CHAPTER

21

Hazard and Risk

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Inland Rail is a subsidiary of
Australian Rail Track Corporation

INLAND RAIL

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21.1 Scope of chapter

The purpose of this chapter is to identify and describe hazards and risks relevant to the Inland Rail New South Wales (NSW)/Queensland (QLD) Border to Gowrie Project (the Project) and to assess the potential for impacts to people, property, and the environment. This chapter addresses the 'Hazards, health and safety' section of the Terms of Reference (ToR) inclusive of ToR items 11.142 to 11.157. Appendix A2: Terms of Reference Cross-reference Table provides a cross reference for each ToR against relevant sections in the Environmental Impact Statement (EIS).

Key hazard and risks considered in this assessment include:

- Natural hazards that can affect all stages of the Project, 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, such as extreme temperatures and humidity.
- Construction hazards and risks, for example:
  - fatigue and heat stress
  - respirable silica and other airborne contaminants, such as asbestos
  - noise and vibration
  - lights
  - land contamination
  - construction traffic
  - changes to emergency access
  - existing infrastructure and utilities
  - potential unexploded ordnance (UXO)
  - abandoned mines
  - use of explosives for excavation works
  - storage and use of hazardous chemicals and dangerous goods.
- Operation hazards and risks, for example:
  - fatigue and heat stress
  - minor levels of operation dust and other airborne contaminants generated from maintenance activities
  - noise and vibration from train operations and/or maintenance activities
  - land resources
  - impact to emergency access
  - interfaces between road and rail
  - concurrent or simultaneous operations with existing railway infrastructure
  - rail incidents such as derailments or rollingstock collisions
  - existing infrastructure and utilities
  - potential abandoned mines
  - storage and use of hazardous chemicals and dangerous goods for maintenance
  - transport of dangerous goods via freight.

This chapter should be read in conjunction with all other chapters of the revised draft EIS.

21.2 Regulatory environment

Policies, standards and guidelines of relevance to this risk assessment are introduced and summarised in Table 21-1. The following legislation is relevant to the assessment of hazards and risks for the Project:

- *Biosecurity Act 2014* (Qld)
- *Electrical Safety Act 2002* (Qld)
- *Environmental Protection Act 1994* (Qld) (EP Act)
- *Explosives Act 1999* (Qld) (Explosives Act)
- *Nature Conservation Act 1992* (Qld)
- *Petroleum and Gas (Production and Safety) Act 2004* (Qld)
- *Planning Act 2016* (Qld) and Planning Regulation 2017 (Qld), including the State Development Assessment Provisions (SDAP)
- *Rail Safety National Law (Queensland) Act 2017* (Qld) (Rail Safety National Law)
- *Soil Conservation Act 1986* (Qld)
- *Transport Infrastructure Act 1994* (Qld)
- *Waste Reduction and Recycling Act 2011* (Qld)
- *Work Health Safety Act 2011* (Qld).

Further discussion about this legislation, its relevance to the Project and how the Project complies is in Chapter 3: Legislation and Project Approvals Process.

TABLE 21-1 POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THIS ASSESSMENT

Policy, standard or guideline	Relevance to the Project
Policy	
State Planning Policy (Department of Infrastructure, Local Government and Planning, *2016*)	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. The policy forms the basis of design decisions, such as route selection and impact assessment, which inform risk assessment for the Project.
Guidelines and standards	
Guideline: Safety Management System (Office of the National Rail Safety Regulator (ONRSR), 2019b)	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 Australian Rail Track Corporation's (ARTC's) Safety Management System.
AS ISO 31000:2018—Risk management—Guidelines (Standards Australia, 2018a)	This standard describes the risk management process that can be applied throughout the life of an organisation and to a wide range of activities. It also provides guidance on the identification and assessment of risk, which has been applied in the methodology of this chapter.
National Standard for Health Assessment of Rail Safety Workers (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.
AS/NZS ISO 45001:2018 Occupational health and safety management systems—Requirements with guidance for use (Standards Australia, 2018d)	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/NZS 4804:2001 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 4292.1:2006 Railway safety management (Standards Australia, 2006c)	This standard informs ARTC's 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.

Policy, standard or guideline	Relevance to the Project
AS 2187.1:1998 Explosives—storage and use, Part 1: Storage (Standards Australia, 1998) and *AS 2187.2:2006 Explosives – Storage and use, Part 2: Use of explosives* (Standards Australia, 2006)	These standards set 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 guide—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, 1999b)	This standard provides lists of Emergency Procedure Guides and Group Text Emergency Procedure Guides and guidance on their selection, completion and use. This standard serves as a reference when selecting the appropriate Emergency Procedure Guide 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 Class 3 flammable and combustible dangerous goods. 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 Class 8 corrosive dangerous goods. This was 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.
AS/NZS 1680.5:2012 Interior and workplace lighting Part 5: Outdoor workplace lighting (Standards Australia/Standards New Zealand, 2012)	This standard sets out requirements, general principles, and recommendations for the permanent lighting of exterior workplaces. It applies to exteriors in which specific visual tasks are undertaken. It applies only when this area is being used as a workplace.
Australian Code for the Transport of Dangerous Goods by Road & Rail (National Transport Commission, 2024)	This code details the technical specifications, requirements, and recommendations applicable to the transportation of dangerous goods in Australia by road and rail. This was taken as the basis of dangerous-goods handling and considered in the development and assessment of mitigation measures.
Transport Noise Management Code of Practice—Interim Guideline: Operational Railway Noise and Vibration (Department of Transport and Main Roads (DTMR), 2019c)	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.
Construction work code of practice (Safe Work Australia, 2013)	This model Code of Practice provides guidance on how to meet the standards of work health and safety (WHS) required under the *Work Health Safety Act 2011* and Work Health Safety Regulation 2011 in relation to construction work.

21.2.1 ARTC safety management framework

21.2.1.1 Safety Management System

Office of the National Rail Safety Regulator (ONRSR) accreditation has been obtained for the Project. This accreditation authorises ARTC to carry out rail operations for the Project including the construction, operation, and maintenance of the rail infrastructure. The purpose of accreditation of a Rail Transport Operator for railway operations is to attest that ARTC has demonstrated to the Regulator competence and capacity to manage risks to safety associated with those railway operations. As an accredited Rail Transport Operator, ARTC is required by rail safety legislation to have a safety management system in place that covers the railway operations it is accredited to carry out. The AS 4292.1-Railway safety management (Standards Australia, 2006c) management performance outcomes have informed ARTC's Safety Management System requirements. 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.

In accordance with Section 69 of the Rail Safety National Law, ARTC's application for Variation of Accreditation has been granted. Further information relevant to the Project is detailed in Chapter 3: Legislation and Project Approvals Process. ARTC will continue to use this system to manage safety risks associated with Inland Rail and the Project's construction and operation activities. The types of documents that form part of ARTC's Safety Management System are shown in Figure 21-1.

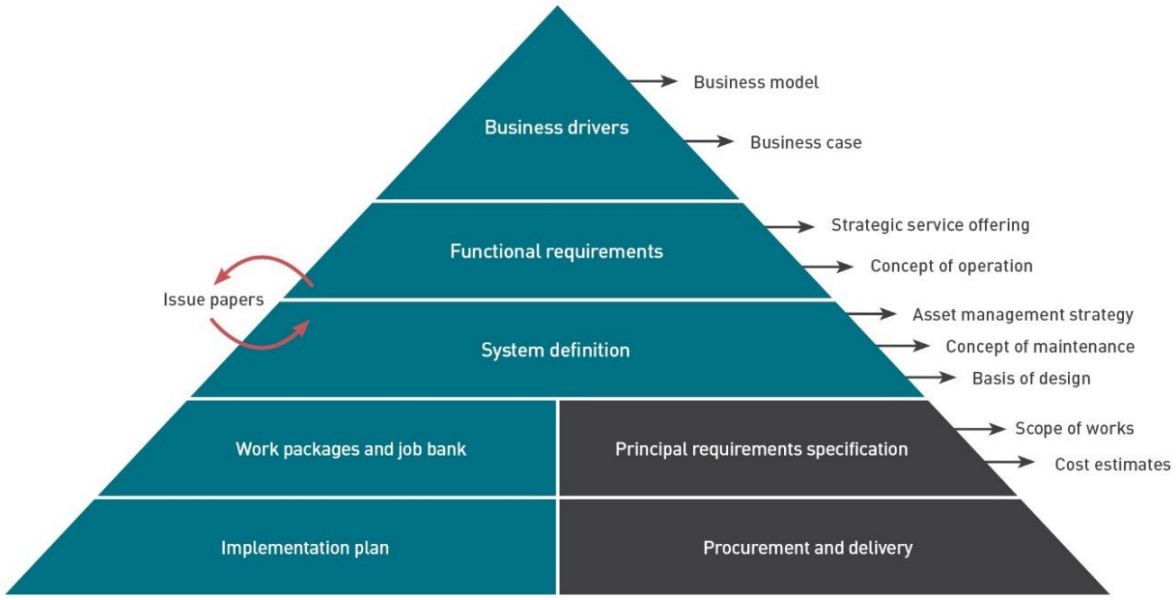


FIGURE 21-1 INLAND RAIL SAFETY MANAGEMENT SYSTEM

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

ARTC participates in an expansive program of internal audits, inspections, and assessment from ONRSR, Work Health and Safety Queensland, Comcare, independent third parties, and Federal Work Health and Safety Regulators, to ensure ARTC systems meet the legal requirements and effectively prevent accidents and injury, demonstrating integration of ARTC's value of 'no harm' into the Inland Rail management system.

ARTC's Safety Management System documents interactive process flows for:

- Governance framework
  - development of strategic priorities, consultation and governance requirements and review process
- Governance committees
  - safety governance structures outline the escalation processes from the Operational Safety, Environmental and Risk Committee, through to the Chief Executive Officer and includes the Boards Safety and Environment Sub-committee.

21.2.1.2 Safety Policy

ARTC's Safety Policy provides the basis for effective management of employee, contractor and public health for the Project.

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 C: Corporate Policies. It will apply to the Inland Rail Program and the Project, including to contractors.

21.2.1.3 Fatal & Severe Risk Program

ARTC maintains and implements a Fatal & Severe Risk Program (ARTC, 2017b) 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. 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
- Contractor management.

Additional details on ARTC's Fatal & Severe Risk Program (2017b) are accessible through the ARTC website and will apply to the Inland Rail Program and the Project, including to contractors.

21.3 Methodology

21.3.1 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), 2015b)
- *Local Disaster Management Plan* (Goondiwindi Regional Council (GRC), 2022b)
- *Natural Disaster Risk Management Plan* (GRC, 2011)
- *Toowoomba Regional Planning Scheme* (TRC, 2012)
- *Goondiwindi Region Planning Scheme 2018* (GRC, 2018a)
- Climate data from the Bureau of Meteorology (BoM)
- ARTC's Infrastructure Standards Extranet
- Other technical assessments that have been undertaken to inform this revised draft EIS, as documented in corresponding chapters and cross-referenced in Section 21.5
- Design drawings, materials selection, feasibility of design assessments and constructability assessments prepared in support of development of the revised reference design for the Project.

21.3.2 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.

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

- Requirements of the ToR, public and stakeholder submissions received on the draft EIS and the Coordinator-General request for additional information
- Other chapters within this revised draft EIS, as relevant and cross-referenced in Section 21.4
- 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 (CCC), GRC, TRC, Queensland Police Service (QPS), Queensland Ambulance Service (QAS) and Resources Safety & Health Queensland.

Details of consultation to support development of the revised reference design and revised draft EIS are included in Chapter 6: Stakeholder Engagement and Appendix E: Consultation Report.

21.3.3 Risk assessment methodology

The risk assessment presented in Section 21.7 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 assessment provides a basis for the assessment of potential impacts and preparation of safeguards to manage and mitigate impacts that may 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 *AS* ISO 31000:2018) (Standards Australia and Standards New Zealand, 2009) and *HB203:2012 Managing environmental risk* (Standards Australia, 2012a).

The risk of potential impacts is assessed in terms of how likely they are to occur, and the consequences if they do occur. Likelihood and consequence criteria, and the resulting risk matrix are set out in Table 21-2, Table 21-3 and Table 21-4. These criteria have been established to be consistent with the intent of *AS ISO 31000:2018 Risk management—Guidelines* (Standards Australia, 2018a).

TABLE 21-2 LIKELIHOOD CRITERIA

Likelihood	Description	Frequency of occurrence
Almost certain	Is expected to occur in most circumstances	Once per month
Likely	Will probably occur in most circumstances	Between once a month and once a year
Possible	Might occur at some time	Between once a year and once in five years
Unlikely	Could occur at some time	Between once in 5 years and once in 20 years
Rare	May occur in exceptional circumstances	Once in more than 20 years

TABLE 21-3 CONSEQUENCE CRITERIA

Risk category		Consequence				
		Not significant	**Minor**	**Moderate**	**Major**	**Extreme**
Safety	Impact to people	No medical treatment required	Lost-time injury or medical treatment required	Serious injury	Single fatality	Multiple, but localised, fatalities
Assets	Engineering impacts and satisfying objectives	Up to 6 hours of track closure	>6 hours to 24 hours of track closure	>24 to 48 hours of track closure	>48 hours to 5 days of track closure	>5 days of track closure
Financial	Total outturn cost impact	Up to 0.05% of program budget (i.e. up to $5m in $10b)	>0.05% to 0.5% of program budget (i.e. >$5m to $50m in $10b)	>0.5% to 1.5% of program budget (i.e. >$50m to $150m in $10b)	>1.5% to 5% of program budget (i.e.>$150m to $500m in $10b)	>5% of program budget (i.e. > $500m in $10b)
		Up to 0.1% of Project budget (i.e. up to $100,000 in $100m)	>0.1% to 0.5% of Project budget (e.g. >$100k to $500k in $100m)	>0.5% to 2.5% of Project budget (e.g. >$500k to $2.5m in $100m)	>2.5% to 10% of Project budget (e.g. >$2.5m to $10m in $100m)	>10% of Project budget (e.g. >$10m in $100m)
Environment	Environmental impact, heritage impact, flora and fauna, impact on archaeology and cultural heritage, pollution and amenity (public)	Contained environmental damage—fully recoverable, no cost or ARTC action required	Isolated environmental damage—minimal ARTC remediation required	Localised/clustered environmental damage—requiring remediation	Considerable environmental damage—requiring remediation	Widespread long-term or permanent environmental damage—remediation required
Regulatory	Regulatory/legislative exposure, non-compliance and 'Licence to Operate'	Minimal or no regulatory involvement	Notice to produce information	Improvement notice or threatened action	Prohibition notice or fines	Prosecution of the company and/or its office holders
Reputation	Reputational exposure, customer dissatisfaction, stakeholder support, service, quality and reliability, public image and stakeholder attitudes	Isolated event able to be resolved (up to 7 days)	Management intervention required (>7 days to 3 months)	Tactical (business unit/divisional intervention required (>3 months to 18 months)	Strategic intervention required (>18 months to 3 years)	Corporate loss of shareholder and/or customer support—tangible business impact lasting >3 years
Schedule	Time-based impacts	Influences schedule up to 1% of program—approved schedule period	Influences schedule >1% to 2.5% of program—approved schedule period	Influences schedule >2.5% to 5% of program—approved schedule period	Influences schedule >5% to 10% of program—approved schedule period	Influences schedule >10% of program—approved schedule period
		Influences schedule up to 2% of Project—approved schedule period	Influences schedule >2% to 5% of Project—approved schedule period	Influences schedule >5% to 10% of Project-approved schedule period	Influences schedule >10% to 20% of Project—approved schedule period	Influences schedule >20% of Project—approved schedule period

TABLE 21-4 RISK MATRIX

Likelihood/consequence	Not significant	Minor	Moderate	Major	Extreme
Almost certain	Medium	Medium	High	Very high	Very high
Likely	Low	Medium	High	Very high	Very high
Possible	Low	Low	Medium	High	High
Unlikely	Low	Low	Low	Medium	Medium
Rare	Low	Low	Low	Low	Medium

The risk management process adopted, as shown in Figure 21-2, 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 Sections 21.4.1 to 21.4.3.

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 stages in Table 21-5.

TABLE 21-5 PROJECT LIFECYCLE DEFINITION

Project stage	Definition
Detailed design	All activities up to the commencement of Project works
Pre-construction activities and early works	All activities which fall under pre-construction activities and early works
Construction works	All activities that are related to construction works undertaken and can commence upon the endorsement of the Construction Environmental Management Plan (CEMP) by the Environmental Monitor for the Relevant Project Works up to commissioning
Commissioning	All activities conducted to ensure the rail infrastructures are in working condition, this includes testing and commissioning (checking) of the rail line and communication/signalling systems to ensure that all systems and infrastructure are designed, installed and operating according to ARTC's operational requirements
Operations	All activities related to operation of the rail, including the use of the railway for freight purposes, and maintenance of safety systems, signalling, and general track and infrastructure maintenance
Decommissioning	Works would be undertaken in accordance with a decommissioning Environmental Management Plan, or similar, which would be developed in consultation with relevant stakeholders and regulatory authorities

While the design stage is important for risk assessment in terms of identifying and developing risk mitigation measures, there is very low risk exposure during this stage. For this reason, the risk assessment will consider only risks within the stages of pre-construction activities and early works, construction works and operations. Pre-construction activities and early works, and construction works stages have been combined for risk assessment and identification of mitigation measures to avoid repetition.

The risk assessment residual impacts as presented in Section 21.7 are a component of the broader risk assessment for the Project which follows AS ISO 31000:2018 Risk Management Process as shown in Figure 21-2.

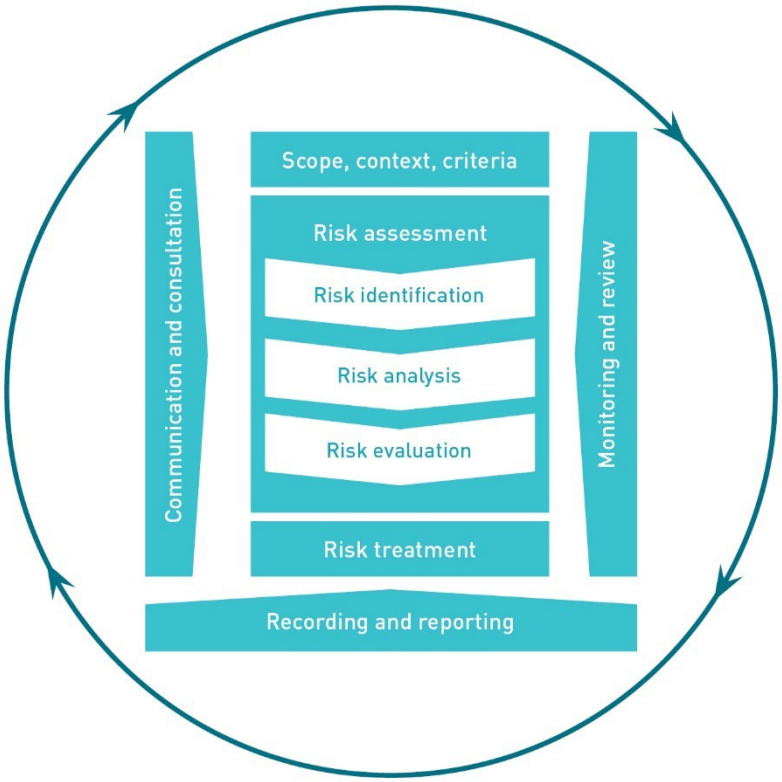


FIGURE 21-2 THE AS ISO 31000:2018 RISK MANAGEMENT PROCESS

21.3.3.1 Hazard and risk identification

In accordance with the requirements of AS/NZS ISO 31000:2009 (compliant with *AS* ISO 31000:2018), hazard and risk identification has been undertaken alongside the risk assessment. 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 involves 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 flora and fauna, land and habitat.

Consideration has been given to potential hazards identified through other assessments as part of this revised draft EIS, in addition to those identified through the revised reference design development process and documented in accordance with requirements under the Rail Safety National Law (see 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 *Work Health Safety Act 2011* (Qld) and Work Health and Safety Regulation 2011 (Qld), 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 purposes of the revised draft EIS, these occupational risks will not be documented in this chapter.

21.3.3.2 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 21.7. The risk ranking methodology, including criteria applied to likelihood and consequence factors, is discussed in Chapter 4: Assessment Methodology.

21.3.3.3 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 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 Sections 21.6.2 and 21.8.

21.4 Existing environment

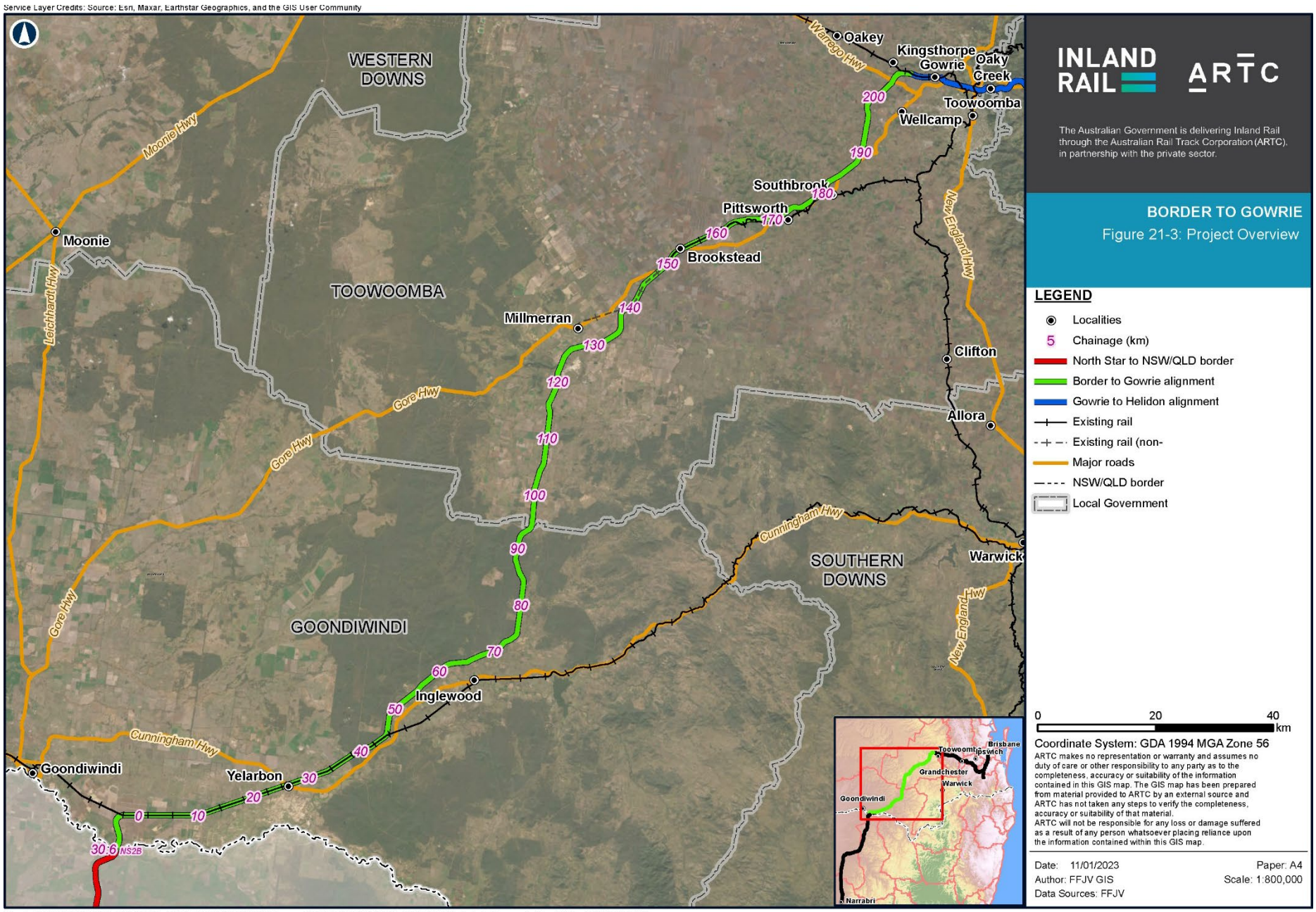
Identification and assessment of risk requires an understanding of the potential impacts on receptors. Receptors can be people (human), sensitive ecosystems (environmental) or societal (land use and infrastructure). Receptors have been identified through data sources specified in Section 21.3.1. This section provides a discussion on the human, environmental, land use and infrastructure receptors identified for the Project.

21.4.1 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, Canning Creek, Brookstead, Pittsworth, Southbrook, Gowrie Mountain, Kingsthorpe, Wellcamp and Gowrie Junction. At the 2021 Census, these townships and populations have been updated and cited in Appendix X: Social Impact Assessment.
- 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 Queensland Rail (QR) 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) (ARTC, 2023d).


Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
WESTERN DOWNS
TOOWOOMBA
GOONDIWINDI
SOUTHERN DOWNS
Moonie
Millmerran
Brookstead
Pittsworth
Southbrook
Wellcamp
Toowoomba
Oakey
Kingsthorpe
Gowrie
Oaky Creek
Clifton
Allora
Warwick
Inglewood
Yelarbon
Goondiwindi
Moonie Hwy
Leichhardt Hwy
Gore Hwy
Cunningham Hwy
Warrego Hwy
New England Hwy
0
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60
70
80
90
100
110
120
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200
30.6
NS2B
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 21-3: Project Overview
LEGEND
Localities
Chainage (km)
North Star to NSW/QLD border
Border to Gowrie alignment
Gowrie to Helidon alignment
Existing rail
Existing rail (non-
Major roads
NSW/QLD border
Local Government
Brisbane
Ipswich
Toowoomba
Grandchester
Warwick
Goondiwindi
Narrabri
0
20
40
km
Coordinate System: GDA 1994 MGA Zone 56
ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material.
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Date: 11/01/2023
Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:800,000
Map by: MEF/KG Z:\GIS\GIS_310_B2G\Tasks\310-ITR-201903071702_Transport\310-ITR-201903071702_ARTC_Fig20.1_Project_Alignment_v3.mxd Date: 11/01/2023 09:46

21.4.2 Environmental receptors

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

- Wetlands, watercourses and drainage features traversed by the Project or within proximity to the Project footprint, as identified in Chapter 13: Surface Water. These features include the Macintyre River, Macintyre Brook, Canning Creek, Pariagara Creek, Cattle Creek, Bringalily Creek, Nicol Creek, Back Creek, Grasstree Creek, Condamine River, Umbiram Creek, Half Mile Gully, Westbrook Creek, Dry Creek and Gowrie Creek.
- Water catchment areas of the Condamine and Border Rivers, as identified in Chapter 13: Surface Water.
- Groundwater sources, as identified in Chapter 15: Groundwater. These sources including the Border Rivers Alluvium, Condamine Alluvium, Main Range Volcanics, Kumbarilla Beds and Walloon Coal Measures.
- Environmental values impacted by air pollutants within the air shed of the Project, as identified in Chapter 12: Air Quality.
- Habitat for threatened species and mapped locations of threatened ecological communities, as identified in Chapter 11: Flora and Fauna.
- Densely vegetated areas, such as the Whetstone State Forest and Bringalily State Forest.
- Areas of Indigenous cultural heritage sensitivity, as identified in Chapter 19: Cultural Heritage.
- Non-Indigenous heritage areas of interest, in the form of buildings, structures and other features, as identified in Chapter 19: Cultural Heritage.

21.4.3 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
  - the Project rail alignment traverses along the north-western boundary of land associated with the Commodore Mine at Domville
- Toowoomba Wellcamp Airport
  - the Project footprint is approximately 865 metres (m) west of the northern limit of the runway
- Transport infrastructure including road and rail
- Cropping activities, such as sorghum, cotton, maize, soybeans in summer months and wheat barley and chickpeas in winter months
- Animal husbandry including grazing land, feedlots, poultry farms and piggeries
- Grain storage and distribution infrastructure
- Livestock production
- Overhead transmission and distribution electrical lines
- Gas and oil pipelines
- Water and sewer pipelines
- Telecommunication and optic fibre lines.

For further details on receptors and land use and infrastructure with potential to be impacted by the Project refer to Chapter 8: Land Use and Tenure and Chapter 16: Noise and Vibration.

21.5 Potential impacts

Hazards that have the potential to impact people, the environment and land use and infrastructure have been identified in reference to the data sources specified in Section 21.3.1 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 two non-resident workforce accommodation facilities (including health hazards and community conflicts) have been addressed in Chapter 17: Social and are not considered in this assessment.

21.5.1 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 include:

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

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

21.5.1.1 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 (Ball et. al., 2019).

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.

Climate modelling from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) predicts a temperature rise of 0.6 degrees Celsius (°C) to 1.5°C and a ±10 per cent 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, Ekstrom et al (2015) predict the following increases in fire danger for the Central Slope region in the most severe conditions:

- Forest Fire Danger Index increases from 1995 baseline by:
  - 9 per cent to 15 per cent by 2030
  - 40 per cent by 2090.
- Number of days with severe fire danger rating increases from 1995 baseline by:
  - 35 per cent to 70 per cent by 2030
  - 220 per cent 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 grinding and welding, with the potential to create sparks
  - construction vehicles and plant
  - power generator sets
- Ignition:
  - bulk stores of combustible liquids
  - flammable or combustible 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 and wagons
  - maintenance vehicles and plant
  - maintenance activities
  - hot works, such as welding, with the potential to create sparks
- Ignition:
  - flammable or combustible 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 pasture production and agricultural crops
- Loss and damage of important species habitat
- 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 see Section 21.5.2.3.

21.5.1.2 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' (Ball et al., 2019).

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 (Ball et al., 2019).

The Project alignment crosses the Condamine River floodplain between Millmerran and Brookstead. The floodplain is formed by three main river branches, including the Condamine River North Branch, the main Condamine River and a southern branch known as Grasstree Creek. On the Condamine River floodplain, the terrain is flat and the sinuous creek channels begin to break their banks in a 50% Annual Exceedance Probability (AEP) event, and then flow between branches in 20% AEP and larger events.

On the northern floodplains of the Murray–Darling Basin, flooding also occurs from overland flow from adjacent higher land (uplands) and from torrential and storm rainfall over the floodplains themselves as well as, conventional flooding from surcharging of creeks and rivers.

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

Chapter 13: Surface Water describes the surface water quality impact assessment for the Project including details of quality of water and water quality objectives.

Chapter 14: Flooding and Geomorphology describes the hydrology, flooding and geomorphology impact assessments for the Project.

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 region.

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 Project 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. Unmitigated, these impacts may affect existing dwellings, sheds, farm buildings and infrastructure, crops, and roads. Flood-sensitive receptors in proximity to the Project have been identified and mapped for each floodplain separately in Chapter 14: Flooding and Geomorphology.

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, and subsequent impacts to the design life of existing assets and the viability and tolerance of crops
- Increased depth of water affecting trafficability of roads and tracks.

See Chapter 14: Flooding and Geomorphology for further discussion on the potential impacts of flooding.

21.5.1.3 Landslide

Hazard description

Landslide or sudden subsidence and movement of soil or rocks is generally caused by heavy rain. For example, 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 16 per cent or greater (Queensland Government, 2024).

The Project has been aligned to avoid steep slopes, where possible, therefore reducing 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 Australian height datum (AHD). From this point, elevation along the Project alignment generally increases steadily at an average slope of 0.5 per cent in a northward direction towards Mount Domville and Commodore Peak, south of Millmerran. The Project alignment peaks at 482 m AHD at chainage (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 AHD. From Yarranlea, the Project alignment increases in elevation at an average slope of 1.6 per cent (maximum of 3.3 per cent) until Ch 178.5 km near Southbrook, where a maximum elevation of 595 m AHD is reached. From this high point, elevation of the Project alignment decreases to an end point at Ch 208.2 km of 458 m AHD, at an average slope of 1.7 per cent (maximum of 5 per cent).

Where slopes could not be avoided, the railway will be positioned in cuts 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). For further detail, see Chapter 9: Land Resources.

Further details of the regional topography that is inherent to landslide risk, is provided in Chapter 9: Land Resources.

Potential impacts

The Project will interface with soil types, geological units and landform features that have the 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 due to 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 screen 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).

Permanent alteration to landform and topography remains a potential risk due to the potential for loss of soil resources through erosion and disturbance of existing contaminated land through the duration of the Project stages and ongoing works. Agricultural land has a high ongoing risk from erosion during floods particularly when the soil surface is bare. Erosion-prone areas include those immediately downstream of rail cross-drainage works, those upstream of the rail corridor due to lateral drainage along the line and soil conservation works both upstream and downstream in and adjacent to the rail corridor.

Further discussion on the potential consequences of soil and geological risks for the Project is provided in Chapter 9: Land Resources.

21.5.1.4 Wildlife

Hazard description

Hazards attributed to wildlife are associated with the potential for:

- Fauna to interact with construction and operation activities, which can include the following examples:
  - domestic livestock that can pose a significant risk to train strikes
  - spread of pest species (e.g. fire ants)
- Habitat fragmentation which is a hazard to reproduction and seed dispersal.

Wildlife has the potential to interact with construction personnel via animal attacks and bites; however, the greater hazard is in construction vehicle movements through vehicle accidents from animal strikes. Similarly, operational 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 11: Flora and Fauna.

21.5.1.5 Biosecurity

Hazard description

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

Potential impacts

. Eight restricted weeds species listed under the *Biosecurity Act 2014* (Qld) have been identified to have the potential to occur within the Project area (Chapter 11: Flora and Fauna).

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

- Transportation of livestock with potential to carry *Coxiella Burnetii (C. burnetii)* bacteria, which can cause Q-Fever in humans.

Further discussion on the potential impacts associated with flora, fauna and biosecurity is provided in Chapter 11: Flora and Fauna as well as airborne disease in air quality impacts provided in Chapter 12: Air Quality.

21.5.1.6 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 217.48 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 21-6.

TABLE 21-6 CLIMATE DATA FROM OAKEY AERO (1973 TO 2023) AND INGLEWOOD FOREST (2000 TO 2015)

Parameter		Unit	Oakey Aero[1]	Inglewood Forest[2]
Highest mean maximum temperature		°C	31.0	33.2
Highest maximum temperature		°C	42.8	42.0
Lowest mean minimum temperature		°C	3.0	5.6
Lowest minimum temperature		°C	-7.5	-2.7
Mean monthly rainfall	Highest	mm	90.3	97.3
	Lowest	mm	25.5	24.3
Monthly rainfall extremes	Highest	mm	304.2	245.8
	Lowest	mm	0.0	0.0
Mean solar exposure	Highest	MJ/m^2	25.3	25.6
	Lowest	MJ/m^2	12.0	11.6
Maximum monthly wind gust speed	Highest	km/h	161	107
	Lowest	km/h	76	61

Table notes:
mm = millimetres MJ/m^2 = megajoule per square metre km/h = kilometre per hour
1 Climate data from Oakey Aero (1973 to 2022) (BoM, 2023a)
2 Inglewood Forest (2000 to 2013) (BoM, 2023b)

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 100 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) and agriculture.

Climate modelling from the CSIRO (Ekström et al., 2015) predicted temperature rises for the Central Slope region relative to the climate from 1986 to 2005. Figure 21-4 shows the modelled trend for the Representative Concentration Pathway 8.5 emissions scenario, which is representative of a future with little curbing of emissions, with a CO_2 concentration continuing to rapidly rise, reaching 940 parts per million by 2100. The Representative Concentration Pathway 8.5 modelling predicts the following temperature rises between:

- 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 et al., 2015). Figure 21-5 shows the modelled trend for the Representative Concentration Pathway 8.5 emissions scenario with the following predicted changes in predicted rainfall relative to 1995:

- -10 per cent to 5 per cent by 2030
- -25 per cent to 10 per cent by 2090.

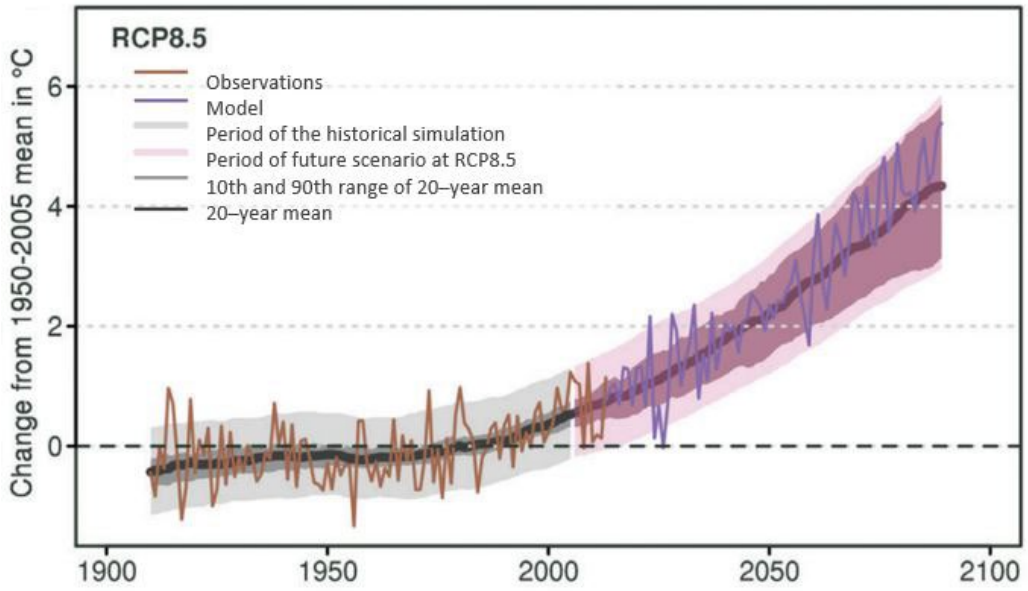

FIGURE 21-4 TIME SERIES FOR CENTRAL SLOPES ANNUAL AVERAGE SURFACE AIR TEMPERATURE FOR 1910 TO 2090

Source: Ekström et al., 2015

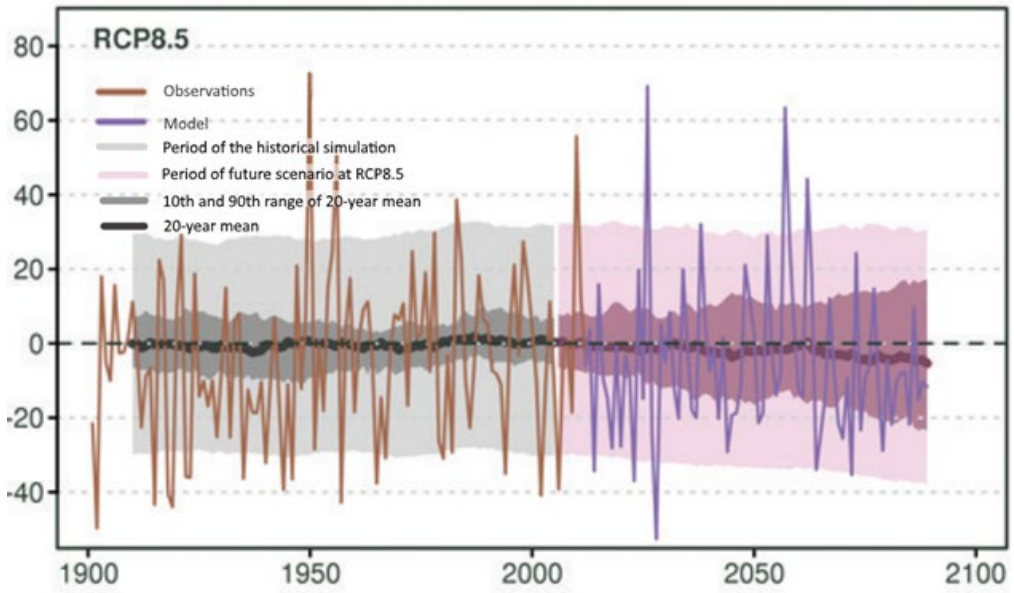

FIGURE 21-5 TIME SERIES FOR EASTERN AUSTRALIA RAINFALL ANNUAL AVERAGE

Source: Ekström 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 (Department of Environment and Heritage Protection (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 (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 ($MtCO_2$-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 14: Flooding and Geomorphology.

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 (Table 21-6). 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 21.5.1.2.

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.

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 (Ekström et al., 2015) 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 (e.g. signalling/communications equipment and drainage basins)
- Increased incidence of extreme events (e.g. 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 throughout Chapter 7: Sustainability, Chapter 13: Surface Water and Chapter 14: Flooding and Geomorphology.

21.5.2 Project hazards

Hazards that have potential to be introduced through the pre-construction works and early works, construction works and operations stages of the Project are as follows:

- Health and environment
  - 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
  - soil erosion
  - outdoor workplace safety (lighting)
- Accidents
  - road infrastructure
  - private access and stock routes
  - rail infrastructure
- Safety
  - infrastructure and services
  - UXO
  - bridges
  - emergency and timber harvesting access
  - abandoned mines.

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

21.5.2.1 Health and environment

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, 2020a). 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, 2020a). 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 pre-construction works and early works, construction works and operations stages of the Project, fatigue may contribute to the occurrence of incidents for individuals who are:

- Operating fixed or mobile plant/equipment
- Driving a road or rail 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 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 (see Chapter 9: 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, 2020b). 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.

While asbestos is banned in Australia, it can still be found in imported items where the use and manufacturing of asbestos is not banned.

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. 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.

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, 2020c). 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.

Construction works (e.g. soil stabilisation through the use of lime), earthworks and truck movements over unpaved surfaces (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, sulfur 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.

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 unforeseeable demand for coal eventuates, there is potential for operation stage releases of coal dust for the Project.

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

Quicklime

To support optimum use of raw material for the Project, quicklime as a neutralising component has been proposed to be applied. Although this substance has not been classified as an environmental hazard, nor to be a cause for physical hazard, quicklime is classified as a hazardous material according to Safe Work Australia criteria (Boral, 2020). To ensure this substance is used and managed appropriately during the course of Project construction, mitigations through storage, air quality and groundwater have been considered. To ensure safe handling, truck deliveries of quicklime, as required, is the preferred management for application method. Alternatively, intermediate bulk container will be actioned if quicklime is required to be stored onsite. During application of quicklime, dust-suppression water sprays, or alternative appropriate treatment will be applied to unsealed surfaces trafficked by construction vehicles and lime stabilisation operations to minimise any potential risks or impacts.

Potential impacts

Published geological data and experience with the basaltic rocks of the Project 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.

Further discussion of potential air-quality impacts associated with the Project is provided in Chapter 12: Air Quality.

Noise and vibration

Hazard description

The terms ‘sound’ and ‘noise’ are interchangeable, with the term noise often used to describe sound that is unwanted. The most common form of noise experienced by people is from the transmission of sound through the air, which is termed airborne noise.

Human hearing does not perceive all frequencies of sound equally, so the measurement of sound often has an adjustment (A-weighting) applied so the sound level corresponds closely to the relative loudness perceived by the human ear. The level of sound is measured and quantified using decibels (dB). The unit ‘dBA’ is the level of sound in decibels with the A-weighting adjustment applied to account for human hearing response and is generally used as the relevant parameter for the measurement and assessment of community noise.

Vibration is transmitted from its source to buildings and property via the intervening ground and can be perceived by building occupants when sitting, standing, or lying down. An individual’s tolerance to vibration varies over a wide range and is usually influenced by the location, for example whether at home, at work or travelling in a car.

In addition to the level of sound or vibration, human perception and response to noise and vibration is sensitive to the characteristics of the emissions and the time, duration, and repetition of the sound or vibration. The descriptors (metrics) of noise and vibration in this assessment consider both the exposure to noise and vibration over defined time periods and the maximum levels from individual events.

Noise and vibration that is clearly perceptible does not necessarily mean that it will be unpleasant, annoying, or disturbing in nature. Often the effects of noise and vibration are diminished (masked) by the sounds in the daily environment and an individual's sensitivity to noise and vibration can be related to personal expectations, psychological attitudes, and social factors. Noise and vibrations may arise through the progression of the Project during the construction works stage, road transport and railway operations.

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 receptors.

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 receptors; however, vibration typically dissipates to negligible levels within 50 m 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 provided in Chapter 16: 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 preliminary assessment has been undertaken to identify potential sources of contamination (see Chapter 9: Land Resources). Potentially contaminating activities and land uses were identified as follows:

- Agricultural land use (developed)—storage and use of agricultural chemicals/fuel, farm buildings/structures, livestock dips/spray races, landfilling
- Housing, sheds and other infrastructure—agricultural and residential storage, use and commercial enterprises (including service stations)
- Landfills (including waste disposal/treatment)—municipal, local government or commercial enterprise
- Mining—Commodore Mine (potential for fly ash to be present from Millmerran Power Station)
- Railway land use—existing/permanent QR railway corridor and rail yards that have been subject to pesticide and herbicide spraying
- Road crossings—public roads
- Unknown fill material (e.g. associated with railway corridors and other developed land uses).

Further details on existing potential land contamination are provided in Chapter 9: Land Resources. Details on Environmental Management Register (EMR) results are presented in Appendix I: EMR Search c\Certificates and Soil Laboratory Certificates.

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 (see Section 21.5.2.1 as well as further detail discussed in Chapter 9: Land Resources).

Soil erosion

Hazard description

The preparation of a soil conservation plan requires consideration of many issues including soil types, topography, current and proposed land use and management, remnant vegetation, property infrastructure and run-off coordination with neighbouring properties and road and rail drainage. The planning process also provides opportunities to improve the overall property layout to achieve greater efficiencies in managing the property.

Approved property and project area plans are binding on all present and future owners and the Crown. Approved property and project area plans can be modified to accommodate circumstances that differ from those applying at the time of approval. Plans may be amended, or their approval may be revoked. This involves similar procedures to those used in the initial approval process.

There are 24 known existing soil conservation plans traversed by the Project alignment that may be affected by the Project and other features, or requirements of the soil conservation plans. A summary of potential impacts had been compiled through consultation with the Department of Resources (DoR).

Further details of soil conservation plans are presented in Chapter 9: Land Resources.

Potential impact

Properties traversed by the Project alignment that are subject to soil conservation plans are at risk of increased or altered overland flow. The potential impacts from the Project are compaction of soils within the rail corridor itself and temporary work areas, together with damage to existing soil conservation structures including waterways.

There is a further risk that landowners will have to change their soil surface management practices (and associated machinery) to counteract any increased overland flows.

There are some soil conservation plans traversed by the Project alignment that are more than 10 years old, and the soil conservation measures may not have been maintained during this period, or the agricultural land use may have changed. Consequently, the currency of all soil conservation plans within the Project footprint will need to be verified during the detailed design stage of the Project.

Outdoor workplace safety (lighting)

Hazard description

A poor physical environment means workers are exposed to unpleasant, poor quality or hazardous working environments or conditions. Poor physical environment can be created from conditions that affect concentration due to poor lighting in an outdoor setting for work during the day and at night.

Australian/New Zealand Standard, *AS/NZS 1680.5:2012 Interior and workplace lighting Part 5: Outdoor workplace lighting* (Standards Australia/Standards New Zealand, 2012) sets out general principles and recommendation for permanent lighting for exterior workplaces where critical factors are the luminance contrast of the task and luminance adaptation level of the observer. Further, creation of the comfortable visual conditions which people require in order to maintain efficiency over a period of time depends on factors such as distribution of light throughout the space, the use of suitable colours and finishes on any relevant reflecting surfaces, the choice of luminaires with adequate glare control, and the elimination of unwanted reflection. Project hazards that may arise from a poor physical environment where there is insufficient lighting provided, include.

- Eye fatigue
- Accidents.

For the Project to meet the requirements of *AS/NZS 1680.5:2012 Interior and workplace lighting Part 5: Outdoor workplace lighting* (Standards Australia/Standards New Zealand, 2012), ARTC have outlined commitment to a ‘pathway to zero’ and ‘no harm’ through ARTC’s Safety Policy (2020e) which provides the basis for effective management of employee, contractor, and public health for the Project. In addition, through ARTC’s Contractor Handbook, contractors must ensure that the environmental risks of rail maintenance and construction activities are assessed and managed in accordance with ARTC and legislation. To meet the visual environmental guide, the following actions are to be considered:

- Housekeeping in good order
- Location and direction of lighting for night works.

Potential impact

The following scenarios may arise from the Project:

- Daytime work in an enclosed and dark space where visual tasks are required to be carried out
- Daytime work located in an environment where there is reflective material impacting on the requirements of visual tasks to be carried out
- Night-time work in dark areas where there is insufficient lighting.

Of the scenarios that may occur through the duration of the Project, the following outcomes have the potential to occur:

- Eyestrain, headaches or fatigue from poor postures due to poor visibility
- Neck, shoulder and back pain from straining to see items in poorly lit areas
- Increased risk of injury from slips, trips and falls incidents, in particular where workers are working in and around machinery (moving or stationary), equipment and/or near stairs in dim, dark or unlit areas
- Security risks due to violence and aggression, particularly at night near dark and unlit areas
- Psychological issues, such as anxiety, stress or depression, particularly if workers are exposed to insufficient or gloomy lighting over a period of time.

21.5.2.2 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 intersections with each public road type is presented in Table 21-7.

TABLE 21-7 SUMMARY OF ROAD AND ACCESS INTERFACES FOR THE PROJECT

Road type	Number of interfaces[1]
State-controlled (DTMR)	9
Local government roads (GRC)	16
Local government roads (TRC)	25

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

Each intersection between rail and road requires a design treatment. Design treatments for public road–rail intersections that are included in the revised reference design have been categorised 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.
- 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 diversions or consolidations is considered acceptable, 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.

The appropriate design treatment for each road–rail interface has been assessed on a case-by-case basis, with consideration given to current and future usage of the existing road asset, its location relative to other crossings of the rail corridor and the road and rail geometry at the crossing location. The key principles guiding the decision-making process for determining treatments at public road–rail interfaces include:

- 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.
- Using a risk-based decision-making process focused on minimising risk so far as is reasonably practicable
- Consistency in the determination of road–rail interface treatments across all projects of the Inland Rail Program
- Applying a consistent methodology to determine if the cost of the potential available treatment is grossly disproportionate to the level of risk to safety and the projected benefits

- Working with stakeholders to minimise the number of level crossings across the Inland Rail Program
- Ensuring the feasibility of the Inland Rail Program by proposing cost-effective solutions.

Where a road–rail interface is required, ARTC will apply a consistent safety-based risk approach to determine crossing treatments.

Further details on road–rail interfaces are presented in Chapter 20: Traffic, Transport and Access.

Potential impacts

The Project includes 22 active level crossings and seven passive level crossings of State-controlled and local government roads, which are summarised in Table 21-8.

TABLE 21-8 NUMBER OF LEVEL CROSSINGS ON ROAD NETWORKS

Road type	Active level crossing	Passive level crossing
State-controlled	2	0
Local (GRC)	8 (includes Yelarbon active pedestrian crossing)	6
Local (TRC)	12	1 (stock route/unformed road reserve)

The majority of level crossing incidents are typically classified as 'near miss' incidents between trains, road vehicles and pedestrians. The statistics used to support assessment of potential impacts are across the total population of Level Crossings in Australia (23,000 as per Track Safe Foundation, 2023).

As presented in *Rail Safety Report 2022–2023* (ONRSR, 2023), level crossing collisions occurred at a rate of 0.02 per million total train kilometres during 2022 to 2023. While other rail accidents including strike and fall, and assault are less likely to occur at level crossings. However, all may cause property damage, service disruptions, impact to adjacent infrastructure, injury and death.

Construction and operation maintenance activities for the Project on nearby and alongside adjoining roads 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 to public or workers
- Interrupt road routes due to oversized deliveries or temporary road closures or modifications which 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.

A traffic, transport and access assessment evaluated a range of issues encompassing potential impacts of the construction works and operations stages of the Project on the surrounding transport infrastructure and its users. It also examined the potential traffic and pavement impacts from the movement of materials, workforce and equipment during construction of the Project on the surrounding road network.

Further discussion of road interface impacts and potential traffic and transport impacts associated with the Project in the construction works and operations stages is provided in Chapter 20: 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 will intersect 168 private, unformed access ways and 74 private, formed access ways.

The Project interfaces with the State stock route network, which consists of stock routes and reserves in 11 locations.

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 21-9 are intersected by the Project revised reference design:

TABLE 21-9 STOCK ROUTE INTERFACES WITH THE REVISED 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	There is a separate and dedicated stock route crossing following 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 this stock reserve at Ch 33.15 km (NS2B) and crosses Eukabilla Road at Ch 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.
South Kurumbul Road Ch 6.1 km Wondalli–Kurumbul Road and Yelarbon–Kurumbul Road Ch 7.2 km	ID: 081GWND Type: Road Status: Open Class: Secondary	The stock route connects Wondalli–Kurumbul Road and South Kurumbul Road, running parallel and adjacent to the existing QR South Western Line rail corridor. This stock route is aligned along Wondalli–Kurumbul Road and parallel to Yelarbon–Kurumbul Road, which runs adjacent to the existing QR 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 26.0 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 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.
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 east of Sawmill Road, which will encroach by up to 15 m into the northwestern corner of the stock reserve. The existing Yelarbon levee extends diagonally across this stock reserve. Modifications to the existing Yelarbon levee, 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 between Ch 73.1km to Ch 76.5 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.

Location and Project interface point (approximate chainage)	Stock route ID, type, status and class	Description
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. Investigations are underway to potentially remove this interface. DoR have indicated that this stock route may not be required and will progress discussions with TRC on this matter.
Millmerran–Inglewood Road (near Heckendorf 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.
Kooroongarra 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.

Table note:
* NS2B is an identifying notation for the southernmost part of the Project alignment where the rail connects from the NSW/QLD border and joins at Ch 0 km where the dual standard/narrow gauge continues the remaining portion of the alignment.

Further details on alteration to private access and stock routes are provided in Chapter 5: Project Description and Chapter 8: 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 landowners
- Increased emergency services response time.

Potential operation stage 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 rollingstock interface with livestock and other stock-route users. This can result in livestock deaths or interruption of livestock transport and food supply.

The revised 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.

Chapter 5: Project Description, Chapter 8: Land Use and Tenure and Appendix AA: Traffic Impact Assessment further detail private land use and stock route impacts associated with the Project.

Rail infrastructure

Hazard description

The Project requires establishment of approximately 149.48 km of new rail corridor (greenfield) and use of approximately 68 km of existing rail corridor (brownfield), specifically the QR 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:

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

The Millmerran Branch Line is currently non-operational south of Brookstead because of damage sustained in the 2010/11 flood events. There is the potential that the conditions may change during construction of the Project so that the line becomes operational.

The preferred construction approach for the Project, within the corridors for the QR 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 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 trains, where unattended rollingstock 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 rollingstock
  - running line collisions at level crossings with other crossing users (vehicles, pedestrians or livestock)
- Loss of freight or fuel from rollingstock, either through minor leaks and spills or larger events attributed to one of the above-mentioned hazards.

Potential impacts

The ONRSR 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. Data from the *Rail Safety Report 2022–2023* (ONRSR, 2023) period, provides contextual reference for understanding the potential likelihood and consequence of rail-based incidents.

Public level crossing data from 2019 to 2023 is summarised in Table 21-10.

TABLE 21-10 PUBLIC LEVEL CROSSING STATISTICS 2019-2023

Year	Level crossing collision		Other rail accident (including strike)		Fall, assault, other	
	Count of fatalities	Rate (per million total train km)	Count of fatalities	Rate (per million total train km)	Count of fatalities	Rate (per million total train km)
2018-2019	5	0.02	1	0.005	0	0.00
2019-2020	3	0.013	1	0.005	1	0.005
2020-2021	3	0.013	0	0.00	2	0.01
2021-2022	4	0.017	3.5	0.013	0	0.00
2022-2023	5	0.02	2	0.009	0	0.00

Source: ONRSR, 2023

Potential impacts that may occur during construction are associated with occupation of the existing rail corridor by plant, equipment and work crews for construction. The preferred construction approach in these locations would be to replace the existing rail infrastructure with new rail infrastructure. To achieve this, ARTC would need to secure temporary possession of the rail corridor under an access agreement with QR.

Depending on the approved construction approach for the Project within the existing rail corridor, construction works stage 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.

All rail incidents, regardless of type and Project stage, 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.

Further discussion of potential rail-interface impacts associated with the Project is provided in Chapter 20: Traffic, Transport and Access.

21.5.2.3 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 or 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 (e.g. 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 contaminated and/or hazardous materials, 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 Aerodrome
- Millmerran Airfield
- Pittsworth Airfield
- Southbrook Airport
- Wyreema Airport
- Cambooya Airfield
- Colanya Airstrip.

The Project alignment also traverses several resource tenements, including four mineral or coal resource authorities and four applications for mineral or coal resource authorities within the Project footprint, as well as one mineral or resource authority within the study area for the Project.

The exploration permits include one for coal and one for minerals other than coal near Canning Creek, and three applications for geothermal permits near Yelarbon (lodged in May 2022), and between Southbrook and Gowrie (lodged in August 2022).

One mineral development licence (MDL 299) for coal is near Bringalily and Domville and expired in December 2022, but a renewal has been lodged. A second mineral development licence (MDL 301) in the same vicinity expired in July 2022; however, it was granted an extension until July 2024.

The mining lease permit and mining lease application are associated with Commodore open cut mine near Clontarf and Domville. The mining lease (ML 700072) application was lodged in December 2021 and facilitates the proposed expansion of the mine through the conversion of MDL 301 and MDL 299. The Project alignment also traverses one petroleum lease at Turallin.

Potential impacts

Utilities

There are 723 known utilities located within the Project footprint and interface with the revised reference design, of which 356 are proposed to be relocated, 36 will require additional protection to be provided, three to be

abandoned and 328 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 approximately 71 meetings to provide Project updates and discuss revised reference design development with a number of 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 the detailed design and construction works stages. Details of consultation to support development of the revised reference design and revised draft EIS are included in Appendix E: Consultation Report. Consultation completed to date has informed the requirements for proposed utility interface treatments provided in Table 21-11.

TABLE 21-11 NUMBER OF UTILITY INTERACTIONS

Utility/service	Protection	Relocation/realignment	No treatment	Abandoned	Total
Communication	28	249	265	3	545
Electricity	-	99	57	-	156
Gas	3	-	-	-	3
Oil	1	-	-	-	1
Potable water	1	4	-	-	5
Raw water	-	0	3	-	3
Recycled water	3	1	3	-	7
Sewer gravity main	-	1	-	-	1
Sewer rising main	-	2	-	-	2
Total	**36**	**356**	**328**	**3**	**723**

Construction activities around existing services introduce a risk of service strikes of underground utilities (e.g. underground gas pipelines and asbestos cement sewer mains) during excavation or collision of plant and equipment with aboveground services (e.g. powerlines). 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 live electrical equipment
  - power outage to individuals or communities, resulting in potential disruption in provision of critical community services (e.g. health care and emergency services)
- Communications:
  - disruption in ability for communities to access critical services (e.g. emergency services) in a timely manner
- Oil:
  - serious[1] 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 healthcare 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, sewage leaks

[1] The oil pipeline (PPL 1) has been decommissioned.

- Asbestos cement services/pipes:
  - release of asbestos fibres with health impacts to workers
  - 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. Furthermore, the proposed utility interface treatments typically involve minimising or eliminating the need for utility owners to access the rail corridor in the future where possible, and consequently minimises disruption to operators and the risk of train collisions.

Existing commercial infrastructure

The location of the proposed alignment has been determined in ongoing consultations with the holder of the mining lease to ensure that adverse impacts on the operations of the mine, including the footprint of future mining operations, are minimised where possible. Both the permanent and temporary disturbance footprints have been intentionally located to avoid land within the current mining lease (ML50151) associated with the Commodore Mine.

The current and future landforms and operations of the Commodore Mine will continue to be considered during the detailed design stage of the Project, through consultation with the holder of the mining lease, to ensure that potential for impacts on, or by, the Project are avoided or minimised where possible.

The Project has been positioned to ensure that double-stacked freight trains will not extend vertically into the Obstacle Limitation Surface 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 20: Traffic, Transport and Access and Chapter 8: Land Use and Tenure for more details on the existing infrastructure and utilities.

Unexploded ordnance

Hazard description

Unexploded ordnance is any sort of military ammunition or explosive ordnance that has been fired but has failed to function 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 Project footprint. 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 and stock may also be able to use 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 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)
- The requirement for maintenance work at height.

Potential impacts

The revised reference design includes 37 bridges, as detailed in Table 21-12.

TABLE 21-12 SUMMARY OF BRIDGE STRUCTURES FOR THE PROJECT

Crossing type	Number
Rail-over-road	14
Rail-over-watercourse	18
Road-over-rail	5

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.

There is potential impact of noise and vibration from piling works which generate ground-borne vibration beyond the bounds of construction.

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 materials.

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 and timber harvesting access

Hazard description

A combination of the public road network and private accesses are used when responding to requests for service or emergencies by emergency services including:

- Police
- Fire
- Ambulance
- State Emergency Services.

The Queensland Parks and Wildlife Service and Partnerships (QPWSP), QFES, and local police stations are reliant on the maintenance of the existing network of tracks and trails for accessing and managing Queensland estate, including Whetstone and Bringalily State Forests. Department of Agriculture and Fisheries (DAF) are reliant on access tracks for timber harvesting.

The modification of established services routes could potentially cause delays for responding emergency services units which require safe and uninhibited access to public and private land or facilities. Uninhibited access to local areas is essential for local emergency, health and safety management and response times.

Management activities include conducting controlled backburns in these areas. Therefore, the existing network of trails within these estates is crucial for maintaining safe access and egress for QPWSP personnel when conducting these estate-management activities. Interactions between the Project and the QPWSP network of tracks and trails in Whetstone State Forest and Bringalily State Forest may occur. For timber harvesting, potential alternative networks are ideal for continued production activities.

Bushfire mitigation measures (including timber harvesting and firefighting activities for maintaining emergency access, wildfire management and public access by recreation users) was also a key area of engagement with QFES and DAF in 2021 and 2022. Consultation regarding emergency response and emergency services access

was undertaken and will continue to occur with local emergency service groups, local governments (GRC and TRC), and other key stakeholders during each stage of the Project. Disaster management processes and emergency management and evacuation processes have also been included during consultation with GRC and TRC. Consultation to date about prevention and management of materials is in Appendix E: Consultation Report.

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 the 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 QPWSP personnel to safely navigate or evacuate the area, as required.

ARTC has consulted with TRC, GRC, QPS, QAS QPWSP and QFES through development of the revised reference design and the risk assessment process. As a result, the revised 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 185 seconds or less may be experienced by road or access users during train pass-bys. These wait times may result in increased emergency response times in localised instances.

Chapter 17: Social and Appendix X: Social Impact Assessment contain further details of impacts on emergency services, and Appendix AA: Traffic Impact Assessment further details impacts on emergency services.

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. 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.

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 sulfide and sulfur 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 and 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 DoR through GeoResGlobe, are tabulated in Table 21-13.

TABLE 21-13 SUMMARY OF HISTORICAL MINING ACTIVITY NEAR THE ALIGNMENT

Historical ML	Lease type	Location description
ML55003	Historical ML extent	Southeast from Pittsworth
ML50245		
ML50246		
ML204610	Historical ML application	Between Pittsworth and Southbrook
ML206817	Historical ML application	Northeast from Gowrie
ML206819	Historical ML application	East-north-east from Gowrie
ML204405	Historical ML granted	Northwest from Gowrie
ML204404		
ML204337		
ML204636	Historical ML granted	Northeast from Gowrie
ML204848		
ML204851		
ML204862		
ML204861		
ML204519		
ML5974	Historical ML extent	Northeast from Gowrie
ML5950		
ML5963		

Potential impacts

There are no known abandoned mines within the Project footprint; therefore, the Project will not interact with any known abandoned mines.

The reliability of DoR's 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 (DoR, 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 have been undertaken along the entirety of the Project alignment, to establish the geotechnical conditions over which the Project will be located and identify the location of unrecorded abandoned mine workings. This geotechnical information is used during detailed design to establish engineered controls to manage risks associated with such findings.

21.5.3 Dangerous goods and hazardous materials

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.

21.5.3.1 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 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 chemicals and dangerous emissions, resulting in illness, injuries or deaths.

The use of hazardous chemicals will be necessary, to varying degrees, for all stages of the Project. Onsite storage of such chemicals is only anticipated during the construction works stage. Appendix AA: Traffic Impact Assessment is a preliminary risk assessment which entails the assessment of risks associated with the transport of dangerous goods used for construction and operations. To meet the *Guide to Traffic Impact Assessment* (DTMR, 2017b), the Project's Traffic Impact Assessment (detailed in Appendix AA) has been RPEQ certified.

The indicative chemical storage and usage details of dangerous goods and hazardous materials for the Project are provided in Table 21-14 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 construction planning and maintenance requirements of the Project, the types and indicative quantities identified in Table 21-14 are considered to provide a reasonable representation of the likely usage requirements for dangerous goods and hazardous materials.

TABLE 21-14 INDICATIVE LIST OF DANGEROUS GOODS AND HAZARDOUS MATERIALS

Chemical type	Typical chemicals	Project stage	Purpose/use	Dangerous good class	Packing group	Indicative rate of use	Expected storage method	Threshold quantity[1]
Fuel oil	Diesel and engine oils	Construction works Operations/ maintenance	Fuel for mobile or fixed equipment	C1[3]	III	20 kL/week	20 kL bulk storage (fuel depots)	Not triggered
	Unleaded petrol	Construction works	Fuel for mobile equipment	C3	II	As required by the local construction team	20 kL bulk storage (fuel depots)	Not triggered
Grease	Rocol rail curve grease	Construction works	Lubricate plant and equipment	C2[4]	N/A	Limited	Package storage	Not triggered
	Caltex 904 grease	Operations/ maintenance	Lubricate plant and equipment	C2[4]	N/A	Limited	Package storage	Not triggered
	Shell GADUS gauge face curve grease	Construction works	Lubricate plant and equipment	C2[4]	N/A	Limited	Package storage	Not triggered
	RS claretech biodegradable grease	Operations/ maintenance	Lubricate plant and equipment	C2[4]	N/A	As required by cutting/borrow pit activities	Package storage	Not triggered
Blasting chemicals	Ammonium nitrate[2]	Construction works	Cuttings and borrow pit operations	5.1	III	Limited	Not stored	Not triggered
	Blasting explosives	Construction works	Cuttings and borrow pit operations	1	II	Limited	Not stored	N/A
Concreting	Concrete and concrete residue	Construction works	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries	N/A
	Concrete curing compound	Construction works	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries	N/A
Welding gases	Oxygen	Construction works	Welding	2.2/5.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage	Not triggered
	Acetylene	Construction works	Welding	2.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage	Not triggered

Chemical type	Typical chemicals	Project stage	Purpose/use	Dangerous good class	Packing group	Indicative rate of use	Expected storage method	Threshold quantity[1]
Pesticides	Australian Pesticides and Veterinary Medicines Authority Approved Pesticides	Construction works Operations/ 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	Not triggered
Lime	Calcium Oxide	Construction works	Soil stabilisation	N/A	N/A	As required by the local construction team	Truck deliveries or intermediate bulk container if storage on site required[5]	Not triggered

Table notes:
kL = kilolitres
1. Threshold quantities evaluated by RPEQ as per Table 5.2 of the *Model Planning Scheme Development Code for Hazardous Industries and Chemicals* (Office of Industrial Relations, Department of Justice and Attorney General, 2016)
2. Product is a security sensitive explosive defined under Schedule 7 of the Explosives Regulation 2017
3. Class C1—a combustible liquid that has a flashpoint of 150 °C or less.
4. Class C2—a combustible liquid that has a flashpoint exceeding 150 °C
5. Quicklime is a type of base under alkaline solutions or solids that will be stored in loose stockpiles to prevent water ingress in accordance with Safety Data Sheets

The Queensland SDAP are an assessment benchmark for matters of State interest. The SDAP is relevant where the Chief Executive of the *Planning Act 2016* (Qld) is the assessment manager or referral agency for development applications as prescribed under the Planning Regulation 2017 (Qld) for matters of State interest. The SDAP consists of State codes, and where relevant, assessment must be undertaken under each relevant State code within SDAP.

Under the SDAP, performance outcome PO26 of *State code 2 – Development in a railway environment* (Department of State Development, Infrastructure, Local Government and Planning, 2022d) is achieved as the development does not involve handling or storage of hazardous chemicals above the threshold quantities listed in Table 5.2 of the *Model Planning Scheme Development Code for Hazardous Industries and Chemicals* (Office of Industrial Relations, Department of Justice and Attorney General, 2016).

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 (see Section 21.5.1.1), 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 works stage, the following facilities are expected to be provided for storage and distribution of construction chemicals:

- Construction of a temporary Material Distribution Centre located in Whetstone, Queensland, on land bounded by the QR South Western Line to the north and Cunningham Highway to the south
- Diesel fuel depots will be located along the alignment at allocated laydown locations.

Laydown was located and sized to minimise impacts to environmental and social receptors where possible. The locations of the laydown areas are indicated in Chapter 5: Project Description. Where the laydown is not required for the purposes of supporting construction activities at watercourse crossings where piling and bridge construction is required, it was located away from areas subject to frequent flood events and set back from watercourses, as far as practicable. 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
- Fuels and chemicals will only be stored on laydowns outside the 1% AEP water level where practicable.

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 chemicals during construction and operation are specified in Section 21.6.2.

21.5.3.2 Freight transportation of dangerous goods

The Project will enable freight transport of dangerous goods as part of the larger Inland Rail Program. The design of the rail system, including tunnels, allows for the transport of dangerous goods. ARTC has indicated that the Project’s rail alignment is intended to be used for the freight of all classes of dangerous goods including explosives (this may vary throughout other Queensland Inland Rail projects). ARTC would impose specific operating requirements for rollingstock operators depending on freight type in relation to freight of explosives. ARTC cannot provide an exhaustive list of the types and quantities of dangerous goods that will be transported; explosives will be included, and transportation of any other dangerous goods will be managed under the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2024).

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 loading/unloading, train pass-bys or as a result of a lost load in the case of a rail incident such as derailment.

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, for instance:
  - a minor spill of a combustible substance such as diesel from a packaged container will be of low significance
- Contamination of land, waterways or air, resulting in environmental degradation and harm, for instance:
  - large-scale loss of a bulk toxic or infectious substance (e.g. Class 6 dangerous good) such as cyanides or pentachlorophenol (used in some pesticides and disinfectants) that extends beyond the rail corridor and is in proximity to social and/or environmental receptors will be of great significance
- Exposure of workers and members of the public to hazardous chemicals and dangerous emissions, resulting in illness, injuries or deaths.

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 *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2024).

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. Class 1 explosives will be transported on the Inland Rail network (in accordance with the Explosives Act), 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.

Consultation with the Chief Inspector of Explosives, Resources Safety and Health Queensland was conducted 1 July 2022 regarding the transportation of security sensitive explosives on the Inland Rail network throughout the Project. Key discussions and outcomes of the consultation, include:

- ARTC consulted with Resources Safety & Health Queensland to work together to manage safety, storage and security of explosives during construction, and environmental issues relating to noise and vibration from blasting
- During pre-construction activities and early works and construction works stages, the Project will have early engagement with Resources Safety & Health Queensland if blasting is planned.

Full details of that consultation are provided in Chapter 6: Stakeholder Engagement and within Appendix E: Consultation Report.

21.5.3.3 Use of explosives in the construction works stage of the Project

Hazard description

Explosives are classified as Class 1 dangerous goods. There is potential that security-sensitive explosives (which includes ammonium nitrate) will be used for the construction of the Project. Ammonium nitrate explosives are hazardous by nature and may result in harm to the environment and people during storage, handling or transport in the event of inadvertent detonation.

Blasting activities associated with construction work also introduces hazards to the surrounding environment through noise and vibration. Noise and vibration impacts are discussed in detail in Chapter 16: Noise and Vibration.

The Explosives Regulation 2017 (Qld) 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 and *AS 2187.2-2006 Explosives—Storage and use, Part 2: Use of explosives* (Standards Australia, 2006a). Explosives must be stored, handled and transported by a licenced person as stipulated by the Explosives Act. Additionally, a range of explosive related activities require notification under Explosives Act, 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 detonators and boosters) and security sensitive ammonium nitrate are expected to be required during construction 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:

- Ch 48.9 km to Ch 51.3 km
- Ch 50.9 km to Ch 50.7 km
- Ch 114.5km to Ch 114.7 km
- Ch 165.3 km to Ch 168.6 km
- Ch 176.1 km to Ch 176.6 km
- Ch 178.8 km to Ch 180.5 km
- Ch 186.5 km to Ch 186.9 km
- Ch 190.2 km to Ch 191.6 km
- Ch 193.5 km to Ch 194.6 km.

To enable blasting, explosives will be transported, stored, handled and used during the construction works stage 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 16: Noise and Vibration. Further information on air quality impacts associated with blasting is presented in Chapter 12: Air Quality.

Railway track signals 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. Railway track signals 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 northwestern 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 works stage of the Project could also affect mine explosive transport routes and, if not appropriately managed, could potentially result in interface conflicts.

21.6 Mitigation measures

This section provides discussion of mitigation measures and controls that have been incorporated into the revised reference design development process, as appropriate and where possible (see Section 21.6.1), as well as those measures that are proposed to be adopted for future stages of Project delivery (see Section 21.6.2).

21.6.1 Mitigation through the revised reference design stage

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

Mitigation measures and controls that have been factored into the design, or otherwise implemented during the revised reference design stage for the Project, are summarised in Table 21-15.

TABLE 21-15 INITIAL MITIGATION MEASURES OF RELEVANCE TO HAZARD AND RISK

Aspect	Mitigation measures
	Natural hazards
Flooding resulting from developing 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 ▸ 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) ▸ Use the existing QR 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 ▸ Incorporate 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 ▸ Locating and sizing bridge and culvert structures to avoid increases in peak water levels, velocities and duration of inundation ▸ Designing all bridges and culverts to reduce the risk of scour with events up to 1% AEP ▸ To include in the revised reference design the option to modify the existing Yelarbon flood levee for the township of Yelarbon with the addition of the Project. At a minimum the flood levee augmentation will ensure no worsening of existing flood risk to the township of Yelarbon ▸ Incorporating a climate assessment 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., 2019) 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 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 7633 Railway infrastructure: Clearances* (Standards Australia, 2020) 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).

	Project hazards

Rail incidents resulting from developing 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 (see Chapter 5: Project Description), which are as follows:
	  ▸ design speed of 115 km/h
	  ▸ maximum grade of:
	  – 1:100 target, 1:80 maximum (compensated)
	  – 1:200 maximum at arrival or departure points at loop
	  ▸ maximum curve radius of 800 m, with 1,200 m target
	  ▸ train lengths of 1,800 m
	▸ The revised 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.

Aspect	Mitigation measures
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 outlined in Appendix AA: Transport Impact Assessment (see Appendix BT: Inland Rail Road Rail Interface Methodology). Where grade separation has not been feasible, the design has been developed in accordance with ARTC standard *Section 12: Level Crossings* (ARTC, 2023d). ▸ 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 the *Australian Level Crossing Assessment Model* (ALCAM, 2016) to identify and reduce, as far as practicable, the potential risks associated with these crossings: ▸ Level crossing safety is a priority for ARTC. All level crossings will be designed in accordance with the current Australian and ARTC safety and engineering standards. This includes elements such as ensuring there is safe sighting distance for the design vehicle and checking that the grade at the crossing allows low clearance vehicles to traverse the level crossing. ▸ In instances where landowners will need to cross stock or slow farm machinery at private level crossings, a process will be put in place where a landowner can get information on when there are windows of time when no trains are planned in that area. Details of the process will be provided to landowners prior to the commencement of operations. ▸ The revised 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 ▸ In the revised reference design, ARTC have updated stock route interface designs to accommodate requirements identified by DoR and local councils ▸ Where the rail line intersects road reserves (no formed road), land tenure solutions and discussions remain ongoing with relevant authorities.
Utilities	▸ Aerial and subsurface utility investigations have been completed to inform the revised 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 and 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 revised reference design (asset owners include APA, Ergon Energy, Essential Energy, Millmerran Operation Co., Queensland Urban Utilities, Powerlink, Santos, Telstra, TRC, 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, including 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 kilovolts (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).
Existing infrastructure	▸ The Project has been aligned to avoid the current working areas of 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 Obstacle Limitation Surface for all airfields in the area, with Toowoomba Wellcamp Airport and any other airfields in the surrounding area.
Soil erosion	▸ To avoid flood impacts to adjacent properties that have the potential to increase or alter overland flows, impacted properties are quantified and will be effectively mitigated through the application of design treatments (eliminate, reduce, mitigate) by application of Flood Impact Objectives (afflux, velocity, inundation).

Aspect	Mitigation measures
Bridges	▸ Track design on rail bridges is in accordance with ARTC's *Engineering Code of Practice—Section 4: Ballast* (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 revised 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 (see Chapter 5: Project Description).
	▸ ARTC have consulted with TRC, GRC, QPWSP, QFES and Resources Safety & Health Queensland through the risk assessment and design development process. As a result, the revised 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.

21.6.2 Proposed mitigation measures

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

Table 21-16 identifies the relevant hazard and risk aspect, Project stage and the proposed mitigation measure. The mitigation measures presented in Table 21-16 have been presented in this format to align with the initial mitigation measures of relevance in the previous section and the impact assessment methodology applied for hazard and risk elements. The proposed mitigation measures have then been factored into the assessment of residual risk, as documented in Table 21-17.

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

TABLE 21-16 HAZARD AND RISK MITIGATION MEASURES FUTURE STAGES OF PROJECT DELIVERY

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Flooding	Natural	Detailed design	▸ The Project will be 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. ▸ Design modifications during the detailed design stage 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. ▸ A Flood Risk Management Plan will be developed to outline management and control measures, and emergency procedures, to be implemented during the pre-construction, early works and construction works stages in order to mitigate flood impacts.

		Pre-construction activities and early works, construction works	▸ 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 and reflect the local flood risk.
			▸ 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
			  ▸ planning and the layout of construction facilities will be undertaken with consideration of overland flow paths and flood risk
			  ▸ earthworks and temporary drainage for each laydown site will be designed to minimise flooding impacts
			  ▸ critical equipment and mobile plant will be placed/stored on earthworks and/or plinths that raise it above the predicted 1% AEP water level.
			▸ 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 and development of appropriate incident management and response procedures for natural disasters, including flooding, will be developed in consultation with the relevant disaster management groups for Toowoomba and Goondiwindi local government and QFES.
			▸ Implement the Flood Risk Management Plan, as a component of the CEMP, in order to mitigate flood impacts.

		Commissioning and operations	▸ Routine and post flood event 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 undertaken in accordance with defect inspection findings and associated site-specific environmental controls.
			▸ 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.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Bushfire	Natural	Detailed design	▸ Appropriate access and egress solutions throughout Whetstone State Forest and Bringalily State Forest will be incorporated into the detailed design and continued access will be allowed for in the construction methodology. This aspect of the design will be supported by consultation with DAF, QPWSP and QFES (including timber harvesting and firefighting activities for maintaining emergency access, wildfire management and public access by recreation users). ▸ Further engagement with QFES will confirm the location of access tracks that may be affected by the Project's detailed design, and the actions required of the Project to ensure firefighters continued access to the areas that they are currently able to service. ▸ The rail corridor will be designed to manage bushfire risk in bushfire risk areas. ▸ ARTC will undertake consultation with DAF to ensure sufficient access is provided for firefighting activities. ▸ Where provided, the rail maintenance access road will be designed to be suitable for use by emergency response vehicles in the event of an incident.
		Pre-construction activities and early works, construction works	▸ 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 industry best practice in consultation with relevant authorities as required. Such works may require a permit (e.g. permit to light fire), issued by QFES. ▸ Elevated risk activities and construction facilities/laydown areas will include the provision and positioning of appropriate fire-extinguishing equipment.
		Commissioning and operations	▸ 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 DAF, QFES and QPWSP 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. ▸ Ongoing communications will be undertaken with DAF regarding emergency access and maintenance activities to provide ongoing emergency access for firefighting and essential maintenance activities.

Landslide, movement of soils or rocks and subsequent damage to property and infrastructure	Natural	Detailed design	▸ Additional geotechnical and soils investigations will be undertaken during detailed design to ensure site-specific geotechnical conditions are reflected in the finalised design solution, in areas where the design includes:
			  ▸ cuts
			  ▸ embankments
			  ▸ bridge piers and abutments.
			▸ The additional soil investigations, if required, will be completed to ensure that the design of structures, embankments, erosion control measures (temporary construction and permanent) and site rehabilitation planning are reflective of site-specific soil conditions. These investigations will be undertaken in accordance with the *Guidelines for surveying soil and land resources* (McKenzie et al., 2008), the *Australian soil and land survey field handbook* (National Committee on Soil and Terrain, 2009) and the *Guidelines for Soil Survey along Linear Features* (Soil Science Australia, 2015). Investigations specifically identify materials that are:
			  ▸ sodic (dispersive)
			  ▸ saline
			  ▸ acidic.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
		Pre-construction activities and early works, construction works	▸ 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 Soil 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. ▸ Construction stage earthworks inspections will be conducted at regular intervals and in accordance with *Earthworks Construction Specification* (ETC-08-04) (ARTC, 2019c) to identify defects and conditions that may affect or indicate problems with the stability of earthworks.
		Commissioning and operations	▸ Operational embankment and cutting inspections will be conducted at regular intervals to identify defects and or environmental conditions that may affect or indicate problems with the stability of the earthworks on the corridor. If required corrective actions will be implemented as identified within the inspection report.
Climatic conditions	Natural	Detailed design	▸ Climate change impacts will be reviewed and considered by ARTC during the detailed design of cross drainage structures for the Project. ▸ The use of elastic fasteners or heavier sleepers will be considered during detailed design to reduce the risk of track buckling 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* (Standards Australia, 2018e).
		Pre-construction activities and early works, construction works	▸ ARTC will develop and apply a Project-specific Flood Emergency Response Plan, including coordination, with the relevant local councils and local disaster management groups for the construction stage of the Project.
		Commissioning and operations	▸ 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. ▸ Adaption strategies for climatic conditions will be reviewed through operational risk assessments. ▸ ARTC will develop and implement an operations Flood Emergency Response Plan, including coordination with the relevant local councils and local disaster management group.
Rail incidents	Project	Detailed design	▸ 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 design.
		Pre-construction activities and early works, construction works	▸ The construction approach for the components of the Project within the existing rail corridor for the QR 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. ▸ QR approval will be obtained prior to commencement of work in accordance with section 255 of the *Transport Infrastructure Act 1994* to ensure coordination between ARTC and QR is established for reduction of rail incidents between the operations. ▸ If construction of Project components within the 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.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
			▸ 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.
		Commissioning and operations	▸ 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, 2024). ▸ 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. ▸ 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.

Emergency access and timber harvesting	Project	Detailed design	▸ Consultation with Toowoomba and Goondiwindi local disaster management groups, in addition to QPS (including the Security and Counter-Terrorism Command), QAS and QPWSP will continue throughout the design process to ensure that:
			  ▸ appropriate access and egress solutions are incorporated into the 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.
			▸ Detailed design will provide 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 so that it will allow separation to prevent interaction between trains and vehicles without impeding escape or rescue activities.
			▸ ARTC will provide the design to DAF (Forestry) to assist with planning for timber salvage prior to construction commencing.
			▸ The detailed design process will include further investigation and development to ensure emergency service access for local residents will be maintained during construction and operation for the Project. ARTC are committed to further investigations and consultations with stakeholders on the hazard reduction measures and impacts on emergency services access.
			▸ A Traffic Management Plan will be developed for the Project during detailed design, as a component of the CEMP, detailing how access across the rail corridor will be maintained during construction for emergency response vehicles.

		Pre-construction activities and early works, construction works	▸ Implement the Traffic Management Plan, as a component of the CEMP, to maintain access across the rail corridor during construction for emergency response vehicles.
		Commissioning and operations	▸ The operational rail maintenance access road will be available for use by emergency vehicles and firefighting requirements as per ongoing consultation with the local disaster management groups, DAF, QFES, QAS and QPS in the event of an incident or egress requirements.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Road–rail interfaces	Project	Detailed design	▸ Design will include active controls (e.g. flashing lights and boom gates) and/or passive controls or treatments (e.g. signage and pavement marking and suitable sight distance availability) 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* (Standards Australia, 2016) 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). ▸ Design will include the provision of exclusion fencing where 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 through the design development. ▸ A Traffic Management Plan will be developed for the Project during detailed design, as a component of the CEMP. ▸ A Road Use Management Plan will be developed for the Project during detailed design, in consultation with DTMR
		Pre-construction activities and early works, construction works	▸ ARTC will consult with DTMR, councils, ARTC, the contractor, and where relevant QR, in the determination of final construction and heavy vehicle routes. ▸ Conduct pavement condition assessments prior and post construction activities as well as at ongoing intervals during construction, with intervals agreed with Council prior to commencement of construction to ensure safe driving surfaces are maintained. ▸ ARTC will consult with relevant stakeholders during the detailed design stage on proposed mitigation measures to ensure structural capacities are maintained and agreement on the minimum design life of returned works (to be included in a third-party agreement) as well as agreed contribution towards the consumption of pavement design life by construction related vehicles. ▸ ARTC to consultation with emergency services and local disaster management groups regarding construction traffic management. ▸ Implement the Road Use Management Plan. ▸ Implement the Traffic Management Plan, as a component of the CEMP. ▸ If required and necessary for the Project, all rail access vehicles and oversize and over mass vehicles requiring transportation of special equipment will apply for the necessary permits from DTMR, QR and relevant authorities as well as the Heavy Vehicle National Regulator.
		Commissioning and operations	▸ ARTC will conduct routine operational inspections of crossing infrastructure and will regularly review crossing performance and incident information to identify opportunities for improved performance and further reduction in road rail interface 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 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.
Design interfaces with utilities	Project	Detailed design	▸ Utility interface treatments that have been included in the revised 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 (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 and confirmation once the Project design is finalised.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Existing infrastructure and utilities	Project	Detailed design	▸ 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 design, these works will be undertaken prior to the commencement of construction to reduce the likelihood of impacts to those services.
		Pre-construction activities and early works, construction works	▸ Protection or relocation of utilities will be conducted in accordance with relevant legislation, Australian standards, guidelines, utility policies and standards are to be used where utility interfaces occur. ▸ Safe working distance between the Project footprint and the worked area of the Commodore Mine is to be determined, to reduce the likelihood of worker or public injury. ▸ The Roma–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—Gas and liquid petroleum* (Standards Australia, 2008b) standards during Project activities. ▸ 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 (e.g. operational/disused) can be confirmed, in accordance with *AS 1345 Identification of the contents of pipes, conduits and ducts* (Standards Australia, 1995). ▸ ARTC will ensure that the construction of the rail infrastructure will not exceed the height of the Toowoomba Wellcamp Airport Obstacle Limitation Surface.
		Commissioning and operations	▸ Maintenance activities will comply with the clearance distances as specified in the *Requirements for Electric Aerials Crossing ARTC Infrastructure* (ARTC, 2021), to ensure sufficient clearance and prevent contact with live electricity. ▸ Consultation with owners of licenced petroleum and gas pipeline assets located in the Project footprint (e.g. APA's Roma–Brisbane gas pipeline and Santos' Moonie–Brisbane oil pipeline) will occur prior to undertaking maintenance activities in proximity to these utilities.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Soil erosion and subsequent damage to property and infrastructure	Project	Detailed design	▸ Soil/land conservation objectives for the Project will be designed to minimise impacts on soil conservation plans and viable productive land, and include: ▸ incorporation and maintenance of appropriate design measures to ensure overland flow through the landscape is not impeded by the Project resulting in increased soil erosion or sedimentation of the surrounding environment, particularly for steams, gully and floodplains ▸ consideration of stream and gully erosion, land slope, land use, soil type, rainfall, trafficability and farm type when designing new contour banks ▸ retention of vegetation and embankment stabilisation to conserve soil ▸ protection of surrounding of floodplains, infrastructure and horticulture. ▸ The status of relevant soil conservation plans that may be impacted by the Project will be checked and confirmed during detailed design to ensure all current plans are identified which correspond to the Project disturbance footprint and those that have the potential to be impacted by the Project. This will be undertaken in consultation with DoR and the landowners relevant to each soil conservation plan. ▸ If a soil conservation plan is found to be current and materially affected by the Project following application of the hierarchy of controls to reduce flood impacts as detailed in the Project's approach to flooding mitigation designed to avoid, reduce and manage impacts, ARTC will address the requirements for amending or modifying plans in accordance with the *Soil Conservation Act 1986* (Qld) and in consultation with DoR and the impacted landowner. If required, this would be progressed under the direction of a Suitably Qualified Professional and in consultation with DoR and the holder of the soil conservation plan.
		Pre-construction activities and early works, construction works	▸ Consultation with relevant agencies and landowners will continue throughout the construction stage of the Project to ensure that all soil conservation plans, including those not currently approved under the *Soil Conservation Act 1986* (Qld), are considered and appropriately mitigated, where required. ▸ Consultation and agreement with impacted landowners with respect to 'at property' treatments and ongoing inspection and maintenance.
		Commissioning and operations	▸ Routine inspection of the Permanent footprint will be undertaken as part of ARTC's operational management processes to identify any signs of scour or erosion and rectification works as identified during the inspection to minimise the risk of further erosion and impacts to environment, property and infrastructure.
Contaminated land	Project	Detailed design	▸ A Contaminated Land Management Plan will be developed for the Project during detailed design, as a component of the CEMP.
		Pre-construction activities and early works, construction works	▸ Contamination management and clean-up measures for spills that may occur during the construction stage of the Project will be in accordance with the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* and amendment measures and the requirements of the EP Act.
		Commissioning and operations	▸ If land contamination is caused by operational activities associated with the Project, the nature and extent of the contamination will be investigated in accordance with the requirements of the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* and EP Act, with identified amendment measures actioned and reported.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Asbestos	Project	Detailed design	▸ A survey of infrastructure that will be demolished, removed or disturbed by the Project will be conducted prior to the commencement of construction to identify the potential for asbestos-containing materials such as housing and or older agricultural buildings, existing rail conduits, service pits, brake-lining form older rail rollingstock.

		Pre-construction activities and early works, construction works	▸ 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 relevant legislation, standards, guidelines and codes of practice.
			▸ If removal of more than 10 m^2 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 licenced service provider and disposed of at an appropriately licenced facility, in accordance with the requirements of the *Waste Reduction and Recycling Act 2011* and the EP Act.
			▸ If material is encountered that is suspected of being asbestos-containing, 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.

Biodiversity	Natural	Detailed design	▸ A Biosecurity Management Plan will be developed during the detailed design as a component of the CEMP to protect biodiversity and agricultural land uses adjoining the Project footprint, in compliance with the *Biosecurity Act 2014* (Qld). ▸ Where the Project interacts with the wild dog check fence, at approximately Ch 5 km, and between Ch 50.1 km and Ch 56.0 km, the fence will be reinstated on the northwest side of the rail corridor. Reinstatement will be in accordance with the design solution agreed with GRC through the design process. ▸ Where the Project crosses the Darling Downs–Moreton Rabbit Board Fence at Ch 120.2 km, the fence will be re-established, and a rabbit trap will be established. Reinstatement will be in accordance with the design solution developed in consultation with the Darling Downs–Moreton Rabbit Board through the design process.
		Pre-construction activities and early works, construction works	▸ Implement the Biosecurity Management as a component of the CEMP. ▸ The effectiveness of weed hygiene measures will be monitored as a component of the construction environmental monitoring procedure for the Project. ▸ Permanent fencing will be installed at locations that are deemed required by design outcome to limit fauna strike and/or maintain habitat connectivity.
		Commissioning and operations	▸ Routine inspections of the operations footprint will be undertaken as part of the operations biosecurity management plan and general maintenance of the Project footprint and include weed identification and appropriate management. ▸ Fauna exclusion fencing and connectivity infrastructure will be monitored to ensure integrity and effectiveness throughout the life of project with any damage being repaired efficiently to reduce potential for fauna/rail interactions during operations.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
Storage and handling chemicals	Dangerous goods and hazardous chemicals	Detailed design	▸ A Hazardous Materials Management Plan will be prepared for the Project during detailed design as a component of the CEMP. The Plan will be prepared in consultation with QFES and local governments. At a minimum the plan will: ▸ 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 ▸ identify the laydown areas that will be used for storage of hazardous materials and designated locations for storage of hazardous materials within the bounds of those laydown areas ▸ 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 or dangerous goods, including retention of records as well as provision of records to landowners where required. ▸ Establish the waste storage and disposal procedures for hazardous materials and chemicals and dangerous goods prior to the establishment of site compounds/laydown areas and construction activities. ▸ 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. The ARTC 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 litres or kilograms ▸ any individual receptacle used for transporting dangerous goods will have capacity less than 500 litres or kilograms 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 extinguishers and personal protection equipment.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
		Pre-construction activities and early works, construction works	▸ Vehicle and plant maintenance will be undertaken in designated bunded laydown areas, on hardstand surfaces. This will minimise risk of contaminants from incidental spills or leaks (accidental discharge) from entering aquifers via infiltration or surface runoff. ▸ Bulk storage and refuelling will only occur at designated locations within the Project footprint and sited at suitable separation distances from sensitive receptors, including surface water features and drainage lines. These refuelling locations will be equipped with onsite chemical and hydrocarbon absorbent socks/booms and spill kits. ▸ Mobile refuelling will be undertaken at suitable separation distances from sensitive receptors, including surface water features and drainage lines. ▸ Bulk storage areas for dangerous goods and hazardous chemicals, other than fuel, 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 State Planning Policy. ▸ Licensed transporters operating in compliance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2024) will be used for the transportation of dangerous goods. ▸ Chemicals stored and handled as part of construction and or operational activities will be managed in accordance with relevant legislation, standards and guidelines. ▸ Safety data sheet information will be obtained from the suppliers of chemicals and stored in an easily accessible location. ▸ Spill kits will be available at all work fronts and laydown areas in the event of a spill or leak. Spill kits will be available at all work fronts and made known to the onsite personnel. These refuelling locations will be equipped with onsite chemical and hydrocarbon absorbent socks/booms and spill kits. ▸ Mobile plant, drill rigs and equipment will be maintained in accordance with manufacturer requirements and inspected frequently to minimise breakdowns and decrease the risk of contamination. ▸ 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.

		Commissioning and operations	▸ An Environmental incident checklist and communication plan will be developed prior to operations commencing, 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. ARTC 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 litres or kilograms
			  ▸ any individual receptacle used for transporting dangerous goods will have capacity less than 500 litres or kilograms 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 extinguishers and personal protection equipment.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
			▸ Procedures for the management of hazardous chemical spills and leaks will be developed and incorporated into the Operations EMP for the Project and 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, emergency showers or eyewash stations) ▸ spills kits for the appropriate chemicals (e.g. Hazchem, general, aquatic and marine spill kits) ▸ the spill response controls and clean up procedures as per the provision of their safety data sheet, ensuring environmental harm is minimised.
Explosives	Dangerous goods and hazardous chemicals	Detailed design	▸ A prescribed shotfirer (the licensed person undertaking the blasting works) will be engaged during the detailed design stage to plan and undertake the necessary blasting activities for excavation of non-rippable rock using the assessments of geology undertaken within Chapter 9: Land Resources. The prescribed shotfirer will be required to maintain a security management system. ▸ A Blast Management Plan will be prepared by the appointed prescribed shotfirer, in consultation with geotechnical engineers and safety personnel, in support of each blasting event for the Project and will specify procedures to: ▸ identify the environment of explosive use, including flood, bushfire, landslide zones. ▸ identify other activities within proximity of explosives use ▸ 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. ▸ Require that the prescribed shotfirer submit a safe blast design together with the Blast Management Plan to the Explosives Inspectorate a minimum of seven days before the scheduled blasting event, for assessment against the requirements under the act and *AS 2187.2:2006 Explosives—Storage and use, Part 2: Use of explosives* (Standards Australia, 2006a).

Aspect	Hazard type	Delivery stage	Proposed mitigation measures

		Pre-construction activities and early works, construction works	▸ Where explosives are used during construction, the works will be undertaken by the holder of a shotfirer licence, in accordance with the Explosives Act and *AS 2187.2:2006 Explosives—Storage and use, Part 2: Use of explosives* (Standards Australia, 2006a). Explosives will be stored, handled and transported by the prescribed shotfirer, 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 will be followed 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.
			▸ The amount and the type of explosive purchased and used will be recorded, and a record of each blast conducted by the appointed prescribed shotfirer will be kept in accordance with the Explosives Act
			▸ 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.

		Commissioning and operations	▸ 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 consignment 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, 2024). 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. ▸ 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 railway track signals. ▸ ARTC will continue to consult with the Commodore Mine owner to establish communication protocols for the operations stage of the Project to ensure compatibility between ARTC activities and Commodore Mine operating activities. ▸ If Commodore Mine's operational plans change and blasting impacts on the Project have the potential to 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.
Fatigue and heat stress management	Project	Pre-construction activities and early works, construction works	▸ ARTC will undertake a risk-based approach to determine appropriate shift and roster lengths and controls to minimise impacts associated with Fatigue. These will be further detailed within the Project Work Health and Safety Management Plan to be developed during detailed design prior to pre-construction activities. ▸ 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 *Managing the risks of working in heat* (Safe Work Australia, 2017).

Aspect	Hazard type	Delivery stage	Proposed mitigation measures
	Project	Commissioning and operations	▸ 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 *Managing the risks of working in heat* (Safe Work Australia, 2017).
Dust, respirable silica and other airborne contaminants	Project	Pre-construction activities and early works, construction works	▸ 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 procedure *Personal Protective Equipment* (WHS-PR-009) (2022) 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 Plan to be finalised and implemented prior to pre-construction activities commencing. ▸ Dust-suppression water sprays, or alternative appropriate treatment, will be applied to unsealed surfaces used 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.
		Commissioning and operations	▸ Should coal be planned to be transported as part of future operations, prior to transportation of coal, engagement would be undertaken with stakeholders and members of the South West Supply Chain regarding coal dust management and monitoring requirements necessary to maintain the integrity of the existing *South West Supply Chain, Coal Dust Management Plan* (South West Supply Chain, 2019). ▸ 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, response to the hotline comments will include visual inspections and implementing appropriate mitigation procedures as required, such as increased watering, reducing maintenance vehicle use/speed on access tracks/rail maintenance access road.

Noise and vibration	Project	Detailed design	▸ The Noise and Vibration Management Plan, as a component of the CEMP, will be developed during detailed design and construction methodology reviews and include:
			  ▸ identification of noise and vibration sources from construction involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers
			  ▸ landowners' notification requirements 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 stages of the Project.

		Pre-construction activities and early works, construction works	▸ Implementation of the Noise and Vibration Management Plan, as a component of the CEMP. ▸ Investigate complaints received and implement appropriate additional controls as per investigation outcomes.

Aspect	Hazard type	Delivery stage	Proposed mitigation measures

Private access, stock routes and emergency access	Project	Detailed design	▸ Detailed design will provide:
			  ▸ 10 m wide crossings at road–rail interface locations will be designed to reduce cattle pressure and crossing times.
			  ▸ Cattle grids will be used at the rail tracks to avoid cattle entering the corridor.
			  ▸ Fences and gates used will be consistent with the published guideline for 7.3 m openings: *Guideline: Fences on stock routes SLM/2019/5152* (DoR, 2022a).
			▸ New stock corridor widths will be consistent with DoR *Operational policy: Land dealings affecting the stock route network SLM/2013/363* (2023).

		Pre-construction activities and early works, construction works	▸ During construction, should cattle move along the stock route/road corridor, communication will occur between the relevant local council and ARTC notifying them of the permit. Traffic management will be in place to ensure there is no conflict between stock and construction activities. The timing between construction laydown requirements and the use of the holding yards for the operational rail environment does not create any conflict. ▸ Implement the Traffic Management Plan, as a component of the CEMP. This plan will specify how access across the rail corridor will be maintained during construction for private access, emergency response vehicles and stock route movements.
		Commissioning and operations	▸ Implement and maintain a system for the communication of train movements through level crossings to facilitate safe movement of livestock and agricultural machinery across the rail corridor. The system will be developed in consultation with landowners, stock operators and DoR, and be accessible to them prior to the commencement of operation.
Road incidents	Project	Pre-construction activities and early works, construction works	▸ Implement the Traffic Management Plan, as a component of the CEMP.
Outdoor workplace lighting safety	Project	Pre-construction activities and early works, construction works	▸ Existing ARTC management plans and codes of practice will be applied to the construction and commissioning of the Inland Rail network, including this Project, to reduce the likelihood of impacts from lighting in outdoor working conditions, which include complying with relevant standards in *AS/NZS 1680.5:2012 Interior and workplace lighting, Part 5: Outdoor workplace lighting* (Standards Australia/Standards New Zealand, 2012).

21.6.2.1 Ongoing consultation

The Social Impact Assessment within Chapter 17: Social and Appendix E: Consultation Report describes the consultation and engagement activities conducted for the Project to date and continuous ongoing consultation including regularly presented Project updates. With regards to the 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 pre-construction activities and early works, construction works and operations stage 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 through agency engagement including meeting with QFES, QPS and local police stations and one-on-one engagement between the Regional Director of Policing and ARTC has been undertaken and is ongoing to inform the revised 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.
- ARTC maintains regular, scheduled engagement with TRC and GRC at multiple levels to ensure these stakeholders have clear opportunities for input and consultation. A formal schedule of meetings with TRC has been consistent since 2017, as an established means to communicate updates, resolve concerns and identify development opportunities.
- During the development of the revised draft EIS, engagement with TRC comprises interactions on four levels:
  - Mayor and councillor briefings, both formal and informal briefings for key milestones
  - Management working group (monthly meetings)
  - Technical working group (fortnightly meetings)
  - Officer level working groups focusing on key issues, including social and economic impacts, skills and training, biodiversity and offsets opportunities, community engagement activities and other matters.
- Engagement with GRC has also been undertaken on a regular basis. During the development of the revised draft EIS, ARTC has carried out 40 meetings with GRC between February 2020 and September 2023. These meetings include technical working groups on specific issues such as the non-resident workforce accommodation, fauna and fencing, wildfire, and Whetstone Materials Distribution Centre, as well as general Project updates on a monthly basis. Further details are provided in Appendix E: Consultation Report.
- Issue-specific workshops, including for informing the social impact assessment (see Chapter 17: 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.

21.7 Impact assessment summary

Potential impacts to people, property and the environment associated with the Project in the construction works and operations stages are outlined in Table 21-17. These impacts have been subjected to risk assessment as per the methodology outlined in Section 21.3, Table 21-2, Table 21-3 and Table 21-4, and Chapter 4: Assessment Methodology.

The initial risk assessment is based on the assumption that the design considerations (or initial mitigation) factored into the revised reference design stage (see Table 21-15) have been implemented.

Additional mitigation measures were then applied, as appropriate, to the relevant stages of the Project to reduce the level of potential impact (see Table 21-16). 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 21-17 to demonstrate the effectiveness of the mitigation measures applied in subsequent Project stages.

TABLE 21-17 IMPACT ASSESSMENT FOR POTENTIAL HAZARD AND RISK IMPACTS

Aspect	Potential impact	Stage	Initial risk[1]			Residual risk after mitigation measures implemented[2]		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Bushfire	Damage to infrastructure, injury to workers or public from bushfire	Pre-construction and early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	Possible	Major	High	Unlikely	Major	Medium
Flooding	Damage to infrastructure, potential for impacts to freight goods caused by flooding, storms and cyclones	Pre-construction and early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	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 early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	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 early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	Possible	Minor	Low	Unlikely	Minor	Low
Wildlife	Wildlife injury or deaths from impact with project or worker injury from wildlife	Pre-construction and early works and construction works	Likely	Minor	Medium	Possible	Minor	Low
		Operations	Likely	Minor	Medium	Possible	Minor	Low
Biosecurity	Damage to biosecurity of surrounding environment due to propagation invasive species	Pre-construction and early works and construction works	Likely	Minor	Medium	Possible	Minor	Low
		Operations	Likely	Minor	Medium	Possible	Minor	Low
Noise and vibration	Disruption to public from noise and vibration	Pre-construction and early works and construction works	Likely	Minor	Medium	Possible	Minor	Low
		Operations	Likely	Minor	Medium	Possible	Minor	Low
Fatigue and heat stress	Worker injury from fatigue and heat stress	Pre-construction and early works and construction works	Almost Certain	Moderate	High	Possible	Moderate	Medium
		Operations	Likely	Moderate	High	Possible	Moderate	Medium

Aspect	Potential impact	Stage	Initial risk[1]			Residual risk after mitigation measures implemented[2]		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Asbestos	Health impacts from asbestos	Pre-construction and early works and construction works	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operations	Possible	Moderate	Medium	Unlikely	Moderate	Low
Dust, respirable silica and other airborne contaminants	Impacts from respirable silica and other airborne contaminants	Pre-construction and early works and construction works	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operations	Possible	Minor	Low	Unlikely	Minor	Low
Historical and abandoned mines	Localised landslide, sudden subsidence and movement of soil and rock	Pre-construction and early works and construction works	Unlikely	Major	Medium	Rare	Moderate	Low
		Operations	Rare	Major	Low	Rare	Moderate	Low
Soil erosion and subsequent damage to property and infrastructure	Increased or altered overland flow on adjacent properties (contour banks and waterways, farm irrigation infrastructure)	Pre-construction and early works and construction works	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operations	Unlikely	Moderate	Low	Unlikely	Moderate	Low
	Erosion and sedimentation: scour, decline of soil quality, loss of groundcover, sedimentation in waterways, loss of topsoils, land and infrastructure degradation, crop and pasture loss	Pre-construction and early works and construction works	Likely	Moderate	High	Possible	Moderate	Medium
		Operations	Likely	Moderate	High	Possible	Moderate	Medium
Rail incidents	Rail accidents caused by increased rail movements	Pre-construction and early works and construction works	N/A	N/A	N/A	N/A	N/A	N/A
		Operations	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 early works and construction works	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operations	Unlikely	Extreme	Medium	Unlikely	Extreme	Medium
	Accidents due to increased number of road–rail interfaces	Pre-construction and early works and construction works	N/A	N/A	N/A	N/A	N/A	N/A
		Operations	Likely	Major	Very High	Unlikely	Major	Medium

Aspect	Potential impact	Stage	Initial risk[1]			Residual risk after mitigation measures implemented[2]		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Existing infrastructure and utilities	Worker injury from services strike at existing infrastructure and underground and overhead services	Pre-construction and early works and construction works	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operations	Unlikely	Extreme	Medium	Rare	Extreme	Medium
	Safety impacts to workers interference with existing commercial receptors such as Commodore Mine or airfields	Pre-construction and early works and construction works	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operations	Possible	Extreme	High	Unlikely	Extreme	Medium
Contaminated land	Health impacts to workers and public, and environmental impact from contaminated land	Pre-construction and early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	Possible	Minor	Low	Unlikely	Minor	Low
Bridges	Bridge collapse or falling object strikes	Pre-construction and early works and construction works	Unlikely	Major	Medium	Unlikely	Major	Medium
		Operations	Unlikely	Major	Medium	Unlikely	Major	Medium
Emergency and timber harvesting access	Impaired emergency access resulting in escalation of incident	Pre-construction and early works and construction works	Possible	Major	High	Unlikely	Major	Medium
		Operations	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 early works and construction works	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operations	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 early works and construction works	N/A	N/A	N/A	N/A	N/A	N/A
		Operations	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 early works and construction works	Possible	Extreme	High	Rare	Major	Low
		Operations	Unlikely	Extreme	Medium	Rare	Major	Low

Table notes:
1. Includes implementation of initial mitigation measures specified in Table 21-15.
2. Assessment of residual risk once the mitigation measures identified in Table 21-16 have been applied.

21.8 Residual impact

Residual impacts were determined by applying mitigation measures (set out in Table 21-16) to the potential hazards and risk impacts. From the assessment conducted (Table 21-17), risks that remain with a medium residual risk ranking include potential hazards associated with:

- 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).

For these residual risks, opportunities to further reduce the level of risk will be investigated through the detailed 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, they will be captured and documented in design drawings, environmental design drawings and the CEMP or the Operation EMP, as appropriate.

Following residual risk reduction, emergency management provides an approach to prevent escalation of hazards and risks.

21.8.1 Emergency management

ARTC's existing *Emergency Management Procedure* (RLS-PR-044) (2024) provides a systematic approach to incident response and recovery or incident investigation on the ARTC network. The Emergency Management Procedure will be applied to the Inland Rail Program and the Project in accordance with the Rail Safety National Law obligations pertaining to emergency management plans. This management procedure will be applied alongside security and crisis management procedures which will be developed for the Inland Rail network, while business continuity plans will be issue-specific. Further details on the implementation of the procedure and response to, and investigation of, incidents and emergencies is provided in Chapter 24: Draft Outline Environmental Management Plan.

21.8.1.1 Incident management plan

As required under ARTC's existing *Emergency Management Procedure* (RLS-PR-044), an Incident Management Plan will be developed for the Inland Rail Program and implemented for this Project in accordance with sections 112 and 113 of the Rail Safety National Law. Requirements for the Incident Management Plans are provided in Chapter 24: Draft Outline Environmental Management Plan and will detail response procedures in the event of foreseeable emergency scenarios. The Incident Management Plan 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 (including hazardous material freight)
- Fire and life safety
- Bomb threat
- Equipment
- Rollingstock or infrastructure failure
- Environmental issues
- Hazardous chemical spills
- Natural disaster.

21.9 Conclusion

Key hazards assessed in the hazard and risk assessment include:

- Natural hazards: bushfire, flooding, storms and cyclones, landslides, wildlife, biosecurity and implications related to climatic conditions
- Construction and operation hazards and risk:
  - Health: fatigue and stress, asbestos (naturally occurring or in existing infrastructure in the Project footprint), respirable silica and other airborne contaminants, noise and vibration and contaminated land
  - Accidents: road infrastructure, private access and stock routes and rail infrastructure
  - Safety: infrastructure and services, unexploded ordnance, bridges, emergency access and abandoned mines
- Dangerous goods and hazardous substances, associated with:
  - construction and operation maintenance chemicals
  - freight transportation of dangerous goods
  - explosives use in proximity to the Project
- The implementation of ARTC's risk management policies and procedures are anticipated to effectively reduce the majority of the risks associated with the Project to a low 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.

Some of these risks remain beyond the control of ARTC and are not tied to the effects of Project implementation (e.g. climatic conditions, bushfire hazards and flooding events). For the other residual risks, opportunities to reduce the level of risk further will be investigated through detailed design by application of the hierarchy of controls (i.e. elimination, substitution, engineering controls, administrative controls and personal protective equipment). A Hazardous Materials Management Plan will also be prepared and implemented as a component of the Project CEMP.