CHAPTER 19

Hazard and Risk

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

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

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19.1 Introduction

The purpose of this chapter is to identify and describe hazards and risks associated with the Project and to assess the potential for impacts to people, property and the environment. Key hazards considered in the hazard and risk assessment include:

- Natural hazards that can affect the Project during all phases, for example:
  - Bushfire
  - Flooding, storm and cyclones
  - Landslide (as well as sudden subsidence or movement of soil or rocks)
  - Wildlife
  - Biosecurity
  - Implications related to climatic conditions.
- Construction hazards and risks, for example:
  - Fatigue and heat stress
  - Respirable silica and other airborne contaminants, such as asbestos
  - Noise and vibration from construction
  - Land contamination
  - Construction traffic
  - Changes to emergency access
  - Existing infrastructure and utilities
  - Potential unexploded ordnance (UXO) and abandoned mines
  - Use of explosives for excavation works
  - Storage and use of hazardous chemicals and dangerous goods for construction.
- Operation hazards and risks, for example:
  - Fatigue and heat stress during operation
  - Minor levels of operation dust and other airborne contaminants generated from maintenance work
  - Noise and vibration from operation of trains and maintenance
  - Land contamination
  - Impact to emergency access
  - Interfaces between road and rail
  - Concurrent or simultaneous operations with existing railway infrastructure and rail incidents such as derailments or rolling stock collisions
  - Existing infrastructure and utilities
  - Potential abandoned mines
  - Storage and use of hazardous chemicals and dangerous goods for maintenance
  - Freight dangerous goods.

19.2 Terms of Reference requirements

This chapter has been prepared to address sections 11.142 to 11.149 and sections 11.155 to 11.157 of the Terms of Reference (ToR). A compliance check of this chapter against each of the relevant components of the ToR is presented in Table 19.1. Compliance of the Environmental Impact Statement (EIS) against the full ToR is documented in Appendix B: Terms of Reference Compliance Table.

TABLE 19.1 COMPLIANCE AGAINST RELEVANT SECTIONS OF THE TERMS OF REFERENCE

Hazard and risk Terms of Reference requirements		EIS section
Information requirements		
11.142	Describe the potential risks to people and property that may be associated with the Project in the form of a preliminary risk assessment for all components of the Project and in accordance with relevant standards. The assessment should include:	
	a) Specific consideration of:	-
	i) Respirable silica and other airborne contaminants (e.g. naturally occurring asbestos)	Section 19.7.2.1
	ii) Sudden subsidence or movement of soil or rock	Section 19.7.1.3
	iii) Flash flooding	Section 19.7.1.2
	iv) Fatigue and heat management	Section 19.7.2.1
	v) Concurrent or simultaneous operations with existing railway infrastructure	Section 19.7.2.2 Section 19.7.2.3
	b) Other potential hazards (including abandoned mines), accidents (including derailments), spillages, fire and abnormal events that may occur during all stages of the Project, including estimated probabilities of occurrence	Section 19.7.1 Section 19.7.2 Section 19.9.1
	c) Identifying all dangerous and hazardous substances (including likely volumes) to be used, stored, processed, transported or produced and the rate of usage	Section 19.7.3
	d) Potential wildlife hazards, natural events (for example, cyclone, flooding, bushfire and landslide)	Section 19.7.1
	e) How the Project may potentially affect hazards away from the preferred alignment (for example, changing flooding characteristics).	Section 19.7.1
11.143	Given the proposed project's co-location and interaction with the Millmerran Branch and South Western Line, confirm what measures will be taken to ensure the safety of people and property for both the construction and operations phase.	Section 19.8.1 Section 19.8.2 Section 19.9.1
11.144	Describe those measures required to ensure that the proposed project avoids the release of hazardous materials to the environment, including as a result of a natural hazard event.	Section 19.8
11.145	Provide details on the safeguards that would reduce the likelihood and severity of hazards, consequences and risks to persons, within and adjacent to the Project area(s). Identify the residual risk following application of mitigation measures including any actual or potential impacts to existing fire trails and evacuation routes. Present an assessment of the overall acceptability of the impacts of the Project in light of the residual uncertainties and risk profile.	Section 19.8 Section 19.9.2
11.146	Provide an outline of the proposed integrated emergency management planning procedures (including evacuation plans, if required) for the range of situations identified in the risk assessment developed in this section.	Section 19.9.3
11.147	Outline any consultation undertaken with the relevant emergency management authorities, including the Local Disaster Management Group.	Section 19.9.3.2
11.148	Identify the need for appropriate explosive licences and requirements to notify of proposed blasting prior to explosives use under the *Explosives Act 1999* and relevant codes and standards including the *Australian Standard AS2187 – Explosives – Storage, transport and use*. Any risk associated with explosives use, manufacture or storage is within an acceptable level in accordance with the *Explosives Act 1999* and codes and standards including AS2187.	Section 19.8
11.149	Detail the risk of the use of explosives in connection to the rail alignment, associated infrastructure and any proposed mitigation measures to limit this risk.	Section 19.8

Hazard and risk Terms of Reference requirements		EIS section
Climate		
11.155	Describe relevant climate patterns that may influence the water, air and noise environment in the vicinity of the Project.	Section 19.7.1
11.156	Climate information should be presented in a statistical form, including long-term averages and extreme values, as necessary.	Section 19.7.1
11.157	Describe the climatic conditions that may affect management of the Project. This includes a description of the vulnerability of the Project area to seasonal conditions, extremes of climate (e.g. cyclones and prolonged rain events) and natural or induced hazards (including bushfire).	Section 19.7.1

19.3 Policies, standards and guidelines

Policies and guidelines of relevance to this hazard and risk assessment are introduced and summarised in Table 19.2. The following legislation is relevant to the assessment of hazards and risks for the Project:

- *Rail Safety National Law*
- *Work Health and Safety Act 2011* (Qld) (WHS Act)
- *Explosives Act 1999* (Qld)
- *Public Health Act 2005* (Qld).

Further discussion regarding the above pieces of legislation, their relevance to the Project and how the Project complies is provided in Chapter 3: Legislation and Project Approvals Process.

TABLE 19.2 POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THIS ASSESSMENT

Policy, standard or guideline	Relevance to the Project
State Planning Policy (Department of Infrastructure, Local Government and Planning (DILGP), 2017c)	This policy provides guidelines to ensure the risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated during planning and development, to protect people and property and enhance the community's resilience to natural hazards. Forms the basis of design decisions, such as route selection and impact assessment, which inform risk assessment for the development.
Australian Code for the Transport of Dangerous Goods by Road & Rail Edition 7.6 2018 (ADG Code) (National Transport Commission, 2018)	This code details the technical specifications, requirements and recommendations applicable to the transportation of dangerous goods in Australia by road and rail. Taken as the basis of dangerous-goods handling and considered in the development and assessment of mitigation measures.
Rail Safety Principles and Guidance (Great Britain Health and Safety Executive, 1996)	This document provides safety principles and guidelines for the construction of railways. Principles applied to risk assessment considering expected mitigation measures and approach to rail construction.
Guideline: Safety Management System (ONRSR, 2019c)	This guideline provides accredited rail transport operators with guidance about legislative requirements for safety management. The assessment has considered that the system requirements will be applied to the Inland Rail Program, specifically in the context of ARTC's Safety Management System.
National Standard for Health Assessment of Rail Safety Workers 2017 (National Transport Commission, 2017)	This document provides guidance for rail transport operators to manage the risk associated with worker health issues and to protect the safety of the public, rail employees and the environment. Specifically, the standard outlines requirements to limit the impact of individual health issues on rail safety.
Transport Noise Management Code of Practice—Interim Guideline: Operational Railway Noise and Vibration 2019 (Department of Transport and Main Roads (DTMR), 2016)	Developed by DTMR, this interim guideline is a standard that provides assessment criteria for operational noise and vibration emissions generated by rollingstock operating on a railway or railway tracks on other rail infrastructure.

Policy, standard or guideline	Relevance to the Project
ISO 31000:2018—Risk Management—Principles and Guidelines (Standards Australia, 2018b)	This standard describes the risk-management process that can be applied throughout the life of an organisation and to a wide range of activities. Also provides guidance on the identification and assessment of risk, which has been applied in the methodology of this chapter.
AS/NZS ISO 45001:2018 Occupational health and safety management systems—Requirements with guidance for use (Standards Australia, 2018c)	This standard provides a framework for managing occupational health and safety risks and opportunities with the aim of preventing work-related injury and ill health to workers and provide safe and healthy workplaces. Development of safety management systems is considered to be in accordance with this standard for assessment as mitigation measures.
AS 4084:2001 Occupational Health and Safety Management Systems—General Guidelines on Principles, Systems and Supporting Techniques (Standards Australia, 2001)	This standard provides guidance on the development and the implementation of occupational health and safety management systems and principles and their integration with other management systems.
AS 4292:2006 Railway Safety Management (Standards Australia, 2006b)	This standard specifies railway safety requirements and management systems associated with design, specifications and operation and maintenance procedures. Considered in the assessment of mitigation measures and risk assessment associated with railway incidents.
AS 2187:2006 Explosives—storage, transport and use (Standards Australia, 2006a)	This standard sets requirements for the storage, transport and use of explosives associated with their location, design, construction and maintenance. Consideration of separation distances, handling requirements and restrictions on quantities has informed the risk assessment of potential explosives activities.
AS 1678:1993 Emergency Procedure Guides—Transport (Standards Australia, 1993)	This standard provides information on transport requirements for different classes of dangerous goods, specifically with respect to the actions taken and likely response procedures to be in place in the event of an incident.
AS 2931:1999 Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods (Standards Australia, 1999)	This standard provides lists of Emergency Procedure Guides (EPGs) and Group Text Emergency Procedure Guides (GTEPGs) and guidance on their selection, completion and use. This standard serves as a reference when selecting the appropriate EPG for particular types of dangerous goods.
AS 1940:2017 Storage and Handling of Flammable and Combustible Liquids (Standards Australia, 2017a)	This standard sets requirements for storage and handling of flammable and combustible dangerous goods Class 3. Considered in the development of mitigation measures for storage of construction chemicals.
AS 3780:2008 The Storage and Handling of Corrosive Substances (Standards Australia, 2008a)	This standard sets requirements for storage and handling of corrosive dangerous goods Class 8. Considered in the development of mitigation measures for storage of construction chemicals.
AS 2436:2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (Standards Australia, 2010)	This standard details the requirements for assessing noise and vibration control measures from construction, demolition and maintenance sites. Mitigation measures are expected to be in accordance with requirements of this guide and are considered in the assessment.

19.4 ARTC safety management framework

19.4.1 Safety Management System

As an accredited rail transport operator, ARTC is required by rail safety legislation to have in place a safety management system that covers the railway operations it is accredited to carry out. The ARTC Safety Management System is accredited under the *Rail Safety Act 2006* (Victoria). The safety management system is based on the promotion of continuous safety improvement and contains information on how ARTC maintains safe operations. This information is documented in policies, procedures, standards, work instructions and guidelines.

ARTC is undertaking action to obtain accreditation for this system under the Rail Safety National Law. ARTC will continue to use this system to manage safety risks associated with construction and operation of Inland Rail and the Project.

19.4.2 Safety Policy

ARTC's Safety Policy provides the basis for effective management of employee, contractor and public health for the Project. The safety policy includes the following:

'No harm' is an ARTC value, with the objective that no one is harmed at work or on the ARTC rail network.

In order to achieve 'No harm', ARTC is committed to a 'pathway to zero' in the following practical ways:

- Providing tools to support the identification of risk as appropriate to work activity
- Establishing and maintaining communication, consultation and coordination with and between employees, contractors and relevant stakeholders
- Providing information, instruction, and training to develop worker capabilities and competence
- Providing plant, equipment and personal protective equipment as suitable to undertake work
- Establishing and maintaining measurable and achievable objectives and targets
- Promoting safe behaviours and a positive safety culture
- Monitoring performance and implementation of requirements to ensure continuous improvements
- Maintaining a safety management system that is accessible and user friendly
- Ensuring the processes and work practices are in line with the requirements of applicable laws.

A copy of ARTC's Safety Policy is provided in Appendix E: Corporate Environment and Safety Policies. It will apply to the Inland Rail Program and the Project, including to contract workers.

19.4.3 Fatal & Severe Risk Program

ARTC maintains and implements a Fatal & Severe Risk Program as a fundamental element of its 'no harm' value. The Fatal & Severe Risk Program aims to implement 10 control protocols to manage risk areas with potentially fatal consequences. In doing so, the Program establishes risk management protocols to provide safe work practices and establish minimum performance and expectations to prevent the following incidents:

- Vehicle accidents (including road/rail vehicles)
- Manual handling incidents
- Rail traffic strikes
- Rail traffic collisions
- Mobile plant strikes
- Contact with electricity incidents
- Injuries by hazardous chemicals, hot materials and confined spaces
- Crushing by a crane or lifted load
- Falls from height.

Additional details on ARTC's Fatal & Severe Risk Program are accessible through the ARTC website and will apply to the Inland Rail Program and the Project, including to contract workers.

19.5 Methodology

19.5.1 Impact assessment area

For the purposes of this assessment, the impact assessment area is defined as the Project footprint, being the area that includes the permanent infrastructure and temporary disturbance areas for the construction and operation of the Project.

Not all risks identified and assessed in this chapter are confined to the impact assessment area.

19.5.2 Data sources

The following data and information sources have been relied on for the identification and assessment of hazards and risks of relevance to the Project:

- *Local Disaster Management Plan 2015* (Toowoomba Regional Council (TRC), 2015)
- *Local Disaster Management Plan (*Goondiwindi Regional Council (GRC), 2019a)
- *Natural Disaster Risk Management Plan* (GRC, 2011)
- *Toowoomba Regional Planning Scheme* (TRC, 2012)
- *Goondiwindi Regional Council Planning Scheme* (GRC, 2018a)
- Climate data from the Bureau of Meteorology (BoM)
- ARTC's Infrastructure Standards Extranet (**extranet.artc.com.au/**)
- Other technical assessments that have been undertaken to inform this EIS, as documented in corresponding chapters and cross-referenced in Section 19.7
- Design drawings, materials selection, feasibility of design assessments, and constructability assessments prepared in support of development of the reference design for the Project.

19.5.3 Existing conditions

Existing sources of hazard and risk have been examined as part of this risk assessment to develop an understanding of the impact the Project may have on the risk profile within the impact assessment area.

Existing hazards and risks have been identified with reference to the following sources:

- Requirements of the ToR
- Other chapters within this EIS, as relevant and cross-referenced in Section 19.7
- Feedback received through consultation with community and stakeholder groups, including the Queensland Fire and Emergency Service (QFES), Inner Darling Downs and Southern Darling Downs Community Consultative Committee (CCCs), Goondiwindi Regional Council (GRC), Toowoomba Regional Council (TRC), Queensland Police Service (QPS) and Queensland Ambulance Service (QAS).

19.5.4 Risk assessment methodology

The risk assessment presented in Section 19.9.1 describes the potential risks to people, property and the environment associated with the Project. The risk assessment considers a variety of sensitive receptors including people (human), sensitive ecosystems (environmental), and society (land use and infrastructure). This provides a basis for the assessment of potential impacts and preparation of safeguards to manage and mitigate impacts that might arise from the Project.

The methodology adopted for this risk assessment is based on *AS/NZ ISO 31000:2009 Risk Management: Principles and Guidelines* (and is compliant with ISO 31000:2018) (Standards Australia, 2018b) and *HB203:2012 Managing Environmental Risk* (Standards Australia, 2012).

The risk-management process adopted, as shown in Figure 19.1, comprises four steps:

1. Risk identification
2. Risk analysis
3. Risk evaluation
4. Risk treatment.

Each of these steps is described in more detail in Section 19.5.4.1 to Section 19.5.4.3.

The risks associated with hazardous chemicals or dangerous goods have been assessed via the risk-management process described with some additional details specific to the nature of the hazards. The following specific actions were incorporated into the management measures for hazardous chemicals and dangerous goods:

- Reviewing the types and quantity of goods to be stored and handled during construction
- Controlling ignition sources and accumulation of flammable and combustible substances
- Identifying risks associated with physical or chemical reaction of dangerous goods and ensuring the stability of goods
- Incorporating dangerous goods management into emergency plans if the quantity of a class of hazardous chemical at a workplace exceeds the manifest quantity. This only relates to yards and depots, e.g. maintenance facilities during the Project's operation.

Application of the risk assessment process established in *AS/NZ ISO 31000:2009* provides a framework that enables ongoing identification and documentation of hazards and risks for the full lifecycle of the Project. For the purposes of this risk assessment, the lifecycle of the Project is defined as the following phases:

- Design—all activities up to the commencement of onsite works
- Pre-construction—all activities required to enable construction of the permanent infrastructure components of the Project to commence
- Construction—all activities up to the commencement of railway commissioning
- Operation—all aspects from the commencement of commissioning through to, and including, operation of the railway.

While the design phase is important for risk assessment in terms of identifying and developing risk mitigation measures, there is very low risk exposure during this phase. For this reason, the impact assessment will consider only risks within the phases of pre-construction, construction and operation. Pre-construction and construction have also been combined for impact assessment to avoid repetition of assessment; however, these have been separated for identification of mitigation measures to maintain specificity.

The risk assessment presented in Section 19.9.1 is a component of the broader risk assessment for the Project.

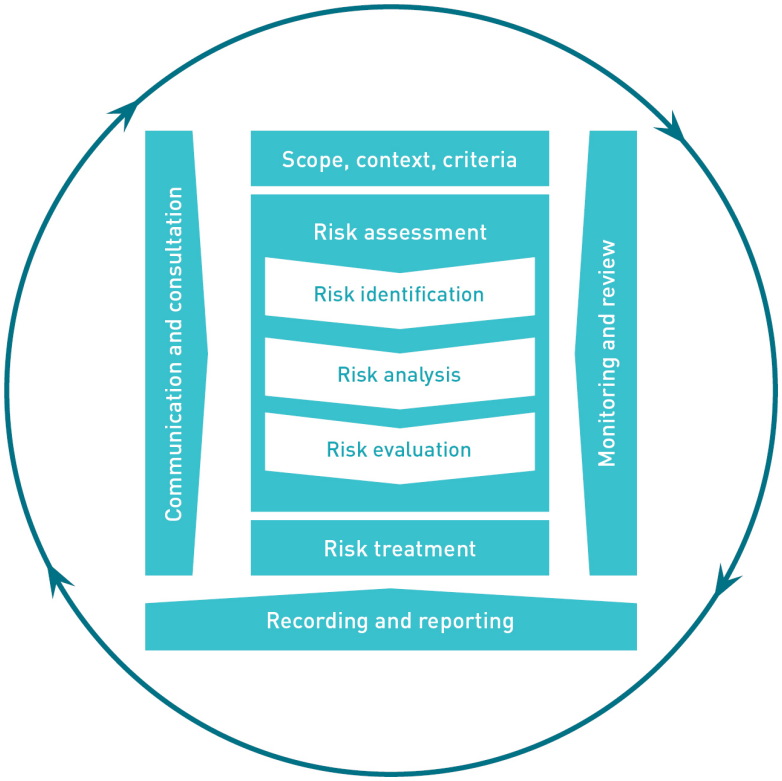


FIGURE 19.1 THE ISO 31000:2018 RISK MANAGEMENT PROCESS

19.5.4.1 Risk identification

Hazard identification and risk assessment has been undertaken in accordance with the requirements of AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018). The following terms are used throughout the chapter:

- Hazards: a source of potential harm or an existing situation with potential to cause loss or harm to people or damage to property and environment
- Risks: the chances of something happening that will have an impact on objectives. A risk is often specified in terms of an event or circumstance and the consequences that may flow from it. Risk is measured in terms of a combination of the consequence of an event and the likelihood of that event occurring.

The risk identification step involved recognising hazards and their potential receptors over the lifecycle of the Project. Receptors were not restricted to individuals or communities, and included sensitive environmental receptors such as land, habitat, flora and fauna.

Consideration has been given to potential hazards identified through other assessments as part of this draft EIS, in addition to those identified through the reference design development process and documented in accordance with requirements under the *Rail Safety National Law* (refer Chapter 3: Legislation and Project Approvals Process).

Occupational hazards will exist throughout the Project, including construction and operation maintenance risks. These hazards will be managed in compliance with the WHS Act and *Work Health and Safety Regulation 2011*, engineering standards and guidelines, as well as the procedures and work instructions that form part of ARTC's Safety Management System. Ongoing workplace risk assessments will be carried out in accordance with the requirements of ARTC's Safety Management System and the ARTC Fatal & Severe Risk Program. For the purpose of the draft EIS, these occupational risks will not be documented in this chapter.

19.5.4.2 Risk analysis

The level of risk for each hazard has been determined as a function of the potential consequence and likelihood, with acknowledgement for any existing risk mitigation measures or controls. This assessment is documented in Section 19.9.1. The risk ranking methodology, including criteria applied to likelihood and consequence factors, is discussed in Chapter 4: Assessment Methodology.

19.5.4.3 Risk evaluation and treatment

The initial risk analysis process enabled hazards to be identified that have a 'medium', or higher, risk rating.

Hazards ranked with 'medium', or higher, risk rating were subjected to further consideration to identify extra mitigation and controls in order to provide additional reduction in risk rating. In this process, additional mitigation and controls were identified from the following hierarchy of control measures:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

This step in the assessment process is discussed in Section 19.8.2 and Section 19.9.2.

19.6 Sensitive receptors

Identification and assessment of risk requires an understanding of the potential impacts on sensitive receptors. Receptors can be people (human), sensitive ecosystems (environmental) or societal (land use and infrastructure). Sensitive receptors have been identified through a desktop review of data sources specified in Section 19.5.2. This section provides a discussion on the human, environmental, land use and infrastructure receptors identified for the Project.

19.6.1 Human receptors

Human receptors identified for the Project, with potential to be exposed to hazardous events, include:

- Residential communities, townships, and rural communities located in proximity to the Project footprint, including Yelarbon, Inglewood, Millmerran, Pampas, Brookstead, Pittsworth, Southbrook, Gowrie Mountain, Kingsthorpe and Gowrie Junction. At the 2016 Census, these townships had populations ranging from approximately 62 for Pampas and 3,294 for Pittsworth (ABS, 2017b)
- Pedestrians, motorists (commercial and private vehicles) and residents who use roads and footpaths within or adjacent to the Project footprint
- Train operators using the existing South Western Line or Millmerran Branch Line
- People working on land adjacent to or intersected by the Project
- Emergency service personnel.

Workers and train drivers on the Inland Rail network, once in operation, will be considered employees and are not defined as sensitive receptors for the purposes of this assessment. The workers and train drivers' safety and working environment has been considered through safe design and human factors assessments. During operation, continuous improvement will take place by assessing and managing risks to employees through ARTC policies and procedures, including the *Work Health and Safety Procedure* (WHS-PR-001).

19.6.2 Environmental receptors

Environmental receptors identified for the Project with potential to be exposed to hazardous events, include:

- Watercourses and drainage features traversed by the Project or within proximity to the Project footprint, as identified in Chapter 12: Surface Water and Hydrology. These features include the Macintyre River, Macintyre Brook, Condamine River, Gowrie Creek, Pariagara Creek, Cattle Creek, Native Dog Creek, Bringalily Creek, Nicol Creek, Back Creek and Westbrook Creek.
- Groundwater sources, as identified in Chapter 13: Groundwater. These sources including the Border Rivers Alluvium, Condamine Alluvium, Main Range Volcanics, Kumbarilla Beds and Walloon Coal Measures
- Water catchment areas of the Condamine and Border Rivers, as identified in Chapter 12: Surface Water and Hydrology
- Habitat for threatened species and mapped locations of threated ecological communities, as identified in Chapter 10: Flora and Fauna
- Areas of Indigenous cultural heritage sensitivity, as identified through due diligence assessment and discussed in Chapter 17: Cultural Heritage
- Non-Indigenous heritage areas of interest, in the form of buildings, structures and other features, as identified in Chapter 17: Cultural Heritage
- Densely vegetated areas, such as Whetstone State Forest and Bringalily State Forest.

19.6.3 Land use and infrastructure

Land use and infrastructure receptors identified for the Project with potential to be exposed to hazardous events, include:

- Commodore Mine and Millmerran Power Station, south of Millmerran
- Toowoomba Wellcamp Airport. At its closest, the Project alignment is approximately 1 km east of the northern end of the runway
- Cropping activities, such as sorghum, cotton, maize, soybeans in summer months and wheat barley and chickpeas in winter months
- Intensive animal husbandry including feedlots, poultry farms and piggeries
- Grain storage and distribution infrastructure
- Overhead transmission and distribution electrical lines (134 interfaces with electrical utilities by the reference design)
- Gas (two interfaces) or oil pipelines (one interface)
- Telecommunication and optic fibre lines (504 communication utilities interfaced by the reference design).

For further details on land use and infrastructure with potential to be impacted by the Project, refer to Chapter 7: Land Use and Tenure.

19.7 Hazard identification and potential impacts

Hazards that have the potential to impact people, the environment, land use and infrastructure have been identified in reference to the data sources specified in Section 19.5.2 and are described in this section. This includes risks that may arise from natural events from which impacts could be increased by the Project. In each instance, a description of the potential hazard is provided in addition to a summary of the possible impacts if the hazard were to occur.

Hazards associated with the three non-resident workforce accommodation camps for the community (including health hazards and community conflicts) have been addressed in Chapter 15: Social and are not considered in this assessment.

19.7.1 Natural hazards

Natural hazards are an external risk influence on the Project. Existing risks associated with natural occurrences may be increased by the Project. An understanding of these hazards enables the Project's contribution to existing risks to be analysed. Key natural hazards identified for the impact assessment area include:

- Bushfire
- Flooding
- Storms and cyclones
- Landslides
- Wildlife
- Biosecurity
- Climatic conditions.

Each of these natural hazards is discussed further in the following sections.

19.7.1.1 Bushfire

Hazard description

Bushfires are an intrinsic part of Australia's environment. Natural ecosystems have evolved with fire, and the landscape, along with its biological diversity, has been shaped by both historic and recent fires. Many of Australia's native plants are fire prone and very combustible, while numerous species depend on fire to regenerate. Historically, bushfires have caused loss of life and significant damage to property (Geoscience Australia, 2019a).

The basic factors that determine whether a bushfire will occur include the presence of fuel, oxygen and an ignition source. The fire intensity and speed at which a bushfire spreads will depend on ambient temperature, fuel load, fuel moisture, wind speed and slope angle.

The threat of bushfire increases with periods of reduced rainfall and increased temperatures, which can increase the amount of vegetation fuel available to burn. In southern Queensland, the peak period for bushfire risk usually occurs in spring and early summer.

Areas of woody vegetation within the impact assessment area are predominantly mapped as 'medium potential bushfire intensity' by the State Planning Policy (SPP) Interactive Mapping System.

Climate modelling from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) predicts a temperature rise of 0.6°C to 1.5°C and a ±10% change in rainfall by 2030 in the Central Slope region (full range of emission scenario). These projected future changes to climatic conditions, particularly with regard to increase in temperatures and decrease in rainfall, are likely to increase the risk associated with bushfire. Specifically, CSIRO (2015) predicts the following increases in fire danger for Central Slopes in the most severe conditions:

Forest Fire Danger Index increases from 1995 baseline by:

- 9% to 15% by 2030
- 40% by 2090.

Number of days with severe fire danger rating increases from 1995 baseline by:

- 35% to 70% by 2030
- 220% by 2090.

Potential impacts

Project activities have the potential to escalate the risk of bushfire by introducing heat and ignition sources. Sources of heat and ignition during construction may include:

- Heat:
  - Hot works, such as welding, with the potential to create sparks
  - Construction vehicles and plant
  - Power generator sets.
- Ignition:
  - Bulk stores of flammable liquids
  - Flammable liquids leaked or spilled from vehicles or machinery
  - Dried vegetation in stockpiles or windrows
  - Waste materials
  - Cigarettes.

During operation (including maintenance activities), sources of heat and ignition may include:

- Heat:
  - Locomotives
  - Thermal runaway reaction of dangerous goods (e.g. flammable and combustible chemicals)
  - Overheating of rail track or train wheels
  - Maintenance vehicles and plant
  - Hot works, such as welding, with the potential to create sparks.
- Ignition:
  - Bulk stores of flammable liquids
  - Flammable liquids leaked or spilled from vehicles or machinery
  - Cigarettes.

Bushfires, as a result of Project activities, have potential to result in the following impacts:

- Damaging public and private utilities (e.g. overhead electrical lines, oil or gas pipelines), which can further escalate the severity of bushfire or interrupt service supply to the community and industry
- Risk to safety and life of operators and nearby residents (e.g. potential for severe injury or fatality)
- Damage to residential properties and other private structures
- Loss of commercial timber reserves
- Loss of livestock and damage to agricultural assets (e.g. apiaries within Bringalily State Forest)
- Risk of derailment due to track buckling from extreme heat of bushfire, resulting in risk to safety of operators and nearby residents as well as potential land contamination from spillage and damage to the Project and private structures
- Risk of signal faults or circuit breaks from extreme heat of bushfire
- Restricted temporary and permanent access for escape routes and emergency response. For further details on this potential impact refer to Section 19.7.2.3.

19.7.1.2 Flooding, storm and cyclones

Hazard description

Flooding

Flooding is defined by Geoscience Australia as, '*The covering of normally dry land by water that has escaped or been released from the normal confines of: any lake, or any river, creek or other natural watercourse, whether or not altered or modified; or any reservoir, canal, or dam*'. Floods can have both positive and negative impacts. They can bring welcome relief for people and ecosystems suffering from prolonged drought, but also are estimated to be the costliest natural disaster in Australia (Geoscience Australia, 2019b).

The Project crosses approximately 46 km of 1% annual exceedance probability (AEP) floodplain across two major basins of the Murray Darling River system—the Condamine and the Border Rivers. Major watercourses crossed by the Project include Macintyre River, Grasstree Creek, Condamine River, Condamine River North Branch, Westbrook Creek, and Gowrie Creek; however, the majority of watercourses in the impact assessment area are ephemeral, holding water only during the wet season or following periods of heavy rainfall.

The Condamine River floodplain is the largest floodplain crossed by the Project. The Project crosses approximately 12.5 km of the Condamine River floodplain (1% AEP), extending from the south of Grasstree Creek, near the locality of Yandilla, to the north of Elsden Road, near the township of Brookstead.

Seasonal variations in rainfall mean that flooding, and particularly flash flooding, is more likely during the storm season between late spring into summer as a result of heavy rainfall events associated with severe storms and tropical cyclones.

Chapter 12: Surface Water and Hydrology, provides further details on the watercourses, drainage features and floodplains crossed by the Project and the scale of historical flood events.

Storms and cyclones

Severe storms are generally formed by a low-pressure system bringing hazardous winds and heavy rain that may extend over large areas. They can be associated with ex-tropical cyclones and can be a substantial contributor to flooding.

Since 1970 only one ex-tropical cyclone, Cyclone Oswald in January 2013, has passed through the impact assessment area.

Apart from cyclones, localised storms are a more frequent occurrence in the region and typically occur from late spring into summer. These seasonal storms typically result in short periods of intense rainfall and high winds.

The intense rainfall experienced during storms and cyclones also introduces the potential for flash flooding. Flash flooding events typically result after periods of intense rainfall, particularly in areas of saturated soil or poor soil absorptivity. Runoff from catchment areas collects in gullies and streams, resulting in large flow volumes, often resulting in fast flowing torrents of water and debris. Although the duration is usually short, the volume and speed of water can cause significant damage to property and people, in addition to exacerbating erosion effects in the flow path.

Potential impacts

Activities within the impact assessment area may contribute to changes in the flood behaviour of the region by changing topography, catchment behaviour and drainage of the local and wider area. Construction activities including bulk earthworks and drainage diversions have the potential to redirect catchment flow paths, while the permanent changes to topography associated with rail track works could similarly divert current drainage systems, resulting in changing flood profiles and the potential for flash flooding. These impacts may affect existing dwellings, sheds, farm buildings and infrastructure, crops, roads, etc. Flood-sensitive receptors in proximity to the Project have been identified and mapped for each floodplain separately in Chapter 12: Surface Water and Hydrology.

Potential impacts include:

- Changes in peak water levels and associated areas of inundation, with potential for injury or fatality as a result of flood inundation. Impacts are exacerbated in the event of flash flooding due to shorter time available for preparation and initial response.
- Concentration of flows, redirection of flows and/or changes to flood flow patterns
- Increased velocities leading to localised scour and erosion, with potential damage to infrastructure and services
- Changes to duration of inundation
- Increased depth of water affecting trafficability of roads and tracks.

For further discussion on the potential impacts of flooding refer to Chapter 12: Surface Water and Hydrology.

19.7.1.3 Landslide

Hazard description

Landslide or sudden subsidence and movement of soil or rocks is generally caused by heavy rain. Rain saturates the soil on a hillside, past the point where any remaining vegetation can support the soil's weight against the force of gravity. This often occurs where there has been previous human activity, resulting in the removal of vegetation. Landslide risk is generally attributed to slopes with a gradient of 15% or greater (DILGP, 2017d).

The Project has been aligned to avoid steep slopes, where possible, and therefore negate the risk of landslide. The Project's lowest point of elevation occurs at the southern end of the rail alignment at the Macintyre River, with an approximate elevation of 227 m. From this point, elevation along the Project alignment generally increases steadily at an average slope of 0.5% in a northward direction towards Mount Domville and Commodore Peak, south of Millmerran. The Project alignment peaks at 482 m at Ch 122.2 km as it passes through the Clontarf and Millmerran area before dropping into the Condamine River floodplain—a shallow topographical parabola between Millmerran and Yarranlea with a low point of 377 m. From Yarranlea, the Project alignment increases in elevation at an average slope of 1.6% (maximum of 3.3%) until Ch 178.5 km near Southbrook, where a maximum elevation of 595 m is reached. From this high point, elevation of the Project alignment decreases to an end point at Ch 206.9 km of 458 m, at an average slope of 1.7% (maximum of 5.0%).

Where steep slopes could not be avoided by the Project alignment, the railway is positioned in cut or on fill embankment in order to negate the natural steep topography and achieve an operational gradient that is compatible with the maximum compensated operational gradient of 1:80 for general alignment (refer Chapter 5: Project Description).

Further details of the regional topography that is inherent to landslide risk, is provided in Chapter 8: Land Resources.

Potential impacts

The Project will interface with soil types, geological units and landform features that have potential to be impacted by, or impact on, the Project. Potential impacts related to landslide, sudden subsidence and movement of soil or rocks include:

- Cracking and/or settlement of structures due to the high potential for shrinkage and swelling of the black soils and cracking clays. Cracking may also result from the removal of vegetation with roots in these soils.
- Slope instability requiring stabilisation of cut faces resulting in additional maintenance or construction expenditure
- Erosion due to the loamy soils on alluvial plains and terraces, particularly on rail embankment and downstream surfaces
- Rock fall onto track due to colluvial loose scree on existing slopes or weathering, particularly where rail alignment is in cut. Falling rocks have the potential for fatality depending on location of strike and escalation of events (e.g. derailment).

Further discussion on the potential consequences of soil and geological risks for the Project is provided in Chapter 8: Land Resources.

19.7.1.4 Wildlife

Hazard description

Hazards attributed to wildlife are associated with the potential for fauna to interact with construction and operation activities.

The impact assessment area encompasses potential habitat for numerous threatened and native species. Wildlife have the potential to interact with construction personnel via animal attacks and bites but represent a much more significant hazard for construction vehicle movements through vehicle accidents and animal strikes. Similarly, operation train services have the potential to result in animal strikes.

Potential impacts

Land clearing to enable the safe and efficient construction and operation of the Project can potentially cause a short-term increase in the movement of wildlife within the Project footprint, with a corresponding increase in the potential for wildlife to be struck by construction plant or vehicles. Wildlife strikes with construction plant or vehicles—particularly personnel transport—have the potential to result in personnel injury or fatality in serious incidents. Even in incidents not involving personnel harm, equipment damage and asset loss can result. Similarly, operational train movements have the potential to result in animal strikes.

Further discussion on the potential impacts associated with wildlife is provided in Chapter 10: Flora and Fauna.

19.7.1.5 Biosecurity

Hazard description

Hazards attributed to biosecurity are associated with the introduction of new, or spread of existing, flora and fauna pest species, or the spread of existing pest species via construction and operation (e.g. maintenance) activities.

Numerous pest species are known to occur or have the potential to occur within the impact assessment area. Eight restricted weeds species listed under the *Biosecurity Act 2014* (Qld) have been identified through ecological assessment for the Project (refer Chapter 10: Flora and Fauna) to have the potential to occur within the impact assessment area.

The Project has the potential to exacerbate existing biosecurity issues, or introduce new concerns through:

- Spreading of existing weed infestations due to vehicle and plant movements and earthworks
- Introduction of new weed species to the region due to vehicle and plant movements and earthworks.

Further discussion on the potential impacts associated with flora, fauna and biosecurity is provided in Chapter 10: Flora and Fauna.

19.7.1.6 Climatic conditions

Hazard description

Historic climate data

Historical climate data of relevance to the Project, obtained from records held by BoM, describes the current conditions for comparison of future predictions on changes to the climate. The Project spans 216.2 km and local meteorological conditions are known to vary across this distance, especially at areas further inland and/or away from notable terrain features. Two BoM-operated weather stations located in relative proximity to the Project have been selected to provide an appropriate regional coverage of climatic conditions. These are Oakey Aero and Inglewood Forest stations and climate statistics from these stations are provided in Table 19.3.

TABLE 19.3 CLIMATE DATA FROM OAKEY AERO (1973 TO 2019) AND INGLEWOOD FOREST (2000 TO 2013)

Parameter		Unit	Oakey Aero	Inglewood Forest
Highest mean maximum temperature		°C	31.0	33.2
Highest maximum temperature		°C	42.8	42.0
Lowest mean minimum temperature		°C	2.9	5.6
Lowest minimum temperature		°C	-7.5	-2.7
Mean monthly rainfall	Highest	mm	91.8	97.3
	Lowest	mm	25.4	24.3
Monthly rainfall extremes	Highest	mm	304.2	245.8
	Lowest	mm	0.0	0.0
Mean solar exposure	Highest	MJ/m^2	25.2	25.6
	Lowest	MJ/m^2	11.9	11.5
Maximum wind gust speed	Highest	km/h	161	107
	Lowest	km/h	76	61

Table note:
Climate data from Oakey Aero (1973 to 2019) (Source: BoM, 2019b)
Inglewood Forest (2000 to 2013) (Source: BoM, 2019a)
MJ/m^2—megajoule per square metre

Historic temperatures at Oakey Aero and Inglewood Forest are consistent with a warm sub-tropical climate and the rainfall data shows distinct wet and dry seasons. These factors are consistent with the general climate of South East Queensland. The historical data shows that extreme temperatures have occurred, evidenced by the 10°C difference between the highest maximum temperature and the highest mean maximum temperatures for both stations. Historical data also shows a difference of 200 mm between the highest monthly mean rainfall and the highest monthly rainfall at Oakey Aero and a difference of 150 mm for Inglewood Forest.

Future predictions

Climatic changes observed throughout the 20th century include increases in global average air and ocean temperature, rising global sea levels, sustained widespread reduction of snow and ice cover, and changes in atmospheric and ocean circulation and regional weather patterns. These changes can influence seasonal rainfall conditions and are caused by extra heat in the climate system due to the addition of greenhouse gases (GHGs) to the atmosphere. The GHGs are primarily due to human activities such as the burning of fossil fuels (coal, oil, and natural gas), agriculture, and land clearing.

Climate modelling from the CSIRO (Ekström, M et al., 2015) has predicted temperature rises for the Central Slope region relative to the climate from 1986 to 2005. Figure 19.2 shows the modelled trend for the RCP8.5 emissions scenario, which is representative of a future with little curbing of emissions, with a CO_2 concentration continuing to rapidly rise, reaching 940 ppm by 2100. The RCP8.5 modelling predicts the following temperature rises:

- 0.6°C to 1.5°C by 2030
- 3°C to 5.4°C by 2090.

The predictive modelling also projects a drying trend clearly evident in eastern Australia (Ekström, M et al., 2015). Figure 19.3 shows the modelled trend for the RCP8.5 emissions scenario with the following predicted changes in predicted rainfall relative to 1995:

- -10% to 5% by 2030
- -25% to 10% by 2090.

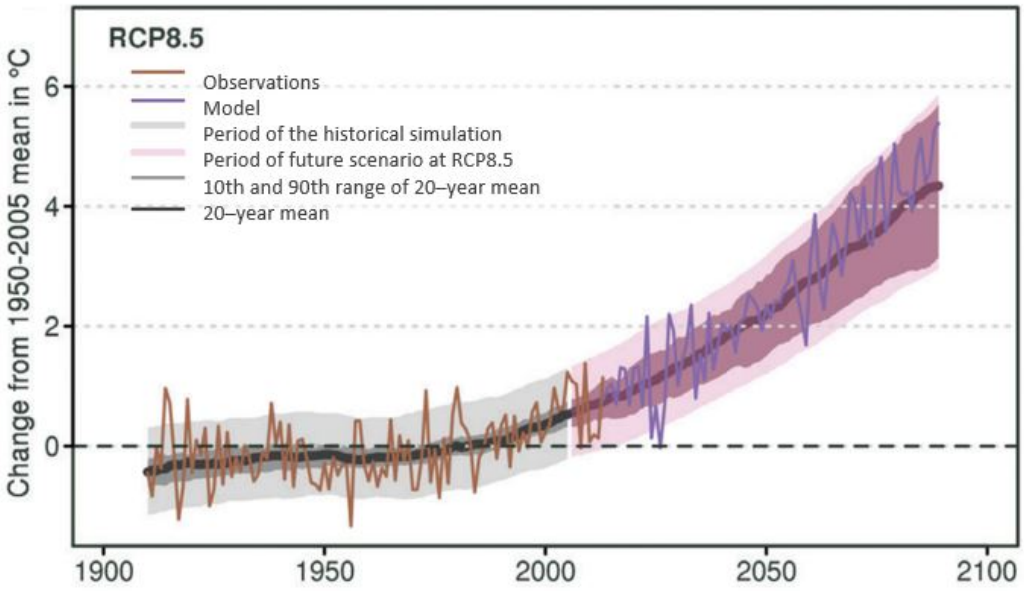


FIGURE 19.2 TIME SERIES FOR CENTRAL SLOPES ANNUAL AVERAGE SURFACE AIR TEMPERATURE FOR 1910 TO 2090

Source: Ekström, M et al., 2015

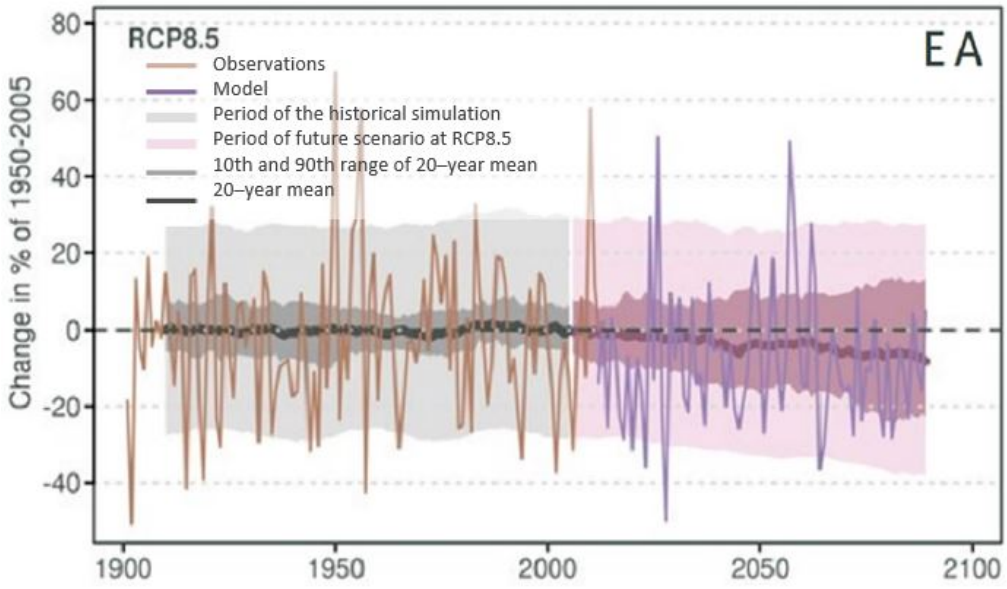


FIGURE 19.3 TIME SERIES FOR EASTERN AUSTRALIA RAINFALL ANNUAL AVERAGE

Source: Ekström, M et al., 2015

The predicted increase in temperature and the lower predicted rainfall combine to result in a higher drought factor and thus an increased fire weather risk in the future.

Queensland's total GHG emissions have been on an upward trajectory since the mid–1990s but have fluctuated significantly due to the large contribution of the land use, land use change and forestry (LULUCF) sector to Queensland's GHG emissions (DEHP, n.d.). The baseline GHG emissions projection for Queensland shows an estimated 35 per cent increase in Queensland GHG emissions to 2030—comprising a sharp increase in emissions between 2014 and 2020, followed by a more gradual rise to 2030 (Department of Environment and Heritage Protection (DEHP), n.d.). This is largely due to increasing GHG emissions in the energy and LULUCF sectors. The projected increases in baseline LULUCF sector emissions are primarily due to an increase in land clearing. LULUCF GHG emissions are projected to rise from 25.2 million tonnes of carbon dioxide equivalents (MtCO2-e) in 2013 to 42 $MtCO_2$-e in 2030.

Potential flooding characteristics as a result of changes to climatic conditions have been considered in the flooding and hydrology assessment presented in Chapter 12: Surface Water and Hydrology.

Potential impacts

The effects of changing climatic conditions may impact numerous environmental hazards, potentially resulting in increased severity and duration of weather activity, increased flooding extents and worsening extreme temperature events such as heat waves. Additionally, increased temperatures may contribute to extended droughts and periods of dryness, which can contribute to increased soil dispersion, increased salinity (and reduced asset life) and the potential for increased erosion.

Historic climate data shows that there is the potential for extreme temperatures, evidenced by the 10°C difference between the highest maximum temperatures and the highest mean maximum temperatures at the Oakey Aero and Inglewood Forest weather stations (refer to Table 19.3). Extreme temperatures can create two forces in the rail—compression and tension—which have the following impacts:

- **Compression**: rail will try to move sideways to lengthen, to relieve compression. When the amount of compression generated in the rails exceeds the ability of the structure to hold itself in place, track movement or buckling occurs.
- **Tension**: rail will try to move sideways to shorten, to relieve tensile stress. When the amount of tension generated is greater than the resistance offered by the track structure, a curve will pull in towards its centre. This is less dramatic than a buckle; however, it can be extremely dangerous if clearances are affected.

Historic climate data shows a 150 mm to 200 mm difference between the highest monthly mean rainfall and the highest monthly rainfall, which indicates the current potential for extreme rainfall events. This can lead to an increased potential for flooding, the impacts of which have been discussed in Section 19.7.1.2.

Construction of the Project is expected to contribute to GHG emissions through the following:

- Fuel consumption from use of machinery and vehicles
- Electricity use at site compounds and offices
- Clearing of vegetation and the loss of its carbon dioxide sink potential
- Indirect emissions embodied in construction materials including concrete and steel.

Operational GHG emissions for the Project are expected to be associated with the use of diesel for powering locomotives and fuel consumption through the use of machinery and vehicles for railway maintenance; however, it is estimated that transportation of freight on Inland Rail is expected to use one third of the fuel when compared to transportation of the same volume of freight via the existing road route (ARTC, 2015a).

The potential impacts of changes to climatic conditions are generally associated with variability of temperature, wind, rainfall and flooding. Extreme rainfall events, flooding and extreme heat are expected to present the greatest risk to the Project.

Climate modelling from CSIRO indicates that the following potential impacts to the Project would be:

- Changes in the magnitude and distribution of extreme weather, which may result in the increased frequency of events that prevent the operation of double-stacked freight trains
- Changes in rates of precipitation and increased duration of drought which can result in soil cracking and subsidence, and lead to instability of drainage infrastructure, bridges and track
- Increased wind speeds, which could potentially result in derailments or escalate the spread of fire (either from bushfire or burning trains)
- Increased flooding, resulting in inundation of track and trackside infrastructure (signalling/communications equipment and drainage basins)
- Increased incidence of extreme events (heat, rainfall and bushfire) resulting in disruption to power supply, causing temporary loss of signalling and communication systems
- Increased heat events and increased temperatures leading to compression and tension, as a precursor to track buckling, and the subsequent disruption of service.

Further discussion on the potential consequences of a changing climate for the Project is provided in Chapter 11: Air Quality and Chapter 12: Surface Water and Hydrology.

19.7.2 Project hazards

Hazards that have potential to be introduced through the construction (including pre-construction) and operation phases of the Project are as follows:

- Health
  - Fatigue and stress
  - Asbestos (naturally occurring or in existing infrastructure within the Project footprint)
  - Respirable silica and other airborne contaminants
  - Noise and vibration
  - Contaminated land.
- Accidents
  - Road infrastructure
  - Private access and stock routes
  - Rail infrastructure.
- Safety
  - Infrastructure and services
  - UXO
  - Bridges
  - Emergency access
  - Abandoned mines.

Each of these Project hazards is discussed further in the following sections.

19.7.2.1 Health

Fatigue and heat stress

Hazard description

In a work context, fatigue is mental and/or physical exhaustion that reduces a person's ability to perform work safely and effectively. Causes of fatigue can be work related, personal or a combination of both. They can also be short term or accumulate over time (Safe Work Australia, 2019c). Work causes of fatigue may include:

- Prolonged or intense mental or physical activity
- Sleep loss and/or disruption of internal body clock
- Organisational change
- Travel
- Exceptionally hot or cold working environments
- Work scheduling
- Excessively long shifts
- Not enough time to recover between shifts
- Strenuous jobs
- Long commuting times.

Working in heat can be hazardous and can cause harm to workers. The human body needs to maintain a body temperature of approximately 37°C. If the body has to work too hard to keep cool or starts to overheat, a worker begins to suffer from heat-related illness. This is a general term to describe a range of progressive heat-related conditions, including fainting, heat rash, heat cramps, heat exhaustion, and heat stroke (Safe Work Australia, 2017). Prolonged exposure to heat can be a contributor to fatigue.

Potential impact

Fatigue can result in a lack of alertness, slower reactions to signals or situations, and affect a worker's ability to make good decisions. This can increase the risk of incidents and injury in a workplace. In regard to construction (including pre-construction) and operation phases of the Project, fatigue may contribute to contribute to the occurrence of incidents for individuals who are:

- Operating fixed or mobile high-risk plant
- Driving a road vehicle
- Working at heights
- Working with flammable or explosive substances
- Undertaking hazardous work, e.g. electrical work.

Fatigue and heat stress issues can impact the broader workforce, as well as surrounding landowners and communities, through increased frequency of incidents during Project activities.

Heat stress can lead to cramps, dizziness, disorientation, exhaustion and, in severe cases, death. Fatigue can increase the risk of incidents, e.g. errors, during equipment operation or misjudging the speed and distance of approaching traffic.

Construction and maintenance workers who are exposed to strenuous work or extreme heat or sun, especially during summer within arid climates, can develop heat-related illness. Continuous hot work processes, such as welding, can also contribute to heat stress. Workers who are overweight or who have underlying health issues, such as heart diseases or high blood pressure, are at greater risk of heat-related illness.

Asbestos

Hazard description

Asbestos is a naturally occurring mineral and can typically be found in rock, sediment or soil. It has strong fibres that are heat resistant and have good insulating properties. Geotechnical investigations undertaken within the Project footprint found no naturally occurring asbestos to be present (refer Chapter 8: Land Resources).

Asbestos was once used in Australia in more than 3,000 different products, including fibro, flue pipes, drains, roofs, gutters, brakes, clutches and gaskets (Safe Work Australia, 2019a). Of relevance to this Project, these materials are commonly found within old structures (e.g. housing, sheds and uncontrolled landfill) or rail infrastructure (e.g. insulation, signal boxes, switchboxes and building fabric). Asbestos is also often found in aged pipework and drainage system infrastructure, where it was a component of asbestos cement. From consultation with GRC, sections of its potable water and sewerage pipeline network are known to be made from asbestos cement; however, disturbance to the GRC water and sewerage pipeline network is unlikely, due to the depth of cover and limited excavations expected in areas containing pipework.

Asbestos becomes a health risk when its fibres are released into the air and breathed in. Breathing in asbestos fibres can cause asbestosis, lung cancer and mesothelioma.

The common causes of asbestos exposure include:

- Demolition or salvaging of structures where asbestos is present
- Removing or encapsulating asbestos-containing materials
- Cleaning up asbestos spills
- Transporting, disposing, storing and containing asbestos.

Potential impacts

Impacts associated with asbestos release are generally limited to the local environment and receptors; however, the extent of potential impacts is influenced by the quantity and type of asbestos-containing material and weather conditions during disturbance. The inappropriate handling of asbestos material, such as improper disposal and transportation, can also contribute to wider-spread impacts.

Disturbance of asbestos-containing materials within the Project footprint may result in the release of airborne fibres. Asbestos fibres are carcinogenic and have significant potential health impacts over the long term. Asbestos fibres released into the environment are persistent and can result in contamination of soil.

Respirable silica and other airborne contaminants

Hazard description

Crystalline silica (silica) is found in sand, stone, concrete and mortar. It is also present in a range of common construction materials, e.g. fibre board used in switching panels. Construction activities involving cutting and grinding of products that contain silica may result in the generation of dust particles that are small enough to lodge deep in the lungs and cause illness or disease, including silicosis (Safe Work Australia, 2019b). While it is unlikely for these activities to have significant impact distances, localised effects may be experienced in areas close to construction activities and among the construction workforce.

Earthworks and truck movements over unpaved surfaces during construction (e.g. land clearing and blasting activities) could result in the disturbance of material, which may result in localised dust emissions. Additionally, erosion of exposed areas, uncovered stockpiles and haul roads have the potential to generate dust depending on the prevailing meteorological conditions.

Other aerosol emissions from construction activities and freight operations include combustion products from the operation of diesel engines. These pollutants include carbon monoxide, nitrogen dioxide, sulphur dioxide, and particulate matter. Carbon monoxide reduces the amount of oxygen that can be carried by haemoglobin, which therefore leads to a lack of blood supply to vital organs. Both nitrogen dioxide and particulate matter can cause respiratory problems.

The deposition of larger dust particles from freight activities may cause nuisance to nearby communities.

Chapter 11: Air Quality provides further discussion of existing air quality within the impact assessment area.

Potential impacts

Published geological data and experience with the basaltic rocks of the area indicates that the free silica content of the basalts is typically <1 per cent. Recrystallised chert or jasper from the Texas beds may contain small amounts of strained quartz grains or micro/crypto-crystalline silica. The Texas beds unit is unlikely to be encountered by the Project or, if encountered, it is not expected to be in substantial quantity. Consequently, the risk of generating respirable silica from these rocks during construction is considered to be negligible.

At sufficiently high concentrations, personnel exposure to construction dust and operation dust (e.g. dispersible freight) can cause respiratory problems; however, this is considered unlikely for the Project as fugitive emissions are generally low in concentration and exposure is typically temporary.

There is currently no market-driven demand for coal or other mining products to be transported on the Inland Rail network between the NSW/QLD border and Gowrie; therefore, operation-phase releases of coal dust are not foreseen for the Project.

Further discussion of potential air-quality impacts associated with the Project is provided in Chapter 11: Air Quality.

Noise and vibration

Hazard description

Noise can be defined as unwanted sound (Department of Health, 2018). Environmental noise, or community noise, is defined by the World Health Organisation (WHO) as, '*noise emitted from all sources except noise at the industrial workplace*' (Berglund et al., 1999). The main sources of community noise include, transport (road, rail and air traffic), industries, construction, public works, and the neighbourhood (Department of Health, 2018). In the context of the Project, noise will be generated during construction activities as a result of machinery, vehicle transport and noise-generating construction work (e.g. percussive drilling, blasting, grinding). Operation noise will also be generated and will be associated primarily with freight train operation.

The potential health risks of environmental noise and vibration are gaining increasing attention. WHO defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (WHO, 1946). This broad definition enables consideration of not only the direct impacts environmental noise and vibration have on health, but also impacts on sleep disturbance, cognitive effects and annoyance.

Potential impacts

Construction plant and equipment used on the Project may impact the local ambient noise environment where construction activities are within 1 km of sensitive receivers.

Earth moving machinery, vibratory rollers and impact plant such as piling rigs and hydraulic hammers are likely to result in perceptible vibration impacts for adjacent sensitive receivers; however, vibration typically dissipates to negligible levels within 50 to 200 m from the source. Blasting and piling activities will also generate high levels of noise and vibration.

During operation, train movements will be the primary source of noise emissions along the rail alignment; however, maintenance activities can also be a source of noise and vibration (although for limited duration and less frequently than train movements).

If left unmitigated, exposure to loud noise and vibration over an extended period of time has the potential to result in:

- Disturbance to sleep patterns and quality
- Reduction in levels of concentration and slower reaction times
- Increase in stress and depression levels, affecting mental wellbeing.

Further discussion of noise and vibration impacts associated with the Project is proved in Chapter 14: Noise and Vibration.

Contaminated land

Hazard description

The following would need to be present for there to be a risk associated with land contamination:

- Source of contamination
- An exposure pathway
- Receptors (environmental or human) that may be affected by this exposure.

A desktop assessment has been undertaken to identify potential sources of contamination within the impact assessment area (refer Chapter 8: Land Resources). Potentially contaminating activities and land uses were identified as follows:

- Agricultural activities: hydrocarbons (fuel and oil storage and use), pesticides and herbicides, asbestos and lead paint, arsenic (cattle dips) and landfilling
- Quarries: hydrocarbons (fuel and oil storage and use), metals/metalloids and hazardous materials
- Landfilling, waste disposal: hazardous materials, hydrocarbons, metals/metalloids, phenols, polychlorinated biphenyls, phthalates, volatiles, pesticides and herbicides
- Existing rail corridor: metals, asbestos, hydrocarbons, pesticides/herbicides
- Road crossings: metals and hydrocarbons
- Unknown fill material: asbestos, metals/metalloids and hydrocarbons.

Further details on existing potential land contamination within the impact assessment area are provided in Chapter 8: Land Resources.

Potential impact

Disturbance of existing contaminated land or works that contaminate the land may result in:

- Migration of contaminants through soil/groundwater, resulting in downstream environmental pollution
- An increase in human health risks through ingestion/dermal contact to contaminants
- An increase in ecological (e.g. terrestrial and aquatic) health risk through the dispersion of soil and dust from wind and surface water runoff.
- The Project may contribute to land contamination through construction activities or operation events, including leaks or spills from:
  - Permanent or mobile fuel and chemical storage (e.g. construction laydown areas)
  - Waste storage areas/facilities (e.g. storage tanks, sewerage, laydown area)
  - Freight movements.

Additionally, the Project may contribute to land contamination through disturbing materials containing asbestos during construction (refer Section 19.7.2.1 and Chapter 8: Land Resources).

19.7.2.2 Accidents

Road infrastructure

Hazard description

Road–rail interfaces are points at which the rail alignment intersects a road. The Project requires the crossing of State-controlled roads, local government roads, occupational (private) accesses, stock route crossings and easements (undeveloped roads). A summary of the number of interfaces with each road or access type is presented in Table 19.4.

TABLE 19.4 SUMMARY OF ROAD AND ACCESS INTERFACES FOR THE PROJECT

Road type	Number of interfaces[1]
State-controlled	9
Goondiwindi Regional Council	18
Toowoomba Regional Council	26

Table note:
1. Only includes locations where a crossing solution is provided. Excludes interface locations where no crossing is provided in the reference design.

The specific design treatment at each road-rail interface is selected based on a combination of factors, which include:

- Topography
- Road classification
- Rail geometry
- Road geometry
- Community and stakeholder feedback through consultation.
- Rail–road interface treatments are generally classified as:
  - Grade separated crossings—road and rail cross each other at different heights so that traffic flow is not affected. Grade separations are either road-over-rail or rail-over-road.
  - Level crossings—road and rail cross each other at the same level. Level crossings have either passive or active controls to guide road users:
    - Passive—have static warning signs (e.g. stop and give way signs) that are visible on approach. This signage is unchanging, with no mechanical aspects or light devices
    - Active—flashing lights with or without boom barriers for motorists, and automated gates for pedestrians. These devices are activated prior to and during the passage of a train through the level crossing.
- Crossing consolidation, relocation, diversion or realignment—existing road–rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted. Roads will only be closed where the impact of diversion or consolidation is considered acceptable, in consultation with relevant stakeholders, or the existing location is not considered safe and cannot reasonably be made safe. Approval for closures, where required, will be progressed in accordance with the requirements of the relevant legislation.

Grade-separated interface treatments are considered safer than level crossings due to the physical separation of road and rail; however, they are not always the most practical treatment, typically due to topography, and road or rail geometry. Level crossings are crossing points where trains, cars and pedestrians can meet at the same elevation, with potential to result in collision. With an overall aim to reduce the number of incidents at road–rail interfaces, interface treatment selection considers safety and practicality.

Hazards associated with road usage may also arise due to:

- Temporary or permanent road reconfigurations
- Temporary alterations to driving conditions, e.g. speed restrictions or lane closures.

Potential impacts

The Project includes 17 active level crossings and 20 passive level crossings of State-controlled and local government roads, which are summarised in Table 19.5.

TABLE 19.5 NUMBER OF LEVEL CROSSINGS ON ROAD NETWORKS

Road type	Active level crossing	Passive level crossing
State-controlled	2	0
Goondiwindi Regional Council	8	8
Toowoomba Regional Council	7	12

The majority of level crossing incidents are typically classified as 'near miss' incidents between trains, road vehicles and pedestrians. As presented in Table 19.7, collisions at railway crossings occurred at a frequency of 1.8 per thousand kilometres of railway crossings in Australia between 2012 and 2017. While rare, actual collisions can occur at level crossings, which may cause property damage, service disruptions, impact to adjacent infrastructure, injury and death.

Construction and operation maintenance activities for the Project have the potential to:

- Increase interface conflict of construction and maintenance vehicles (e.g. grader, loader) with local and access roads, with vehicle accidents causing severe harm or fatality
- Interrupt road routes due to oversized deliveries or temporary road closures or modifications. Interrupted road routes can affect the capacity of emergency services and cause disruption to essential road freight networks for the supply of goods and food.
- Decrease the accessibility and increase travel times to key destinations, facilities, and community services for local residents.

Further discussion of road interface impacts associated with the Project is provided in Chapter 18: Traffic, Transport and Access.

Private access and stock routes

Hazard description

Private access crossings occur where the Project is aligned in a way that would result in the severance of an access path that extends between the public road network and a dwelling or place of work. The Project reference design crosses 215 private access roads or tracks.

The State stock route network is primarily used by the pastoral industry as:

- An alternative to transporting stock by rail or road
- Pasture for emergency agistment
- Long-term grazing.

The stock routes listed in Table 19.6 are intersected by the Project reference design:

TABLE 19.6 STOCK ROUTE INTERFACES WITH THE REFERENCE DESIGN

Location and Project interface point (approximate chainage)	Stock route ID, type, status and class	Description
Kildonan Road Ch 33.1 km (NS2B)	**ID:** 005GWND **Type:** Road **Status:** Open **Class:** Primary	This stock route follows Kildonan Road. The Project alignment crosses this stock route at Kurumbul.
Rainbow Reserve and Eukabilla Road Ch 33.4 km (NS2B)	**ID:** RAINBOW RESERVE **Type:** Reserve **Status:** Open **Class:** Primary	This stock reserve encompasses the Rainbow Reserve camping area and Eukabilla Road. The Project alignment enters into this stock reserve at Ch 33.15 km (North Star to Border (NS2B)) and crosses Eukabilla Road at 33.4 km (NS2B). The Project alignment continues to run parallel to the western edge of the existing Eukabilla Road, within the stock reserve, to Ch 34.9 km (NS2B). At this point it exits the stock reserve.
Wondalli–Kurumbul Road and Yelarbon–Kurumbul Road Ch 7.2 km	**ID:** 081GWND **Type:** Road **Status:** Open **Class:** Secondary	This stock route is aligned along Wondalli–Kurumbul Road and parallel to Yelarbon–Kurumbul Road, which runs adjacent to the existing South Western Line rail corridor. The Project alignment crosses this stock route at the intersection of Wondalli–Kurumbul Road and Yelarbon–Kurumbul Road.
Yelarbon Ch 25.4 km	**ID:** 811GWND **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route is aligned with Merton Road, the Cunningham Highway and Yelarbon–Keetah Road. The stock route crosses the existing Queensland Rail (QR) South Western Line at an active level crossing on the Cunningham Highway. The Project will require the closure of the existing active level crossing, to be replaced by a road-over-rail crossing approximately 400 m to the west of the existing crossing point. This road reconfiguration will result in the severance of the current stock route.

Location and Project interface point (approximate chainage)	Stock route ID, type, status and class	Description
East of Sawmill Road Ch 27.0 km	**ID:** RESERVE **Type:** Reserve **Status:** Open **Class:** Minor and unused	This is an isolated stock reserve, with no mapped stock route linkages. The stock reserve is bound by the Cunningham Highway to the west and East of Sawmill Road to the north. The Project involves curve easing of East of Sawmill Road, which will encroach by up to 15 m into the north–west corner of the stock reserve. The existing Yelarbon levee extends diagonally across this stock reserve. Modifications to the existing Yelarbon levee, if they are to occur, will temporarily require works within the stock reserve.
Lovells Crossing Road Ch 65.8 km	**ID:** 813GWD **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route follows Lovells Crossing Road. The Project alignment crosses this stock route approximately 3 km north of Inglewood.
Millmerran–Inglewood Road (Inglewood) Ch 73.1 km to Ch 76.5 km	**ID:** 820GWD **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route follows Millmerran-Inglewood Road. The Project alignment crosses this stock route twice in 10 km, once at Ch 75.0 km and again at Ch 85.0 km.
Millmerran–Inglewood Road (Inglewood) Ch 84.2 km	**ID:** 820GWD **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route follows, or runs parallel to, the east of Millmerran–Inglewood Road. The Project alignment crosses this stock route at the point of the stock route re-joining Millmerran–Inglewood Road.
Kooroongarra–Anderson Road Ch 96.1 km	**ID:** 856TOOW **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route branches off 820TOOW and provides an east–west connection to Stonehenge Road. The Project alignment crosses this stock route at the intersection of Koorongarra–Anderson Road and Millmerran–Inglewood Road.
Millmerran–Inglewood Road (near Heckendorfs Road) Ch 115.5 km	**ID:** 820TOOW **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route follows Millmerran–Inglewood Road. The Project alignment crosses this stock route approximately 900 m south of the intersection of Heckendorfs Road and Millmerran–Inglewood Road.
Koorongara Road (Commodore Mine) Ch 127.2 km	**ID:** 820TOOW **Type:** Road **Status:** Open **Class:** Minor and unused	The stock route follows Millmerran–Koorongarra Road and Millmerran–Inglewood Road. This Project alignment crosses this stock route approximately 550 m north of the intersection between Millmerran–Inglewood Road, Millmerran–Koorongarra Road and Schwartens Road.
Warrego Highway Ch 203.01 km	**ID:** No ID—Unused **Type:** Road **Status:** Open **Class:** Minor and unused	This stock route follows the Warrego Highway. The Project alignment crosses this stock route approximately 700 m west of the intersection between the Warrego Highway, Chamberlain Road and Jannuschs Road.

As previously discussed, level crossings, where provided, introduce the potential for collisions between trains and other level crossing users.

Further details on alteration to private access and stock route are provided in Chapter 5: Project Description and Chapter 7: Land Use and Tenure.

Potential impacts

Private access to individual properties may be temporarily disrupted during construction. The consequences of such disruption can include:

- Reduced accessibility to and from destinations for property owners
- Increased emergency services response time.

Potential operation-phase impacts associated with the crossing of private access are:

- Collision between trains and private access users, where a level crossing design treatment is provided, resulting in severe harm or fatality
- Modification to property access or egress in the event of an emergency, particularly where alternative access arrangements are provided.

Stock routes allow safe movement of stock between locations. The sharing of land uses can create conflict where the Project traverses stock routes, such as:

- During construction, alternative routes introduced can disrupt the commercial operations of agricultural activities due to the potential extended transportation time of water, feed and stock to and from these land uses
- During operation, there is the potential for rolling stock interface with livestock and other stock-route users. This can result in livestock deaths or interruption of livestock transport and food supply.

The reference design has, in all instances, maintained access for private properties and stock route users. This has been provided through either:

- The provision of a crossing point of the rail alignment in the location of the existing private access or stock route
- The provision of an alternative means of:
  - Accessing a dwelling or place of work from the public road network
  - Moving stock.

For a more detailed discussion of private land use and stock route impacts associated with the Project refer to Chapter 5: Project Description and Chapter 7: Land Use and Tenure.

Rail infrastructure

Hazard description

The Project involves the use of approximately 71.2 km of existing rail corridor (brownfield), specifically the South Western Line and the Millmerran Branch Line which are components of QR's South Western System.

In addition, the Project will incorporate turnouts from the existing railway network, allowing trains to be guided from one section of track to another, at the following locations:

- South Western Line connection at Kildonan near the NSW/QLD border towards Goondiwindi
- South Western Line connection at Whetstone towards Warwick
- Millmerran Branch Line connection at Millmerran
- Millmerran Branch Line connection at Yarranlea
- Turnouts to crossing loops
- Existing QR sidings.

The Millmerran Branch Line is currently 'red boarded' and non-operational between Millmerran and Brookstead (south from Ch 149.8 km). There is the potential that the conditions may change during construction of the Project, such that the line becomes operational.

The preferred construction approach for the Project, within the corridors for the South Western Line and the Millmerran Branch Line, would involve replacement of the existing rail infrastructure with Inland Rail infrastructure. On this basis, the potential hazards associated with existing rail infrastructure and addition of the Project include:

- Usage of the existing QR network during the construction of the Project, with collision hazards in locations where construction activities are occurring within live rail corridor
- Usage of the existing QR network during the operation of the Project, with collision hazards at turnout locations
- Increased frequency and scale of train movements during operation of the Project, increasing the likelihood of occurrence of rail-based incidents, such as:
  - Derailments due to collision with another object, an operation error, the mechanical failure of tracks (e.g. broken rails), or the mechanical failure of the wheels
  - Runaway train, where unattended rolling stock is accidentally allowed to roll onto the main line, a moving train loses enough braking power to be unable to stop safely, or a train operates at unsafe speeds due to loss of operator control
  - Running line collisions with other rolling stock
  - Running line collisions at level crossings with other crossing users (vehicles, pedestrians or livestock).
- Loss of freight or fuel from rolling stock, either through minor leaks and spills or larger events attributed to one of the above-mentioned hazards.

Potential impacts

The Office of the National Rail Safety Regulator (ONRSR) and Department of Transport and Main Roads (DTMR) publish investigation reports into rail incidents, which are available on their websites. The ONRSR is an independent body corporate established under the *Rail Safety National Law*, which aims to encourage and promote national rail operations and safety. Table 19.7 shows data from the ONRSR *Rail Safety Report 2017-2018* (ONRSR, 2018) period, chosen as Queensland joined ONRSR in July 2017. This information provides contextual reference for understanding the potential likelihood and consequence of rail-based incidents.

TABLE 19.7 AUSTRALIAN RAIL SAFETY OCCURRENCE DATA, 2017–2018

Statistic	Value	Units
Running line derailment of freight train	0.214	per million km of train line
Running line collisions with rolling stock (not involving in-service passenger trains)	0.026	per million km of train line
Crossing collisions at (train and road vehicle)	2.876	per thousand km of railway crossings
Crossing collisions (train and person)	1.408	per million km of train line
Fatalities (involving passengers, workers, public and trespass, excluding suspected suicide)	0.075	per million km of train line

Source: Office of the National Rail Safety Regulator, 2019

Potential impacts that may occur during construction are associated with occupation of the existing rail corridor by plant, equipment and work crews for construction of large sections of the Project. The preferred construction approach in these locations would be to replace the existing rail infrastructure with new Inland Rail infrastructure. To achieve this, ARTC would need to secure temporary possession of the rail corridor under an access agreement with QR. In the absence of such an agreement, an offline (parallel) construction approach may be required.

Depending on the approved construction approach for the Project within the existing rail corridor, construction-phase impacts may include:

- Interaction or collision between trains using the existing QR network and construction crews
- Derailment of trains using the existing QR network due to modification of track conditions through construction works for the Project.

Once operational, the Project will result in an increased frequency and scale of train movements within the existing rail corridors. This increased intensity of use will result in a corresponding increase in the potential for rail incidents to occur on the Border to Gowrie section of the Inland Rail network; however, as discussed in Chapter 2: Project Rationale, one of the core justifications for the Inland Rail Program is the potential for better safety outcomes as a result of:

- 200,000 fewer long-haul truck movements each year from 2049–50. It is expected that road transport will still be required for distribution from intermodal terminals.
- Reduced congestion and increased capacity on existing road and rail networks, particularly in metropolitan areas
- Reduction in the burden on roads
- Reduction in truck volumes in over 20 regional towns
- Relocation of mainline freight traffic from existing railways out of some town centres such as Inglewood, Pittsworth and Southbrook, providing for a safer environment with enhanced liveability.

All rail incidents, regardless of type and Project phase, have the potential to result in significant injuries or fatalities, in addition to environmental impacts associated with loss of fuel and freight. The impact of rail incidents increases significantly in cases where dangerous goods are being transported (refer Section 19.7.3.2).

Further discussion of potential rail-interface impacts associated with the Project is provided in Chapter 18: Traffic, Transport and Access.

19.7.2.3 Safety

Existing infrastructure and utilities

Hazard description

Project activities, particularly during construction, have the potential to come into contact with existing overhead and underground services and infrastructure. The consequences of contacting and disturbing existing services depend on the service and infrastructure type; however, the associated hazards of this occurring are typically attributed to:

- Unscheduled contact with, or release of, an energy source (electrical, pressure or chemical)
- Disruption to the provision of a service, e.g. loss of electricity, water or communications for one or more users
- Loss of previously contained contaminating and/or hazardous substances, such as oil, gas or sewerage.

Additionally, Project activities have the potential to interfere with existing commercial infrastructure and operations. The Project footprint is approximately 1 km from the northern end of the runway for the Toowoomba Wellcamp Airport. Other airfields also located in the surrounding area of the alignment include:

- Oakey Army Aviation Centre
- Inglewood airfield
- Millmerran airfield
- Pittsworth airfield
- Southbrook airfield
- Wyreema airfield
- Cambooya airfield
- Colanya airfield.

The Project alignment also traverses several resource tenements, including two mineral development licences, three coal exploration permits, and one coal mining lease associated with the Commodore Mine.

Potential impacts

UTILITIES

There are 656 known utilities located within the Project footprint and interface with the reference design, of which 560 are proposed to be relocated, 53 will require additional protection to be provided and 43 will be unaffected. Consultation has commenced with utility providers and engineering asset owners regarding their specific asset interface requirements. In doing so, ARTC has held 14 meetings to provide Project updates and discuss reference design development with 10 separate utility asset owners. In addition, one risk workshop with APA Gas (APA) was conducted to discuss the management of interface treatments between the Project and APA's Roma–Brisbane gas pipeline and access protocols for APA pipeline easements during construction. Such consultation will continue during detail design and construction. Details of consultation to support development of the reference design and EIS are included in Appendix C: Stakeholder Engagement Report (Table 4.1.7). Consultation completed to date has informed the requirements for proposed utility interface treatments provided in Table 19.8.

TABLE 19.8 NUMBER OF UTILITY INTERACTIONS

Utility/service	Protection	Relocation	Remain in place, no treatment required	Total
Communication	44	457	3	504
Electricity	0	95	39	134
Gas	2	0	0	2
Oil	1	0	0	1
Potable water	1	3	0	4
Raw water	0	2	1	3
Recycled water	5	1	0	6
Sewer gravity main	0	1	0	1
Sewer rising main	0	1	0	1
Total	**53**	**560**	**43**	**656**

Construction activities around existing services introduce a risk of service strikes of underground utilities (e.g. underground gas pipeline, asbestos cement sewer mains) during excavation or collision of plant and equipment with aboveground services (e.g. powerlines). Activities during operation of the Project also have the potential to impact existing utilities and services such as track vibrations or derailments, causing damage. Interactions with existing services could pose a risk to public safety and the natural environment. Damage to or contact with services during construction could result in service outage to nearby communities and land uses.

Unscheduled contact or disturbance to utilities has the potential to result in the following impacts:

- Electricity:
  - Serious injury or death to workers due to contact with high-voltage live electrical source
  - Power outage to individuals or communities, resulting in potential disruption in provision of critical community services (e.g. health care and emergency services) and safety controls (e.g. electrical signalling).
- Communications:
  - Disruption in ability for communities to access critical services (e.g. emergency services) in a timely manner.
- Oil:
  - Serious injury or death to workers due to release of pressurised oil
  - Environmental impacts, such as contamination of land and water, due to loss of oil.
- Gas:
  - Serious injury or death to workers due to release of pressurised gas and/or subsequent ignition of released gas
  - Serious injury or death to members of the community in proximity to a significant gas leak or explosion.
- Water:
  - Disruption in the provision of potable water to individuals or communities. Over an extended period, this disruption in service has potential to impact the provision of health-care services and result in issues relating to hygiene and sanitisation.
- Sewage:
  - Health impacts to workers or members of the community, due to contact with raw sewage
  - Environmental impacts, such as contamination of land and water, due to loss of sewage.
- Asbestos cement services/pipes:
  - Release of asbestos fibres with health impacts to workers (limited, short-duration exposure)
  - Contamination of surrounding areas.

The significant number of service relocations introduces exposure risks to the construction workforce. However, the relocation of the services will reduce ongoing operation risks by eliminating potential rail-utility interactions such as overhead service strikes.

EXISTING COMMERCIAL INFRASTRUCTURE

In response to consultation with the operators of the Commodore Mine, the Project has been aligned to avoid the current and future proposed working areas of that mine site. In doing so, the likelihood of interaction between Project activities and mining services and activities has been greatly reduced.

The Project has been positioned to ensure that double-stacked freight trains will not extend vertically into the Obstacle Limitation Surface (OLS) for all airfields in the area, with Toowoomba Wellcamp Airport being the largest and closest airfield and thus imposing the most limitations. This is the defined area of airspace designed to provide protection for occasions when pilots are flying by sight.

Refer to Chapter 7: Land Use and Tenure for more details on the existing infrastructure and utilities.

Unexploded ordnance (UXO)

Hazard description

UXO is ammunition that has been fired but did not explode or detonate when used as intended. If UXO is encountered and disturbed at a later point in time, then an unintended detonation may occur.

Potential impacts

An assessment of the Department of Defence UXO mapping concludes there are no areas of UXO potential within the impact assessment area. Consequently, the likelihood of encountering UXO for this Project is considered to be negligible.

Bridges

Hazard description

Bridges are structures that provide an elevated trafficable surface for trains or road vehicles. In some instances, pedestrians may also be able to use road bridges.

Bridges will be one of the more complex components of the Project to construct due to:

- The requirement for piling to establish structural piers
- The requirement for large pre-cast concrete components to be delivered to site and manoeuvred into position
- The requirement to work activities at height
- The need to undertake construction activities over water or over operational roads.

During operation, hazards associated with bridges are mostly attributed to:

- The ongoing structural integrity of each bridge and the importance this plays in their operational safety and functionality. Structural integrity may be compromised for a variety of reasons, but generally due to:
  - Natural hazards, such as floods
  - Vehicular collisions with components of a bridge structure
  - Ageing of materials, which could be accelerated by the previous two causes
- The elevated platform that bridges provide for objects or persons to fall (either intentionally or unintentionally).

Potential impacts

The reference design includes 34 bridges, as detailed in Table 19.9.

TABLE 19.9 SUMMARY OF BRIDGE STRUCTURES FOR THE PROJECT

Crossing type	Number
Rail-over-road	11
Rail-over-watercourse	20[1]
Road-over-rail	3

Table note:
1. Includes one bridge that crosses a road and a watercourse

The construction of bridges consists of a combination of high-risk activities. If an incident were to occur during the construction of a bridge, then such an incident has a high likelihood of resulting in serious injury or even death to workers or members of the public within the immediate vicinity of the occurrence.

During operation, the compromised integrity of a bridge structure, if it were to occur, could result in:

- Temporary closure of the railway network until the structural defect is corrected. This would impact on the ability of the broader Inland Rail network to operate in an efficient manner.
- In extreme and rare cases, structural collapse may occur. In such cases, serious injury or death may occur to train operators or members of the public within the immediate vicinity of the occurrence. Other infrastructure (e.g. roads or utilities) in close proximity to the collapse may also experience substantial damage.
- Dangerous goods will be transported along the rail alignment; therefore, collapse of, or damage to, bridges can lead to the loss of freight from elevated track. In such cases, loss of containment and spills could result in:
  - Contamination to land and/or waterways
  - Fire or explosion, impacting surrounding persons in the immediate vicinity
  - Dangerous conditions on trafficable surfaces beneath the bridge structure at the location of the leak or spill
  - Potential for members of the public to come in physical contact with dangerous goods or hazardous substances.

Bridges also facilitate the risk of objects or persons falling from an elevated level, which has the potential to impact personal safety for road or rail traffic.

Emergency access

Hazard description

Emergency services include:

- Police
- Fire
- Ambulance
- SES, in cases of flood or storms.

Each of these services would use a combination of the public road network and private accesses when responding to a request for service or emergency.

While not strictly an emergency service, the Queensland Parks and Wildlife Service (QPWS) are reliant on a network of tracks and trails for accessing and managing Queensland estate, including Whetstone and Bringalily State forests. Management activities include conducting controlled back-burns in these areas. Therefore, the existing network of trails within these estates is crucial for maintaining safe access and egress for QPWS personnel when conducting these estate-management activities. Interactions between the Project and the QPWS network of tracks and trails in Whetstone and Bringalily State forests is shown in Figure 19.4.

Potential impacts

Both planned and unplanned severance or modification to established emergency access routes has the potential to cause delayed response times to emergencies. Construction activities for the Project have the potential to cause:

- Increased traffic on public road networks in proximity to the Project
- Temporary road and access closures requiring detours
- Temporary alterations to driving conditions, such as lane closures, reduced speed limits and traffic controls.

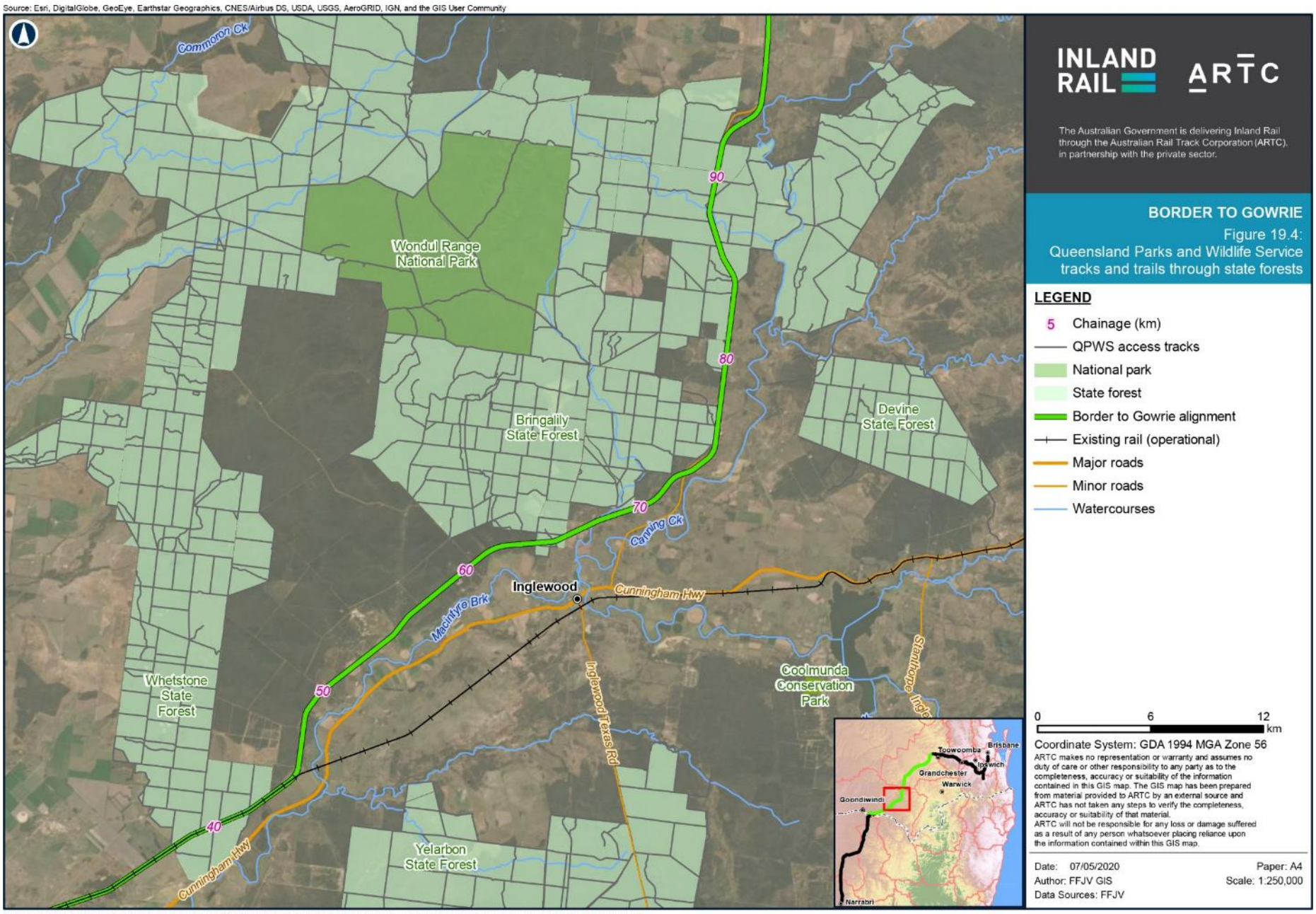
Each of these examples have potential to result in increased response times for emergency services. In the case of estate management, restricted access and detours within State forests will impact on the ability of QPWS personnel to safely navigate or evacuate the area, as required.

ARTC has consulted with TRC, GRC, QPWS and Queensland Fire and Emergency Service (QFES) through development of the reference design and the impact assessment process. As a result, the reference design for the Project has, in all instances, maintained connectivity across the Project footprint for public roads. The design also provides maintained access to private and State land. This has been provided through either:

- Crossing points of the rail alignment in the location of the existing access
- Continued means of access, via an alternative location, with interconnectivity provided.

At locations where level crossings of the rail alignment will be provided, wait times of up to 199 seconds (active level crossing at Owens Scrub Road) may be experienced by road or access users during train pass-by. These wait times may result in increased emergency response times in localised instances.

For further details of impacts on emergency services refer to Chapter 15: Social, Appendix P: Social Impact Assessment, and Appendix T: Traffic Impact Assessment for further details of impacts on emergency services.


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Common Ck
Wondul Range National Park
Bringalily State Forest
Devine State Forest
Inglewood
Cunningham Hwy
Macintyre Brk
Canning Ck
Inglewood Texas Rd
Whetstone State Forest
Coolmunda Conservation Park
Yelarbon State Forest
Cunningham Hwy
90
80
70
60
50
40
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 19.4:
Queensland Parks and Wildlife Service tracks and trails through state forests
LEGEND
5 Chainage (km)
QPWS access tracks
National park
State forest
Border to Gowrie alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
Toowoomba
Brisbane
Ipswich
Grandchester
Warwick
Goondiwindi
Narrabri
0
6
12
km
Coordinate System: GDA 1994 MGA Zone 56
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Paper: A4
Author: FFJV GIS
Scale: 1:250,000
Data Sources: FFJV
Map by: FC Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004301445_Hazard_and_Risk_chapter_figures\B2G_EAP_fig19.4_ParksAccessTracks_ARTC.mxd Date: 7/05/2020 11:52

Abandoned mines

Hazard description

Under Queensland law, a mine is considered abandoned when there is no longer a current mining tenement or environmental authority in place. Abandoned mines pose potential risks to community health, safety and the environment (Queensland Government, 2019b). Historically, mines were constructed and maintained to be safe only while they were in operation. The abandonment process, if performed, was not always done well. Even when a mine is closed properly, the effects of time can reduce the effectiveness of the precautionary measures (Government of Western Australia, 2017).

Hazards associated with historical and abandoned mine workings are as follows:

- Mine openings, i.e. shafts, pits and quarries: weathered ground around these areas can subside or break away under vibrations from a vehicle or under a person's weight
- Dangerous gases and lack of oxygen: methane, carbon monoxide, hydrogen sulphide and sulphur dioxide can accumulate in underground workings to create a toxic atmosphere within a confined space
- Cave-ins: old mine workings are potentially unstable and can cave in at any time
- Unsafe structures: old and disused underground or surface mining structures may be unsafe for use as their original purpose
- UXO: deteriorating explosives that have been left in place on abandoned operations may occasionally be encountered
- Highwalls: rock walls resembling cliffs may remain at the point where mining excavation ceased. These highwalls can be unstable and prone to collapse
- Waste rock heaps: waste heaps from the mining process can become unstable when steep slopes are saturated by water (e.g. rainfall)
- Water hazards: many abandoned mines fill with water over time. The water may be salty, acidic or contain microorganisms. There may also be unseen hazards below the water surface from abandoned equipment or rock falls.

Historical and abandoned mines in proximity to the Project, as mapped by the Department of Natural Resources, Mines and Energy (DNRME), are shown in Figure 19.5a to Figure 19.5c.

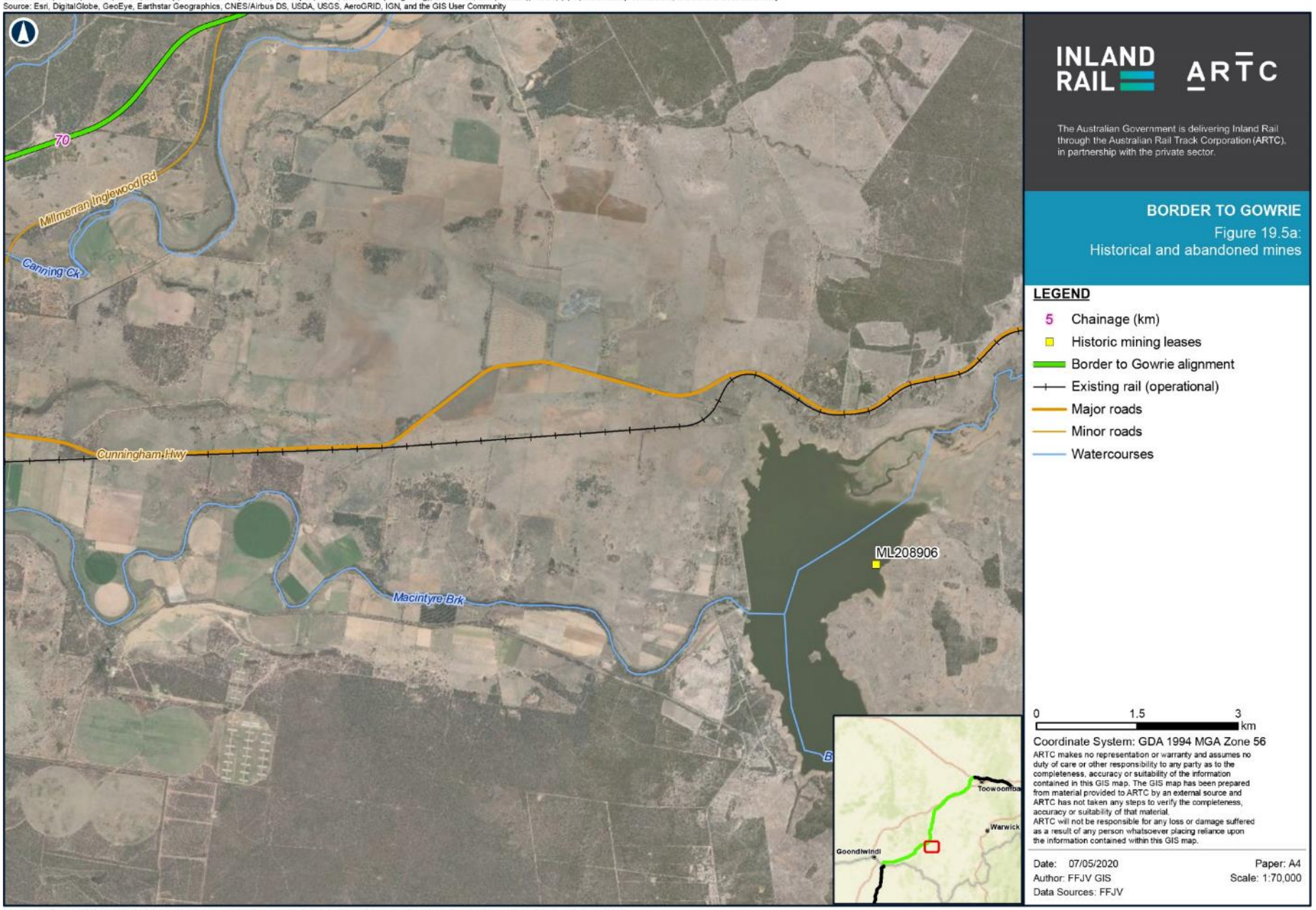
Potential impacts

DNRME historical and abandoned mine data shows that the closest historical mining activity to the alignment occurred on mining lease ML204358 (refer Figure 19.5a to Figure 19.5c). This historic mining lease was located on the south-eastern outskirts of Kingsthorpe, approximately 2 km north of the Project alignment. There are no known abandoned mines within the Project footprint; therefore, the Project will not interact with any known abandoned mines.

The reliability of DNRME abandoned mines mapping, for both accuracy and completeness, cannot be readily established and the possibility of unrecorded mine workings occurring within the Project footprint cannot be ruled out (DNRME, personal communication, 2020); therefore, the potential remains, however unlikely, for elements of the Project to overlay unrecorded abandoned mine workings.

Encountering unrecorded abandoned mine workings during Project activities may result in localised landslide, sudden subsidence and movement of soil and rock, each of which may, in turn, result in damage to equipment or plant and injury or death to people.

Additional geotechnical investigations will be undertaken along the entirety of the Project alignment, to establish the geotechnical conditions over which the Project will be located, thereby identifying the location of unrecorded abandoned mine workings. This geotechnical information would be used during detail design to establish engineered controls to manage risks associated with such findings.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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
70
Millmerran Inglewood Rd
Canning Ck
Cunningham Hwy
Macintyre Brk
ML208906
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 19.5a:
Historical and abandoned mines
LEGEND
5 Chainage (km)
Historic mining leases
Border to Gowrie alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
Toowoomba
Warwick
Goondiwindi
0 1.5 3
km
Coordinate System: GDA 1994 MGA Zone 56
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Data Sources: FFJV
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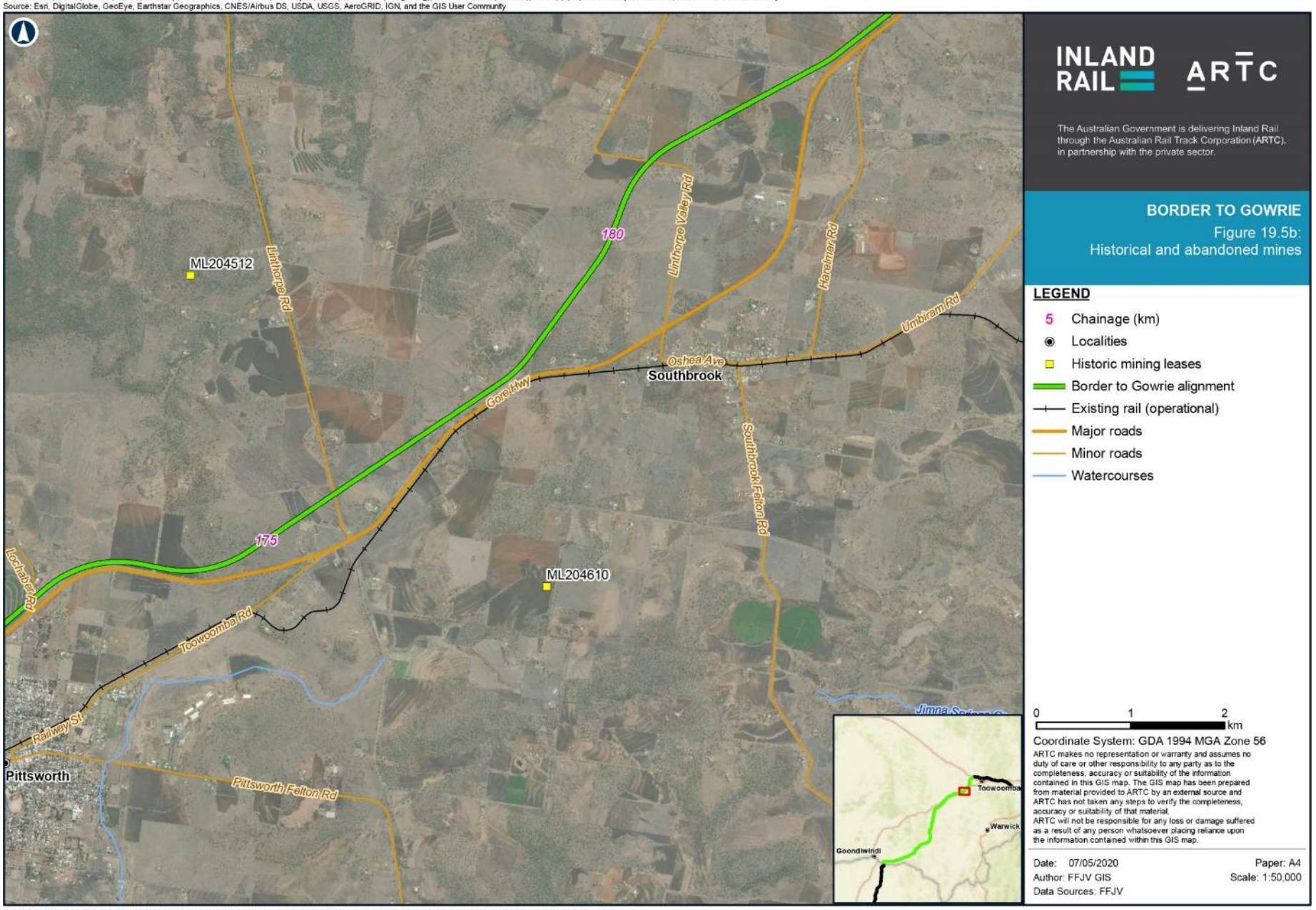
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
ML204512
ML204610
180
175
Linthorpe Rd
Linthorpe Valley Rd
Harelmari Rd
Umbiram Rd
Oshea Ave
Southbrook
Gore Hwy
Southbrook Felton Rd
Lochabers Rd
Toowoomba Rd
Railway St
Pittsworth
Pittsworth Felton Rd
Jimna
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 19.5b:
Historical and abandoned mines
LEGEND
5 Chainage (km)
Localities
Historic mining leases
Border to Gowrie alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
0 1 2
km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
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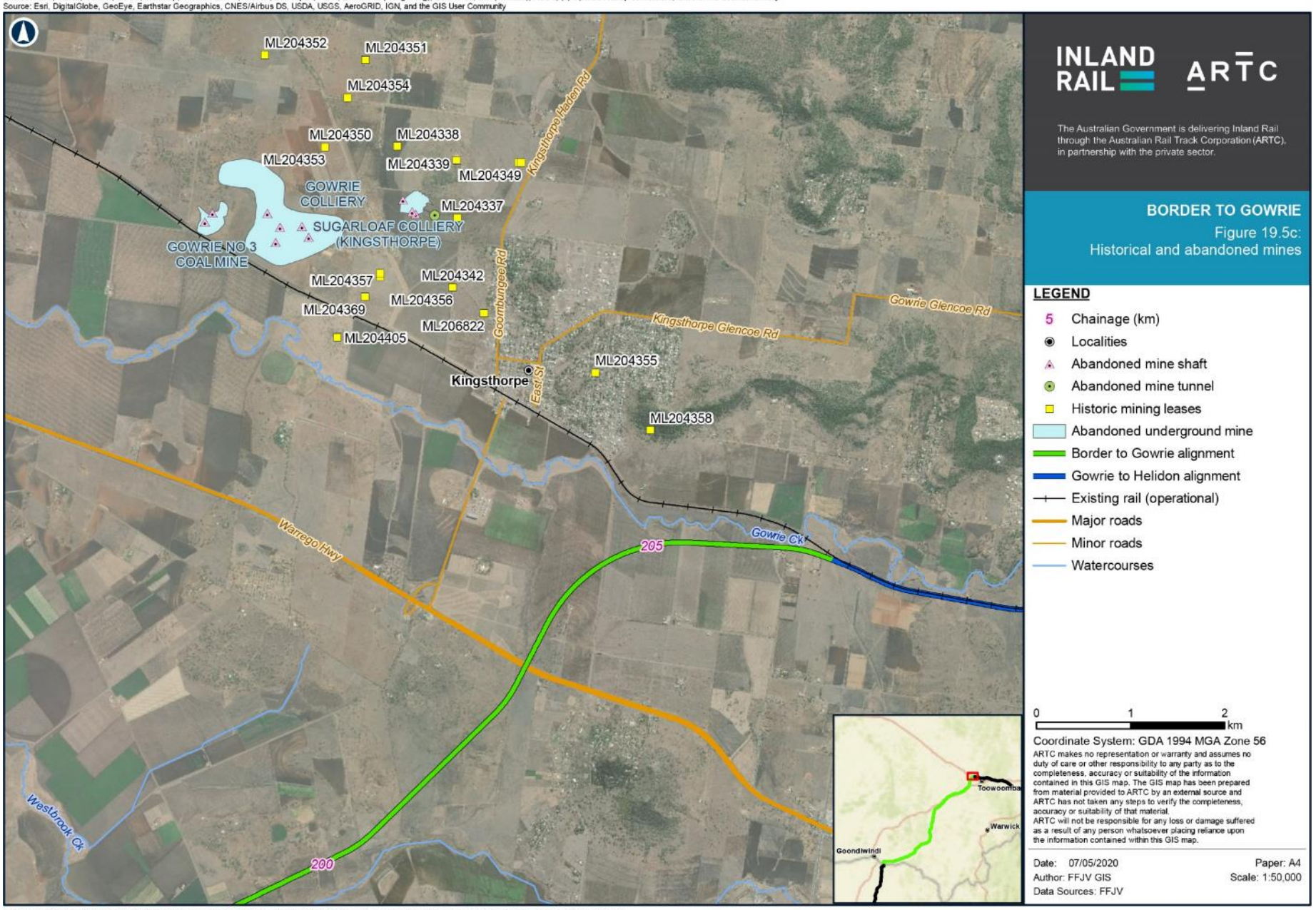
Map by: FC Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004301445_Hazard_and_Risk_chapter_figures\B2G_EAP_fig19.5_HistoricalMines_ARTC.mxd Date: 7/05/2020 14:14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ML204352
ML204351
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ML204350
ML204338
ML204353
ML204339
ML204349
Kingsthorpe Haden Rd
GOWRIE COLLIERY
ML204337
SUGARLOAF COLLIERY (KINGSTHORPE)
GOWRIE NO 3 COAL MINE
ML204357
ML204342
ML204356
ML204369
ML206822
ML204405
Goombungee Rd
Kingsthorpe
East St
ML204355
ML204358
Gowrie Glencoe Rd
Kingsthorpe Glencoe Rd
Warrego Hwy
Gowrie Ck
205
200
Westbrook Ck
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 19.5c:
Historical and abandoned mines
LEGEND
5 Chainage (km)
Localities
Abandoned mine shaft
Abandoned mine tunnel
Historic mining leases
Abandoned underground mine
Border to Gowrie alignment
Gowrie to Helidon alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
0 1 2 km
Coordinate System: GDA 1994 MGA Zone 56
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Map by: FC Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004301445_Hazard_and_Risk_chapter_figures\B2G_EAP_fig19.5_HistoricalMines_ARTC.mxd Date: 7/05/2020 14:14

19.7.3 Dangerous goods and hazardous substances

Dangerous goods are substances and articles that have explosive, flammable, toxic, infectious or corrosive properties. If stored, handled or used incorrectly, they pose a risk to public safety, property or the environment.

Dangerous goods substances and articles are allocated to one of nine classes. Some of these classes are subdivided into divisions:

- **Class 1:** Explosives
  - **Division 1.1:** substances and articles that have a mass explosion hazard
  - **Division 1.2:** substances and articles that have a projection hazard but not a mass explosion hazard
  - **Division 1.3:** substances and articles that have a fire hazard and either a minor blast hazard or a minor projection hazard, or both, but not a mass explosion hazard
  - **Division 1.4:** substances and articles that present no significant hazard
  - **Division 1.5:** very insensitive substances that have a mass explosion hazard
  - **Division 1.6:** extremely insensitive articles that do not have a mass explosion hazard.
- **Class 2:** Gases
  - **Division 2.1:** flammable gases
  - **Division 2.2:** non-flammable, non-toxic gases
  - **Division 2.3:** toxic gases.
- **Class 3:** flammable liquids
- **Class 4:** flammable solids; substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases
  - **Division 4.1:** flammable solids, self-reactive substances and solid desensitised explosives
  - **Division 4.2:** substances liable to spontaneous combustion
  - **Division 4.3:** substances that emit flammable gases when in contact with water.
- **Class 5:** oxidising substances and organic peroxides
  - **Division 5.1:** oxidising substances
  - **Division 5.2:** organic peroxides.
- **Class 6:** toxic and infectious substances
  - **Division 6.1:** toxic substances
  - **Division 6.2:** infectious substances.
- **Class 7:** radioactive material
- **Class 8:** corrosive substances
- **Class 9:** miscellaneous dangerous substances and articles.

This section introduces the hazards and potential impacts associated with dangerous goods in relation to the Project.

19.7.3.1 Construction and operational maintenance chemicals

Hazard description

Dangerous goods are commonplace when undertaking construction and operational maintenance activities for rail infrastructure. Such dangerous goods may include fuels, greases, gases and chemicals. Hazards attributed to dangerous goods during construction and operational maintenance activities for the Project are associated with the following activities:

- Transportation
- Storage
- Handling and usage
- Disposal.

Hazardous circumstances may arise if unsuitable or incomplete controls are implemented during the undertaking of any of the above-listed activities. The potential consequences of such hazards will vary depending on the class and division of the dangerous goods in question. The potential consequences of hazards associated with dangerous goods may involve one or more of the following:

- Explosion
- Fire
- Creation of toxic atmospheres
- Injuries and/or death
- Release of radiation
- Contamination of surrounding environments (e.g. soil, water, air).

Potential impacts

Potential impacts involving dangerous goods are mostly commonly attributed to loss of containment that may arise due to accidents or inappropriate practices during the transport, storage, handling, use or disposal of those materials. Such instances may result in:

- Fire and/or explosion, resulting in damage to property, plant and equipment, and injuries or deaths
- Contamination of land, waterways or air, resulting in environmental degradation and harm
- Exposure of workers and members of the public to hazardous materials and dangerous emissions, resulting in illness, injuries or deaths.

The use of hazardous chemicals will be necessary, to varying degrees, for all phases of the Project; however, onsite storage of such chemicals is only anticipated during the construction phase. The indicative chemical storage and usage details of dangerous goods and hazardous materials for the Project are provided in Table 19.10 and have been determined based on usage on similar rail projects. While the chemicals required, and their quantities, may vary due to refinement of the construction approach during detail design and maintenance requirements of the Project, the types and indicative quantities identified in Table 19.10 are considered to provide a reasonable representation of the likely usage requirements for dangerous goods and hazardous materials.

TABLE 19.10 INDICATIVE LIST OF DANGEROUS GOODS AND HAZARDOUS SUBSTANCES

Chemical type	Typical chemicals	Project phase	Purpose/ use	Dangerous good class	Packing group	Indicative rate of use	Expected storage method
Fuel oil	Diesel	Construction Operation/ maintenance	Fuel for mobile equipment	9 (C1)[2]	III	40 kL/2 weeks	40 kL bulk storage (fuel depots)
Grease	Rocol Rail Curve Grease	Construction	Lubricate plant and equipment	C2[3]	N/A	Limited	Package storage
	Caltex 904Grease	Operation/ maintenance	Lubricate plant and equipment	C2[3]	N/A	Limited	Package storage
	Shell GADUS Gauge Face Curve Grease	Construction	Lubricate plant and equipment	C2[3]	N/A	Limited	Package storage
	RS Claretech Biodegradable Grease	Operation/ maintenance	Lubricate plant and equipment	C2[3]	N/A	As required by cutting/borrow pit activities	Package storage
Blasting chemicals	Ammonium nitrate[1]	Construction	Cuttings and borrow pit operations	5.1	III	Limited	Not stored
	Blasting explosives	Construction	Cuttings and borrow pit operations	1	II	Limited	Not stored
Concreting	Concrete and Concrete Residue	Construction	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries
	Concrete curing compound	Construction	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries
Welding gases	Oxygen	Construction	Welding	2.2/5.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage
	Acetylene	Construction	Welding	2.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage
Pesticides	Australian Pesticides and Veterinary Medicines Authority Approved Pesticides	Construction Operation/ maintenance	Pests and weeds control	6.1 or 9	I, II or III	As required during maintenance inspections by ARTC's Pesticide Use and Recording Procedure ENV-PR-003	Not stored in alignment

Table notes:

1. Product is a security sensitive explosive defined under Schedule 7 of the *Explosives Regulation 2017*
2. Class C1—a combustible liquid that has a flashpoint of 150°C or less.
3. Class C2—a combustible liquid that has a flashpoint exceeding 150°C

The storage and handling of hazardous chemicals at laydown areas introduces the potential for impacts associated with material properties such as flammability, corrosiveness and toxicity. Significant releases of hazardous chemicals can impact property, people and environmental receptors.

Class 3 flammable liquids and C1/C2 combustible liquids (i.e. fuels, oils and lubricants) have the potential to cause fires or escalate the risk of bushfire (refer Section 19.7.1.1), although their high flash points reduce the potential for small incidents to create significant consequences.

Generally, low volumes of hazardous chemicals would be stored at construction work fronts and laydown areas near to points of use. Laydown areas are situated next to the rail corridor to facilitate direct access to/from the laydown to the rail corridor. The quantities stored will be equivalent to the demand for construction activities within that area of the rail corridor.

During the construction phase, the following facilities are expected to be provided for storage and distribution of construction chemicals:

- Laydown areas will be located approximately every 5 km along the Project alignment, in addition to bridge and turnout locations onto the QR network. Small quantities of lubricants and oil (e.g. drum and intermediate bulk container package stores) will be stored at these locations.
- Diesel fuel depots will be located at approximately 20 km intervals along the Project alignment, which will provide for 40 kL bulk storage of diesel.

Each laydown has been positioned to avoid or minimise potential impacts to environmental constraints and social receptors. The locations of the laydown areas are provided in Chapter 5: Project Description and have been chosen to avoid areas that are within the 1% AEP floodplains where possible; however, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas must be located within floodplains and near water sources. In such instances, the following precautions will be taken:

- The potential site will be surveyed prior to site establishment to understand the exact extent of potential flooding impact to facilities and storage areas
- Earthworks and temporary drainage for each laydown site will be designed to minimise flooding impacts
- Critical equipment will be placed on earthworks and plinths that raise it above the predicted 1% AEP water level.

Operational use of chemicals is expected to be on an 'as required' basis and will typically involve limited quantities during specific maintenance activities (e.g. application of pesticides in accordance with ARTC rail corridor maintenance protocols).

Controls for the transport, storage, handling, use and disposal of dangerous goods and hazardous materials during construction and operation are specified in Section 19.8.2.

19.7.3.2 Freight transportation of dangerous goods

Hazard description

Hazards during the freight of dangerous goods on the Inland Rail network, including this Project, are associated with the potential for loss of containment of these materials in the process of train pass-by or as a result of a lost load in the case of a rail incident.

The potential consequences of such hazards will vary depending on the class and division of the dangerous goods in question. The potential consequences of freight transportation of dangerous goods may involve one or more of the following:

- Explosion
- Fire
- Injuries and/or death
- Contamination of surrounding environments (e.g. soil, water, air).

Potential impacts

Potential impacts involving the freight transportation of dangerous goods are attributed to loss of containment. Such instances may result in:

- Fire and/or explosion, resulting in damage to property, plant and equipment, and injuries or deaths
- Contamination of land, waterways or air, resulting in environmental degradation and harm
- Exposure of workers and members of the public to hazardous materials and dangerous emissions, resulting in illness, injuries or deaths.

The severity of such impacts would be dependent on the dangerous goods in question, the scale of spillage or loss and the location where the incident occurs. For instance, a minor spill of a combustible substance (C2 hazardous substance) such as diesel (refer Table 19.10), during train pass-by that is confined to the rail corridor will be of low significance. Conversely, the large-scale loss of a toxic or infectious substance (Class 6 dangerous good) such as cyanides or pentachlorophenol (used in some pesticides and disinfectants) (refer Section 19.7.3) that extends beyond the rail corridor and is in proximity to societal and/or environmental receptors would be of much greater significance. Generally, the likelihood of occurrence is inversely proportional to the significance of impact, such that a minor leak or spill is substantially more likely to occur than a large-scale loss of freight.

ARTC will manage the Inland Rail network, including this Project; however, the types of freight transported on the Inland Rail network will be dictated by market demand. ARTC does not own or operate rollingstock, but the transportation of dangerous goods on the Project rail alignment by independent operators will require authorisation by ARTC. The quantities and types of dangerous goods that may be transported will be managed in accordance with the requirements of the National Transport Commission's (NCT) *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018).

Where the Project traverses areas of environmental sensitivity, such as watercourses and land with shallow groundwater, there is the potential for significant loss of containment events to result in environmental degradation through release of toxic, corrosive or flammable materials. In the case of groundwater contamination, such release could lead to impacts such as health issues or crop damage if locals rely on the groundwater for personal use or irrigation purposes.

Incidents involving dangerous goods have potentially significant safety risks. Fires and the release of harmful chemicals can result in injuries and fatalities. Although Class 1 explosives will not be transported on the Inland Rail network, transportation of chemically unstable materials or oxidising agents (e.g. ammonium nitrate) can explode when spilled and mixed with fuel. Additionally, ammonium nitrate is at risk of explosion if exposed to a heat or ignition source, especially when in a confined space. Other potential loss of containment of flammable liquid, solid or gas, and toxic chemicals can also create major incidents such as pool fire, jet fire, explosion or toxic release.

19.7.3.3 Explosives use in proximity to the Project

Hazard description

The *Explosives Regulation 2017* (Queensland) defines security sensitive explosives as either:

a) A blasting explosive

b) A propellant powder

c) A firework other than an unrestricted firework

d) A pyrotechnic substance used in a firework

e) Security sensitive ammonium nitrate, which is defined as either:

   i) ammonium nitrate

   ii) a solid substance that either:

      1. consists of a mixture of ammonium nitrate and another substance if the mixture contains more than 45 per cent ammonium nitrate by mass
      2. is not classified as a Class 1 explosive.

f) Ammunition, other than small arms ammunition, that contains explosives.

Explosives are hazardous due to their mass explosion characteristic, projectile motion and radiant heat intensity; however, the severity of these hazards is dependent on the quantity and loading density. Hazards associated with the use of explosives, either for, or in proximity to, the Project, include:

- Inadvertent detonation
- Residual geotechnical instability
- Generation and emission of projectiles
- Dangerous noise levels
- Damaging vibration levels.

Construction methodologies that require the use of explosives are evaluated by the Explosives Inspectorate against the requirements under the *Explosives Act 1999* (Qld) and *AS 2187.2-2006 – Explosives – Storage, transport and use, Part 2: Use of explosives* (Standards Australia, 2006). Explosives must be stored, handled and transported by a licensed person as stipulated by the *Explosives Act 1999* (Qld). Additionally, a range of explosive related activities require notification under *Explosives Act 1999* (Qld), including:

- Before undertaking a blast
- Before importing or exporting explosives
- When storing or interacting with stored explosives at explosive storage facilities and government activities
- When there are changes to buildings and vehicles related to the storage or transport of explosives
- After conducting an explosive trial.

Potential impacts

Blasting explosives (including blast caps, detonators and boosters) and security sensitive ammonium nitrate are expected to be required during construction in order to achieve the requisite cutting depth in locations where hard rock is expected to be encountered. Locations where blasting is anticipated due to the presence of weathered and fresh basalt include:

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

To enable blasting, explosives will be transported, stored, handled and used during the construction phase of the Project. The possible impacts associated with these hazards are as follows:

- Serious injury or death to workers and/or members of the public in the immediate vicinity of inadvertent detonation or as a result of residual geotechnical instability
- Damage to property, machinery and existing infrastructure
- Health effects on workers and/or members of the public as a result of the generation of noise, vibration and dust.

Further information on the anticipated noise and vibration impacts of blasting are presented in Chapter 14: Noise and Vibration. Further information on air quality impacts associated with blasting is presented in Chapter 11: Air Quality.

Security sensitive explosives, including ammonium nitrate or any Class 1 explosive, will not be transported on the Inland Rail network, including the Project, when operational. Freight of explosives is excluded as it introduces substantial risks that would require further mitigation in accordance with the *Explosives Act 1999* (Qld).

Audible track warning devices are small track-mounted detonators that contain Class 1 explosives. They are used to attract the attention of work crews within an operational rail corridor and notify of an approaching train. Audible track warning devices may be used during operational maintenance activities for the Project, where the works are occurring within operational rail corridors. These devices will be used in very small quantities and therefore do not require specific design considerations. Maintenance crews working on the Inland Rail network will be required to have completed safe work training, which includes a module on the use of audible track warning devices.

The rail alignment is located between 500 m and 900 m of the current north–western extent of the Commodore Mine's open-cut workings. On occasion, the mine may use explosives to progress workings. The Project is sufficiently separated from the mine's operations for blast vibration to dissipate without impacting on the integrity of the rail infrastructure; however, runaway reactions from explosive transportation, use, or handling as part of mine operations have the potential to escalate the risks associated with dangerous goods freight and damage to rail infrastructure, including rail power supplies. Altered traffic conditions during the construction phase of the Project could also affect mine explosive transport routes and, if not appropriately managed, could potentially result in interface conflicts.

19.8 Mitigation measures

This section provides discussion of mitigation measures and controls that have been incorporated into the reference design development process, as appropriate and where possible (refer Section 19.8.1), as well as those measures that are proposed to be adopted for future phases of Project delivery (refer Section 19.8.2).

19.8.1 Mitigation through the reference design phase

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

Mitigation measures and controls that have been factored into the design, or otherwise implemented during the reference design phase for the Project, are summarised in Table 19.11.

TABLE 19.11 INITIAL MITIGATION MEASURES OF RELEVANCE TO HAZARD AND RISK

Aspect	Mitigation measures
Natural hazards	
Flooding as a result of development of the Project	▸ The Project has been designed to achieve the following: ▸ 50-year design life for formation and embankment performance ▸ Track drainage ensures that the performance of the formation and track is not affected by water ▸ Earthworks designed to ensure that the rail formation is not over-topped during a 1% AEP flood event, with 300 mm freeboard to formation level ▸ Embankment cross section can sustain flood levels up to the 1% AEP ▸ Bridges are designed to withstand flood events up to and including 0.05% AEP (2000-year event) ▸ The Project uses the existing South Western Line and Millmerran Branch Line rail corridors as much as possible to avoid introducing a new linear infrastructure corridor across floodplains, where possible ▸ The Project incorporates bridge and culvert structures to maintain existing flow paths and flood-flow distributions, such as across the Condamine River floodplain, where six bridges have been incorporated into the design with a combined length of 6 km ▸ Bridge and culvert structures have been located and sized to avoid increases in peak water levels, velocities and duration of inundation ▸ All bridges and culverts have been designed to reduce the risk of scour with events up to 1 % AEP ▸ The reference design includes the option to modify the existing Yelarbon flood levee to increase the flood immunity for the township of Yelarbon with the addition of the Project ▸ A climate assessment has been incorporated into the design of cross drainage structures for the Project in accordance with the *Australian Rainfall and Runoff Guidelines* (Book 1 Chapter 6) (Ball et al., 2016) for the local drainage catchments for the 1% AEP design event to determine the sensitivity of the design to the potential increase in rainfall intensity.
Landslide, sudden subsidence, movement of soil or rocks	▸ Geotechnical investigations have been undertaken within the Project footprint to determine geotechnical conditions. Investigations have been targeted to specific locations, such as: ▸ Locations of bridge abutments ▸ Locations of significant cuts ▸ Locations of significant fill ▸ Geotechnical field data has been used to derive design criteria for structures and rail formation. This has enabled the Project to be designed to cater for field verified geotechnical conditions. ▸ Design and ratings of earthworks in support of culverts, viaducts, and bridges are in accordance with *AS 5100 Bridge Design* (Standards Australia, 2017b) and *AS 7636 Railway Structures* (Standards Australia, 2013b) and other applicable Australian standards ▸ The Project has been aligned to avoid steep slopes, where possible. Where slopes could not be avoided, the railway will be positioned in cut, in order to negate the natural steep topography and achieve an operational gradient that is compatible with the maximum compensated operational gradient of 1:80 for general alignment (1:50 for medium speed alignment standards or mountainous terrain).

Aspect	Mitigation measures
Project hazards	
Rail incidents as a result of development of the Project	▸ The Project has been designed to minimise the likelihood of rail incidents for the types of trains projected to use the Inland Rail network. This has been achieved by adhering to the minimum design requirements of the basis of design (refer Chapter 5: Project Description), which are: ▸ Design speed of 115 km/h ▸ Maximum grade of 1:80, with 1:100 the target ▸ Maximum curve radius of 800 m, with 1,200 m target ▸ Initial train lengths of 1,800 m, with potential to increase up to 3,600 m. ▸ The reference design includes mixed-gauge turnouts at locations where the Project interfaces with existing rail networks or infrastructure, to enable QR rollingstock to join and exit the Inland Rail network.
Road–rail interfaces	▸ Grade separated crossings of existing roads have been adopted instead of level crossings, where feasible. The specific design treatment at each road–rail interface has been selected based on a combination of factors, which include: ▸ Topography ▸ Road classification ▸ Rail geometry ▸ Road geometry ▸ Community and stakeholder feedback through consultation. ▸ Where grade separation has not been feasible, the design has been developed in accordance with ARTC *Engineering Code of Practice—Level Crossings* (ARTC, 2011) ▸ Additional physical controls at level crossings such as boom gates and warning lights are provided in accordance with the code of practice ▸ Level crossings have been subject to safe design studies and risk assessments in accordance with ALCAM to identify and reduce, as far as practicable, the potential risks associated with these crossings ▸ The reference design for the Project has, in all instances, maintained access for private properties and stock route users. This has been provided through either: ▸ The provision of a crossing point of the rail alignment in the location of the existing private access or stock route ▸ The provision of an alternative means of: – Accessing a dwelling or place of work from the public road network – Moving stock.
Utilities	▸ Aerial and subsurface utility investigations have been completed to inform the reference design. Investigations confirmed the presence, location and orientation of utilities within the Project footprint. ▸ Minimum design requirements have been established for the Project to guide the design treatment of utility clashes. The design requirements have been developed to be consistent with recommendations in *AS 4799-2000 Installation of underground utility services and pipelines within railway boundaries* (Standards Australia, 2000). ▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project footprint has commenced and have informed the initial utility interface treatments that have been included in the reference design. Asset owners include APA, Energex, Millmerran Operation Co., QUU, Powerlink, Santos, Optus/Uecomm, NBN and TPG. ▸ The Project has been designed to avoid substantial earthworks over high-risk underground assets, therefore avoiding the need to relocate such utilities. Examples include APA's Roma–Brisbane gas pipeline and Santos' Moonie–Brisbane oil pipeline. ▸ The Project's vertical alignment has been established to avoid direct impact to Powerlink's overhead transmission line asset, such as the 330 kV overhead lines at Whetstone (Ch 39.5 km) and Millmerran (Ch 120.9 km) and the 110 kV overhead line at Westbrook (Ch 193.9 km).

Aspect	Mitigation measures
Existing infrastructure	▸ The Project alignment has been positioned to avoid areas of planned future workings associated with Commodore Mine ▸ The Project footprint is approximately 1 km from the northern end of the runway for the Toowoomba Wellcamp Airport. The Project has been positioned to ensure that double-stacked freight trains will not extend vertically into the OLS for this airport and any other airfields in the surrounding area.
Bridges	▸ Track design on rail bridges is in accordance with ARTC's *Engineering Code of Practice—Ballast* (ARTC, 2012). The requirements of this code of practice ensure that ballast kerb profiles on bridges achieve sufficient height to maintain the ballast for the anticipated operational train speed. Adherence to this code of practice reduces the likelihood of ballast being lost from rail bridge structures. ▸ Anti-throw screens have been incorporated into the design of road bridges to reduce the likelihood of objects being thrown off road bridges onto the rail track ▸ Maintenance access to the deck level of all new bridge structures has been incorporated into the reference design ▸ Bridge clearances have been established in consultation with the owners of existing assets over which the bridge structures span, i.e. DTMR, local governments and private landowners ▸ No public pedestrian access is provided on road-over-rail bridges.
Historical and abandoned mines	▸ The Project alignment has been positioned to avoid areas of previous workings associated with Commodore Mine ▸ The Project alignment has been positioned to avoid recorded historical and abandoned mines.
Dangerous goods and hazardous chemicals hazards	

Freight dangerous goods	▸ The rail alignment has been designed to minimise the likelihood of rail incidents for the types of trains projected to use the Inland Rail network. This has been achieved by adhering to the minimum design requirements of the basis of design (refer Chapter 5: Project Description).
	▸ ARTC have consulted with TRC, GRC, QPWS and QFES through the impact assessment and design development process. As a result, the reference design for the Project has, in all instances, maintained connectivity across the Project footprint for public roads. The design also provides maintained access to private and State land. This has been provided through either:
	  ▸ The provision of a crossing point of the rail alignment in the location of the existing access
	  ▸ The provision of continued means of access, via an alternative location, with interconnectivity provided.

19.8.2 Proposed mitigation measures

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

Table 19.12 identifies the relevant Project phase, the aspect to be managed and the proposed mitigation measure. The mitigation measures presented in Table 19.12 have then been factored into the assessment of residual risk, as documented in Table 19.13.

Chapter 22: Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures.

TABLE 19.12 HAZARD AND RISK MITIGATION MEASURES FUTURE PHASES OF PROJECT DELIVERY

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detail design	Natural	Flooding	▸ The Project has been designed to achieve a 1% AEP flood immunity to rail formation level and, at the same time, to avoid impacts exceeding the guiding design criteria on the existing flooding and drainage regime. These same design principles will apply to the detail design of the Project. ▸ Ancillary infrastructure such as construction compounds, stockpiles and laydown areas will be designed to achieve a 1% AEP flood immunity, where possible. Laydown areas and other temporary construction facilities that are located within the 1% AEP will be temporary. ▸ Some laydown areas must be located within floodplains and near water sources. In such instances, the following precautions will be taken: ▸ The potential site will be surveyed prior to site establishment to understand the exact extent of potential flooding impact to facilities and storage areas ▸ Earthworks and temporary drainage for each laydown site will be designed to minimise flooding impacts ▸ Critical equipment will be placed on earthworks and plinths that raise it above the predicted 1% AEP water level. ▸ Design modifications during the detail design phase will be subject to re-runs of the existing flood models to demonstrate continued compliance with the design objectives of the Project, including for extent and time of inundation, afflux and flow velocities ▸ Modification of the existing Yelarbon levee may be the preferred design solution to avoid worsening of hydrological conditions in the Yelarbon area. If this solution is confirmed as preferred through detail design, the design requirements for modifying the existing Yelarbon levee will be confirmed through further consultation with GRC. It is anticipated that the modified levee would be considered a Category 2 levee (Schedule 10 of the *Water Regulation 2016*), and a waterway barrier, requiring a development approval under the *Planning Act 2016* (Qld).
	Natural	Bushfire	▸ Appropriate access and egress solutions throughout Whetstone and Bringalily State forests will be incorporated into the detail design and continued access will be allowed for in the construction methodology. This aspect of the design will be supported by consultation with DAF and QPWS (DES). ▸ The rail corridor will be designed to be free of woody vegetation, thereby acting as a firebreak in bushfire risk areas, e.g. Whetstone and Bringalily State forests. This aspect of the design will be supported by consultation with DAF to ensure sufficient access is available for emergency access and firefighting activities. ▸ Where provided, the rail maintenance access road (RMAR) will be designed to be suitable for use by emergency response vehicles.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detail design (continued)	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ Additional geotechnical investigations will be undertaken during detail design to ensure site-specific geotechnical conditions are reflected in the finalised design solution. Additional geotechnical investigations will specifically target locations where: ▸ The design includes: – Cuts – Embankments – Bridge piers and abutments. ▸ Potential/actual ASS, specifically material with Macintyre River, Macintyre Brook, Condamine River and Oxley Creek, may be disturbed by construction. ▸ Additional soil investigations will be undertaken during detail design to ensure that the design of structures, embankments, erosion control measures (temporary and permanent) and site rehabilitation planning are reflective of site-specific soil conditions. Soil investigations will be in accordance with the *Guidelines for surveying soil and land resources* (CSIRO/McKenzie et al., 2008), the *Australian soil and land survey field handbook* (CSIRO, 2009) and the *Guidelines for Soil Survey along Linear Features* (Soil Science Australia, 2015). Additional soil investigations will specifically identify materials that are: ▸ Sodic (dispersive) ▸ Saline ▸ Acidic. ▸ Examples of soils that will require specific design consideration include: ▸ The high naturally occurring sodicity of soils in the Yelarbon area (sodosols) ▸ Cracking clays of the Condamine River floodplain (vertosols).
	Natural	Climatic conditions	▸ The detail design will be developed to accommodate the outcomes of climate analysis. This analysis will be conducted in accordance with the *Australian Rainfall and Runoff Guidelines* (Ball et al., 2016) by increasing the rainfall intensities for the local catchments to reflect RCP8.5. RCP8.5 is a future climate trend projection, reflective of a low effort made to curb greenhouse gas emissions; therefore, RCP8.5 projections are reflective of a close to worst-case climactic scenario for 2011. This corresponds to an increase in temperature of 4.2°C in 2090 and an increase in rainfall intensity of 23%. The incorporation of this analysis into design will ensure the Project is designed for the expected effects of climatic conditions (RCP8.5) for the design life of the Project. ▸ The use of elastic fasteners or heavier sleepers will be considered to reduce the risk of track buckling as a result of extreme temperatures in future climatic scenarios ▸ The type and colour of track materials will be selected to reduce heat load on trackside equipment as a result of extreme temperatures in future climatic scenarios ▸ The track will be designed to conform with all mandatory components of *AS/RISSB 7643 Track Stability*. ▸ Adaption strategies for climatic conditions will be identified and adopted through detail design. Strategies may include installing an early flood warning system to alert ARTC to impending flood risks, locating critical electrical systems (signalling, communications huts, etc.) above potential flood zones and considering the use of solar and battery devices to ensure uninterrupted operation of signalling and network communication in the event of power failure.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detail design (continued)	Project	Rail incidents	▸ Track design will incorporate trackside monitoring systems, which will detect faults in the wheel set of trains and monitor rail wheel condition and defects to reduce the likelihood of rail incidents, including derailment. The locations for trackside monitoring systems will be confirmed and incorporated into the detail design. ▸ The construction approach for the components of the Project within the existing rail corridor for the South Western Line and the Millmerran Branch Line will be confirmed through discussion with QR to ensure coordination between operations to reduce likelihood of rail and/or road incidents. The agreed construction approach in these locations will require a wayleave agreement, or similar, between ARTC and QR.
	Project	Emergency access	▸ The detail design will be developed to ensure that access for private properties is maintained such that emergency access to residents is not impeded ▸ Consultation with Toowoomba and Goondiwindi local disaster management groups, in addition to QPS (including the Security and Counter-Terrorism Command), QAS and QPWS will continue throughout the detail design process to ensure that: ▸ Appropriate access and egress solutions are incorporated into the detail design to enable movements across the rail corridor ▸ The scope and schedule of proposed works is communicated to first responders ▸ Possible impacts and affected locations, groups and/or individuals are recognised. ▸ A Traffic Management Sub-plan will be developed and incorporated into the Construction Environmental Management Plan (CEMP). This sub-plan will specify how access across the rail corridor will be maintained during construction for emergency response vehicles (refer Chapter 18: Traffic, Transport and Access and Chapter 22: Outline Environmental Management Plan). ▸ Safe corridor access and vehicle turnaround points will be provided in the design for maintenance work, to ensure sufficient setback while working adjacent to live railway. Maintenance and emergency access roads will be designed such that it will allow separation to prevent interaction between trains and vehicles without impeding escape or rescue activities.
	Project	Historical and abandoned mines	▸ Additional geotechnical investigations will be undertaken along the entirety of the Project alignment to establish the geotechnical conditions over which the Project will be located, thereby identifying the location of unrecorded abandoned mine workings. This geotechnical information would be used during detail design to establish engineered controls to manage risks associated with such findings.
	Project	Road–rail interfaces	▸ Mitigation measures incorporated into design may include active controls (e.g. flashing lights and boom gates) and/or passive controls or treatments (e.g. signage and pavement marking) in accordance with the *Guide to Development in a Transport Environment: Rail* (DTMR, 2015) and *AS 1742.7—Manual of uniform traffic control devices, Part 7: Railway crossings* (DTMR, 2019g) to reduce the likelihood and impact of road–rail collisions. Such measures will be implemented in conjunction with the road asset owner (i.e. DTMR and private owners). ▸ Detail design of appropriate exclusion fencing is required near roads or where trespass is likely to occur, to reduce the likelihood of trespasser injury or death from rail collision. Specific fencing requirements are to be agreed through discussion with adjoining landowners and asset owners. The general fencing strategy for the Project is provided in Chapter 5: Project Description.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detail design (continued)	Project	Design interfaces with utilities	▸ Utility interface treatments that have been included in the reference design have been discussed with individual utility owners. The exact methodology for utility modification, upgrade, diversion or realignment will be subject to confirmation once the Project design is finalised and will be determined through further consultation with the affected utility owners. ▸ Designs for utility protection, where necessary, will be developed in consultation with the relevant utility owner and be in accordance with the following: – *Electrical Safety Act 2002* (Qld) – Electrical Safety Regulation 2002 – ENA NENS 03-2006: *National Guidelines for Safe Access to Electrical and Mechanical Apparatus* (Energy Networks Association, 2006) – AS/NZS *7000 Overhead Line Design* (Standards Australia, 2016c) – Safe *Work Australia Model Code of Practice— Managing Electrical Risks in the Workplace* (Safe Work Australia, 2018b) ▸ Gas and petroleum pipelines: – *Petroleum & Gas (Production & Safety) Act 2004* (Qld) – AS 2885 *Pipelines—Gas and liquid petroleum* (Standards Australia, 2008b) – AS/NZS 4645 *Gas Distribution Network* (Standards Australia, 2018d) ▸ Communications: – Telecommunication Cabling Provider Rules 2014 – Telecommunications Technical Standard (Requirements for customer cabling products – AS/CA S008) 2015 – Australian Standard – Installation requirements for customer cabling (Wiring Rules) (Communications Alliance Ltd, 2020) ▸ Water: – Water Supply Code of Australia (Water Services Association of Australia, 2011) – AS/NZS 2566 Buried flexible pipeline: Structural design (Standards Australia, 1998b) ▸ Sewerage: – Gravity Sewerage Code of Australia (Water Services Association of Australia, 2014) – Pressure Sewerage Code of Australia (Water Services Association of Australia, 2007) – AS/NZS 2566 Buried flexible pipeline: Structural design (Standards Australia, 1998b)

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction	Project	Existing infrastructure and utilities	▸ Utilities within the Project footprint will be surveyed and marked prior to the commencement of construction ▸ Where protection or relocation of a utility is required as an outcome of consultation with asset owners and detail design, these works will be undertaken prior to the commencement of construction to reduce the likelihood of impacts to those services ▸ Protection or relocation of utilities will be conducted in accordance with relevant legislation, Australian Standards and guidelines (refer above) ▸ Safe working distance between the Project footprint and the worked area of the Commodore Mine to be determined, to reduce the likelihood of worker or public injury ▸ The Roma-to-Brisbane gas pipeline and the decommissioned Moonie-to-Brisbane oil pipeline (which still presents a risk of potential flammable atmosphere in the pipeline) are to be considered in collaboration with pipeline operators to minimise the risk of loss of containment of gas or flammable atmospheres. Ongoing consultation with pipeline operators will be conducted throughout the Project. Consultation will also be undertaken in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and *AS 2885 Pipelines* (Standards Australia, 2008b) standards during Project activities.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ A Soil Management Sub-plan will be developed by a suitably qualified practising professional (e.g. certified professional soil scientist) and incorporated into the CEMP, which includes the following procedures and protocols (refer Chapter 8: Land Resources and Chapter 22: Outline Environmental Management Plan): ▸ Soil/land conservation objectives for the Project ▸ Management of problem soils, such as: – Acid sulfate soils, which may occur in proximity to wetland features and water storages – Erosive or dispersive soils, such as sodosols, which are expected to be encountered between the Macintyre River and Yelarbon as well as along the fertile lands north of Inglewood to the west of Kooroongarra – Cracking clays (vertosols), which are expected to be encountered between Kooroongarra and Millmerran and from Yandilla to Gowrie – Saline soils, particularly in high salinity hazard areas such as between Kurumbul and Yelarbon. ▸ Specification of the type and location of erosion and sediment controls, developed by a certified professional in erosion and sediment control, in accordance with the International Erosion Control Association *Best Practice Erosion and Sediment Control* (2008). Erosion and sediment control measures to be implemented during construction of the Project include: – Locations for specific temporary/permanent erosion and sediment control measures, such as: ▸ Sediment retention basins (17 included in the reference design) ▸ Scour protection (included in the reference design) ▸ Sediment fencing ▸ Berms and other surface flow diversions. – Nomination of location-specific erosion controls will include consideration of site conditions, proximity to environmental receptors, adjoining land uses, climatic and seasonal factors, and will be based on an erosion risk assessment – Minimise the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the rail corridor – Scheduling of works with consideration to periods of higher rainfall (summer months) – Establish and specify the monitoring and performance objectives for handover on completion of construction – Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material – Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the *Biosecurity Act 2014* (Qld).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Project	Contaminated land	▸ A Contaminated Land Management Sub-plan will be developed by a suitably qualified person to undertake contaminated land regulatory functions defined in Chapter 7, Part 8 of the *Environmental Protection Act 1994* (Qld) (EP Act). The sub-plan will be incorporated into the CEMP to reduce the likelihood and impact of worker or public health issues due to land contamination (refer Chapter 8: Land Resources and Chapter 22: Outline Environmental Management Plan). This sub-plan will: ▸ Document management controls for works on land that is known or suspected to be contaminated and will outline the process to identify, document and manage contaminated sites ▸ Be developed based on the contaminated land strategy presented (refer Chapter 8: Land Resources) ▸ Seek to minimise soil disturbance in areas listed on the Environment Management Register (EMR), e.g. existing rail corridor, Lot 1 RP835800 and Lot 8 SP126840 (refer Chapter 8: Land Resources). A soil disposal permit under the EP Act is required if contaminated soil is to be moved from a lot listed on the EMR. ▸ Establish the methodology, and sampling and analysis plan for environmental site investigation where soil disturbance is required on an EMR site in the potentially contaminated area ▸ Establish an unexpected finds protocol/procedure in the event that potentially contaminated materials are encountered during construction activities.
	Project	Asbestos	▸ A survey of infrastructure that will be removed or disturbed by the Project will be conducted prior to the commencement of construction to identify asbestos-containing materials ▸ Where identified, asbestos-containing materials will be removed prior to the commencement of construction. Asbestos removal and handling as well as tracking and recording of information will be conducted in accordance with: ▸ *National Environmental Protection (Assessment of Site Contamination) Measure 2013* ▸ *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* or equivalent ▸ *Safe Work Australia Model Code of Practice—How to Manage and Control Asbestos in the Workplace 2016* (Safe Work Australia, 2016) ▸ *Safe Work Australia Model Code of Practice—How to Safely Remove Asbestos 2018* (Safe Work Australia, 2018a). ▸ If removal of more than 10 m2 of asbestos is required, the necessary licence will be obtained from Workplace Health and Safety Queensland, as follows: ▸ A Class Licence—Removal of loose (friable) asbestos ▸ B Class Licence—Removal of bonded asbestos ▸ Asbestos-containing materials will be transported by a licensed service provider and disposed of at an appropriately licensed facility, in accordance with the requirements of the *Waste Reduction and Recycling Act 2011* (Qld) (WRR Act) and the EP Act.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Project	Noise and Vibration	▸ The Noise and Vibration Management Sub-plan, as a component of the CEMP, will be implemented (refer Chapter 14: Noise and Vibration and Chapter 22: Outline Environmental Management Plan). This sub-plan will include: ▸ Construction noise and vibration criteria for the Project, as detailed in Chapter 14: Noise and Vibration ▸ Location of sensitive receptors in proximity to the construction area. Sensitive receptors include: – A dwelling (detached or attached) including house, townhouse, unit, reformatory institution, caravan park or retirement village – A library, childcare centre, kindergarten, school, school playground, college, university, museum, art gallery or other educational institution, hospital, respite care facility, nursing home, aged care facility, surgery or other medical centre – A community building including a place of public worship – A court of law – A hotel, motel or other premises that provides accommodation for the public – A commercial (office) or retail facility – A protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the *Nature Conservation Act 1992* (Qld) (NC Act) – An outdoor recreational area (such as a public park or gardens open to the public, whether or not on payment of a fee, for passive recreation other than for sport, or organised entertainment) or a private open space. ▸ Location-specific management measures for activities that could exceed the construction noise and vibration criteria, for example: – Earthworks and civil works – Structural work, including piling – Operation of workforce accommodation facilities – Concrete batching – Borrow pit operation – Blasting. ▸ Location, design and timing of need for temporary noise barriers ▸ Community notification process to advise of significant works with potential for noise nuisance or vibration at sensitive receivers and surrounding residences/premises ▸ Locations and procedures for: – Pre and post-condition surveys – Activity-based noise monitoring – Activity-based vibration monitoring – Noise or vibration monitoring in response to validated complaints. ▸ Requirements for training, inspections, corrective actions, monitoring, notification and classification of environmental incidents/complaints, record keeping and performance objectives for handover on completion of construction.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Natural	Biodiversity	▸ A Biodiversity Management Sub-plan will be developed as part of the CEMP (refer Chapter 10: Flora and Fauna and Chapter 22: Outline Environmental Management Plan). This sub-plan will include appropriate criteria, directives and procedures in relation to: ▸ Methods and sequencing of protected plant surveys, in accordance with the requirements of *Flora Survey Guidelines—Protected Plants* (DES, 2019e) ▸ Methods and sequencing of pre-clearance fauna surveys, including terrestrial, aquatic habitats and breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures) ▸ Staging works, so that they avoid animal breeding periods as much as possible ▸ Staged and sequential clearing protocols ▸ Animal handling protocols, including engagement of an approved fauna handler with a valid damage mitigation permit ▸ Relocation of plants and habitats, particularly habitat components for the Brigalow Belt reptiles (five-clawed worm skink, collared delma, yakka skink and Dunmall's snake) and the Condamine earless dragon ▸ Requirements for inspections and corrective actions during construction and rehabilitation activities. ▸ Biodiversity/fauna and flora management actions to be undertaken by suitably qualified persons ▸ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction ▸ Corrective actions should the outcomes not achieve the objectives adopted ▸ A Biosecurity Management Sub-plan will be developed as a component of the CEMP to detail pest and weeds management approaches for the Project in order to protect biodiversity within the Project footprint, in compliance with the *Biosecurity Act 2014* (refer Chapter 10: Flora and Fauna and Chapter 22: Outline Environmental Management Plan). This sub-plan will include: ▸ Requirements for pre-clearing and operational surveys to determine the risk of weeds or pest animals being present within the Project footprint ▸ Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters including mother-of-millions, Opuntioid cactus, African boxthorn and lantana) and weed management requirements ▸ Pest animal management controls, including protocols for severing, realigning and reinstating the wild dog check fence and the Darling Downs–Moreton Rabbit Board (DDMRB) rabbit fence ▸ Site hygiene and waste-management procedures to deter pest animals ▸ Locations of vehicle washdown (light vehicle and oversize vehicles) and rumble grids ▸ Weed surveillance and treatment during construction and rehabilitation activities ▸ Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of matters of national environmental significance (MNES) or matters of State environmental significance (MSES) habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides (e.g. organic farming practices). ▸ Erosion and sediment control risks associated with broad-scale weed removal or treatment ▸ Corrective actions should the outcomes not achieve the adopted objectives.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Natural (continued)	Biodiversity (continued)	▸ Where the Project interacts with the wild dog check fence, approximately between chainages Ch 26.8 km and Ch 56.0 km, the fence will be reinstated on the northwest side of the rail corridor. It is anticipated that fence severance and reinstatement will be undertaken as an early works package prior to the commencement of construction of rail infrastructure. Reinstatement will be in accordance with the design solution agreed with GRC through the detail design process. ▸ Where the Project crosses the DDMRB fence at chainage Ch 120.2 km, the fence will be re-established, and a rabbit trap will be established. It is anticipated that fence severance and reinstatement will be undertaken as an early works package prior to the commencement of construction of rail infrastructure. Reinstatement will be in accordance with the design solution developed in consultation with DDMRB through the detail design process. ▸ Undertake pre-construction survey and mapping of weeds within the Project footprint, during the detail design phase, in accordance with the Biosecurity Management Sub-plan (refer above) in preparation of works proposed during pre-construction.
	Dangerous goods and hazardous chemicals	Storage and handling chemicals	▸ A Hazardous Materials Management Sub-plan will be prepared and implemented as a component of the CEMP. The sub-plan will be required to: ▸ Identify the materials and chemicals required to be stored and used in support of construction, including volumes of each, such as: – Fuel and oil – Greases – Blasting chemicals – Concreting – Welding gases – Pesticides. ▸ Specify how dangerous goods and hazardous materials and chemicals will be handled, stored and transported for the Project, with consideration for: – Other dangerous goods being stored simultaneously – Providing resilience from natural events, such as storms and floods. ▸ Describe the response procedures in the event of an incident involving hazardous materials and chemicals or dangerous goods ▸ Establish the waste storage and disposal procedures for hazardous materials and chemicals and dangerous goods.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Dangerous goods and hazardous chemicals	Explosives	▸ A licensed shotfirer (blasting contractor) will be engaged to plan and undertake the necessary blasting activities for excavation of non-rippable rock. The Blasting Contractor will be required to maintain a security management system. ▸ A Blast Management Plan will be produced by the appointed Blasting Contractor, in consultation with geotechnical engineers and safety personnel, in support of each blasting event for the Project and will specify procedures to: ▸ Prevent misfire ▸ Minimise the risk associated with material projected by a blast ▸ Minimise adverse effects of ground vibration and shock waves caused by a blast ▸ Ensure explosives are not used after either the manufacturer's recommended shelf life or the approved, extended shelf life ▸ Ensure public safety, vehicular access and security, including temporary site road closures and warnings notifications before blasting ▸ Identify other activities within proximity of explosive use ▸ Identify the environment of explosive use, including flood, bushfire, landslide zones.
Construction and commissioning	Natural	Bushfire	▸ Hot works and other activities that may act as a source of ignition will be restricted during periods with a BoM fire danger rating of 'extreme' or higher to reduce the likelihood of construction activities initiating or exacerbating a bushfire ▸ If hot works or other high fire-risk activities are required during periods of elevated fire danger, these works will be planned in accordance with ARTC's *Total Fire Bans Procedure* (ETM-13-01) (ARTC, 2019d). Such works may require a permit (e.g. permit to light fire), issued by QFES. ▸ Bushfire prevention and response procedures will be incorporated into the CEMP to reduce the likelihood and impact of bushfires ignited or exacerbated by the Project. This will include the provision and positioning of appropriate fire-extinguishing equipment.
	Natural	Flooding	▸ Construction tasks will be scheduled to avoid, where possible, bulk earthwork activities within the 1% AEP during periods of elevated flood risk. Where works cannot be scheduled outside of this time period, activity-specific flood readiness and response planning will be required. This planning will be developed in consultation with the relevant local government and QFES. ▸ Laydown areas and other construction facilities that are located within the 1% AEP, will be temporary. Their planning and function in supporting construction will reflect the local flood risk. For example, hazardous goods will not be bulk stored in these locations due to the risk of contamination of land or waterways if flooded. ▸ Mobile plant will not be stored in the 1% AEP when not scheduled or in use for construction purposes. ▸ ARTC will engage with the local disaster management groups for Toowoomba and Goondiwindi to coordinate appropriate incident management and response procedures for natural disasters, including flooding.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ The period that soil is left exposed to erosional processes will be minimised, through progressive ground-cover revegetation, to reduce the likelihood of landslides ▸ Material will be temporarily stockpiled in accordance with the CEMP and the Soil Management Sub-plan (refer Chapter 8: Land Resources and Chapter 22: Outline Environmental Management Plan) ▸ The geotechnical stability of blasted surfaces will be assessed by a geologist, or similar, prior to the area of works immediately surrounding the blast site being reopened for general construction activities ▸ Earthworks inspections will be conducted at regular intervals determined in the CEMP to identify defects and conditions that may affect or indicate problems with the stability of earthworks.
	Natural	Wildlife	▸ A Biodiversity Management Sub-plan and Biosecurity Management Sub-plan (described above) will be implemented for appropriate wildlife management during construction (refer Chapter 10: Flora and Fauna and Chapter 22: Outline Environmental Management Plan).
	Natural	Biodiversity	▸ Weed hygiene measures, as prescribed in the CEMP and Biosecurity Management Sub-plan, will be implemented (refer Chapter 10: Flora and Fauna and Chapter 22: Outline Environmental Management Plan). ▸ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the Project (refer Chapter 22: Outline Environmental Management Plan).
	Natural	Climatic conditions	▸ Best-practice opportunities for the reduction of GHG generation during construction will be assessed and adopted, where practical and appropriate to do so, including: ▸ Selection of construction materials with low embodied energy ▸ In-vehicle monitoring systems for road vehicles.
	Project	Fatigue and heat stress management	▸ ARTC's existing *Work Instruction for Fatigue* (WHS-WI-423) will be implemented for the Project to ensure conditions of work of personnel align with requirements of the WHS Act ▸ In accordance with ARTC's existing Work Instruction for Fatigue (WHS-WI-423), the following hours of work will apply: ▸ Maximum scheduled shift length, including travel—13 hours ▸ Maximum hours in seven days—60 hours ▸ Maximum hours in 14 days—108 hours ▸ Minimum break between shifts—8 hours ▸ Maximum consecutive night shifts (8 hours)—6 shifts ▸ Maximum consecutive night shifts (10 hours)—5 shifts ▸ Maximum consecutive night shifts (12 hours)—4 shifts.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Project	Asbestos	▸ If material is encountered that is suspected of being asbestos-containing material, work will stop in the immediate vicinity. The suspected material will be subject to sampling and analysis by a certified professional for determination of its material classification. ▸ Where identified, asbestos-containing materials will be removed prior to the commencement of construction. Asbestos removal and handling as well as tracking and recording of information will be conducted in accordance with: ▸ *National Environmental Protection (Assessment of Site Contamination) Measure 2013* ▸ *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* or equivalent ▸ *Safe Work Australia Model Code of Practice—How to Manage and Control Asbestos in the Workplace 2016* (Safe Work Australia, 2016) ▸ *Safe Work Australia Model Code of Practice—How to Safely Remove Asbestos 2018* (Safe Work Australia, 2018a) ▸ If removal of more than 10 m2 of asbestos is required, the necessary license will be obtained from Workplace Health and Safety Queensland, as follows: ▸ A Class Licence—removal of loose (friable) asbestos ▸ B Class Licence—removal of bonded asbestos ▸ Asbestos-containing materials will be transported by a licensed service provider and disposed of at an appropriately licensed facility, in accordance with the requirements of the WRR Act and the EP Act.
	Project	Dust, respirable silica and other airborne contaminants	▸ Direct exposure of construction workers to respirable silica and other airborne contaminants will be controlled through the use of appropriate personal protective equipment in line with ARTC's *Work Instruction for Personal Protective Equipment* (WHS-WI-315) to reduce the likelihood and consequence of construction work impacting worker health ▸ Construction speed limits will apply to all unsealed routes used by construction vehicles to reduce vehicle-generated dust. Applicable speed limits will be determined through consultation with the relevant local government and documented in the Traffic Management Sub-plan within the CEMP (refer Chapter 18: Traffic, Transport and Access and Chapter 22: Outline Environmental Management Plan). ▸ Dust-suppression water sprays, or alternative appropriate treatment, will be applied to unsealed surfaces trafficked by construction vehicles, to minimise the generation of dust. Additional dust-suppression controls will be implemented prior to the onset of adverse weather. This may include covering of stockpiles and additional watering of access roads. Water will be obtained from sustainable sources, with the necessary water entitlement, water allocation, water licence or water permit. ▸ Construction activities will be planned, in the first instance, to prevent dust generated by works extending beyond the Project footprint. Where this is not possible, landowners predicted to be affected will be notified in advance of the commencement of activities with potential to generate dust that propagates offsite. This notification will be in accordance with community notification procedures established for the Project. ▸ A complaint hotline will be established for the Project to enable members of the public to notify ARTC of issues, including the generation of excessive dust during construction

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Project	Noise and vibration	▸ The Noise and Vibration Management Sub-plan, as a component of the CEMP, will be implemented (refer Chapter 14: Noise and Vibration and Chapter 22: Outline Environmental Management Plan) ▸ Noise and vibration sources from construction involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers ▸ Landowners will be notified in advance of the commencement of activities with potential to generate excessive noise and/or vibration, such as blasting. This notification will be in accordance with community notification procedures established for the Project. ▸ A complaint hotline will be established for the Project to enable members of the public to notify ARTC of issues, including the generation of excessive noise and/or vibration during construction.
	Project	Private access, stock routes and emergency access	▸ The Traffic Management Sub-plan, as a component of the CEMP, will be implemented. This sub-plan will specify how access across the rail corridor will be maintained during construction for private access, emergency response vehicles and stock route movements (refer Chapter 18: Traffic, Transport and Access and Chapter 22: Outline Environmental Management Plan).
	Project	Road incidents	▸ The Traffic Management Sub-plan, as a component of the CEMP, will be implemented. This sub-plan will specify appropriate separation distances of pedestrians from construction traffic hazards and the separation distances of construction traffic from public traffic (refer Chapter 18: Traffic, Transport and Access and Chapter 22: Outline Environmental Management Plan).
	Project	Rail incidents	▸ QR's written approval will be obtained prior to commencement of work in accordance with section 255 of the *Transport Infrastructure Act 1994* (Qld) to ensure coordination between ARTC and QR is established for reduction of rail incidents between the operations ▸ If construction of Project components within existing rail corridor is completed during a temporary possession of the rail corridor, then works will be completed in accordance with the conditions of the temporary possession and/or wayleave agreement granted to ARTC by QR ▸ All works carried out on QR property will be in accordance with the requirements of QR's *Civil Engineering Technical Requirement: Work in or about Queensland Rail Property* (CIVIL-SR-002) (QR, 2016) ▸ All work performed on QR property or when directed by QR will be under the supervision of a Possession Protection Officer or Protection Officer and will be carried out only at times authorised by QR or the QR-appointed project manager
	Project	Existing infrastructure and utilities	▸ Construction activities will be planned and executed to not inhibit the safe and efficient operation of utilities that remain located within the Project footprint ▸ Affected businesses and residences will be notified in advance of any planned interruptions (including durations) ▸ Disturbance of existing utilities will occur under access arrangements and approval with the relevant asset manager, obtained prior to commencing work ▸ In the event that previously unidentified underground utilities are encountered during construction, work will cease in proximity to the utility until the type and status of the services (operational/disused) can be confirmed, in accordance with AS 1345 *Identification of the contents of pipes, conduits and ducts* (Standards Australia, 1995)
	Project	Contaminated land	▸ Contamination, if encountered during construction, will be managed in accordance with the Contamination Management Sub-plan, as a component of the CEMP (refer Chapter 8: Land Resources and Chapter 22: Outline Environmental Management Plan).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Dangerous goods and hazardous chemicals	Storage and handling chemicals	▸ Construction facilities where bulk hazardous materials may be used or stored have been located outside of the 1% AEP floodplain in accordance with the intent of the *State Planning Policy* (DILGP, 2017c) (SPP) due to the risk of land and water contamination if flooded. Additionally, the locations where vehicle maintenance and refuelling activities will occur will be located to achieve appropriate separation to riparian vegetation and waterways. ▸ Bulk storage areas for dangerous goods and hazardous materials will be located away from areas of social and environmental receptors such that offsite impacts or risks from any foreseeable hazard scenario will not exceed the dangerous dose for the defined land use zone, i.e. either sensitive, commercial/community, or industrial, in accordance with the intent of the SPP. ▸ The Hazardous Materials Management Sub-plan (refer above) will be implemented as a component of the CEMP ▸ Licensed transporters operating in compliance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018) will be used for the transportation of dangerous goods ▸ Chemicals stored and handled as part of construction activities will be managed in accordance with: ▸ The *Work Health Safety Act 2011* (Qld) and Regulation ▸ *AS 2187.1:1998 Explosives—Storage* (Standards Australia, 1998a) ▸ *AS 2187.2-2006 – Explosives – Storage, transport and use, Part 2: Use of explosives* (Standards Australia, 2006) ▸ *AS 1940:2017 Storage and Handling of Flammable and Combustible Liquids* (Standards Australia, 2017a) ▸ *AS 3780:2008 The Storage and Handling of Corrosive Substances* (Standards Australia, 2008a) ▸ *Australian Code for the Transport of Explosives by Road & Rail* (Commonwealth of Australia, 2018b) ▸ The requirements of chemical safety data sheets. ▸ Safety data sheet information will be obtained from the suppliers of chemicals and stored in an easily accessible location ▸ Implementation of a Groundwater Monitoring and Management Plan and adaption of the program for each stage of the Project will allow for sufficient monitoring of the groundwater regime to identify potential impacts on groundwater quality (refer Chapter 13: Groundwater).
	Dangerous goods and hazardous chemicals	Explosives	▸ Where explosives are used during construction, the works will be undertaken by the appointed licensed blasting contractor, in accordance with the *Explosive Act 1999* (Qld) and *AS 2187:2006—Explosive—Storage, Transport and Use* (Standards Australia, 2006). Explosives will be stored, handled and transported by the licensed blasting contractor, who will be responsible for the security of the explosives for the entire duration of the task, including the segregation of incompatible products. ▸ Notification requirements of the *Explosives Act 1999* (Qld) will be followed: ▸ Before undertaking a blast ▸ Before importing or exporting explosives ▸ When storing or interacting with stored explosives at explosive storage facilities and government activities ▸ When there are changes to buildings and vehicles related to the storage or transport of explosives ▸ After conducting an explosive trial. ▸ The appointed licensed blasting contractor will submit a safe blast design and Blast Management Plan (refer above) to the Explosives Inspectorate a minimum of seven days before the scheduled blasting event, for assessment against the requirements under the act and *AS 2187:2006—Explosive—Storage, Transport and Use* (Standards Australia, 2006).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Dangerous goods and hazardous chemicals (continued)	Explosives (continued)	▸ Record of the amount and the type of explosive purchased and used, and a record of each blast conducted by the appointed licensed Blasting Contractor will be kept in accordance with the *Explosives Act 1999* (Qld) ▸ Proper stemming (sealing of blast holes) will be used in the preparation of charges and appropriate charge ratios will be used to limit the amount of fly rock produced by a blast ▸ Where drilling and blasting is to be undertaken, residents, occupants and other stakeholders within a 1 km radius of a blast location will be notified a minimum of three calendar days in advance of a blast occurring. This notification will be in accordance with community notification procedures established for the Project. ▸ A complaint hotline will be established for the Project to enable members of the public to notify ARTC of issues, including the generation of excessive noise and/or vibration during construction.
Operation	Natural	Bushfire	▸ Existing ARTC management plans and codes of practice will be applied to the operation of the Inland Rail network, including this Project, to reduce the likelihood of ignition or exacerbation of bushfire ▸ Communication protocols will be established with QFES and QPWS (DES) for the operation of the Project, to ensure that all relevant stakeholders are aware of planned (e.g. controlled burns, railway crossing closures) or unintended events (e.g. escaped fires) that have potential to impact on the provision of services by others ▸ The rail corridor (nominally a minimum of 40 m wide) will be maintained free of woody vegetation.

	Natural	Flooding	▸ Inspections will be carried out during operations to identify defects and conditions that may affect waterway and drainage system capacity or indicate increased risk of flooding, such as:
			  ▸ Scour
			  ▸ Blockages due to debris build up
			  ▸ Indication of floods overtopping a structure
			  ▸ Culvert or drain damage or collapse.
			▸ Where defects are identified and corrective actions are required, these works will be completed in accordance with the Operation EMP for the Project
			▸ Asset inspections will be completed as soon as safe access can be achieved following a flood event.

	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ Inspections and maintenance will be carried out in accordance with ARTC's current engineering procedures during operations, to identify defects such as scour and conditions that may affect the stability of embankments or rock faces within the rail corridor ▸ Where defects are identified and corrective actions are required, these works will be completed in accordance with the Operation EMP for the Project.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Natural	Climatic conditions	▸ Operations on the corridor will comply with mandatory speed restrictions during hot weather ▸ Regular rail inspection, maintenance, and de-stressing of the rail to maintain track stability during both seasonal and annual temperature fluctuations.
	Natural	Wildlife	▸ Permanent fencing will be installed at locations that are deemed required by design outcome to limit fauna strike and/or maintain habitat connectivity.
	Natural	Biosecurity	▸ Biosecurity controls will be implemented as a component of the Operation EMP to comply with the *Biosecurity Act 2014* (Qld) for pest and weeds management.
	Project	Dust, respirable silica and other airborne contaminants	▸ There is currently no market-driven demand for coal or other mining products to be transported on the Inland Rail network between the NSW/QLD border and Gowrie; however, if coal is to be transported in future operation scenarios, the potential for coal-dust generation would be managed in accordance with a coal-dust management plan. ▸ A complaint hotline will be established for the Project to enable members of the public to notify ARTC of issues, including the generation of excessive dust or other air emissions during operation.
	Project	Road-rail interface	▸ ARTC will conduct routine inspections of crossing infrastructure and will regularly review crossing performance and incident information to identify opportunities for improved performance and further reduction in risk ▸ Railway safety messages will be provided to the community through awareness activities, community engagement activities, and campaigns to increase public awareness regarding the Project. Fact sheets and guidelines will also be freely available on the ARTC website, aiming to provide guidance to the community regarding safety around level crossings. ▸ In the event of trespass or vandalism on the ARTC rail corridor and trackside, staff will be empowered to instruct intruders to leave the corridor immediately. Incidents will be reported to the QPS, as required, for assistance and resolution. ▸ Implementation of train notification procedures for the planned crossing of the rail corridor by stock.
	Project	Rail incidents	▸ The quantities and types of dangerous goods that may be transported will be managed in accordance with the requirements of the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018) ▸ Trackside monitoring systems will be adopted and maintained, which will detect faults in the wheel set or trains and monitor rail wheel condition and defects to reduce the likelihood rail incidents, such as derailments ▸ A signalling and communications testing procedure will be developed and implemented for the Inland Rail network, including for this Project, to reduce the likelihood and consequence of rail collisions ▸ ARTC will coordinate with QR for operation activities within a shared active rail corridor, as required, to ensure safe operation.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Project	Bridges	▸ Maintenance inspections of bridge structures will be undertaken generally in accordance with ARTC's current practices and procedures ▸ Inspections of bridge structures will be undertaken in three levels—visual Inspections (two-year frequency), engineering inspections (12-year frequency) and special inspections (as required). The inspections will require visual inspection and, in some cases, non-destructive testing and sampling.
	Project	Noise and vibration	▸ Noise and vibration management principles will be developed and implemented as a component of the Operation EMP ▸ Noise and vibration sources from maintenance work involving heavy machinery will incorporate appropriate noise mitigation equipment and devices, including mufflers and acoustic barriers ▸ Equipment will be maintained in good working order to reduce the potential for offensive noise.
	Project	Emergency access	▸ The rail maintenance access road (RMAR) will be available for use by emergency vehicles in the event of an incident ▸ Training of personnel through desktop and simulated test exercises will be designed to ensure that, individually and collectively, the Incident Management Procedures adequately address the requirements for emergency management.
	Project	Fatigue and heat stress	▸ ARTC's existing work Instructions for fatigue management will apply to the Inland Rail network and this Project, to ensure conditions of work for employees align with the requirements of the *Work Health Safety Act 2011* (Qld) ▸ ARTC will follow the guidance document published by Safe Work Australia, *Managing the risks of working in heat* (2017)
	Project	Existing infrastructure and utilities	▸ Maintenance activities will comply with the clearance distances as specified in the ARTC *Engineering Standard for Requirements—Electric Aerials Crossing ARTC Infrastructure*, to ensure sufficient clearance and prevent contact with live electricity ▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project footprint (APA's Roma–Brisbane gas pipeline and Santos' Moonie–Brisbane oil pipeline) will occur prior to undertaking maintenance activities in proximity to these utilities.
	Project	Contaminated land	▸ If land contamination is caused by operation activities associated with the Project, the nature and extent of contamination will be investigated in accordance with the requirements of the National Environmental Protection Measure (NEPM) and amendment measures ▸ Contamination management and clean-up measures, if required, will be in accordance with the NEPM and amendment measures and the requirements of the EP Act.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Dangerous goods and hazardous chemicals	Storage and handling chemicals	▸ Before a train travels on the Inland Rail network, operators must 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 must be loaded, labelled, and marshalled in accordance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018). Freight carts will display appropriate Hazchem signage, including placards, and carry appropriate spill containment equipment to be used by emergency services personnel in the event of an emergency. ▸ Chemicals stored and handled as part of normal operation and maintenance activities will be managed in accordance with Australian Standards ▸ Safety data sheet information will be obtained from the supplier of chemicals and stored in an easily accessible location ▸ Procedures for the management of hazardous chemical spills and leaks will be developed and incorporated into the Operation EMP for the Project. The procedures will include: ▸ A site map that indicates where hazardous chemicals are located ▸ Consideration as to whether fire protection systems are appropriate where hazardous chemicals may be stored ▸ Consideration of whether hazardous chemicals may affect where an evacuation point should be, e.g. is there a risk of fire, explosion or toxic fumes ▸ Consideration of any specific emergency equipment or safety equipment needs, e.g. type of fire extinguisher, required first aid kit contents, and whether emergency showers or eyewash stations are needed, and the best location for such equipment ▸ Spills kits for the appropriate chemicals, e.g. Hazchem, general, aquatic and marine spill kits, adequately signed, located and staff to be trained in their use ▸ The spill response controls and clean up procedures as per the provision of their safety data sheet, ensuring environmental harm is minimised ▸ Environmental incident checklist and communication plan in the event of reportable environmental incident arising from major spills, such that a procedure prepared to ensure that emergency services can be told of the location, types and quantities of the hazardous chemicals.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)			▸ The ARTC's work instructions will be applied for all maintenance activities requiring the transport of dangerous goods within the rail corridor. The work instruction includes the following control measures to reduce the risk associated with dangerous goods storage and transport: ▸ Where practical, dangerous goods, specifically detonators, will be transported in their original packaging and stored separately from one another on the vehicle ▸ All dangerous goods will be adequately restrained within the vehicle's confines to prevent movement during transit, e.g. gas bottles restrained to headboard or in designated ventilated storage compartments ▸ The combined (aggregate) quantity of dangerous goods will not exceed 1,000 L or kg ▸ Any individual receptacle used for transporting dangerous goods will have capacity less than 500 L or kg or dangerous goods licensing for both the vehicle and driver will apply ▸ All vehicles carrying mixed loads of dangerous goods will display the appropriate mixed class placard at least on the front and rear of the vehicle ▸ The vehicle will be fitted with appropriate safety equipment for the load as per ARTC operational procedures, including double-sided triangle reflector signals, fire extinguisher(s) and personal protection equipment.
	Dangerous goods and hazardous chemicals	Explosives	▸ Maintenance crews working on the Inland Rail network will be required to have completed safe work training, which includes a module on the use of audible track warning devices ▸ ARTC will continue to consult with InterGen to establish communication protocols for the operation phase of the Project to ensure compatibility between ARTC activities and mining operating activities ▸ If Commodore Mine's operational plans change and blasting impacts on the Project may occur, then ARTC will consult with the mine operator to establish protocols and procedures for conducting blasting activities in proximity to the Project during operation.

19.9 Impact assessment summary

19.9.1 Risk assessment

Potential impacts to people, property and the environment associated with the Project in the construction, and operation phases are outlined in Table 19.13. These impacts have been subjected to risk assessment as per the methodology outlined in Section 19.5 and Chapter 4: Assessment Methodology.

The initial risk assessment is based on the assumption that the design considerations (or initial mitigation) factored into the reference design phase (refer Table 19.11) has been implemented.

Additional mitigation measures were then applied, as appropriate, to the phase of the Project to reduce the level of potential impact (refer Table 19.12). The residual risk level of the potential impacts was then reassessed.

The pre-mitigated risk levels are presented next to the residual risk levels in Table 19.13 to demonstrate the effectiveness of the mitigation measures.

TABLE 19.13 IMPACT ASSESSMENT FOR POTENTIAL IMPACTS ASSOCIATED WITH HAZARD AND RISK

			Initial risk[1]			Residual risk after mitigation measures implemented[2]		
Aspect	**Potential impact**	**Phase**	**Likelihood**	**Consequence**	**Risk**	**Likelihood**	**Consequence**	**Risk**
Bushfire	Damage to infrastructure, injury to workers or public from bushfire	Pre-construction and construction	Possible	Moderate	Medium	Possible	Moderate	Medium
		Operation	Possible	Moderate	Medium	Possible	Moderate	Medium (through to 2090)
Flooding	Damage to infrastructure, potential for impacts to freight goods caused by flooding, storms and cyclones	Pre-construction and construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Climatic conditions	Increased temperatures, leading to failure of infrastructure/derailment accidents, i.e. track buckling or too dangerous conditions for dangerous goods, caused by climatic conditions (extreme weather events)	Pre-construction and construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Landslide, sudden subsidence, movement of soil or rocks	Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks	Pre-construction and construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Wildlife	Wildlife injury or deaths from impact with project or worker injury from wildlife	Pre-construction and construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low
Biosecurity	Damage to biosecurity of surrounding environment due to propagation invasive species	Pre-construction and construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low
Noise and vibration	Disruption to public from noise and vibration	Pre-construction and construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low
Fatigue and heat stress	Worker injury from fatigue and heat stress	Pre-construction and construction	Almost Certain	Moderate	High	Possible	Moderate	Medium
		Operation	Likely	Moderate	High	Possible	Moderate	Medium

			Initial risk[1]			Residual risk after mitigation measures implemented[2]		
Aspect	**Potential impact**	**Phase**	**Likelihood**	**Consequence**	**Risk**	**Likelihood**	**Consequence**	**Risk**
Asbestos	Health impacts from asbestos	Pre-construction and construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	Possible	Moderate	Medium	Unlikely	Moderate	Low
Dust, respirable silica and other airborne contaminants	Impacts from respirable silica and other airborne contaminants	Pre-construction and construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Historical and abandoned mines	Localised landslide, sudden subsidence and movement of soil and rock	Pre-construction and construction	Unlikely	Major	Medium	Rare	Moderate	Low
		Operation	Rare	Major	Low	Rare	Moderate	Low
Rail incidents	Rail accidents caused by increased rail movements	Pre-construction and construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Possible	Extreme	High	Unlikely	Extreme	Medium
Road-rail interface	Road accidents caused by increased vehicles required for the Project (e.g. traffic from construction, maintenance)	Pre-construction and construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Unlikely	Extreme	Medium	Unlikely	Extreme	Medium
	Accidents due to increased number of road–rail interfaces	Pre-construction and construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Likely	Major	Very High	Possible	Major	Medium
Existing infrastructure and utilities	Worker injury from services strike at existing infrastructure and underground and overhead services	Pre-construction and construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Unlikely	Extreme	Medium	Rare	Extreme	Medium
	Safety impacts to workers interference with existing commercial receptors such as Commodore Mine or airfields	Pre-construction and construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Possible	Extreme	Medium	Unlikely	Extreme	Medium
Contaminated land	Health impacts to workers and public, and environmental impact from contaminated land	Pre-construction and construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Bridges	Bridge collapse or falling object strikes	Pre-construction and construction	Unlikely	Major	Medium	Unlikely	Major	Medium
		Operation	Unlikely	Major	Medium	Unlikely	Major	Medium

			Initial risk[1]			Residual risk after mitigation measures implemented[2]		
Aspect	**Potential impact**	**Phase**	**Likelihood**	**Consequence**	**Risk**	**Likelihood**	**Consequence**	**Risk**
Emergency access	Impaired emergency access resulting in escalation of incident	Pre-construction and construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Chemicals spillage and loss of containment	Loss of containment of dangerous goods during storage and handling	Pre-construction and construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	N/A	N/A	N/A	N/A	N/A	N/A
Freight dangerous goods	Loss of containment of freight dangerous goods and hazardous chemicals	Pre-construction and construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Possible	Extreme	High	Rare	Extreme	Medium
Explosives	Damage to infrastructure or injury, or fatality caused by explosives incidents during blasting, during construction or by adjacent operators	Pre-construction and construction	Possible	Extreme	High	Rare	Major	Low
		Operation	Unlikely	Extreme	Medium	Rare	Major	Low

Table notes:

1. Includes implementation of initial mitigation measures specified in Table 19.11.
2. Assessment of residual risk once the mitigation measures identified in Table 19.12 have been applied

19.9.2 Residual risks

From the assessment conducted (provided in Table 19.13), risks that remain with a medium residual risk ranking include potential incidents related to:

- Bushfire
- Flooding
- Climatic conditions
- Landslide, sudden subsidence, movement of soil or rocks
- Fatigue and heat stress
- Rail incidents
- Road–rail incidents
- Existing infrastructure and utilities
- Contaminated land
- Bridges
- Emergency access
- Freight of dangerous goods.

In some instances, a residual risk ranking of 'medium' is reflective of the high potential consequence of an impact, despite a range of design and mitigation measures, which are effective in reducing likelihood. In most instances, the likelihood and consequence of these risks are influenced by factors that are outside ARTC's control (e.g. latent conditions, human behaviour, etc.).

For these residual risks, opportunities to further reduce the level of risk will be investigated through the detail design process in accordance with the following hierarchy of controls:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

Where opportunities to further reduce risk are identified, these will be captured and documented in detail design drawings, environmental design drawings, the CEMP or the Operation EMP, as appropriate.

19.9.3 Emergency management

ARTC's existing *Emergency Management Procedure* (RLS-PR-044), which provides a systematic approach to incident response and recovery or incident investigation on the ARTC network, will be applied to the Inland Rail Program and the Project. Further details on the response to, and investigation of, incidents and emergencies is provided in Chapter 22: Outline Environmental Management Plan.

Security and crisis management procedures will be developed for the Inland Rail network and will be in line with business continuity plans and will be issue specific.

19.9.3.1 Incident management plan

An Incident Management Plan will be developed for the Inland Rail Program and implemented for this Project. This plan will detail response procedures in the event of foreseeable emergency scenarios. The Incident Management Plan will be consistent with the intent of ARTC's *Emergency Management Procedure* (RLS-PR-044) and will identify the necessary resources, training and communication interfaces with relevant emergency organisations, to ensure effective emergency response for the Inland Rail Program and the Project.

The Incident Management Plan will, as a minimum, provide response procedures for the following incident scenarios:

- Derailment and collision
- Fire and life safety
- Bomb threat
- Equipment
- Rollingstock or infrastructure failure
- Environmental issues
- Dangerous goods spills
- Natural disaster.

19.9.3.2 Consultation

The Social Impact Assessment described in Chapter 15: Social, describes the consultation and engagement activities conducted for the Project. With regards to the hazard and risk assessment, community stakeholder feedback obtained during ARTC's Southern Darling Downs CCC and Inner Darling Downs CCC meetings as well as meetings, surveys and workshops held with community stakeholders has been applied to hazard identification and the assessment of risk levels. Examples of key issues identified by stakeholders with relation to Project construction (including pre-construction) and operation include:

- The increase in road–rail interfaces leading to safety issues, and delay in emergency response
- The increase in road traffic during construction leading to safety issues
- Impacts of noise, vibration and air quality changes on community wellbeing.

Consultation and engagement with relevant emergency service providers have also commenced to inform the reference design and the environmental assessment process for the Project. The Project will continue to be developed in consultation and attendance at Toowoomba and Goondiwindi local disaster management groups and Queensland Police District disaster management groups to ensure that external support can be provided by these services in the event of an emergency and that their daily operations are not detrimentally impacted by the Project.

ARTC hosted State government agency briefings in Brisbane and Toowoomba to coincide with the release of the final ToR in May 2018. In addition to the State government agency briefings, other government consultation included:

- Monthly meetings with the Office of the Coordinator–General, with delegates from other departments invited as required
- Regular consultation with GRC (13 meetings from September 2017 to August 2019) and TRC (24 meetings from September 2017 to August 2019), in the form of Project progress meetings and issue-specific workshops
- Issue-specific workshops, including for informing the social impact assessment (refer Chapter 15: Social), attended by representatives from State government agencies and local stakeholder groups.

ARTC has focused on ensuring that relevant State and local government emergency service providers have been invited to attend these consultation sessions, as relevant. For instance, QPS and QAS were both invited to attend social impact assessment workshops.

An objective of these consultations has been to ensure coordination between development of the Project and the provision of emergency response services.

For additional information on consultations that have informed the assessment of hazard and risk for the Project refer to Chapter 15: Social and Appendix C: Stakeholder Engagement Report.

19.10 Cumulative impacts

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. This section provides a discussion on the potential for cumulative impacts in relation to hazards and risks. Further details on the potential for cumulative impacts to arise as a result of the Project, in combination with others, is presented in Chapter 21: Cumulative Impacts. Details on the assessment methodology for cumulative impacts is presented in Chapter 4: Assessment Methodology.

This chapter has provided coverage of potential hazards and risks associated with the development of the Project, some of which have been discussed in greater detail in corresponding chapters of this EIS. For the purpose of assessing cumulative impacts from hazards and risks, those attributed to the following potential impacts have been assessed in other chapters of the draft EIS, as referenced:

- Flooding—Chapter 12: Surface Water and Hydrology
- Climatic conditions—Chapter 12: Surface Water and Hydrology
- Landslide, sudden subsidence, movement of soil or rocks—Chapter 8: Land Resources
- Wildlife and biosecurity—Chapter 10: Flora and Fauna
- Traffic—Chapter 18: Traffic, Transport and Access
- Utilities, private access and stock route—Chapter 7: Land Use and Tenure
- Existing land use and infrastructure—Chapter 7: Land Use and Tenure
- Contaminated land—Chapter 8: Land Resources.

Impacts associated with the following aspects have been assessed in this section for their cumulative potential:

- Hazardous materials and dangerous goods
- Explosives.

Twenty-three (23) projects were initially identified as having potential to contribute to cumulative impacts in combination with the Border to Gowrie Project. These projects are either currently operational, expected to undergo future expansion or are currently going through an approval process. A full list of the 23 projects, with a description of each, is presented in Chapter 21: Cumulative Impacts.

The types and quantities of hazardous chemicals that are expected to be used for the construction or operation and maintenance of other projects are not considered to be sufficient to introduce the potential for significant offsite impacts or the potential to contribute to cumulative impacts at the adjacent, regional, and national level.

The loss of containment of dangerous goods through transportation during construction and operation is regarded as having potential for cumulative impacts between the Project and concurrent or future projects. As such, only 2 of the initial 23 projects identified meet these criteria. These projects are listed in Table 19.14.

TABLE 19.14 PROJECTS CONSIDERED FOR THE CUMULATIVE IMPACT ASSESSMENT

Projects	Location	Description	Construction dates
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project at its southern limit	New 37 km rail corridor to connect North Star (NSW) to the QR South West Rail Line just north of the NSW/QLD border.	2021–2024
Gowrie to Helidon (Inland Rail)	Rail alignment from Gowrie to Helidon, Queensland Adjoins the Project at its northern limit	New 26 km dual-gauge track between Gowrie (northwest of Toowoomba) and Helidon (east of Toowoomba), extending through the LGAs of Toowoomba and Lockyer Valley. Includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.	2021–2025

An assessment of cumulative impacts that may arise from these projects in combination with the Project is presented in Table 19.15.

TABLE 19.15 CUMULATIVE IMPACT ASSESSMENT FOR HAZARD AND RISK

Impact	Type	Aspect	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
North Star to NSW/QLD Border Inland Rail project	Loss of containment of dangerous goods through transportation during construction	Probability of the impact	Low (1)	8	Medium	Will be managed through: ▸ Development and implementation of a Hazardous Materials Management Sub-plan, as a component of the CEMP for the Project ▸ ARTC to ensure that compatible management measures are applied across projects within the Inland Rail Program ▸ Adherence to the requirements of ARTC's Safety Management System ▸ Adherence to ARTC's existing Emergency Management Procedure (RLS-PR-044) ▸ The development and implementation of network-wide Incident Management Plan
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	High (3)			
	Loss of containment of dangerous goods through transportation during operation	Probability of the impact	Low (1)	8	Medium	Will be managed through: ▸ Class 1 explosives will not be transported on the Inland Rail network ▸ Dangerous goods will be loaded, labelled, and marshalled in accordance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018) ▸ Adherence to ARTC's existing Emergency Management Procedure (RLS-PR-044) ▸ The development and implementation of network-wide Incident Management Plan
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	High (3)			

Impact	Type	Aspect	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
Gowrie to Helidon Inland Rail project	Loss of containment of dangerous goods through transportation during construction	Probability of the impact	Low (1)	8	Medium	Will be managed through: ▸ Development and implementation of a Hazardous Materials Management Sub-plan, as a component of the CEMP for the Project ▸ ARTC to ensure that compatible management measures are applied across projects within the Inland Rail Program ▸ Adherence to the requirements of ARTC's Safety Management System ▸ Adherence to ARTC's existing Emergency Management Procedure (RLS-PR-044) ▸ The development and implementation of network-wide Incident Management Plan
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	High (3)			
	Loss of containment of dangerous goods through transportation during operation	Probability of the impact	Low (1)	8	Medium	Will be managed through: ▸ Class 1 explosives will not be transported on the Inland Rail network ▸ Dangerous goods must be loaded, labelled, and marshalled in accordance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018) ▸ Adherence to ARTC's existing Emergency Management Procedure (RLS-PR-044) ▸ The development and implementation of network-wide Incident Management Plan
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	High (3)			

19.11 Conclusions

This chapter has been prepared to address Sections 11.142 to 11.149 and Sections 11.155 to 11.157 of the ToR. The assessment described in this chapter has been carried out based on information available at the time of preparing the draft EIS, including research and information from the reference design and existing operational plans for ARTC's network. Further development of design information may lead to the identification of additional hazards or changes to the risk level of identified hazards. Risk assessment and monitoring will be a continual process for the entirety of the Project life cycle.

The Project has the potential to impose new hazards and risks onto people, property and the environment, which must be identified and managed through construction (including pre-construction) and operation. In acknowledgement of this, the Project has incorporated risk identification and assessment practices throughout development of the reference design, and ARTC has a strong commitment to implementing and maintaining appropriate safety practices.

A preliminary risk assessment has been conducted for the Project, in compliance with the requirements of the ToR. The implementation of ARTC risk management policies and procedures as described in Section 19.4 and Chapter 22: Outline Environmental Management Plan are anticipated to effectively reduce the majority of the risks associated with the Project to a 'low' or 'medium' level. The residual risks that remain with 'medium' risk ratings include potential incidents related to:

- Bushfire
- Flooding
- Climatic conditions
- Landslide, sudden subsidence, movement of soil or rocks
- Fatigue and heat stress
- Rail incidents
- Road–rail incidents
- Existing infrastructure and utilities
- Contaminated land
- Bridges
- Emergency access
- Freight of dangerous goods.

For these residual risks, opportunities to further reduce the level of risk will be investigated through the detail design process in accordance with the following hierarchy of controls:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

Where opportunities to further reduce risk are identified, these will be captured and documented in detail design drawings, environmental design drawings, the CEMP or the Operation EMP as appropriate. Refer Chapter 22: Outline Environmental Management Plan for details on the CEMP and Operation EMP.