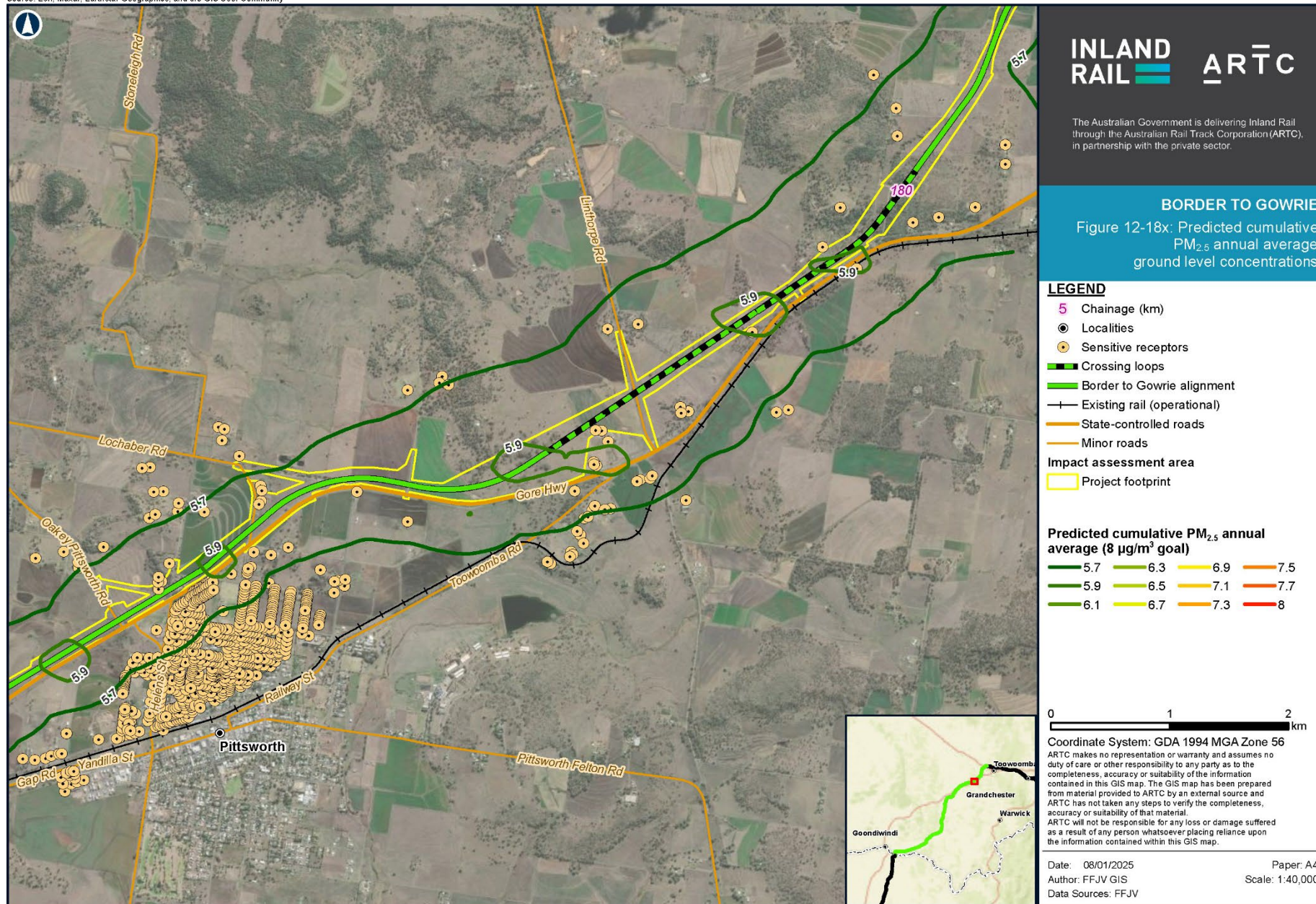
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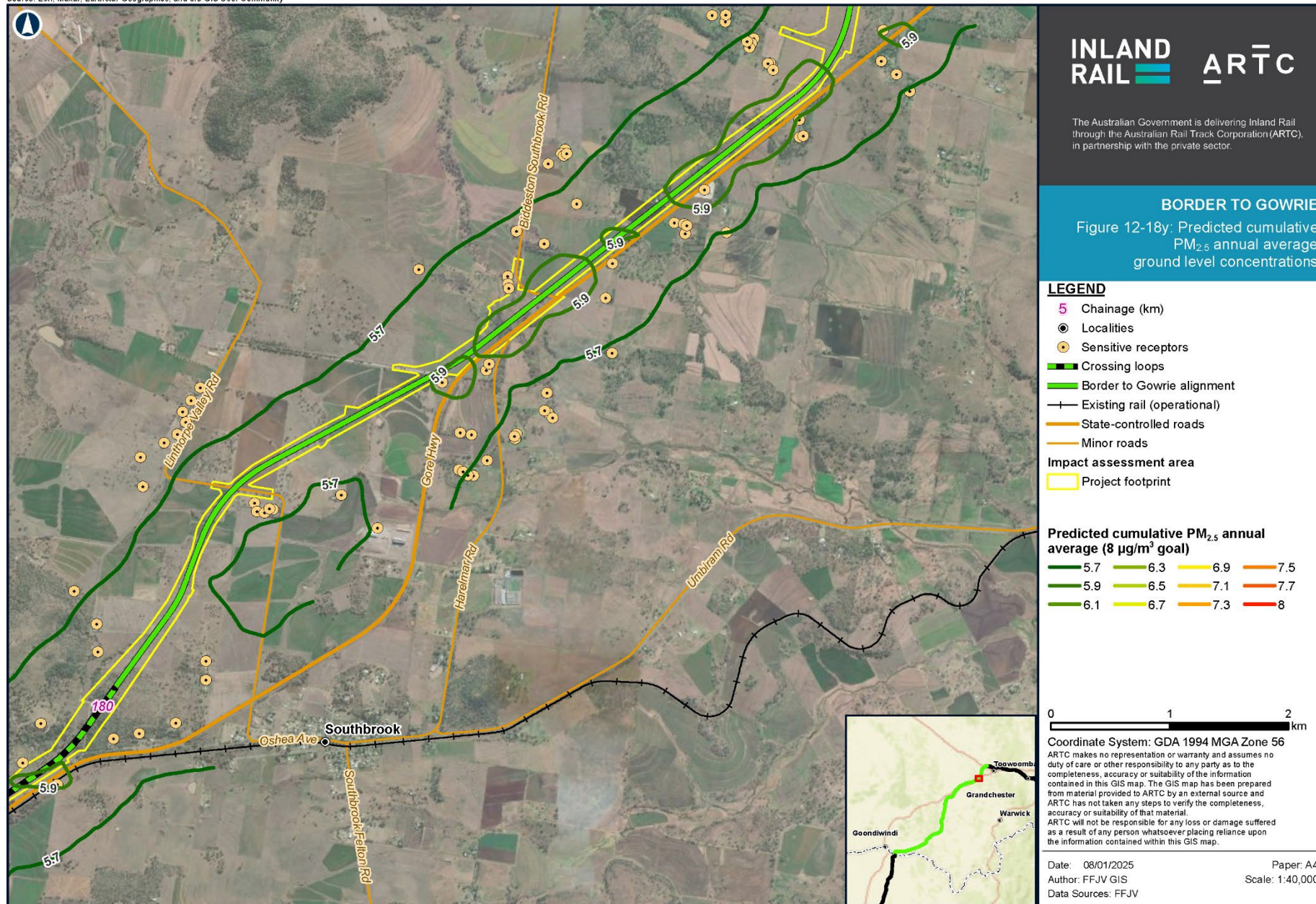
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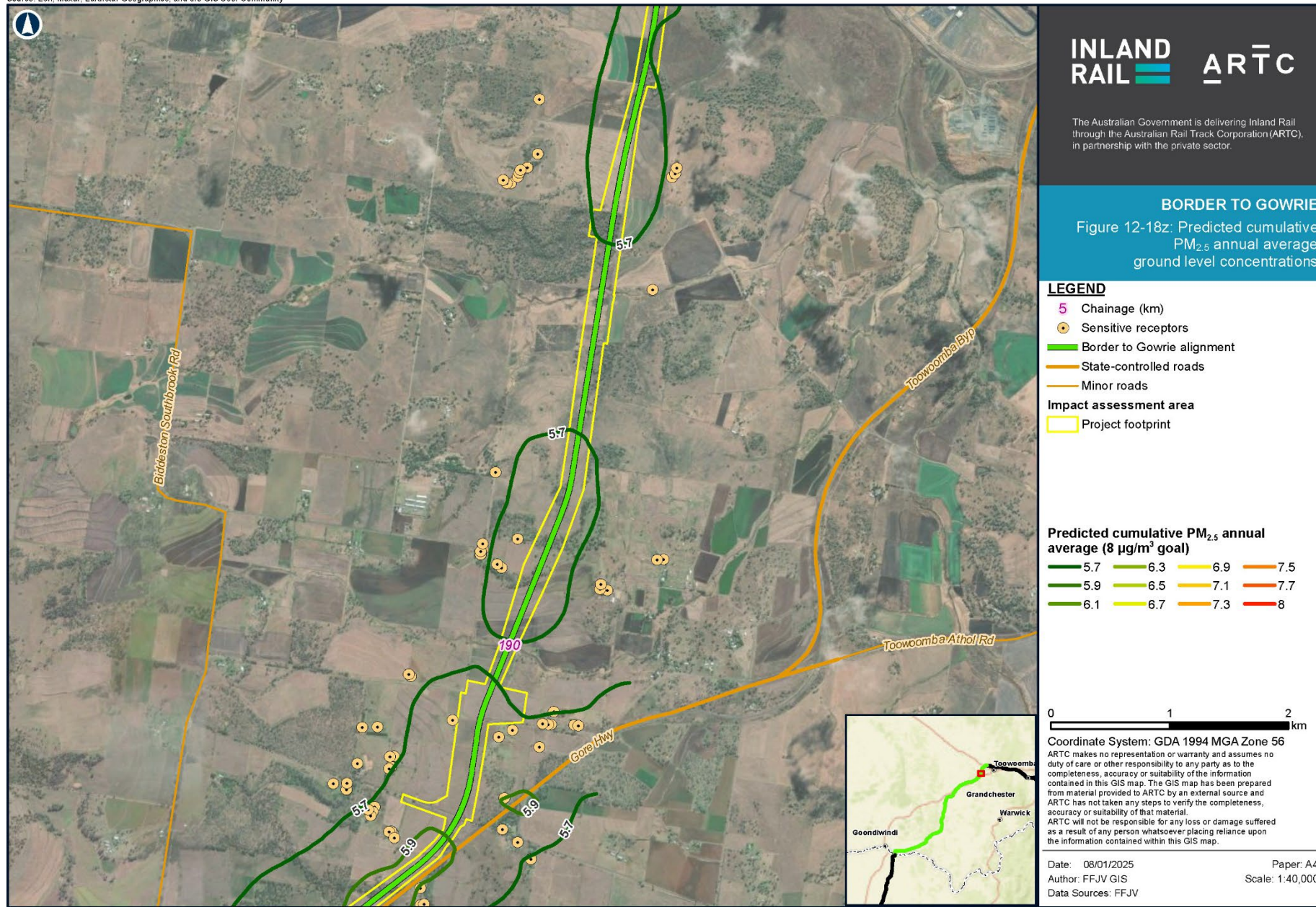


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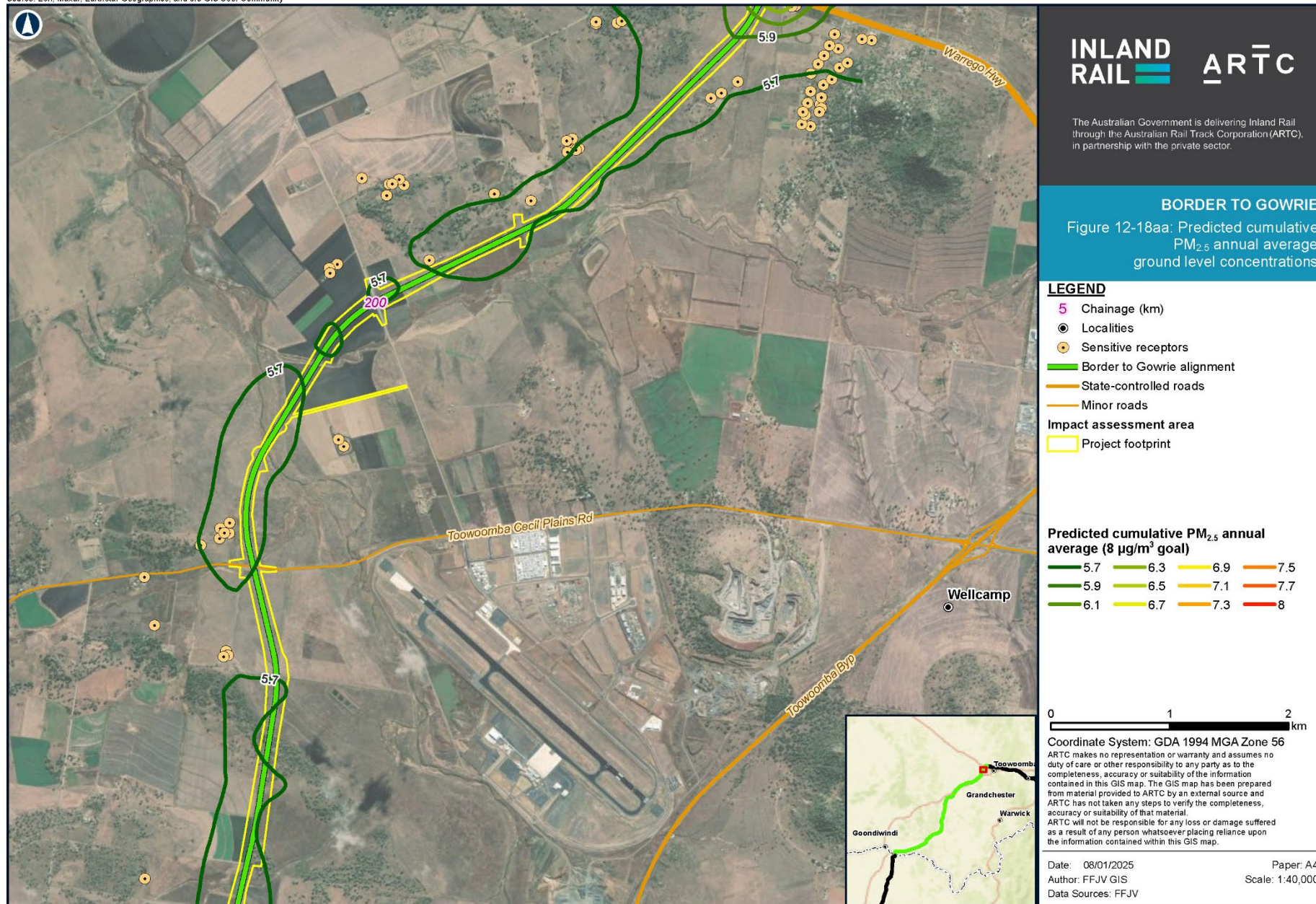
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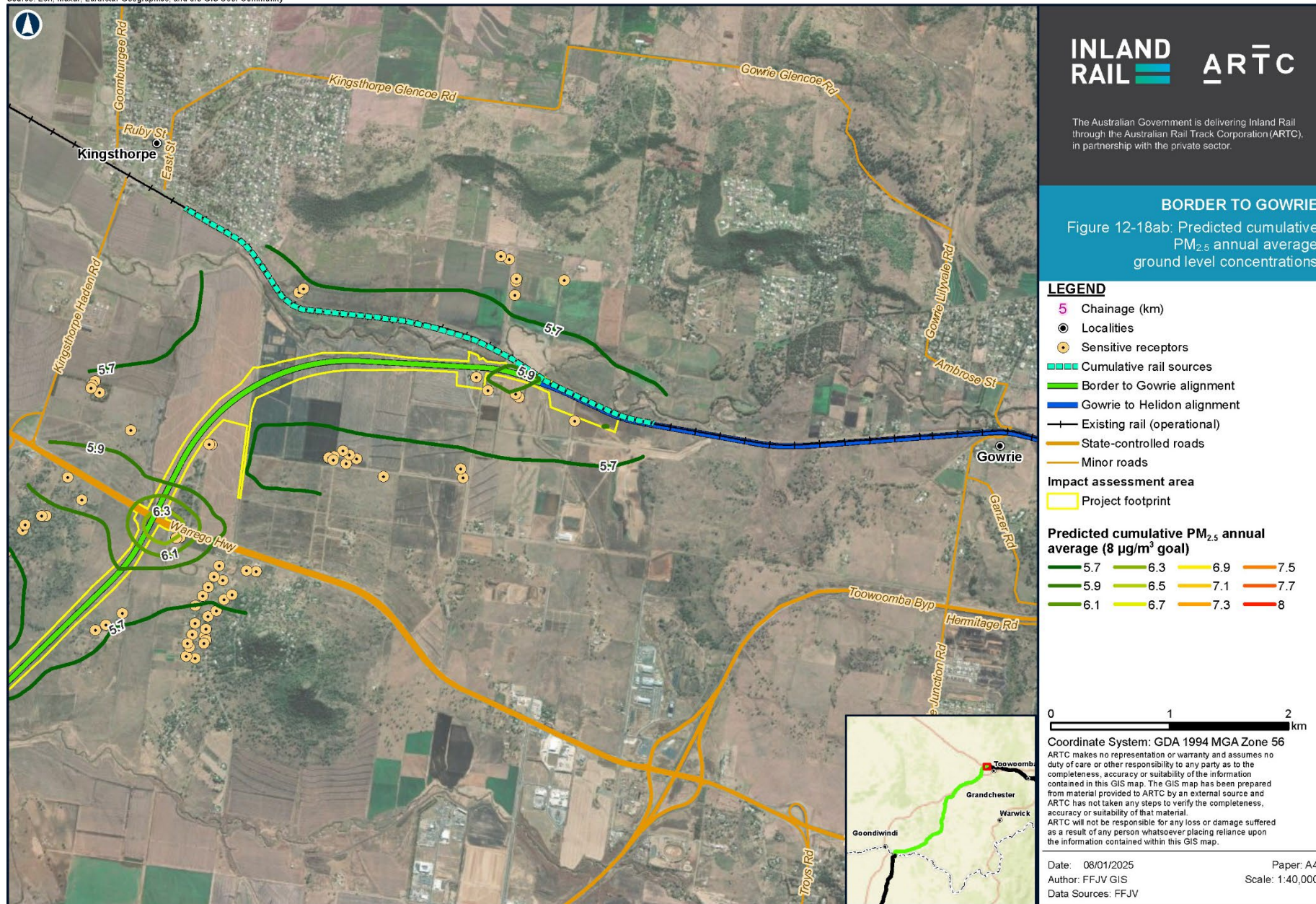


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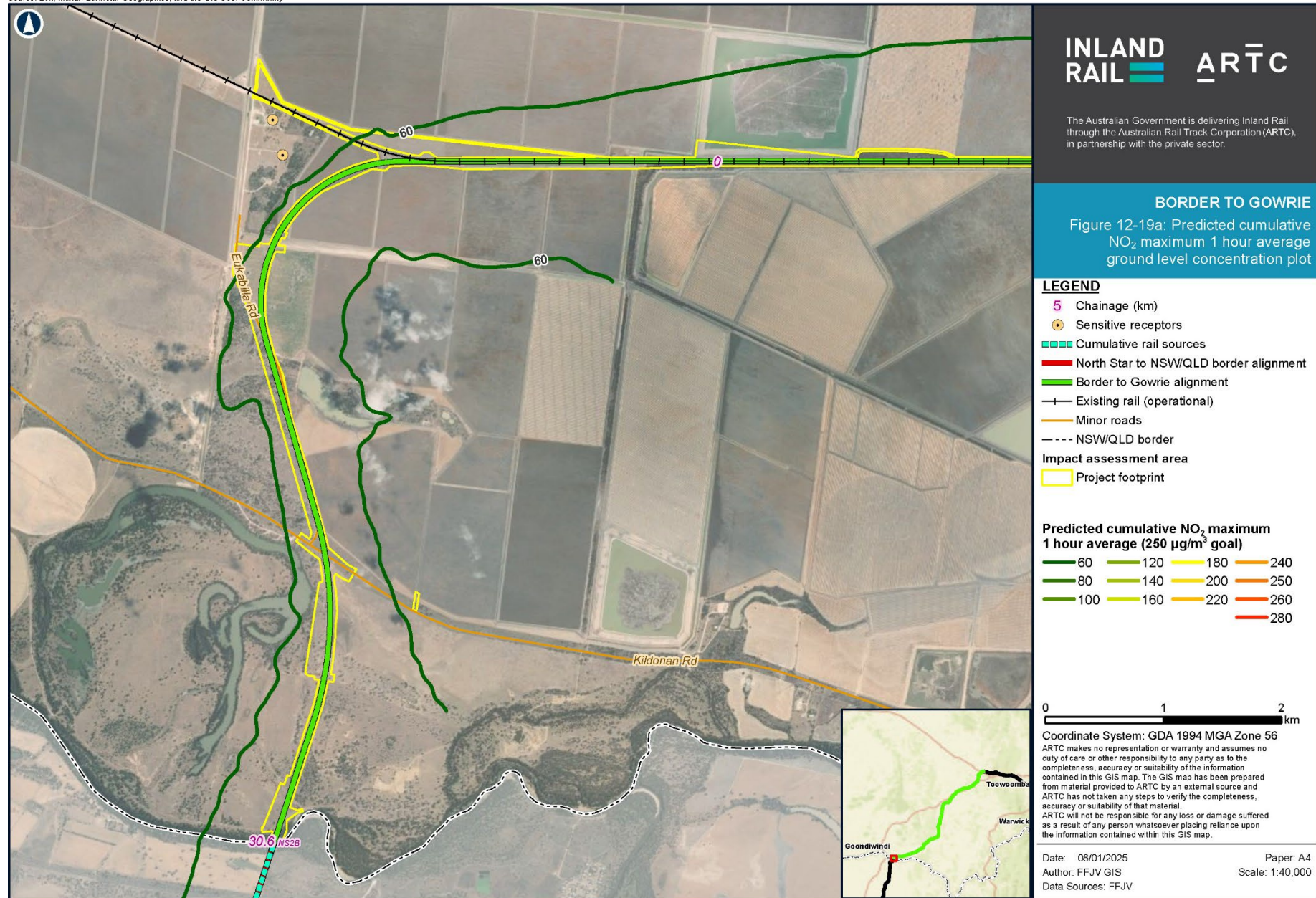


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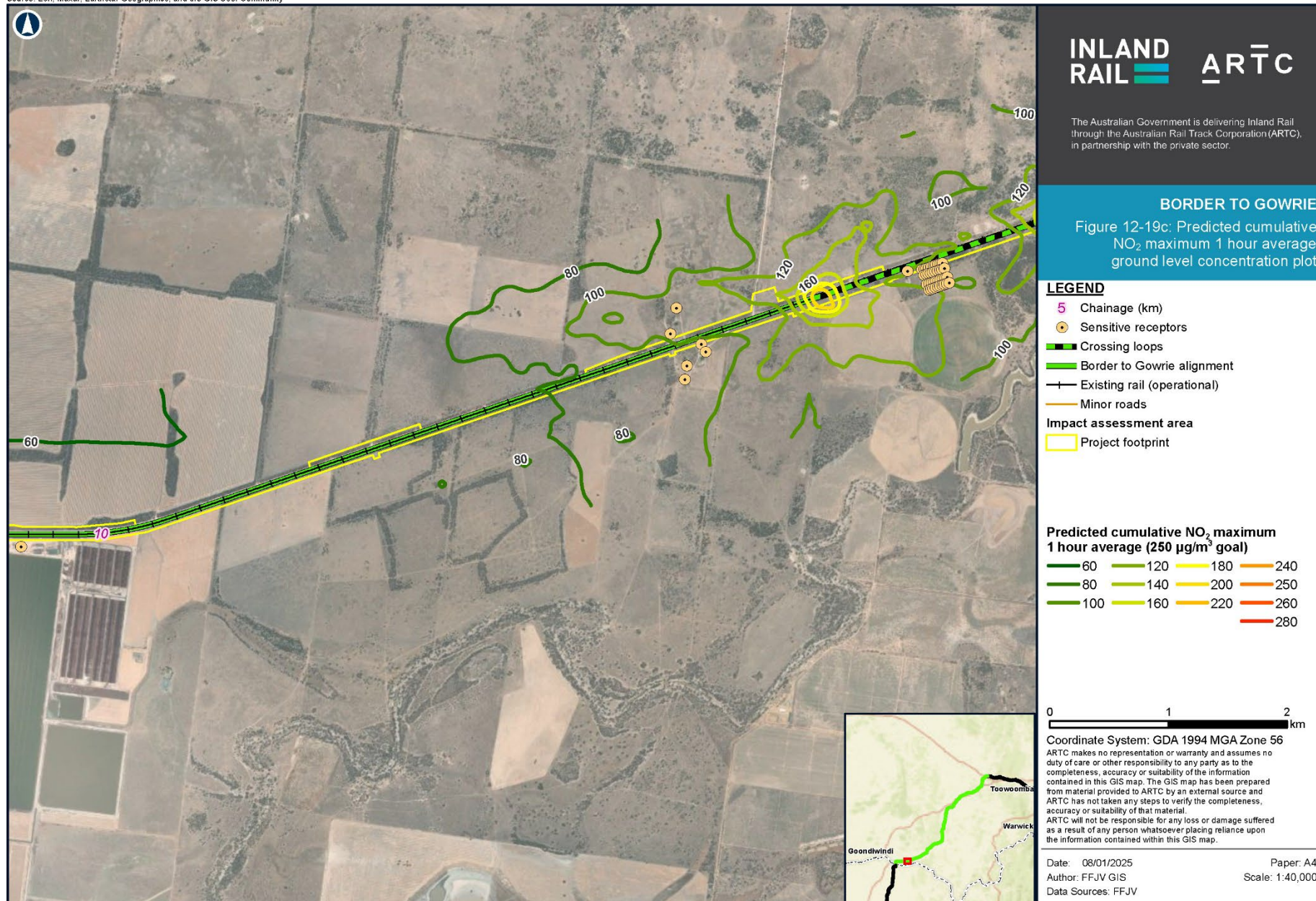
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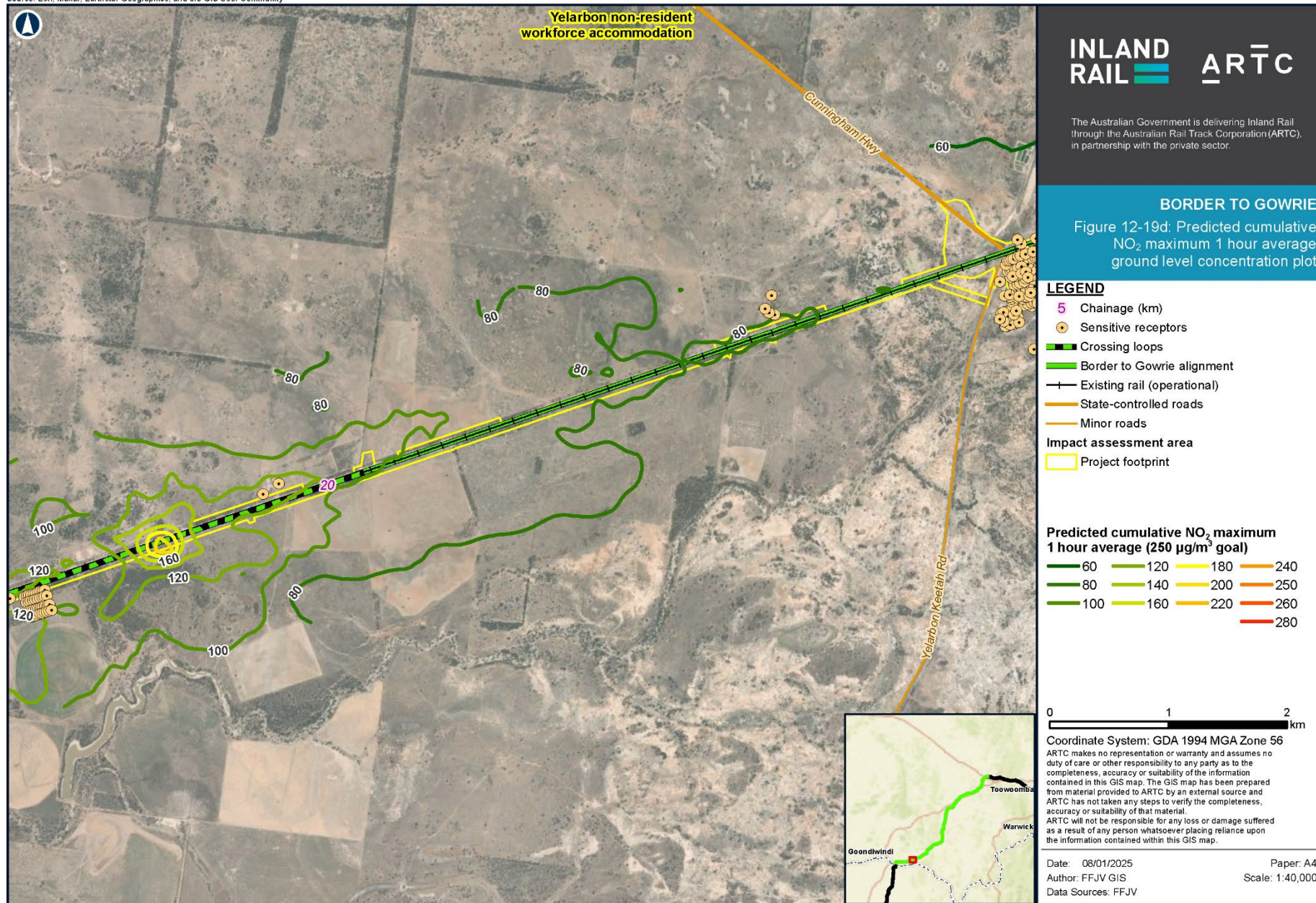


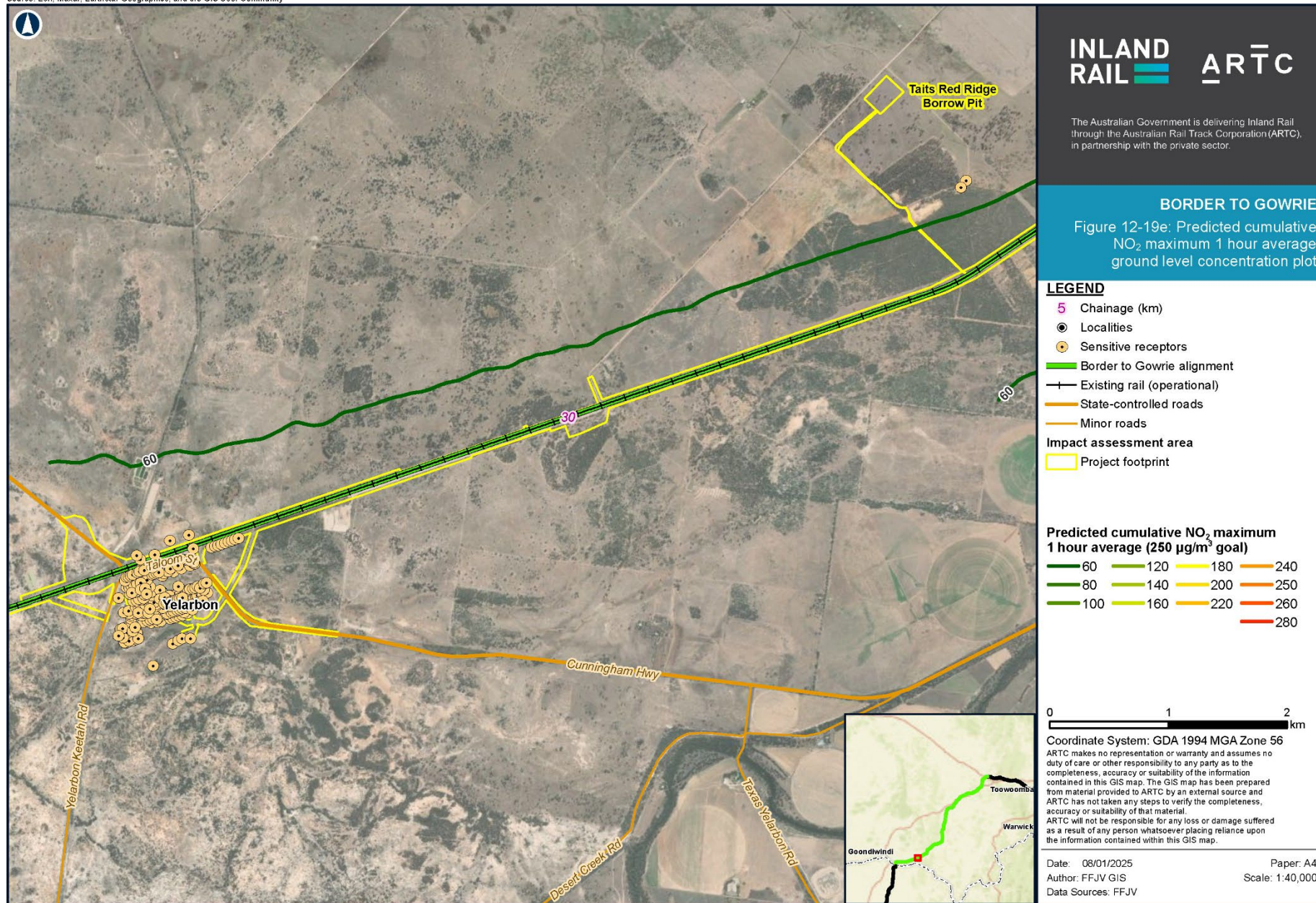
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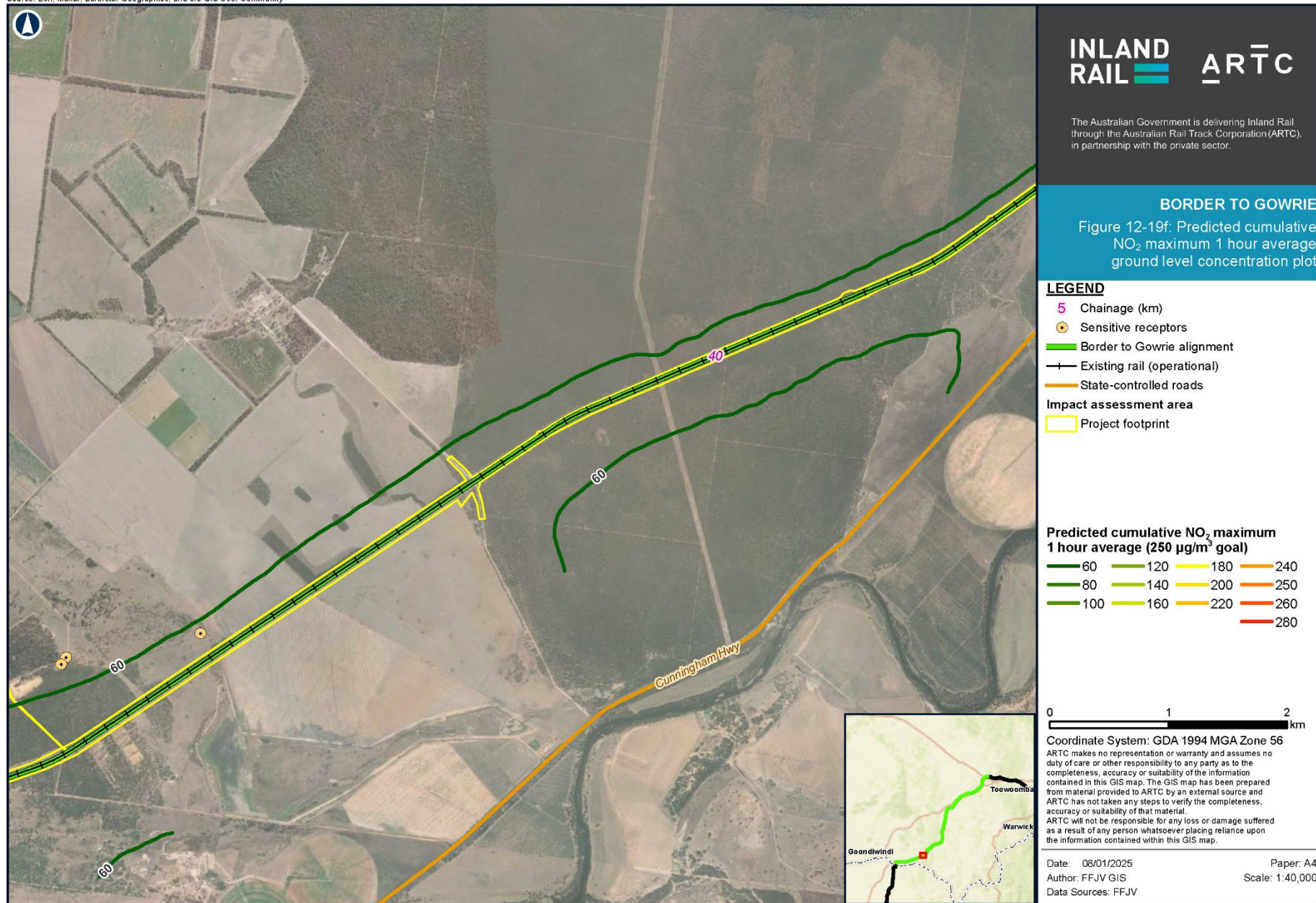


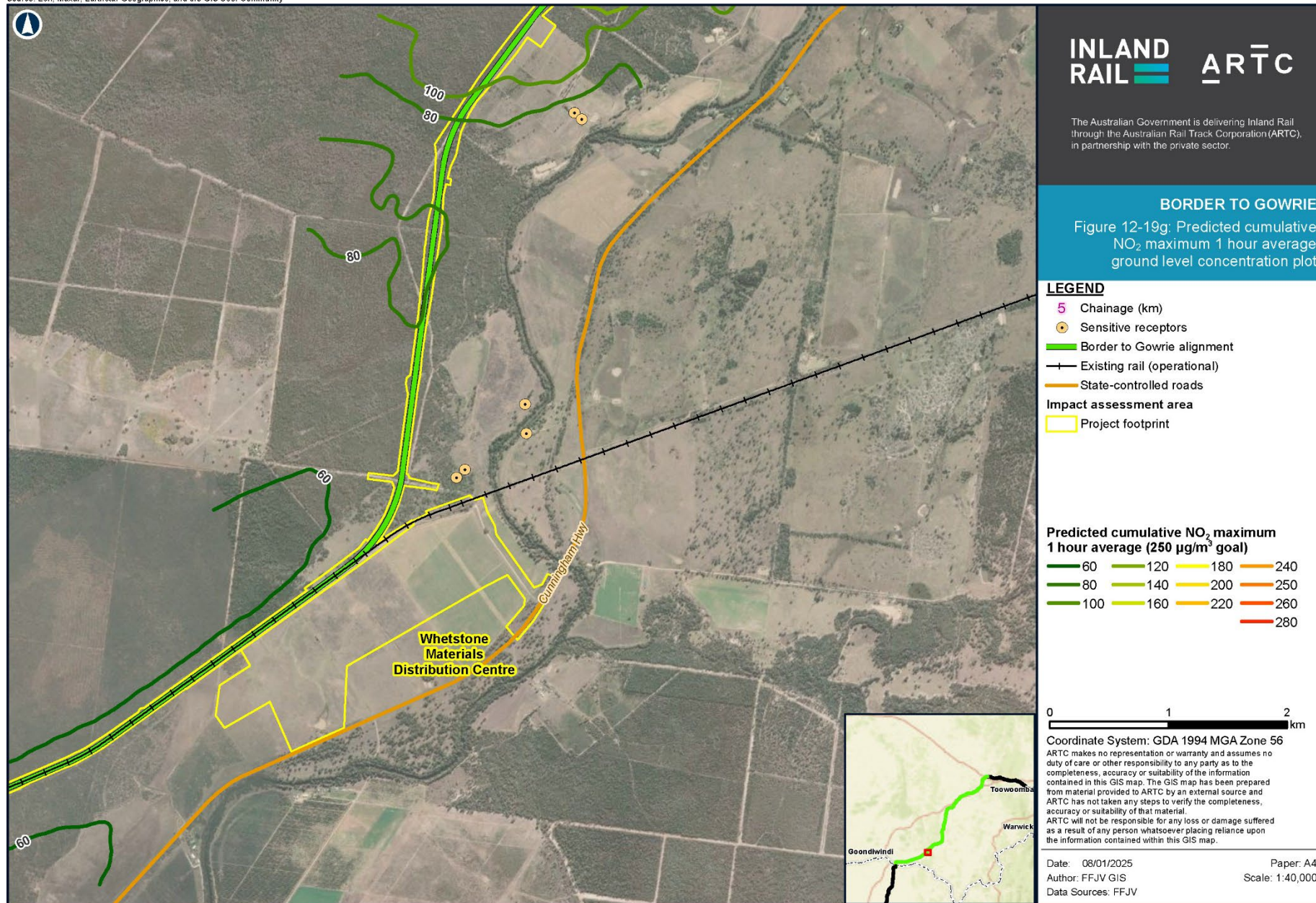
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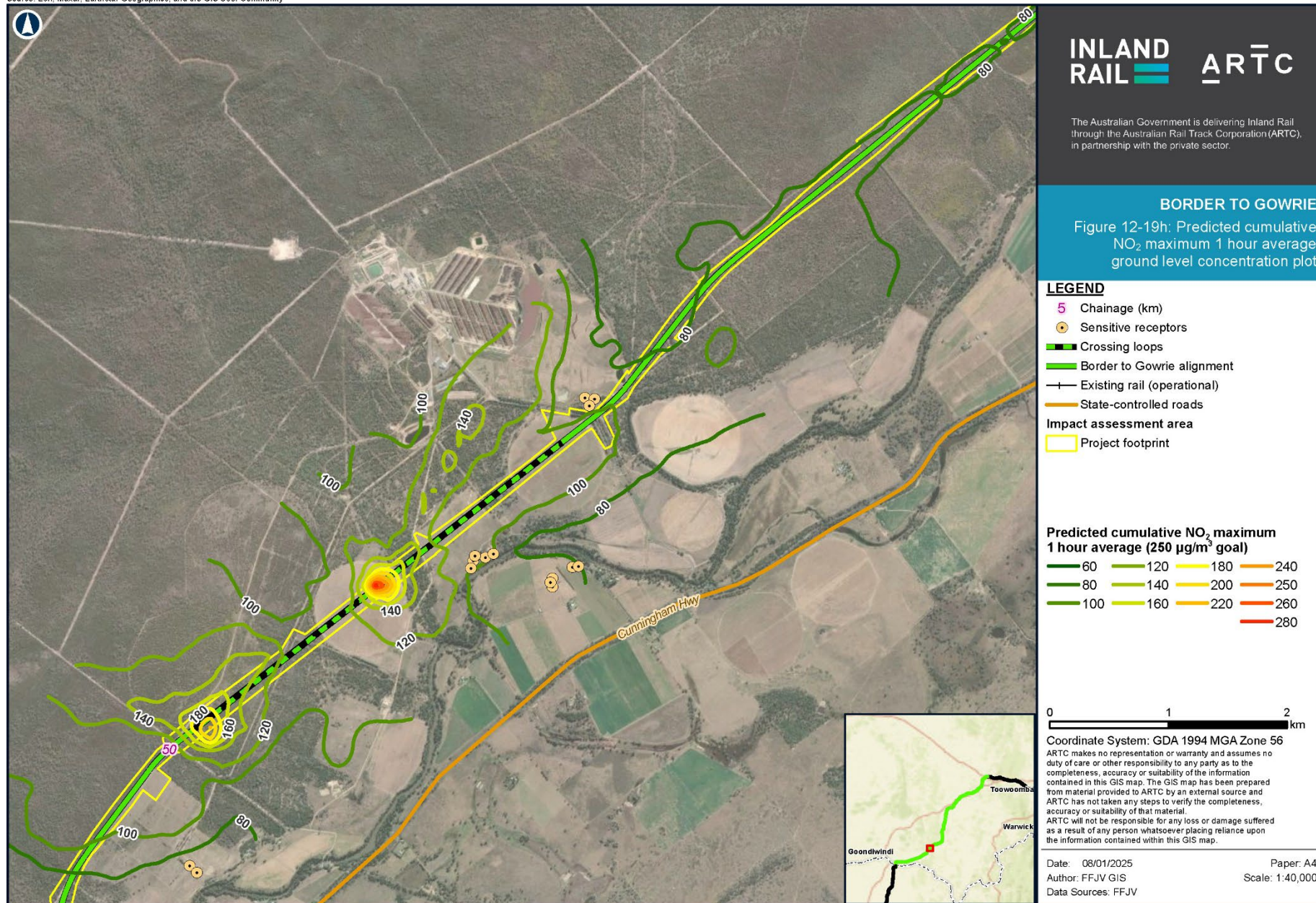
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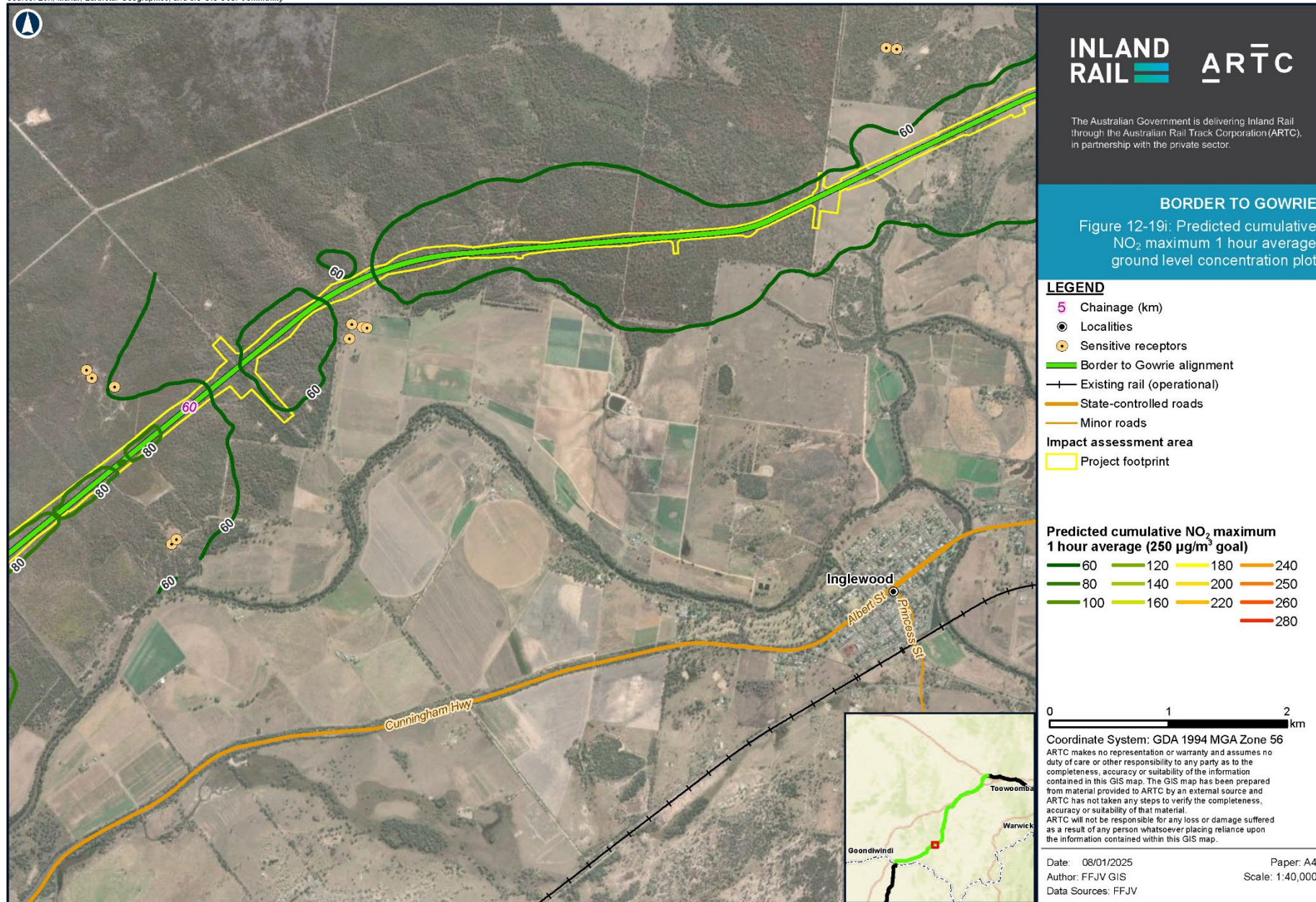




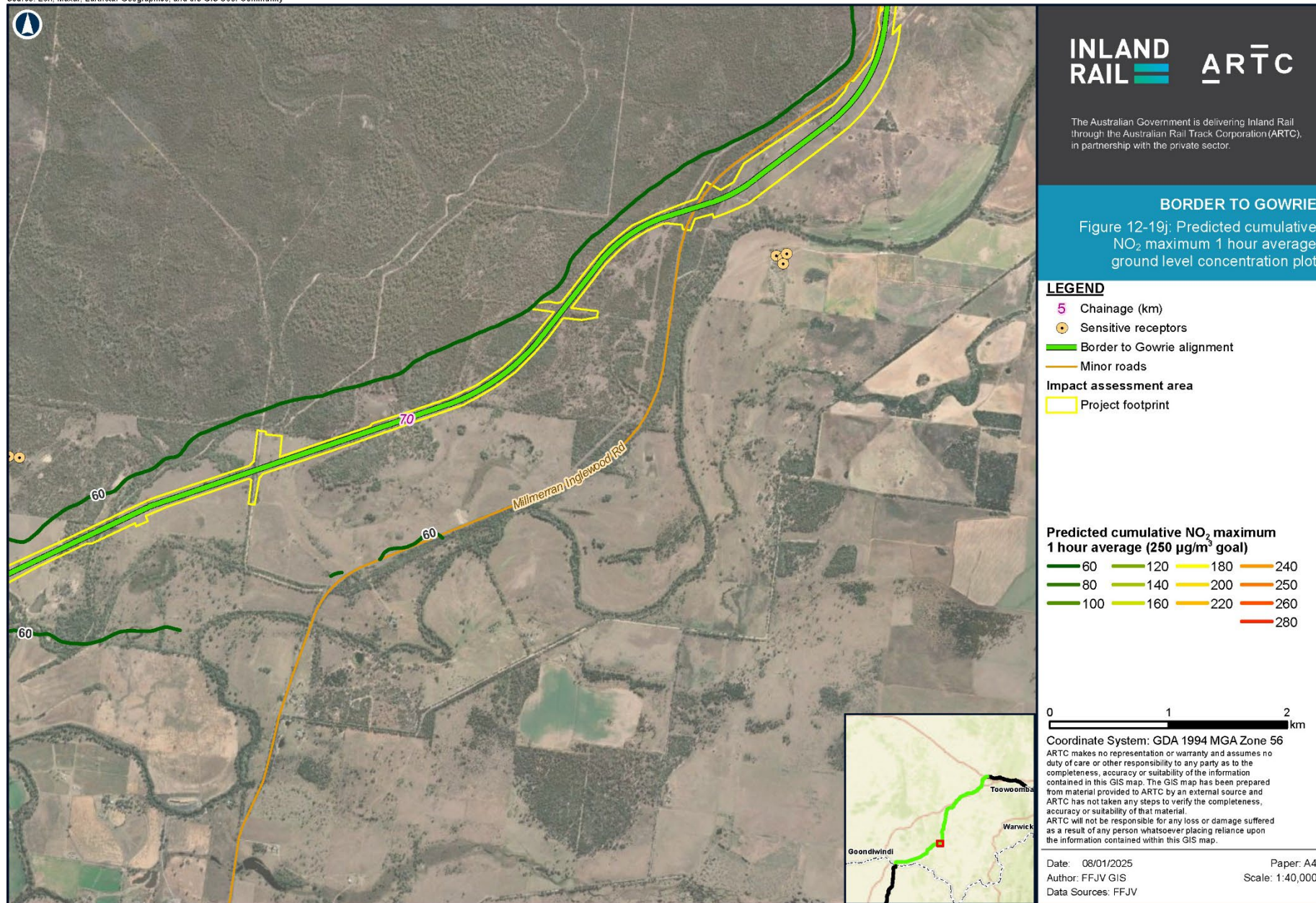


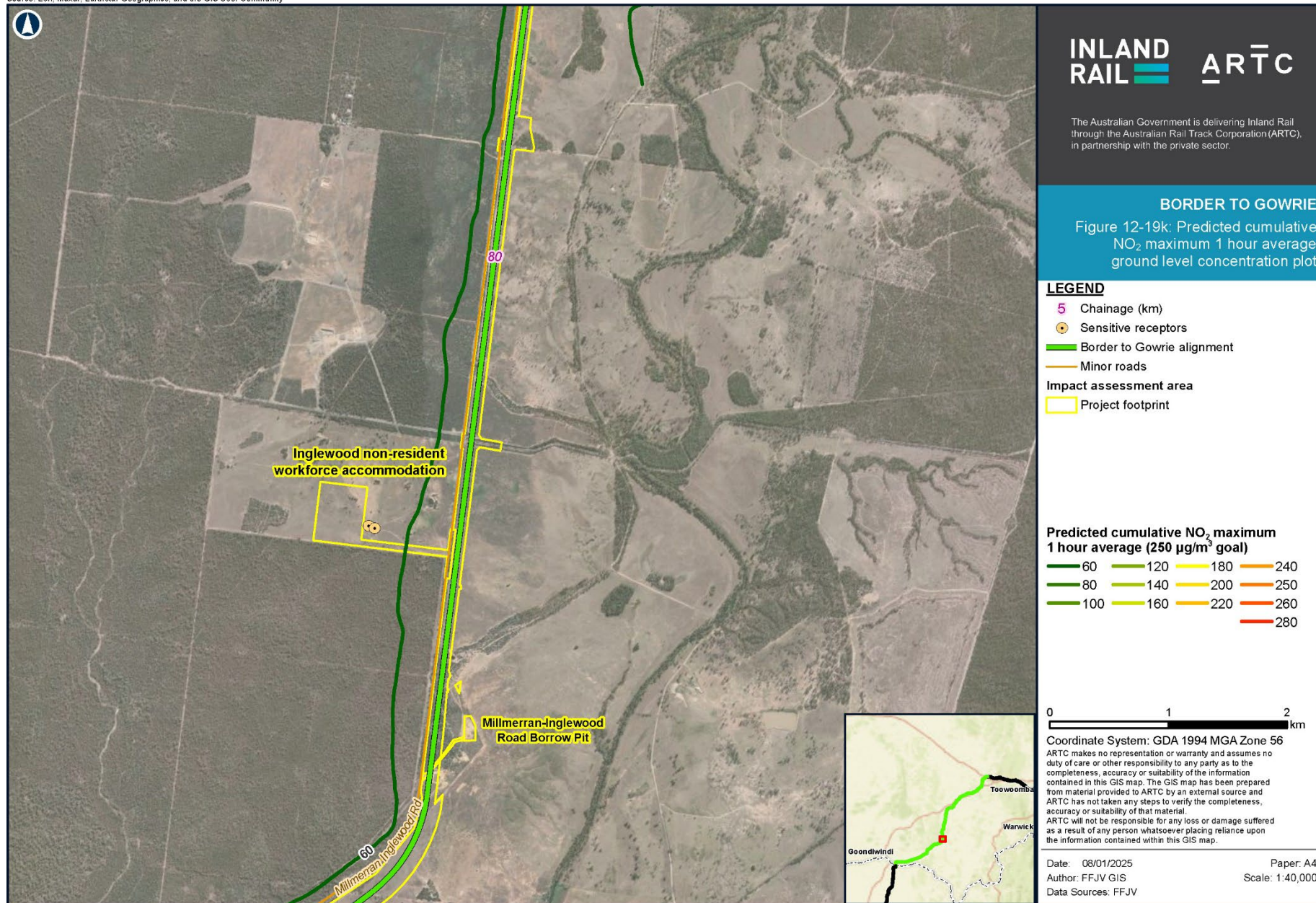


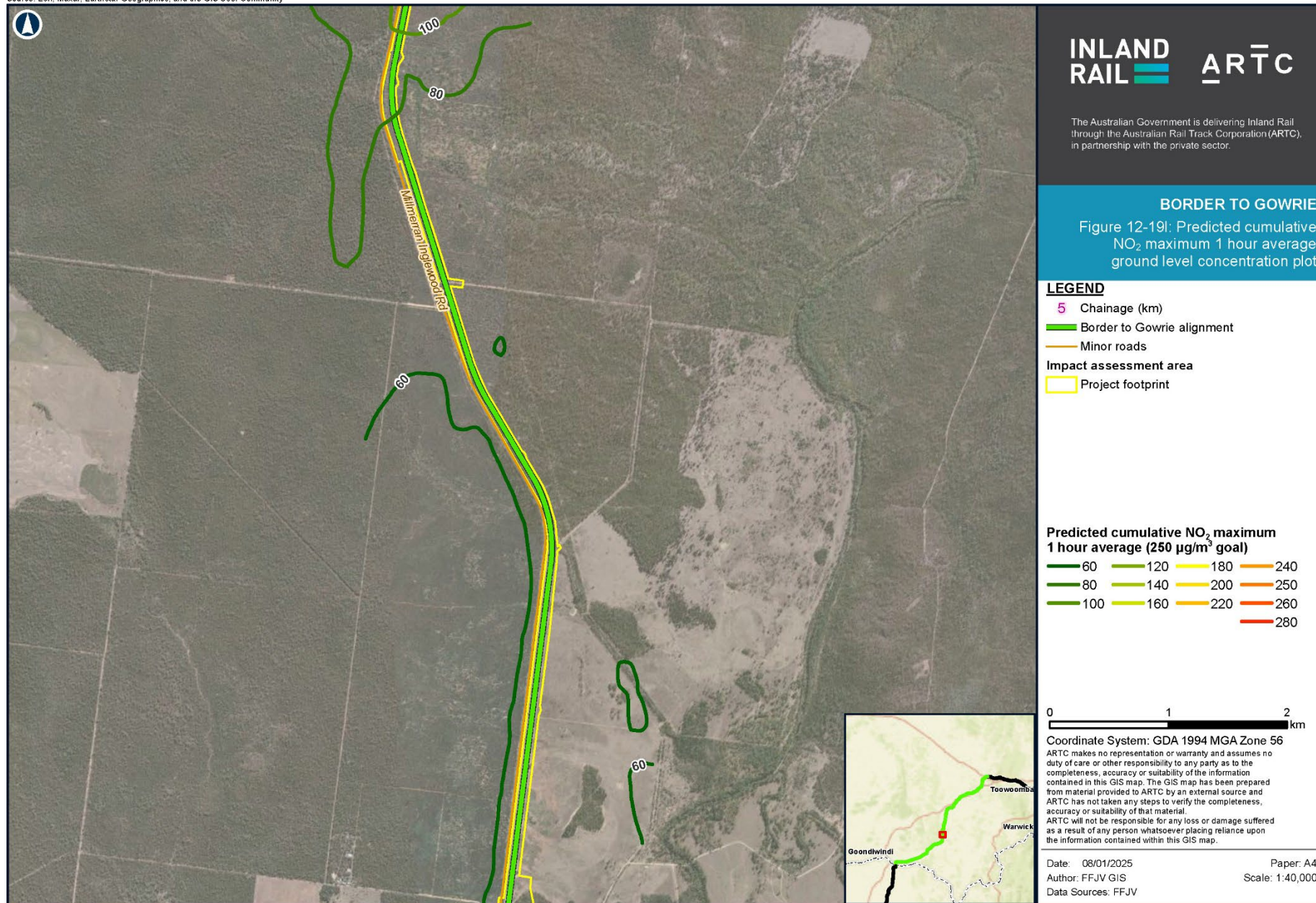
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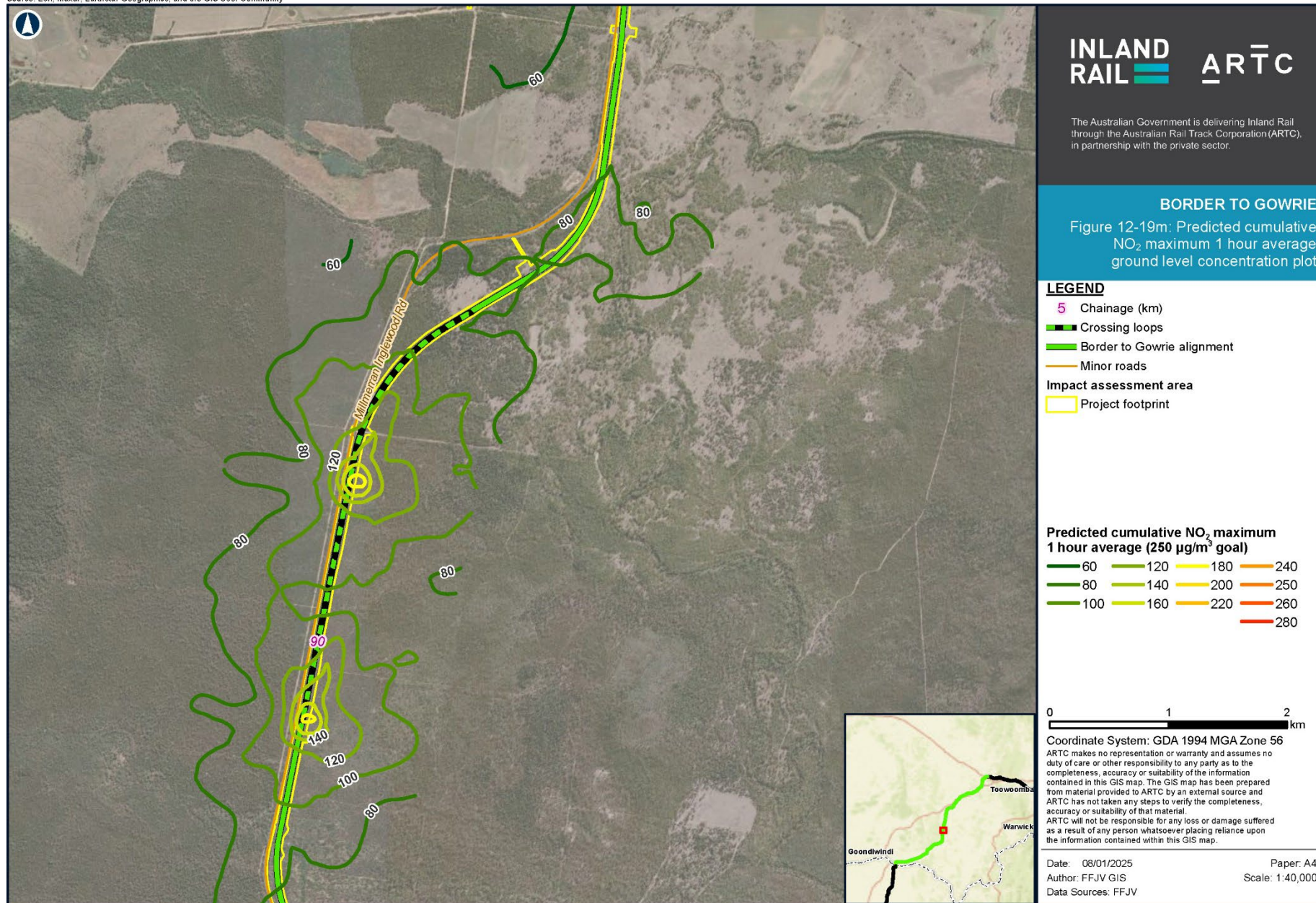
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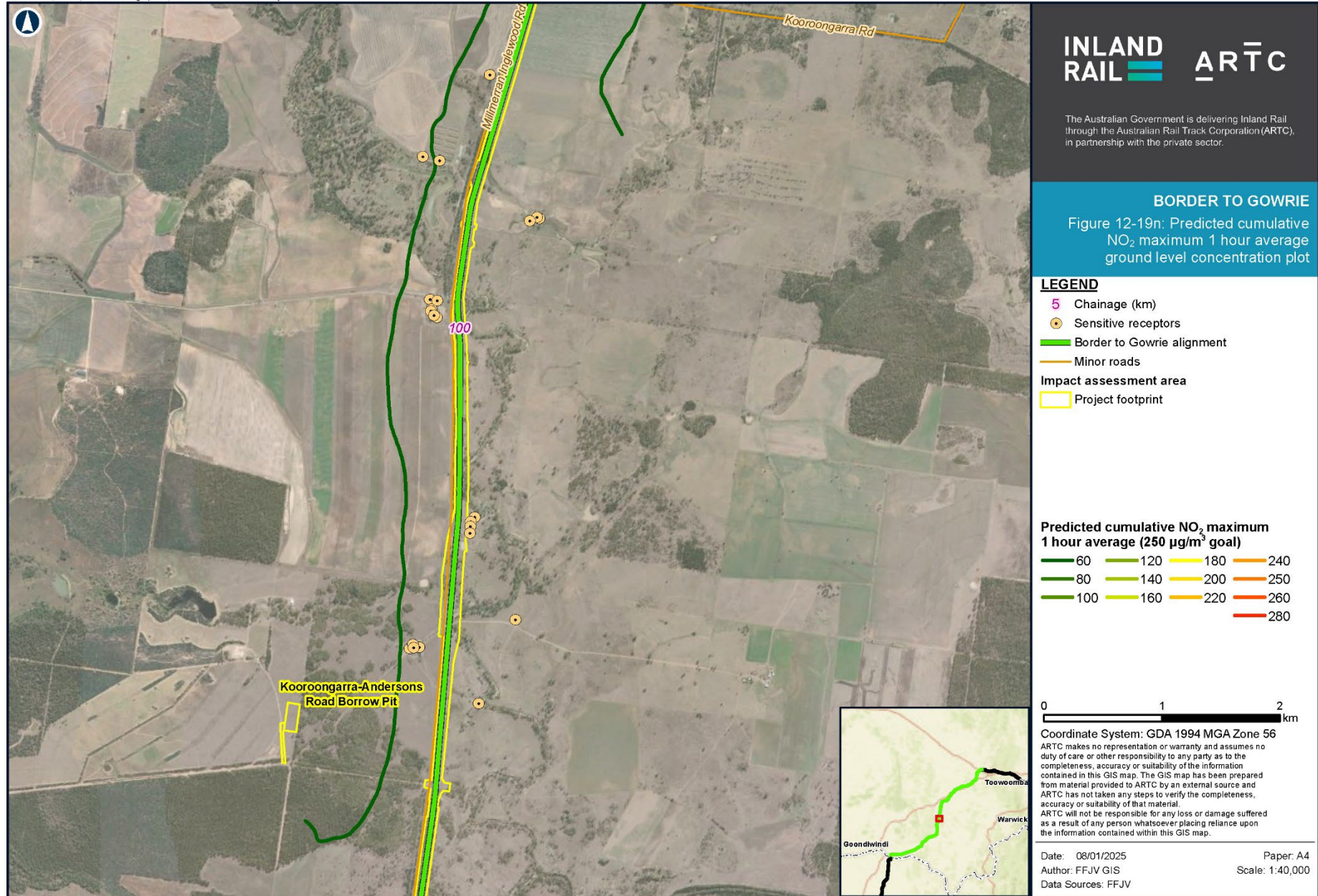


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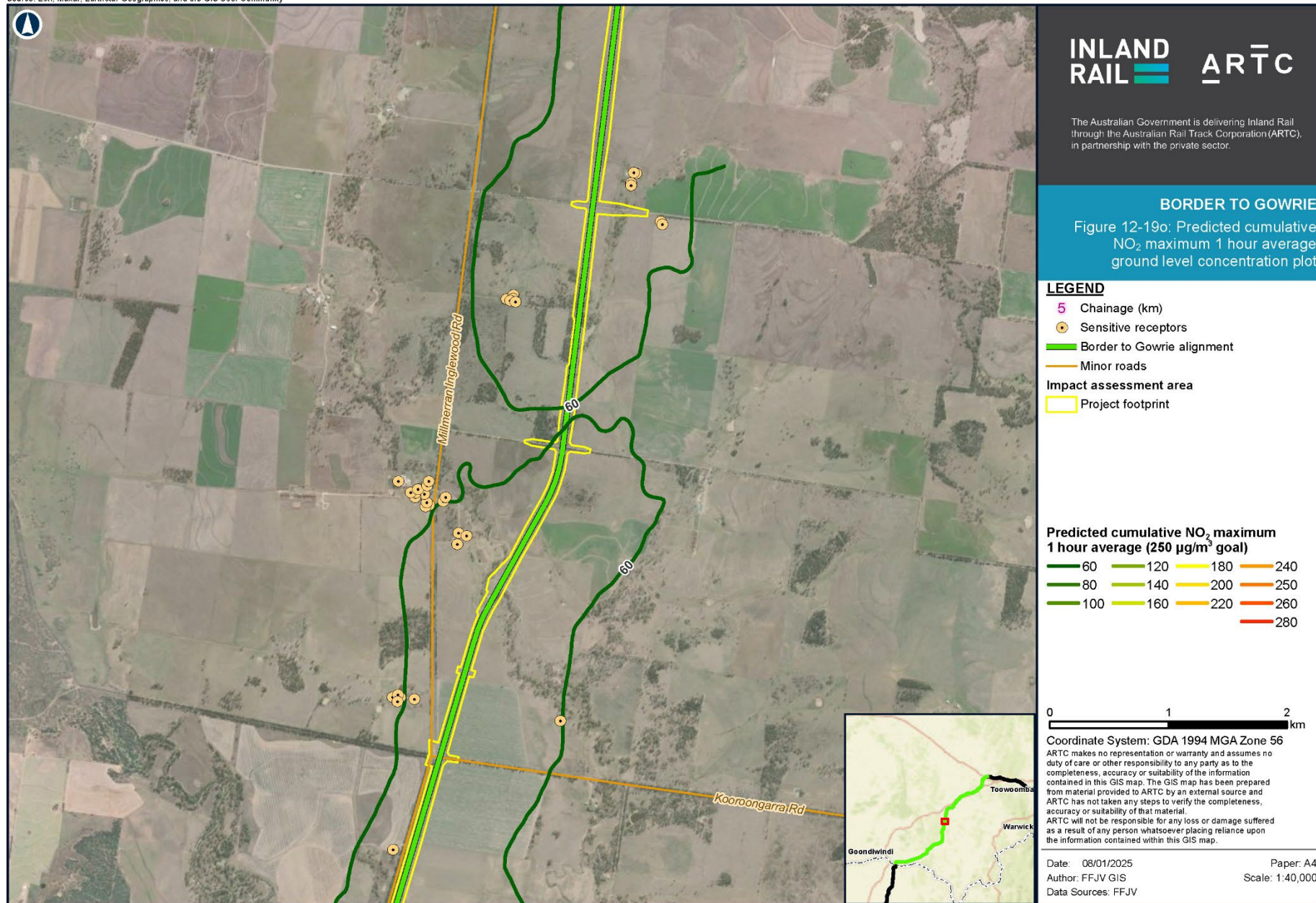


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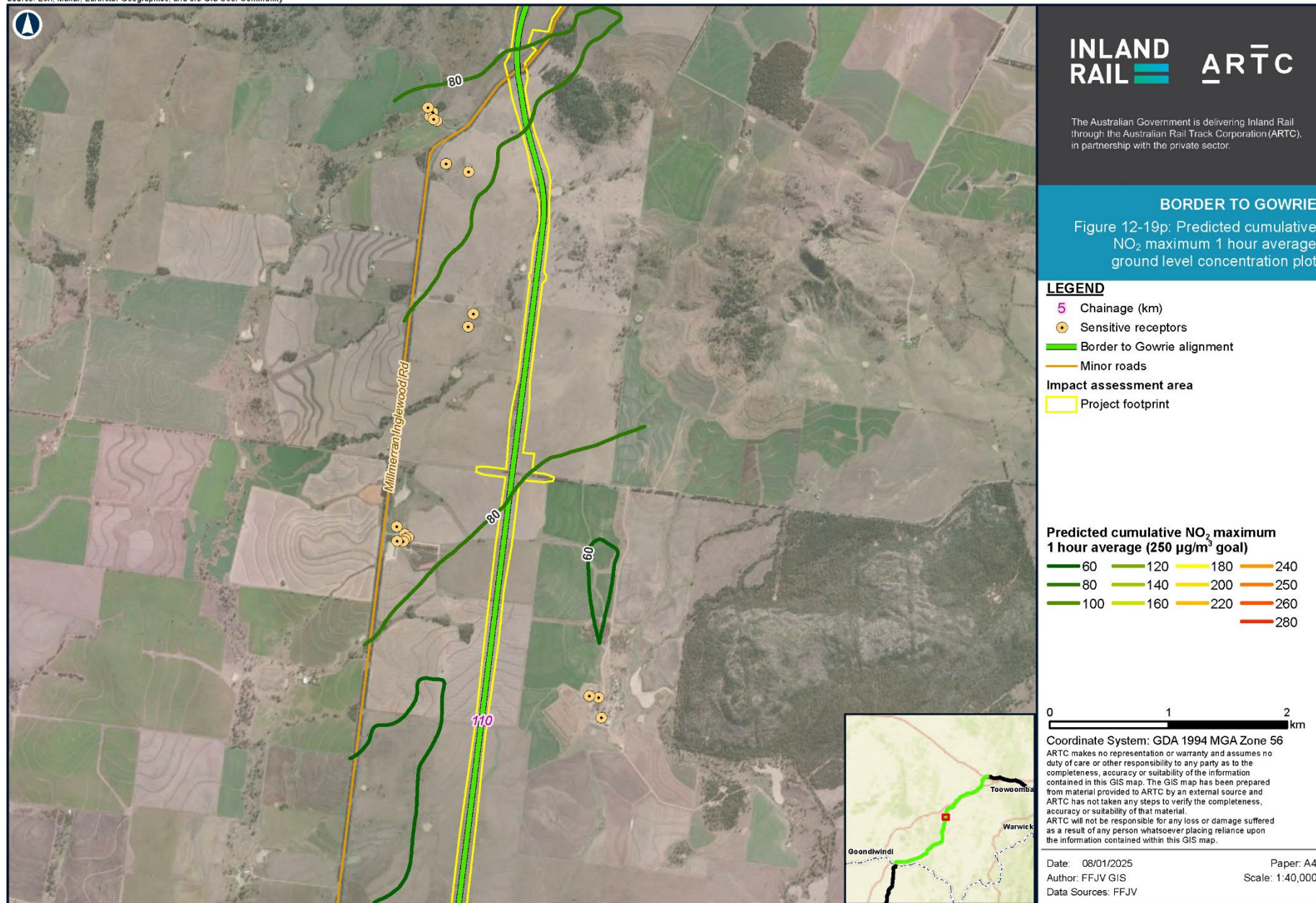
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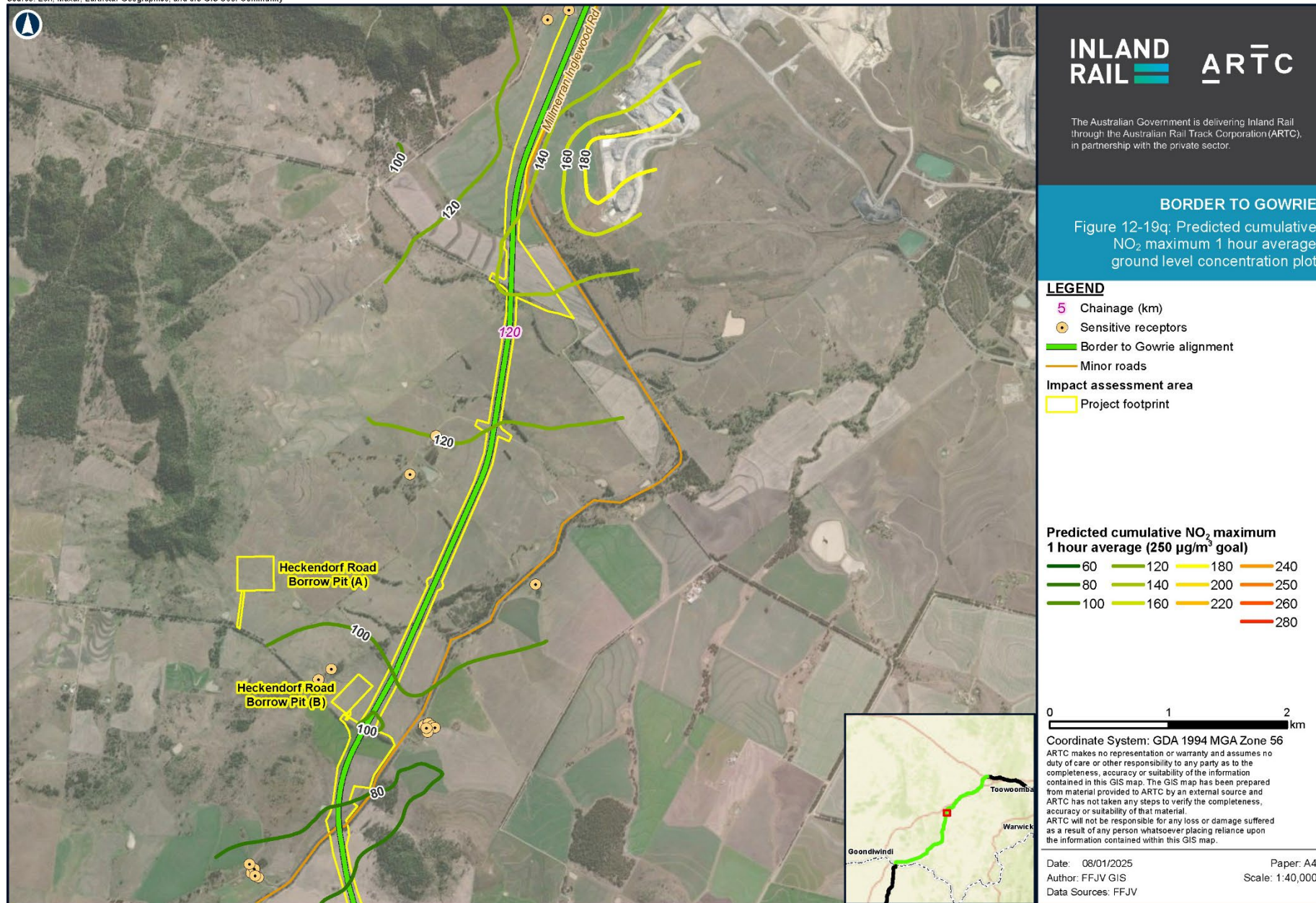


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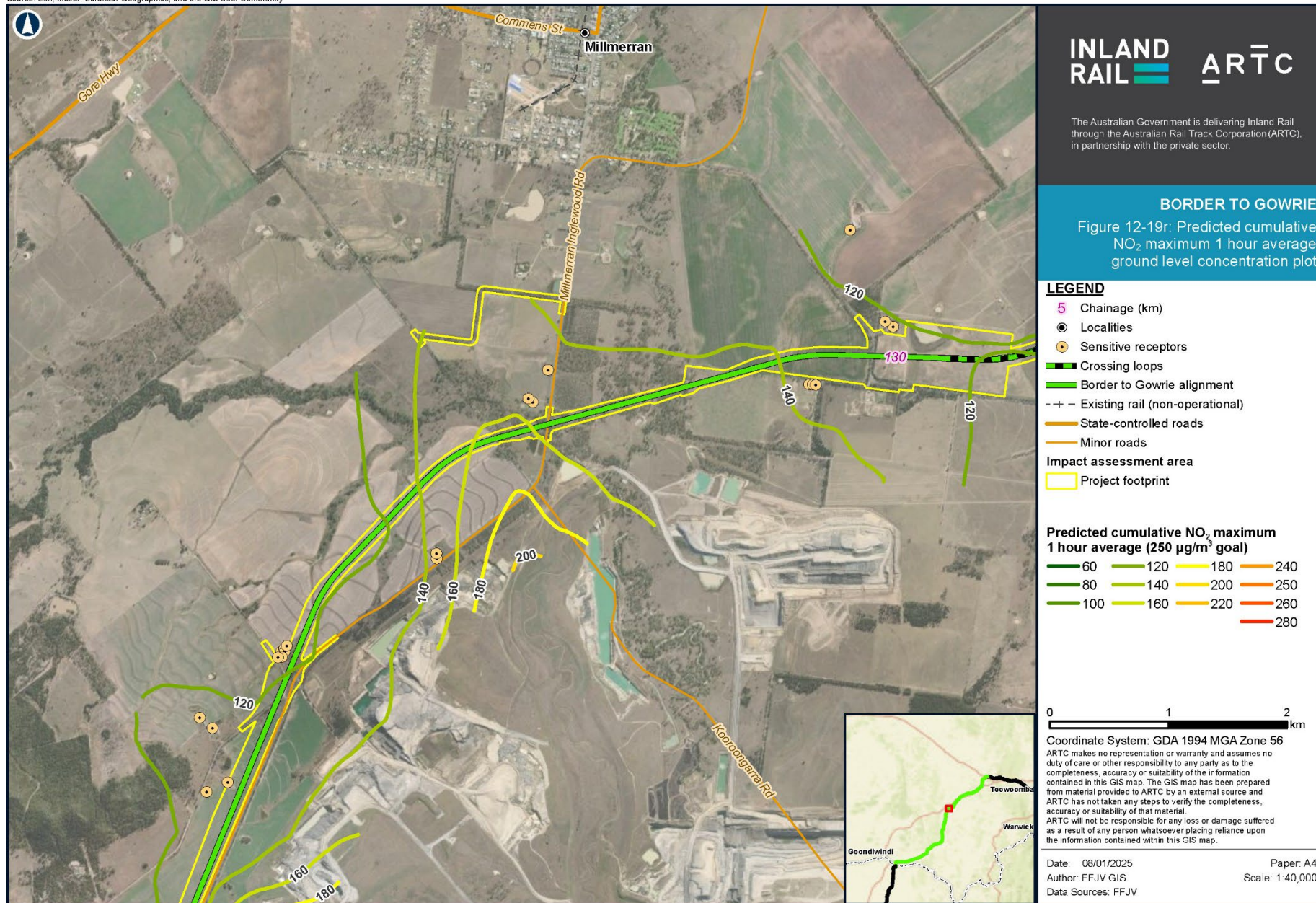


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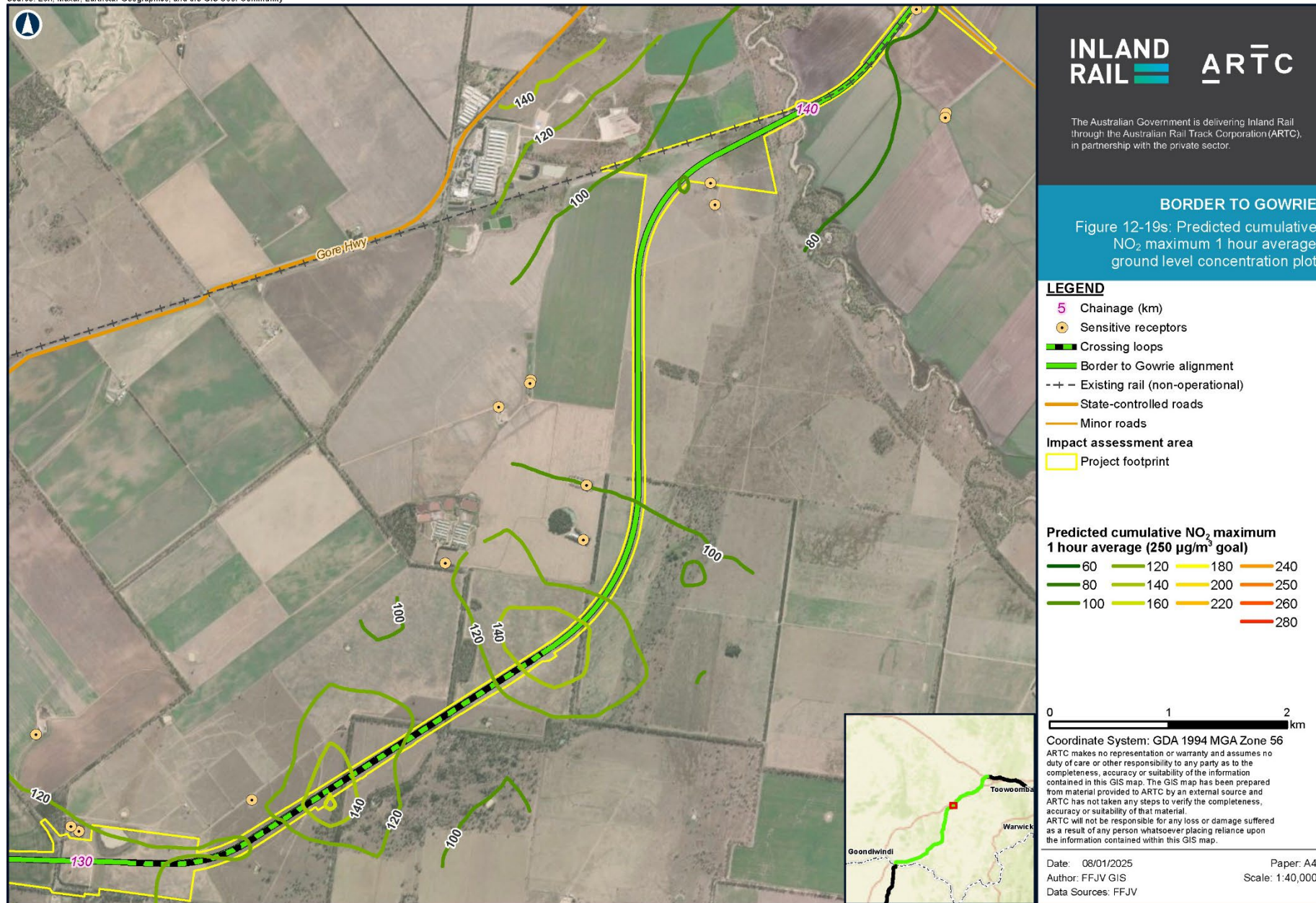


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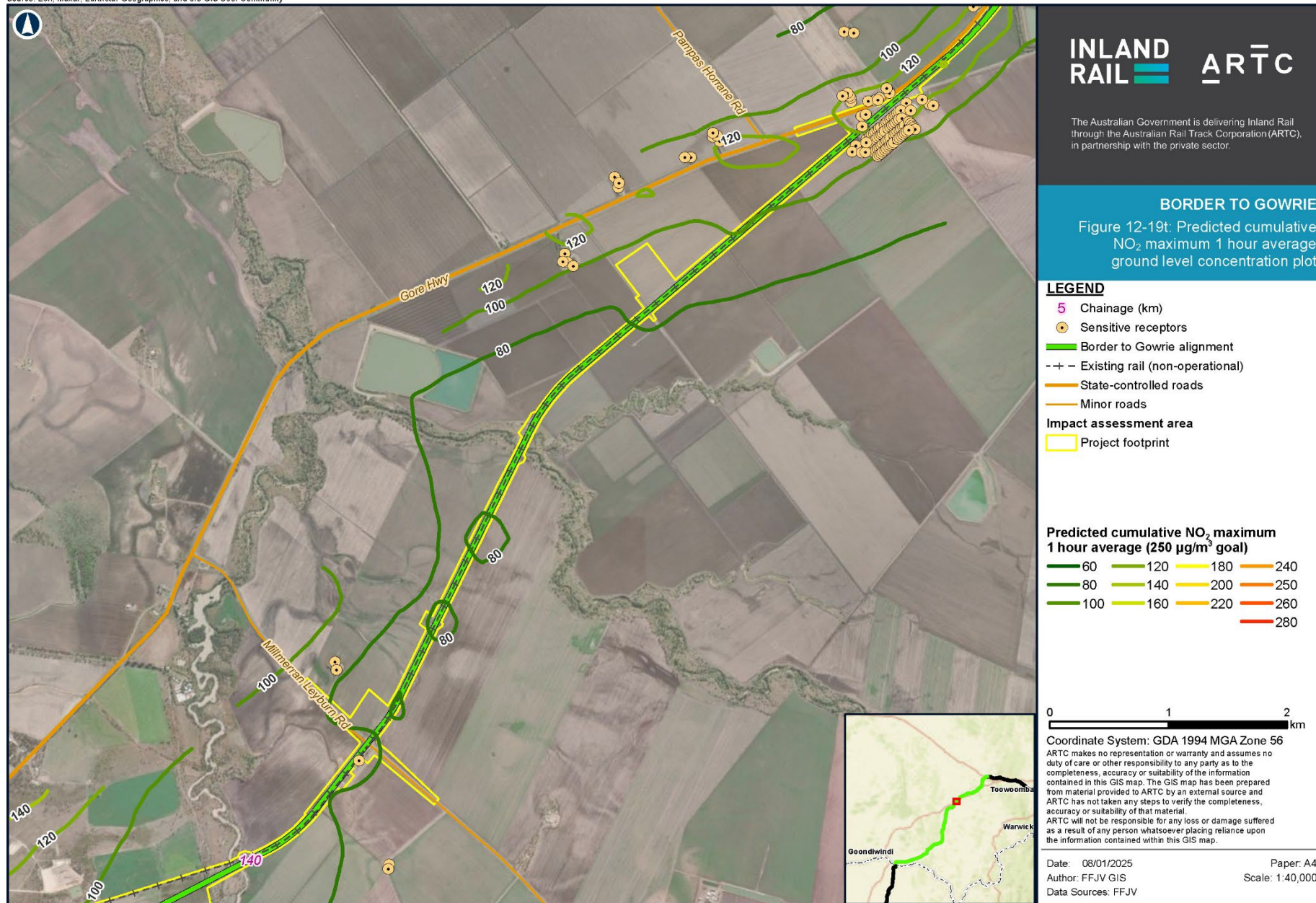
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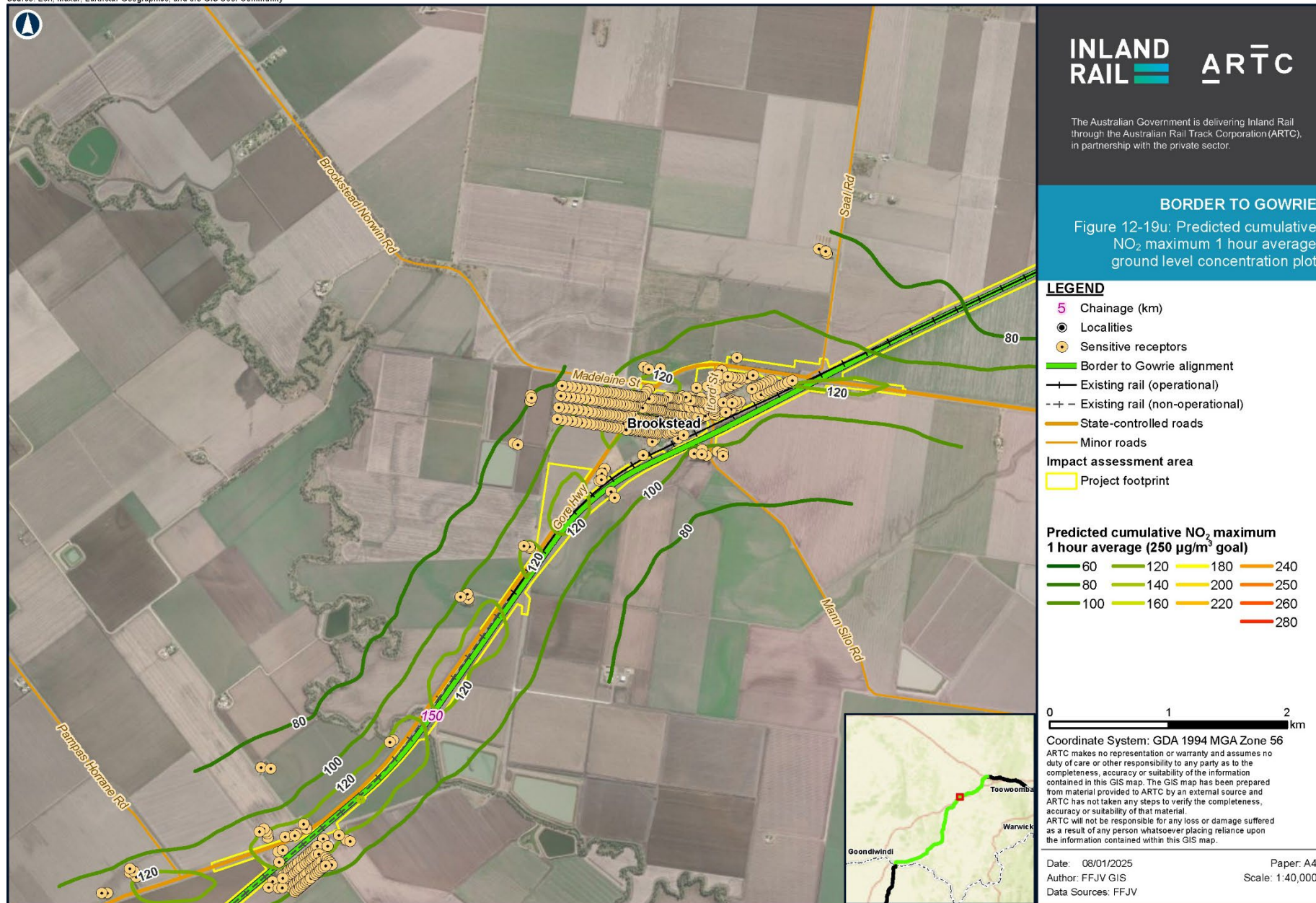
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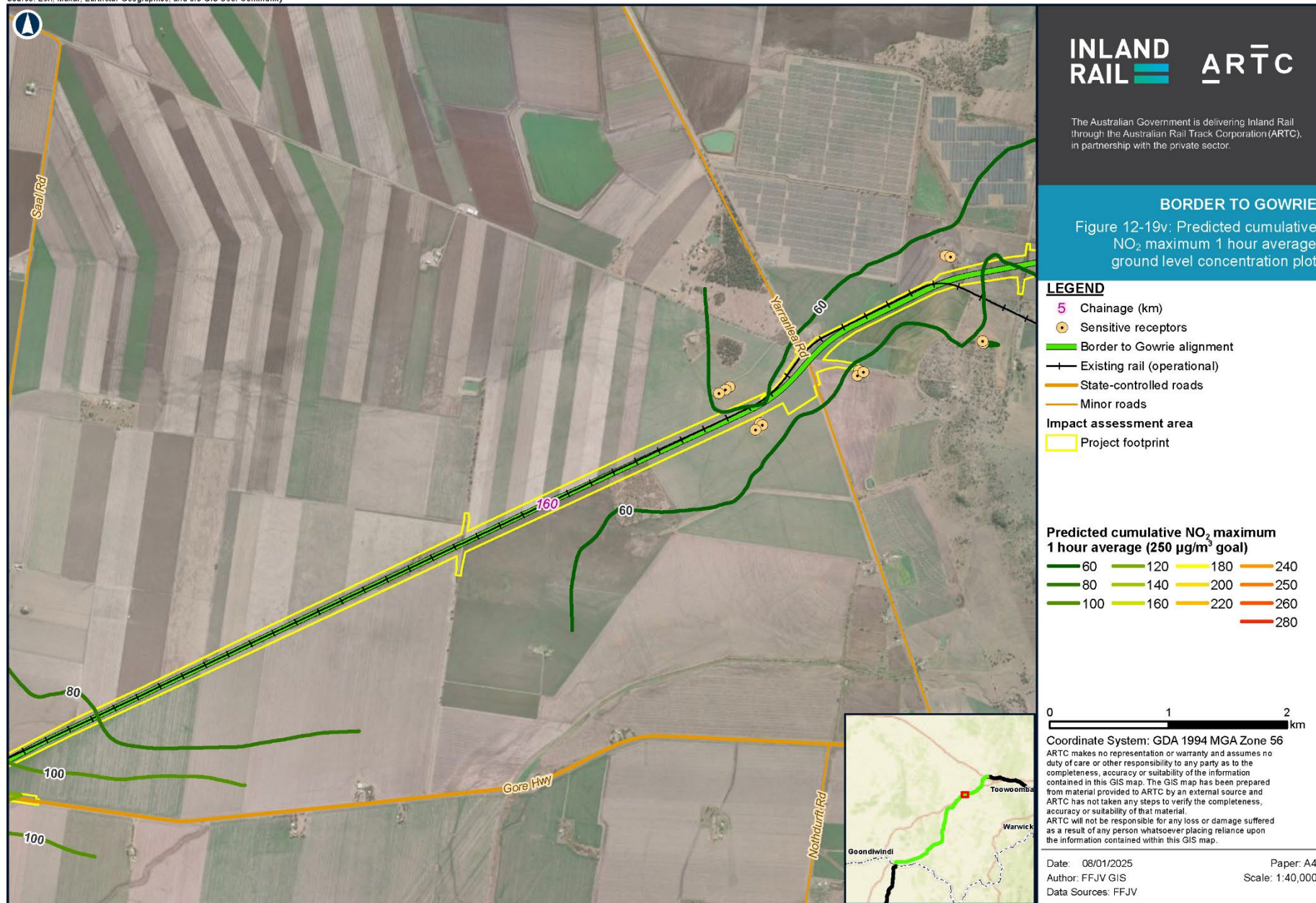


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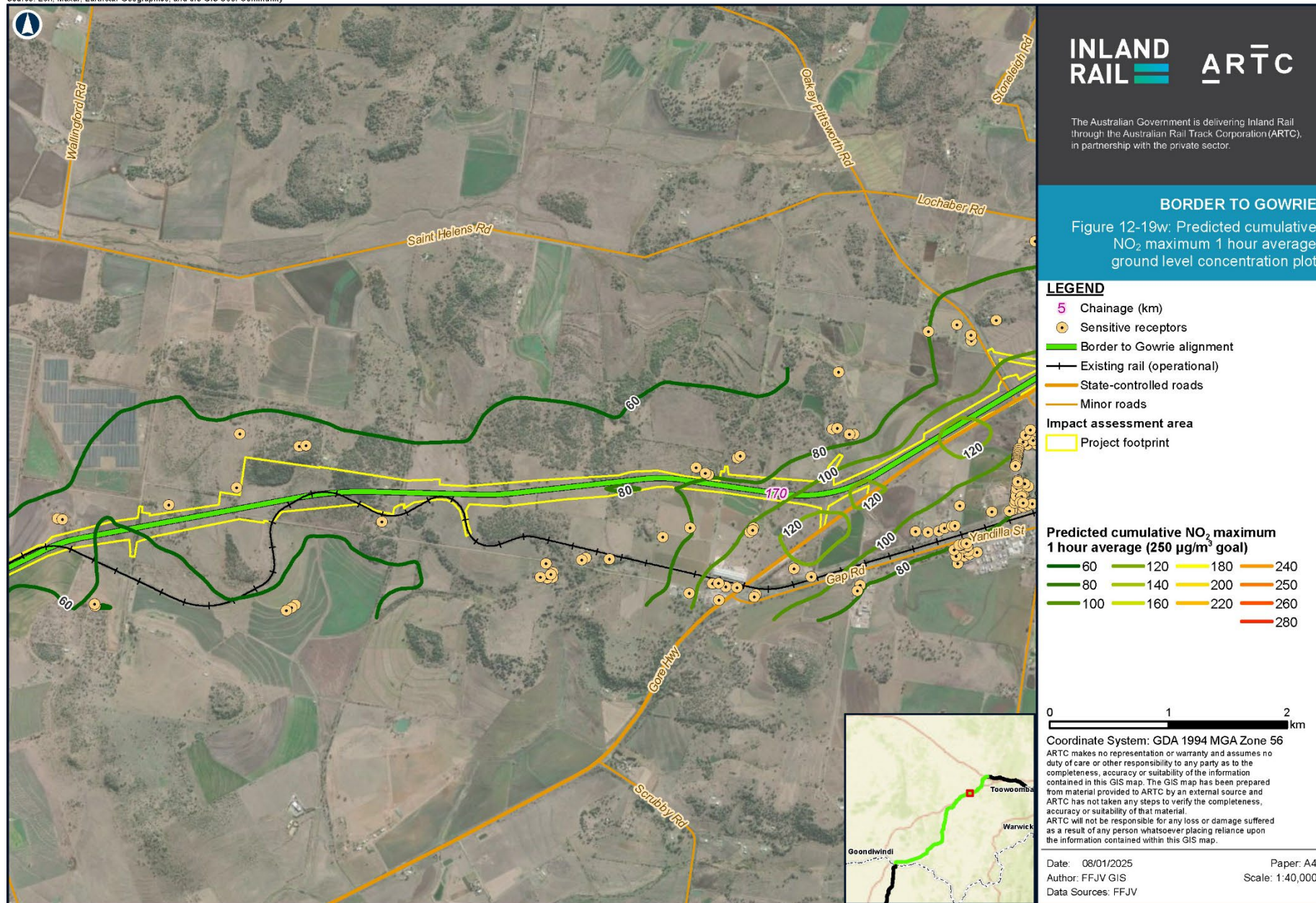


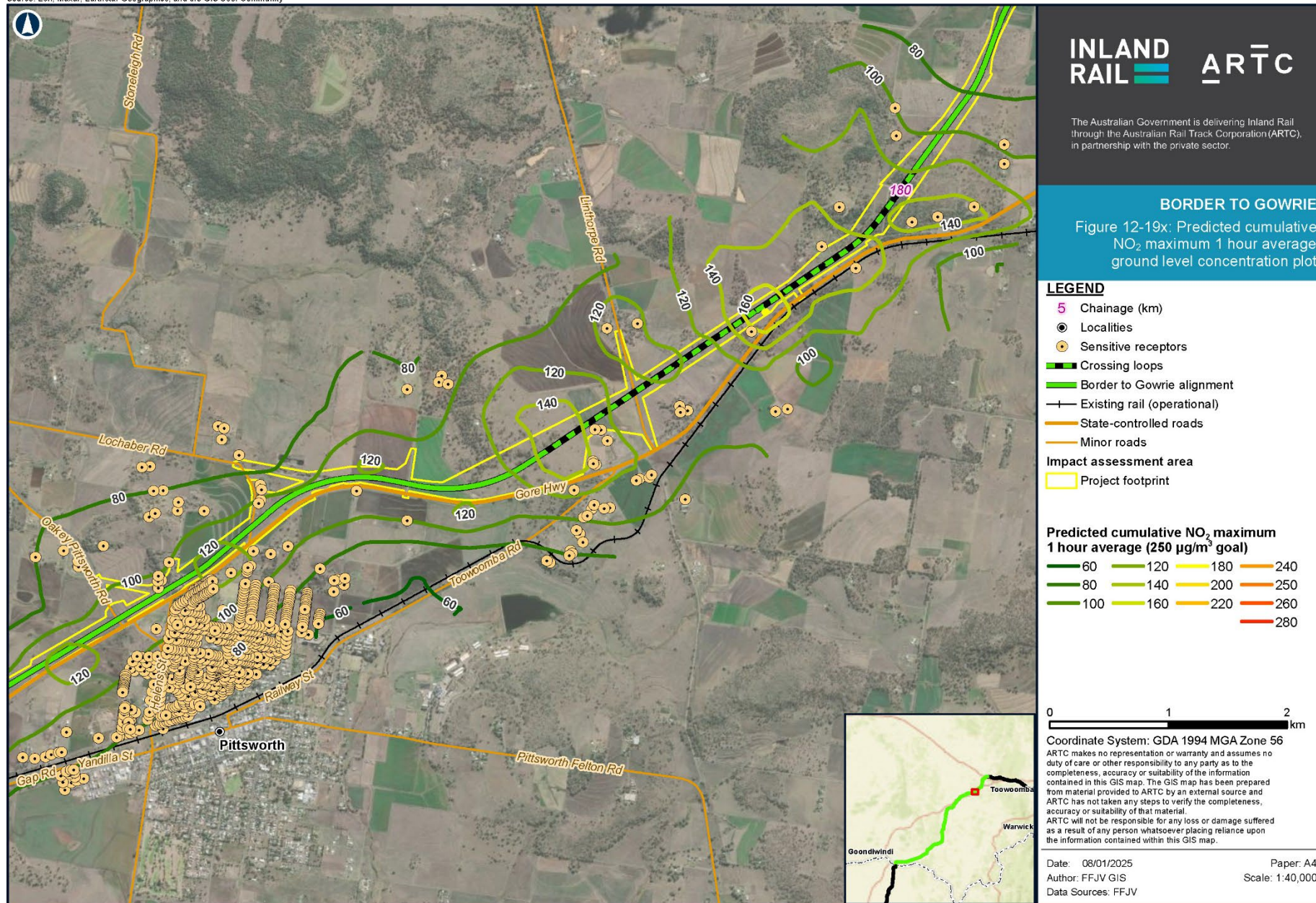
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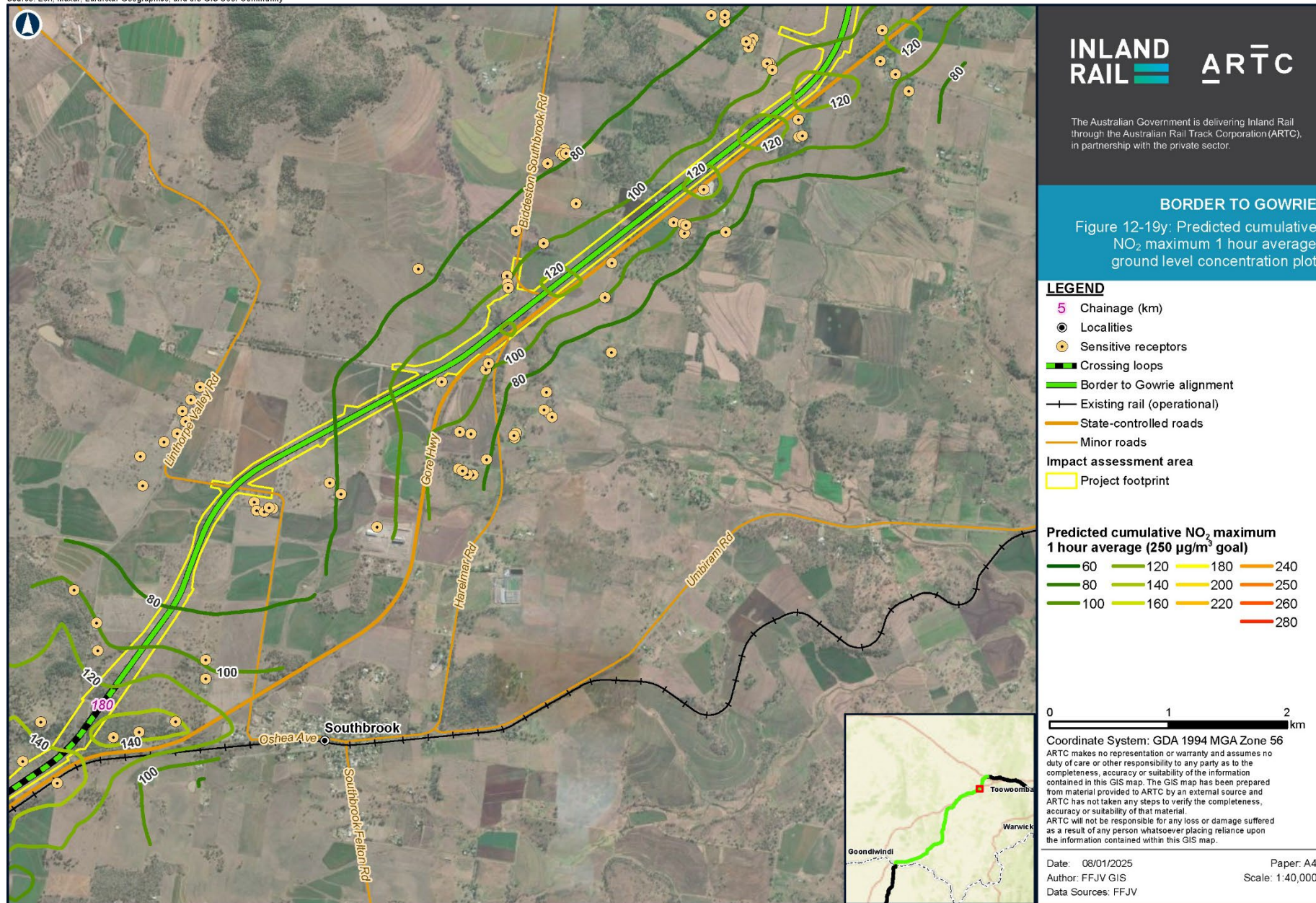
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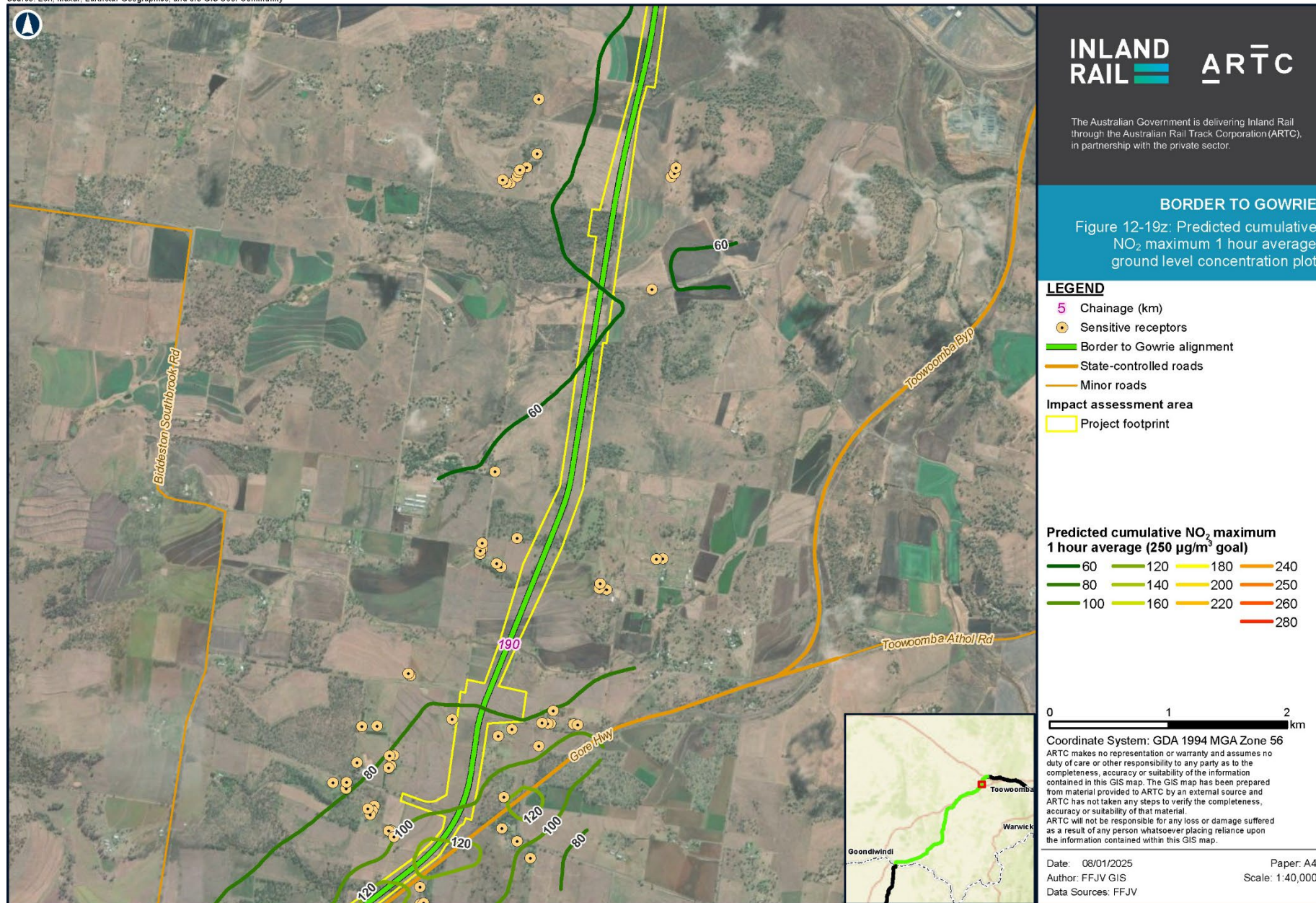




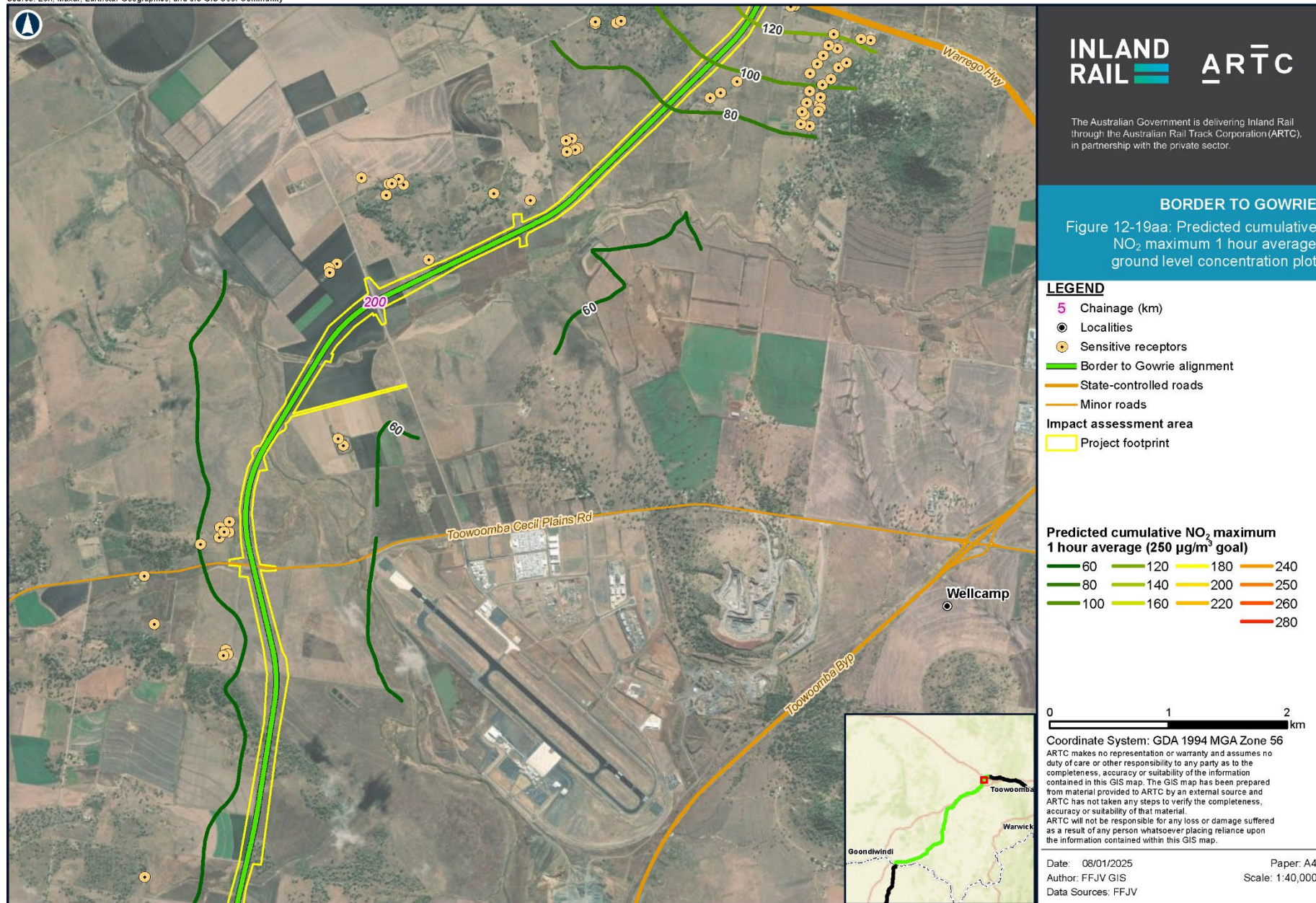
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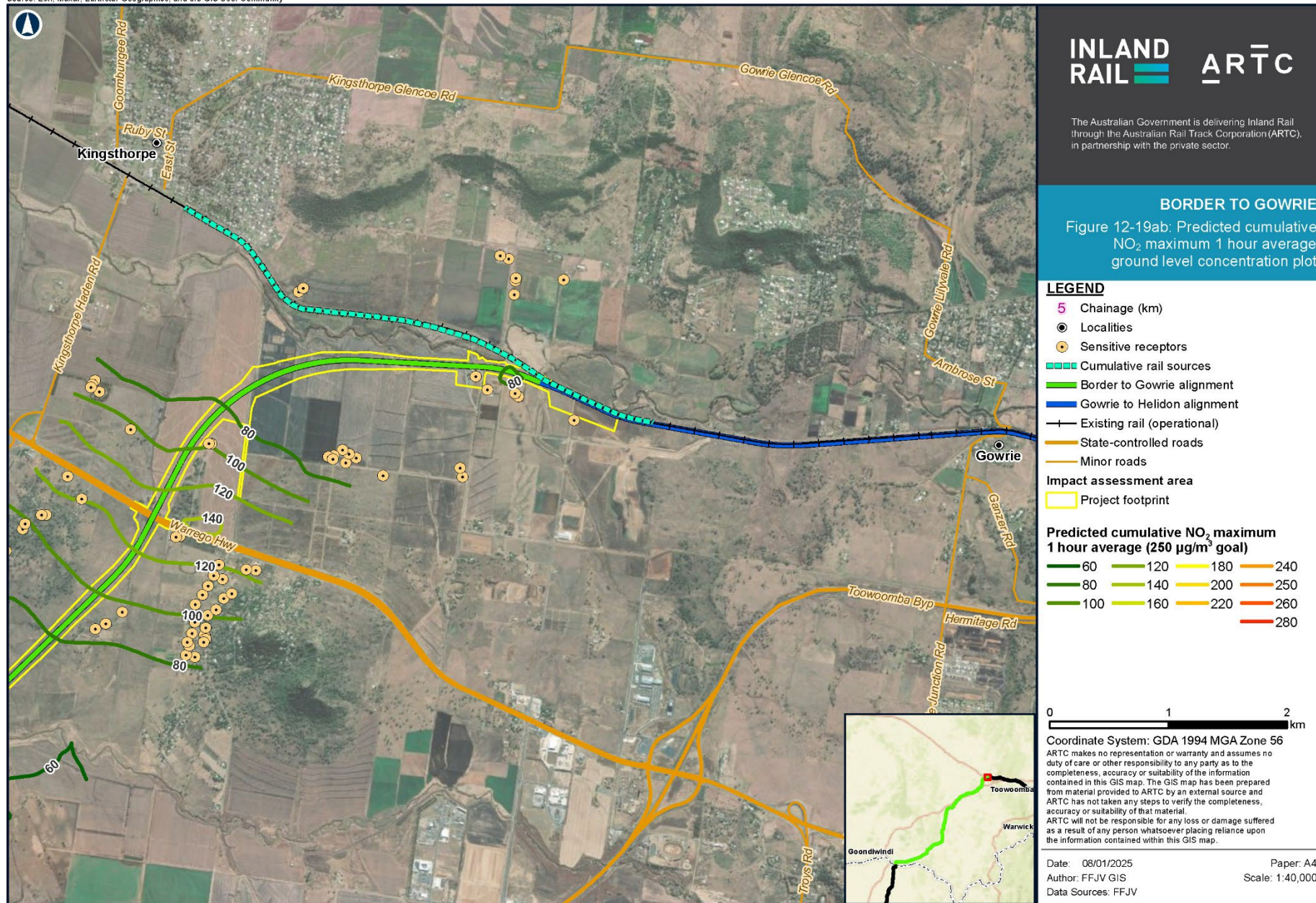


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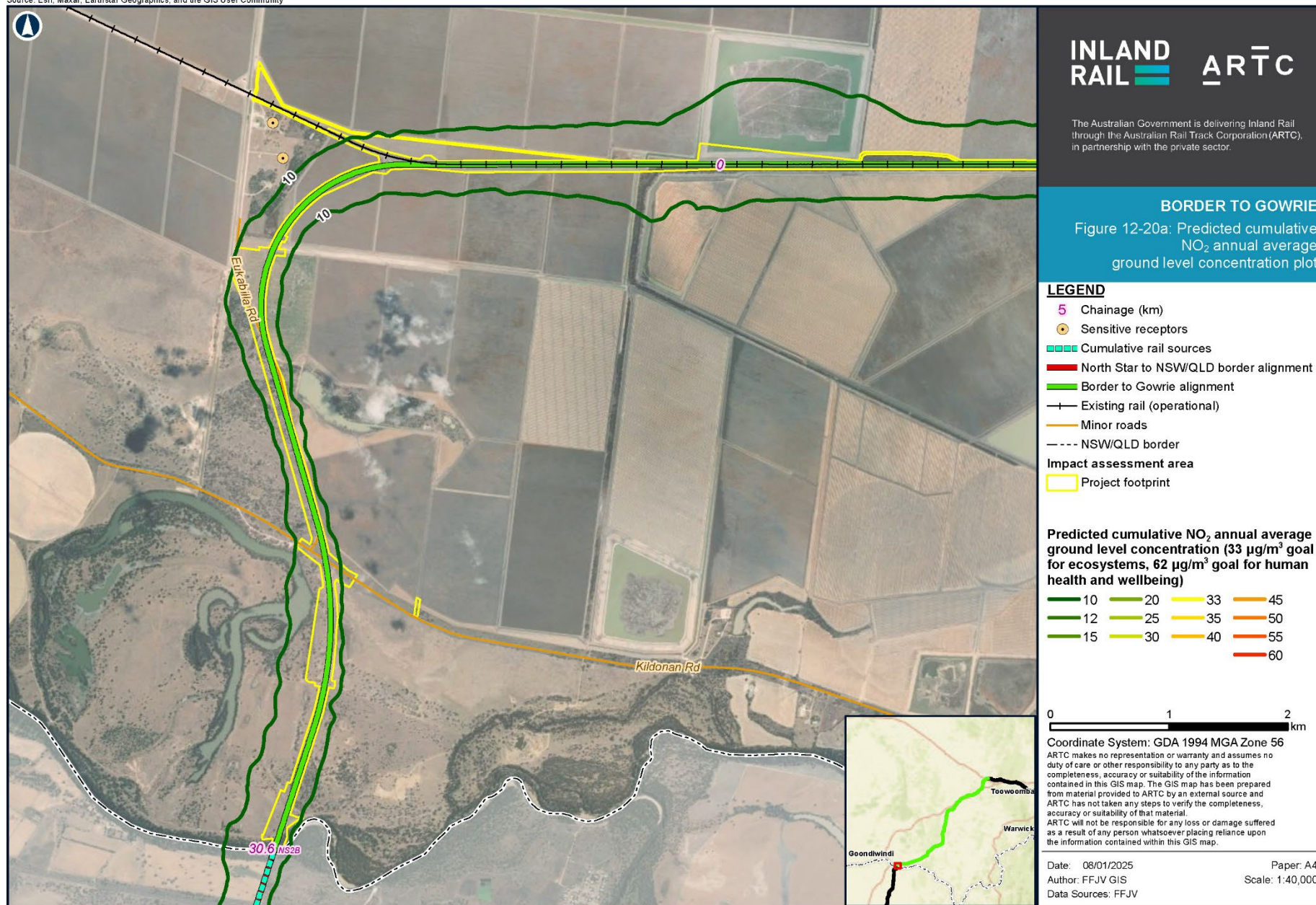
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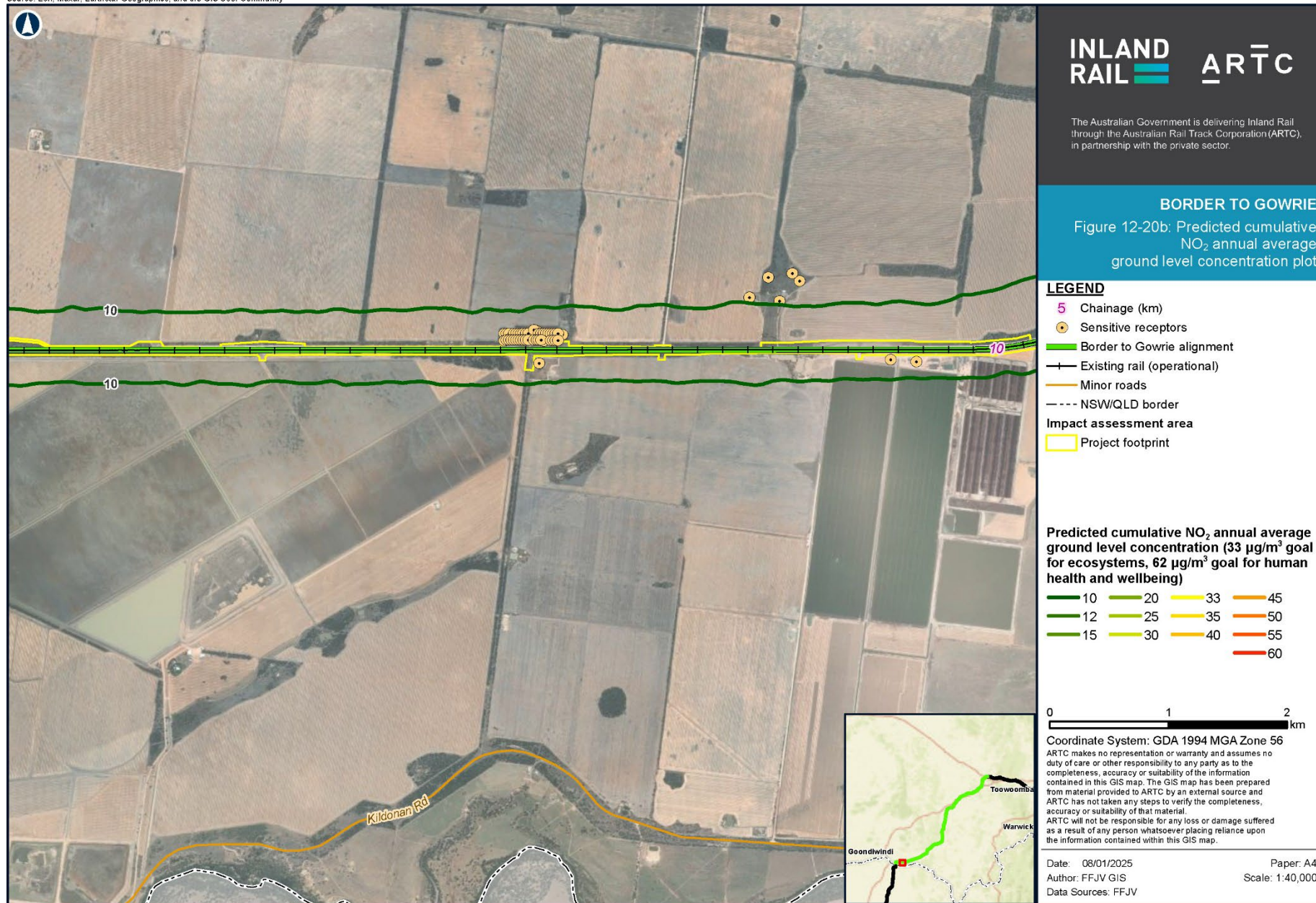


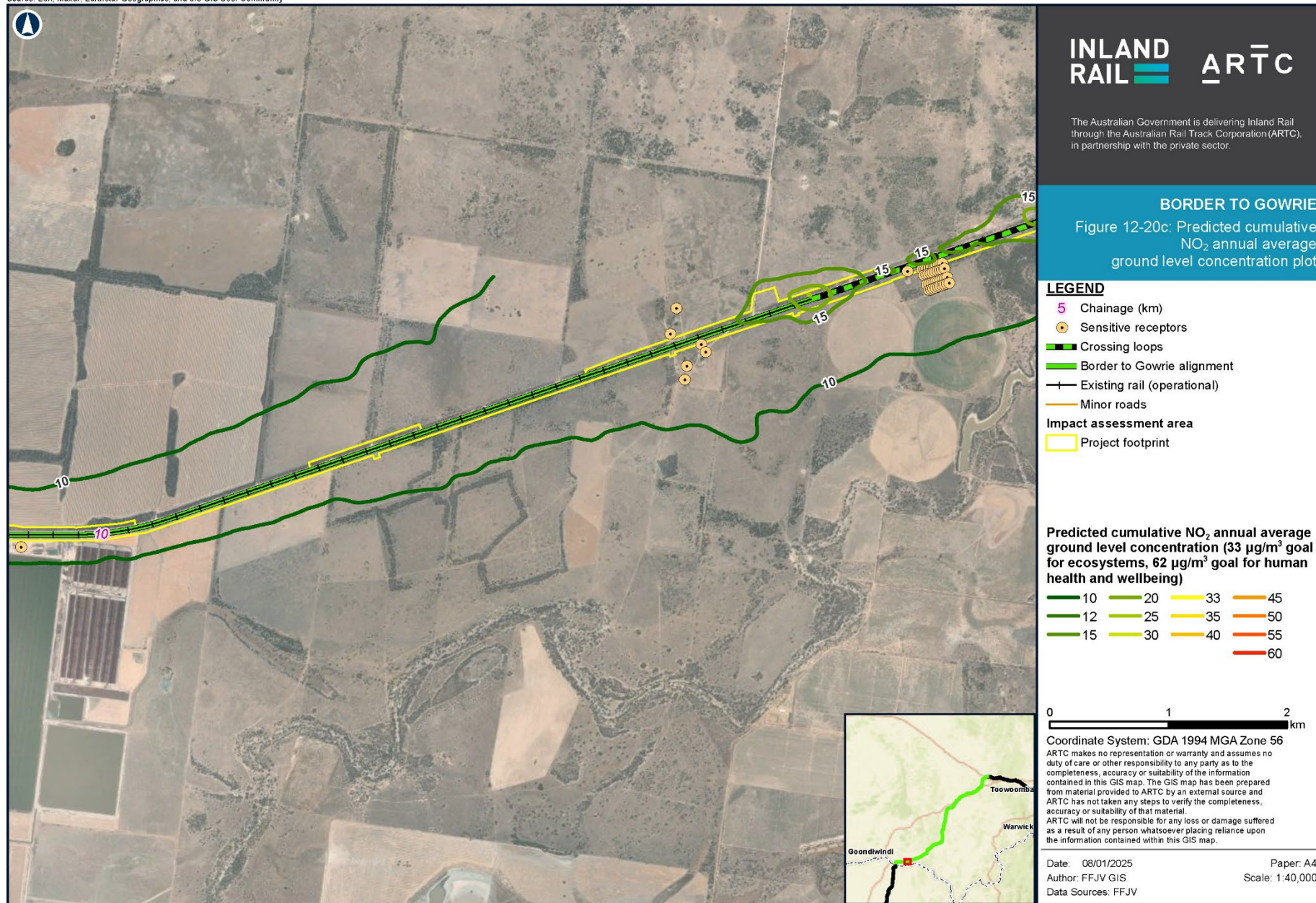
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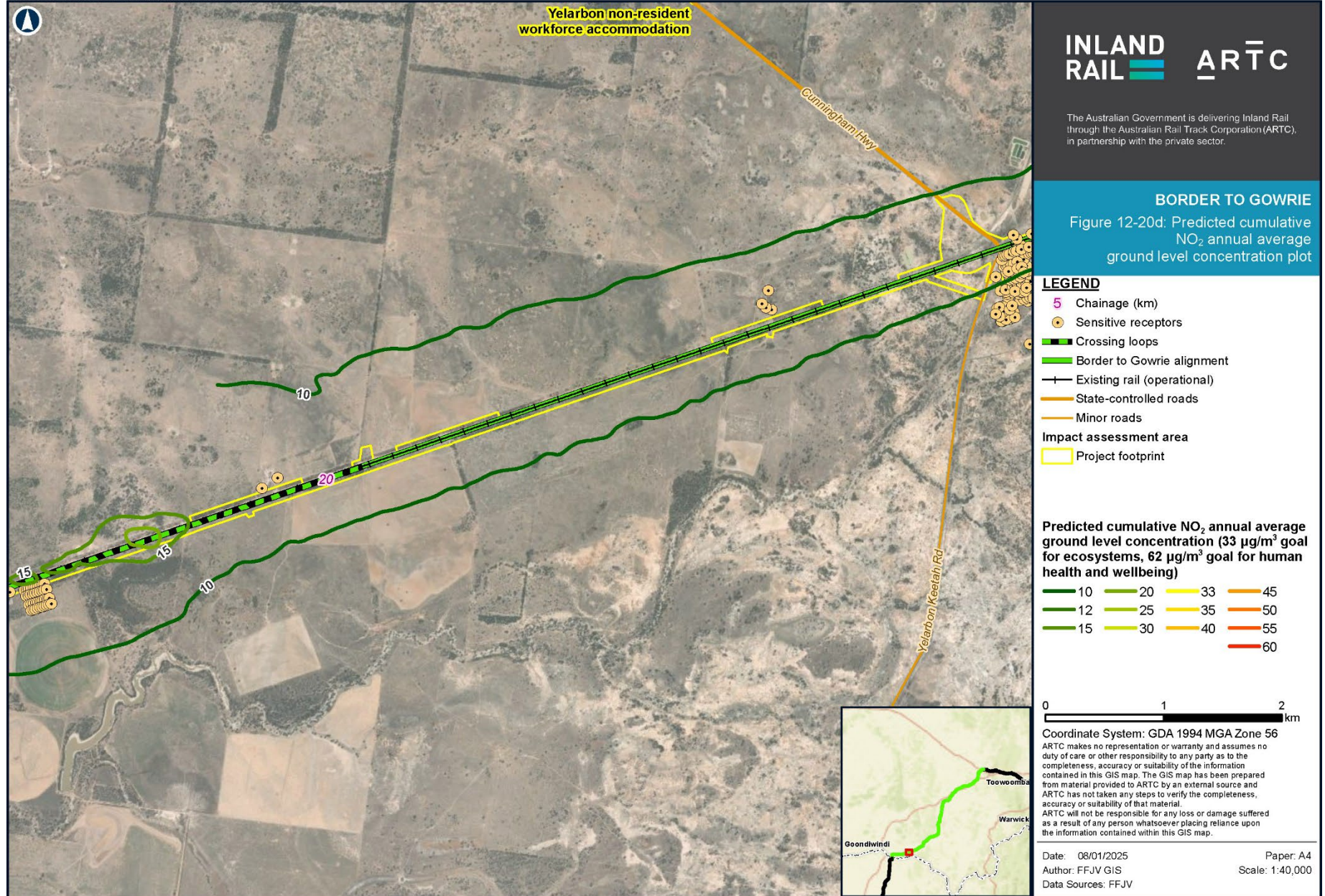


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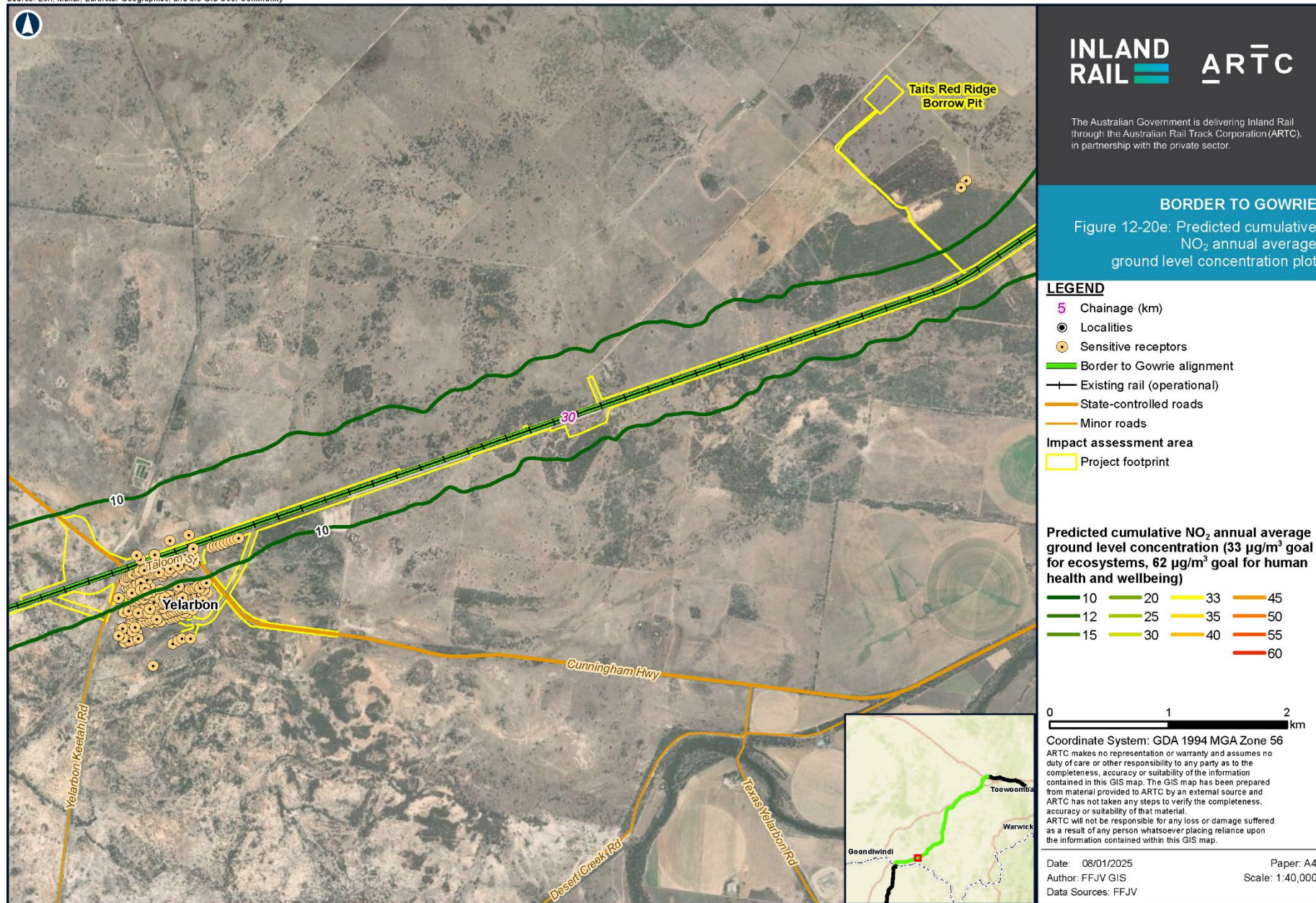


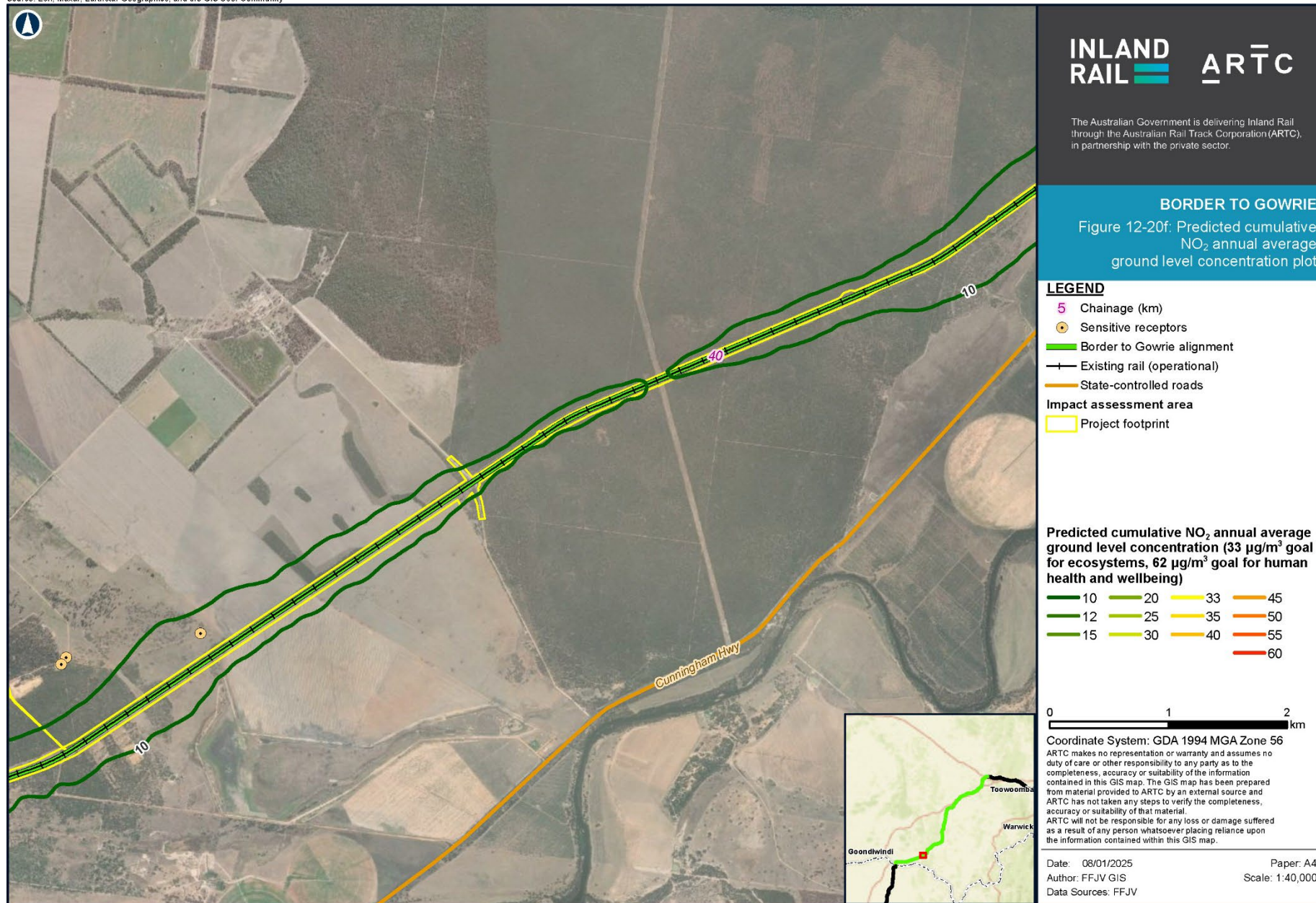


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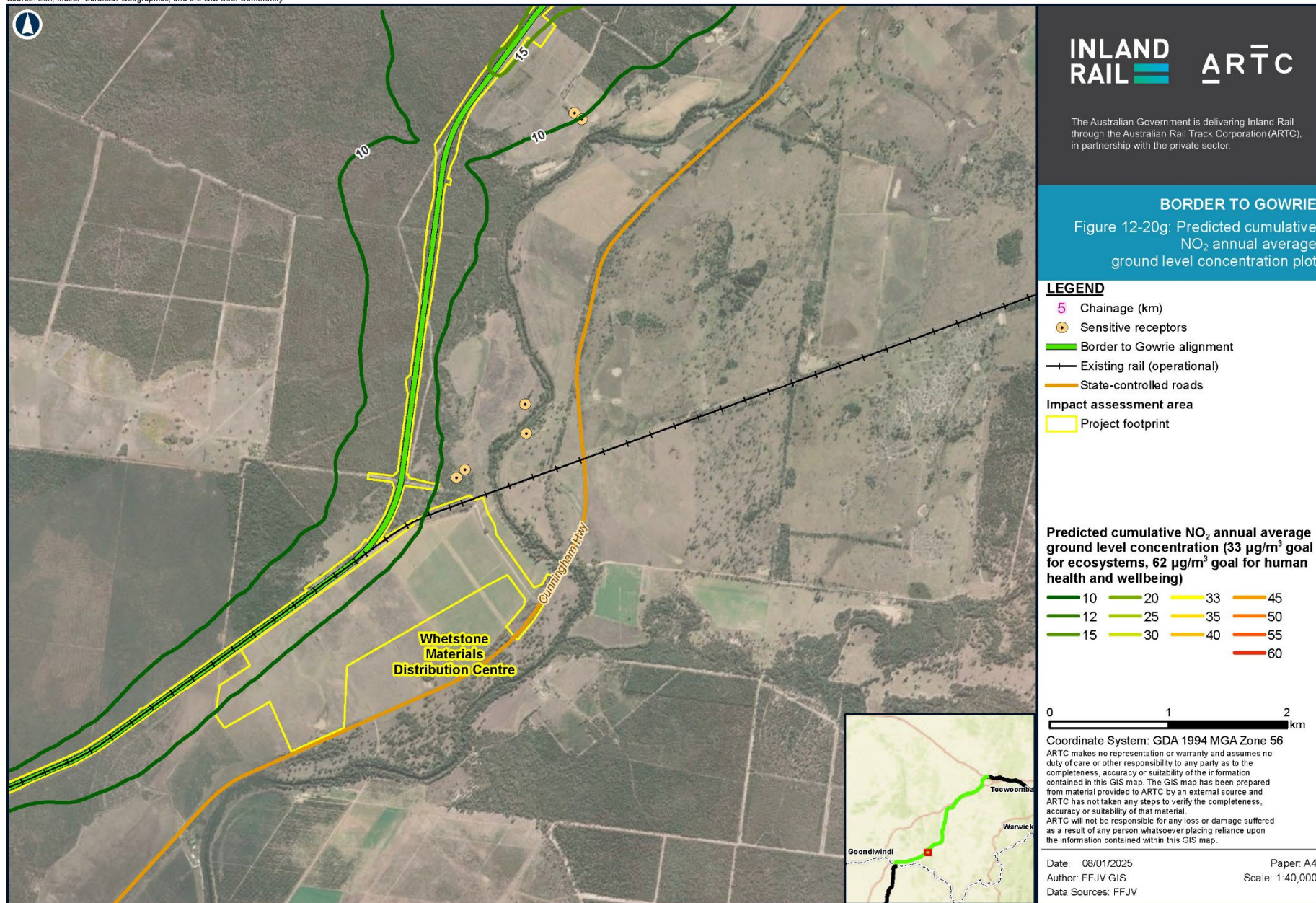


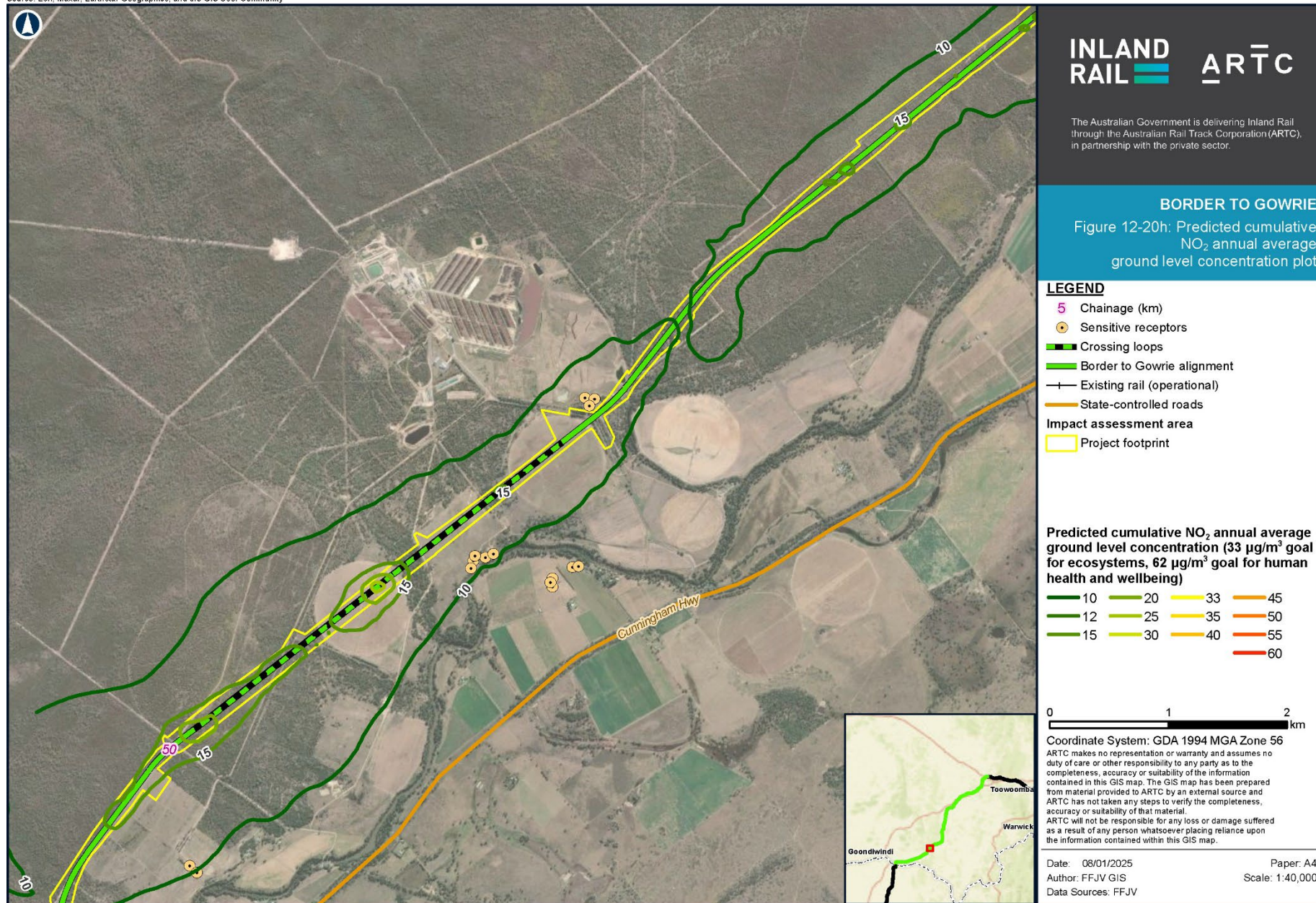
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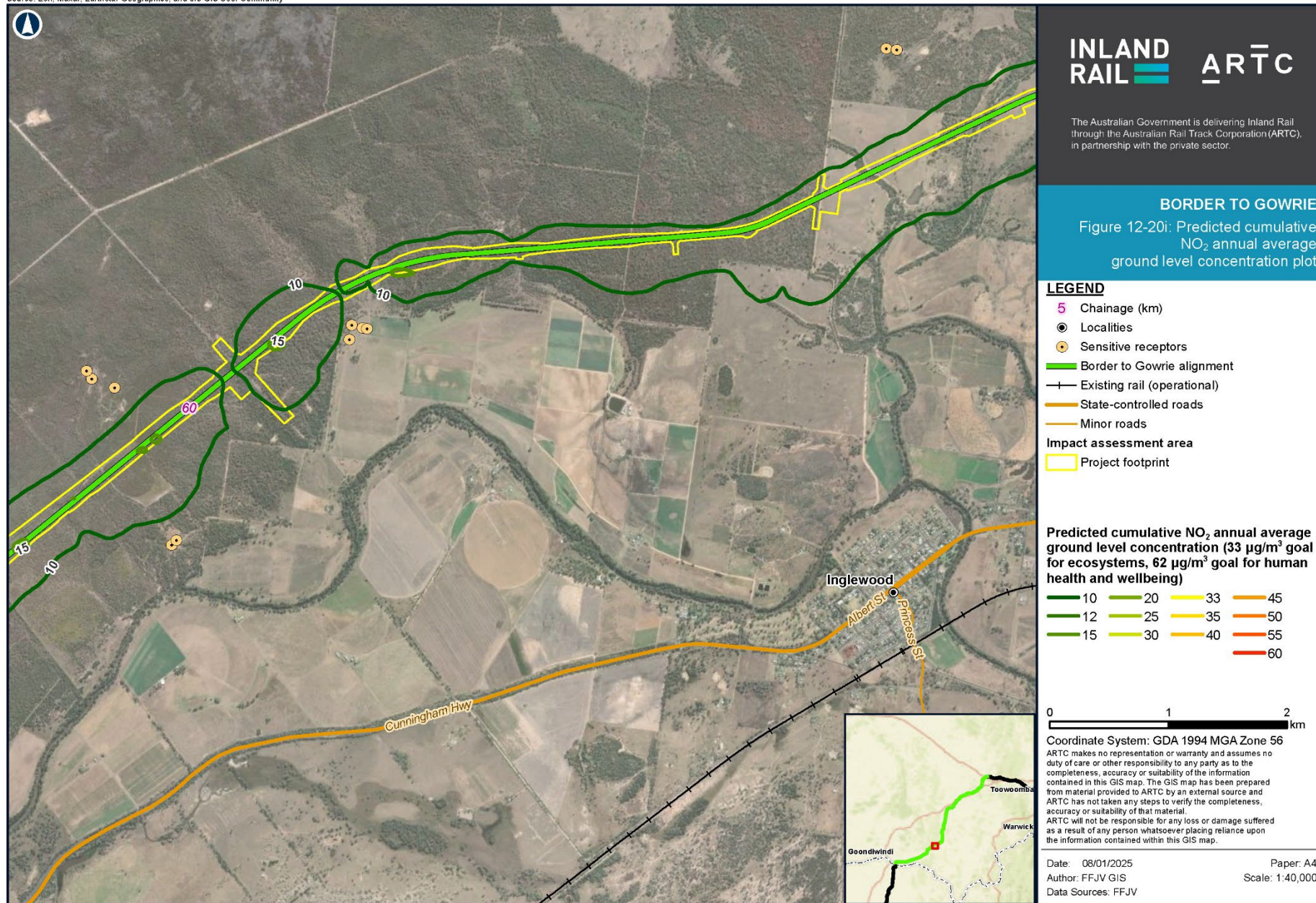


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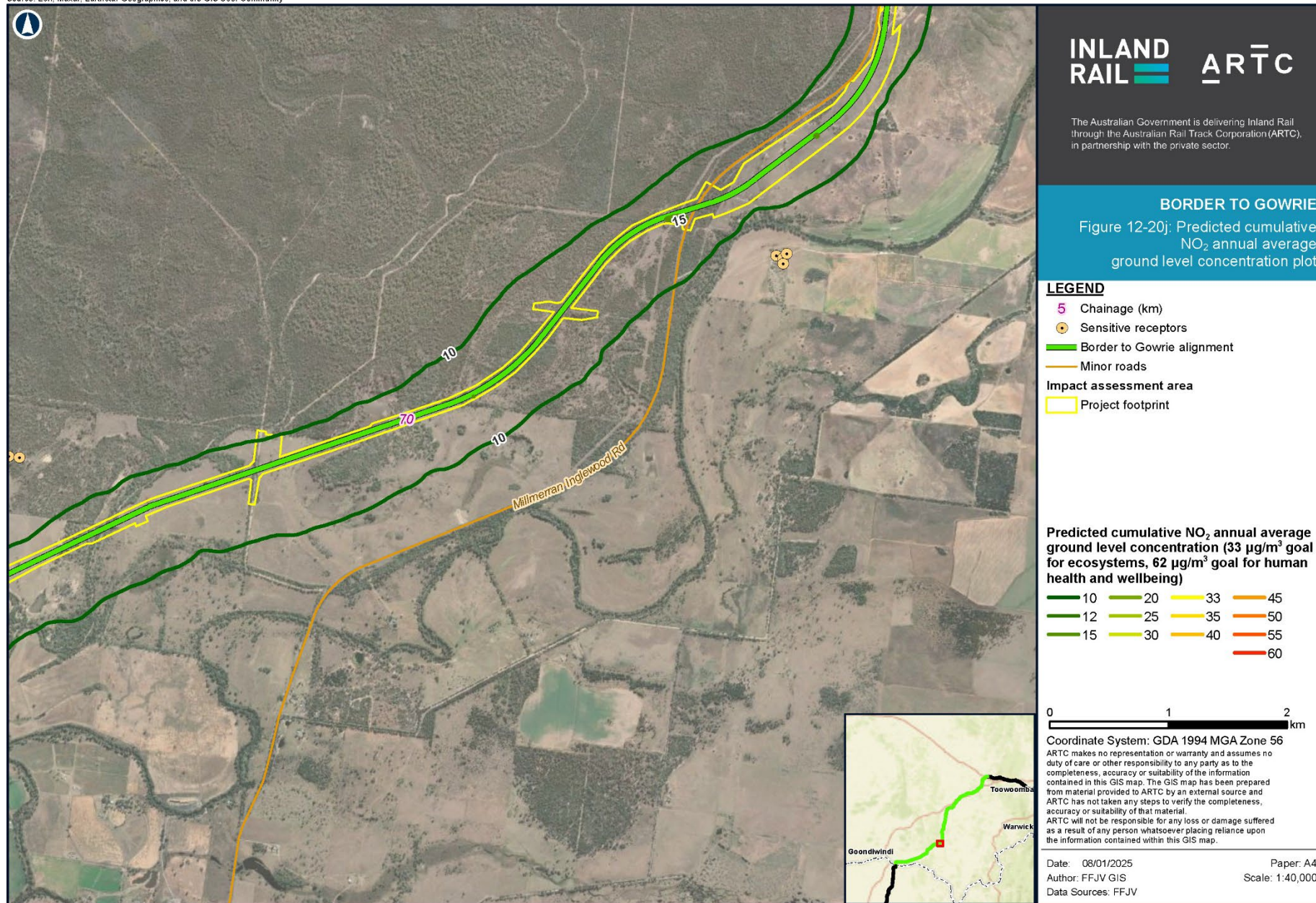


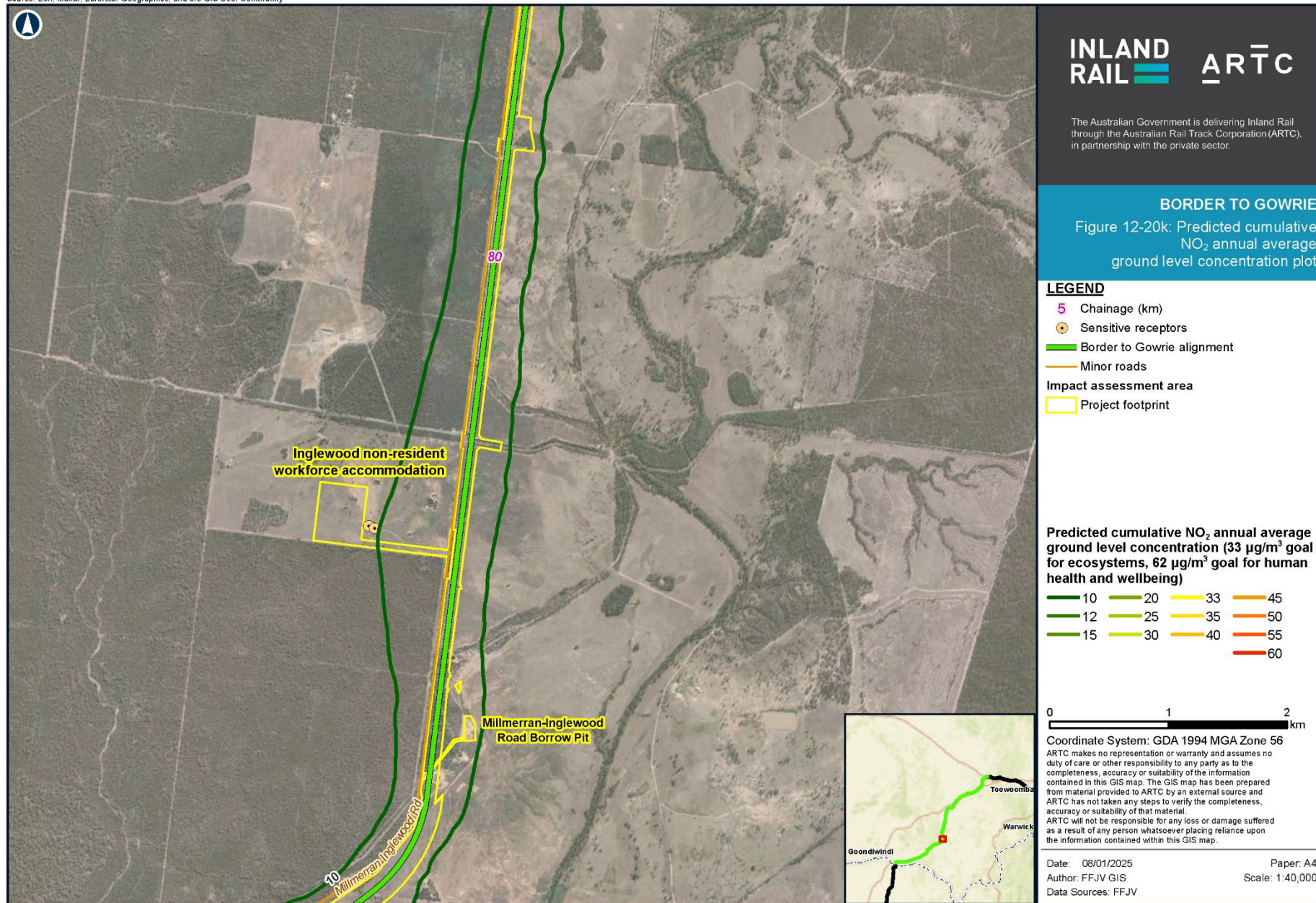


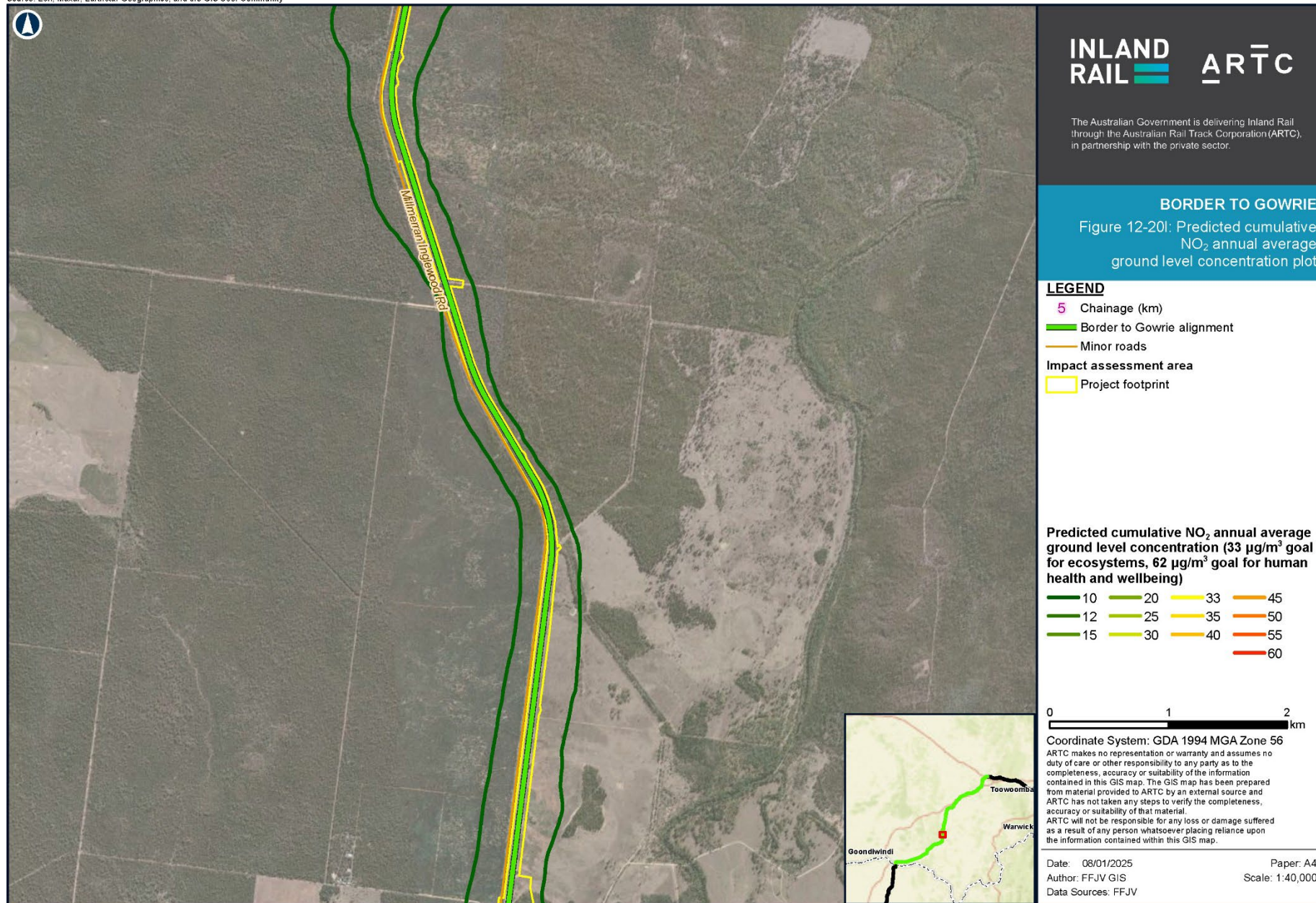
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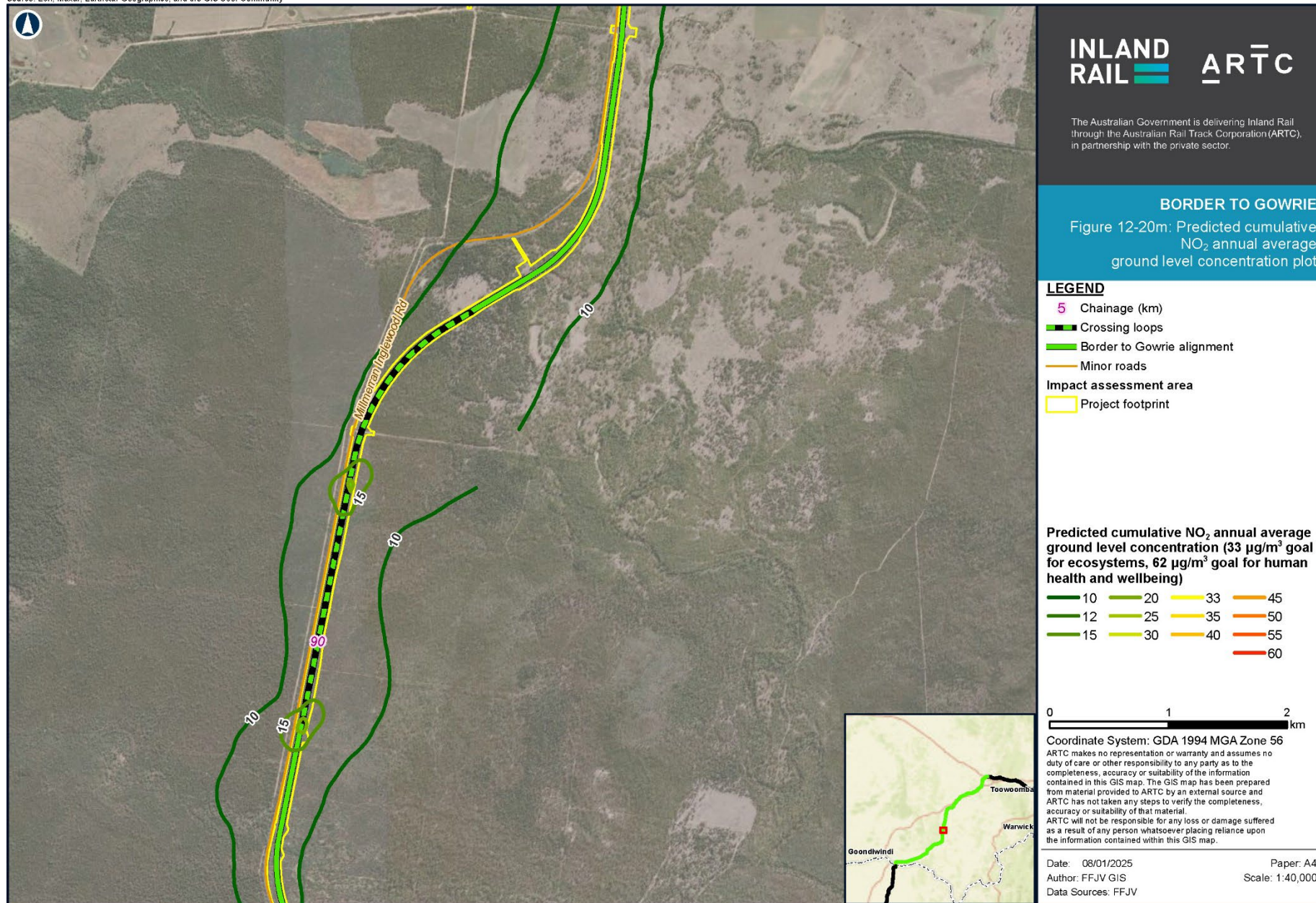
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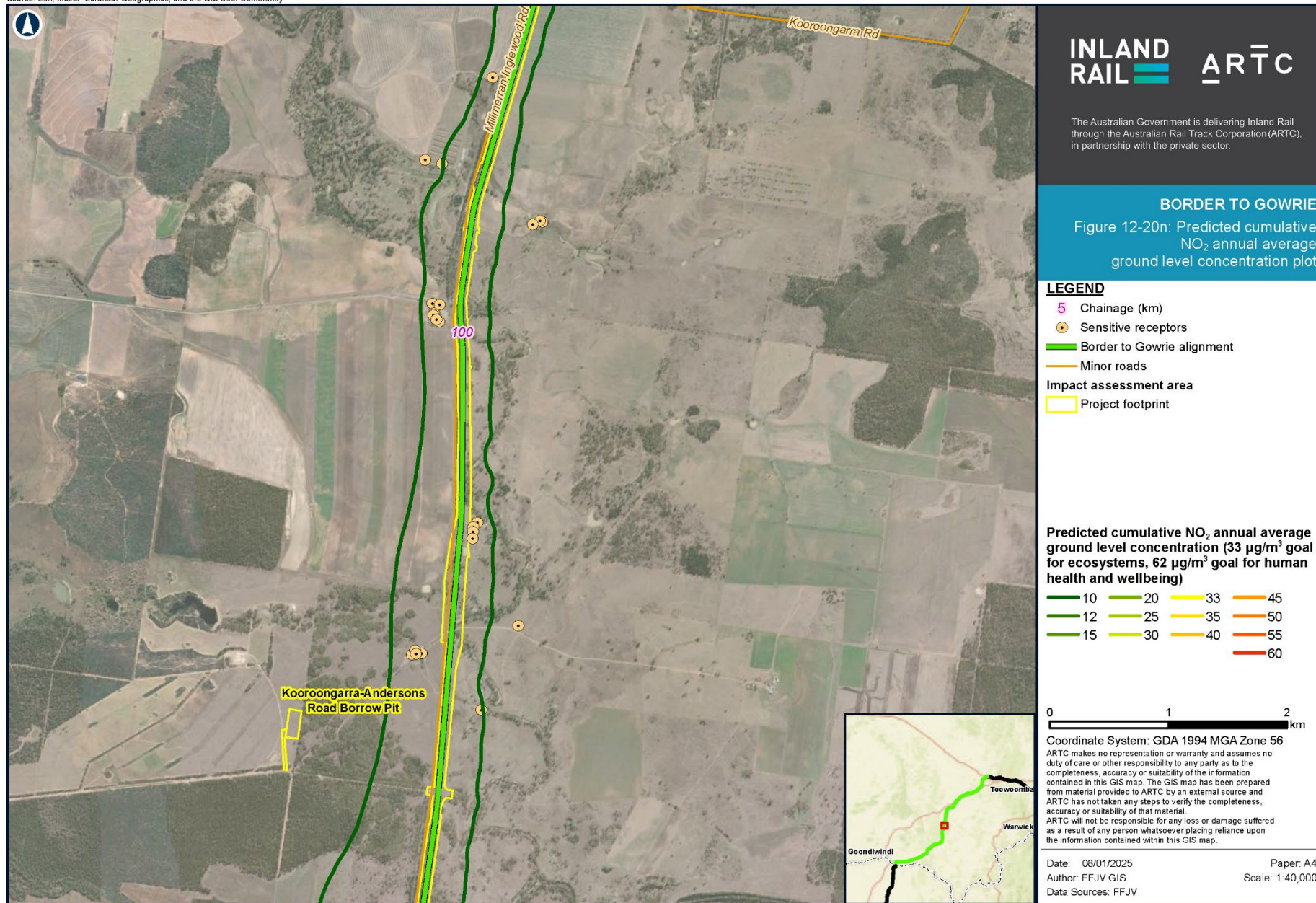




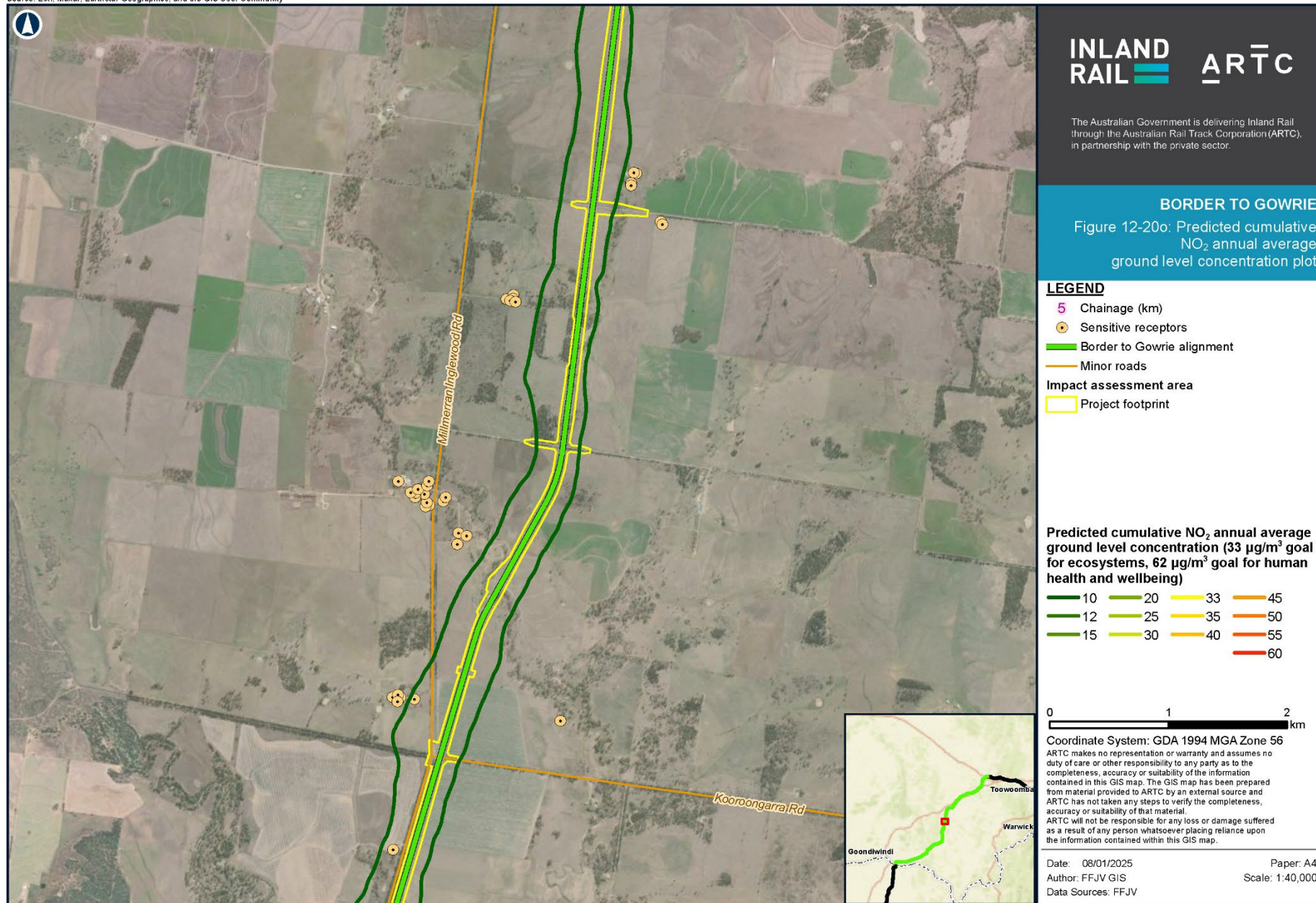
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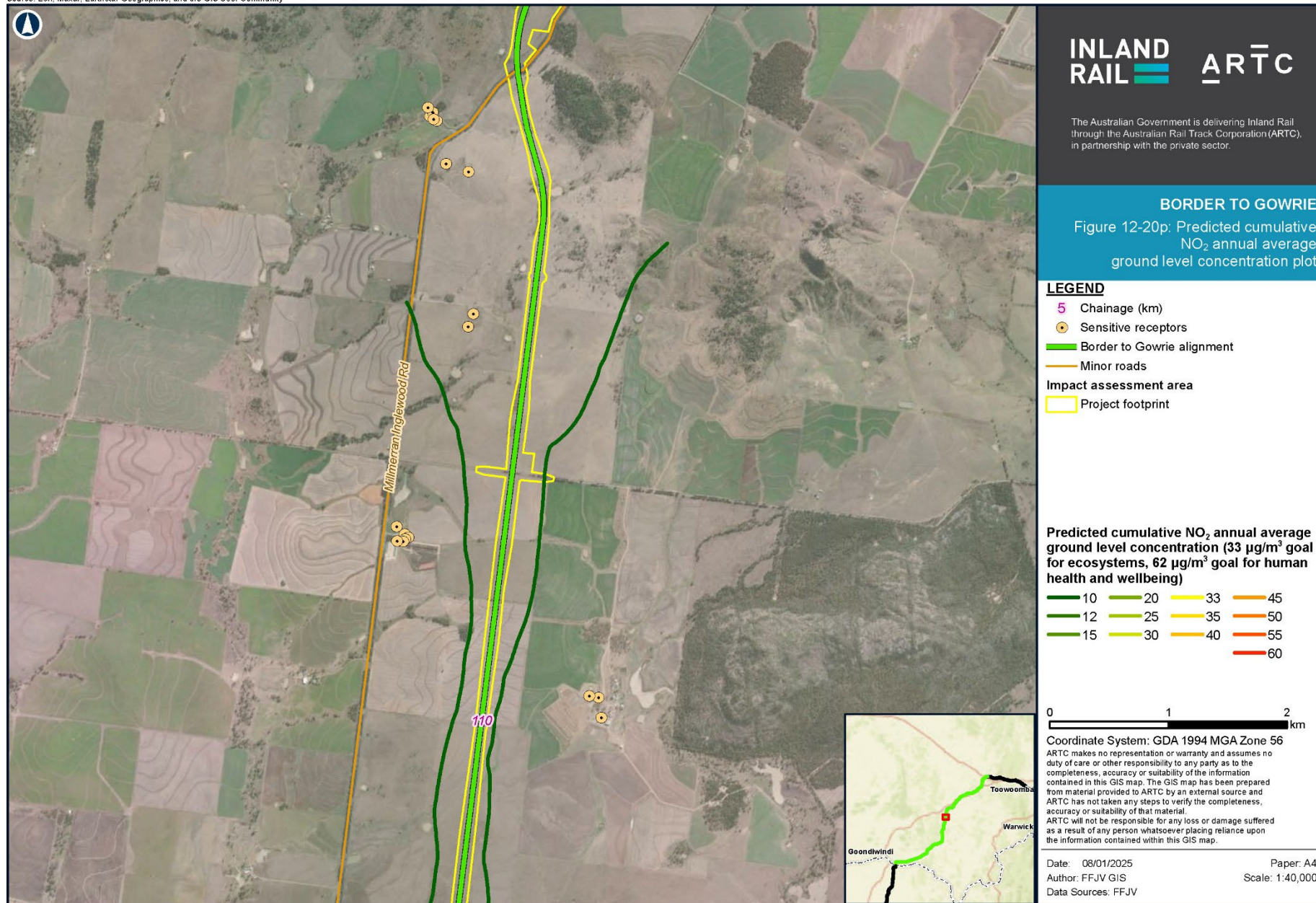
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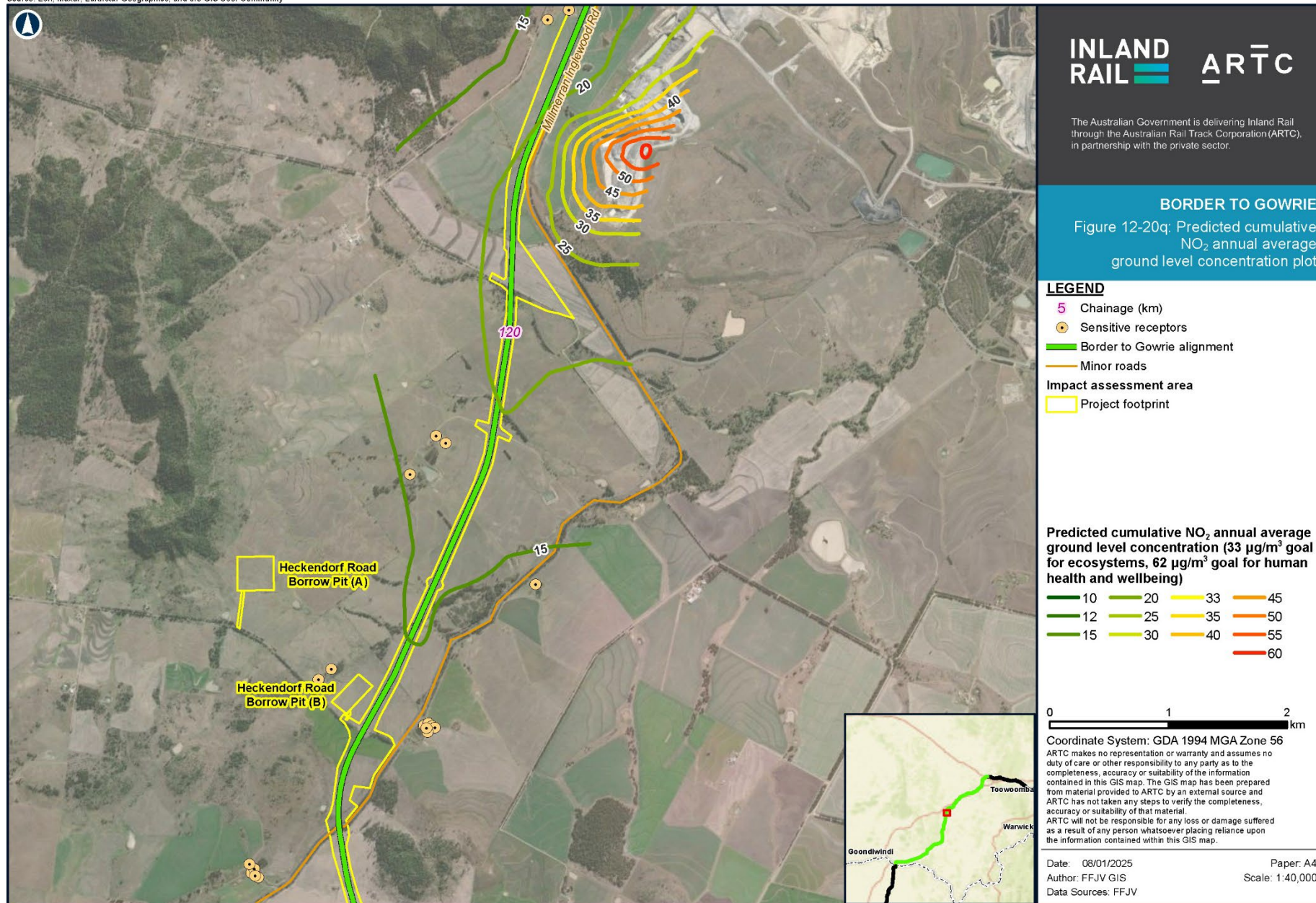


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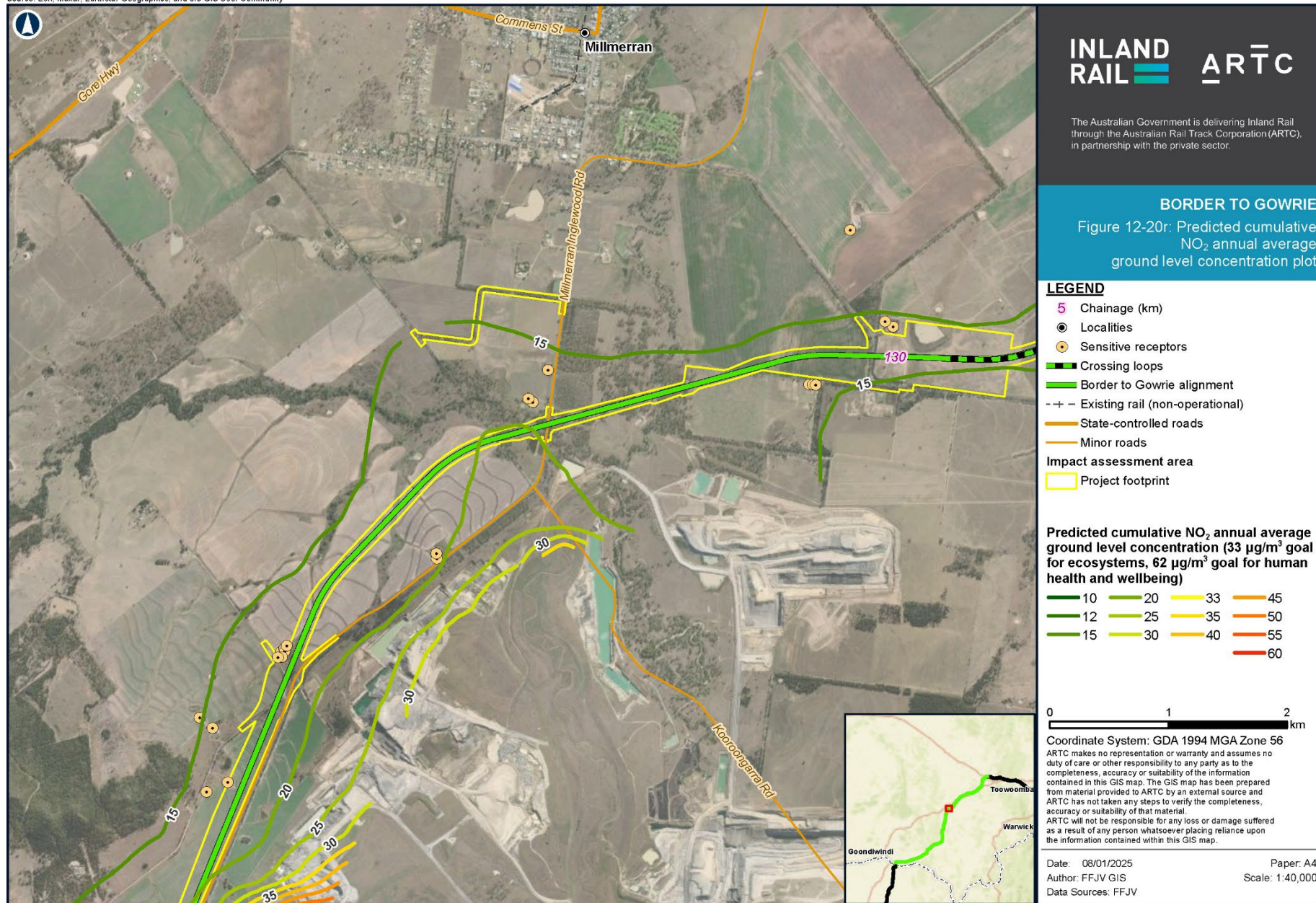


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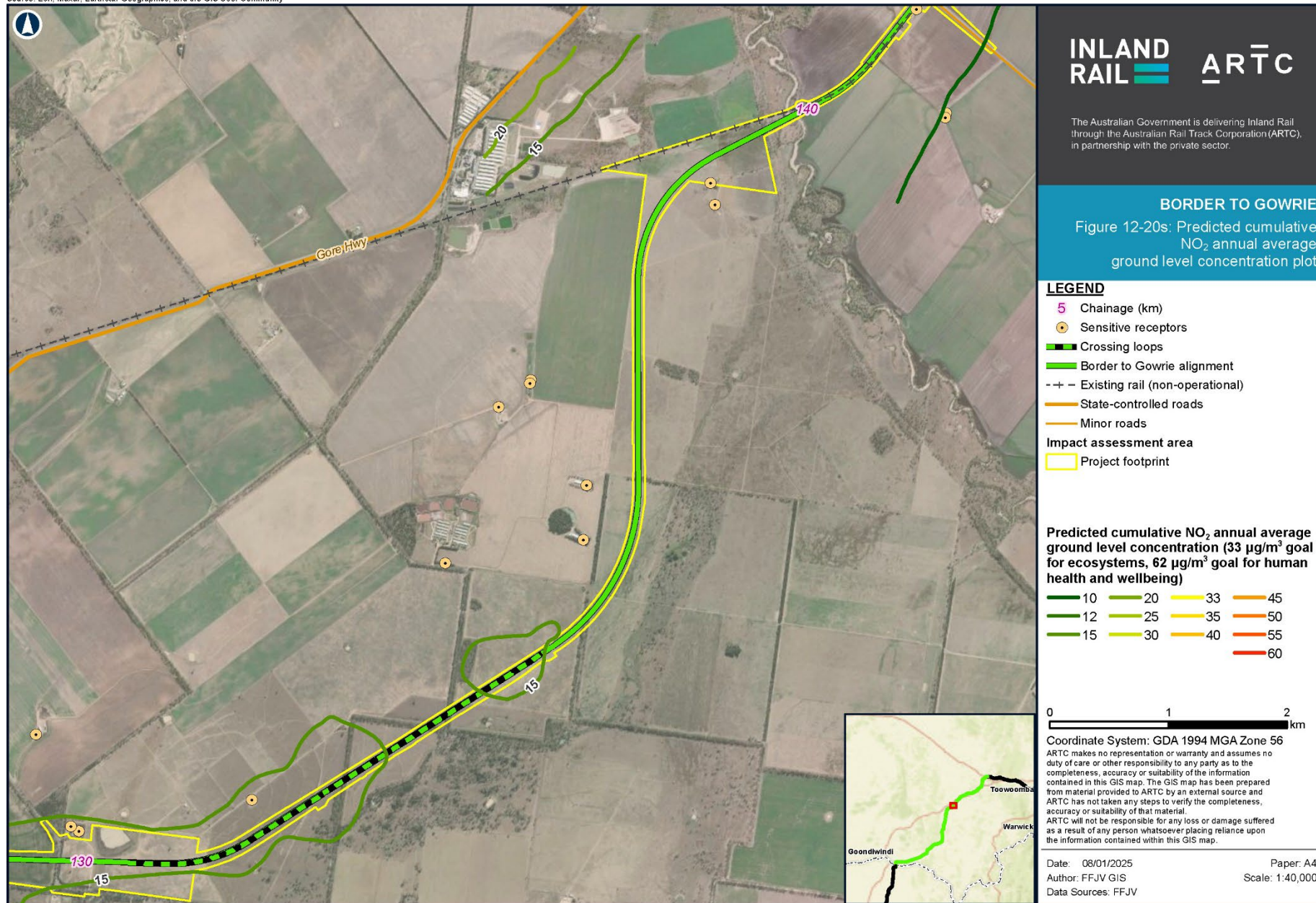




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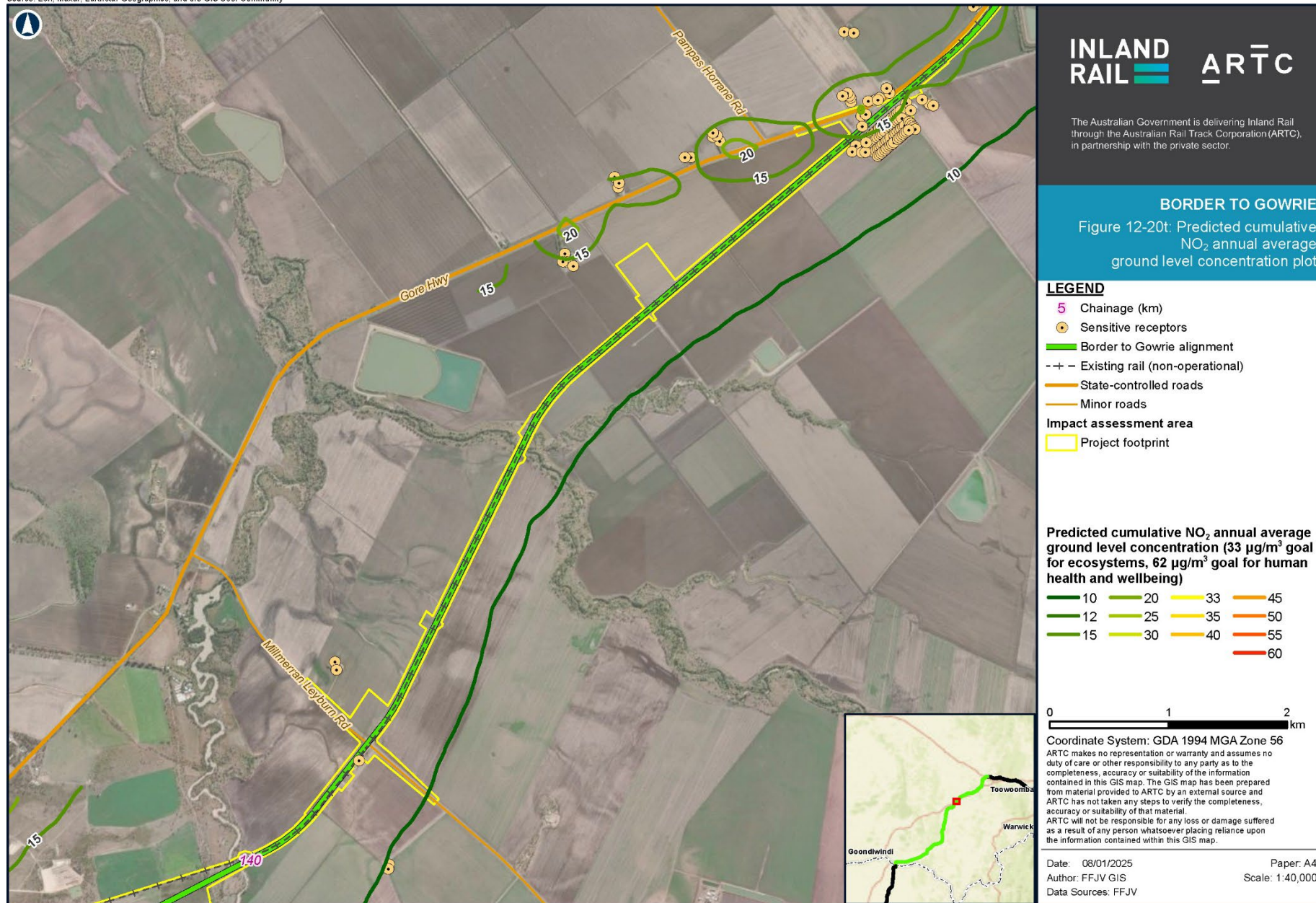


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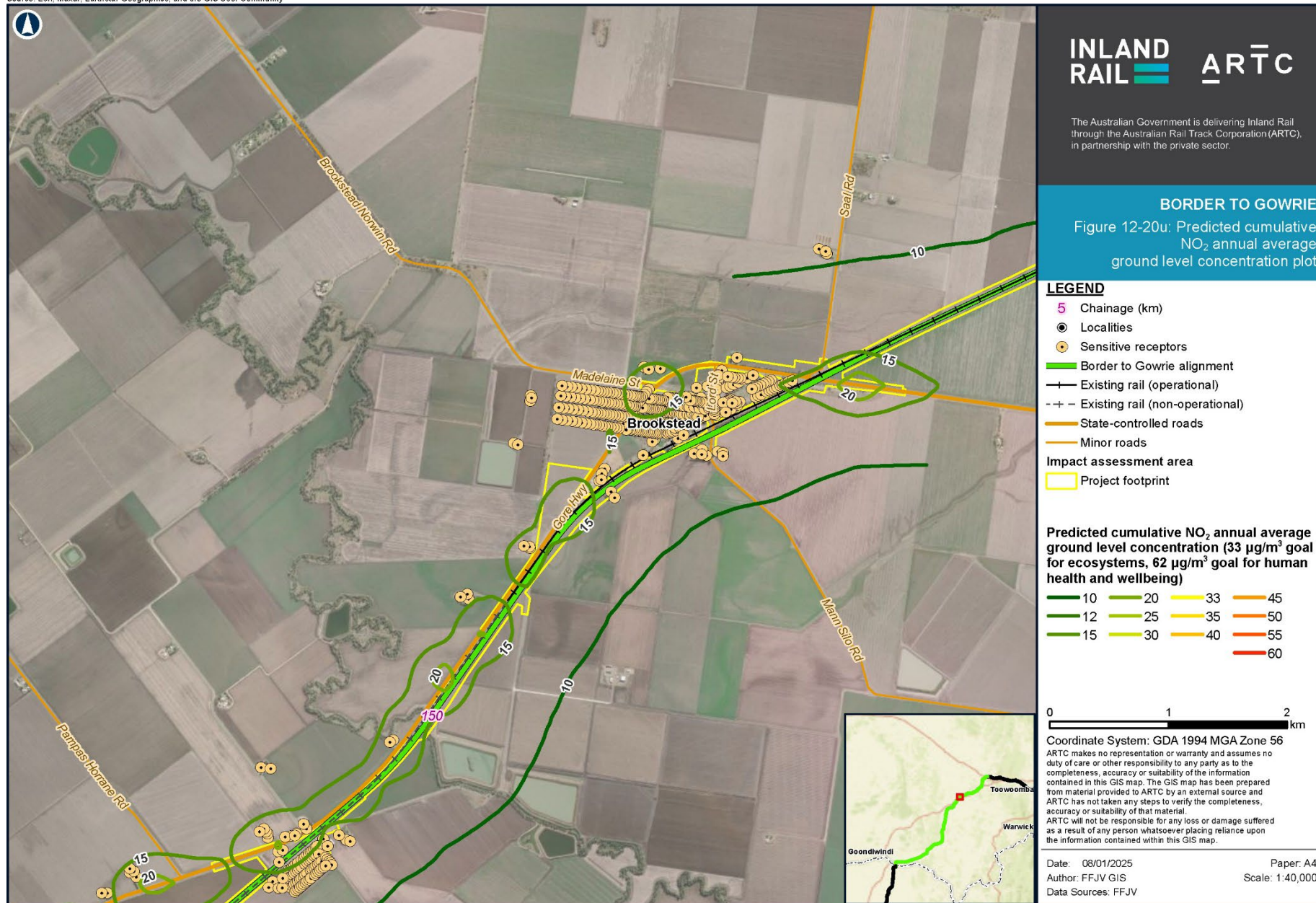


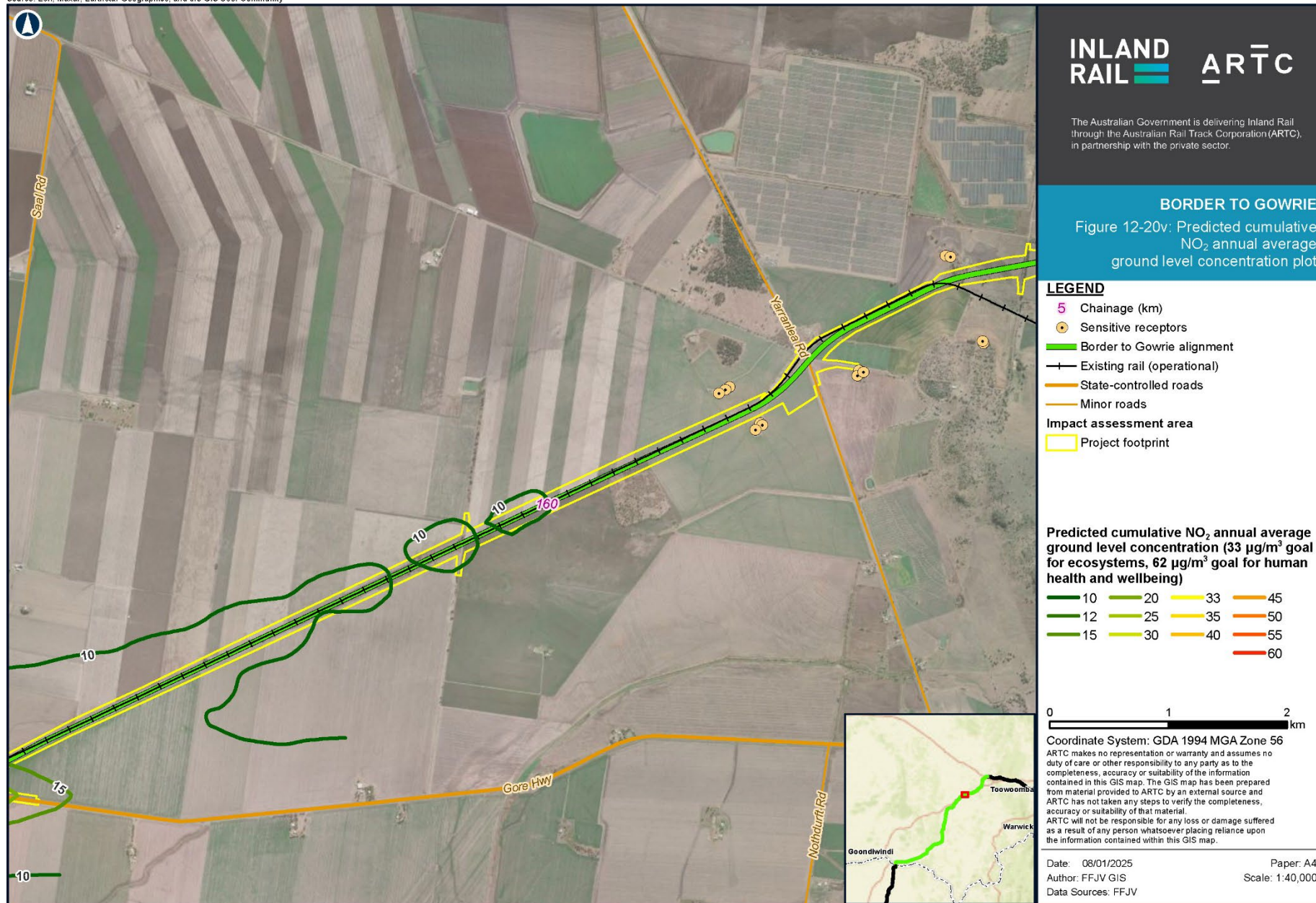
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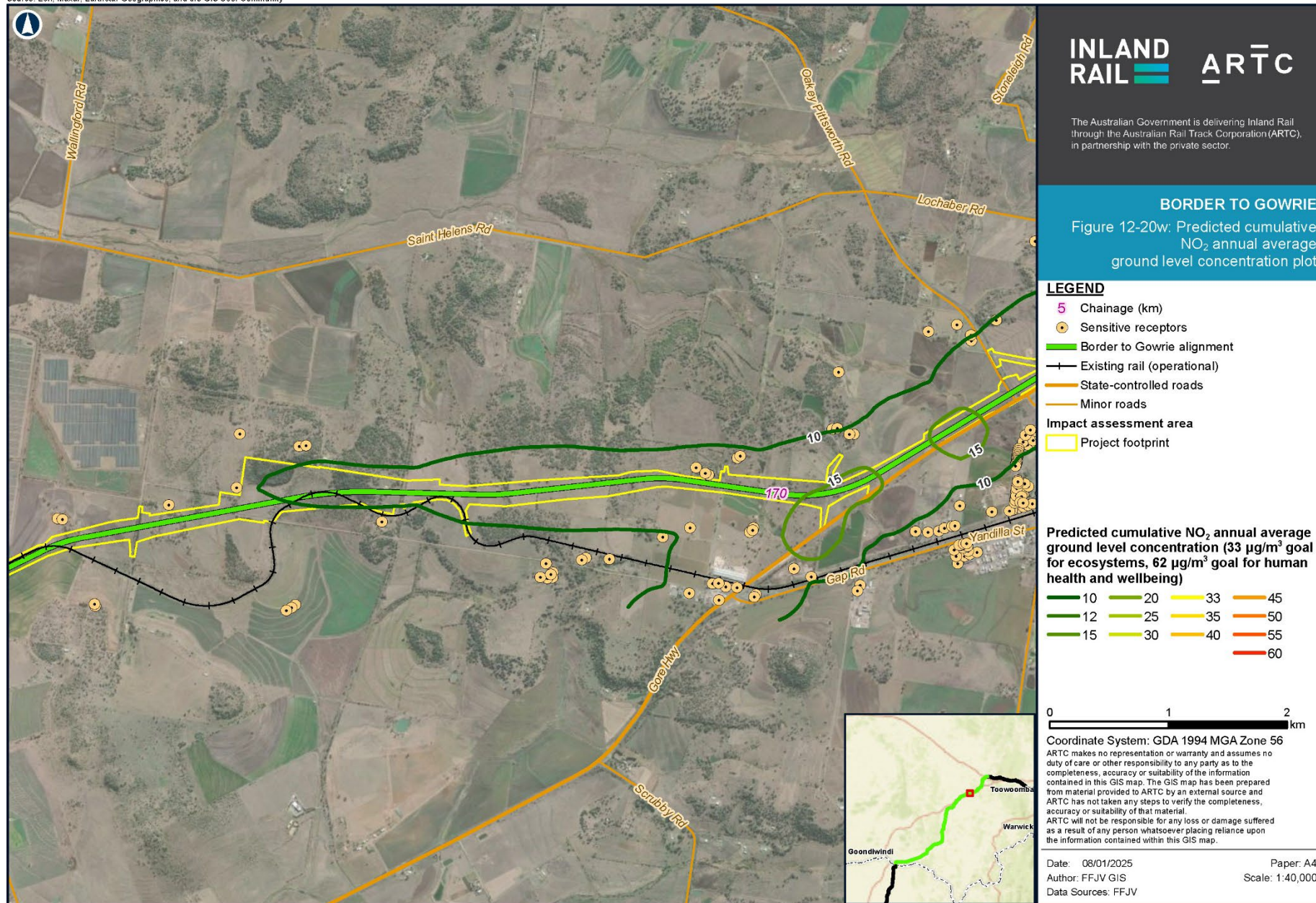


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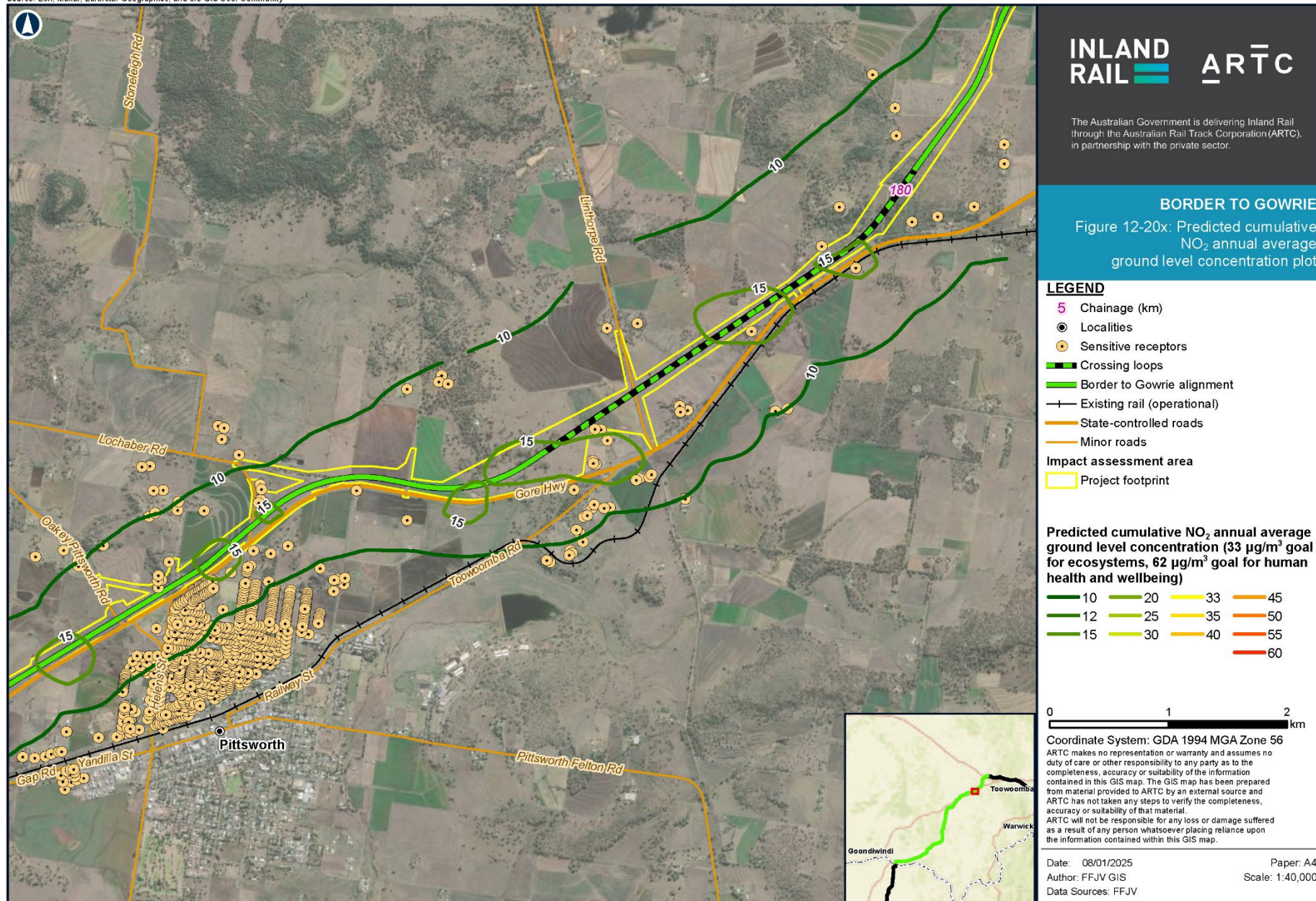




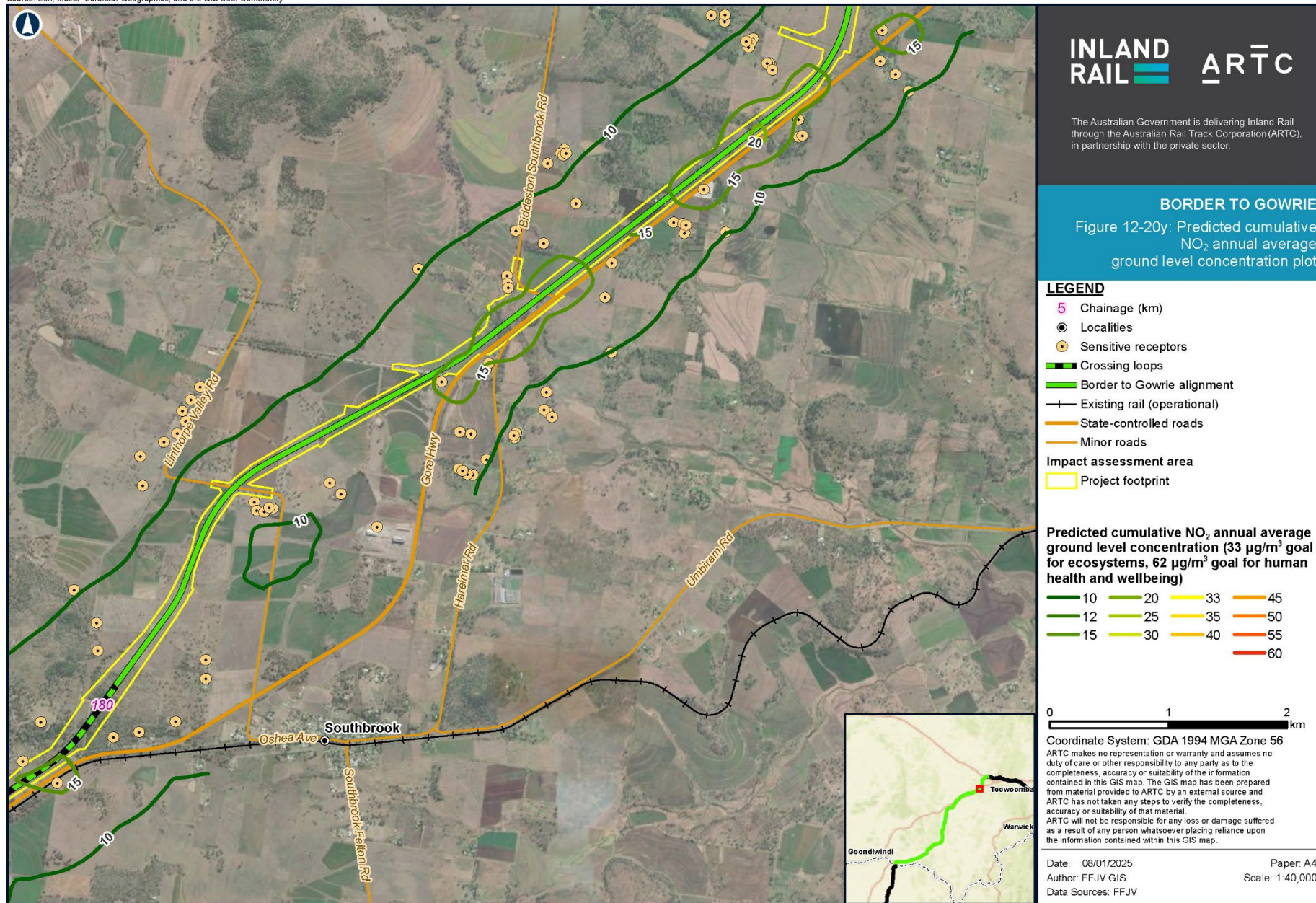
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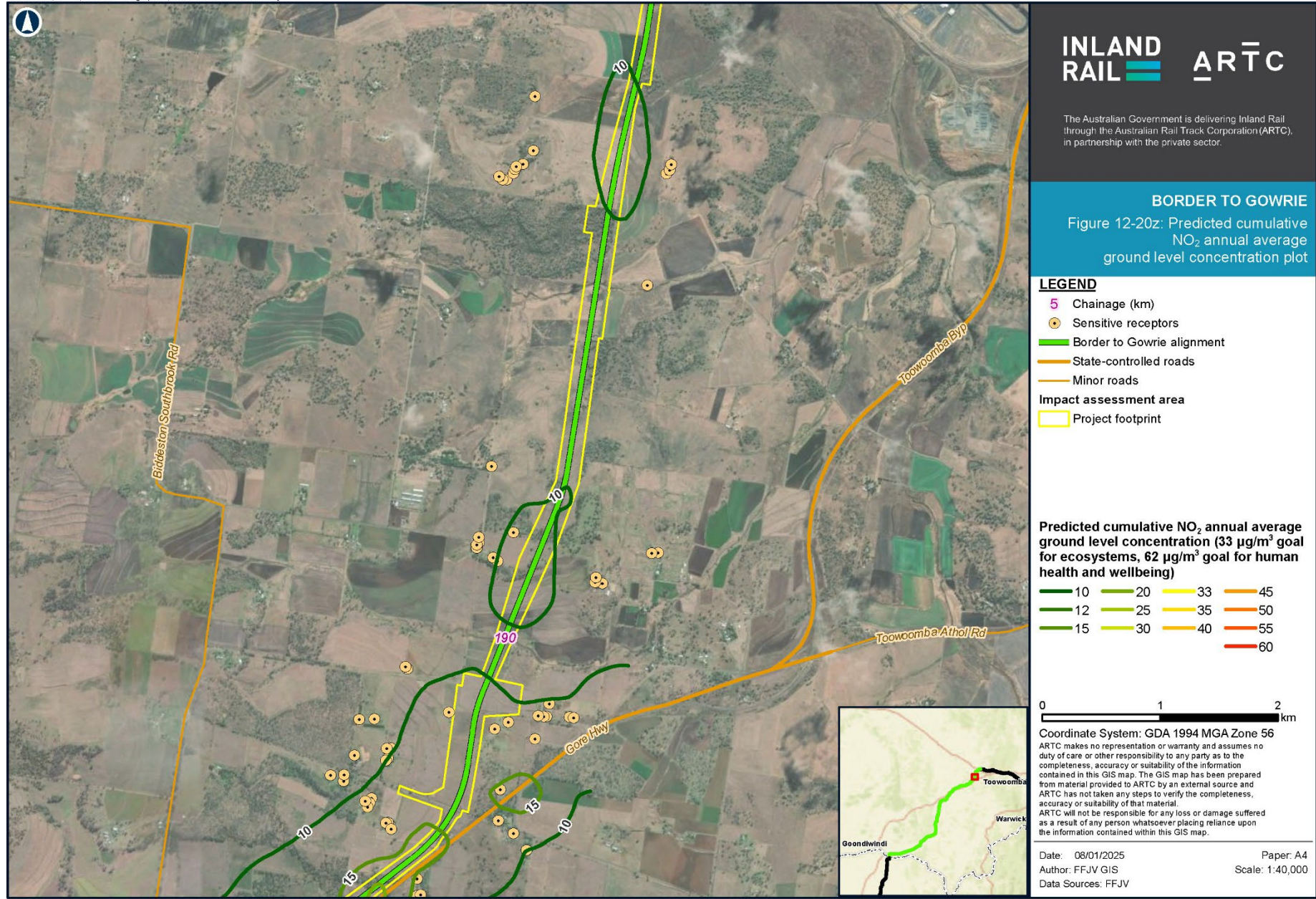
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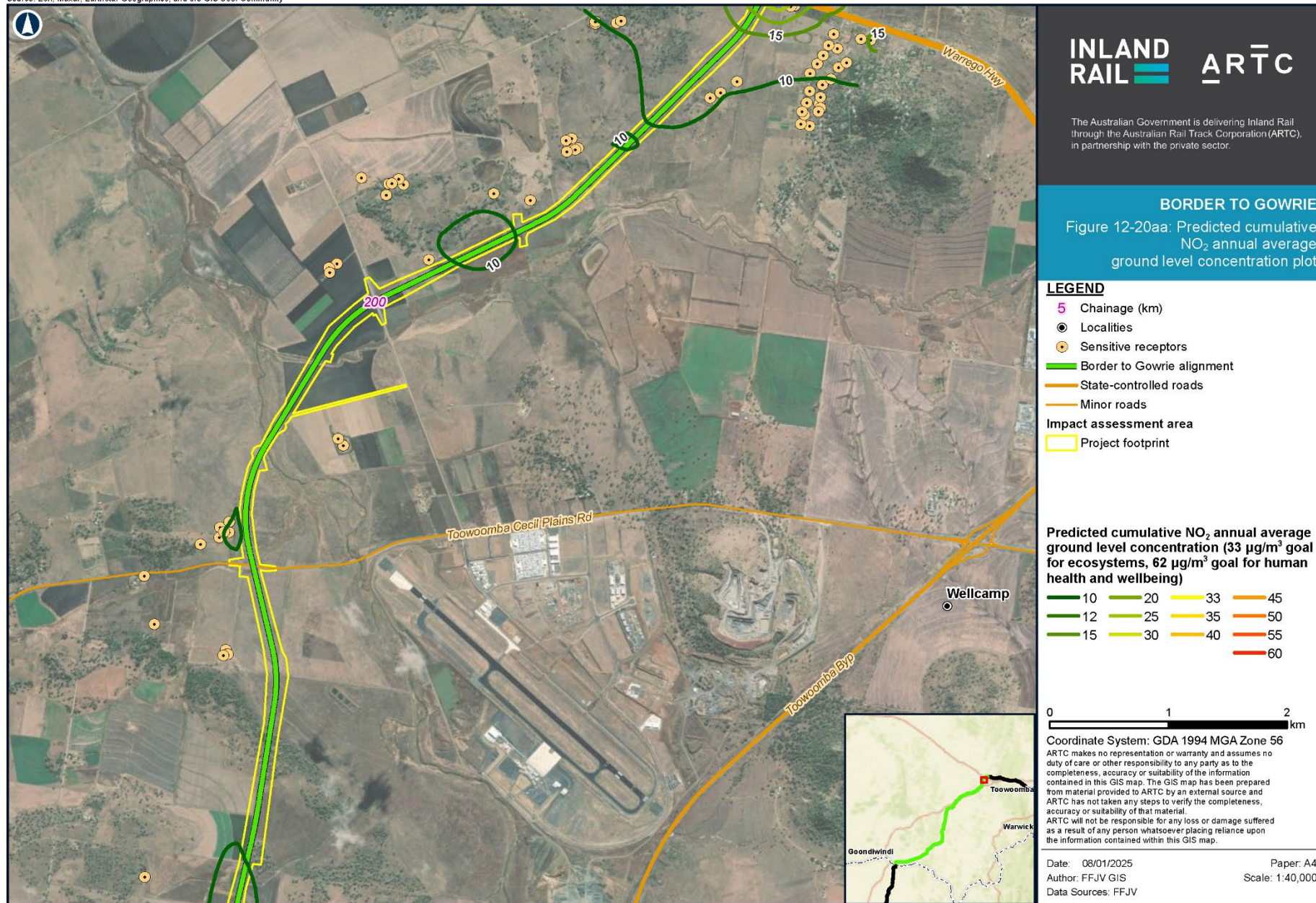
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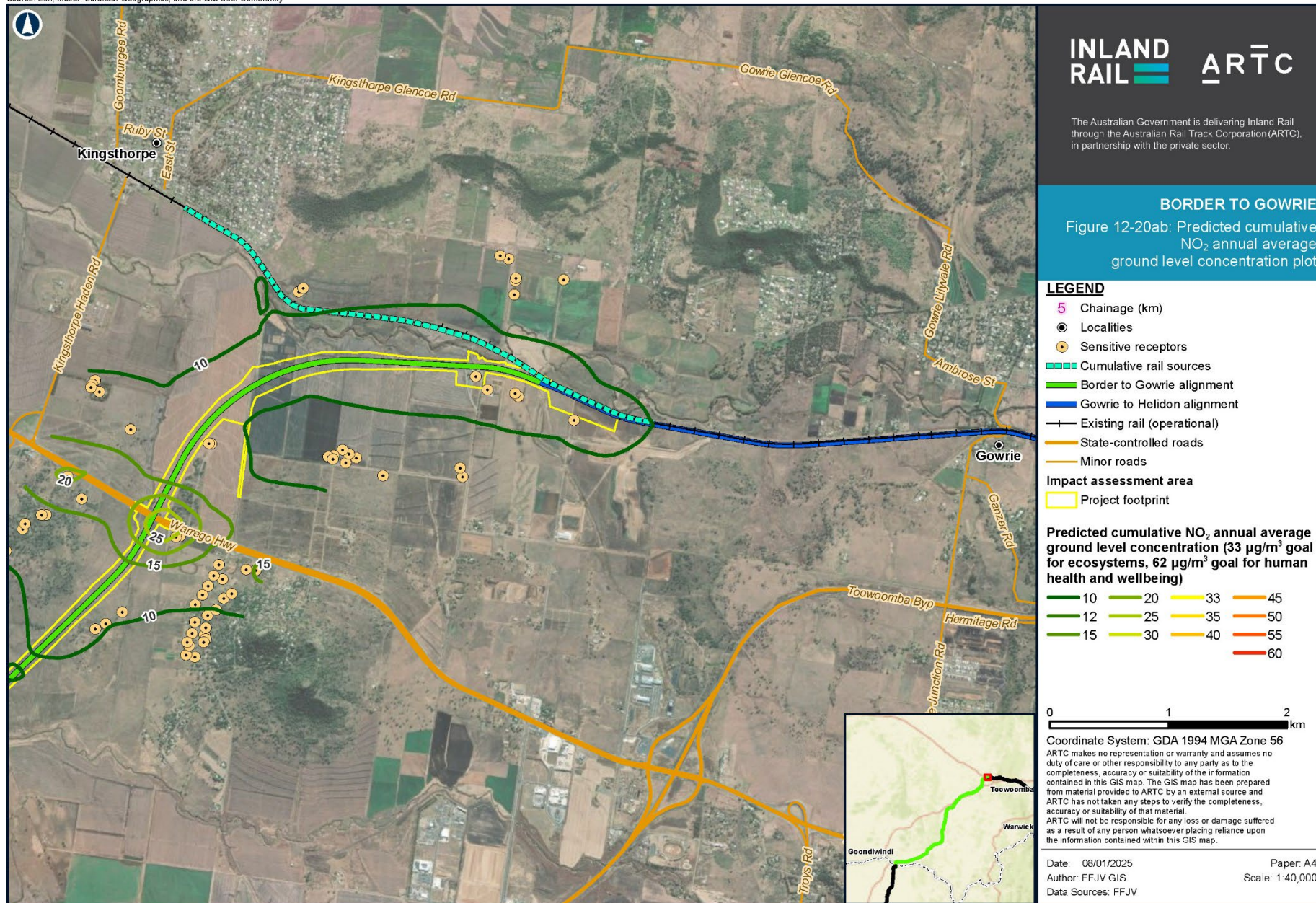


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12.5.2.2 Drinking water impacts

Table 12-33 presents the highest predicted Project-only pollutant concentrations for the water tank of the worst affected sensitive receptor in the operations stage of the Project, assessed against the drinking water guideline values prescribed by the *Australian Drinking Water Guidelines* (NHMRC & NRMCC, 2011).

For peak train volumes in year 2040, compliance is predicted for all pollutants by a significant margin. As typical train numbers will be lower than the peak numbers applied, impacts to tank water would generally be less than that predicted.

Compliance with the drinking water guideline values is predicted by a significant margin; as such, the residual impact to drinking water because of the Project is likely to be negligible.

TABLE 12-33 HIGHEST PREDICTED WATER TANK POLLUTANT CONCENTRATIONS

Pollutant	Maximum predicted annual deposition rate ($\mu\text{g}/\text{m}^2/\text{s}$)	Estimated roof area (m^2)	Maximum predicted total deposited mass (microgram (μg))	Tank water volume (L)	Highest predicted concentration (mg/L)	Guideline value (mg/L)
Arsenic	3.6×10^{-12}	200 ^a	0.023	1000 ^b	2.1×10^{-8}	0.01
Cadmium	3.6×10^{-10}	200 ^a	2.3	1000 ^b	2.1×10^{-6}	0.002
Lead	1.8×10^{-11}	200 ^a	0.11	1000 ^b	1.1×10^{-7}	0.01
Nickel	2.5×10^{-9}	200 ^a	15.8	1000 ^b	1.5×10^{-5}	0.02
Chromium VI	1.8×10^{-9}	200 ^a	11.3	1000 ^b	1.1×10^{-5}	0.05

Table notes:

a. Based on the average surface area of a large house

b. Assumption of a 10,000 L water tank at 10% capacity, with a resultant water volume of 1000 L

c. Worst-affected receptors have been visually identified in Appendix R: Air Quality Technical Report

mg/L = milligrams per litre

12.5.2.3 Ecological impacts

The potential for impacts to ecological receptors has been investigated via review of predicted annual average NO_2 concentration contours. Modelling predictions have been reviewed to determine if the annual average NO_2 air quality goal of $33 \mu\text{g}/\text{m}^3$, set for the protection of the environmental value of the health and biodiversity of ecosystems (Table 12-2), is exceeded within the AQIA area.

Predicted cumulative NO_2 annual average concentration contours are shown in Figure 12-20. The concentration contours shown in Figure 12-20 are cumulative predictions, and include emissions from the Gore Highway, Warrego Highway, Commodore Mine and Millmerran Power Station.

Consistent with the concentration contour plots for PM_{10} (24 hour), $\text{PM}_{2.5}$ (annual) and NO_2 (1 hour) (Figure 12-18 to Figure 12-20), Figure 12-20 shows that the highest predicted annual average NO_2 concentrations are predicted at locations near Project crossing loops, adjacent to the Commodore Mine and Millmerran Power Station, and adjacent to the Warrego Highway and Gore Highway.

The concentration contours in Figure 12-20 show that the annual average NO_2 air quality goal ($33 \mu\text{g}/\text{m}^3$) is only exceeded within the area of Commodore Mine. It is evident from the contour plots that the influence of Project emissions is minor.

Based on the limited areas outside the Project footprint at which the annual average NO_2 air quality goal of $33 \mu\text{g}/\text{m}^3$ is predicted to be exceeded, and the influence of Project emissions on these areas, it is considered unlikely that significant impacts to ecological receptors will occur as a result of the operation of the Project.

12.5.2.4 Impacts to agriculture

The predicted maximum dust deposition levels for the worst-affected receptors in the AQIA area are shown in Table 12-32. The worst-affected receptor for dust deposition has a predicted maximum cumulative deposition level of $50.1 \text{ mg}/\text{m}^2/\text{day}$.

As discussed in Section 12.2.1, research on vegetation response to dust deposition impact has shown that a measurable reduction in crop growth is not observed below a dust deposition rate of $1,000 \text{ mg}/\text{m}^2/\text{day}$ (Doley, 2003), and that a deposition rate of up to $4,000 \text{ mg}/\text{m}^2/\text{day}$ does not influence the amount of feed that cattle eat or the amount of milk produced (Andrews & Shriskandarajah, 1992).

Based on the predicted dust deposition levels, with the maximum cumulative deposition level being $50.1 \text{ mg}/\text{m}^2/\text{day}$, the impact of dust deposition on agricultural uses within the AQIA area is not likely to cause impacts to crop production rates or cattle feed consumption or milk production.

In addition to deposited dust, NO_2 has the potential to impact agricultural uses; however, as discussed in Section 12.5.2.3, there is limited area outside the Project footprint at which the annual average NO_2 air quality goal of $33 \mu\text{g}/\text{m}^3$ (set for the protection of the health and biodiversity of ecosystems) is predicted to be exceeded, which is limited to the area of Commodore Mine. Based on the predicted annual average concentrations of NO_2 within the AQIA area, it is considered unlikely that impacts to agricultural receptors will occur as a result of emissions of NO_2 from the operation of the Project.

12.5.2.5 Odour from livestock trains

Presently there is no plan for livestock trains to use the alignment; however, livestock train services have operated historically between Goondiwindi and Warwick; therefore, for the purpose of the assessment and to evaluate the risk of odour impacts, it has been conservatively assumed that one livestock train per week (maximum length of 900 m) may use the alignment. The potential for impacts from agricultural train odour have been assessed using the methodology described in Section 12.3.3.

Odour emissions from agriculture freight train pass-bys are expected to be highly diluted due to the volume of air that will pass through and around the train over the duration of travel; therefore, odour emissions from moving agriculture freight trains are considered unlikely to cause significant nuisance impact.

Table 12-34 presents an assessment of odour impacts from livestock freight trains using the FIDOL factors described in Section 12.3.3. Livestock trains have the highest potential for odour to impact sensitive receptors (much greater potential than grain, as an example) and therefore have been adopted for the assessment of odour.

TABLE 12-34 SUMMARY OF FIDOL FACTORS FOR ODOUR GENERATED BY AGRICULTURAL TRAINS

FIDOL factor	Livestock trains
Frequency (F)	During peak operations, it is expected that a maximum of one livestock train per week will travel the Inland Rail Program alignment. As such, the frequency of the event is low, with an average of less than one livestock train per day during peak periods.
Intensity (I)	Odour intensity is expected to range from strong to very strong for livestock trains.
Duration (D)	Duration of exposure is expected to be short, with the time of exposure limited to the length of time taken for train pass-by (approximately 1 minute for a 900 m livestock train travelling at 60 km/h). At crossing loops, the exposure is expected to be longer (estimated average of approximately one hour) but will still be relatively short.
Offensiveness (O)	The offensiveness of the odour is expected to be unpleasant.
Location (L)	The land use of the receiving environment can be classified as mainly rural agricultural and residential for the larger town centres of Yelarbon, Inglewood, Millmerran, Pittsworth, Southbrook, Kingthorpe and Gowrie. Due to the land use of the receiving environment, intermittent odour from agricultural activities and livestock is unlikely to be uncommon to the existing ambient air environment. People living and visiting rural areas are expected to have a higher tolerance for rural activities and their associated effects, such as odour.

It is expected that odour produced from passing trains or trains stopped at crossing loops could be of high intensity and offensiveness, depending on the separation distance of the nearest sensitive receptors and the sensitivity of the receptor to odour; however, impacts are expected to be infrequent and of a short duration (one hour or less). The Project is located in a predominantly rural area where intermittent odour from agricultural uses is likely to be common to the existing ambient air environment; therefore, the sensitivity of the AQIA area to intermittent agricultural odour events is expected to be lower than for more urban environments.

Odour impacts can be cumulative if odour emitted by multiple sources is of the same character (the same type of odour). Although intermittent agricultural odour is expected to be common to the existing ambient air environment, the potential for significant cumulative odour impacts is considered to be low due to the short duration of a train pass-by event (Table 12-34).

Based on the reasoning provided, odour emissions from agriculture freight are unlikely to result in significant impacts to sensitive receptors within the AQIA area.

12.5.2.6 Q-Fever

Livestock have the potential to carry *Coxiella burnetii* (*C. burnetii*) bacteria, which can cause Q-Fever in humans (Queensland Health, 2019). Presently there is no plan for livestock trains to use the alignment; however, livestock train services have operated historically between Goondiwindi and Warwick; therefore, for the purpose of the assessment of the Project, it has been conservatively assumed that one livestock train per week may use the alignment.

The *C. burnetii* bacteria are most prevalent in animal products including birthing tissues such as placenta, blood, urine, faeces, bedding and soils contaminated by these wastes (EPA Victoria, 2020). *C. burnetii* can survive harsh conditions and can attach to dust particles (Reedijk, Leuken, & Hoek, 2013), which can be inhaled by humans, resulting in the onset of Q-Fever. The EPA Victoria guideline *Q-Fever: Guidance for Preparing Planning Approvals* (Victorian EPA, 2020) states that at least 50 per cent of infected humans are asymptomatic; however, symptoms can include fever, sweating, nausea, headaches, vomiting and diarrhea, with extreme fatigue seen in 5 to 20 per cent of cases, pneumonia seen in 1 to 2 per cent of cases and approximately 5 to 15 per cent of acute cases becoming chronic (EPA Victoria, 2020).

Clark and Magalhaes (2018) indicated that *C. burnetii* bacteria can travel up 18 km on gale-force winds, with the highest risk areas being in rural areas within 5 km of sources such as stockyards and abattoirs. The study also concluded that the species of livestock that most strongly correlated with Q-Fever outbreaks were sheep and goats, rather than cattle.

EPA Victoria (2020) provides guidance on assessing the risk of Q-Fever infection from new developments. The guideline indicates that high-risk areas for Q-Fever are workplaces such as such as abattoirs, knackeries, tanneries, dairy/animal farms, saleyards, or farmland located near residential communities, with workers having the highest risk of being exposed. The guidelines reference three thresholds where referrals for works approval is required to consider Q-Fever risk; these include the following:

- ▶ Animal industries, if greater than 5,000 animals
- ▶ Livestock saleyards or holding pens
- ▶ Abattoirs.

In contrast to the Project, each of these threshold activities represent a static and high-risk source of *C. burnetii* bacteria. The EPA Victoria guideline also states that risk groups are workers at high-risk workplaces (abattoirs, farmland), and that risks to the public are higher when the following factors increase:

- ▶ Size of facility and number of animals involved
- ▶ Birthing activity at a site such as intensive dairy farming
- ▶ Type of livestock; goats and sheep may be a higher risk than cattle (Clark and Magalhaes, 2018)
- ▶ Proximity to sensitive land uses and unvaccinated individuals
- ▶ Wind speed and direction
- ▶ Local topography, rainfall, vegetation cover that may contribute to the overall 'dustiness' of an area.

The Project represents a transient, intermittent and infrequent potential source of *C. burnetii* bacteria, and does not include high-risk factors such as birthing activity or the transport of goats or sheep.

It is noted that as part of the assessment of Q-Fever risk, Queensland Health was consulted. Queensland Health advised that the risk of Q-Fever infection from livestock trains would be 'broadly similar to a road train transporting cattle' (Flynn, 2021).

Overall, based on the guidance provided in the EPA Victoria guideline, the transport of livestock along the Inland Rail Program alignment is considered to present a low-level risk for Q-Fever.

12.6 Mitigation measures

This section outlines the air quality mitigation measures that have been identified and incorporated into the revised reference design for the Project (Section 12.6.1), in addition to those that will be implemented through future stages of the Project (Section 12.6.2).

No comprehensive guideline information is currently available for best-practice environmental management measures for the emissions of air pollutants from construction-related emissions in Queensland or Australia. Guidance on management measures is provided within the UK IAQM *Guideline for the assessment of dust from demolition and construction* (2014). The proposed mitigation measures for the Project align with the suggested mitigation measures from the UK IAQM guideline document.

In addition to the UK IAQM guideline document, the mitigation measures proposed for the construction works stage of the Project are also generally consistent with construction mitigation measures prescribed by the New Zealand Ministry for the Environment *Good Practice Guide for Assessing and Managing Dust* (New Zealand Ministry for the Environment, 2016) and the NSW EPA *Air quality guidance note for construction sites* (NSW EPA, 2017), which are both recognised technical guideline documents.

Mitigation measures prescribed in the *NPI Emission Estimation Technique Manual for Mining* (Department of Sustainability, Environment, Water, Population and Communities, 2012b) are also considered applicable for the construction works stage, and selected mitigation measures from this document are proposed.

The mitigation measures that are identified are considered to represent best-practice environmental management of air emissions.

12.6.1 Mitigation through the reference design

Development of the revised reference design for the Project has progressed in parallel with the impact assessment process; therefore, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the revised reference design as appropriate and where possible. The mitigation measures and controls are summarised in Table 12-35.

TABLE 12-35 MITIGATION MEASURES IN REFERENCE DESIGN

Aspect	Initial mitigation measures
Emissions from refuelling activities during construction	▶ The planning, siting and assessment of potential fuel storage locations has taken into consideration the location of sensitive receptors to avoid potentially impacting sensitive receptors as far as practical.
Emissions from construction vehicles	▶ The horizontal and vertical alignment has been established to optimise the earthworks required and achieve as close to a net-balance as is possible. By minimising the material deficit for construction of the Project, the volume of material required to be imported has been reduced. Less imported material equates to fewer construction works stage truck movements and less vehicular emissions ▶ construction works stage haulage routes that provide the shortest journey time between origin and destination have been identified. These routes restrict fuel consumption and vehicular emissions. These routes have been assessed as part of the traffic impact assessment (Chapter 20: Traffic, Transport and Access).
Fugitive dust emissions (windborne erosion) during construction and operation	▶ Planning of the Project has aimed to minimise clearing extents to that required to safely and efficiently construct and operate the rail corridor ▶ Laydown areas and other construction works stage facilities have been located to avoid impacts to environmental and social receptors ▶ Railway batters and other exposed surfaces have been designed to enable stabilisation to reduce fugitive dust emissions.
Emissions from operational locomotives	▶ The Project has been co-located within existing transport corridors as much as possible, including being positioned within the existing South Western Line and Millmerran Branch Line rail corridors, to avoid introducing a new linear infrastructure corridor in proximity to receptors potentially sensitive to air emissions ▶ The Project has been aligned to avoid, where possible, steep terrain and topographical constraints to provide for more efficient operational track geometry and grade. This results in faster train transit time and less locomotive emissions.
Emissions from idling locomotives	▶ Crossing loops at Yelarbon, Inglewood, Kooroongarra, Yandilla and Broxburn have been positioned to avoid, where possible, the exposure of sensitive receptors to diesel emissions from idling trains.

12.6.2 Operations considerations

During operations, ARTC will be responsible for the management of access to the Inland Rail network by third-party freight train operators and maintenance of the railway and other infrastructure components within the rail corridor.

Dust and air quality management measures will be incorporated into the environmental risk management frameworks that will apply to third-party freight train operators as part of network access agreements. The Project network access agreements established with ARTC as the rail network manager will require train operators to prepare suitably detailed environmental management plans for their operations to detail how the operator will manage all foreseeable risks. These plans will include clear performance requirements and traceable corrective measures and be subject to verification and auditing by the rail network manager.

ARTC presently have no foreseeable market-driven demand for coal to be transported on the Inland Rail network between NSW/QLD border to Gowrie; however, should this change during operations in the future, the potential for coal dust generation would require management through the implementation of a Coal Dust Management Plan by the rail user.

Should coal be planned to be transported as part of future operations, prior to transportation of coal, engagement would be undertaken with stakeholders and members of the South West Supply Chain regarding coal dust management and monitoring requirements necessary to maintain the integrity of the existing *South West Supply Chain Coal Dust Management Plan* (CDMP) (South West Supply Chain, 2019).

Such commitments that already exist in the South West Supply Chain CDMP (2019) among varying stakeholders in the coal supply chain include but are not limited to:

- ▶ Providing support and/or funding to air quality monitoring programs
- ▶ Speed restrictions in high-risk areas
- ▶ Coal washing prior to entry on to the network
- ▶ Covered in-load dump stations and enclosed conveyors
- ▶ Video and LIDAR technology to monitor levels of residual coal remaining in wagons
- ▶ Use of water fogging sprays at the rail receipt hoppers
- ▶ Monitoring of sills of wagons prior to return journey along the supply route
- ▶ Dust monitoring at the port and along the supply route.

ARTC believes that the combination of all of these activities as well as others listed in the South West Supply Chain CDMP (2019) are adequate to reduce the exposure to airborne particulates. Should monitoring, further risk assessment or otherwise suggest the risk to exposure has increased along the alignment, ARTC will investigate other practical mitigation measures with the responsible rail user.

12.6.3 Proposed mitigation measures

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

Table 12-36 identifies the relevant Project stage, the aspect to be managed and the proposed mitigation measure. For this purpose, proposed mitigation measures of relevance to pre-construction and early works, and construction works stage activities have been combined. For several of the mitigation measures proposed, the expected control efficiency (emission reduction percentage) has been nominated. The control efficiencies reported have been obtained from the NPI *Emission Estimation Technique Manual for Mining* (Department of Sustainability, Environment, Water, Population and Communities, 2012b).

The mitigation measures presented in Table 12-36 have then been factored into the assessment of residual significance, as documented in Table 12-37.

Chapter 24: Draft Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures.

Requirements for construction water for dust suppression have been evaluated as part of the constructability assessment undertaken for the Project. Water demand for the construction of the Project has been estimated allowing for water application for dust suppression for:

- ▶ Material conditioning (pre-wetting)
- ▶ General dust suppression across the construction footprint
- ▶ Haul road and laydown area maintenance
- ▶ Concrete batching
- ▶ Trackwork (ballast laying, tamping and regulating).

Based on the forecast construction schedule and the adopted water allowances, expected water demand along the alignment and over time has been estimated to assist in understanding and planning for the demand for construction water.

Several construction water sources have been identified as part of constructability assessments. Sources of construction water will be finalised as the construction approach and schedule is refined during the detailed design stage of the Project, and will be dependent on:

- ▶ Climatic conditions in the lead up to construction
- ▶ Confirmation of private water sources made available to the Project by landowners under private agreement
- ▶ Access agreements with local governments.

There are a number of mitigation measures presented in Table 12-36 that can be employed in adverse conditions, for example, during dry periods or unfavourable wind conditions. The mitigation measures which could be employed under adverse conditions include but are not limited to:

- ▶ Dry conditions:
 - ▶ increase the application of water to stockpiles, unsealed haul roads and exposed areas where there is significant risk of wind erosion and fugitive dust emissions. If required, apply temporary ground-stabilising treatments
 - ▶ if water application is not practical, cover exposed areas with an impermeable covering (i.e. tarpaulin)
 - ▶ avoid or reduce the intensity of high magnitude dust-generating activities, such as blasting and ground-disturbing activities including excavation and vegetation clearing
 - ▶ move the active works location to an area that has significant separation distance to sensitive receptors and where the risk of dust impact is lower.
- ▶ Strong or adverse wind conditions (wind direction blowing from source to nearby sensitive receptor):
 - ▶ avoid or reduce the intensity of works in areas that are upwind of the nearest sensitive receptor
 - ▶ move the active works location to an area that is not upwind of the nearest sensitive receptor, or is benefitted by wind breaks (either natural or Project related)
 - ▶ increase the application of water to stockpiles and unsealed road sections located upwind of the nearest sensitive receptor; if required, apply temporary ground-stabilising treatments
 - ▶ avoid ground-disturbing activities including excavation and vegetation clearing.

TABLE 12-36 PROPOSED AIR QUALITY MITIGATION MEASURES

Delivery stage	Aspect	Mitigation and management measures
Detailed design	Potential impacts to sensitive receptors and special areas	▶ Assessment of the potential for air quality and odour impacts to the intrinsic value of Indigenous Heritage sites will be undertaken during detailed design. If the assessment determines the potential for significant impact, mitigation and management measures would be recommended to reduce the likelihood of and potential for significant impacts to occur ▶ Quantitative assessment of potential dust impacts from planned major construction works areas in proximity to sensitive receptors will be completed during detailed design when more detailed construction information is available, which will inform the Air Quality and Dust Management Plan. The assessment will include the following: ▶ an estimate of predicted construction emissions, with a focus on major earthworks, as earthworks activities typically generate the highest quantities of dust; the assessment will be limited to activities occurring along the rail alignment ▶ a focus on anticipated construction work required near Yelarbon (Ch 25 km), Brookstead (Ch 154 km) and Pittsworth (Ch 173 km), which are the most populated locations adjacent to the alignment ▶ activity rates based on the expected average earthworks intensity, as dust deposition has a monthly average criterion. ▶ Design of fuel storage areas will ensure that fuel tanks will be located at least 50 m from the nearest sensitive receptor, with separation distances maximised as far as practical within site restrictions.
	Availability of water for dust suppression and stabilisation during construction	▶ During the detailed design stage, quantities of water required for dust suppression, construction, landscaping and stabilisation activities will be confirmed. The availability and suitability of water supply sources will be determined and where water supply is deemed insufficient or in high demand for other uses, other dust suppression and stabilisation methods will be implemented. These alternative methods may include: ▶ chemical dust suppressants ▶ covering stockpiles ▶ construction of wind breaks.
	Emissions from construction vehicles	▶ Confirm haulage routes and access roads during detailed design based on the shortest and safest trafficable route for each vehicle type, in consultation with relevant road managers, to minimise vehicular emissions ▶ Planning of access and haulage routes will seek to maximise the use of sealed trafficable surfaces, where appropriate, and to locate access and haulage routes away from sensitive receptors ▶ Additional geotechnical data, collected during the detailed design stage, will be used to refine the earthworks balance for the Project by providing further confirmation on the expected quantities of suitable and unsuitable materials. The objective of refinement will be to further minimise the risk of material deficit for construction of the Project, thereby reducing the number of vehicular movements as part of the mass haul task ▶ Opportunities to treat and re-use otherwise unsuitable materials will be identified and assessed during detailed design for applicability with the objective of minimising vehicular movements, and emissions, for offsite disposal ▶ Opportunities for the use of ethanol blend fuels for use in construction will be investigated during detailed design. These opportunities will be adopted if found through investigation to be beneficial and if it is practical to do so.
	Fugitive dust emissions (windborne erosion) during construction and operation	▶ Baseline dust deposition data will be acquired in proximity to Commodore Mine (e.g. from Ch 120.0 km to Ch 128.0 km). This baseline data will enable comparison with dust deposition data obtained during construction of the Project. Dust deposition monitoring will be completed at a small number of locations (< 5) adjacent to the Commodore Mine and nearby sensitive receptor locations. Monitoring will occur for a period of at least three months and will aim to collect data representative of dust-generating activities that occur at the mine to provide baseline data on the existing air environment. This data will provide an indication of the impact on the local air quality from the nearby Commodore Mine and Millmerran Power Station. Dust deposition monitoring will be conducted in accordance with <i>AS/NZ 3580.10.1:2016 – Method 10.1: Determination of particulate matter - Deposited matter - Gravimetric method</i> (Standards Australia and Standards New Zealand, 2016a).

Delivery stage	Aspect	Mitigation and management measures
		▶ Development of an Air Quality and Dust Management Plan as a component of the CEMP during detailed design. The Plan will include the following minimum requirements: ▶ minimise major dust-generating activities, (e.g. blasting or material loading/unloading during high wind speeds where practicable, spoil haulage including covering of loads when traversing roads to minimise and where possible avoid loss of loaded materials, rock debris and dust) ▶ routing roads away from sensitive areas, wherever practically possible, such as: – residential dwellings and caravan parks – motels/hotels – schools and kindergartens – medical centres – public parks and recreation areas ▶ restricting vehicle speeds on unsealed haul roads to reduce dust generation, (e.g. to sign-posted speeds) on public roads or to construction site speed limits on construction tracks (nominally 40 km/hr)—to be determined during detailed design through consultation with the relevant local government and documented in the Traffic Management Plan as a component of the CEMP which will potentially include: – further speed restrictions on construction tracks (e.g. from 40 km/hr to 20 km/hr) where the trafficable surface is within 200 m of a sensitive receptor ▶ long-term stockpiled material will be covered or seeded to prevent wind erosion from the prevailing wind ▶ regular cleaning of machinery and vehicle tyres to prevent track-out of dust onto public roads ▶ installation of rumble grids or similar at locations where construction traffic departs from the construction site and joins the public road network ▶ internal construction roads will be appropriately surfaced as soon as possible after the commencement of site activities ▶ revegetating disturbed areas as soon as practicable, in accordance with the Rehabilitation and Landscaping Management Plan ▶ vehicles and equipment will be appropriately maintained to maximise fuel efficiency ▶ visual monitoring of the effectiveness of dust controls will occur daily. ▶ Define and design temporary access tracks to minimise dust generation, (e.g. appropriate surface treatments for the predicted construction traffic movements), installation of rumble grids, concrete pads or other physical measures to reduce track-out ▶ Designated proposed stockpile locations within the Project corridor during the detailed design stage to identify location specific controls if required.
	Carbon emissions reporting requirements	▶ Emissions reporting requirements for the construction works will be confirmed during the detailed design stage and will respond to National Greenhouse and Energy Reporting requirements.
	Emissions from operational locomotives	▶ The vertical alignment of the rail will be subject to refinement and confirmation during detailed design. Opportunities to further optimise the track geometry will be assessed to reduce operational fuel consumption
	Emissions from idling locomotives	▶ Detailed design of the railway corridor will be developed to minimise impacts to sensitive receptors from emissions from idling locomotives, through consideration of topography, gradients, landscaping treatments and other surface treatments where practical ▶ The confirmation of the location of the five crossing loops for the Project will seek to minimise the number of receptors in proximity to each loop.

Delivery stage	Aspect	Mitigation and management measures
Pre-construction and early works, and construction works ¹	Impacts to sensitive receptors	▶ If onsite wastewater treatment systems are required for non-resident workforce accommodation facilities, these systems will be planned and positioned in accordance with separation distances consistent with the EPA Victoria guideline <i>Recommended separation distances for industrial residual air emissions</i> (Victorian EPA, 2013) and operated and maintained in accordance with conditions of approval (sought separately to approval sought through the revised draft EIS). Based on the anticipated requirement for a treatment system with a capacity of 300 EP, and assuming that a mechanical or biological wastewater treatment system will be used, a minimum separation distance of 67 m to sensitive receptors will be provided ▶ Laydown areas and other construction facilities (e.g. concrete batching plant, flash-butt welding facility, stockpiles) will be planned so that sources of emissions, such as temporary fuel tanks, generator sets, stockpiles, travel routes, are positioned as far as possible from neighbouring sensitive receptors, within the confines of the temporary footprint and considering prevailing wind directions ▶ The placement of workforce accommodation facilities to consider nearby Project-related emissions sources (e.g. fuel tank storage, concrete batching plant, locomotive emissions from non-Project existing rail), fugitive emissions from construction, and considering the prevailing wind directions.
	Dust generation from earthworks, clearing and grubbing, construction activities, concrete batching and exposed areas within the temporary footprint	▶ Limit clearing to the extent required to construct the works, in accordance with the Project footprint as defined during detailed design ▶ Stage clearing and grubbing activities to limit the size and duration of exposed areas ▶ Controls will be implemented to prevent or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast: ▶ use of water sprays or water carts for dust suppression as required (anticipated emission reduction of 50 per cent for water sprays when loading to or from material stockpiles, anticipated emission reduction of 70 per cent when water sprays applied to trucks unloading material) ▶ installation of hoardings or barriers on worksite perimeters, where appropriate ▶ polymer sealing of access roads, or similar, where practicable within the construction worksites and ensuring sealed access roads into worksites are kept relatively dust free by regular sweeping and washing, wherever needed (significant emissions reduction can be achieved by polymer sealing subject to the method adopted, emission reduction of up to 100 per cent is claimed in technical literature but performance to this level is unrealistic in real-world application) ▶ conducting demolition activities will use appropriate dust controls, such as water sprays ▶ install truck wheel wash stations in designated laydown areas, to control the spread of unsuitable materials from worksites ▶ concrete batching plant will employ appropriate dust controls, such as water sprays, covering exposed areas as much as practical, and designing the orientation of the batching plant to limit the potential for impacts to the nearest sensitive receptors. The installation of fabric filters to cement silos would also significantly reduce fugitive dust emissions. A minimum separation distance of 100 m to the boundary of sensitive receptors for concrete batching plants will be provided. ▶ Implement the Air Quality and Dust Management Plan, as a component of the CEMP with respect to spoil haulage, including covering of loads when traversing roads to minimise and, where possible, avoid loss of loaded materials, rock debris and dust ▶ Water used in dust suppression will be consistent with the quality requirements specified for irrigation and general water use in the <i>Australian and New Zealand Guidelines for Fresh and Marine Water Quality</i> (Australian and New Zealand Governments, 2018). Suitable additives to the water will be investigated to improve dust suppression effectiveness and minimise water usage. Adopt the use of additives where appropriate and compliant with relevant approvals and legislation (i.e. the addition of soil binders to water for dust suppression on roads or hard stand areas).

Delivery stage	Aspect	Mitigation and management measures
		▶ Disturbed areas and exposed surfaces will be stabilised as soon as practical following the completion of works in each area, in accordance with the Rehabilitation and Landscaping Management Plan. The following mitigation methods will be used, subject to final purpose of the exposed area: ▶ initial establishment of vegetation (anticipated emission reduction of 30 per cent) ▶ maintained revegetation (anticipated emission reduction of 90 per cent) ▶ establishment of self-sustaining rehabilitation vegetation (anticipated emission reduction of 100 per cent) ▶ sealing of exposed surface (i.e. concrete, asphalt) (anticipated emission reduction of 100 per cent). ▶ Long-term stockpiles will be avoided wherever possible; however, where necessary (e.g. topsoil), long-term stockpiles will be established in designated locations. Stockpiles will be positioned to minimise erosion by the prevailing wind ▶ Stabilise and protect long-term stockpiles from erosive processes while not in use, such as through impermeable cover or seeding ▶ To reduce wind erosion from stockpiles, the following mitigation methods will be used, subject to water availability and stockpile activity: ▶ water sprays (anticipated emission reduction of 50 per cent) ▶ wind breaks or earthworks profiling (anticipated emission reduction of 30 per cent) ▶ application of rock armour/covering (anticipation emission reduction of 30 per cent) ▶ covering of the stockpile with an impermeable covering (i.e. tarpaulin) or binding agent (anticipated emission reduction of 100 per cent). If water sprays are implemented for stockpiles, the application rate of water will be increased for stockpiles that will receive new material regularly. ▶ Dust emissions from blasting will be managed through avoiding blasting during adverse wind conditions. Blasting will not be undertaken if the prevailing wind direction and size of the blast is likely to transport dust emissions towards sensitive receptors within 500 m of the blast location. Blasting during periods of high wind speeds (>36 km/hr) will be avoided where practical as per the CEMP. To determine potential for impact at sensitive receptors, risk assessments will be undertaken prior to blasting events ▶ Direct exposure of construction workers to respirable silica and other airborne contaminants will be controlled through the use of appropriate personal protective equipment (PPE) in line with ARTC's procedure <i>Personal Protective Equipment</i> (WHS-PR-009) (ARTC, 2022b) (available on the ARTC extranet) ▶ Construction speed limits will apply to all unsealed routes used by construction vehicles. Applicable speed limits for local government roads will be determined through consultation with the relevant local government and documented in the Project Traffic Management Plan within the CEMP ▶ Minimise the requirement for vehicle movement outside worked areas, where practically possible ▶ Landowners will be notified in advance of the commencement of construction activities in an area proximal to them. This notification will be in accordance with community notification procedures established for the Project and will provide information on the types of activities that will occur, indicative scheduling and the potential impacts that may be experienced (e.g. generation of dust) ▶ Detail the Project's air quality complaints procedure: ▶ a complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust or other air emissions during construction ▶ in the event of a dust complaint, ARTC will: – in the first instance, investigate the cause of the complaint and confirm details of the complaint with respect to the nature and severity of impact – determine appropriate remedial action, where appropriate – liaise with complainant over remedial action, liaise with administering authority if required – implement appropriate remedial action, if required. ▶ maintain a complaints register relating to air quality, including record of remedial actions.

Delivery stage	Aspect	Mitigation and management measures
	Dust generation and deposition as a result of adverse weather conditions	▶ Avoid ground-disturbing activities during sustained windy conditions (i.e. winds >36 km/hr over a period of 10 minutes or more, where appropriate). When this is not practical, implement additional management measures, such as enhanced watering of access roads (anticipated emission reduction of 50 to 75 per cent) and works areas to minimise the potential increase in dust ▶ Monitor meteorological conditions at worksites, particularly wind speed and direction. Implement additional dust suppression controls prior to the onset of adverse weather, including additional watering of access roads (anticipated emission reduction of 50 to 75 per cent) ▶ Maintain and improve (if necessary) weather monitoring protocols to enable dust suppression activities to occur prior to the onset of adverse weather ▶ Increase application of water to stockpiles and access roads where necessary during extended dry conditions.
	Cumulative effects of dust emissions from construction and external land uses or activities	▶ Undertake dust deposition monitoring during the active period of construction in proximity to Commodore Mine, at locations where baseline data was collected (above), to determine if construction results in significant dust impacts. Dust deposition monitoring to be in accordance with AS/NZ 3580.10.1:2016 – <i>Method 10.1: Determination of particulate matter – Deposited matter – Gravimetric method</i> (Standards Australia and Standards New Zealand, 2016a). The results of construction dust deposition monitoring will be included in construction environmental reporting ▶ Advise the operators of the Commodore Mine of proposed construction activities scheduled to occur in proximity to the mine to enable coordinated consultation with potentially impacted stakeholders.
	Emissions from combustion engines (construction vehicles and generators)	▶ Avoid queuing of the construction traffic vehicle fleet on public roads, which, in turn, would minimise the amount of exhaust emissions generated during construction works ▶ Marshalling and queuing of trucks and worksite vehicles will occur away from residential areas and other sensitive receptors, where possible ▶ Direct exhaust emissions from mobile and stationary plant away from the ground and sensitive receptors, where possible ▶ When locating temporary fuel storage, will provide a minimum separation distance of 50 m from sensitive receptors and compliance with AS 1940:2017 <i>The storage and handling of flammable and combustible liquids</i> (Standards Australia, 2017a). This is of particular relevance where laydown facilities are in proximity to sensitive receptors, (e.g. B2G-LDN006.3 on Yelarbon-Kurumbul Road) ▶ Minimise the use and intensity of use of diesel-powered engines and vehicles, as much as practicable ▶ For stationary plant and equipment, will ensure all diesel motors are fitted with emission control measures and are regularly maintained to manufacturer's specifications ▶ Turn off idling plant, equipment and vehicles when not in use ▶ Minimise haul distances between construction sites to spoil sites ▶ Implement a regular maintenance program to ensure equipment and construction fleet are maintained to manufacturer's specifications ▶ Use appropriately sized equipment for construction activities ▶ Procure energy efficient construction equipment, when appropriate and subject to availability ▶ Minimise waste from construction by procuring pre-fabricated products, where possible ▶ Where possible, will use low energy intensity materials instead of high energy intensity building materials ▶ Implement a regular maintenance program so that equipment and construction fleet are maintained to manufacturer's specifications.
	Use of non-potable water for dust suppression	▶ Water used in dust suppression will be of suitable quality and not result in environmental or human health risks, or impact rehabilitation outcomes. Water additives used to improve dust suppression effectiveness (e.g. the addition of soil binders to water for dust suppression on roads or hard stand areas) will be risk assessed prior to adoption.

Delivery stage	Aspect	Mitigation and management measures
	Fugitive dust emissions from vehicles transporting materials to and from site	▶ During construction, additional monitoring for dust and other pollutants will be maintained in key locations adjacent to sensitive and susceptible urban and semi-urban locations, including Yelarbon, Brookstead and Pittsworth. Detailed monitoring plans will be developed in conjunction with construction planning and informed by water availability studies ▶ Vehicles transporting material to and from the works site on public roads will cover loads to minimise the potential for wind-blown dust emissions and spillages ▶ Implement road sweeping and washing of public road sections where earthen material has been deposited by construction vehicles to minimise dust generation. The need for sweeping and washing will be identified via visual observation ▶ Visually inspect vehicles entering/exiting the site and implement additional controls if corrective actions are required ▶ Install and maintain rumble grids, or similar, at the entry and exit points of laydown areas ▶ If required, ensure use of lime in construction does not create lime dust nuisance by way of targeted mitigation. Dust mitigation will be implemented by storage of lime in enclosed containers when not in use, not applying in windy conditions, and controlled application near sensitive receptors. ▶ Site based construction traffic will be limited to identified haul routes as per the Traffic Management Plan as a component of the CEMP.
	Greenhouse gas emissions	▶ Maintain construction equipment and vehicles to ensure engine efficiency and minimise fuel use and resulting emissions ▶ Procure energy efficient construction equipment, when appropriate and subject to availability ▶ Minimise waste from construction by procuring pre-fabricated products, where possible ▶ Where possible, will use low energy intensity materials instead of high energy intensity building materials ▶ Reduce third party (Scope 3) emissions by sourcing imported materials from local areas, minimising travel distances ▶ Reduce travel distances and fuel consumption onsite by planning construction haul roads and staging of related activities efficiently ▶ Minimise as much as possible the idling time of plant and equipment, and switch engines off when not in use ▶ Minimise the extent of vegetation cleared during construction to the clearing limits required ▶ Recycle any waste produced where feasible.
Operations	Operation of and emissions from freight trains along the alignment	▶ Before a train travels on the Inland Rail network, operators will make sure that the classes of dangerous goods, and the identification numbers of vehicles carrying dangerous goods, are recorded in the train consist documentation. Dangerous goods will be loaded, labelled, and marshalled in accordance with the <i>Australian Code for the Transport of Dangerous Goods by Road & Rail</i> (National Transport Commission, 2024) ▶ If coal is to be transported in future operation years, the potential for coal dust generation will require management via a CDMP by the rail user and source of coal. The measures included in the CDMP will aim to minimise surface lift-off of materials in transit and establish protocols to minimise spillage onto external areas of wagons. ▶ If coal is to be transported as part of future operations, prior to transportation of coal, engagement would be undertaken with existing stakeholders and members of the South West Supply Chain regarding coal dust management and monitoring requirements necessary to maintain the integrity of the existing South West Supply Chain CDMP (2019) and maintain compliance with the air quality objectives as prescribed in the EPP (Air).
	Emissions from combustion engines (maintenance vehicles and generators)	▶ Maintenance plant, vehicles and machinery will be maintained and operated in accordance with the manufacturer's recommendations to maximise fuel efficiency ▶ Minimise unnecessary travel between maintenance locations ▶ Turn off idling plant, equipment and vehicles when not in use.

Delivery stage	Aspect	Mitigation and management measures
	Stakeholder communication	▶ Landowners will be notified in advance of the commencement of maintenance activities in an area proximal to them. This notification will be in accordance with community notification procedures established for the Project and will provide information on the types of activities that will occur, indicative scheduling and the potential impacts that may be experienced (e.g. generation of dust) ▶ A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust during operation and maintenance ▶ In the event of a complaint regarding air quality, ARTC will: ▶ in the first instance, investigate cause of the complaint and confirm details of the complaint with respect to the nature and severity of impact ▶ determine remedial action, where appropriate ▶ liaise with complainant over remedial action, liaise with administering authority if required ▶ implement appropriate remedial action, if required. ▶ Maintain a complaints register relating to air quality, including remedial actions ▶ Monitor, record and audit complaints about dust and emissions in accordance with the relevant complaints management handling procedures.
	Fugitive dust emissions from vehicles transporting materials to and from site (e.g. for maintenance)	▶ Awareness of operational personnel of the sensitivities with regard to elevated dust levels within and adjacent to the Project footprint ▶ Vehicles transporting material to and from the maintenance works site on public roads will cover loads to prevent wind-blown dust emissions and spillages ▶ Implement road sweeping and washing of public road sections where earthen material has been deposited by maintenance vehicles to minimise dust generation. The need for sweeping and washing will be identified via visual observation ▶ Visually inspect vehicles entering/exiting the permanent footprint and implement additional controls if corrective actions are required ▶ During adverse wind conditions or extended dry conditions, visual inspection of stockpiles will be conducted and mitigation procedures implemented if required, such as increased watering.
	Greenhouse gas emissions	▶ Investigate opportunities for reducing fuel consumption, e.g. through the use of electric vehicles ▶ Maintain support vehicles and equipment to increase engine efficiency and minimise fuel use and resulting emissions ▶ Plan and stage maintenance activities considering efficiency and fuel consumption ▶ Investigate opportunities to reduce greenhouse emissions through the use of renewable energy ▶ Regular auditing of operational performance with a view to progressively improving efficiency and reducing emissions through reduced fuel consumptions (e.g. reduced train idling time at crossing loops) ▶ Periodic energy audits with a view to progressively improving energy efficiency ▶ Monitor, audit and report on greenhouse gas emissions from relevant significant activities and emission sources, and the success of abatement measures ▶ Develop a process for regularly reviewing new technologies to identify opportunities to further reduce emissions and energy use, consistent with best-practice environmental management.

Table note: 1. Combined, as there is no distinction between mitigation measures applicable for the pre-construction and early works and construction works stages of the Project

12.7 Monitoring

This section discusses the monitoring that has been undertaken for the Project (Section 12.7.1), and monitoring that is proposed as part of the construction works (Section 12.7.2) and operations (Section 12.7.3) stages of the Project.

Prior to the start of construction, an Air Quality and Dust Management Plan will be developed as a component of the CEMP.

The Plan will be informed by a quantitative dispersion modelling assessment of potential construction dust impacts from major construction works areas. This quantitative assessment will be completed prior to construction when more detailed construction information is available. The scope of the assessment will be focused as follows:

- ▶ The focus of the assessment will be airborne particulates, PM₁₀, PM_{2.5} and deposited dust (derived from TSP)
- ▶ The focus of the modelling will be major earthworks, as earthworks activities typically generate the highest quantities of dust
- ▶ The assessment will focus on construction work required near Yelarbon (Ch 25 km), Brookstead (Ch 154 km) and Pittsworth (Ch 173 km), which are the most populated locations adjacent to the alignment
- ▶ Dust deposition monitoring will be undertaken at three locations as part of the assessment. This will be in Yelarbon, Brookstead and Pittsworth
- ▶ Emission sources considered will be limited to those along the alignment. For example, haul vehicles would be assumed to be travelling along the alignment (e.g. up and back), and individual haul routes away from the alignment (e.g. to quarries) would not be considered
- ▶ The focus of the assessment will be pollutants with 24-hour (PM₁₀ and PM_{2.5}) and monthly average (dust deposition) goals. It is expected that activity rates will be based on the expected average earthworks intensity (average determined by dividing quantity of earthworks by the length of program in working days) rather than maximum activity rates, as it is uncertain if realistic maximum activity information will be available
- ▶ Annual average predictions are not proposed as there will be significantly greater uncertainty in long-term predictions due to the transitional nature of construction
- ▶ Models will be prepared for Yelarbon, Brookstead and Pittsworth, with two scenarios of these models investigated for each location: an unmitigated scenario and a mitigated scenario (six scenarios in total) considering the likely mitigation measures to be employed based on those presented in Section 12.6.3.

The outcomes of the quantitative assessment will be used to inform the implementation of mitigation measures and the deployment of dust monitoring during the construction works stage.

The Plan will include requirements for air quality monitoring, including for dust deposition monitoring, real-time dust monitoring, reporting and the complaints and resolution process. It will also describe the corrective actions and additional mitigations that may be undertaken in response to an exceedance or complaint. ARTC will seek input from Toowoomba Regional Council and Goondiwindi Regional Council during the drafting of the Plan regarding the process of establishing AQMSs and the auditing of complaints related to air quality.

12.7.1 Existing particulate matter monitoring

As discussed in Section 12.4.2, an air quality monitoring program was conducted for the Project consisting of the Inland Rail AQMS and Millmerran AQMS, which both monitor PM₁₀ and PM_{2.5}. These monitoring stations were established near the alignment to assist the AQIA and provide monitoring data to understand air quality in the AQIA area.

The monitoring data obtained by the Inland Rail AQMS and Millmerran AQMS has been used in this AQIA. The monitoring data obtained by the Millmerran AQMS has been used to understand air quality in the area local to the Commodore Mine and Millmerran Power Station and guide the assessment of these existing emission sources, as discussed in Section 12.4.3. The monitoring data from the Inland Rail AQMS has been adopted as background for the assessment of cumulative impacts (Section 12.4.2).

Monitoring data from Inland Rail AQMS and Millmerran AQMS will be used in the quantitative assessment of construction dust impacts to determine baseline concentrations (which would be added to predicted Project construction activity contributions to allow for cumulative assessment). Monitoring data from the Inland Rail AQMS and Millmerran AQMS may also be used to estimate the contribution of the Project in the event that airborne particulate monitoring is undertaken during the construction works stage (i.e. in response to a complaint).

12.7.2 Construction works monitoring

12.7.2.1 Weather conditions monitoring

To aid in the avoidance of dust generation during adverse weather conditions, weather forecasts and observations for adverse weather (e.g. winds greater than 36 km/h) will be monitored during the construction works stage of the Project.

During adverse weather conditions, enhanced management measures, such as increased water application and/or implementation of temporary stabilisation treatments will be implemented. When these measures are ineffective, and where practical to do so, ground-disturbing activities including excavation and vegetation clearing will be avoided during adverse wind conditions to limit the potential for significant dust generation and impacts offsite.

To assist with auditing and the analysis of air quality monitoring and complaints (if received), periods of adverse weather periods will be recorded in monthly environmental reports. Weather monitoring stations may be deployed along the alignment to assist in providing information on weather conditions.

12.7.2.2 Baseline dust deposition monitoring

Baseline dust deposition monitoring will be conducted prior to the commencement of construction. Baseline monitoring will be undertaken at Yelarbon, Brookstead, Pittsworth and in proximity to the Commodore Mine. This baseline data will enable comparison with dust deposition data obtained during construction of the Project.

Baseline monitoring is proposed for the area near Commodore Mine as this area has a higher potential for dust impacts due to the presence of an existing dust source (the mine). Baseline dust deposition monitoring data obtained will only be applicable to the area near the mine for the purpose of evaluating construction dust impacts and will not be applied across the alignment.

Dust deposition monitoring will be completed at a small number of locations (less than five) adjacent to the Commodore Mine and nearby sensitive receptor locations. The exact locations of the monitoring will be determined following review of land access requirements. Monitoring will occur for a period of at least three months and will aim to collect data representative of dust-generating activities that occur at the mine, such as blasting, to provide baseline data on the existing air environment. This data will provide indication of existing (baseline) dust deposition at locations that may be impacted by the Commodore Mine and Millmerran Power Station.

Baseline dust deposition monitoring undertaken at Yelarbon, Brookstead and Pittsworth will be undertaken at a single location for each town as part of the quantitative dust modelling assessment discussed in Section 12.7.2.3. The dust monitoring at these locations will be undertaken for a period of at least one month. The results of the monitoring will be referred to when evaluating predicted dust deposition levels from quantitative modelling.

Dust deposition monitoring will be conducted in accordance with *AS/NZ 3580.10.1:2016 – Method 10.1: Determination of particulate matter - Deposited matter - Gravimetric method* (Standards Australia and Standards New Zealand, 2016a).

12.7.2.3 Construction works monitoring

Monitoring near Commodore Mine

Dust deposition monitoring will continue to be conducted during the active period of construction in proximity to the Commodore Mine, at locations where baseline data was collected (refer above), to determine if construction activity is resulting in significant dust impacts. Dust deposition monitoring will be undertaken in accordance with *AS/NZ 3580.10.1:2016 – Method 10.1: Determination of particulate matter - Deposited matter - Gravimetric method* (Standards Australia and Standards New Zealand, 2016a). The results of construction works stage dust deposition monitoring will be included in construction environmental reporting, as specified in Chapter 24: Draft Outline Environmental Management Plan.

Monitoring near urban and semi-urban areas

In addition to air quality monitoring near the Commodore Mine, dust deposition monitoring will also be undertaken in urban and semi-urban areas including, but not limited to, the areas of Inglewood, Yelarbon, Pittsworth, Brookstead, Pampas and Gowrie Mountain. These more urban areas are of higher sensitivity for air quality impacts due to the increased density of sensitive receptors located near construction activity areas and associated dust emission sources. The monitoring locations used for the baseline monitoring (Section 12.7.2.2) will be maintained if land access agreements allow. Where new locations are required, the locations for monitoring in urban and semi-urban areas will be determined after detailed design has commenced.

Further assessment of potential dust deposition at sensitive receptors from construction activity will be completed in future stages (prior to construction) when more detailed construction information is available, as discussed in Table 12-36. The outcomes of this further assessment will be used to guide requirements for the locations of dust deposition monitoring in urban and semi-urban areas. For example, where quantitative assessment determines that construction activity in an area has the potential to exceed the Project's dust deposition goal (120 mg/m²/day—insoluble solids, monthly average), dust deposition monitoring will be undertaken at sensitive receptors near this activity area. Where multiple receptors are present at different orientations from the construction area, multiple dust deposition gauges will be deployed.

The Air Quality and Dust Management Plan will include requirements for air quality monitoring, including for dust deposition.

In the event that dust deposition monitoring determines exceedance of the Project's air quality goal (120 mg/m²/day – insoluble solids, monthly average) at selected monitoring location(s), additional monitoring, including monitoring of airborne particulate concentrations (e.g. TSP or PM₁₀), may be required. If required, it is recommended that airborne particulate monitoring is undertaken using a monitor that allows for continuous real-time monitoring.

If validated air quality complaints are received from locations that are not represented by the location of air monitoring stations, additional monitoring stations may be deployed or existing monitoring stations may be relocated.

All relevant results (inspections, monitoring, corrective measures and follow-up) will be included in environmental monitoring reports prepared by the Project.

Corrective actions in the event of a measured exceedance of the Project air quality goals during the construction works stage are described in Appendix R: Air Quality Technical Report.

12.7.3 Operations stage monitoring

Quantitative air quality monitoring will be undertaken during the operations stage at a yet to be confirmed location(s) along the Queensland section of the Inland Rail alignment. This location may not be along the B2G section of the alignment. As the rail network manager, ARTC would be responsible for providing support and funding for air quality monitoring.

Requirements for the AQMS, including the location of the monitoring station, will be discussed with the stakeholders of the South West Supply Chain, including DESI and DTMR. It is expected that the pollutant species monitored will include dust deposition and airborne concentrations of PM₁₀ and TSP. It is also expected that the monitoring station will be generally equivalent in nature to the existing monitoring stations operating as part of the South West Supply Chain CDMP.

The existing monitoring stations operating as part of the South West Supply Chain CDMP currently include continuous monitoring of airborne concentrations of TSP, PM₁₀ and PM_{2.5} at Cannon Hill, and dust deposition monitoring at Cannon Hill, Fairfield and Toowoomba.

The purpose of the operations stage air quality monitoring will be to ensure that the Project is meeting, and will continue to meet, its air quality goals (Table 12-2). The data collected will be compared against the Project's air quality goals and may also be analysed to measure trends over time, such as identifying train services or conditions leading to higher than typical concentrations of air pollutants.

The ongoing need for the monitoring program and operation of the station will be reviewed after three years. The complexity of the monitoring may be reduced at that time to fewer pollutants, or ceased, if the following conditions can be demonstrated:

- ▶ Measured concentrations are consistently low and consistent with predictions
- ▶ Measured concentrations are not expected to change significantly based on freight service forecasts
- ▶ Agreement is reached with stakeholders and relevant environmental regulators.

The location for the AQMS will be selected in accordance with the requirements of *AS/NZS 3580.1.1:2016 Part 1.1: Guide to siting air monitoring equipment* (Standards Australia and Standards New Zealand, 2016b). For example, the following are minimum requirements for a peak monitoring station measuring PM₁₀ or PM_{2.5}:

- ▶ Sample inlet height between 1.5 m and 15 m
- ▶ Unrestricted airflow of 180° around sample inlet with no obstruction between the major source and the sample inlet
- ▶ 10 m from any object with a height exceeding 2 m below the height of the sample inlet (trees are measured from the dripline)
- ▶ No extraneous sources nearby
- ▶ No trees between sampling inlet and source.

Other site considerations for monitoring stations include security from vandalism, access for transporting and maintaining equipment and electricity supply, if required. The site should also have regard to the local influence of meteorology and topography.

Coal trains will join the Inland Rail alignment east of the B2G section at Toowoomba (travelling eastbound). It is therefore likely that a monitoring site east of Toowoomba (i.e. not within the B2G section of the alignment), will be the most appropriate location as it will measure the impact of a higher number of freight services, covering the full range of potential sources, including coal services.

The responsibility for the reporting of the monitoring data, and the maintenance and ongoing operation of the monitoring station will be discussed with the stakeholders of the South West Supply Chain.

If a complaint related to air quality is received during operations, investigations will be undertaken to verify the cause and nature of the complaint. Corrective actions in the event of a measured exceedance of the Project air quality goals during the operations stage are described in Appendix R: Air Quality Technical Report.

Requirements for operations stage monitoring will be developed in future stages of the Inland Rail Program.

12.7.3.1 Operations stage—emissions reporting

Emissions reporting will be undertaken, where applicable. Emissions reporting requirements will be determined during the detailed design stage to be consistent with Infrastructure Sustainability Council and National Greenhouse and Energy Reporting requirements.

12.8 Impact assessment summary

Residual air quality impacts have been assessed in accordance with the qualitative impact assessment methodology discussed in Chapter 4: Assessment Methodology.

Potential construction works stage impacts to air quality and sensitive receptors have been assessed qualitatively as presented in Section 12.5.1. Assessment of the residual impact of the construction works stage of the Project following the implementation of the proposed mitigation measures (Section 12.6.3) is presented in this section, with the outcomes presented in Table 12-37.

This section provides a summary of the potential significance of construction works stage impacts to air quality and sensitive receptors, before and after the application of mitigation measures. A quantitative (compliance) assessment has been undertaken for potential operations stage impacts, as predicted concentrations at sensitive receptors have been assessed against legislative and other nominated air quality goals (Section 12.2.1); therefore, operations stage impacts are omitted from discussion in this section. The results of the quantitative assessment of potential operations stage impacts are detailed in Section 12.5.2 and mitigation measures for the operations stage are included in Section 12.6.3.

Potential air quality impacts during construction have been assessed in accordance with the qualitative impact assessment methodology discussed in Section 12.3.2.

The initial significance assessment in Table 12-37 is undertaken on the assumption that the design considerations (or initial mitigation measures) factored into the reference design (Table 12-35) have been implemented.

The anticipated influence of additional mitigation and management measures (Table 12-36) were then applied as appropriate to the relevant stage of construction. The residual significance level of the potential impacts was then reassessed and is presented in Table 12-37. This table has been structured to maintain consistency with the IAQM methodology which is activity based and as such, earthworks and track-out are assessed across both the pre-construction and early works and construction works stages.

The IAQM construction dust assessment guidance states:

For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'.

Consistent with the IAQM statement, it is expected that, with effective implementation of the proposed mitigation measures, the impacts to air quality with respect to dust deposition and human health will not be significant. Therefore, with effective implementation of the proposed mitigation measures, the construction of the Project is not anticipated to significantly adversely impact the environmental values of human health and the aesthetic environment.

TABLE 12-37 IMPACT ASSESSMENT FOR POTENTIAL AIR QUALITY IMPACTS ASSOCIATED WITH CONSTRUCTION

Activity	Aspect ¹	Potential impact	Receptor sensitivity	Initial significance ²		Residual significance ³	
				Emission magnitude	Significance	Emission magnitude	Significance
Demolition	All dust-generating sources associated with demolition	Dust deposition	Medium	Small	Low	Small	Low
		Human health	Medium	Small	Low	Small	Negligible
Earthworks associated with pre-construction and early works, and construction works stage	All dust-generating sources associated with pre-construction and early works, and construction works stage earthworks	Dust deposition	Medium	Large	Medium	Small	Low
		Human health	Medium	Large	Medium	Small	Low
Construction works stage	All dust-generating sources associated with construction works stage for the Project	Dust deposition	Medium	Large	Medium	Small	Low
		Human health	Medium	Large	Medium	Small	Low
Track-out associated with pre-construction and early works and construction works stage	All dust generating sources associated with pre-construction and early works and construction works stage traffic associated with the Project	Dust deposition	Medium	Large	Medium	Medium	Low
		Human health	Medium	Large	Medium	Medium	Low

Table notes:

1 Refer Table 12-36 for reference to the proposed additional mitigation measures relevant to each aspect

2 Includes implementation of initial mitigation measures specified in Table 12-35

3 Assessment of residual risk once the mitigation measures identified in Table 12-35 and Table 12-36 have been applied.

12.9 Conclusion

The air quality impact assessment addressed both Project construction works and operations stages and included:

- ▶ A qualitative construction dust risk assessment in reference to the guidance on the assessment of dust from demolition and construction (IAQM) (UK IAQM, 2014)
- ▶ A quantitative dispersion modelling assessment of operation impacts (diesel exhaust emissions) using the dispersion model CALPUFF
- ▶ An investigation into the deposition of pollutants at sensitive receptors and potential contamination of water tanks with reference to the *Australian Drinking Water Guidelines* (NHMRC & NRMCC, 2011)
- ▶ A qualitative assessment of the impact of odour from agricultural trains using FIDOL factors.

For the assessment of construction impacts, the risk of dust deposition and human health impacts resulting from particulate matter emissions was assessed based on the scale of construction activities and the proximity to sensitive receptors. The outcome of the assessment showed that the residual risk with the proposed mitigation measures is low or negligible. Consistent with the IAQM guidance, it is expected that, with implementation of the proposed mitigation measures, construction of the Project is not anticipated to adversely impact environmental values related to air quality.

For the assessment of operational impacts, diesel exhaust emissions from locomotives were estimated for projected peak train movements for the Project in the year 2040. Ground-level concentrations of particulate matter, NO₂, VOCs, and heavy metals were predicted using CALPUFF at nearby sensitive receptors.

The assessment predicted that cumulative pollutant concentrations and deposition levels would be below the relevant air quality goals at all identified sensitive receptors for all pollutants of concern. Based on the EPP (Air), the operation of the Project is not expected to adversely impact environmental values, including human health.

Investigation into pollutants at sensitive receptors and potential contamination of water tanks showed that predicted pollutant concentrations in tank water would be significantly lower than *Australian Drinking Water Guidelines* (NHMRC & NRMMC, 2011).

The impact of odour from agricultural freight is considered unlikely to result in significant impact to neighbouring sensitive receptors due to the frequency and duration of the odour generating event (train pass-by) and the predominantly rural nature of the AQIA area. The assessment has also found that, based on the guidance provided by EPA Victoria (EPA Victoria, 2020), the Project and the transport of livestock along the Inland Rail Program alignment presents a low-level risk for Q-Fever.

The AQIA undertaken for the Project concludes that, with the proposed mitigation measures in place, the implementation of the Project can be managed so that air quality impacts to environmental values and sensitive receptors are maintained at an acceptable level.