CHAPTER 23

Draft Outline Environmental Management Plan

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

IR_1536

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23.1 Introduction

The Australian Government has committed to delivering the Inland Rail Program, which is significant national transport infrastructure. The Gowrie to Helidon (G2H) Inland Rail Project (the Project) is one of 13 projects that make up the Inland Rail Program and delivers a missing link in the existing rail network between Gowrie and Helidon.

This draft Outline Environmental Management Plan (draft Outline EMP) establishes the environmental management framework for delivery of the Project.

The Project has been declared a 'coordinated project for which an Environmental Impact Statement (EIS) is required' under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act). The Coordinator-General will prepare a report evaluating the EIS and may make recommendations for the Project, and impose conditions for undertaking the Project.

The Project is also a 'controlled action' for the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), with the controlling provisions being listed threatened species and communities (EPBC 2017/7882).

Following completion of the EIS process, and subject to approval under the EPBC Act and SDPWO Act, subsequent approvals and permits under other legislation will be required for the Project. These additional approvals and permits have been discussed in Chapter 3: Project Approvals.

23.2 Purpose of the Draft Outline Environmental Management Plan

The draft Outline EMP:

- Provides an environmental management framework to enable the identified environmental and social outcomes to be achieved for the detailed design, pre-construction and construction and commissioning of the Project
- Establishes the process for the preparation and implementation of the Outline Construction Environmental Management Plan (Outline CEMP), CEMP and sub-plans.

Once operational, the Project will become part of the existing Australian Rail Track Corporation (ARTC) national rail network, and will be subject to the laws, policies and procedures that already apply to that network. Internal ARTC policies and procedures will be reviewed to include any special operational requirements of the Project. Operational matters are included in Appendix F: Proponent Commitments.

Proposed mitigation measures relevant to the operation of the Project are described in Chapter 7 to Chapter 21.

23.2.1 Structure of the Draft Outline Environmental Management Plan

The draft Outline EMP:

- Describes the key elements and delivery phases of the Project
- Describes the environmental management framework for the design, construction and commissioning of for the Project
- Describes the relationship between the draft Outline EMP, the Outline CEMP, the CEMP, sub-plans, plans and other environmental management documents
- Describes monitoring, reporting, auditing, review and documentation requirements
- Describes processes for dealing with non-compliance, including corrective actions
- Includes requirements for training and awareness, community and stakeholder engagement
- Outlines the complaints management and response process.

The draft Outline EMP includes discipline-specific draft Outline EMP sub-plans, which establish a framework of sub-plans that will be prepared as components of the CEMP during the next phase of the Project. The sub-plans presented in the draft Outline EMP draw on the outcomes of the discipline environmental assessments of this EIS and, in doing so, set out key environmental and performance outcomes, mitigation measures and monitoring requirements for the following aspects:

- Land use and tenure
- Land resources
- Landscape and visual amenity
- Flora and fauna
- Air quality
- Surface water and hydrology
- Groundwater
- Noise and vibration
- Cultural heritage
- Traffic, transport and access
- Hazard and risk
- Waste and resource management.

Specialised construction management sub-plans will be developed under these aspects of the Project in support of the CEMP. Where appropriate, the requirements to develop these specialised sub-plans have been documented in this draft Outline EMP.

23.2.2 Structure of the draft Outline Environmental Management Plan sub-plans

Table 23.1 outlines the components of each sub-plan contained in this draft Outline EMP.

It is proposed that any conditions that are imposed by the Office of the Coordinator-General in the EIS evaluation report will be incorporated into future versions of the Outline CEMP and corresponding sub-plans, as well as the CEMP, to ensure that all works are authorised and consistent with the imposed conditions.

It is expected that the CEMP will be developed in stages, in advance of relevant Project works, and will be amended/updated as the Project proceeds.

TABLE 23.1: SUB-PLAN COMPONENTS

Component	Description
Environmental element	Environmental aspect to be managed through the EMP Sub-plan
Environmental outcomes	Environmental outcomes are mandatory and will be achieved. The environmental outcomes are derived from statutory requirements or other relevant criteria and are reflected in the criteria adopted in the draft EIS.
Performance criteria	Measurable goals or indicators of the environmental outcomes. Environmental outcomes are deemed to be achieved if the performance criteria are met. If the performance criteria are not met, mitigation measures will be implemented to achieve the environmental outcomes.
Proposed mitigation measures	Measures directed at achieving the environmental outcomes. The proposed mitigation measures have been identified through the EIS process, recognising that additional or different mitigation measures may be applied in order to achieve the environmental outcome. Additional mitigation measures may be developed in consultation with directly affected persons, relevant stakeholders and with the advice of the Environmental Monitor and Community Relations Monitor.
Monitoring and reporting requirements	Monitoring and reporting requirements to demonstrate that the environmental outcomes have been achieved

23.3 Background

23.3.1 Proponent

ARTC was created in 1997 after the Australian and State governments agreed to the formation of a 'one stop shop' for all operators seeking to access the national interstate rail network. Today, ARTC plays a critical role in the transport supply chain and in the overall economic development of Australia.

ARTC manages and maintains 8,500 kilometres (km) of rail network across five states and has invested billions of dollars to build, extend and upgrade the rail network to get freight off the road and onto rail.

The ARTC network supports industries and businesses that are vital to the nation's economy by facilitating the movement of a range of commodities, including general freight, coal, iron ore, other bulk minerals and agricultural products. ARTC also manage the seamless, safe transit of hundreds of freight and passenger trains across the rail network every day.

ARTC is committed to the health and safety of our people, the environment and the communities in which we operate.

23.3.2 The Project

The Project consists of approximately 28 km of new single-track dual-gauge greenfield railways with three crossing loops to accommodate double-stacked freight trains up to 1,800 metres (m) long. It will also involve the construction of an approximately 6.24 kilometres (km) undrained tunnel through the Toowoomba Range to facilitate the required gradient across the undulating topography. The corridor will be of sufficient width to accommodate future possible upgrades of the track, including a requirement to accommodate trains up to 3,600 m in length.

The Project has been designed to generally be located within the existing West Moreton System rail corridor and the Gowrie to Grandchester future state transport corridor. The Gowrie to Grandchester future state transport corridor was protected by the Queensland Government, after the completion of strategic planning and corridor planning studies in 2005, under the Public Passenger Transport Guideline (No. 1) 2019, made under the *Transport Planning and Coordination Act 1994* (Qld) (TP&C Act).

The Project is one of the 'missing links' in the Inland Rail Program. As part of the broader Inland Rail Program, this Project provides a more direct route between Melbourne and metropolitan Brisbane, compared to the existing inland and coastal road and rail networks, and meets the Australian Government's objective of providing a long-term rail solution for competitive freight movement.

The Project consists of the following key permanent and temporary features listed in Table 23.2.

TABLE 23.2: KEY FEATURES OF THE PROJECT

Aspect	Description
Permanent features	
New track	▸ Approximately 28 km of new single-track dual-gauge railway
Rail corridor	▸ Establishment of approximately 22.4 km of new 'greenfield' rail corridor ▸ Development of approximately 5.6 km of 'brownfield' rail corridor ▸ The land required for the Project comprises a corridor with a minimum width of 62.5 m. A reduced corridor is required where the Project is co-located with the existing rail corridor, or for the tunnel ▸ The rail corridor width will initially be constructed for 1,800 m long double-stacked trains, and designed such that the future extension of some crossing loops to accommodate 3,600-m long trains is not precluded ▸ The rail corridor will include land associated with the intermediate tunnel ventilation shaft and supporting infrastructure, access roads and other supporting infrastructure (e.g. water pipelines)
Tunnel	▸ Construction of an approximately 6.24-km long undrained tunnel through the Toowoomba Range, including expanded corridor to accommodate tunnel portal infrastructure (e.g. tunnel operations facilities and tunnel material stockpile at the western tunnel portal) ▸ Intermediate ventilation shaft (which draws in air to ventilate the tunnel) and associated infrastructure to be established at Cranley ▸ Land acquisition (volumetric) for the tunnel will include a provisional area around the tunnel to protect the asset from future development

Aspect	Description

Crossing loops and turnouts	▸ Crossing loops are places on a single-line track where trains in opposing directions can pass each other. Three crossing loops, each a minimum of 2,200 m in length are proposed along the alignment
	▸ Turnouts allow the train to be guided from one section of track to another. Turnouts that tie-in to the existing West Moreton System rail corridor will be incorporated as part of the Project. There are 16 turnouts proposed along the alignment, including those associated with:
	  ▸ Crossing loops
	  ▸ Maintenance sidings
	  ▸ Cross overs between Inland Rail and the existing West Moreton System
	  ▸ Connection to the proposed InterLinkSQ facility
	  ▸ Connection provided at the western tunnel portal to the West Moreton System, to allow for train movements between Brisbane and Toowoomba

Bridges and viaducts	▸ Bridges and viaducts to accommodate topographical variation, crossings of waterways or other infrastructure, such as roads
	▸ There are 13 new bridge and viaduct structures, totalling approximately 6.7 km in length, proposed for the Project, comprising:
	  ▸ Two rail-over-waterway viaducts
	  ▸ Three rail-over-terrain-and-waterway viaducts
	  ▸ Four rail-over-terrain-road-and-waterway viaducts
	  ▸ One rail-over-road-rail-and-waterway viaduct
	  ▸ One rail-over-waterway bridge
	  ▸ One road-over-rail-and-waterway bridge
	  ▸ One road-over-rail bridge
	▸ Instream structures and scour protection measures associated with waterway crossings, where relevant

Drainage	▸ Reinforced concrete pipe (RCP) culverts and reinforced concrete box culverts (RCBC). Scour protection measures will generally be installed around culverts and other drainage structures to minimise the potential for erosion
Rail crossings	▸ Rail crossings, including grade separations/rail or road overbridges, occupational/private crossings and fauna crossing structures
Embankments and cuttings	▸ Embankments and cuttings will be required along the length of the alignment, which includes road and rail infrastructure within the alignment, such as crossing loops and road-over-rail bridges ▸ The total length of embankments required for the Project will be in the range of 15.4 km, with a maximum embankment height of approximately 33.3 m ▸ The total length of cut for the Project will be in the range of 6.65 km with a maximum cut depth of approximately 45.7 m
Ancillary works	▸ Associated rail infrastructure, including maintenance sidings, Safeworking Systems and signalling infrastructure ▸ Ancillary works, include signalling and communications, signage and fencing, drainage works, establishment and/or reinstatement of access roads, and installation or modification of services and utilities ▸ Road closures and realignments, including closure of an existing level crossing on the Queensland Rail (QR) West Moreton System rail line at Gowrie
Environmental treatments	▸ Potential noise barriers, fauna crossing structures, instream structures and fish passage design, fauna exclusion fencing, and rehabilitation and landscape treatments

Aspect	Description
Temporary features	
Land	▸ Temporary access tracks will be used to access construction sites. Where required, these will be retained to serve as rail maintenance access roads (RMAR) during the operation of the Project ▸ Land requirements for construction will include temporary workspace, site offices and laydown facilities ▸ Laydown areas will be located approximately every 5 to 10 km (avoiding 1% annual exceedance probability (AEP) floodplains where possible). Laydown areas will be required for activities such as tunnel construction, flash-butt welding, concrete batching, water treatment facilities and rail assembly ▸ Approximately 2,500 square metres (m^2) of laydown areas to support bridge construction, where practicable (smaller in sensitive habitats)
Material sourcing	▸ Identification, and lawful use of established quarries for sourcing construction materials
Utilities	▸ Clashes with utilities flagged, and treatments identified, for refinement during detailed design; utility relocations will be subject to separate assessments, with all necessary approvals obtained prior to any relocation being undertaken ▸ Major utility impacts and treatments have been confirmed with utility owners

23.3.3 Proposed activities

23.3.3.1 Detailed design

Detailed design is the process of developing the Project design up to an 'Approved for Construction' stage.

Detailed design includes outputs such as 2-D and 3-D models, detailed engineering drawings, construction specifications, and detailed bill of quantities for estimates and procurement.

The draft Outline EMP sub-plans identify proposed mitigation measures to be considered during detailed design. Environmental design drawings will document the environmental design considerations that are incorporated as part of the detailed design.

23.3.3.2 Ongoing activities

Some ongoing activities may occur concurrently with detailed design. This includes, although is not limited to, corridor acquisition, obtaining environmental approvals, land surveys, geotechnical investigations, land acquisition, plans and documentation in support of secondary permits and approvals, environmental surveys and monitoring.

23.3.3.3 Project works

Project works include early works and pre-construction activities, construction and commissioning works. Project works exclude enabling works as described under Section 23.3.3.4.

Early works and pre-construction activities

Early works and pre-construction activities are required for construction mobilisation and to support the permanent infrastructure components. These activities must not commence until a CEMP for the relevant Project works has been endorsed by the Environmental Monitor as being consistent with the Outline CEMP and imposed conditions.

Early works and pre-construction activities may include but are not limited to:

- Establishment of access tracks for early works and pre-construction works
- Installation of erosion and sediment control measures associated with early works and preconstruction works
- Relocation or protection of QR assets (excluding those undertaken as enabling works)
- Installation of temporary fencing
- Utility and service relocations (excluding those undertaken as enabling works)
- Establishment of some site compounds, where identified, as required, in support of early works/pre-construction activities
- Delivery of materials to site.

Construction

Construction activities include but are not limited to:

- Site set out and pegging, including establishing clearing limits and no-go zones
- Establishment of laydowns and compounds, including vehicle inspection/workshops, washdown facilities and temporary facilities, as required
- Clearing—using dozers, chainsaws, excavators, trucks and similar equipment
- Bulk earthworks—major cut-to-fill operations, including the winning of suitable construction material from sections of cut along the railway alignment for reuse in embankments and/or rail formations
- Construction of drainage infrastructure—cut-off drains, table drains and culvert structures
- Construction/installation of concrete railway bridges and culverts
- Ballast—supply, delivery and installation
- Concrete sleepers—supply, delivery and installation
- Installation of rail track and other items of rail infrastructure using rail mounted equipment
- Installation of railway signalling and communications equipment, RMARs and access roads
- Construction of tunnel maintenance facilities, administration and amenities buildings, parking facilities and bulk fuel provisioning and storage areas
- Construction of new and/or updated road infrastructure, including access points in local and State-controlled road reserves
- Other miscellaneous activities to complete the works, such as site restoration and landscaping works.

Additionally, transportation of equipment, materials, construction waste and workforce will also take place across the Project.

Reinstatement and rehabilitation

A Reinstatement and Rehabilitation Plan will be developed during the detailed design phase, and implemented during the construction and commissioning phases of the Project, to manage the temporary disturbance of land that is not required for the operations phase.

A Reinstatement and Rehabilitation Plan will be developed to define:

- Progressive and post construction installation of the Project landscape design
- Establishment and ongoing maintenance and monitoring requirements
- Construction contract completion criteria for areas defined in the landscape design and/or identified in the Reinstatement and Rehabilitation Plan.

All construction sites, compounds and access routes will be reinstated or rehabilitated progressively, once available, and will include the following activities:

- Demobilise temporary site compounds and facilities
- Remove all waste, unused construction materials and redundant structures from the work sites
- Forming and stabilising of exposed earth materials and stockpiles, where required
- Remove all temporary work site signs
- Remove temporary fencing
- Progressive establishment of permanent fencing in coordination with rehabilitation and landscaping activities
- Decommission site access roads that are no longer required.

Upon removal of construction site offices, laydowns and stockpiles areas, retained topsoil and, where available, retained mulch will be used as part of the rehabilitation activities, in addition to other appropriate treatments, in accordance with the Reinstatement and Rehabilitation Plan. Access roads and tracks that will no longer be used will be rehabilitated by restoring natural contours, hydrology and vegetation through mechanical and/or natural means.

During the reinstatement and rehabilitation activities, sediment and erosion control measures will be left in place, monitored and maintained until the relevant erosion and sediment control plan catchment areas are stabilised.

Commissioning

All construction works will be subject to approved Testing and Commissioning Plans, as required, and appropriate Inspection and Test Plans. Final testing and commissioning of the track and systems is programmed for approximately six months after completion of construction works.

Testing and commissioning of the rail line and communication/signalling systems will be undertaken to ensure that all systems and infrastructure are designed, installed and operating according to ARTC's operational requirements. All rail system commissioning activities will be undertaken in accordance with an approved Test and Commissioning Plan developed by the construction contractor and approved by ARTC.

For the connections to the existing QR and ARTC networks, the Testing and Commissioning Plan will need to address the existing QR and ARTC signalling system and also be approved by ARTC and QR.

Commissioning of the trackworks will require completed Inspection and test plans, clearance reports, weld certification, rail stressing records, as-built documentation and track geometry reports. The commissioning period will also be used for driver training and test trains.

The commissioning period will also be used for driver training and test trains, with the CEMP remaining in place and the responsibility of the construction contractor to continue to implement through till the operation phase of the project.

23.3.3.4 Works that are not part of Project works

Enabling works are not considered to be part of the Project, with the works to be undertaken by, or for, third parties, primarily for the relocation or re-provision of public utilities, or existing QR rail assets. These works may be undertaken by the asset owner, or under a separate contract, and are required to comply with the relevant environmental or regulatory framework applicable to the works or public utility.

For example, Powerlink has undertaken a feasibility study to relocate a section of the Middle Ridge and Tarong transmission line, with the study determining that the transmission line towers can be raised to mitigate any interactions. Further, it has been confirmed that the works can also occur within the existing easement and will be subject to Powerlink's existing environmental management systems and approval processes.

Similar assessments to identify potential amendments to other existing assets, together with required approval pathways, costs and land requirements have also been undertaken by Energex, Ergon, TRC and the APA Group.

23.4 Legislative framework

The Project was declared a 'coordinated project for which an EIS is required' by the Coordinator-General in March 2017, under the SDPWO Act. The Project is also a 'controlled action' under the EPBC Act, with the controlling provisions being listed threatened species and communities (reference number EPBC 2017/7882). The Project is being assessed under the assessment bilateral agreement between the Commonwealth and Queensland Governments.

Relevant Commonwealth and State legislation requirements are detailed in Chapter 3: Project Approvals, and other specific matter chapters and technical reports. Applicable guidelines and standards are incorporated into the relevant sections of the draft Outline EMP and associated sub-plans.

Further approvals and licences will be required following the EIS phase. A summary of further secondary approvals, licences and permits, etc. that are likely to be triggered for the Project is provided in Chapter 3: Project Approvals.

Approval, licence and permit requirements may vary depending on the final detailed design and construction methodology, and future changes in statutory requirements prior to Project implementation. The draft Outline EMP will be updated by ARTC to incorporate approval and permit requirements post-EIS and prior to design and construction contract finalisation.

23.5 Approach to environmental management

This draft Outline EMP establishes the requirements for the development and implementation of the CEMP. This draft Outline EMP exists within a suite of documents that will guide the delivery of the Project, being the:

- ARTC corporate policies (refer to Section 23.5.1)
- ARTC's Environmental Management System (EMS) (refer to Section 23.5.1.2)
- Inland Rail Environment and Sustainability Policy and Project Sustainability Management Plan (refer to Section 23.5.1.3)
- Social Impact Management Plan (SIMP) (refer to Section 23.5.2)
- Approved Cultural Heritage Management Plans (CHMPs) (refer to Section 23.5.3).

23.5.1 Corporate governance and policies

23.5.1.1 ARTC Policies

ARTC's system of corporate governance comprises corporate policies and core values. This governance system applies to the whole of the ARTC network, including all works associated with the Inland Rail Program.

In addition to various legislative compliance requirements, all works associated with the Inland Rail Program will be completed in accordance with the following ARTC corporate policies:

- ARTC Environmental Policy (Appendix G: Corporate Policies)
- ARTC Safety Policy (Appendix G: Corporate Policies).

The ARTC Environmental Policy provides a framework for continual improvement of ARTC's EMS and sets out commitments for managing potential environmental risks.

23.5.1.2 ARTC Environmental Management System

ARTC's EMS supports effective management of environmental risk and legal obligations during the detailed design, construction and commissioning phases of development of the Project. On the commencement of operation of the Project, ARTC's EMS and operational and maintenance procedures will apply.

23.5.1.3 Inland Rail Environment and Sustainability Policy

ARTC have developed the *Inland Rail Environment and Sustainability Policy* (refer Appendix G: Corporate Policies). Sustainability initiatives and measures have been identified and captured in Project designs and proposed mitigation measures, where relevant.

A Sustainability Management Plan will be developed for the delivery of the design and construction of the Project. The Plan will be reviewed and audited by ARTC as part of the Infrastructure Sustainability (IS) Program rating ARTC are pursuing in line with the version 1.2 IS Framework. Prior to the commencement of operations, the design and construction phase Sustainability Management Plan will be reviewed and updated to focus on operations and maintenance activities. Further details are provided in Chapter 7: Sustainability.

23.5.2 Social Impact Management Plan

A SIMP has been developed in accordance with the Coordinator-General's Social Impact Assessment Guideline. The SIMP outlines the objectives, outcomes and performance measures for the mitigation of social impacts, and the actions that ARTC will undertake and/or require its contractor to undertake. Measures intended to enhance Project benefits and opportunities are also provided.

The SIMP includes the following action plans:

- Community and stakeholder engagement
- Workforce management
- Housing and accommodation
- Health and community wellbeing
- Local business and industry content.

A SIMP implementation plan, which outlines the respective responsibilities of ARTC and other stakeholders; timing; stakeholders to be involved in each measure; and performance monitoring will be developed during the detailed design phase of the Project, for implementation during the pre-construction, construction and commissioning activities.

The SIMP is described in Chapter 16: Social and provided in Appendix Q: Social Impact Assessment.

23.5.3 Cultural Heritage Management Plans

As a requirement of the Indigenous heritage component of the Project's Terms of Reference (ToR), one or more CHMPs was to be developed with the relevant Aboriginal Parties for the Project and be approved by the Chief Executive of the Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships (DSDSATSIP).

This process was undertaken by ARTC in 2018 with the Yuggera Ugarapul People and the Western Wakka Wakka People, in accordance with the requirements of Part 7 of the *Aboriginal Cultural Heritage Act 2003* (Qld) (ACH Act), and the Cultural Heritage Management Plan Guidelines (Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP), 2005).

CHMPs (CLH017009) have been approved under the ACH Act and, consequently, meet all the requirements for the identification, assessment and management of Indigenous heritage under the ToR. As such, the EIS defers to the CHMPs in all matters related to the management of Indigenous heritage.

23.6 Roles and responsibilities

The roles and responsibilities of relevant entities for delivery of the Project works are set out in Table 23.3. These roles may be refined as contractual arrangements are finalised and subject to changing agency responsibilities.

TABLE 23.3: ROLES AND RESPONSIBILITIES

Role	Responsibilities
ARTC	▸ Proponent for the Project ▸ Administers the Project agreement ▸ Oversee the contractor's detailed design process to achieve the environmental outcomes ▸ Participate in community engagement activities ▸ Engage the Environmental Monitor for the duration of construction ▸ Engage the Community Relations Monitor for the duration of construction
Contractor	▸ Prepare, maintain and implement the CEMP ▸ Deliver the Project in accordance with all laws, including conditions of approvals ▸ Provide notifications and reports, as required by law, including conditions of approvals ▸ Ensure the construction workforce are properly and regularly trained in environmental responsibilities, including cultural heritage responsibilities, in accordance with the CEMP ▸ Establish and maintain a complaints management system, to receive and respond to complaints
Coordinator-General	▸ Administers the SDPWO Act
State regulator	▸ Administers compliance with imposed conditions and the Coordinator-General's evaluation report ▸ Receives reporting and notification in accordance with commitments and any imposed conditions
Commonwealth regulator	▸ Administers compliance with EPBC Act conditions of approval

Role	Responsibilities
Environmental Monitor—an independent, appropriately skilled and experienced entity and a separate entity to the Community Relations Monitor	▸ Review and endorse the contractor's CEMP (including sub-plans) and revisions against the draft Outline EMP and any imposed conditions ▸ Monitor compliance with the CEMP (including sub-plans) and any imposed conditions ▸ Maintain a current copy of the CEMP (including sub-plans) including any progressive revisions and records of modifications to the Projects construction or commissioning procedures ▸ Maintain a register of sensitive receptors ▸ Review any audit and compliance reports prepared by the contractor or the proponent ▸ Have oversight of the implementation of the environmental monitoring requirements established in the CEMP. Review the results of the monitoring and verify these results if the Environmental Monitor considers it necessary.
Community Relations Monitor—an independent, appropriately skilled and experienced entity and a separate entity to the Environmental Monitor	▸ Provide monthly reports on community issues emerging from the construction and commissioning activities in relation to any imposed conditions, the CEMP, complaints, monitoring and community relations ▸ Communicate with ARTC and the Environmental Monitor with regard to any imposed conditions, the CEMP, the SIMP, community consultation strategies and community concerns ▸ Review complaints procedures, and the resolution of complaints and corrective action reporting, to assess performance of the construction contractor's implementation of the SIMP and CEMP ▸ Facilitate discussions between the ARTC and the contractor, and affected entities, about mitigation measures, as required, by either the ARTC or affected entity ▸ Provide advice to the Environmental Monitor in relation to complaints
Community Reference Group (CRG)	▸ Provide feedback to ARTC and the contractor in relation to construction planning, impacts and mitigation measures

23.7 Training and awareness

All Project personnel will be required to attend an induction session to inform them of their responsibilities under the CEMP.

A training register will be developed and maintained throughout construction and commissioning that identifies requirements in relation to:

- Qualifications and competencies
- Project-specific environmental training courses, refreshers and induction relevant for different activities/groups of personnel/locations.

This register will also be used to track the relevant qualifications held by Project personnel and subsequent completion of induction/training/refreshers sessions.

Short-term visitors to site, for purposes such as deliveries, will be required to undertake a visitor's induction and will be accompanied by inducted personnel, at all times.

All employees, contractors and subcontractors will receive an environmental induction which will include, but not be limited to:

- CEMP requirements
- Relevant imposed conditions of approvals
- Statutory duties in regard to notification of environmental harm
- Environmental incident notification procedures
- Complaints management procedures
- Key environmental risks and issues
- Location of sensitive receptors and environmentally sensitive areas
- Cultural heritage and cultural awareness training in consultation with the Yuggera Ugarapul People and the Western Wakka Wakka People

- Permissible hours of work
- Construction traffic routes
- Key environmental contacts.

Communication to all construction personnel in relation to environmental management will occur. The contractor, ARTC and other relevant responsible entities will ensure that the general intent, scope and relevance of this draft Outline EMP are understood by all site personnel.

Environmental education of environmental risks and issues such as: dust and air quality; erosion and sediment controls (during wet seasons or prior to forecasted events); fauna awareness during clearing phases or breeding periods, etc. for the Project will be communicated as relevant (such as seasonal, work activity, etc.) by the following methods:

- Environmental induction programs and training
- Daily prestart meetings
- Weekly toolbox meetings
- Risk workshops
- Management meetings
- Noticeboards
- Environmental incident reports.

Attendance records and any training associated with the environmental education program will be recorded and maintained by the environment team through a Project database recording with summaries of topics included in Project environmental monthly reporting. The effectiveness of these communication methods will be subjected to periodic review.

23.8 Incidents, notifications and emergencies

Sections 320 to 320G of the *Environmental Protection Act 1994* (Qld) (EP Act) outline the requirements for the duty to notify of environmental harm. Environmental incidents and activities that cause, or threaten to cause, potential serious environmental harm or potential material environmental harm must be reported within 24 hours to the Department of Environment and Science (DES), and other stakeholders as required, so that appropriate action can be taken to prevent or limit possible environmental harm.

All staff and contractors will be required to report any environmental incidents (including complaints) or breaches of the approval conditions, in accordance with the requirements and timeframes set out in the CEMP, and any statutory requirements.

Project-specific Incident Management Procedures will also be developed to detail the process and resources required to respond to and manage incidents and emergencies during construction and commissioning.

23.9 Inspections, monitoring, auditing and reporting

Inspections, monitoring, auditing and reporting will be undertaken to demonstrate compliance with imposed conditions and the CEMP.

Where monitoring and auditing determines that the existing management measures are not effective, corrective and preventative measures will be developed and implemented as soon as practicable.

23.9.1 Environmental inspections

The CEMP will include requirements for inspections of construction sites to ensure compliance with imposed conditions and other Project -specific plans.

23.9.2 Environmental monitoring

Environmental monitoring programs will be developed and implemented for the pre-construction and construction phases of the Project. These monitoring programs will be designed to assess the compliance of the Project with the CEMP and determine the effectiveness of mitigation measures.

Where identified as a requirement of a sub-plan or industry standards, monitoring will commence during the pre-construction phase, to establish baseline conditions.

Monitoring activities will be conducted by a person who is suitably trained, qualified and experienced. Monitoring will be carried out in accordance with relevant guidelines. All monitoring equipment will be maintained and calibrated in accordance with manufacturers' instructions, which will ensure reliability of equipment and data.

Environmental samples will be sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis, unless otherwise stated in approved sub-plan or as approved by the Environmental Monitor. The results of the monitoring programs will be interpreted and reviewed regularly, through monthly Project reporting, with non-conformances investigated and resolved as per agreed timeframes.

If monitoring indicates construction or commissioning are not in compliance with the CEMP or imposed conditions, necessary actions will be taken to rectify the identified issue.

23.9.3 Auditing

During construction and commissioning, audits will be completed to assess compliance with all applicable environmental requirements, including the imposed conditions of approval and the CEMP. This will include internal audits (an internal audit plan will be developed) and third-party independent audits by suitably qualified/experienced and competent auditors.

Third-party independent audits will be completed on an annual basis during the construction period.

Internal environmental audits will be conducted quarterly and, where current site activities are deemed to have a higher risk, audit intervals may be increased (e.g. monthly).

The audits will assess compliance with the following requirements:

- Any imposed conditions determined by the Coordinator-General or as stated in approval, licence and permit conditions
- The CEMP, including sub-plans.

Audit reports will summarise the findings of the audits and include any corrective actions. The audit results, corrective actions required, and conclusions will be communicated to those responsible for implementing the corrective actions. The audit reports will be made available as required.

23.9.4 Reporting

During construction, a monthly construction compliance report will be prepared by the construction contractor. This will include:

- Summary of monitoring data and interpretation of the results
- Details of any non-compliance events, including a description of the incident, resulting effects, corrective actions, revised practices to prevent a recurrence, responsibility and timing
- Reporting of complaints, including the number of complaints, description of issues, responses and corrective actions.

For the duration of construction, an Annual Construction Report will be prepared that includes:

- A compliance evaluation table detailing the relevant imposed condition, whether compliance with the imposed condition was achieved, and how compliance was evaluated
- An evaluation of compliance with the CEMP
- A summary of any non-compliance events during the reporting period

- A summary of any non-compliance events during the previous reporting period, with details of site construction works, remediation of relevant local activities, corrective actions taken or to be taken and revised practices implemented or to be implemented (as relevant)
- Relevant trends and interpretation as related to environmental outcomes and performance criteria for each environmental element (all periods to date).

23.10 Non-compliance and corrective actions

Non-compliances identified during site inspections, environmental audits, incidents and through other mechanisms, such as the complaints register, will be managed in accordance with ARTC reporting and investigation procedures.

The procedures will include:

- Classification of what is a non-conformance
- Investigation requirements
- Identification and implementation of corrective and preventative actions
- Assigning adequate resources and timelines for completion of corrective and preventative actions
- Reporting requirements (internally and externally)
- Process for closing out non-conformances
- Requirements for, and the maintenance of, a non-conformance register
- Processes for the regular review and status of non-conformances.

Non-conformances and corrective actions may trigger the requirement for a review and modification of practices onsite. These changes in work practices will be reflected in amendments to the CEMP and EMS, as appropriate, and demonstrate continual improvement practices.

23.11 Document control

Records that are applicable to environmental management during construction and commissioning will be retained for a minimum of five years post-construction. Environmental records will include but will not be limited to:

- Site inspection checklists
- Environmental audit reports
- Training records
- Monitoring data
- Environmental approval documentation and associated compliance reporting
- Complaints and associated records of communication
- Environmental procedures and plans
- Meeting minutes
- Regular correspondence.

23.12 Community and stakeholder engagement principles

Following Project approval, a Community and Stakeholder Engagement Plan will be developed to guide and monitor engagement activities during the construction phase. The Community and Stakeholder Engagement Plan will include measures to address:

- Communication with potentially impacted communities regarding the EIS findings
- Engagement with Toowoomba Regional Council (TRC) and Lockyer Valley Regional Council (LVRC) on the schedule, progress, potential impacts and mitigation measures for the Project, and development of partnerships to maximise social opportunities
- Working with the owners of properties that would be acquired, and those who may experience exceedances of the Project's noise criteria, to keep them updated and address property-specific impacts

- Consultation with the owners of homes and agricultural operations adjacent to the Project's work sites to discuss mitigation of property-specific impacts (such as changes to road access, surface water diversion, noise issues or dust) where necessary
- Provision of information to landholders and communities near construction works about the nature of construction, including the timing, duration and predicted impacts of the works, and the predicted effects of Project works on road, rail, and pedestrian and cycle network operations, in advance of their commencement
- Establishment of a CRG for the construction phase, to meet regularly with the purpose of providing timely, open advice, representation of community issues and concerns arising from the works
- Engagement with government agencies to develop protocols, confirm the detail of mitigation measures for impacts on social infrastructure and develop joint response arrangements with:
  - Department of Education, e.g. school bus route safety measures
  - Queensland Health, e.g. forecasting the workforce ramp-up and agreeing the schedule for communication with the Project
  - Queensland Police Service (QPS), Queensland Ambulance Services (QAS) and Queensland Fire and Emergency Services (QFES), e.g. emergency access arrangements
  - Department of Communities, Housing and Digital Economy (DCHDE) and the DSDSATSIP, e.g. monitoring of demands for community support services
  - DCHDE to ensure that they are aware of any support needed by Department of Transport and Main Roads (DTMR) tenants
- Cooperation with Traditional Owners and other Aboriginal parties and organisations
- Meetings and partnership discussions with local high schools and training providers, to develop training pathways for Project construction and operation
- Consultation with Tourism Darling Downs and Lockyer Valley Tourism Inc regarding major event schedules and support for the promotion of local tourism
- Engagement with local businesses, local Chambers of Commerce and the Department of Employment Small Business and Training (DESBT) to identify existing skills, gaps in local capacity to work with major projects, and capacity building programs
- Promotion of operational employment and supply opportunities to local and regional residents
- Updating the Project's webpage and other locally available communication materials to include:
  - The Project's CEMP and SIMP
  - Quarterly construction updates, including detailed explanations of upcoming activities, workforce ramp-up and stakeholder engagement mechanisms
  - Complaints and feedback mechanisms.

The Project's Community and Stakeholder Engagement Plan will inform the development of the Community Engagement Sub-plan in the CEMP.

The Community and Stakeholder Engagement Plan will be reviewed annually in consultation with the CRG during the construction phase and updated as required. Further information is provided in Chapter 16: Social.

23.13 Complaints management

A Project Complaint Management Handling Procedure will be developed to ensure that complaints are dealt with efficiently and effectively, and that stakeholders have confidence in the organisations complaint system.

Complaints can be lodged by any member of the public, landholder or other stakeholder.

The Complaint Management Handling Procedure will include the following steps:

- Acknowledge: Upon receiving a complaint, staff will take reasonable steps to ensure that the complaint is properly understood and seek clarification or additional information from the complainant where required. The complaint will be reported and forwarded to the relevant technical area for appropriate action or information.

- Assessment: A preliminary assessment of the complaint is conducted to determine whether the complaint is one that can be resolved, or needs to be referred to another appropriate agency or party (e.g. a local council or government agency)
- Planning: Complaints that are straightforward can often be resolved on first contact. If this is not the case and the complaint requires investigation, a planning process will be undertaken to identify what will be investigated, the steps involved in investigation, the remedy the complainant is seeking and other possible remedies.
- Investigation: The complaint will be investigated, based on the principles of impartiality, confidentiality and transparency
- Response: The progress of the complaint will be monitored and communicated to the complainant, until the outcome has been communicated to the complainant
- Follow-up: Complainants will be offered the opportunity to seek review of how their complaint was handled and resolved. If a complainant is dissatisfied with an investigator's findings or decision, a review will be carried out by a representative who has not been involved in the matter.

ARTC will regularly monitor the quality and effectiveness of the complaints management system and revise relevant components, where appropriate, based on feedback from internal and external sources.

ARTC's stakeholder management system will be used to record details of complaints and their resolution for issues analysis and reporting purposes. Further information is provided in Chapter 16: Social.

23.14 Construction hours

The proposed hours for various construction activities are set out in Table 23.4 and are reflected in the performance criteria in the draft Outline EMP Noise and Vibration Sub-plan.

TABLE 23.4: PROPOSED HOURS OF WORK FOR CONSTRUCTION ACTIVITIES

Description of works	Hours of work	
Surface works (other than works set out below)	**Monday–Friday** 6.30 am–6.00 pm **Saturday** 6.30 am–1.00 pm **No work on Sundays or public holidays**	**Monday–Friday** 6.00 pm–10.00 pm **Saturday** 1.00 pm–5.00 pm Only if the construction works comply with the Performance Criteria in Section 23.15.8.2
Tunnelling activities	24 hours a day, 7 days a week	
Spoil haulage	24 hours a day, 7 days a week	
Transport, assembly or decommissioning of oversized plant, equipment, components or structures	24 hours a day, 7 days a week	
Delivery of 'in time' materials, such as concrete, hazardous materials, large components and machinery	24 hours a day, 7 days a week	
Works that require continuous construction support, such as continuous concrete pours, pipe-jacking or other forms of ground support necessary to avoid a failure or construction incident	24 hours a day, 7 days a week	
Materials and equipment delivery	24 hours a day, 7 days a week	
Works in a rail corridor (track possessions)	24 hours a day, 7 days a week and in accordance with the hours of work prescribed by the rail infrastructure manager	
Works in a road	In accordance with the hours of work prescribed by the road authority in any permit under a local law (for a local government) or a permission under the *Transport Infrastructure Act 1994* (Qld), or if no hours of work are prescribed, then works may be undertaken Monday–Saturday (not public holidays) 6.00 am–6.00 pm.	

Description of works	Hours of work
Works carried out in an emergency to avoid the loss of life, damage to property or to prevent environmental harm	At any time
Blasting	**Monday–Friday** 7:30 am–4:30 pm **Saturday** 7:30 am–1.00 pm **No blasting on Sundays or public holidays** Blasting will not be conducted outside standard hours. If blasting outside of standard hours is required, approval from the Department of Environment and Science will be obtained prior to blasting. Reduced limits may be required.

23.15 Draft Outline Environmental Management Plan sub-plans

This section provides discipline-specific draft Outline EMP sub-plans, drawing on the outcomes of the discipline environmental assessments of this EIS. The draft Outline EMP sub-plans establish a framework for sub-plans that will be prepared as components of the CEMP during the next phase of the Project.

Each draft Outline EMP sub-plan includes:

- Environmental outcomes
- Performance criteria
- Mitigation measures
- Monitoring requirements.

23.15.1 Land use and tenure

23.15.1.1 Environmental outcomes

Project works are designed and managed to minimise the potential for adverse impacts and maximise the potential benefits to surrounding land use.

23.15.1.2 Performance criteria

- Access to private land is maintained for the duration of construction
- Minimise the impact of the Project construction and operational activities on adjoining and surrounding properties and land use, through: preparation and implementation of the sub-plans for noise and vibration, air quality and traffic, and the landscape design; Reinstatement and Rehabilitation Plan; and Landscape and Rehabilitation Management Plan
- The Project's permanent and temporary disturbance footprint is refined and limited to that which is required to safely construct, operate and maintain the Project.

23.15.1.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.5.

TABLE 23.5: MITIGATION MEASURES—LAND USE AND TENURE

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Property	▸ Detailed design to further refine the Project disturbance footprint identified and assessed in the EIS, to that which is required to safely construct, operate and maintain the Project ▸ Minimise property acquisition requirements, property severance and disruption to land use, transport networks and State land reserves ▸ Project clearing extents will be surveyed and clearly defined, physically and digitally, prior to Project activities commencing ▸ Property management agreements with directly impacted landholders and trustees, including where the Project impacts State land reserves, will be finalised prior to Project construction activities commencing on the specific property ▸ Interface agreements with mineral and petroleum resource interest holders and public utility providers will be finalised prior to construction activities commencing. This includes further discussion with APT Petroleum Pipelines Pty Ltd regarding asset interface agreements. ▸ Consultation with resource interest holders, including operators of Harlaxton Quarry (KRA 8), will continue to be undertaken during detailed design. Where the Project may impact on likely significant deposits within the KRA, appropriate mitigation will be agreed with the resource interest holders.
	Access	▸ Detailed design and construction planning will minimise alteration of the surrounding road and transport network and maintain legal property accesses. Where this is not feasible or practical, alternative solutions will be developed. ▸ Site-specific traffic management plans will be developed with key land uses and with key land uses and businesses adjoining or within close proximity of the Project disturbance footprint to minimise business operations disruptions ▸ Road–rail interface detailed design to be undertaken in accordance with QR, DTMR and local government requirements

	Reinstatement and/or rehabilitation	▸ A Reinstatement and Rehabilitation Plan will be developed for areas within the Project disturbance footprint that do not form part of the permanent works (e.g. construction compounds, laydown areas, temporary access, and some temporary erosion and sediment controls) to return these temporary disturbance areas to pre-disturbance condition and/or conditions that are commensurate to the surrounding environment and land use in accordance with landholder agreements
		▸ The Reinstatement and Rehabilitation Plan will include and clearly specify:
		  ▸ The location of areas subject to reinstatement and/or rehabilitation
		  ▸ Details of the actions and responsibilities, performance criteria and monitoring framework to progressively rehabilitate, regenerate, and/or revegetate areas no longer active
		▸ A Landscape and Rehabilitation Plan will be developed to define progressive and post-construction installation of the Project landscape design, its establishment and ongoing maintenance and monitoring requirements, in addition to construction contract completion criteria for areas defined in the landscape design and/or identified in the Reinstatement and Rehabilitation Plan

	Utilities	▸ The location of utilities, services and other infrastructure will be identified and documented during detailed design to determine requirements for access to, diversion/relocation, protection and/or support ▸ Interface agreements with impacted public utility providers will be finalised prior to construction activities commencing
	Stakeholder engagement	▸ A Community and Stakeholder Engagement Plan will be developed under the Social Impact Management Plan (SIMP) to provide Project updates and upcoming work activities to the identified property owners, occupants and operators for the duration of the Project.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction, Construction and Commissioning	Stakeholder engagement	▸ A Community and Stakeholder Engagement Plan will be progressively revised to provide Project updates and upcoming work activities to the identified property owners, occupants and operators for the duration of the Project ▸ A Project Complaint Management Handling Procedure will be developed to ensure that complaints are dealt with efficiently and effectively, and that stakeholders have confidence in the organisation's complaint system ▸ ARTC will progressively reinstate and rehabilitate disturbed sites that do not form part of the permanent works (e.g. construction compounds) in accordance with the Reinstatement and Rehabilitation Plan
	Fencing	▸ Where practicable, permanent Project boundaries will be fenced in accordance with Inland Rail fencing standards

23.15.1.4 Monitoring

Monitoring compliance of the development and implementation of the land-use-and-tenure related management processes and performance criteria. identified in this draft Outline EMP sub-plan, will be captured in the processes identified in Section 23.9.

23.15.2 Land resources

23.15.2.1 Environmental outcomes

Project works are designed and managed to avoid, minimise or manage potential adverse impacts to soils within and adjacent to the Project works.

Projects works are managed to prevent contamination of soil as a result of construction and commissioning activities.

Project works are managed to minimise biosecurity risk within and on land adjacent to the Project disturbance footprint.

23.15.2.2 Performance criteria

- Project works do not cause erosion or contamination beyond the temporary or permanent works
- Project works are undertaken in accordance with the approved Erosion and Sediment Control Plan (ESCP) prepared by a Certified Professional in Erosion and Sediment Control (CPESC)
- Acid sulfate soils (ASS) and contaminated soils are avoided or intercepted, and managed, to avoid adverse impacts to environmental values
- The storage, transport and use of hazardous materials does not cause contamination of land or waters
- Any imported fill is tested and classified to confirm it is not contaminated and suitable for use for the Project
- All contamination incidents are rectified as soon as possible, and in accordance with legislative requirements
- Minimise the import and disposal of fill material
- Minimise and manage the environmental and health impacts arising from disturbance of pre-existing contaminated and/or hazardous soil and materials (including unexploded ordnances (UXO))
- Management of biosecurity matter (plants, animals and diseases (i.e. fire ants)) that is restricted under the *Biosecurity Act 2014* (Qld) (Biosecurity Act) or listed as locally significant under a local government biosecurity management plan
- Manage the transport to and from site of biosecurity matter and biosecurity matter carriers
- Movement of biosecurity matter and carriers across biosecurity zones in compliance with the Biosecurity Regulation 2016 and Biosecurity Instrument Permits, where applicable.

23.15.2.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction and construction, and commissioning phases of the Project are included in Table 23.6.

TABLE 23.6: PROPOSED MITIGATION MEASURES—LAND RESOURCES

Delivery phase	Aspect	Proposed mitigation measures

Detailed design	Additional investigations	▸ Additional soil data, from the current soil sampling assessment along the Inland Rail alignment from Gowrie to Kagaru, will be incorporated into the Final EIS and will enable identification of potential/actual problematic soils including: acid sulfate, reactive, erosive, dispersive, saline, acidic, alkaline and liberation of contaminants.
		▸ Soil conditions across the Project disturbance footprint will be appropriately characterised at a suitable scale by a suitably qualified soil practitioner through additional geotechnical surveys during the detailed design phase of the Project, to inform design of structures, embankments, erosion control, soil treatment, soil reuse, as well as rehabilitation works. Subject to land access, the soil sampling will be of an intensity to enable mapping at a 1:10,000 scale. Soil investigations will be in accordance with the *Guidelines for Surveying Soil and Land Resources* (CSIRO/McKenzie et al., 2008), the *Australian Soil and Land Survey Field Handbook* (CSIRO, 2009) and the *Guidelines for Soil Survey along Linear Features* (Soil Science Australia, 2015). This includes identification of potential/actual ASS, acid rock, reactive soils, erosive soils, dispersive soils, salinity, acidic soils, alkaline soils, wetness, depth and contaminated land. Examples of soils that will require specific design consideration include:
		  ▸ The high naturally occurring sodicity of sodosols predominantly found east of the GDR escarpment
		  ▸ Vertosols or cracking clays predominantly found west of the GDR escarpment
		  ▸ Saline soils, particularly in high-salinity hazard areas like the Lockyer Valley.
		▸ Additional geotechnical investigations will be undertaken to inform the design of earthworks and foundations for structures, suitability of borrow and quarry material, and construction planning for the Project. Additional geotechnical investigations will specifically target locations such as:
		  ▸ Cuts
		  ▸ Embankments
		  ▸ Bridge piers and abutments.
		▸ The volume, characteristics and fate of spoil material is contingent on further detailed geotechnical investigations and detailed design being completed. The suitability and extent of the material intercepted by the Toowoomba Range Tunnel cannot be estimated with accuracy due to the variable nature of basalt flows deposited on the undulating Jurassic sedimentary paleo topography. Typically, the spoil characteristics are monitored as the excavation progresses with samples taken directly from a temporary stockpile.
		▸ Additional geotechnical investigations along the tunnel are proposed to confirm the geological characteristic of the material to assist in determining :
		  ▸ Amount of material of excavated material in particular basalt as a stabilised structural fill and/or capping layers in accordance with ARTC's *Earthworks Material Specification* (refer Appendix T: Spoil Management Strategy)
		  ▸ The amount and characteristics (e.g. contaminated or structurally unsuitable) of excavated material that may not meet the specifications for reuse
		  ▸ The viability of the reuse of excavated material as high-quality general fill or structural fill to minimise the import of rock amour

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Additional investigations [continued]	▸ The viability of the reuse of dispersive and sodic soils as generally fill in embankments and/or formations ▸ The viability of the material within the Project disturbance footprint for reuse as per the ARTC Earthworks Material Specification and the Earthworks and Material Management Framework, including extent of material that may need treatment (e.g. soil sampling and where applicable additional contaminated land surveys in accordance with relevant guidelines and procedures) ▸ Risk of environmental harm (e.g. contamination, acid rock etc.) from the stockpile at the western poral and level of treatment (If any).
	Landform and material use	▸ Optimise the number, width and depth of cuts to avoid the generation of material that would be considered surplus to Project requirements. ▸ Review cut-and-fill balance for the Project based on the detail design, to minimise the external sourcing of fill. Based on reviewed cut- -and-fill balance, determine the number of borrow pits and volumes from each that is required to supply the confirmed material demand for the Project. ▸ Review and update the draft spoil management strategy (refer Appendix T: Spoil Management Strategy) for the Project to reflect anticipated cut-and-fill quantities at the end of the detail design process. ▸ Cut batter angles will need to be appraised during detail design, based on material strengths and other geotechnical properties. Stability analysis will be required to assess the factor of safety of these cut slopes. Slopes of 1V:2H and the application of topsoil and seeding have been assumed for the reference design. The appropriateness of this gradient and erosion protection will require confirmation through trials and further testing, as part of the detail design. ▸ Stability of creek/waterway banks and areas of erosion will be assessed, and treatment measures be designed to control erosion and sediment movement.
	Erosion and sediment control	▸ Project clearing extents are limited to the disturbance footprint, which will be minimised to that required to safely construct, operate and maintain the Project. ▸ An ESCP will be prepared by a CPESC and be in accordance with the International Erosion Control Association (IECA) *Best Practice Erosion and Sediment Control* (2008). and with reference to the Soil Conservation Guidelines for Queensland (DSITI, 2015b), and will be implemented during construction of the Project. The plans will detail the following procedures and protocols relevant to potential impacts identified in Chapter 9: Land Resources: ▸ Soil/land conservation objectives for the Project ▸ Temporary/permanent erosion and sediment control measures ▸ Workplace health and safety requirements relating to management of contamination and UXO risk ▸ Management of problem soils (e.g. ASS, erosive, dispersive, reactive, acidic, sodic, alkaline soils) ▸ Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material ▸ Vehicle, machinery and imported fill hygiene protocols and documentation. ▸ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Hazardous materials Handling and Storage	▸ A Contaminated and Hazardous Materials Management Plan will be included as a component of the CEMP to eliminate, minimise and manage spills. The sub-plan will be required to: ▸ Identify the materials and chemicals required to be stored and used in support of construction, including volumes of each, such as: – Fuel and oil – Greases – Blasting chemicals – Concreting – Welding gases – Pesticides ▸ Identify the laydown areas that will be used for storage of hazardous materials and designated locations for storage of hazardous within the bounds of those laydown areas ▸ Specify how dangerous goods and hazardous materials will be handled, stored and transported for the Project ▸ Describe the response procedures in the event of an incident involving hazardous materials or dangerous goods ▸ Establish the waste storage and disposal procedures for hazardous materials and dangerous goods. ▸ Design of bunding containment will be in accordance with Australian Standard (AS) 1940:2017—*Storage and handling of flammable and combustible liquids* (Standards Australia, 2017). ▸ Although unlikely, based on the UXO assessment for the Project, where a risk of encountering known or possible UXO is identified, assessment and identification of management options will be carried out by a suitably qualified person.
	Reinstatement and/or rehabilitation	▸ The ESCPs will align with the Reinstatement and Rehabilitation Plan and will include progressive stabilisation of earth materials and soil consolidation to prevent erosion and sedimentation in areas within the disturbance footprint that do not form part of the permanent works (e.g. temporary construction compounds and laydown areas, etc.). ▸ The ESCPs will align with the Reinstatement and Rehabilitation Plan and will include progressive stabilisation of earth materials and soil consolidation, to prevent erosion and sedimentation in areas in the Project disturbance footprint that do not form part of the permanent works (e.g. temporary construction compounds and laydown areas, etc.). ▸ A Rehabilitation and Landscaping Management Sub-plan will be developed for the Project, as a component of the CEMP. This sub-plan will be based on the Inland Rail Landscape and Rehabilitation Strategy, in addition to location and property specific reinstatement commitments. The plan will include and clearly identify: ▸ Location-specific objectives for rehabilitation, reinstatement and/or stabilisation. Outside of the rail corridor, property-specific and township-specific rehabilitation and landscaping requirements may apply. Within the rail corridor, maintaining operational safety and rail formation stability will be the driving factors ▸ Objectives and timeframes for rehabilitation and/or reinstatement/stabilisation works (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved) ▸ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, while minimising the duration of exposure in disturbed areas.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Reinstatement and/or rehabilitation	▸ Include rehabilitation requirements such as: ▸▸ Milling and removal of bitumen pavement ▸▸ Removal of any decommissioned culverts ▸▸ Tyning and ripping of base and sub-base material ▸▸ Application of soil ameliorants ▸▸ Topsoiling and/or compost blanket ▸▸ Stabilisation and rehabilitation (e.g. planting and or seeding) ▸▸ Native flora species endemic to the Darling Downs and Toowoomba regions or other suitable species appropriate to the landscape context and nursery/seed stock sources ▸▸ Consideration for maintenance or performance issues of rehabilitation e.g. use of groundcover that does not grow and obscure signals or impact the longevity of rail infrastructure ▸▸ Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas ▸▸ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved.
	Land and soil	▸ Minimise risks through implementation of appropriate detailed design processes where reactive or problem soils are present or suspected. ▸ Cut-and-fill balance and minimisation of transport requirements for import/disposal of spoil will be considered as part of the design process. ▸ The quantity of spoil to be generated by the Project has been reduced through optimising the number, width and depth of cuts to avoid the generation of material that would be considered surplus to Project requirements. ▸ Detailed design will demonstrate assessment and viability of opportunities for: ▸▸ Re-use of local sources of aggregate, and treatment of dispersive and reactive materials to improve mass haul ▸▸ Re-use of material excavated below the rail embankment for less critical parts of infrastructure ▸▸ Re-use of excavated material as a stabilised structural fill ▸▸ Re-use of ballast as high-quality general fill or structural fill to minimis the import of rock amour. ▸ A Soil Management Plan will be developed to provide the framework for stripping, storage, treatment and reuse of topsoil. ▸ Where dispersive material may be allowed as part of the earth fill, adequate design and construction practices will be implemented to reduce the risk of damage to the embankment. Mitigation measures may include containment of the dispersive soil by non-dispersive and low permeability outer layers, high level of compaction at optimum moisture content, lime stabilisation or other similar methods. ▸ Ensure that temporary earthworks and permanent landform for the Project are designed to avoid unwanted ponding of water. This objective will be achieved through surface levelling and use of cross-drainage and longitudinal drains within the rail corridor. ▸ A Biosecurity Management Plan will be developed and implemented, and will include measures to address the risk of impacts from feral animals grazing, trampling, digging and/or burrowing in rehabilitated/landscaped areas.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Land and soil [continued]	▸ Biosecurity matter (plants, animals and diseases) that is restricted under the Biosecurity Act, or listed as locally significant under a local government biosecurity management plan, will be appropriately managed. ▸ The transport of biosecurity matter and biosecurity matter carriers to and from site will be appropriately managed. ▸ Movement of biosecurity matter and carriers across biosecurity zones will be in compliance with the Biosecurity Regulations 2016 and Biosecurity Instrument Permits, where applicable.

	Contamination, land and soil	▸ As required, a Contaminated Land Management Strategy will be developed and implemented by a suitably qualified professional, as recognised under the EP Act, incorporating consultation outcomes from landholders and other relevant stakeholders. This will:
		  ▸ Be developed based on the contaminated land strategy presented in Chapter 9: Land Resources, Figure 9.19
		  ▸ Specify controls for works on land that is known or suspected of being contaminated and will outline the process to identify, document and manage contaminated sites
		  ▸ Seek to minimise soil disturbance in areas listed on the EMR (refer Chapter 9: Land Resources, Table 9.15). A Soil Disposal Permit under the EP Act is required if contaminated soil is to be moved from a lot listed on the EMR
		  ▸ Establish the methodology, and sampling and analysis plan for environmental site investigation where soil disturbance is required on an EMR site in the potentially contaminated area
		  ▸ Establish an unexpected finds protocol/procedure in the event that potentially contaminated materials, including UXO, ASS/acid rock are encountered during construction activities.
		▸ A detailed contamination assessment of EMR-listed sites and other areas of potential contamination will be undertaken (if required and determined by a Contaminated Land Suitably Qualified Person) once detailed design, Project disturbance footprint and the cut-and-fill balance are finalised, in accordance with the requirements of ASC NEPM.
		▸ Any imported fill material will be clean, certified pest- and contaminant-free.
		▸ Where geotechnical/drilling activities require drilling fluids or muds, environmentally neutral and biodegradable materials will be selected. 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.

	Acid sulfate soils/ acid rock	▸ If ASS/acid rock is identified through further geotechnical investigations and will be disturbed by construction activities, an ASS Management Plan will be developed, if required, in accordance with the *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines v4.0* (DSITI, 2014a) and the State Planning Policy.
	Secondary salinity	▸ Ensure that temporary earthworks and permanent landform for the Project are designed to avoid unwanted ponding of water. This objective will be achieved through surface levelling and use of cross-drainage and longitudinal drains within the rail corridor. ▸ Design water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar. ▸ Avoid, where possible, the need for diversions or alterations to waterways. ▸ The ultimate water sourcing strategy for the Project will be documented in a construction water plan. The quality of water from available sources will be considered in the development of the Plan.

Delivery phase	Aspect	Proposed mitigation measures

Pre-construction	Materials Handling and Storage, hazardous waste	The CEMP will contain the following provisions relevant to potential impacts of land resources:
		▸ A pollution incident response procedure will be prepared for accidental spills, leaks and other polluting incidents. The supervisor or person in charge of the work activity will be notified immediately. The matter will be recorded on the reportable environmental incident checklist and in accordance with ARTC's Emergency Management Procedure (ARTC, 2019b).
		▸ All bunding, hydrocarbon and chemical storage areas will be routinely checked, and their integrity and functionality maintained as per design capacity.
		▸ Appropriate controls will be in place to prevent environmental incidents including leaks/spills from refuelling activities and to protect the environment in the event that incidents occur.
		▸ Personnel involved in ground-disturbing works will be trained in the unexpected finds protocol/procedure and in:
		  ▸ The identification of potential contaminated soil/material and relevant controls such as how to recognise potential contaminated material (colour, texture, odour, presence of asbestos, metal, ash) from inert waste or materials
		  ▸ Stop work and corrective/containment actions
		  ▸ Classification and notification of incidents procedures.
		▸ Identification of contaminated, hazardous or potentially contaminated material onsite (i.e. soil/formation, etc.) will be subject to a risk assessment.
		▸ Review or certification of contaminated, hazardous or potentially contaminated material will be undertaken and recorded.
		▸ Transportation of hazardous substances wastes and/or dangerous goods will be undertaken by appropriately licensed contractors, and a register of waste transfer certificates will be maintained for the Project.

	Spoil management/ excavated material	▸ A Construction Spoil Management Plan will be developed and implemented to document and manage the stockpiling and storage, onsite removal, transport and disposal of excavated material. ▸ Any imported fill material will be clean, certified pest- and contaminant-free.
	Contamination	▸ Suspected contaminated soils or materials, if encountered, will be managed in accordance with the unexpected finds protocol/procedure documented in the Contaminated Land Management Strategy (refer above). ▸ Opportunities to treat and re-use contaminated materials within the rail corridor will be assessed and subjected to a risk assessment.
	Erosion and sediment control, land and water, water quality	▸ The ESCP will include water quality monitoring requirements, as defined in the Surface Water Sub-plan, to assess the effectiveness of erosion and sediment controls and reinstatement and rehabilitation programs.
	Land and soil	▸ Closure or realignments of local roads will be undertaken in accordance with the Reinstatement and Rehabilitation Plan. ▸ Wherever practical, topsoil will be transferred directly to placement as planting media. ▸ Topsoil stockpiles will be stabilised and managed to maintain biological function and avoid heat sterilisation of microbial activity and existing seed bank.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction [continued]	Land and soil continued]	▸ Where stockpiling of topsoil is required, it will be carried out in accordance with the Soil Management Plan, and in a manner that ensures that the properties of the topsoil are not permitted to degrade such that it becomes unsuitable as planting media. The Soil Management Plan will establish: ▸ Limitation for height of stockpiles ▸ Limits for the width of the base of stockpiles ▸ Requirements for adopting batter slopes, protective covers and drainage, which reduce potential for erosion and/or segregation ▸ Limits for the period of stockpiling to a minimum practical time. ▸ Requirements for carrying out herbicide spraying or other treatment of the stockpile at intervals required to prevent weed growth and ensure the stockpile faces are weed-free prior to use. ▸ Develop and implement a Biosecurity Management Plan as part of the CEMP to include: ▸ Compliance requirements, including relevant biosecurity surveillance or prevention programs authorised under the Biosecurity Act and any requirements of the *Vegetation Management Act 1999* (Qld) (VM Act), the *Planning Act 2016* (Qld) and the *Agricultural Chemicals Distribution Control Act 1966* (Qld) (ACDC Act) ▸ Requirement for pre-clearing survey to determine the risk of weeds or pest animals being present ▸ Map of the existing severity and extent of weed infestations and weed management requirements, including land adjacent to the disturbance footprint and construction access tracks ▸ Pest animal management (including fire ants and fire ant biosecurity zones) ▸ Site hygiene and waste management procedures to deter pest animals ▸ Weed surveillance and treatment during construction and rehabilitation activities ▸ Requirement in relation to pesticide and herbicide use and documentation, including any limitations on use, such as restrictions on use in sensitive environmental areas, agricultural areas, drainage lines that flow to waterways and aquatic habitats, and ensuring that broad-scale use does not result in an increase erosion and sediment risk ▸ Vehicle, machinery and imported fill hygiene protocol and documentation ▸ Erosion and sediment control risk associated with broad-scale weed removal or treatment. ▸ Mitigation or remediation measures contained in the Biosecurity Management Plan will be developed in accordance with relevant agencies and local government.
	Hazardous waste	▸ A contaminated and hazardous material survey will be undertaken prior to relocation of infrastructure (e.g. signalling boxes and equipment) and the demolition of structures (e.g. sheds, housing/buildings and, where applicable, rail infrastructure). In the event that asbestos or other hazardous materials are identified in these structures, a Contaminated and Hazardous Materials Management Plan will be developed and implemented. The Contaminated and Hazardous Management Plan will contain procedures to ensure that removal is undertaken in accordance with *How to Safely Remove Asbestos Code of Practice* (Safe Work Australia, 2018b).

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning	Erosion and sediment control, land and water, water quality	▸ Appropriate erosion and sediment control measures will be implemented and continuously revised for the construction works, in accordance with the ESCP developed and maintained specifically for the Project.
	Contamination	▸ For work activities undertaken properties identified on the EMR within the Project construction boundary, or any other sites identified as part of the actions under the Contaminated Land Management Strategy, a Contaminated Site Management Plan will be implemented to reduce the risk of adverse impacts to the surrounding environment. ▸ If suspected contaminated land or material in drums, tanks, bags or plastic containers are encountered during excavation works, all work will stop in the affected area and measures to manage the contamination will be implemented, as per the Contaminated Site Management Plan. ▸ Contaminated waste must be transported and disposed of in accordance with the EP Act and procedures in the Waste Management Sub-plan. ▸ Asbestos-containing materials will be transported by a licensed service provider and disposed of at an appropriately licensed facility, in accordance with the requirements of the *Waste Reduction and Recycling Act 2011* (Qld) and the EP Act. ▸ The reuse or retention of contaminated or potentially contaminated material onsite (i.e. soil, ballast) will be subject to a risk assessment.

	Materials handling and storage	▸ Appropriate registers and records of chemicals, hydrocarbons and hazardous substances and materials onsite will be maintained and kept up to date. Where appropriate, this will include a relevant risk assessment prior to the substance coming to, and being used onsite, plus a Safety Data Sheet (SDS) Register.
		▸ Where an incident occurs that threatens or causes environmental harm, the Service Provider will take all reasonable steps, including allocation of additional trained resources or specialists, to remediate and manage the incident.
		▸ Bulk storage areas for dangerous goods and hazardous materials will be located away from areas of social (e.g. residential areas) and environmental receptors (e.g. watercourses) such that offsite impacts or risks from any foreseeable hazard scenario will not exceed the dangerous dose for the defined land use zone, i.e. either sensitive, commercial/community, or industrial, in accordance with the intent of the SPP.
		▸ Licensed transporters operating in compliance with *Australian Code for the Transport of Dangerous Goods by Road and Rail, (NTC, 2018)* will be used for the transportation of dangerous goods.
		▸ Chemicals stored and handled as part of construction activities will be managed in accordance with relevant legislation and where applicable:
		  ▸ AS 2187.2:2006: Explosives—Storage, transport and use (Standards Australia, 2006a)
		  ▸ Australian Code for the Transport of Explosives by Road and Rail, 3rd edition (Australian Government, 2009)
		  ▸ AS 1940:2017 Storage and Handling of Flammable and Combustible Liquids (Standards Australia, 2017)
		  ▸ AS 3780:2008 The Storage and Handling of Corrosive Substances (Standards Australia, 2008a)
		  ▸ The requirements of chemical safety data sheets.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Secondary salinity	▸ Surface levelling of the site will occur, to prevent inadvertent ponding of water. ▸ Water that is dispersed for vegetation establishment, landscaping and rehabilitation will be consistent with the quality requirements specified for irrigation and general water use in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000). ▸ Ensure efficient water application, so as to avoid prolonged oversaturation of soils within and adjoining the Project footprint.
	Rehabilitation	▸ Reinstatement, stabilisation and rehabilitation of temporarily disturbed areas (such as laydown, site offices and temporary access tracks) will be undertaken progressively, consistent with the Reinstatement and Rehabilitation Management Plan.
	Hazardous waste	▸ Hazardous and/or dangerous waste (e.g. asbestos, chemicals, oils) will be correctly stored and managed onsite and/or correctly disposed of by a licensed contractor to a registered waste facility and in accordance with the CEMP.

23.15.2.4 Monitoring

Monitoring compliance of the development and implementation of the land-resources related management processes and performance criteria identified in this draft Outline EMP sub-plan will be captured in the processes identified in Section 23.9.

23.15.3 Landscape and visual amenity

23.15.3.1 Environmental outcomes

Project works are designed to minimise vegetation loss and mitigate impacts through appropriate rehabilitation.

Project works are designed to minimise impacts on the visual amenity of watercourses.

The design of rail infrastructure and associated landscape treatments (including slope and stabilisation measures) responds to the natural and rural landscape, topography and landform, to the greatest extent possible, while complying with engineering design standards and legislative requirements.

Project design results in a minimal maintenance landscape.

23.15.3.2 Performance criteria

- Construction compounds and ancillary facilities are located to minimise visual impacts
- Vegetation screens and other barriers are provided or retained, where practicable, to minimise visual amenity impacts
- Temporary construction areas are rehabilitated progressively and in accordance with the Reinstatement and Rehabilitation Plan
- The Reinstatement and Rehabilitation Plan is implemented
- Nuisance from construction lighting on sensitive places and nearby roads is avoided.

23.15.3.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.7.

TABLE 23.7: MITIGATION MEASURES—LANDSCAPE AND VISUAL AMENITY

Delivery Phase	Aspect	Proposed mitigation measures
Detailed design	Landscape and visual impacts due to vegetation removal	▸ Clearing extents of visually significant vegetation are further limited, where feasible, to that required to safely construct, operate and maintain the Project. Locations include: ▸ Vegetation associated with Gowrie Creek, impacted by construction works associated with Gowrie Junction Road Bridge (approximately Chainage (Ch) 2.0 km) ▸ Vegetation associated with the Toowoomba Range and elevated undulating land near Ballard, Withcott and Postmans Ridge (approximately Ch 10.1 km to Ch 25.0 km); in particular, with consideration of reducing the impact on the landscape character of Landscape Character Type (LCT) G: Forested Uplands and views towards this landscape from the Toowoomba escarpment. ▸ Develop a Reinstatement and Rehabilitation Plan based on the Inland Rail Landscape and Rehabilitation Strategy for areas within the disturbance footprint that do not form part of the permanent works (e.g. construction compounds, laydown areas, temporary access tracks, etc.). The Plan will include and clearly identify: ▸ Location of areas subject to rehabilitation and/or reinstatement/stabilisation, in accordance with the landscape and rehabilitation design developed during detailed design ▸ Clear objectives and timeframes for rehabilitation and/or reinstatement/ stabilisation works (including biodiversity, vegetation establishment, and erosion and sediment control outcomes to be achieved) ▸ Where appropriate, the plan describes how the objectives align with the relevant recovery plans, threat abatement plans, conservation advice or policy guidance for target species in areas identified for rehabilitation ▸ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives ▸ Native flora species endemic to the Toowoomba and Lockyer Valley regions, or other suitable species appropriate to the landscape context, and nursery/seed stock sources ▸ Procedures, timeframes, measurable performance objectives, and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas ▸ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved. ▸ Reinstatement and Rehabilitation Management Plan will be developed to define post-construction maintenance requirements, monitoring requirements and completion criteria for areas defined in the landscape design and/or identified in the Reinstatement and Rehabilitation Plan; including, the identification of areas where degraded (eroded), bare and/or unstable (potentially erodible) soils need to be rehabilitated with consideration to the requirements of the DTMR *Soil Management Manual* (DTMR, 2020) and soil-testing parameters and requirements, as set out in Appendix A of the manual.

Delivery Phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Landscape and visual impacts on watercourses	▸ Develop the detailed design to further minimise impacts to waterways, riparian vegetation and in-stream flora and habitats. Locations (noting some of these include rail infrastructure already located on the viaduct) include Gowrie Creek (Landscape Character Area (LCA) A1), Lockyer Creek (LCA A9) and Six Mile Creek (LCA A10). ▸ Aim to avoid, then minimise the extent of waterway diversions.
	Visual impact of rail infrastructure	▸ Infrastructure (such as structures, embankments/cuttings, tunnel portals, tunnel control centre, viaducts, and bridges) will be designed following an integrated design process with regard to landscape character and views, as identified in the EIS, seeking to: ▸ **Legacy:** Create consistent design treatments along the Project alignment to enhance the overall recognition and legacy of the Project ▸ **Viaducts and bridges:** Viaduct and bridge design considers appropriate design principles at key viewpoints, including: – Gowrie Junction Road Bridge (approximately Ch 2.0 km) – Toowoomba Bypass and Six Mile Creek Viaduct (approximately Ch 15.8 km to Ch 16.9 km) – Murphys Creek Road Viaduct (approximately Ch 25.6 km to Ch 26.0 km) ▸ **Embankments**: At locations where embankments are near roads and/or adjoin bridge structures, minimise the extent to which landform (embankments) restricts views or affects views from nearby residences, to the greatest extent possible, via sensitive stabilisation, revegetation or—where appropriate—screen planting. These locations may include: – Draper Road (Viewpoint 1) – Paulsens Road (approximately Ch 0.6 km to Ch 1.4 km where residential properties are situated to the north of the Project) – Adjacent Toowoomba Bypass between Ch 19.6 km and Ch 20.8 km (Viewpoint 15) ▸ **Cuttings:** Where practical, minimise the extent of cut batters and undertake sensitive design of these to blend them into their landscape setting (e.g. considering potential for revegetation and/or rock pitching). Locations to consider include: – The approach to the eastern and western Toowoomba Range Tunnel portals – Cuts in the vegetated and undulating land near Ballard, Withcott and Postmans Ridge (approximately Ch 10.1 km to Ch 22.0 km) that will be visible from a high number of receptors, including elevated scenic lookouts.
		▸ **Tunnels:** Consider cuts on the approach to tunnels, as described above, and give consideration to the detailed design of tunnel portals and the Toowoomba Range Tunnel intermediate ventilation shaft location, including the provision of vegetation to screen views towards proposed infrastructure, such as ventilation buildings, particularly the intermediate ventilation shaft building with respect to its rural and industrial landscape context ▸ **Ventilation buildings:** Consider the urban design of the Toowoomba Range Tunnel intermediate ventilation shaft and associated buildings and design them to minimise the visual impact on the adjacent rural landscape and existing industrial area ▸ **Noise barriers:** If required, minimise the use of noise barriers to the greatest extent possible. Where these exist, or may be required in the future, particularly in towns and urban areas, ensure they are designed sympathetically to their surroundings and consider CPTED and graffiti issues, where appropriate, considering the inclusion of community artwork and urban design.

Delivery Phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Landscape design treatments	▸ Develop a Project landscape design with landscaping treatments determined with reference to the key landscape characteristics and elements identified in the EIS with particular emphasis on sensitive design that is appropriate to the setting. The Project landscape design will also define appropriate treatments for areas subject to the Reinstatement and Rehabilitation Plan (or equivalent) and comply with the ARTC's *Section 17 Right of Way—Engineering Code of Practice* (ARTC 2013b). ▸ **Rural and natural landscapes:** The landscape design will respect and enhance the rural landscapes. Considerations include: ▸ Design of the landscape earthworks and planting to screen and integrate the railway and associated structures and features, wherever practicable, and appropriate to the character and maintenance of desired views. This approach includes additional opportunities for design of targeted planting of buffer or shelterbelts adjacent to major earthworks within the rail corridor to the extent consistent with safety. For example, planting strips could be introduced adjacent to significant embankments to reduce visual impact and assist in integrating the landform into the existing landscape setting, which already include similar shelter belts beside roads and riparian vegetation along watercourses in the following locations: – Adjacent to Gowrie Junction Road, Krienke Road, Morris Road, East Paulsens Road and the realigned Old Homebush Road (including adjacent the Gowrie Junction Road Bridge), between approximately Ch 1.7 km to Ch 3.2 km, to screen views to the Project from residential properties of Gowrie Junction (to both the north and south of the Project) – Adjacent private residential properties on Ashlands Drive impacted by clearance associated with the nearby laydown area (refer G2H-LDN023.80) ▸ The landscape design will seek to enhance the features and qualities that give the landscape its particular characteristic, ensuring the design responds to the natural patterns of the rural or natural landscape, in particular: – Appropriate revegetation of disturbed areas between approximately Ch 10.0 km to Ch 25.0 km. ▸ Where appropriate consult with local stakeholders and landholders during design (and construction) to understand the landscape context and the particular qualities of existing landscapes. ▸ *Ecologically sensitive areas*: Design to provide opportunities for ecological gain, to benefit biodiversity. This includes: ▸ Development of diverse planting for ecological gain ▸ Enhancement of landscape corridors and ecological links across the landscape by, where possible, joining or re-joining fragmented areas of habitat ▸ Landscape design and planting to incorporate ecological requirements to benefit the characteristic and visual amenity of local landscapes, including revegetation with locally indigenous species. ▸ *Heritage landscapes*. Through detailed design: ▸ Seek to further limit direct impacts or impacts to the setting of identified items of Indigenous, historic or natural heritage significance, including non-Indigenous heritage places (comprising local heritage places and other areas of interest as identified in Chapter 18: Cultural Heritage) and Indigenous heritage places (to be identified through the CHMPs) ▸ Consider the development of an interpretation strategy and wayfinding to assist in the interpretation of visual elements of heritage significance, such as old rail infrastructure features, bridges, buildings/houses or other items of visual value.

Delivery Phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Visual impacts of lighting	▸ During detailed design, review assessment of the potential for operational light impacts to residents and identify if/where attenuation measures are required.
Pre-construction	Landscape and visual values	▸ Implement the relevant aspects of the Reinstatement and Rehabilitation Plan and progressively deliver to minimise disturbance to landscape and visual amenity values during and post the pre-construction period. ▸ Where feasible and practicable, construction areas, including compounds, stockpiles, fuel storage, laydown areas and staff parking to be located outside the tree protection zone, as defined in AS4970-2009 *Protection of trees on development sites* (Standards Australia, 2009b).
Construction and commissioning	Landscape and visual values	▸ Establish vegetation protection zones and Project clearing extents prior to commencement of works, to avoid impacts on adjoining vegetation and habitats as far as practicable, with particular consideration to: ▸ Vegetation associated with the Toowoomba Range and elevated undulating land near Ballard, Withcott and Postmans Ridge (approximately Ch 10.0 km to Ch 25.0 km); in particular, with consideration of reducing the impact on the landscape character of LCT G: Forested Uplands and views towards this landscape from the Toowoomba escarpment ▸ Vegetation within the footprint of laydown area G2H-LDN023.80 (retention of a buffer adjacent residential properties on Ashlands Drive) ▸ Where feasible and practicable, construction areas, including compounds, stockpiles, fuel storage, laydown areas and staff parking to be located outside the tree protection zone, as defined in AS4970:2009—*Protection of trees on development sites* (Standards Australia, 2009b).
	Visual impacts of construction activities	▸ Avoid or minimise construction compounds within close proximity to sensitive receptors to provide as much separation as possible. ▸ Minimise the height of all stockpiles to the greatest extent possible to reduce their visual impact. ▸ Cover stockpiles with temporary vegetative cover (such as mulch, grass seeding/hydro-mulch, soil binder, etc.). ▸ Temporary treatments (such as hoardings and shade-cloth screens) to site compounds will be considered to assist in reducing visual impacts of temporary infrastructure and sun glare in close proximity to sensitive receptors. This may include art-based treatments to assist with screening the works from the public and using information boards (or similar) to inform the public about the construction works.
	Reinstatement and rehabilitation	▸ Implement the landscape design, the Reinstatement and Rehabilitation Plan and the relevant requirements of the Landscape and Rehabilitation Management Plan, including soil rehabilitation, monitoring and testing, with consideration to the *Soil Management Manual* (DTMR, 2020), until performance criteria are satisfactorily achieved.
	Lighting impacts of construction activities	▸ Avoid or minimise the effects of unavoidable out-of-hours works (such as the Toowoomba Range Tunnel construction areas) in close proximity to residences and, where construction light impacts are predicted, implement attenuation measures in discussion with potentially affected residents

23.15.3.4 Monitoring

Monitoring compliance of the development and implementation of the landscape- and visual-amenity related management processes and performance criteria identified in this draft Outline EMP sub-plan will be captured in the processes identified in Section 23.9.

23.15.4 Flora and fauna

23.15.4.1 Environmental outcomes

Project works are designed and managed to minimise impacts to the existing ecological values of the adjoining habitats.

Environmental offsets are provided where Project works have a significant residual impact on flora and fauna that are matters of national or state environmental significance.

23.15.4.2 Performance criteria

- Clearing extents are clearly defined and enforced
- Clearing for the Project does not occur outside of the Project corridor
- Clearing extents do not exceed the disturbance limits
- Appropriate fauna habitat connectivity measures including fencing and fauna movement structures are provided during construction in accordance with detailed design to ensure permeability for wildlife
- Environmental weeds and pests including prohibited and restricted matters prescribed under the Biosecurity Act and Biosecurity Regulation 2016 within the Project area are appropriately managed
- Environmental offsets are provided for significant, residual impacts on matters of national environmental significance and matters of state environmental significance, in accordance with the Environmental Offsets Delivery Strategy
- Proposed mitigation measures.

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.8.

TABLE 23.8: MITIGATION MEASURES—FLORA AND FAUNA

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	All matters	While the assessment assumes the entire Project disturbance footprint will be cleared, the disturbance footprint will be refined through detailed design as far as practical, to that required to safely and efficiently construct and operate the Project and avoid unnecessary clearing. This will involve inputs from the design team, construction contractor and where applicable, the constructing authority. Key areas include: ▸ Vine thicket communities within the vicinity of the eastern tunnel portal ▸ Terrestrial and aquatic habitat intersected by the 13 bridges and viaducts ▸ Works across a watercourse or wetland ▸ Known habitat for threatened species or species of local significance
	TEC	▸ Three EPBC Act Threatened Ecological Communities (TECs) are known, or have potential, to occur within the vicinity of the Project footprint: Lowland Rainforest of Subtropical Australia; Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland; and White Box-Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. The following mitigation measures will be applied to the Project: ▸ Pre-construction surveys will be carried out to confirm to what extent the identified TECs occur within, or adjacent to, the Project footprint[1,2,3]. Surveys will be carried out using diagnostic criteria/condition thresholds detailed in relevant approved conservation advice for the community. Where TECs are found to occur, condition assessment will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. ▸ If found to occur within the Project disturbance footprint—quantification of the area of TECs removed to enable the Environmental Offsets Delivery Strategy—Qld to be refined.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	TEC [continued]	▸ The Soil Management Sub-plan will include soil conservation measures and erosion and sediment controls with specific reference/controls to identified TEC areas. ▸ The Biosecurity Management Plan will include reference to relevant guidelines to control potential deleterious pathogens, including *Phytophthora cinnamomi* and Myrtle rust (e.g. Department of the Environment (DotE), 2015b) associated with Project activities; both of which may impact eucalypt and rainforest species. ▸ Design modifications during the detailed design phase will seek to maintain inundation regimes within any occurrence of a TEC potentially impacted by the Project as close to natural conditions as possible. ▸ Annual monitoring of TECs retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified.[3] ▸ Rehabilitation of disturbed areas, within the Project footprint but outside of the rail corridor, using local native species.
	Conservation significant species	▸ Flora and fauna surveys will be undertaken within and immediately adjacent to the Project footprint, where they are required to verify prior surveys and assessments, refine potential offsets, inform micro-siting of infrastructure, support secondary approvals and establish baseline conditions against which relevant outcomes of the Reinstatement and Rehabilitation Plan and monitoring activities can be compared. ▸ Methods and sequencing of surveys, including seasonal timing, will be in accordance with the relevant published State and Commonwealth survey guidelines and conservation advices for each target species (e.g. *Survey guidelines for Australia's threatened birds* (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2010a)) or Queensland guidelines where Commonwealth guidelines do not exist (e.g. *Protected Plants Survey Guidelines* (DES, 2016g)). ▸ Flora species to be targeted through these surveys include the following species: ▸ MNES flora: – Hairy-joint grass (*Arthraxon hispidus*) – Bunya Mountains bluegrass (*Bothriochloa bunyensis*) – Miniature moss-orchid (*Bulbophyllum globuliforme*) – Stream clematis (*Clematis fawcettii*) – King bluegrass (*Dichanthium queenslandicum*) – Bluegrass (*Dichanthium setosum*) – Hawkweed (*Picris evae*) – Austral cornflower (*Rhaponticum australe*) – Wandering pepper-cress (*Lepidium peregrinum*) – Four-tailed grevillea (*Grevillea quadricauda*) – Blunt-leaved leionema (*Leionema obtusifolium*) – *Paspalidium grandispiculatum* – Waxy sarcochilus (*Sarcochilus hartmannii*) – Blotched sarcochilus (*Sarcochilus weinthalii*) – Brush sophora (*Sophora fraseri*) – Austral toadflax (*Thesium australe*)

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Conservation significant species [continued]	▸ Matters of State Environmental Significance (MSES) flora: – Bailey's cypress (*Callitris baileyi*) – Caustis (*Caustis blakei subsp. macrantha*) – A Sedge (*Cyperus clarus*) – Finger panic grass (*Digitaria porrecta*) – Slender milkvine (*Marsdenia coronata*). ▸ Methods and sequencing of pre-clearance fauna surveys, including terrestrial, aquatic habitats and breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures). Fauna species to be targeted through these surveys include: ▸ MNES fauna: – Five-clawed worm-skink (*Anomalopus mackayi*) – Regent honeyeater (*Anthochaera phrygia*) – Australasian bittern (*Botaurus poiciloptilus*) – Curlew sandpiper (*Calidris ferruginea*) – Spotted-tail quoll (*Dasyurus maculatus maculatus*) – Collared delma (*Delma torquata*) – Red goshawk (*Erythrotriorchis radiatus*) – Painted honeyeater (*Grantiella picta*) – Swift parrot (*Lathamus discolor*) – Murray cod (*Maccullochella peelii*) – Greater glider (*Petauroides volans*) – Brush-tailed rock-wallaby (*Petrogale penicillata*) – Koala (*Phascolarctos cinereus*) – Long-nosed potoroo (*Potorous tridactylus tridactylus*) – New Holland mouse (*Pseudomys novaehollandiae*) – Grey-headed flying-fox (*Pteropus poliocephalus*) – Australian painted snipe (*Rostratula australis*) – Black-breasted button-quail (*Turnix melanogaster*) – Condamine earless dragon (*Tympanocryptis condaminensis*) – Common sandpiper (*Actitis hypoleucos*) – Fork-tailed swift (*Apus pacificus*) – Sharp-tailed sandpiper (*Calidris acuminate*) – Pectoral sandpiper (*Calidris melanotos*) – Red-necked stint (*Calidris ruficollis*) – Oriental cuckoo (*Cuculus optatus*) – Latham's snipe (*Gallinago hardwickii*) – Caspian tern (*Hydroprogne caspia*) – Black-faced monarch (*Monarcha melanopsis*) – Yellow wagtail (*Motacilla flava*) – Satin flycatcher (*Myiagra cyanoleuca*) – Osprey (*Pandion haliaetus*) – Glossy ibis (*Plegadis falcinellus*) – Pacific golden plover (*Pluvialis fulva*) – Rufous fantail (*Rhipidura rufifrons*) – Spectacled monarch (*Symposiachrus trivirgatus*) – Common greenshank (*Tringa nebularia*) – Marsh sandpiper (*Tringa stagnatilis*).

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Conservation significant species [continued]	▸ MSES fauna: – Glossy black-cockatoo (eastern) (*Calyptorhynchus lathami lathami*) – Powerful owl (*Ninox strenua*) – Grey snake (*Hemiaspis damelii*) – Platypus (*Ornithorhynchus anatinus*) – Short-beaked echidna (*Tachyglossus aculeatus*). ▸ Where a species is detected, this will be reported to the relevant agencies along with information on the species habit, habitat in which the species was identified and, where possible, population size and local threatening processes. The information will be used to refine the predictive habitat mapping, significant residual impact assessment, disturbance limits, mitigation measures and offsets. ▸ Surveys of representative threatened habitat that will be impacted by the Project will be undertaken in accordance with the *Guide to determining terrestrial habitat quality—methods for assessing habitat quality* under the Queensland Environmental Offsets Policy Version 1.3 (DES, 2020g) and the EPBC Act *Environmental Offsets Policy* (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012b to enable a condition assessment of vegetation communities that require offset for the Project. ▸ Based on the outcome of flora, fauna and habitat surveys: ▸ Work with the design team and construction team to implement measures to avoid and/or further minimise the extent of impacts (i.e. designate no-go zones, reduce the construction or operational footprint within or adjacent to communities or habitat for threatened species, define clearing limits) ▸ Refine the location of ancillary works (e.g. laydown areas) to avoid habitats and/or known populations/communities. ▸ This information will inform staged and sequential clearing (i.e. clearing of non-habitat trees in area, then a wait period and then the clearing of the remaining habitat). This will help maintain connectivity during construction. ▸ Identify suitable locations for the release of fauna that may be encountered during pre-clearing or clearing or for the salvaging of microhabitats. ▸ For any threatened flora species identified through surveys within the disturbance footprint, consult with relevant specialist to determine the feasibility of translocating or propagating specimens in accordance with relevant guidelines (e.g. *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al., 2018)), including the collection of seed. Feasibility will be assessed, noting that not all species can be translocated or propagated and that, for the majority of the species identified as potentially occurring within the Project disturbance footprint, there is limited evidence of these species being successfully translocated, even though some are used in the horticultural industry.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Conservation significant species	▸ The following species-specific measures for threatened flora species listed as potentially present (refer list of species above): ▸ Avoid works in areas that may support an important population of the species. ▸ Undertake protected flora surveys as per *Protected Plants Survey Guidelines* (DEHP, 2016g) with a particular focus in areas predicted as supporting the species (refer species habitat mapping in Appendix J: Matters of National Environmental Significance). The following species-specific measures for Murray cod (*Maccullochella peelii*) and the Platypus (*Ornithorhynchus anatinus*) will be implemented: ▸ Avoid clearing within and along Gowrie Creek, through the use of bridge structures and the placement of pylons away from bed and banks. ▸ Pre-construction surveys of waterways identified as potential habitat of species (i.e. Gowrie Creek) to identify whether Murray cod occurs. Surveys will follow the Survey guidelines for Australia's threatened fish (Department of Sustainability, Environment, Water, Populations and Community (DSEWPaC), 2011c). ▸ Where a temporary impoundment or diversion is required for construction purposes, and the species is found to be present, the Flora and Fauna Sub-plan will include requirements for an appropriately qualified person to be consulted to make an assessment on the method of recovery, transport and release of fish. The Flora and Fauna Sub-plan will follow relevant State (Department of Agriculture and Fisheries (DAF)) fish salvage guidelines during construction activities. ▸ The Biosecurity Management Plan will include measures to manage the risk of translocating non-endemic flora and fauna through dewatering and fish salvage activities. ▸ The Surface Water Sub-plan will be developed to include measures to maintain low flows during drought conditions and avoid fluctuations to water levels downstream during spawning period (i.e. Gowrie Creek). ▸ The Reinstatement and Rehabilitation Plan will establish requirements for instream and riparian habitats impacted by Project works. This includes restoration of natural riparian vegetation and, where possible, reinstatement of instream habitat to pre-construction state (e.g. replacement of large woody debris, ensure no or limited change to instream flows and allow fish passage). The following species-specific measures for Spotted-tail quoll (*Dasyurus maculatus maculatus*), Long-nosed potoroo (*Potorous tridactylus tridactylus*), New Holland mouse (*Pseudomys novaehollandiae*) and Brush-tailed rock-wallaby (*Petrogale penicillata*) will also be implemented: ▸ Avoid works above the tunnel as this area is a key corridor to maintain movement during construction and operation of the Project. ▸ Targeted surveys for identified mammal species will follow the Survey guidelines for Australia's threatened mammals (DSEWPaC, 2011b) and include the identification of species-specific habitat (refer species habitat mapping in Appendix J: Matters of National Environmental Significance and habitat features considered suitable for species presence (e.g. cliff faces/boulder piles for Brush-tailed rock-wallaby and Spotted-tail quoll).

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Conservation significant species [continued]	▸ The Flora and Fauna Sub-plan will include restricted works measures for implementation if the abovementioned species are observed within or adjacent to disturbance footprint, to allow safe movement away from works area. These measures may include but are not limited to the following: ▸ Measures to remove carrion from the Project disturbance footprint (and the rail corridor), along with waste management measures ▸ Pest control measures in known or potential habitat for the abovementioned species, to consider risks to the species (e.g. use of baiting to control wild dogs predation) ▸ Salvage hollow logs and rocky outcrops removed from the Project disturbance footprint into adjoining habitat ▸ Establish buffer zones around known key habitat and den sites ▸ Where possible, avoid clearing within the known habitat during the breeding season ▸ Measures to manage the clearing of hollow logs and hollow bearing trees (e.g. tapping of tree prior to clearing, removal of hollows prior to clearing and grubbing activities). ▸ The following species-specific measures for Swift parrot (*Lathamus discolor*) will also be implemented: ▸ Where possible, through design, reduce the disturbance footprint in winter foraging habitat, including avoiding clearing for ancillary works ▸ Incorporate winter foraging tree species into the landscape design and Reinstatement and Rehabilitation Plan The following species-specific measures for Australian painted snipe (*Rostratula australis*), Curlew sandpiper (*Calidris ferruginea*), Common sandpiper (*Actitis hypoleucos*), Sharp-tailed sandpiper (*Calidris acuminata*), Red-necked stint (*Calidris ruficollis*), Latham's snipe (*Gallinago hardwickii)*, Yellow wagtail (*Motacilla flava*), Glossy ibis (*Plegadis falcinellus*), Pacific golden plover (*Pluvialis fulva*), Common greenshank (*Tringa nebularia*), Marsh sandpiper (*Tringa stagnatilis*) and Australasian bittern (*Botaurus poiciloptilus*) will also be implemented: ▸ Targeted surveys to be undertaken of potential habitat following the *Survey guidelines for Australia's threatened birds* (DEWHA, 2010a, where applicable. ▸ Should the abovementioned species or other target wetland species be found to occur, the CEMP Flora and Fauna Sub-plan will include: ▸ Clearing/construction works in potential habitat areas will be timed, where possible, to avoid wet conditions where habitat is likely to be most suitable ▸ Restricted works/avoidance measures in place should nesting be detected. ▸ The CEMP will include measures to minimise noise as much as feasible and the Air Quality Sub-plan will include measures to minimise dust impacts, including dust monitoring and suppression methods. ▸ The Biosecurity Management Plan will include site hygiene and waste management measures to ensure pest predator fauna are not attracted to works areas or using Project disturbance footprint.

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Conservation significant species [continued]	The following species-specific measures for Collared delma (*Delma torquata*), Condamine earless dragon (*Tympanocryptis condaminensis*), Grey snake (*Hemiaspis damelii*) and Five-clawed worm-skink (*Anomalopus mackayi*) will also be implemented:
		• Targeted pre-construction surveys to be undertaken as per *Survey guidelines for Australia's threatened reptiles* (DSEWPaC, 2011d) where suitable habitat is identified (refer species habitat mapping in Appendix J: Matters of National Environmental Significance).
		• The Flora and Fauna Sub-plan will include restricted works measures for implementation if any of the abovementioned species is observed within or adjacent to disturbance footprint, to allow safe movement away from works area. Other measures may include but are not limited to the following:
		  ◦ Measures to ensure retrieval of potential habitat elements (e.g. loose surface rock, large fallen timber) during vegetation clearing and placement in adjacent unimpacted habitat
		  ◦ Erosion and sediment control measures in steep slopes (known important habitat for collared delma) to avoid/minimise slippages
		  ◦ Measures to allow safe handling of fauna (where required) and repatriation in a suitable habitat away from site.
		• Undertake pre-clearance ground surveys for threatened reptile species where pre-construction surveys have identified the species as occurring or likely to occur (refer species habitat mapping in Appendix J: Matters of National Environmental Significance).
		The following species-specific measures for Red goshawk (*Erythrotriorchis radiatus*), Regent honeyeater (*Anthochaera phrygia*), Painted honeyeater (*Grantiella picta*), Black-breasted button-quail (*Turnix melanogaster*), Glossy black-cockatoo (*Calyptorhynchus lathami lathami*), Powerful owl (*Ninox strenua*), Eastern osprey (*Pandion haliaetus*), Oriental cuckoo (*Cuculus optatus*), Black-faced monarch (*Monarcha melanopsis*), Satin flycatcher (*Myiagra cyanoleuca*), Rufous fantail (*Rhipidura rufifrons*), Spectacled monarch (*Symposiachrus trivirgatus*) and Grey falcon (*Falco hypoleucos*) will also be implemented:
		• Pre-clearing surveys of woodlands identified as potential habitat for the abovementioned species (refer species habitat mapping in Appendix G of EIS Appendix J: Matters of National Environmental Significance) will be undertaken to identify whether individuals occur and potentially nest (red goshawk only) within the disturbance footprint. Surveys for nest sites within or near the disturbance footprint will be as per MNES Guidelines (if applicable) where suitable nesting habitat (i.e. large emergent trees near water) are identified.
		• Where nesting is identified in pre-clearing surveys, the Flora and Fauna Sub-plan will include restricted works measures for construction to allow nesting to continue undisturbed (e.g. micro siting of works to avoid nests or maximise separation distance, 100 m buffer and signage around nests, no disturbance to nests until after breeding season (being until fledglings/offspring no longer use the nest/roost for habitat). Some limited works may occur in the buffer zone during this period (e.g. cultural heritage surveys).

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Conservation significant species [continued]	▸ Use of the primary food source for the Glossy black cockatoo (i.e. Allocasuarina or Casuarina trees) in the rehabilitation works, while also reducing clearing extents in known habitat for the species (e.g. between Ashlands Drive and Lockyer Creek).
		▸ Where key microhabitats cannot be avoided developed protocols/procedures to manage these features, including relocating hollow bearing trees into adjacent habitat and the use of nest boxes, tapping of hollows bearing trees or where possible by lowering trees slowly with a claw extension.
		The following species-specific measures for Koala (*Phascolarctos cinereus*) will also be implemented:
		▸ Avoid works above the tunnel as this area is a key corridor to maintain movement during construction and operation of the Project.
		▸ Pre-clearing surveys to be undertaken of woodlands (and other relevant habitats) identified as potential habitat of species (refer species habitat mapping in Appendix G of EIS Appendix J: Matters of National Environmental Significance) to identify whether individuals occur within disturbance footprint.
		▸ Project design to incorporate fauna crossing structures to allow fauna movement across alignment. The location and frequency of the passages will be based on an understanding of local Koala movements and in consultation with relevant stakeholders (e.g. DTMR and local councils).
		▸ Fauna passage and fencing in accordance with ARTC guidelines and DTMR's Fauna Sensitive Road Design Manual (DTMR, 2010). Fencing extent will be determined by the availability of suitable habitat adjacent to alignment.
		▸ Viaducts and the bridge structures will assist in the retention of corridor(s) of at least 100 m width, while the tunnel will ensure a corridor over 5.5 km width is maintained in the western portion of the Toowoomba Range.
		▸ The Flora and Fauna Sub-plan will include restricted works measures for implementation within or adjacent koala habitat to allow safe movement away from works area. These measures may include the following:
		  ▸ Staged and sequential clearing within koala habitat in areas where koala have been identified as being present (e.g. undertake pre-clearing koala searches on the morning prior to clearing commencing). This will help maintain connectivity during construction
		  ▸ Measures to allow safe handling of koalas (where required) and repatriation in suitable habitat away from site
		  ▸ Requirements for koalas subject to handling to be examined and if suspected of Chlamydia infection be taken to a predesignated veterinarian/wildlife care facility for treatment prior to release
		  ▸ A procedure to guide koala interactions, including any translocations
		  ▸ Appropriate construction traffic speed limits will be established and managed to minimise vehicle strike risk.
		▸ Incorporation of koala trees in landscape design and rehabilitation works, especially along existing corridors that are to be retained (e.g. riparian corridors).

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Conservation significant species [continued]	The following species-specific measures for greater glider (*Petauroides volans volans*) will also be implemented:
		▸ Pre-clearing surveys to be undertaken of woodlands (and other relevant habitats) identified as potential habitat for the species (refer species habitat mapping in Appendix G of EIS Appendix J: Matters of National Environmental Significance) to identify whether individuals occur within disturbance footprint, including potential movement pathways, nest sites (i.e. hollow bearing trees) and feeder trees.
		▸ Where key microhabitats cannot be avoided developed protocols/procedures to manage these features, including relocating hollow bearing trees into adjacent habitat and the use of nest boxes, tapping of hollows bearing trees or where possible by lowering trees slowly with a claw extension.
		▸ Fauna passage and fencing in accordance with ARTC guidelines and DTMR's Fauna Sensitive Road Design Manual (DTMR, 2010). Fencing extent will be determined by the availability of suitable habitat adjacent to the alignment. Also, where possible, avoid the use of barb wire; particularly, on the top strand, to prevent threatened species (particularly greater glider, flying foxes and microbats) from becoming entangled. Fauna-friendly fencing must be used, while being in accordance with landholder and/or structural requirements.
		▸ The Flora and Fauna Sub-plan will include:
		  ▸ Pre-clearing surveys to identify and map out hollow bearing trees, feeder trees and potential movement pathways
		  ▸ Consultation with the Project team and construction team to determine whether key microhabitats can be avoided
		  ▸ Where key microhabitats cannot be avoided, developed protocols/procedures to manage these features, including relocating hollow bearing trees into adjacent habitat and the use of nest boxes, tapping of hollows bearing trees or, where possible, by lowering trees slowly with a claw extension.
		The following species-specific measures for Grey-headed flying-fox (*Pteropus poliocephalus*) will also be implemented:
		▸ Pre-clearing surveys to be undertaken of riparian habitat identified as potential roost sites of species to identify whether camps occur within or near the disturbance footprint. It is noted a roost site that previously supported the species has been identified approximately 540 m from the Project, near Toowoomba. The nearest known roost currently occupied by the species is located 5 km north of the Project (Highfields area).
		▸ Where possible, reduce the disturbance footprint in winter foraging species, including avoiding clearing for ancillary works.
		▸ Incorporate winter foraging species into the landscape design and Reinstatement and Rehabilitation Plan.
		▸ Work with the design team and property team to incorporate fencing that minimises the risk of entanglement (e.g. avoid the use of barbed wire fencing with a high tensile wire strand as the top wire).
		▸ The Flora and Fauna Sub-plan will include measures to be implemented should a roost site be found to occur. These will incorporate the mitigation standards detailed in the Commonwealth's Referral guideline for management actions in grey-headed and spectacled flying-fox camps (Department of the Environment (DotE), 2015c).

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Conservation significant species [continued]	▸ For other species included in the initial impact assessments, review the outcome of additional flora and fauna surveys, and ensure the species-specific measures are appropriately implemented for survey, landscape design, the Reinstatement and Rehabilitation Plan or the Flora and Fauna Sub-plan. ▸ Develop a post-construction monitoring plan. The monitoring plan will be informed by the survey results and developed in consultation with relevant stakeholders. The monitoring plan will define the TEC or other MNES/MSES habitat location, reference condition, assessment framework, infrastructure elements (e.g. erosion and sediment control devices, fauna crossing structures), corrective actions, completion criteria and monitoring timeframes. ▸ Project design to incorporate minimum lighting requirements feasible for Project safety.

	Surface water quality and erosion	▸ The potential for Project works to impact MNES/MSES through erosion, soil loss, land degradation, sedimentation or decreased surface water or groundwater quality, or availability, will be managed through the following:
		  ▸ Soil surveys to further characterise soil conditions across the disturbance footprint, at a suitable scale, to inform detailed design, including appropriate design responses where reactive or problem soils are present or suspected
		  ▸ Contaminated land surveys to inform detailed design and subsequent contaminated land strategy
		  ▸ A Soil Management Plan will be developed to provide the framework for the stripping, storage, treatment and reuse of topsoil
		  ▸ An ESCP will be developed as part of the CEMP, in accordance with the *Best Practice Erosion and Sediment Control* (IECA, 2008). It will include:
		  – Soil/land conservation objectives for the Project
		  – Management of problem soils
		  – Temporary/permanent drainage, erosion and sediment control measures
		  – Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material
		  – Vehicle, machinery and imported fill hygiene protocols and documentation
		  – Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction
		  – Where practical, and/or in accordance with specific flora and fauna management plans, vegetation clearing and ground disturbing works will be staged sequentially across the Project, to minimise areas exposed to erosion and sediment risk of receiving waterways and drainage lines in accordance with the general environmental duty of the EP Act
		  – Measures for minimising the exposure time of unprotected materials to prevent sedimentation of receiving waterways and subsequent impacts to ecological receptors

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Surface water quality and erosion [continued]	– A process for site- and activity-specific preparation when forecast large or high-intensity wet weather events are predicted. This may include, but not be limited to, removing equipment out of riparian zones, stabilising/covering live work areas, additional application of soil binders/veneers and pre event treatment, and dewatering of sediment basins. – Process for the continuous review of effectiveness of erosion and sediment controls ▸ Water quality monitoring requirements, as defined in the Surface Water Sub-plan, to assess the effectiveness of erosion and sediment controls and reinstatement and rehabilitation programs ▸ The ESCP will align with the Reinstatement and Rehabilitation Plan and will include progressive stabilisation of earth materials and soil consolidation to prevent erosion and sedimentation in areas within the disturbance footprint that do not form part of the permanent works (e.g. temporary construction compounds, temporary waterway barrier works, laydown areas, etc.). ▸ A surface water monitoring framework, which will inform the development of the Surface Water Sub-plan and construction water quality monitoring program. It will identify monitoring locations including upstream, downstream and at the intersection of the Project disturbance footprint and watercourse. It will include the relevant water quality objectives (WQOs), parameters, criteria and specific monitoring locations, frequency and duration identified in consultation with relevant regulators to reduce impacts to surface water quality ▸ The Surface Water Sub-plan will establish the construction water quality monitoring program, which will include (as a minimum): ▸ Analysis of the representative background monitoring dataset ▸ Identification of Project works and activities during construction and operation, including runoff, emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways and riparian land (via discharge points) ▸ A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of impacts that trigger contingency and ameliorative measures.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Surface water quality and erosion [continued]	▸ Additional monitoring and sampling required to establish baseline water quality conditions, as a continuation of data collected during the EIS. Baseline water quality conditions will preferentially se water quality monitoring sites used within the EIS, with consideration of construction activities, seasonality and watercourse sensitivity. These will be monitored, at a minimum monthly, for a period of 12–24 months prior to construction to determine baseline conditions as a reference for monitoring of impact (as per *Queensland Water Quality Guidelines* (QWQG)): ▸ Watercourse-specific water quality criteria, based on baseline data, ANZECC/ARMCANZ, QWQG and relevant Water Quality Objectives (WQO) ▸ Frequency and location of surface water sampling during construction of the Project, with consideration for: ▸ Construction activities with potential to impact water quality ▸ Seasonality ▸ Sensitivity of receiving watercourses. ▸ A risk management framework will be prepared for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of instances (including accidental discharge of contaminants and sediments) that trigger contingency and ameliorative measures. ▸ In-situ water quality parameters will be tested (pH, Electrical Conductivity, dissolved oxygen, temperature, Oxidation-reduction Potential and Total Dissolved Solids) and laboratory analysis required for samples collected at each sampling location. ▸ Other parameters to be assessed including biological and geomorphological indicators to provide a holistic approach to the assessment (e.g. riparian condition, characteristics of in-stream habitats): ▸ QA/QC requirements for surface water sampling and analysis ▸ Location-specific impact thresholds ▸ Responses to impact threshold exceedances (to be determined after the establishment of baseline water quality conditions) ▸ Data management and reporting requirements. ▸ Potential aquatic and terrestrial Groundwater Dependent Ecosystems (GDEs) will be field-truthed to confirm presence. ▸ Further geotechnical investigations will be undertaken at deep-cut sections to inform design and location-specific construction management of groundwater. ▸ Risks associated with dewatering (i.e. water table lowering) and environmental management requirements during construction will be identified through appropriate baseline groundwater monitoring, modelling and analysis, and incorporated into the CEMP.

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Riparian vegetation and aquatic habitats	▸ On-groundwater assessment to confirm the statis of all watercourses/waterways under the Water Act and the Fisheries Act which will information design requirements and where applicable approvals.
		▸ Project design minimises impacts to waterways, riparian vegetation and in-stream flora and habitats by:
		  ▸ Adopting a waterway crossing structure hierarchy: bridges/viaducts preferred to culverts, to maintain infrastructure permeability for fauna at identified habitat connectivity points; however, local conditions and constructability impacts must be considered when determining the preferred environmental solution
		  ▸ Avoiding, then minimising the extent and duration of temporary waterway diversions. Where unavoidable, implement water quality, erosion and sediment control measures to minimise impacts to downstream environments and water users
		  ▸ Continuing to refine Project design in response to hydraulic modelling outcomes. This includes addressing flood impact objectives, which include consideration of peak water levels, flow distribution, velocities, and duration of inundation, and implications for fish passage. This will confirm bridge lengths, culvert sizing and numbers, localised scour and erosion protection measures for both rail, road and other permanent Project infrastructure
		  ▸ Avoiding, then minimising the extent of permanent waterway diversions. Where unavoidable, waterway diversion design to include simulation of natural features, e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections and different types of sub-strata, depending on the pre-disturbance environmental values, as per requirements of relevant and applicable conditions of approval, legislation, regulations and industry guidelines. Maintenance activity locations, construction compounds and storage areas will be defined as part of Project detailed design and positioned away from waterways
		  ▸ Stormwater controls, such as scour protection, are to be further developed and incorporated, where necessary, to achieve compliance with established WQOs. Temporary and permanent measures must be appropriate to the site conditions—responding to the erosion risk assessment, environmental receptors, climatic zone and seasonal factors. The ESCP will establish and specify the monitoring and performance objectives for handover to operational management on completion of construction.
		▸ Ensuring the disturbance footprint extents allow sufficient space for provision of the required temporary and permanent erosion and sediment control measures/pollution control measures defined during detailed design.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Riparian vegetation and aquatic habitats [continued]	▸ Undertaking rehabilitation of temporary waterway crossings in accordance with the Reinstatement and Rehabilitation Plan. ▸ Developing ESCPs for implementation during pre-construction, construction and commissioning.
	Water quality	▸ A Surface Water and Hydrology Sub-plan will be developed as a component of the CEMP. The Sub-plan will provide a surface water monitoring framework for the Project that establishes: ▸ Additional monitoring and sampling required to establish baseline water quality conditions, as a continuation of data collected during the EIS. Baseline water quality conditions will preferentially use water quality monitoring sites used in the EIS, with consideration of construction activities, seasonality and watercourse sensitivity. These will be monitored, at a minimum monthly, for a period of 12–24 months prior to construction to determine baseline conditions as a reference for monitoring of impact (as per *Queensland Water Quality Guidelines* (QWQG) (DEHP, 2009)) ▸ Watercourse-specific water quality criteria, based on baseline data, Australian and New Zealand Environment and Conservation Council (ANZECC)/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), QWQG and relevant WQOs ▸ Frequency and location of surface water sampling during construction of the Project, with consideration for: – Construction activities with potential to impact water quality – Seasonality – Sensitivity of receiving watercourses ▸ A risk management framework will be prepared for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of instances (including accidental discharge of contaminants and sediments) that trigger contingency and ameliorative measures ▸ In-situ water quality parameters will be tested (pH, electrical conductivity, dissolved oxygen, temperature, Oxidation-reduction Potential and Total Dissolved Solids) and laboratory analysis required for samples collected at each sampling location ▸ Quality assurance and quality control (QA/QC) requirements for surface water sampling and analysis ▸ Location-specific impact thresholds ▸ Responses to impact threshold exceedances (to be determined after the establishment of baseline water quality conditions). ▸ Data management and reporting requirements.

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Fauna passage[1,2]	▸ Consultation with DTMR regarding the current fauna passage design under the Toowoomba Bypass, noting that DTMR are currently assessing the effectiveness of the structures. Consultation will aim to:
		  ▸ Identify treatments and treatment locations which complement existing measures adopted along the Toowoomba Bypass and avoiding treatments where there is a risk of species being trapped by either project
		  ▸ Design is informed by lessons learnt from the Toowoomba Bypass.
		▸ Refine fauna passage locations and associated rehabilitation areas in the design to maintain infrastructure permeability; particularly, at the key locations identified as part of the EIS assessment process to maintain and/or re-establish habitat connectivity.
		▸ Design of fauna passage structures and associated rehabilitation areas will respond to local topographical and hydrological context, with consideration of safety requirements for the rail corridor and adjoining properties.
		▸ Design bridges and culverts to accommodate terrestrial fauna passage, where assessed as appropriate, in addition to fish passage design requirements.
		▸ Fauna passage design will be consistent with the intent of DTMR's *Fauna Sensitive Road Design Manual* (DTMR, 2010) and, where applicable, species specific requirements.

	Fauna fencing[1,2]	▸ Consultation with DTMR regarding the current fauna fencing on the Toowoomba Bypass project to confirm:
		  ▸ Whether the existing fauna fencing will need to be removed/relocated
		  ▸ What temporary measures will be required during construction to manage fauna impacts from the Toowoomba Bypass
		  ▸ Where fencing design can complement the existing fauna design measures implemented along the Toowoomba Bypass
		  ▸ Where fencing should be reinstated between the two projects.
		▸ Fauna fencing opportunities will be further assessed and, where appropriate, developed during detailed design to limit fauna strike and fauna mortality risk and/or maintain habitat connectivity. This will include:
		  ▸ Assessment of the compatibility of each approach for the targeted local species with the general fencing principles at each proposed fencing location
		  ▸ Consideration of safety requirements for the rail corridor and adjoining properties
		  ▸ Consultation with adjoining landholders
		  ▸ Requirements for maintaining an appropriate clearance buffer between adjacent vegetation and fauna fences
		  ▸ Consideration for maintenance constraints and responsibilities that a fauna connectivity or fencing opportunity may introduce to operations.
		▸ Fauna fencing will be designed with reference to the *Fauna Sensitive Road Design Manual* (DTMR, 2010). Additional expert guidance in relation to specific design features will be sought during the detailed design process.
		▸ The design will aim to maximise infrastructure permeability by connecting fauna fencing with safe crossing opportunities.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Aquatic fauna	▸ Design watercourse crossing structures (including culverts and bridges) to maintain fish passage, where applicable, in accordance with *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b) or conditions of development approval for operational work that is constructing or raising waterway barrier works. ▸ The design will aim to minimise the need for ongoing maintenance and inspection to maintain fish passage. ▸ Develop a dewatering strategy in accordance with the Biosecurity Act, providing reasonable measures to avoid the spread of pest species and in accordance with any required aquatic fauna species management plans and WQOs defined in the outline CEMP. ▸ Where a temporary impoundment or diversion is required for construction purposes, and the species is found to be present, the Flora and Fauna Sub-plan will include requirements for an appropriately qualified person to be consulted to make an assessment on the method of recovery, transport and release of fish. The Flora and Fauna Sub-plan will include requirements for the application of relevant DAF fish salvage guidelines during construction activities. ▸ The Biosecurity Management Plan will include measures to manage the risk of translocating non-endemic flora and fauna through dewatering and fish salvage activities.

	Flora and fauna (general)	▸ Surveys of representative remnant and regrowth vegetation communities that will be impacted by the Project will be undertaken during the detailed design phase in accordance with the *Guide to determining terrestrial habitat quality - Methods for assessing habitat quality under the Queensland Environmental Offsets Policy Version 1.3* (DES 2020g) to enable a condition assessment of vegetation communities that require offset for the Project.
		▸ Identify and engage with veterinarian/wildlife care facilities to verify the capacity to support the construction of the Project, including constraints associated with the facility.
		▸ Develop the Flora and Fauna Sub-plan to include appropriate criteria, directives and procedures in relation to:
		  ▸ Pre-clearing surveys, including terrestrial, aquatic and wetland habitats, protected plants, breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures, riparian habitat identified as potential roost sites) for both threatened and non-threatened species by suitably qualified persons
		  ▸ Staged and sequential clearing protocols, which will help maintain connectivity during construction
		  ▸ Signage requirements for the delineation of no-go areas and clearing extents, including avoiding works above the tunnel, as this area is a key corridor to maintain movement during construction and operation of the Project
		  ▸ Animal handling protocols, including relocation and emergency care and where applicable engagement of an approved fauna handler with a valid damage mitigation permit. For example, koalas subject to handling will be examined and, if suspected of Chlamydia infection, will be taken to a predesignated veterinarian/wildlife care facility for treatment prior to release
		  ▸ Provide a list and contact details for veterinarian/wildlife care facilities relevant to the Project

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Flora and fauna (general) [continued]	▸ Works protocols to allow safe movement away from works area, should other fauna be observed within or adjacent to the works area ▸ Requirements for inspections and corrective actions during construction and rehabilitation activities ▸ Requirements for fauna and flora management actions to be undertaken by suitably qualified persons ▸ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction ▸ Where feasible and practicable, locate construction areas, including compounds, stockpiles, fuel storage, laydown areas and staff parking outside the tree protection zone, as defined in AS4970:2009—*Protection of trees on development sites* (Standards Australia, 2009b). ▸ Where practical, existing tracks will be used and the design for new access tracks (permanent and temporary) will be undertaken with the aim of minimising disturbance of substrate and vegetation.
	Weeds and pests	▸ Develop the Biosecurity Management Plan[1,2,3] to include: ▸ Requirements for pre-clearing surveys in areas within and immediately adjacent to the Project disturbance footprint, to determine the risk of environmental weeds and pests, including prohibited and restricted matters prescribed under the Biosecurity Act and Biosecurity Regulation 2016, along with weeds of concern to the relevant council being present ▸ Relevant guidelines to control potential deleterious pathogens including *Phytophthora cinnamomi* and Myrtle rust (e.g. DotE, 2015b) associated with Project activities, both of which may impact Melaleuca and eucalypt species ▸ Revegetation species to be obtained from source certified free of *Phytophthora cinnamomi* ▸ Mapping of the existing extent and severity of any weed infestation and weed management requirements in the disturbance footprint or on adjacent land, (restricted matters including Small-leaved privet, Opuntioid cactus, and Lantana species) ▸ Pest animal management including red imported fire ant management within the Biosecurity Zones 1 and 2, as per current DAF advice ▸ Weed surveillance and treatment during construction and rehabilitation activities ▸ Vehicle and plant washdown protocols when traversing properties via temporary access tracks or if any high-risk areas are identified during the Project construction ▸ Requirements in relation to pesticide and herbicide use and documentation, recognising the *Agricultural Chemicals Distribution Control Act 1966* (Qld) (ACDC Act) requirements including any limitations on use, such as: restrictions on use in sensitive environmental areas; drainage lines that flow to waterways and aquatic habitats; and ensuring that broad-scale use does not result in an increased erosion and sediment risk

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Weeds and pests [continued]	▸ Vehicle and plant equipment, and imported fill hygiene protocols and documentation ▸ Erosion and sediment control risks associated with broad-scale weed removal or treatment ▸ Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material ▸ Consideration of local government Biosecurity Plans (*Toowoomba Region Biosecurity Plan* (TRC, 2020)) ▸ Dewatering and fish salvage requirements to manage the risk of translocating non-endemic flora and fauna ▸ Requirements for monitoring the effectiveness of weed hygiene measures ▸ Property-specific weed hygiene requirements will be developed in consultation with the relevant landowners/operators prior to pre-construction/construction activities occurring on that property, outside of the Project's permanent footprint. Protocols, where agreed, will be documented in individual property management agreements ▸ Align treatments with works being undertaken by council and local landholders. ▸ Develop the Community Engagement Sub-plan in the CEMP to enable members of the public to assist with weed surveillance in the vicinity of Project works. Also provide measures to inform landholders of proposed treatments and risks to public health.
	Rehabilitation	▸ Landscape design establishes the requirements for rehabilitation of disturbed areas for habitat re-creation, landscaping and stabilisation, including for riparian zones, and informs the development of the Reinstatement and Rehabilitation Plan and the Landscape and Rehabilitation Management Plan[1,3]. This will also include criteria for retrieval of potential habitat elements (loose surface rock, large fallen timber) during vegetation clearing for habitat recreation, where appropriate. ▸ Develop a Reinstatement and Rehabilitation Plan for areas within the disturbance footprint that do not form part of the permanent works (e.g. construction compounds, laydown areas, temporary access tracks, etc.). The Plan will include and clearly identify: ▸ Location of areas subject to rehabilitation and/or reinstatement/stabilisation, in accordance with the landscape and rehabilitation design developed during detailed design, including operational rail safety considerations ▸ Objectives and timeframes for rehabilitation and/or reinstatement/stabilisation works (including biodiversity, vegetation establishment, and erosion and sediment control outcomes to be achieved) ▸ Where appropriate, the plan describes how the objectives align with relevant recovery plans, threat abatement plans, conservation advices or policy guidance for target species in areas identified for rehabilitation ▸ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the Reinstatement and Rehabilitation Plan objectives

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Rehabilitation [continued]	▸ Native flora species endemic to the Toowoomba region or other suitable species appropriate to the landscape context and nursery/seed stock sources. Where possible (i.e. propagated material is available) include threatened species (e.g. *Sophora fraseri*) in rehabilitation activities. ▸ Incorporate koala trees in landscape design and rehabilitation works, especially along existing corridors that are to be retained (e.g. riparian corridors) ▸ Consideration for maintenance or performance issues of rehabilitation e.g. vegetation that does not grow and obscure signals or impact the longevity of rail infrastructure ▸ Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas. For example, where temporary construction facilities are required, land will be returned to a stable condition in accordance with the landholder agreements ▸ Include rehabilitation requirements such as: – Milling and removal of bitumen pavement – Removal of any decommissioned culverts – Tyning and ripping of base and sub-base material – Application of soil ameliorants – Topsoiling and/or compost blanket – Stabilisation and rehabilitation (e.g. planting and or seeding) – Near fauna passage structures ▸ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved ▸ A Landscape and Rehabilitation Management Plan will be developed to define post-construction maintenance requirements, monitoring requirements and completion criteria for areas defined in the landscape design and/or identified in the Reinstatement and Rehabilitation Plan.
	Offsets[1,2]	▸ Restriction of the Project disturbance footprint through detailed design, as far as practical, to that required to safely and efficiently construct and operate the Project.[1,2,3] In doing so, areas of MNES/MSES and their associated habitat will be avoided, thereby minimising significant adverse residual impacts to MNES/MSES. ▸ Significant adverse residual impacts to habitat for threatened species will be re-calculated to confirm the Project's offset obligations under Australian Government and Queensland Government requirements based on the outcomes of the flora, fauna and threatened species habitat surveys. ▸ A Project offset delivery plan and offsets management plans will be developed to provide for the staged delivery of offsets, where appropriate, ahead of relevant clearing works being undertaken and finalised in consultation with relevant Australian Government and State regulatory agencies (refer Appendix I within EIS Appendix J: Matters of National Environmental Significance).

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction	Flora and fauna	▸ Implement the Flora and Fauna Sub-plan. ▸ Undertake pre-clearing surveys in any areas to be cleared to enable pre-construction activities and confirm the species-specific works protocols to be implemented. ▸ Document the area and type of vegetation cleared in a post clearance summary, including the relevant MNES/MSES for offsetting and compliance purposes. ▸ Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways or watercourses particularly during periods of flow. ▸ Protected plant surveys, in accordance with the requirements of the NC Act, will be undertaken as required in support of pre-construction enabling works. Such works may include additional geotechnical investigations to confirm the viability of borrow pit locations or re-fencing works. ▸ Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined with flagging or marking tape. 'No go' areas will also be marked. ▸ Engage with local wildlife carers and vets regarding their capacity to support the constriction of the Project.
	Landscape, rehabilitation and stabilisation	▸ The Reinstatement and Rehabilitation Plan will guide the approach to rehabilitation and be implemented progressively during pre-construction and construction phase activities.
	Weeds and pests	▸ Implement the Biosecurity Management Plan during pre-construction to reduce the potential for the spread of weeds and pests into the surrounding environments and land uses Where possible, complement this work with works being undertaken by local landholders, other stakeholders and council. ▸ Continue to monitor infestations identified during the pre-construction survey works and treat where applicable.
	Erosion and sediment control	▸ Specify appropriate site stabilisation treatments, including seeding and planting requirements, in the ESCPs and Reinstatement and Rehabilitation Plan.
Construction	Flora and fauna (including MNES)	▸ Project clearing extents are limited to that which is required to safely construct, operate and maintain the Project, in accordance with the approved disturbance footprint. ▸ Locate temporary construction facilities compounds, stockpiles, fuel storage, laydown areas, temporary access roads and staff parking to minimise the extent of disturbance on existing habitat and significant vegetation (i.e. undertake micro-siting of these temporary activities and facilities). ▸ Appropriate construction traffic speed limits will be established and managed to minimise vehicle strike risk. ▸ Clearly define clearing boundaries associated with the construction disturbance footprint with flagging or marking tape, signage or other suitable means to delineate no-go areas Undertake this delineation and marking process in a manner that is consistent with the Project flagging/marking tape process and specifications, to ensure that it is consistent with the wider Project control processes and does not conflict or contradict any other demarcation practices.

Delivery phase	Aspect	Proposed mitigation measures
Construction	Flora and fauna (including MNES)	▸ Staged and sequential clearing, where feasible, to minimise the extent of exposed areas and maintain connectivity during construction. Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species.[1] ▸ Staged works so that they avoid animal breeding periods as much as possible within known areas of habitat (large watercourses). ▸ A qualified Fauna Spotter Catcher will undertake pre-clearance surveys of habitats and vegetation, including fauna reduction activities, where applicable. The Fauna Spotter Catcher will supervise the subsequent clearing. The area and type of vegetation cleared will be documented, where required, for compliance with secondary approvals and offset purposes.[1,2,3] ▸ Implement the Post-Construction Monitoring Plan. Continue monitoring each nominated threatened species against initial assessment values, until completion criteria are achieved. Corrective actions to be implemented where Project-associated impacts are identified. ▸ Implement Air Quality Sub-plan to minimise dust impacts, including dust monitoring and suppression methods.

	Riparian vegetation and aquatic habitats	▸ Locate construction areas including compounds, stockpiles, fuel storage, laydown areas, temporary and permanent access roads within the disturbance footprint.
		▸ Undertake a flood/drainage assessment to inform the siting and scale of temporary construction areas (including stockpiles, construction compounds, fuel storage and laydown areas, etc.). Locate these areas on land that is not subject to flooding to the extent possible.
		▸ Siting of plant and equipment and refuelling facilities to be undertaken in accordance with *AS1940:2017—The storage and handling of flammable and combustible liquids* (Standards Australia, 2017).
		▸ Implement the site-specific ESCPs.
		▸ Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank.
		▸ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species.[1]
		▸ Works within or adjacent to watercourses will be conducted in accordance with relevant secondary approvals, including:
		  ▸ *Riverine protection permit exemption requirements* (WSS/2013/726) (Department of Natural Resources, Mines and Energy, 2019b) or conditions of a riverine protection permit issued for the Project
		  ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b) or conditions of development approval for operational work that is constructing or raising waterway barrier works.
		▸ Dewatering/extraction of water from artificial impoundments will be undertaken after consultation with relevant stakeholders.
		▸ Dewatering strategies will be required to comply with the Biosecurity Act to take reasonable measures to avoid the spread of pest species (with capacity to affect water quality) and in accordance with any required aquatic fauna species management plans.

Delivery phase	Aspect	Proposed mitigation measures

Construction [continued]	Riparian vegetation and aquatic habitats [continued]	▸ The salvage and relocation of fish in isolated aquatic environments will be managed in accordance with the *Guidelines for Fish Salvage* (DAF, 2018d).
		▸ An appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and other aquatic fauna, as required. As a minimum, the following will be implemented:
		  ▸ Relocation will be undertaken by a suitably qualified person
		  ▸ Dewatering pumps will have an intake screen
		  ▸ Records of all fish recovered, and the location of their release, will be maintained.
		▸ In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.[1]

	Flora	▸ Minimise clearance of remnant vegetation to that necessary for safe and efficient construction and operation.[1,2,3] ▸ Where practicable and feasible, locate construction areas including compounds, stockpiles, fuel storage, laydown areas, staff parking outside the tree protection zone, as defined in AS4970:2009—*Protection of trees on development sites* (Standards Australia, 2009b). ▸ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species. ▸ Implement a Soil Management Plan as part of the CEMP, guiding the stripping, stockpiling and management of topsoil where it has the potential to contain seedbank or weed material. ▸ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora. ▸ Plan and implement revegetation and rehabilitation works so that they do not create safety, maintenance or performance issues, e.g. vegetation does not grow and obscure signals or impact longevity of rail infrastructure.
	Aquatic fauna	▸ Construct temporary and permanent watercourse crossing structures in accordance with the detailed design and *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b) or conditions of development approval for operational work that is constructing or raising waterway barrier. This is required to minimise impacts to aquatic fauna (i.e. fish passage) and hydrology during construction and operation.
	Fauna passage	▸ Where incorporated in the final design, fauna movement opportunities will be constructed to reinstate safe fauna passage as soon as possible, in accordance with a fauna movement strategy, which will be finalised and documented in the detailed design.
	Fauna fencing	▸ Install fauna exclusion fencing in accordance with detailed design and fencing hierarchy, especially in conjunction with the identified fauna passages/creek crossing locations for the Project to maintain permeability in the alignment.[1,2]

Delivery phase	Aspect	Proposed mitigation measures
Construction [continued]	Weeds and pests	▸ Implement the Biosecurity Management Plan during construction to reduce the potential for the spread of weeds and pests into the surrounding environments and land uses. ▸ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the Project. ▸ Any vegetated material containing, or with the potential to contain, weed seed material will not be used for onsite mulching or erosion protection.[1,2] ▸ Implement the Community Engagement Sub-plan in the CEMP, to enable members of the public to assist with weed surveillance in the vicinity of Project works.

	Erosion and sediment control	▸ Vegetation clearing and ground-disturbing activities will be supplemented by the progressive installation of erosion and sediment controls, including stabilisation works to minimise areas exposed to erosion and sediment risk.
		▸ Implement site stabilisation treatments in accordance with:
		  ▸ ESCP
		  ▸ Air Quality Sub-plan
		  ▸ Reinstatement and Rehabilitation Plan.
		▸ Assess the suitability of cleared vegetation for mulching/erosion protection on a case-by-case basis. Any vegetated material containing, or with the potential to contain, weed seed material will not be used for onsite mulching or erosion protection without prior treatment. For any unsuitable material, i.e. noxious weeds etc., the cleared and grubbed material must be removed from the site and disposed of in accordance with relevant statutory requirements and the Biosecurity Management Plan.
		▸ Re-use suitable mulch generated by construction of the Project within appropriate timeframes and manner as specified in the ESCP and the Reinstatement and Rehabilitation Plan.

	Landscape, rehabilitation and stabilisation	▸ Construct landscaping treatments in accordance with the landscape design. ▸ Implement the Soil Management Plan to protect threatened species (e.g. soil seedbanks and habitat). ▸ Undertake progressive rehabilitation and reinstatement of disturbed areas in accordance with the Reinstatement and Rehabilitation Plan and the Landscape and Rehabilitation Management Plan to minimise threatening processes such as weed invasion and erosion.

Table notes:

1. Mitigation measure successfully implemented as part of the Toowoomba Second Range Crossing Project
2. Mitigation measure approved by the Commonwealth as part of the rail component for the Carmichael Coal Mine and Rail Project (EPBC 2013/6885) (refer measures within Species Management Plans. Carmichael Rail Project (Carmichael Rail Project, 2019))
3. Mitigation measure commonly applied across other projects, as approved by the Commonwealth in central and southern Queensland, e.g. Santos Significant Species Management Plan—GFD Project (Santos, 2016), Anya Significant Species Management Plans (Shell, 2017), Species Management Plans—Carmichael Rail Project (CRN, 2019).

23.15.4.3 Monitoring

ARTC is committed to implementing ongoing monitoring of the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified environmental values are observed, or are not minimised, as per the objectives of the proposed mitigation measures.

Requirements for monitoring will be documented in the following plans that will support the CEMP:

- Flora and Fauna Sub-plan
- Biosecurity Management Plan

- Matters of National Environmental Significance Monitoring Plan
- Reinstatement and Rehabilitation Plan
- Post-construction MNES Monitoring Plan.

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP sub-plan will be captured in the processes identified in Section 23.9.

23.15.5 Air quality

23.15.5.1 Environmental outcomes

Design and construction of the Project is undertaken in a manner that minimises air quality impacts; specifically, impacts to the following environmental values, which are relevant for the construction of the Project:

- The qualities of the air environment that are conducive to human health and wellbeing
- The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property.

23.15.5.2 Performance criteria

The air quality goals applicable to the construction phase of the Project are presented in Table 23.9.

TABLE 23.9: PROJECT AIR QUALITY GOALS

Pollutant	Air quality goal (µg/m^3)	Averaging period	Environmental value
Total suspended particulates (TSP)	90	Annual	Health and wellbeing
Particulate matter (PM_{10})	50	24 hours	Health and wellbeing
	25	Annual	Health and wellbeing
Dust deposition	120 mg/m^2/day	Monthly[a]	Protecting aesthetic environment

Table notes:
µg/m^3 = micrograms per cubic metre
mg/m^2/day = milligram per square metre per day
a. Dust deposition is assessed as the insoluble solids component of deposited dust

23.15.5.3 Proposed mitigation measures

Relevant environmental aspects, and proposed mitigation and management measures, for the detailed design, pre-construction and construction and commissioning phases of the Project are presented in Table 23.10.

TABLE 23.10: MITIGATION MEASURES—AIR QUALITY

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Availability of water for dust suppression and stabilisation during construction	Prior to construction, quantities of water required for dust suppression, construction, landscaping and stabilisation activities will be confirmed. The availability and suitability of water supply sources will be determined and, where water supply is deemed insufficient or in high demand for other uses, other dust suppression and stabilisation methods will be implemented.
	Fugitive dust emissions (windborne erosion) during construction and operation	Detailed design will aim to avoid increasing the disturbance footprint for the Project. Laydown areas and other construction-phase facilities will be designed and arranged to minimise emissions and reduce the potential for impacts to air quality. Design considerations will include the locations of stockpiles, activity areas, travel routes, rumble grids and truck washdown areas, etc. The location of the permanent spoil mound at the western tunnel portal laydown area will consider proximity to sensitive receptors and allowance for mitigation measures (e.g. profiling and stabilisation of stockpile and maximising separation distance from nearest sensitive receptors (noting that the stockpile may also buffer other amenity issues)). Earthworks and landscape design of railway batters and other exposed surfaces will be designed to incorporate treatments and enable stabilisation, to reduce wind erosion.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Emissions from refuelling activities during construction	Design of fuel storage areas will ensure that fuel tanks will be located at least 50 m from the nearest sensitive receptor, with separation distances maximised as far as practical within site restrictions.
	Emissions from operation of batching plants	Design the laydown area at the eastern tunnel portal (G2H-LDN010.5) such that the concrete batching plant (if required) can be located at a position at least 500 m from the nearest sensitive receptor.
	Emissions reporting requirements	Emissions reporting requirements for the construction phase will be confirmed during detailed design and respond to NGERS requirements and the Sustainability Management Plan.
Pre-construction and construction	Dust generation from pre-construction activities	Vehicle travel on unsealed roads will be minimised as far as practical. Sealed roads will be used where possible. Disturbed areas will be rehabilitated and stabilised as soon as practical upon completion of works. Vehicles and mobile plant will minimise idling as much as practical.
Construction and commissioning	Dust generation from earthworks, clearing and grubbing, construction activities and exposed areas within the Project disturbance footprint	Limit clearing to the disturbance footprint as identified during the detailed design constructability assessment and planning. Limit clearing to that required to safely construct and operate the Project. Where practical, stage clearing and grubbing, and construction activities to limit the size of exposed areas. Implement water sprays to reduce dust emissions from excavation or disturbance of soils or vegetation, or handling ballast. Implement water sprays to reduce dust emissions from trucks unloading material (anticipated emission reduction of 70 per cent). Implement water sprays to reduce dust emissions for mobile plant loading to or from material stockpiles (anticipated emission reduction of 50 per cent). To reduce wind erosion from stockpiles, the following mitigation methods are proposed subject to water availability and stockpile activity: ▸ Water sprays (anticipated emission reduction of 50 per cent) ▸ Wind breaks or earthworks profiling (anticipated emission reduction of 30 per cent) ▸ Application of rock armour/covering (anticipated emission reduction of 30 per cent), or covering of the stockpile with an impermeable covering (i.e. tarpaulin) or binding agent (anticipated emission reduction of 100 per cent). If water sprays are implemented for stockpiles, the application rate of water will be increased for stockpiles that will receive new material regularly, such as tunnel excavation stockpiles. Disturbed areas and exposed surfaces will be stabilised as a soon as practical. The following mitigation methods will be used subject to final purpose of the exposed area: ▸ Initial establishment of vegetation (anticipated emission reduction of 30 per cent) ▸ Maintained revegetation (anticipated emission reduction of 90 per cent) ▸ Establishment of self-sustaining rehabilitation vegetation (anticipated emission reduction of 100 per cent) ▸ Sealing of exposed surface (i.e. concrete, asphalt, etc.) (anticipated emission reduction of 100 per cent).

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Dust generation from earthworks, clearing and grubbing, construction activities and exposed areas within the Project disturbance footprint [continued]	Long-term stockpiles will be avoided where possible; however, where necessary (e.g. topsoil), long-term stockpiles will be established in locations with suitable separation from sensitive receptors and not in the path of prevailing winds (which would transport dust towards sensitive receptors). During periods of inactivity, stockpiles will be covered with an impermeable covering (i.e. tarpaulin) or binding agent (anticipated emission reduction of 100 per cent). Establish and communicate the protocol for notifying relevant stakeholders when potentially dust-generating activities (e.g. blasting) are planned to be carried out, with contact details for queries or complaints. Monitor air quality during construction of the Project, and report and audit monitoring results as discussed in Section 23.15.5.4. Monitor, record and audit complaints about dust and emissions in accordance with the Complaint Management Handling Procedure described in Section 23.13 and the requirements of the Social Impact Management Plan.
	Emission from blasting	Do not undertake blasting during wind conditions that are likely to transport dust emissions toward sensitive receptors within 500 m of the blasting location.
	Emissions from refuelling activities	Fuel storage areas will be located at least 50 m from the nearest sensitive receptor, with separation distances maximised as far as practical within site restrictions.
	Emissions from combustion engines (construction vehicles and generators)	Construction plant, vehicles and machinery will be maintained and operated in accordance with manufacturer's recommendations. Vehicles and mobile plant will minimise idling as much as practical. Diesel generators will be avoided where practical. Where required, generators will be located as far as possible from sensitive receptors.
	Use of non-potable water for dust suppression	Water used in dust suppression will be of suitable quality and not result in environmental or human health risks, or impact rehabilitation outcomes. Water additives used to improve dust suppression effectiveness (e.g. the addition of soil binders to water for dust suppression on roads or hard stand areas, which has an anticipated control efficiency of 100 per cent) will be risk assessed prior to adoption.
	Dust generated by traffic on access tracks	To reduce emissions from vehicle travel on unsealed roads, the following measures will be implemented for haul roads with receptors located within 350 m of the road: ▸ Level 1 road watering (2 litres per metre squared per hour (L/m^2/h)) (anticipated emission reduction of 50 per cent) ▸ Level 2 road watering (greater than 2 L/m^2/h) (anticipated emission reduction of 75 per cent) ▸ Road sealing with binding agent or asphalt (anticipated emission reduction of 100 per cent).
	Fugitive dust emissions from vehicles transporting materials to and from site	Vehicles transporting potentially dust and/or spillage-generating material to and from the construction site will have their loads covered immediately after loading (prior to traversing public roads). Rumble grids and the operation of truck washdown areas will be maintained to reduce trackout of material onto public roads where it may become resuspended. Site-based construction traffic is limited to identified haul routes as per the Project Construction Traffic Management Plan.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Cumulative effects of dust emissions from construction and external land uses or activities	Sensitive receptors near the existing Harlaxton Quarry may be impacted by the operation of the quarry and the construction phase of the Project. The cumulative impact of both sources on sensitive receptors, and the effectiveness of the proposed mitigation measures for Project construction activity near the quarry, will be monitored via visual monitoring and air quality monitoring, as discussed in Chapter 12: Air Quality. In the event of validated complaints or measured exceedances of the Project air quality goals, enhanced mitigation will be implemented. Project construction activities to be undertaken near the quarry that have the highest potential to generate air emissions include excavation works, blasting and vehicle travel on unsealed roads.
	Dust generation and deposition as a result of adverse weather conditions	Avoid ground-disturbing activities including excavation and vegetation clearing during windy conditions (e.g. winds > 36 km/hr or 20 knots), where practical. When avoidance of ground-disturbing activities is not practical, implement enhanced management measures, such as: ▸ Increased rate of water application to haul roads (e.g. increase to Level 2 watering (at a rate of greater than 2 litres per square metre per hour) (>2 $L/m^2/hr$) ▸ Increased rate of water application to excavation and clearing areas ▸ Implement temporary stabilisation (binding agent) to access tracks and haul roads (anticipated emission reduction of 100 per cent). Where possible, stockpiles will be covered (anticipated emission reduction of 100 per cent) prior to the onset of adverse weather.

23.15.5.4 Monitoring and reporting requirements

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP Sub-plan will be captured in the processes identified in Section 23.9. Emissions reporting during construction (e.g. NGER and reporting against Sustainability Management Plan targets) will be undertaken, where applicable.

In addition, this section describes how the Project will monitor, report and audit compliance with the Project air quality objectives.

Construction phase—weather conditions monitoring

To aid in the avoidance of dust generation during adverse weather conditions, weather forecasts and observations for adverse weather (e.g. winds greater than 36 km/h) will be observed during the construction phase of the Project using existing Bureau of Meteorology weather stations.

To assist with auditing and the analysis of air quality monitoring and complaints (if received), periods of adverse weather periods will be recorded in monthly environmental reports.

Construction phase—air quality monitoring

Visual and quantitative air quality monitoring will be undertaken for the construction phase of the Project.

Visual monitoring of dust generation (visible plumes) will be undertaken throughout construction. Daily onsite inspections of dust generation will be undertaken by construction staff to monitor dust being generated onsite, to inform mitigation measures. In addition, weekly offsite inspection will be undertaken at sensitive receptors located near high-intensity construction areas such as heavily trafficked haul roads, excavation areas and laydown areas. Visual monitoring will include checks of dust deposition on horizontal surfaces such as cars and windowsills. Visual monitoring will be the responsibility of the construction contractor.

Quantitative air quality monitoring will be undertaken via monitoring of dust deposition. Dust deposition monitoring will be undertaken at sensitive receptor locations near the Harlaxton Quarry, which have the potential to be impacted by emissions from the construction phase of the Project and emissions from the operation of the quarry.

Selection of the exact locations for the installation of dust deposition gauges will be undertaken by a suitably qualified air quality professional. The monitoring locations will be demarcated and sign posted.

In the event that dust deposition monitoring determines exceedance of the Project's air quality goal (120 milligrams per square metre per day (mg/m^2/day) at sensitive receptors, additional monitoring, including monitoring of airborne particulate concentrations (e.g. TSP or PM_{10}), may be required. If legitimate air quality complaints are received from locations that are not represented by the location of air monitoring stations, additional monitoring stations may be deployed.

In the event that dust deposition or airborne air quality monitoring determines exceedance of the Project's air quality goals, corrective actions will be implemented to mitigate impacts and minimise the risk of further exceedances. Corrective actions will be the responsibility of the construction contractor; however, as a minimum, the corrective actions will include the following:

- Review of the air quality monitoring data to determine the period/s of exceedance
- Review of Project and non-Project related emission sources, which may have been responsible for, or contributed to, the measured exceedance
- On identification of Project-related emission source, undertake a review of the mitigation measures implemented at the time when the exceedance was recorded
- Evaluate the effectiveness of mitigation measures and standard working procedures, and adjust or enhance the application of mitigation measures to reduce construction emissions and minimise the risk of future exceedances
- Monitor the effectiveness of enhanced mitigation measures and, if required, reduce the intensity of construction works.

Air quality monitoring data and logs of visual monitoring inspections will be included in the monthly environmental monitoring reports prepared by the construction contractor.

Operational phase—air quality monitoring

Quantitative air quality monitoring will be undertaken during the operational phase at a location(s) (yet to be determined) along the Queensland section of the Inland Rail Program. As the rail network manager, ARTC would be responsible for providing support and funding for air quality monitoring.

Requirements for the air quality monitoring station, including the location of any monitoring stations, will be discussed with the stakeholders of the South West Supply Chain, including DES and DTMR. It is expected that the pollutant species monitored will include dust deposition and airborne concentrations of PM_{10} and TSP, and that the monitoring station will be generally equivalent in nature to the existing monitoring stations operating as part of the South West Supply Chain *Coal Dust Management Plan* (2019).

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

In the event of complaints being received regarding air quality, appropriate response and monitoring may occur following investigation into the complaint.

In the event that exceedances of the Project's air quality goals are measured during the operational phase, corrective actions will be required to mitigate impacts and minimise the risk of further exceedances. Requirements for corrective actions will be discussed with the stakeholders of the South West Supply Chain; however, corrective actions that may be undertaken include:

- Review of the air quality monitoring data to determine the period/s of exceedance
- Review of Project and non-Project related emission sources, which may have been responsible for, or contributed too, the measured exceedance
- Upon identification of Project-related emission sources, undertake a review of operational activities at the time when the exceedance was recorded
- Evaluation of the effectiveness of mitigation measures and standard operational procedures with respect to the potential for future exceedances.

In addition to monitoring adjacent the rail line, in-tunnel air quality monitoring data will also be used to audit compliance with in-tunnel air quality goals.

Operational phase—emissions reporting

Emissions reporting will be undertaken where applicable. Emissions reporting requirements will be determined during the detailed design phase to be consistent with the Infrastructure Sustainability Council of Australia (ISCA) and NGER requirements.

23.15.6 Surface water and hydrology

23.15.6.1 Environmental outcomes

Project works are designed to minimise the use of water resources and maximise the opportunities for re-use of suitable water from the construction site.

Discharge of surface water from construction sites does not adversely affect the environmental values of receiving water and habitats.

Project works are designed to achieve the flood criteria established for the Project at flood sensitive receptors.

23.15.6.2 Performance criteria

- Steps are taken to investigate and maximise the use of water collected onsite, including use of water captured in sediment basins and from the tunnel construction activities.
- Use of potable water is minimised where possible.
- Project works are undertaken in accordance with the ESCPs (refer Section 23.15.2.2).
- Project works are planned and staged to minimise the potential for adverse impacts on existing water flows and/or flooding profiles.
- Water released from construction sites to receiving waters complies with the Environmental Protection Policy (Water and Wetland Biodiversity) 2019 and the relevant environmental values and corresponding WQOs as outlined in the following documents:
  - The relevant environmental values and WQOs are outlined
  - Murray-Darling Basin environmental values and water quality objectives (DES, 2018b).
  - *Healthy Waters Management Plan: Condamine River Basin* (Department of Environment and Science (DES), 2019e),
  - Lockyer Creek environmental values and water quality objectives (DERM, 2010a).
  - ANZECC/ARMCANZ 2000/2018 guidelines.
- Stormwater discharges released from the construction worksites to receiving surface waters will comply with goals established in the CEMP at the nominated discharge points.
- Project works will not cause adverse flooding impacts at flood sensitive receptors (including but not limited to existing dwellings, sheds, farm buildings and infrastructure, crops and roads in the vicinity of the Project) up to and including the 1% AEP flood event.

23.15.6.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.11.

TABLE 23.11: MITIGATION MEASURES—SURFACE WATER

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Erosion and sediment control	▸ Develop a Soil Management Sub-plan that includes the following procedures and protocols relevant to potential impacts on land resources: ▸ Soil/land conservation objectives for the Project ▸ Management of problem soils, such as: – The high naturally occurring sodicity of sodosols predominantly found east of the GDR escarpment – Vertosols cracking clays predominantly found west of the GDR escarpment – Saline soils, particularly in high salinity hazard areas such as the Lockyer Valley. ▸ Specification of the type and location of erosion and sediment controls. The erosion and sediment control measures will be developed by a CPESC and be in accordance with the IECA *Best Practice Erosion and Sediment Control* (2008). The Soil Management Sub-plan will include: – Locations for specific temporary/permanent erosion and sediment control measures, such as: ▸ Sediment retention basins ▸ Scour protection (included in the reference design) ▸ Sediment fencing ▸ Berms and other surface flow diversions: – Nomination of location-specific erosion controls will include consideration of site conditions, proximity to environmental receptors, adjoining land uses, climatic and seasonal factors, and will be based on an erosion risk assessment – Minimise the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the rail corridor – Scheduling of works with consideration to periods of higher rainfall (summer months) – Establish and specify the monitoring and performance objectives for handover on completion of construction – Stockpiling and management/segregation of topsoil where it contains native plants seedbank or weed material – Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the Biosecurity Act – Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Flooding	▸ Consult with stakeholders including directly impacted landholders, local government authorities, State Government departments and local flood specialists to inform and refine the Project design. ▸ The size and location of new structures has been determined through detailed hydraulic modelling, including extending the existing drainage structures or providing larger structures than the existing drainage structures. Consultation and approval is required from QR, as the rail manager for works within the West Moreton System corridor, including the addition of a new culvert under the West Moreton System. Similarly, approval is required with the relevant councils where changes to the existing road network are proposed. ▸ Continue to refine Project design in response to hydraulic modelling outcomes. This includes addressing flood impact objectives, which include consideration of peak water levels, flow distribution, velocities and duration of inundation. This will confirm bridge lengths, culvert sizing and numbers, localised scour and erosion protection measures for both rail, road and other permanent Project infrastructure. ▸ Undertake a Project flood risk assessment to inform the siting and scale of temporary construction areas (including stockpiles, construction compounds, access, laydown areas, etc.) to ensure they are located in areas that do not experience periodic inundation. ▸ Planning reviews of the design to locate plant and equipment maintenance activities and chemical/hazardous goods storage facilities, in accordance with the risk assessment, and incorporate appropriate location-specific controls and procedures to minimise the risk and avoid impacts to waterways, aquatic habitats, and groundwater.
	Water quality of surface waters	Refine the disturbance footprint identified and assessed in the EIS, to avoid and, where avoidance is not possible, further minimise impacts to all surface waters including defined watercourses, currently unmapped drainage features (as defined by the *Water Act 2000* (Qld) (Water Act)) and water quality of Gowrie Creek, Lockyer Creek, Six Mile Creek, Rocky Creek, Oaky Creek and their tributaries and downstream impoundments or users by: ▸ Avoiding, then minimising the extent and duration of temporary surface water diversions. ▸ Avoiding, then minimising the extent of permanent surface water diversions or realignments. Where unavoidable, permanent surface water realignment/diversion design to include simulation of natural features, e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections and different types of sub-strata, depending on the pre-disturbance environmental values, as per requirements of relevant and applicable conditions of approval, legislation, regulations and industry guidelines. ▸ Planning and defining maintenance activity locations, construction compounds and storage areas, and management procedures. ▸ Undertaking preconstruction water quality monitoring and detailed design hydraulic modelling to inform temporary and permanent drainage design. Requirements for treatment train controls, scour protection, etc. will be incorporated, where necessary, to achieve modelled compliance with established WQOs. Temporary and permanent measures will be appropriate to the site conditions, responding to the erosion risk assessment, environmental receptors, climatic zone and seasonal factors. ▸ Developing Erosion and Sediment Control Plans, in accordance with IECA for implementation during pre-construction, construction and commissioning, which will establish and specify the monitoring and performance objectives for handover on completion of construction. ▸ Ensuring the disturbance footprint defined during detailed design allows sufficient space for provision of the required temporary and permanent erosion and sediment control measures/pollution control measures. ▸ Designing batters, cuts and other exposed surfaces to reduce erosion risk. ▸ Designing watercourse crossing structures (including culverts and bridges) to minimise the need for ongoing maintenance and inspection to maintain aquatic fauna (e.g. fish) passage and minimise the risk of debris deposition during large flow events, in accordance with relevant regulatory requirements.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Water quality of surface waters [continued]	▸ Design of any required treatment plant (associated with the eastern tunnel portal) to have the capacity to treat up to 10 ML/annum, with the source of groundwater likely being the Koukandowie Formation. Treatment will be designed with reference to water quality data collected during groundwater baseline monitoring, targeting the bore holes along the tunnel alignment (refer Appendix N: Groundwater Technical Report), along with data collected by other stakeholders (where available). The water may be reused during operations (e.g. landscape and rehabilitation works) or discharged into a tributary of Rocky Creek Ch 10.50 km), where the objective will be to either maintain (use some assimilative capacity) or improve (over time) the watercourse. ▸ Design of any required treatment plant (associated with the western tunnel portal) to have the capacity to treat up to 82 ML/annum, with the source of groundwater likely being Main Range Volcanics. Treatment will be designed with reference to water quality produced during groundwater baseline monitoring targeting the bore holes along the tunnel alignment (refer Appendix N: Groundwater Technical Report), along with data collected by other stakeholders (where available). This will deem the level of treatment required before discharge into a tributary of Gowrie Creek near Ch 3.45 km (vegetation swales, wetland retention basins or a water treatment plant). ▸ Design of tunnel portal to consider measures to reduce surface water and groundwater inflow (e.g. tanking of the western portal below the average groundwater table). ▸ Design in accordance with assessment outcome benchmarks for developments (as per the *State Planning Policy—state interest guideline Water quality* (SPP Water Quality) (DLIGP, 2016) are considered for the Project to protect the water supply buffer area associated with the Project. These benchmarks include: ▸ Development contributes to protecting or enhancing the environmental values of receiving waters ▸ Development facilitates the achievement of WQOs for Queensland waters ▸ Development avoids or minimises disturbance to natural drainage, erosion risk, salinity, and landscape features and mitigates any impacts from disturbance to receiving waters, to maintain environmental values ▸ The water quality of both surface and groundwaters and the ecological and hydrological processes of catchments are protected ▸ Development in areas that drain directly into high ecological value waters demonstrate that relevant water quality and hydrologic objectives can be achieved ▸ Stormwater is managed to maintain or re-create natural hydrological processes and minimise impacts from altered run-off regimes ▸ Environmental values of receiving waters are protected from adverse development impacts arising from the creation or expansion of non-tidal artificial waterways, such as urban lakes ▸ Development adopts best-practice water-sensitive urban design and integrated water cycle management approaches, responding to regionally specific climate and water quality characteristics ▸ Lifecycle costs of water quality infrastructure are considered and minimised.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Monitoring	Develop the surface water monitoring framework to inform the development of the CEMP and the Water Quality Monitoring Program. The framework will be developed to align with the *Monitoring and Sampling Manual* (DES, 2018a) and will identify monitoring locations at discharge points and locations in watercourses where works are being undertaken. It will include the relevant WQOs, parameters, and criteria, and specific monitoring locations, frequency and duration identified in consultation with relevant regulators to reduce impacts to surface water quality. Water quality monitoring will commence in accordance with the surface water quality monitoring framework in 2020 for an adequate period of time to acquire representative data prior to construction at surface water crossing locations (e.g. Lockyer Creek—upstream of, downstream of, and at the intersection of the Project disturbance footprint and watercourse) to establish baseline water conditions and provide a sufficient seasonal dataset prior to the commencement of construction.
	Drainage design, erosion sediment control and salinity hazard	Water quality will be undertaken to inform permanent drainage design for the rail and road realignments (i.e. requirements for treatment train controls, where necessary, to comply with established WQOs through scour protection) and to inform erosion and sediment control plans. The design will define temporary and permanent stormwater, erosion and sediment/pollution control measures in ESCPs and Reinstatement and Rehabilitation Plans, that comply with IECA guidelines. These plans are to also establish and specify the monitoring and performance objectives for handover on completion of construction.
	Construction water	Developing a dewatering strategy (where dewatering of artificial impoundments is required) (e.g. dewatering of artificial impoundment at Ch 16.20 km and Ch 24.35 km) to comply with the Biosecurity Act, to take reasonable measures to avoid the spread of pest species (with capacity to affect water quality) and in accordance with any required aquatic fauna species management plans. Requirements for construction water (volumes, quality, demand curves, approvals requirements and lead times) will be defined during detailed design and construction planning. This will include identification of opportunities to use dewatered artificial impoundments (where impacted along the disturbance footprint) for construction purposes. Approval for a change of use of water from licensed artificial waterbodies may be required. Water that will be extracted through dewatering will be defined during detailed design and construction planning. Where dewatering is to occur and where artificial dams utilise overland flow and are less than 5 ML, no authorisation is required for recycling the water for construction purposes. Noting this, ongoing consultation with DRDMW will occur to consider any approval processes required for dewatering. Construction water sources and demand will use a hierarchical approach to confirming the suitability of water sources, with a focus on using existing sustainable allocated water entitlements from private water holders. Licenses, approvals and agreements to access water for construction water will be obtained. These may include water licenses under the Water Act or access agreements with bulk water suppliers or private landholders. Specify performance criteria for construction water requirements to minimise the risk of adverse water quality, environmental or health impacts and avoid the use of potable water where non-potable sources can be applied, where possible.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued[	Tunnel dewatering	Construction methodology to consider closed head TBM, along with the use of ground curtains, probe drilling the tunnel face and use of gaskets to manage groundwater inflows. Additional groundwater monitoring and modelling will be undertaken to inform the design for the tunnel dewatering treatment facility, including the capacity of the treatment facility (treated and untreated water) and the required treatments (e.g. salinity). Develop a treatment and discharge plan, consistent with the water quality monitoring framework for implementation at the tunnel dewatering plant. The collected water will be required to meet the WQOs defined for Gowrie Creek at the western tunnel portal and Oaky/Rocky Creek at the eastern tunnel portal, and schedule release periods as necessary so as to minimise changes in hydrological regime, physical and chemical characteristics and ecological processes.
	All water users	Confirm with landholders the water infrastructure on the impacted properties, the intended purpose of the water and any associated water authorisations. Ensuring that the landholder is made aware that water authorisation associated with land parcel will be null and void as a result of the land acquisition process. Identify landholders willing to provide construction water to the Project, including briefing the landholder on potential amendments required to the existing authorisations Where applicable, engage with any downstream landholders deemed at risk from the Project (e.g. where the Project may impact on instream or overland flow (temporary or permanent). Ensure that the constructing contractor is made aware of existing water infrastructure and authorisations attached to a land parcel. Consider the acceptable outcomes recommended in the Seqwater *Development Guidelines for Water Quality Management in Drinking Water Catchments* (Seqwater, 2017) when planning works within the water supply buffer area; noting that a number of the mitigation measures satisfy these outcomes.
Pre-construction	Erosion and sediment control (water-quality related)	Install initial erosion and sediment controls in support of pre-construction minor civil works, e.g. establishing laydown areas, in accordance with the Soil Management Sub-plan.
	Flooding	Impacts will be determined at all drainage structures and waterways affected by construction works. The change in flood levels and impacts on infrastructure and properties outside the rail corridor will be justified for a range of events up to and including the 1% AEP event.
	Water quality	Review and adjust (as required) the surface water monitoring framework and develop the Water Quality Monitoring Program as part of the Surface Water Management Sub-plan. The Water Quality Monitoring Program will include: ▸ Representative background monitoring data for an adequate period of time, required for surface water quality to establish baseline water conditions prior to the commencement of construction. ▸ Identification of works and activities during construction and operation of the Project, including runoff, emergencies and spill events, which have the potential to impact on surface water quality of potentially affected surface waters and riparian land (via discharge points). ▸ A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of impacts that trigger contingency and ameliorative measures. ▸ The identification of locality specific and construction activity erosion and sediment control, and stormwater management requirements relating to surface waters during construction, commissioning and operation. ▸ The presentation of WQOs trigger values, standards and parameters against which any changes to water quality will be assessed, having regard to the relevant water quality guidelines and ANZECC/ARCAMZ 2000/2018 Guidelines. Where alternate guidelines are used to establish water quality goals, justification for this will be provided.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction [continued]	Water quality [continued]	▸ Establishment of construction and operational phase surface water monitoring locations, including waterways, waterbodies and wetlands, (e.g. construction monitoring of Lockyer Creek—upstream of, downstream of, and at the intersection of, the Project disturbance footprint, and watercourse and tunnel dewatering, with release to a tributary of Gowrie Creek at the western tunnel portal (Ch 3.45 km) and a tributary of Rocky Creek (Ch 10.50 km) at the eastern tunnel portal), which are representative of the potential extent of impacts from the Project, including relevant analytes and frequency of monitoring. ▸ Identification of seasonal factors with the potential to influence water quality at the monitoring sites. ▸ A monitoring period following the completion of construction completion criteria (i.e. until the affected surface waters, drainage infrastructure and landscaped or rehabilitated areas are certified by a suitably qualified and experienced independent expert as being stabilised and rehabilitated to an acceptable condition, unless otherwise approved or directed by regulatory authorities. Surface water quality during baseflow conditions that meet pre-construction up and downstream background monitoring, and/or WQOs will confirm adequate rehabilitation. The monitoring will also confirm the establishment of operational water control measures which will be identified as part of drainage during detailed design of the Project (such as vegetated buffer strips basins and vegetated swales). ▸ Contingency and ameliorative measures in the event that adverse impacts to water quality are identified, with reference to the impact triggers defined as part of the water quality monitoring program. ▸ Surface water quality samples will be collected and analysed in accordance with industry accepted standards and quality assured procedures, with laboratory analysis undertaken by NATA accredited facilities. Dewatering/extraction of water from artificial impoundments will be undertaken after consultation with relevant stakeholders and in accordance with relevant landholder agreements. Where dewatering is to occur and where artificial dams utilise overland flow and are less than 5 ML, no authorisation is required for recycling the water for construction purposes. Noting this, ongoing consultation with DRDMW will occur to consider any approval processes required for dewatering. To the extent possible and where required, stage construction activities to use dewatered artificial impoundments to reduce external water requirements. Water authorisation may be required under the Water Act if a change in purpose is required under current Water Act licensing. Dewatering strategies will comply with the Biosecurity Act to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality).
Construction and commissioning	Erosion and sediment control	Clearing extents will be limited to the disturbance footprint, and clearing will be scheduled to minimise the exposure time of unprotected materials to prevent sedimentation of receiving surface waters. Appropriate erosion and sediment control measures will be implemented for each stage or element of the construction works, in accordance with the progressive revisions of the ESCPs that are undertaken by a CPESC in accordance with IECA guidelines. Stages/elements will include: ▸ Vegetation clearing and grubbing. ▸ Temporary access tracks and/or temporary surface water crossings. ▸ Early installation of stormwater drainage and clean water catch drains to divert clean water flows through/around the construction site. ▸ Bulk earthworks and interim topography changes. ▸ Surface water diversion (as required for diversion drains over existing flow paths of Gowrie Creek and Six Mile Creek and western tunnel portal of Gowrie Creek). ▸ Bridge and culvert works. ▸ Ballast placement. ▸ Reinstatement activities. ▸ Rehabilitation and landscape activities.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Erosion and sediment control [continued]	Install permanent erosion control measures, such as sediment retention basins and scour protection, in accordance with the detailed design and erosion and sediment control plans. Monitor the effectiveness of erosion controls installed as part of the environmental inspection schedule for the Project, as prescribed in the CEMP. Controls that are found to be failing or not performing as intended will either be modified or replaced, as required. Clearing extents are limited to the Project disturbance footprint, and clearing is scheduled to minimise the exposure time of unprotected earth to prevent sedimentation of receiving surface waters. Temporary surface water crossings are rehabilitated in accordance with the Reinstatement and Rehabilitation Plan. Where practical, and or in accordance with specific flora and fauna management plans, vegetation clearing, and ground disturbing works will be staged sequentially/across the proposal to minimise areas exposed to erosion and sediment risk of receiving surface waters and drainage lines, in accordance with the general environmental duty of the EP Act.

	Water quality	The surface water monitoring framework will include the relevant WQOs, parameters and criteria, and specific monitoring locations, frequency and duration identified in consultation with relevant regulators to reduce impacts to surface water quality.
		To the extent possible, schedule works to use dewatered artificial impoundments within the disturbance footprint to reduce external water requirements. Dewatering strategies will be required to comply with the Biosecurity Act to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality).
		In the event that WQOs cannot be achieved for waters to be released, alternate treatment/disposal options are to be implemented prior to release or re-use:
		▸ Implementation of the Water Quality Monitoring Program (refer above)
		▸ Water will need to meet the established WQOs for receiving surface waters before being released/discharged into local surface waters. Water that does not comply with relevant WQOs will either be:
		  ▸ Treated onsite to enable discharge
		  ▸ Used for construction water purposes that are not quality dependent, if safe to do so (e.g. dust suppression)
		  ▸ Removed from site for disposal at an appropriately licensed facility.
		Bulk storage areas for dangerous goods and hazardous materials will be located away from areas of social and environmental receptors such that offsite impacts or risks from any foreseeable hazard scenario will not exceed the dangerous dose for the defined land use zone, i.e. either sensitive, commercial/community, or industrial, in accordance with the intent of the SPP Water quality.
		Appropriate register and records of chemicals, hydrocarbons and hazardous substances and materials onsite will be kept up to date as required by the CEMP. Where appropriate this would include a relevant risk assessment prior to the substance coming to, and being used onsite, plus a Safety Data Sheet Register.
		The construction-phase service provider will have the ability to engage or employ appropriate resources and suitably qualified persons to respond to major incidents if these occur and will respond sufficiently to prevent environmental harm.
		Licensed transporters operating in compliance with the *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2018) will be used for the transportation of dangerous goods.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Water quality [continued]	Chemicals stored and handled as part of construction activities will be managed in accordance with: ▸ *Work Health Safety Act 2011* (Qld) and Regulation. ▸ AS 2187.1: 1998 *Explosives—storage, transport and use* (Standards Australia, 1998). ▸ AS 1940:2017—*Storage and Handling of Flammable and Combustible Liquids* (Standards Australia, 2017). ▸ AS 3780:2008—*The Storage and Handling of Corrosive Substances* (Standards Australia, 2008). ▸ Requirements of chemical safety data sheets. Procedures will be established for safe and effective fuel, oil and chemical storage and handling. This includes storing these materials in roofed, bunded areas. The bunding will have floors and walls that are lined with an impermeable material to prevent leaching and spills. Construction tasks will be scheduled to avoid, where possible, bulk earthwork activities within the 1% AEP during periods of elevated flood risk. Where works cannot be scheduled outside of this time period, activity-specific flood readiness and response planning will be required. This planning will be developed in consultation with the relevant local government and Queensland Fire and Emergency Services. Laydown areas and other construction facilities that are located within the 1% AEP will be temporary. Their planning and function in supporting construction will reflect the local flood risk, e.g. hazardous goods will not be bulk stored in these locations. Mobile plant will not be stored in the 1% AEP when not scheduled to be in use for construction purposes. Plant maintenance and refuelling will be carried out a minimum of 25–100 m (Condamine River Basin) or 10–50 m (Lockyer Creek catchment) from riparian vegetation and surface waters, with appropriate interception measures in place to avoid impacts to surface waters and aquatic habitats. The buffer distances are based on regulated vegetation watercourse buffer distances for non-coastal and coastal bioregions, respectively. Appropriate spill control materials, including booms and absorbent materials will be onsite at refuelling facilities at all times. Appropriate waste bins will be located in laydown areas to facilitate segregation and appropriate containment of waste materials.
	Dewatering	Where the dewatering of excavations (e.g. trenches, pier holes, etc.) is required, water will meet the established WQOs for receiving surface waters before being released/discharged into local surface waters. If dewatering of existing storages is required, dewatering strategies will be undertaken to comply with the Biosecurity Act to take reasonable measures to avoid the spread of pest species, e.g. screening of pump intake. Where dewatering is to occur and where artificial dams utilise overland flow and are less than 5 ML, no authorisation is required for recycling the water for construction purposes. Noting this, ongoing consultation with DRDMW will occur to consider any approval processes required for dewatering.
	Construction water	The extraction of water will occur in accordance with licenses, approvals and/or agreements. Volume monitoring during extraction will be required for each source point, with extraction logs maintained. If the *Exemption requirements for construction authorities for the take of water without a water entitlement* (WSS/2013/666) (DNRME, 2019a) are considered to be applicable to ARTC and the Project, then the take of water will occur in accordance with the exemption requirements. Extraction reporting will occur, as required, in accordance with requirements of relevant licenses, approvals and/or agreements obtained to cover this activity.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Surface waters	Maintenance activities and refuelling will be carried out at an appropriate distance from riparian vegetation and surface waters, with appropriate measures in place to avoid impacts to surface water quality. Where this is not achievable due to type of activities (e.g. piling activities within a riparian zone), additional mitigation measures will be implemented to prevent impacts on water quality.
	Rehabilitation	Reinstatement, stabilisation and rehabilitation of disturbed areas will be undertaken progressively, consistent with the Rehabilitation and Landscaping Management Plan.

23.15.6.4 Monitoring

A surface water monitoring framework will be developed and implemented as part of the CEMP. It will identify monitoring locations at discharge points and selected locations in watercourses where works are being undertaken. Monitoring will be undertaken as close as possible to the proposed discharge points of the project to the receiving waters. The sampling locations will be representative of where the site discharge mixes with the receiving waters. Upstream and downstream samples will be taken.

The surface water monitoring framework will include the relevant WQOs, parameters, and criteria from Chapter 13: Surface Water and Hydrology. Specific monitoring locations, frequency and duration will be established as per the Water Quality Monitoring Program.

Rainfall and weather monitoring and recording will also be undertaken across the Project disturbance footprint for live input into mitigation measures and reporting throughout the Project.

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP sub-plan will be captured in the processes identified above, in Section 23.9.

23.15.7 Groundwater

23.15.7.1 Environmental outcomes

Groundwater inflow to construction works, including the Toowoomba Range Tunnel, cuttings and excavations, is minimised.

Groundwater quality is maintained at pre-Project levels during and after construction.

Construction works are designed to minimise the use and impact to groundwater resources and impacts to existing users.

23.15.7.2 Performance criteria

- Contamination of groundwater by construction materials is avoided
- Groundwater released from construction sites to receiving waters complies with the *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* and the relevant environmental values and corresponding WQOs as outlined in the following documents:
  - *Healthy Waters Management Plan: Condamine River Basin* (Department of Environment and Science (DES), 2019e),
  - Murray–Darling Basin environmental values and water quality objectives (DES, 2018b)
  - *Lockyer Creek environmental values and water quality objectives* (DERM, 2010a)
  - Surface Water and Hydrology Sub-plan and other relevant water quality guidelines
- Risks associated with dewatering (i.e. water table lowering) and environmental management requirements during construction are identified through appropriate baseline groundwater monitoring, modelling and analysis during the detailed design/preconstruction phases of the Project
- Rectify impairments (e.g. water level decline impairing the bore's ability to provide a reasonable quantity or quality of water for the bore's authorised use or purpose) as a result of the construction of the Project.

23.15.7.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction and construction and commissioning phases of the Project are included in Table 23.12.

TABLE 23.12: MITIGATION MEASURES—GROUNDWATER

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Interaction with groundwater by elements of the Project	▸ Investigate solutions to reduce the volume of groundwater inflow at the western tunnel portal and, where applicable, the tunnel, during construction and operations: ▸ Probe drilling ahead of the tunnel face ▸ Identification of high permeability features ▸ Installation of grout curtains ▸ Use of gaskets in areas of high inflow, to minimise seepage to the tunnel ▸ Tanking of the western portal below the average groundwater table. ▸ Continue to work with the Department of Regional Development, Manufacturing and Water (DRDMW) regarding the groundwater impacts from the different phases of the Project to ensure the correct approval pathways are implemented and that the necessary data to inform a decision under the Water Act is available (e.g. groundwater modelling and measures to mitigate impairment to bores). ▸ Further geotechnical and hydrogeological investigations will be undertaken in parallel to the detailed design process to ensure site-specific conditions are reflected in the final design solution. Investigations will be targeted to specific locations, such as: ▸ Toowoomba Range Tunnel, portals, and the intermediate ventilation shaft ▸ Deep cut sections ▸ Locations of significant fill ▸ Fault/dyke/fracture structures ▸ To better understand the hydraulic conductivity of the Koukandowie Formation of the Marburg Subgroup, WCM, and colluvium deposits. ▸ Additional aquifer permeability tests are ongoing prior to final design to understand the structural elements, hydraulic connectivity between units, and aquifer characteristics (compartmentalisation) which may result in cut/tunnel inflow seepage rates higher than expected, increased regional or localised groundwater drawdown and/or impacts on EVs. Specifically, collection and assessment of baseline groundwater monitoring data (levels and quality) along the tunnel alignment will continue to confirm seasonal variation and inform detailed design (groundwater levels) and the WQOs for the Groundwater Management and Monitoring Plan (GMMP). There is limited local data along the Toowoomba Range Tunnel aspect—groundwater levels in the Marburg Subgroup/Koukandowie Formation may be higher than estimated. Additional monitoring bores along the tunnel alignment (~400 m intervals), and at every cut identified to intersect groundwater and inclusion into the baseline monitoring program (levels and quality), will establish groundwater levels prior to final design (and may identify perched aquifers). Continuous collection of groundwater levels in monitoring bores along the tunnel alignment, at each cut location anticipated to intersect groundwater, will allow for assessment of recharge rates to better understand the hydrogeological regime's response to large rainfall events in highly conductive zones. This data will limit risks to over/under designing the tunnel and cuts. ▸ Site inspections of proposed cut locations will be conducted to visually examine surface outcrops for sulfide minerals or remnant products indicative of sulfide mineralisation. This would inform the need for management of potential Acid Rock Drainage (ARD) from cuttings in sedimentary units prior to construction works. ▸ Predictive numerical modelling will be refined using additional information obtained from further geotechnical and hydrogeological investigations; and updated to the sensitivity analyses and hydraulic conductivity parameters, in addition to finalised cut dimensions. This revised modelling will be completed for the final EIS to better understand seepage estimates and groundwater level variation resultant from the tunnel, portals and cuts. Seepage analysis will be used to advise of construction of the tunnel, drainage blanket specifications, or alternative design controls, for deep cuts into hard rock.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Interaction with groundwater by elements of the Project	▸ As an outcome of baseline groundwater monitoring and predictive modelling, confirm the water treatment facility required for the construction and operation of the Project (source relevant approval, where applicable). ▸ Investigate measures to harvest the groundwater inflow during construction for reuse by the Project (currently estimated to 2.5x the volume required for construction) or by other projects in the area. Alternatively, consult with DES and DRDMW regarding the release of the water into the surrounding environment.
	Impacts to bores	▸ Undertake a landholder bore survey to verify the number of bores within, and directly adjacent to, the Project disturbance footprint, bores above the Toowoomba Range Tunnel and, where applicable, the drawdown extents modelled for the Project. The survey may include a bore assessment with due consideration of the Queensland Government's Guideline Bore Assessments (Queensland Government, 2017). The assessment will aim to: ▸ Provide a measure of security for ARTC and the bore owners by providing information about the current condition and pumping capacity for a water bore ▸ Provide a reference point for comparison with subsequent bore assessments to assist in the negotiation of make-good arrangements and assist in the development of groundwater data modelling ▸ Assist in resolution of any future disputes that may arise between bore owners and ARTC following a bore assessment or in the negotiation of a make-good arrangement. ▸ Landholders affected by the Project will be consulted to confirm the location of registered bores and to establish the presence of any unregistered bores within the Project footprint that may be decommissioned to enable construction and operation of the Project. Where a groundwater bore is expected to be decommissioned, or have access to it impaired as a result of the Project, 'make good' measures will be agreed in consultation with the affected landholder and may include monetary compensation developed on a case by case basis.
	Sourcing of construction water	▸ The construction water requirements (i.e. volumes, quality, demand curves, approvals requirements and lead times) will be confirmed as the construction approach is refined. The ultimate water sourcing strategy for the Project will be documented in a Construction Water Plan developed for the Project. The Construction Water Plan will be developed involving all levels of government; specifically, DRDMW Water Services and other entities. In developing the Construction Water Plan, ARTC will investigate and assess sustainable water solutions to support the Project that will not impact on the function of business, industry and communities along the Project. Sources of construction water will be finalised as the construction approach is refined during the detailed design and tender phases of the Project (post-EIS) and will be dependent on: ▸ Climatic conditions in the lead up to construction ▸ Confirmation of private water sources made available to the Project by landholders under private agreement. ▸ Confirmation of access agreement with local governments for sourcing of mains water. ▸ The use of groundwater to supplement the construction demand for the Project may be considered if private owners of licensed/registered bores have capacity under their water licence or entitlement that they wish to sell to, or trade with, ARTC under a private agreement. Discussions with private water owners may include an accompanying officer from DRDMW Water Services and amendments to existing water authorisations.

Delivery phase	Aspect	Proposed mitigation measures

Detailed design [continued]	Groundwater quality	▸ Continue collection of baseline groundwater monitoring data (levels and quality) from monitoring bores established for the Project through the EIS process, as well as from additional bores installed through the detailed design process, in accordance with the Baseline GMMP (refer Chapter 14: Groundwater). Data will be collected to provide a robust dataset for characterisation of the primary aquifers of relevance over a time sufficient to identify seasonal variation trends. Continuous and repeated quality sampling of groundwater along the portals, tunnel and deep cuts will provide site-specific quality with respect to magnesium, dissolved oxygen, calcium concentrations, groundwater aggressivity and scaling potential prior to final design.
		▸ Groundwater monitoring and sample collection will be conducted in accordance with recognised groundwater sampling guidelines such as *Monitoring and Sampling Manual* (DES, 2018a) and *Groundwater Sampling and Analysis—A Field Guide* (Geoscience Australia, 2009).
		▸ Collected data will be used to establish a groundwater condition baseline for the Project against which construction-phase impacts can be monitored and compared (refer Chapter 14: Groundwater). Baseline groundwater monitoring data will be used to:
		  ▸ Derive location/bore-specific groundwater monitoring procedures
		  ▸ Establish location/bore-specific impact thresholds
		  ▸ Establish responses to impact threshold exceedances, including 'make good' agreements.
		▸ These details will be incorporated into the future revisions of the GMMP, which will be subject to approval from DRDMW and DES prior to implementation.
		▸ A Contaminated Land Management Sub-plan will be developed and incorporated into the CEMP. This sub-plan will document management controls for works on land that is known or suspected of being contaminated, and outline the process to identify, document and manage contaminated sites (refer Chapter 9: Land Resources).
		▸ Confirm that groundwater inflow at the western and eastern tunnel portals can meet the relevant WQO for discharge into the surrounding environment without treatment. If treatment is required confirm the nature of the treatment and use of the treated water and waste material.
		▸ Refine the design of the Water Treatment Plant (WTP), including the target water quality of treated water disposal, based on additional groundwater quality (baseline) data.

Pre-construction	Impacts to bores	▸ There are 16 bores within the Project disturbance footprint, two of which are located above the Toowoomba Range Tunnel. With the exception of the bores above the tunnel, these bores are likely to be decommissioned for the progression of the Project. Bores identified within the construction footprint will be decommissioned in accordance with the *Minimum Construction Requirements for Water Bores in Australia—Fourth Edition* (National Uniform Drillers Licensing Committee, 2020). Where a groundwater bore is expected to be decommissioned or have access to it impaired as result of the Project, 'make good' measures will be agreed in consultation with the affected landholder and may include monetary compensation developed on a case-by-case basis. ▸ Confirm vibration impacts to existing bores that are not planned to be decommissioned (refer Chapter 14: Groundwater). The high-risk bores are RN107110 and RN107104 (above the Toowoomba Range Tunnel). The construction team will undertake vibration monitoring to assess whether the vibration from the works meet the criteria.
	Sourcing of construction water	▸ Private agreements will be negotiated to secure access to registered bores for use of sustainable groundwater supplies during construction, if required by the Project as part of the construction water strategy (refer above).

Delivery phase	Aspect	Proposed mitigation measures
Construction	Water resources	▸ The Construction GMMP will be implemented (refer above and Chapter 14: Groundwater). ▸ Opportunities to re-use/recycle water during construction will be identified and implemented, where feasible. ▸ Implement the relevant measures agreed with the individual bore owners regarding 'make good' measures. ▸ Continue to engage with the community and the bore owners regarding the construction schedule, in particular the tunnelling activities.
	Sourcing of construction water	▸ In circumstances where groundwater access is secured through private agreement, the licensed capacity of existing bores will not be exceeded. Flow and volume monitoring during extraction will be required for each bore, with extraction logs maintained.

	Groundwater quality	▸ Suspected contaminated soils or materials, if encountered, will be managed in accordance with the unexpected finds protocol/procedure documented in the Contaminated Land Management Sub-plan.
		▸ Opportunities to treat and re-use contaminated materials within the rail corridor will be assessed and subjected to a risk assessment.
		▸ Vehicle and plant maintenance will be undertaken in designated 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.
		▸ 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.
		▸ Bulk storage areas for dangerous goods and hazardous materials will be located away from areas of social and environmental receptors such that offsite impacts or risks from any foreseeable hazard scenario will not exceed the dangerous dose for the defined land use zone (i.e. either sensitive, commercial/ community, or industrial, in accordance with the intent of the SPP).
		▸ A Hazardous Materials Management Sub-plan will be prepared and implemented as a component of the CEMP. The sub-plan will be required to:
		  ▸ Identify the materials required to be stored and used in support of construction, including volumes of each
		  ▸ 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 will be handled, stored and transported for the Project
		  ▸ Describe the response procedures in the event of an incident involving hazardous materials or dangerous goods

Delivery phase	Aspect	Proposed mitigation measures
Construction [continued]	Groundwater quality	▸ Establish the waste storage and disposal procedures for hazardous materials and dangerous goods ▸ Chemicals stored and handled as part of construction activities will be managed in accordance with: – The WHS Act and Regulation – AS 2187.1:1998 *Explosives—storage, transport and use* (Standards Australia, 1998 – AS 1940:2017 *Storage and Handling of Flammable and Combustible Liquids* (Standards Australia, 2017) – AS 3780:2008 *The Storage and Handling of Corrosive Substances* (Standards Australia, 2008) – The requirements of chemical safety data sheets. ▸ Spill kits will be available at all work fronts and laydown areas in the event of a spill or leak. All vehicles and machinery will have dedicated spill kits. These refuelling locations will be equipped with onsite chemical- and hydrocarbon-absorbent socks/booms and spill kits. ▸ Drilling and excavation activities during construction will make use of drilling fluids and chemicals that are environmentally neutral and biodegradable. 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. ▸ All excavated material that is suspected to contain sulfides will be stockpiled, lined and covered, and managed to minimise rainfall infiltration and leaching. Where possible, treatment and onsite reuse is preferred to offsite disposal. A case-by-case assessment of the suitability of material for treatment and reuse will be required, in accordance with the Project's spoil management strategy (Appendix T: Spoil Management Strategy).
	Encountering Potential Acid Sulfate Soils (PASS) and/or ARD	▸ All excavated material that is suspected to contain sulfides will be stockpiled, lined and covered, and managed to minimise rainfall infiltration and leaching. Where possible, treatment and onsite reuse is preferred to offsite disposal. A case-by-case assessment of the suitability of material for treatment and reuse will be required, in accordance with the Project's spoil management strategy (refer Appendix T: Spoil Management Strategy). ▸ If ARD potential is identified through pre-construction investigations (refer above), seepage water from the relevant deep cuts will be sampled at weekly intervals to monitor for the occurrence of acid rock oxidation. This monitoring will involve the onsite screening of the seepage water for pH (trending down) and EC (trending up) and comparison to the baseline groundwater results. Further laboratory analyses for the key analytes (i.e. pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Total Suspended Solids (TSS), alkalinity, and dissolved metals) will be required, if pH and EC trends indicate the potential for oxidation occurring, and will be used to validate the presence or absence of ARD potential to mitigate potential leachate to the environment. ▸ If ARD-contaminated discharge water/leachate is found to be generated from the deep cuts, this water may need to be impounded in ponds and neutralised via treatment with hydrated lime or dilution prior to release into the surrounding catchment or other discharge mechanism.

23.15.7.4 Monitoring

Continue collection of groundwater baseline data (levels and quality) to ensure robust dataset to be incorporated into the GMMP, discussed further in Chapter 14: Groundwater.

Risks associated with dewatering (i.e. water table lowering) and environmental management requirements during construction are identified through appropriate baseline groundwater monitoring, modelling and analysis, as required by relevant applicable legislation and regulations.

Implementation and adherence to the CEMP and GMMP with appropriate groundwater level and quality monitoring criterion based on the baseline groundwater monitoring, modelling, analysis and regulatory requirements, and enter into make-good arrangements with the owners of the groundwater bores as necessary.

Routine sampling of discharge waters from the deep cuts intersecting groundwater is proposed to assess the potential for ARD processes taking place. Screening of the seepage water onsite for pH (trending down) and EC (trending up), and comparison to the baseline groundwater monitoring program results/trends, will allow for indication of ARD processes. Further laboratory analyses for the key analytes pH, TDS, EC, TSS, alkalinity, and dissolved metals will validate the presence or absence of ARD potential.

Groundwater levels for bores will be continuously monitored for variation from the baseline levels established prior to operation phase.

Tunnel and deep cut seepage water will be monitored and actively discharged in accordance with the water management plan and appropriate local and State regulations, as selected in the detailed design phase.

Requirements for monitoring during the operational phase will be established to inform the Operation EMP. Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP sub-plan will be captured in the processes identified above in Sections 23.9.

23.15.8 Noise and vibration

23.15.8.1 Environmental outcomes

Project works are designed, planned and implemented to maintain human health and wellbeing with respect to noise and vibration, to the extent reasonable and practicable.

Project works, generally, are designed, planned and implemented to maintain daily patterns of activity and to minimise sleep disturbance at night.

Construction works are managed to avoid vibration-related structural damage on all properties.

23.15.8.2 Performance criteria

- Project works aim to not exceed noise levels to achieve the goals presented in Table 23.13 at a sensitive receptor, measured in accordance with section 5 of *Transport Noise Management: Code of Practice Volume 2* (CoP Vol 2), to the extent reasonable and practicable:
  - It is noted that although the below standard hours are not consistent with the CoP Vol 2, ARTC is seeking to strike a balance between maintaining a reasonable amenity, and cost and program implications
  - In some cases, extended construction hours that limit the overall duration of construction will, in itself, be a mitigation measure.
- Project works aim to not exceed the following airblast limits:
  - Airblast overpressure:
    - 115 dB (Lin) Peak for 9 out of any 10 consecutive blasts
    - 120 dB (Lin) Peak for any blast.
- Project works are designed, planned and implemented to achieve the blasting ground vibration criteria in Table 23.15 to the extent reasonable and practicable.
- Project works are designed, planned and implemented to achieve the vibration goals in Table 23.16, Table 23.17, Table 23.18 and Table 23.19, at a sensitive receptor to the extent reasonable and practicable.

TABLE 23.13: CONSTRUCTION NOISE GOALS (EXTERNAL)

	External noise level $L_{Aeq,adj,15min}$[4,5], dB(A)			
Work period	**Lower limit**		**Upper limit**[6]	
Proposed standard hours Monday–Friday 6:30am–6:00pm Saturday 6:30am–1:00pm No work on Sundays or public holidays	Rating background level (RBL) + 10[1,2,3] Minimum 50 dB(A) Maximum 75 dB(A)	75 where RBL > 55 dB(A)	70 where 40 dB(A) < RBL ⩽ 55 dB(A)	65 where RBL ⩽ 40 dB(A)
Non-Standard Hours	RBL + 5 Minimum 45 dB(A)		RBL + 5	

Table notes:

1. RBL + 5 dB(A) should be considered where a facility, equipment and long-term earthworks are required in an area for greater than six months
2. Where the lower limit value exceeds the upper limit value, the lower limit value is taken to equal the upper limit value.
3. Minimum lower limit is 50 dB(A) for standard hours and 45 dB(A) for non-standard hours. A maximum lower limit of 75 dB(A) applies to non-standard hours
4. Noise contribution from construction activity determined as the component level
5. The noise level from construction includes adjustment factors in Table 23.14 (for example, low frequency noise, impulsivity, tonality, intermittency and modulation)
6. For a single short event in a 24-hour period, the upper limit may be increased by:
   a. For standard hours:
      i. 2 dB(A) for event of 6 minutes to 15 minutes
      ii. 10 dB(A) for event of 1.5 minutes to 6 minutes
      iii. The lower value for eve15 dB(A) for event of less than 1.5 minutes.
   b. For non-standard hours
      i. 5 dB(A) for event of less than 1.5 minutes

TABLE 23.14: ADJUSTMENT FACTORS

Factor	Assessment/ measurement	When to apply	Correction	Comments
Tonal noise	1/3 octave or narrow band analysis	Level of 1/3 octave band exceeds the level of the adjacent bands on both sides by: ▸ 5 dB or more if the centre frequency of the band containing the tone is above 400 Hertz (Hz). ▸ 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive. ▸ 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	5 dB	Narrow-band frequency analysis may be required to precisely detect presence of tonality
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A frequency weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.	5 dB	C-weighting is designed to be more responsive to low-frequency noise. All noise energy down to 10 Hz should be considered.
Impulsive noise	A-weighted fast response and impulse (I) response or C-weighted for low frequency noise	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB. If difference in C-weighted maximum noise levels between fast response and impulse response is greater than 2 dB for low frequency noise.	Apply difference in measured levels as the correction, up to a maximum of 5 dB	Impulse response is defined by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s

Factor	Assessment/ measurement	When to apply	Correction	Comments
Intermittent/ modulating noise	Measurement of difference between L_{A10} and $L_{A90,}$ average difference between short-term samples, or subjectively assessed	▸ Difference between L_{A10} and L_{A90} exceeds 5 dB repeatedly for a characteristic averaging period (e.g. 10 seconds) for intermittent sources. ▸ Average difference between measured L_{Aeq} levels exceeds 5 dB for a characteristic sampling frequency (e.g. 10 Hz) for rapidly varying source. ▸ Subjectively annoying for a combination not easily characterized.	5 dB	Adjustment to be applied for night-time only
Maximum adjustment	Refer to individual modifying factors	Where two or more adjustment factors are indicated	Maximum correction of 10 dB(A)	-

TABLE 23.15: BLASTING GROUND VIBRATION CRITERIA

Category	Human comfort	Structural damage[1]
Sensitive structures (e.g. residential, theatres, schools)	5 mm/s for 95 per cent blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply.[2]	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Occupied non-sensitive structures of reinforced concrete or steel construction (e.g. factories and commercial premises)	25 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation.	50 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Occupied non-sensitive structures that include masonry, plaster and plasterboard in their construction (e.g. factories and commercial premises)	25 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied non-sensitive structures of reinforced concrete or steel construction (e.g. factories and commercial premises)	N/A	100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Unoccupied non-sensitive structures that include masonry, plaster and plasterboard in their construction	N/A	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Buildings of special value or significance (may include historical buildings, monuments)	2 mm/s	N/A

Source: AS 2187.2

Table notes:

1. The values above are less stringent than those in *Deutsches Institut für Normung 4150.3:1999—Part 3 Structural Vibration in Buildings—Effects on Structures* (DIN 4150.3). This is because DIN 4150.3 considers resonance in buildings from continuous vibration. Due to the short duration of blasting events the propensity for resonance within buildings is minimal, giving rise to higher criteria
2. It should be noted that the human comfort limits should be based off the values presented above from the DEHP guideline as per the CoP Vol 2

TABLE 23.16: STRUCTURAL DAMAGE LONG-TERM CONSTRUCTION VIBRATION GOALS

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

TABLE 23.17: STRUCTURAL DAMAGE SHORT-TERM CONSTRUCTION VIBRATION GOALS

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

Table notes:
Hz = Hertz
1. For frequencies above 100 Hz, the higher values in the 50 to 100 Hz column should be used.

TABLE 23.18: HUMAN COMFORT CONSTRUCTION VIBRATION GOALS

		Resultant PPV (mm/s)	
Building	Work period[1]	Lower limit	Upper limit
Dwellings (including hotels and motels)	Standard hours	1.0	2.0
	Non-standard hours	0.3	1.0
Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)	All	0.3	1.0
Educational facilities (rooms designated for teaching purposes)	While in use		
Court of law (court rooms)			
Court of law (court reporting and transcript areas, judges' chambers)			
Community buildings (libraries, places of worship)	While in use	1.0	2.0
Commercial (offices) and retail areas			

Table note:
1. Work periods are defined as per Table 23.13

TABLE 23.19: CONSTRUCTION VIBRATION GOALS ON BURIED PIPEWORK

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

23.15.8.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction and construction and commissioning phases of the Project are included in Table 23.20.

TABLE 23.20: MITIGATION MEASURES—NOISE AND VIBRATION

Delivery phase	Aspect	Proposed mitigation measures

Detailed design	Construction noise and vibration impacts on sensitive receptors	▸ Ongoing communication and consultation with nearby residents to create awareness and understanding of Project impacts prior to works occurring Prepare and implement a communications plan to liaise with potentially affected community stakeholders and landholders regarding potential noise and vibration impacts.
		▸ Update the construction noise and vibration assessment to reflect the final location of construction sites, construction activities and construction scheduling to inform the development of a Noise and Vibration Sub-plan to ensure that the performance criteria are met.
		▸ Consultation with APA to confirm design and construction methodology across the Roma Brisbane Gas Pipeline and the required interaction treatment options. This includes the following measures:
		  ▸ additional ground-borne vibration modelling for the Toowoomba Range Tunnel and the TBM operations to confirm whether vibratory monitoring or a coating survey is required
		  ▸ workshopping the design and construction across the pipeline east of the eastern tunnel portal
		  ▸ external spanning the gas pipeline easement east of Lockyer Creek sufficiently mitigates the possibility of pipeline external loading (e.g. bored or cast in situ piles)
		  ▸ the use of protection slabs and road crossings as per relevant standards.
		▸ Similar works may also be undertaken for other public utility providers, including TRC rising sewer main and the Wetalla Water Pipeline.
		Consultation with sensitive receptors identified from the construction noise modelling for the tunnelling operations, to determine on a case by case the preferred mitigation measures (e.g. temporary relocation of residents, respite periods as acoustic treatment are not an effective mitigation for ground-borne noise) and process to implement the measures (e.g. reconfirm the mitigation at specific points of time (e.g. 300 days, 100 days, 30 days and 10 days prior or within a specific distances). Noting that the tunnel's construction is expected to be approximately 24 months once the TBM is provisioned and as such impacts in the Mount Kynoch area may not be until 2025 three years after construction commences.

Delivery phase	Aspect	Proposed mitigation measures
Detailed design [continued]	Operational railway noise and vibration impacts on sensitive receptors	▸ Review and, if necessary, update the operational noise and vibration assessment to reflect/inform the detailed design, including incorporation of potential noise or vibration treatments. The vibration assessment will include consideration of: ▸▸ Buildings/structures that will remain near to the Project works ▸▸ Other vibration-sensitive receptors (including buildings/structures of heritage value). ▸ The vibration assessment will identify building condition survey requirements at vibration-sensitive receptors that are expected to exceed the structural damage vibration limits given by DIN 4150-3 and recommended by the CoP Vol 2. ▸ The following treatments will be considered as part of detailed design: ▸▸ Source controls—mitigation measures applied to the railway infrastructure to control the emission of noise and vibration at its source. Such measures include: rail dampers, track lubrication (for control of curving noise), identification of rollingstock, causing discrete high noise events or lower noise emission alarm bells ▸▸ Pathway controls—measures to impede and limit the propagation of railway noise to the sensitive receptors and typically constructed within the rail corridor. Measures can include: railway noise barriers, low height noise barriers or earth mounding. ▸ Receptor controls—measures to mitigate noise and vibration levels or manage potential noise and vibration impacts at the sensitive receptor properties and land uses. Measures can include: architectural acoustic treatment of property, property construction/relocation, upgrades to existing property fencing or negotiated agreement with property owners.
	Operational road traffic noise impacts on sensitive receptors	Update the operational road traffic noise and vibration assessment to reflect the detailed design, including incorporation of potential noise treatments. The following mitigation measures are to be considered as part of detailed design where operational road traffic noise impacts are predicted to exceed the adopted road traffic noise limit based on the detailed design: ▸ Realignment of road segments impacting nearby sensitive receptors ▸ Pavement surface treatment ▸ Provision of acoustic façade treatments to affected sensitive receptors ▸ Noise barriers in the form of a landscaped earth mound and/or a noise fence. A combination of noise mitigation measures may be appropriate.
	Operational fixed infrastructure noise impacts on sensitive receptors	Safety systems, such as door alarms, have not been assessed as operational fixed infrastructure but should be fit for purpose and meet safety system requirements. Where possible, the contractor will select systems with the aim of achieving the EPP (Noise) 35 dBA $L_{Aeq,\,1\,hr}$ acoustic quality objective at all sensitive receptors.

Delivery phase	Aspect	Proposed mitigation measures

Pre-construction	Noise and vibration impacts on sensitive receptors	▸ Ongoing communication and consultation with nearby residents to create awareness and understanding of Project impacts prior to works occurring.
		▸ Acoustic specialist to reassess the model based on the approved construction methodology to verify sensitive receptors likely to be impacts, where the impacts may occurred and the likely duration. The specialist will also recommend acoustic treatments to mitigate the impacts with all this to be conveyed to the community and the affected landholders in accordance with the relevant communications plan.
		▸ Develop and implement the Construction Noise and Vibration Management Plan. The plan will include:
		  ▸ Location of sensitive receptors in proximity to the disturbance footprint
		  ▸ Requirements for pre-construction dilapidation surveys and/or vibration monitoring at vibration sensitive receptors, including heritage receptors and near underground infrastructure, during construction
		  ▸ Specific management measures for activities that could exceed the construction noise and vibration criteria at a sensitive receptor (e.g. squawkers for reversing vehicles, acoustic sheds, noise curtains/barriers)
		  ▸ Measures to monitor ground-borne noise during construction and the process to update the models
		  ▸ Noise and vibration criteria, trigger or alarm levels and distances for above and underground infrastructure
		  ▸ Notification process within the community engagement plan (including who to contact in the event of a complaint) to advise of significant works with potential for noise nuisance or vibration at sensitive receptors
		  ▸ Noise management measures, including controlling noise and vibration at the source, controlling noise and vibration at the source to receptor transmission path and controlling noise and vibration at the sensitive receptor
		  ▸ Practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on sensitive receptors
		  ▸ Any other measures necessary to comply with the stated conditions imposed under Coordinator General's EIS evaluation report and legislative requirements.
		▸ Where it is found that existing mitigation measures are not sufficient to reduce noise and vibration impacts to acceptable levels, additional mitigation measures will be investigated and implemented. Where construction noise and vibration impacts are unavoidable and predicted to exceed relevant criteria, after all reasonable and practicable mitigation measures are implemented, residual impact mitigation should be considered in consultation with the community and affected residents. Residual impact mitigation measures, such as construction respite periods, temporary relocation of affected occupants and provision of architectural treatments. Residual impact mitigation measures, such as construction respite periods, temporary relocation of affected occupants, and provision of architectural treatments are discussed in Chapter 15: Noise and Vibration.

Delivery phase	Aspect	Proposed mitigation measures
Pre-construction [continued]	Noise and vibration impacts on sensitive receptors from tunnelling	▸ Prior to commencement of tunnelling, site tests are proposed to determine a more representative model of the ground surrounding the tunnel. This includes: ▸▸ Conducting transfer mobility tests along the alignment during bore-holing or other deep ground intrusive activities to determine site propagation ▸▸ Conducting vibration monitoring during the TBM launch and during preliminary TBM operations to confirm TBM source vibration levels and propagation characteristics specific to the TBM. ▸ Vibration monitoring and transfer mobility test locations are to be nominated in the construction noise and vibration management sub-plan, as part of the CEMP. ▸ Results of vibration monitoring and transfer mobility test locations are to be used to refine ground-borne noise impact predictions and inform where mitigation measures are to be applied. ▸ Residents within at least 390 m of the Toowoomba Range Tunnel section of the Project alignment to be consulted regarding ground-borne noise impacts of the TBM. ▸ Residual impacts of tunnelling, expected at sensitive receptors within a 390 m diagonal distance of the tunnel, are most likely to be managed through temporary relocation of affected residents. ▸ For the small industrial areas in proximity to the alignment (including receptors RET0002, IND0009 and RET0004) the owners/tenants to be engaged to identify if office spaces are onsite. If so, a mitigation plan is to be in place to minimise disruption.
Construction and commissioning	Noise and vibration impacts on sensitive receptors	▸ Sensitive receptors identified in the Noise and Vibration Sub-plan, as well as residents within at least 2 km of the disturbance footprint, and other relevant stakeholders, will be provided with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts during construction. ▸ Sensitive receptors with the potential to be affected by noise will be notified prior to the commencement of relevant works. ▸ Construction progress and upcoming activities will be regularly communicated to local residents/stakeholders, particularly when noisy or vibration-generating activities are planned, such as vibratory compaction and piling. ▸ Implementation of the SIMP. ▸ Additional vibration modelling to assess vibration impacts on Roma Brisbane Gas Pipeline.
	Damage to buildings and structures	▸ Building condition/dilapidation surveys will be undertaken for buildings/structure in close proximity to the activities and at vibration sensitive receptors, including buildings of heritage value identified as potentially impacted by the Project during the detailed design phase modelling and assessment. Building condition surveys will also be undertaken at vibration sensitive receptors, which are expected to exceed the structural damage vibration limits given by DIN 4150.3 and recommended by the CoP Vol 2. Surveys are to take place prior to commencement and on completion of vibration-generating works (such as pile-driving). Following such surveys, more accurate data may be used to assess the impacts to vibration sensitive receptors. ▸ If, during detailed design and construction methodology assessments, vibration impacts are predicted to exceed the criteria at a heritage sensitive receptor, the following mitigation will be undertaken: ▸▸ Consultation with the owner of the structure to determine the sensitivity of the structure to construction vibration. A more appropriate criteria to be applied at the location may be agreed on as a result

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Damage to buildings and structures [continued]	▸ Baseline vibration monitoring will be undertaken prior to the activity commencing, and monitored throughout the activity, to assess compliance with vibration limits set as part of the sub-plan for the relevant receptor. Vibration monitoring results will be assessed and used to refine vibration predictions and management measures, as applicable, such as developing and enforcing exclusion zones around the sensitive structure. ▸ Where reasonable and practicable, modify the construction methodology to reduce the predicted vibration impacts. This could include: ▸ Using smaller equipment, such as a handheld jackhammer instead of a rock breaker ▸ Changing the construction methodology. ▸ Construction vibration predictions will be revised following detailed geotechnical investigations and the development of a detailed construction methodology. Predictions will identify sensitive receptors and underground infrastructure with the potential to be exposed to vibration levels exceeding the relevant criteria, and any criteria specific to particular infrastructure adopted through consultation with stakeholders. ▸ Vibration monitoring will be undertaken at locations where the potential for building/structural damage risk to sensitive receptors or underground infrastructure has been identified during the detailed design and is warranted. This includes vibration sensitive receptors at which vibration impacts are expected to exceed the structural damage criteria recommended by DIN 4150.3 and recommended by the CoP Vol 2. Vibration monitoring will be undertaken by a suitably qualified professional, in accordance with the CoP Vol 2.
	Noise impacts on sensitive receptors	▸ Where practicable and feasible, noise monitoring will be undertaken at noise sensitive receptors where the potential for noise impacts to exceed relevant criteria has been identified. ▸ Noise and/or vibration monitoring is also to be undertaken in response to noise or vibration complaints.
	Noise impacts on sensitive receptors—hours of work	▸ Construction works will be undertaken in accordance with the nominated hours of work within the Noise and Vibration Sub-plan and as per community consultation with sensitive receptors regarding permitted out of hours activities. ▸ Where feasible, construction works will be undertaken during CoP Vol 2 standard hours, to minimise impacts to nearby sensitive receptors.
	Noise impacts on sensitive receptors—staff	▸ Staff training will be undertaken so that unnecessary sources of noise are avoided. Training will enforce that: ▸ Unnecessary shouting or loud stereos/radios onsite is not tolerated ▸ Materials are not to be dropped from height ▸ Metal items are not thrown ▸ Doors/gates are not slammed ▸ Vehicle radios and engines will be turned off or volume lowered wherever possible.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Noise and vibration impacts on sensitive receptors—selection of construction equipment near sensitive receptors	▸ Quieter and non-vibratory construction equipment will be selected for use near sensitive receptors, where feasible and reasonable. This is particularly important for any non-standard/out-of-hours construction activities where sensitive receptors are nearby. This is also particularly important for loud and/or vibration-intensive plant such as mulchers and piling rigs. ▸ Appropriately sized equipment will be selected for the task, such as vibratory compactors and rock excavation equipment, e.g. a 22-tonne excavator is expected to operate 8 dB(A) quieter than a 40-tonne excavator, based on equipment noise emissions given by BS5228.1. ▸ Where reasonable and practicable, alternative construction methods will be adopted to reduce the noise and vibration impacts, such as: ▸ Using damped tips on rock breakers, where appropriate ▸ Using rock saws instead of blasting ▸ During clearing, using excavators with grabs and rake attachments instead of chainsaws; and mulching cleared material at locations away from sensitive receptors ▸ Avoiding onsite fabrication work where possible ▸ Using alternatives to impact pile driving where possible, such as continuous flight auger injected piles, pressed-in preformed piles, auger bored piles, impact bored piles or vibratory piles ▸ When piling, avoiding dynamic compaction using large tamping weights near sensitive and critical receptors, where possible ▸ Reducing energy per blow when piling (consider first whether this may result in prolonged exposure with no realised reduction in community disturbance).
	Noise and vibration impacts on sensitive receptors—blasting	▸ Where blasting impacts are expected to exceed the vibration limits adopted from the CoP Vol 2, the following measures will be undertaken, where practicable: ▸ Reducing the charge size by use of delays and reduced charge masses ▸ Ensuring adequate blast confinement to minimise the amount of overpressure ▸ Avoiding secondary blasting where possible; the use of rock breakers or drop hammers may be an acceptable alternative ▸ Avoiding blasting during heavy cloud cover or during strong winds blowing towards sensitive receptors ▸ Establishing a blasting timetable through community consultation, e.g. blasts times negotiated with surrounding sensitive receptors.
	Noise and vibration impacts on sensitive receptors—during hours of construction	▸ Where reasonable and practicable, the duration of simultaneous operation of noise or vibration-intensive plant will be minimised. Plant and equipment used intermittently or no longer in use will be throttled or shut down. ▸ Vibration-intensive stationary plant located near sensitive receptors will be isolated with resilient mounts. ▸ Noise-emitting plant and equipment, construction laydown areas will be orientated away from sensitive receptors, where feasible and reasonable. ▸ Equipment will be operated in the correct manner and correctly maintained, including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components and repair of leakages in compressed air lines. Construction plant, vehicles and machinery will be maintained and operated in accordance with manufacturer's instructions to minimise noise and vibration emissions. ▸ When piling, the pile and rig will be carefully aligned, and cable slap and chain clink minimized.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Noise and vibration impacts on sensitive receptors—mechanical plant management	▸ All mechanical plant near sensitive receptors will be modified to reduce noise by best practical means, such as: ▸ Internal combustion engines are fitted with a suitable muffler in good repair, operating as per the manufacturer's specifications, as a minimum ▸ Pneumatic tools are fitted with an effective silencer on their air exhaust port, where feasible and practicable ▸ Aggregate bins and chutes are lined with a rubber material, to dampen the vibration of the structure ▸ When piling, acoustic damping are provided to sheet steel piles to reduce vibration and resonance ▸ When piling, resilient pads are used between pile and hammerhead. Care will be taken when selecting a resilient pad as energy is transferred to the pad in the form of heat. ▸ Based on manufacturer data, between 4 and 11 dB(A) of attenuation can be achieved by engine mufflers. Various other equipment treatments, such as dozer track plate dampers, can provide between 6 and 10 dB(A) of attenuation, based on manufacturer data.
	Noise impacts on sensitive receptors—stationary noise sources	▸ Stationary noise sources near noise sensitive receptors will be shielded or enclosed where feasible and reasonable. Acoustic shielding will also be considered where works are expected to occur close to sensitive receptors for lengthy periods. Temporary noise barriers or enclosures can provide between 5 and 10 dB(A) of attenuation, based on preliminary calculations.
	Noise and vibration impacts on sensitive receptors—shielding of noise emitting plant	▸ Where feasible, structures and noise-emitting plant will be located such that the structures provide some shielding to any nearby receptors. Structures include: ▸ Temporary site buildings, such as sheds ▸ Materials stockpiles, including the spoil stockpile at the western tunnel portal ▸ Fencing ▸ Storage/shipping containers. ▸ Attenuation by a single row of standard shipping containers of between 5 and 10 dB(A) is achievable based on preliminary calculations, provided that: ▸ Four containers are located side-by-side between the noise source and the sensitive receptor, and 5 m from the noise source ▸ Gaps are overlaid with mass loaded vinyl. ▸ Where vibration impacts at sensitive receptors are expected to exceed the structural damage limits adopted from the CoP Vol 2 and, where reasonable and safe to do so, cut-off trenches to interrupt the direct transmission path of vibrations between source and receptors will be provided.
	Noise impacts on sensitive receptors	▸ Non-tonal reversing beepers (or an equivalent mechanism) be fitted and used on all construction vehicles and mobile plant regularly used onsite and for any out-of-hours work.
	Noise impacts on sensitive receptors—delivery of materials	▸ Site access points and roads will be sited as far as is practicable from sensitive receptors. ▸ Acoustic shielding will be considered if loading/unloading areas are close to sensitive receptors. ▸ Delivery vehicles will be fitted with straps rather than chains, where feasible. ▸ Offsite truck parking areas, if required, will be located away from residences and will be nominated, where practicable. ▸ The drop height of materials will be minimised, e.g. while loading and unloading vehicles or in storage areas. ▸ Reversing movements of vehicles will be minimised to reduce the use of reversing alarms. Where practicable, sites will be designed such that delivery vehicles are able to drive through the site and not be required to reverse.

Delivery phase	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Noise impacts on sensitive receptors—construction traffic	▸ Unsealed areas will be regularly graded, and potholes filled on sealed access roads and in hardstand areas to reduce noise from construction vehicles. ▸ Construction traffic will be kept to a minimum, e.g. it will be ensured that trucks are fully loaded so that the volume of each delivery is maximised. Where practicable, night-time construction traffic will be redirected away from noise sensitive receptors. ▸ The speed of construction traffic will be minimised near noise sensitive receptors.
	Noise and vibration impacts on sensitive receptors	▸ Residents within at least 390 m of the Toowoomba Range Tunnel section of the Project alignment will be consulted regarding ground-borne noise impacts of the TBM. ▸ Implement the agreed mitigation with the relevant landholder. ▸ Undertaken ground-borne noise and vibration monitoring where applicable.

23.15.8.4 Monitoring

Vibration monitoring will be undertaken at locations where the potential for building/structural damage risk has been identified and deemed warranted. This includes vibration sensitive receptors at which vibration impacts are expected to exceed the structural damage criteria recommended by DIN 4150.3 and recommended by the CoP Vol 2. Vibration monitoring will be undertaken by a suitably qualified professional, in accordance with the CoP Vol 2.

Noise monitoring will be undertaken to verify compliance at locations nominated in the Noise and Vibration Sub-plan, and at noise sensitive receptors that have been identified as having the potential for noise impacts to exceed relevant criteria.

Noise and/or vibration monitoring will also be undertaken in response to substantiated noise or vibration complaints.

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP will be captured in the processes identified in Section 23.9.

23.15.9 Cultural heritage

23.15.9.1 Environmental outcomes

Project works that involve excavation, construction or other activities that may cause harm to Aboriginal cultural heritage will be undertaken in accordance with the approved CHMPs for the Project under the ACH Act (CLH017009).

Project works are designed, located and undertaken to avoid or minimise impacts or disturbance of Aboriginal, historic and natural heritage items.

23.15.9.2 Performance criteria

- Comply with the approved CHMPs under the ACH Act.
- Seek opportunities for ARTC staff and contractors to learn about the Aboriginal cultural heritage and non-indigenous heritage associated with delivery of the Inland Rail Program.
- Clearing extents avoid impacts to previously undisturbed areas as far as practicable.
- Construction avoids direct and indirect impacts (e.g. vibration) to identified items/sites/areas of Aboriginal heritage significance, historic and natural heritage significance, where practicable.

23.15.9.3 Proposed mitigation measures

Relevant aspects and proposed mitigation and management measures for the detailed design, pre-construction and construction and commissioning phases of the Project are included in Table 23.21.

TABLE 23.21: MITIGATION MEASURES—CULTURAL HERITAGE

Delivery phase	Aspect	Proposed additional mitigation measures
Detailed design	All heritage	▸ Undertake initial consultation with relevant heritage asset owners regarding the Project alignment and proposed activities, including level of risk to the identified heritage and, if relevant, develop site-specific management measures with the asset owner/government agency. ▸ Design to avoid direct impacts to identified sites/items of Indigenous and non-Indigenous heritage significance where practicable. ▸ Undertake additional non-Indigenous cultural heritage surveys targeting locations where access was constrained, or where values were of local significance. Where applicable, design to respond to the outcomes of any further cultural heritage surveys.

Pre-construction	All heritage	▸ Construction planning will avoid directly impacting on identified sites/items of non-Indigenous heritage significance, where practicable. If items/sites cannot be avoided, photographic/digital archival recording of the items/sites (e.g. former rail station sites and associated infrastructure, homestead/dairies) and other contextual locations/structures of heritage significance will occur in accordance with outcomes of any further cultural heritage surveys for the Project. Items and/sites will be collected prior to construction in accordance with the Heritage Management Sub-plan to be developed as part of the CEMP.
		▸ The Heritage Management Sub-plan will detail mitigation and management measures to be implemented during construction in relation to cultural heritage. It will include specific reference to the CHMPs and incorporate:
		  ▸ Requirements for site induction, training, heritage monitors, inspections, audits, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction
		  ▸ Heritage management actions to be undertaken by suitably qualified persons
		  ▸ Specific requirements for cultural heritage sites/items that cannot be avoided during construction, particularly the Bicentennial National Trail (G2H-19-H25), the Gowrie Junction Railway Station (G2H-19-H13), Junction Street structures (G2H-19-H14) and Helidon Dip Road culvert (G2H-19-H30)
		  ▸ Unexpected finds procedure, including assessment by a suitably qualified person and notification obligations under the applicable legislation
		  ▸ Procedure for encountering potential burial sites or potential human skeletal material including notification obligations under applicable legislation
		  ▸ Any other requirements necessary to comply with conditions of approval, subsequent approvals, regulatory requirements or repair
		  ▸ Any damage to heritage structures will be repaired in a way that conserves the heritage values of the place (see *The Burra Charter* Article 1.4 (International Council on Monuments and Sites (ICOMOS) (Australia), 2013))
		  ▸ ARTC cultural heritage management plans/agreements.
		▸ Archaeological investigations will only be undertaken by archaeologists qualified and experienced in Indigenous and non-Indigenous (historic) heritage. Where necessary, works will be conducted in consultation with the relevant registered Aboriginal stakeholders in accordance with the CHMPs in place between ARTC and relevant parties.

Delivery phase	Aspect	Proposed additional mitigation measures
Pre-construction [continued]	Vibration	▸ Building condition/dilapidation surveys will be undertaken at all heritage structures identified during detailed design as being subject to potential vibration impacts. Surveys will occur before and after undertaking vibration-generating works (e.g. pile-driving), with the potential for monitoring during the construction activities as per the noise and vibration plans. ▸ Tailor construction methodology to limit vibration impacts to heritage structures, e.g. select plant and equipment with a preference for non-vibratory plan items near vibration sensitive receptors. ▸ Vibration at heritage places to be kept below 2 millimetres per second (mm/sec) wherever possible (in accordance with German Standard *DIN 4150: Part 3 1999 Structural Vibration in Buildings—Effects on Structures, 1999* (DIN 4150.3) (Deutsches Institut für Normung, 1999)). ▸ Pre-construction and post-construction condition dilapidation surveys to be undertaken at all heritage places at risk of vibration impact, in consultation with a suitably qualified person (heritage practitioner). ▸ Vibration to be monitored at places where threshold exceedances are possible. ▸ Where vibration exceedances occur, change design/construction methodology, where possible, to reduce impact. If impacts cannot be avoided, consultation with the relevant heritage asset owner/government agency will be undertaken to identify and implement appropriate mitigation measures prior to vibration-generating activities commencing. The measures are to be included in the Heritage Management Plan. Prior to the commencement of Project works, further targeted assessments will be undertaken to determine whether the vibration impacts exceed the criterion at the following heritage sites (but not limited to) and whether subsequent vibration monitoring is required: ▸ Main Range Railway (601480) ▸ Mount Lofty Rifle Range ▸ Bicentennial National Trail (G2H-19-H25) ▸ Gowrie Junction Road structure (G2H-19-H14) ▸ Howmans Road multiple structures (G2H-19-H26) ▸ Helidon Dip Road culvert (G2H-19-H30).

	Non-indigenous heritage
	Built heritage
		If impacts cannot be avoided (e.g. G2H-19-H13), the following pre-construction measures may be implemented:
		▸ Archival recording:
		  ▸ Undertake archival photographic recording in accordance with Department of Environment and Heritage Protection (2013a) Guideline: *Archival Recording of Heritage Places*
		  ▸ Copies of archival records to be lodged with the John Oxley Library, and local libraries or historical societies as appropriate.
		▸ Repair:
		  ▸ Any damage to heritage structures will be repaired in a way that conserves the heritage values of the place (see The Burra Charter Article 1.4 (ICOMOS (Australia), 2013)).
		▸ Relocation:
		  ▸ Relocation of heritage items is generally undesirable, as setting forms an intrinsic part of heritage value (ICOMOS (Australia), 2013); however, if impacts cannot be managed in any other way, it may be appropriate to relocate buildings or items of moveable heritage to another location, such as a local historical society.

Delivery phase	Aspect	Proposed additional mitigation measures

Pre-construction [continued]	Non-Indigenous archaeological heritage	If impacts to non-Indigenous cultural heritage places cannot be avoided, the following pre-construction measures may be implemented by suitably qualified historical archaeologists:
		▸ Archaeological survey:
		  ▸ Undertake archaeological survey to map all elements of complex sites and identify areas of possible subsurface deposit.
		▸ Archaeological excavation:
		  ▸ If warranted by results of archaeological survey, undertake a two-stage archaeological excavation:
		  – Stage 1—test excavation to confirm subsurface deposit
		  – Stage 2—salvage excavation of subsurface deposits (if required)
		  – Stage 3—prepare and finalise post excavation report and analysis.
		▸ Archaeological surface collection:
		  ▸ Collect archaeological artefacts on the ground surface
		  ▸ Depending on nature of site, may be undertaken in conjunction with, or in place of, excavation.
		▸ Archaeological monitoring:
		  ▸ If warranted by results of archaeological survey, archaeologists will monitor ground-breaking works to identify any subsurface deposits.
		▸ Archaeological chance finds:
		  ▸ In the case of unexpected archaeological finds, the appropriate protocols will be included in the Heritage Management Sub-plan and will be followed.

	Indigenous heritage	▸ Cultural heritage to be managed in accordance with CHMPs. This might include:
		  ▸ Undertaking comprehensive cultural heritage surveys for both early works and Project activities with the Traditional Owners
		  ▸ Undertaking archaeological survey (including excavations where necessary)
		  ▸ Generating survey reports to provide detailed assessment and management recommendations
		  ▸ Assessing significance of any cultural heritage
		  ▸ Recording (where Project activities may have a direct impact on cultural heritage values).
		Archaeological investigations will only be undertaken by archaeologists qualified and experienced in Aboriginal heritage, in consultation with the Aboriginal Parties, and in accordance with the CHMPs.

Construction and Commissioning	All heritage	▸ Where impacts can be avoided to known Indigenous or non-Indigenous heritage, appropriate precautionary measures, such as informing relevant staff and contractors of the nature and location of the items and need to avoid impacts, detailing location on site maps, along with temporary protective fencing and signage, will be implemented for those sites in close proximity of the area of works. ▸ Works will not be performed on potential heritage items without required approvals and appropriate management plans. ▸ Temporary protective barricading will be installed around heritage places or artefacts that are located within the Project disturbance footprint and will be retained. ▸ If a suspected Aboriginal or historic heritage item or site is identified, any works that may impact the item or site will stop, and the unexpected finds procedure in the Cultural Heritage Sub-plan will be followed. Any responses to chance finds will only be undertaken by archaeologists qualified and experienced in the relevant discipline. ▸ In the event of the discovery of potential human remains, all work in the area will cease and the relevant statutory process for the notification and management of human remains will be instigated in accordance with the Heritage Management Sub-Plan.

Delivery phase	Aspect	Proposed additional mitigation measures
Construction and Commissioning [continued]	Vibration	▸ Vibration monitoring will be required at heritage structures where the potential for building/structural damage risk is identified during the detailed design phase or as part of preconstruction dilapidation surveys. Vibration monitoring will be undertaken by a suitably qualified person, in accordance with relevant standards and guidelines. Where monitoring is required to occur at a heritage structure, placement of equipment will be carried out on advice from a suitably qualified person (heritage practitioner). ▸ Where vibration exceedances occur, the design/construction methodology will be changed, where possible, to reduce impact. This may include the use of rock saws instead of blasting, damped tips on rock-breakers, and/or avoiding dynamic compaction when piling. ▸ Any damage that occurs at heritage places as a result of vibration or other Project activity will be repaired in accordance with *The Burra Charter* principles (Article 1.4).
	Indigenous heritage	Cultural heritage will be managed through the approved CHMPs (CLH017009), in accordance with the ACH Act, which includes the following management measures: ▸ A cultural heritage induction for ARTC staff, including contractors and subconsultants. ▸ Developing a cultural heritage awareness program. ▸ Provisions for managing unexpected finds of cultural material/sites (including burials). In accordance with the CHMPs, impacts on previously unregistered and unassessed items or places of cultural heritage significance will be mitigated by: ▸ Undertaking comprehensive cultural heritage surveys for both early works and Project activities with the Traditional Owners. ▸ Undertaking archaeological survey (including excavations, where necessary). ▸ Generating survey reports to provide detailed assessment and management recommendations. ▸ Assessing significance of any cultural heritage. ▸ Recording (where Project activities may have a direct impact on cultural heritage values). ▸ Establishment of buffer zones. ▸ Monitoring (during Project activities to ensure impacts to known cultural heritage are appropriately mitigated).

	Non-indigenous archaeological heritage	▸ Archaeological monitoring:
		  ▸ If warranted by results of archaeological survey, archaeologists will monitor ground-breaking works to identify any subsurface deposits.
		▸ Archaeological chance finds:
		  ▸ In the case of unexpected archaeological finds, the appropriate protocols will be included in the Heritage Management Plan and will be followed.

23.15.9.4 Monitoring

Vibration monitoring will be required at locations where the potential for building/structural damage risk is identified through the EIS reporting, further surveys during the detailed design phase or as part of pre-construction dilapidation surveys. Vibration monitoring will be undertaken by a suitably qualified person, in accordance with relevant standards and guidelines. Where monitoring is required at a heritage structure, placement of equipment will be carried out on advice from a suitably qualified person (heritage practitioner).

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP Sub-plan will be captured in the processes identified in Section 23.9.

23.15.10 Traffic, transport and access

23.15.10.1 Environmental outcomes

- Project construction traffic is managed to avoid or minimise, and mitigate, adverse impacts on road safety and traffic flow, public transport, school bus routes, property access and existing road pavements.
- Workforce parking is provided within the disturbance footprint and managed to avoid or minimise, and mitigate, adverse impacts to the local community.
- Traffic access for emergency services to construction worksites and adjoining properties, and wider road network identified in the Traffic Impact Assessment is maintained throughout the construction phase.
- Reasonable access is maintained to properties throughout Project works.

23.15.10.2 Performance criteria

- A Traffic Management Plan (TMP) will be developed and implemented by the construction contractor and communicated to all site personnel during site induction, including requirements for traffic routes and parking.
- Construction vehicles, including spoil haulage vehicles, are managed to avoid school zones during school pick up and drop off, and minimise the use of local streets. Construction vehicles that are 'heavy vehicles' are managed appropriately to avoid speeding, queuing, traffic incidents and to manage and avoid over-loading, spills and safety incidents.
- Information about the timing and scale of changes to traffic and transport conditions on traffic networks in the vicinity of construction works is provided in advance to the local community, road users and, on request, to other people interested in the construction works.
- Access to private properties is maintained during construction, unless an acceptable solution is agreed with the property owner.
- A TMP will be developed and implemented by the construction contractor and communicated to all site personnel during site induction, including requirements for traffic routes and parking.
- The construction workforce is provided with adequate onsite parking and use of parking is reinforced during induction and training.

23.15.10.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction and construction and commissioning phases of the Project are included in Table 23.22.

TABLE 23.22: MITIGATION MEASURES—TRAFFIC, TRANSPORT AND ACCESS

Delivery phase	Aspect	Proposed mitigation measures

Design/ pre-construction	Road safety	▸ Road safety audits will be undertaken pre-construction at level crossings in accordance with the Austroads guidelines to confirm:
		  ▸ The level of protection continues to be appropriate for the construction period until the level crossing is closed and traffic redirected
		  ▸ The infrastructure is appropriate for the traffic conditions during construction.
		▸ Ongoing consultation with local council/DTMR and asset owners will be undertaken to ensure safety concerns and issues are addressed.
		▸ Relevant emergency services will be notified of changes to the road network and of construction activities prior to construction commencing.
		▸ Pre- and post-construction inspections of routes to ensure suitability, including a Road Safety Analysis.
		▸ Ongoing consultation with Department of Education, TRC and school bus operators in regard to the closure of Morris Road and the proposed road network changes (including timing of the changes to the road network and potential school bus re-routes).

Delivery phase	Aspect	Proposed mitigation measures
Design/ pre-construction [continued]	Road network	▸ A travel demand management (TDM) campaign will be prepared and implemented to inform the public on works and their effect on network operations. ▸ Any changes to design and land requirements will be assessed and notified to the relevant stakeholder/agency/council. ▸ Road closures (temporary and permanent) to be discussed with DTMR, Department of Resources, local councils and emergency services, with alternative solutions provided to ensure minimal impact on existing and future traffic. ▸ A Traffic Management Plan (TMP) will be prepared prior to the construction phase as a joint effort between the construction contractor, DTMR, relevant local council, QR (where applicable) and an accredited road safety auditor, once preferred construction routes are known. This plan will identify the impact that construction traffic is likely to have on the transport infrastructure and detail any additional measures required to avoid, reduce or mitigate all identified impacts of the Project. ▸ Road Use Management Plans (RUMPs) for the Project will be developed to identify, where required, appropriate traffic and transport management strategies for the use of the State Controlled Roads (SCRs) and Local Government Roads (LGRs) for each of the construction stages of the Project and to minimise the impact on the efficiency of road networks as well as the operational safety of the Project-related vehicles accessing the construction disturbance footprint. The RUMP will be developed in consultation with DTMR, emergency services including Queensland Police Service, and the relevant LGA and, where relevant, QR.
	Road–rail interface	▸ Prepare agreements in writing with stakeholders for public roads and private landholders before detailed design phase.
	Rail–rail interface	▸ Ongoing consultation with DTMR and QR regarding design of the Project, including discussions around relocation of existing services, required permits and approvals and design measure to ensure both networks can operate autonomously.
	Intersections	▸ Traffic management plans, traffic control plans and temporary road works, including diversion and signage, will be prepared prior to construction and will consider construction activity delivery timeframes that avoid peak-hour travel conditions. ▸ Ongoing consultation with QR during the construction planning process (detailed design phase) to determine scheduling and safety issues with existing QR owned and operated level crossings in close proximity to intersections used by construction vehicles. ▸ Temporary intersections will be established in consultation with the relevant road authority and will comply with agreed conditions and design standards.

	Pavement	▸ Pavement impact assessment will be undertaken on SCRs in the detailed design stage once the construction contractor has been appointed and construction routes have been selected. This assessment will identify measures to avoid, reduce or mitigate effects on the pavement life of the SCRs, such as:
		  ▸ Provide a payment contribution for future pavement works
		  ▸ Provide extra pavement width (e.g. to prevent edge degradation)
		  ▸ Provide additional pavement thickness
		  ▸ Seal an unsealed pavement
		  ▸ Provide maintenance during construction
		  ▸ Undertake pavement rehabilitation.
		▸ For local control roads, a condition assessment will be undertaken (e.g. National Association of Australian State Road Authorities (NAASRA) roughness count, visual inspections) prior to construction activities commencing, including agreed intervals for further inspections.
		▸ Identification of any routes that may benefit from load limits.

Delivery phase	Aspect	Proposed mitigation measures
Design/ pre-construction [continued]	Access	▸ Confirm and consolidate access tracks, where possible, leveraging over the existing road network and existing access tracks. Where required, enter into an agreement with the landholder for the use or establishment of the access tracks, along with whether the track will be left in-situ or rehabilitated. ▸ Confirm, in consultation with landholders, required access across the rail alignment in response to service of a property or private stock route. ▸ Ongoing consultation with local councils/DTMR and asset owners will be undertaken to ensure proposed access arrangements are suitable. ▸ The RMAR strategy will be updated to ensure it remains consistent with changes in design.
Construction	Road safety	▸ Fatigue management measures will be introduced and enforced for all workers during construction. ▸ Pre- and post-construction inspections of routes to ensure suitability, including a Road Safety Analysis. ▸ Road safety measures will be implemented, taking into consideration speed restrictions, driver fatigue, in-vehicle communications, signage, demarcations, maintenance, safety checks, interaction with public transport, transport of hazardous and dangerous goods, and emergency response and disaster management. ▸ Relevant emergency services will be notified in advance prior to the movement of all hazardous/dangerous or oversize construction material and equipment. ▸ All oversize over mass (OSOM) and restricted access vehicles (RAV) will comply with all relevant safety regulations and guidelines set out by DTMR and the National Heavy Vehicle Regulator (NHVR). ▸ Consideration will be given to limiting construction traffic on school bus routes during pick-up and set-down times on school days; alternatively, appropriate school bus infrastructure may be installed. ▸ Consultation with relevant local councils will be undertaken prior to the construction stage of the Project, once construction routes have been finalised, to ensure that all public transport routes that may be impacted by construction traffic have been considered. Temporary traffic management will be implemented, e.g. road signs stipulating reduced speed limits as per the relevant TMP. ▸ Ongoing consultation will be undertaken with relevant local councils, DTMR, Police, emergency services and affected property owners/occupiers to inform of Project status, likely traffic disruptions and temporary road closures. ▸ Temporary road closures to be performed by police escorts (as required) with closure times limited to a maximum of 15 minutes. ▸ ARTC contractor to identify any damage to road from construction traffic. Any damage or decreased asset life resulting from construction traffic to be addressed through consultation process with the relevant road authority.

Delivery phase	Aspect	Proposed mitigation measures
Construction [continued]	Road network	▸ A TDM campaign to inform the public on works and its effect on network operations will be implemented. ▸ The TMP will be implemented and reviewed periodically for effectiveness by stakeholders. ▸ Heavy vehicles may be associated with the construction activities and, therefore, use of school bus routes will be avoided, if possible, or carefully managed to avoid conflicts. ▸ Consideration will be given to limiting construction traffic on school bus routes during pick-up and set-down times on school days; alternatively, appropriate school bus infrastructure could be installed. ▸ Workers to be made aware of school bus routes as well as typical pick-up and drop-off times in the vicinity of the Project. ▸ Temporary traffic management to be implemented, e.g. road signs stipulating reduced speed limits. ▸ Road closures (if required) to be performed by police escorts (if required) with closure times limited to a maximum of 15 minutes. ▸ Ongoing consultation will be undertaken with relevant local councils, DTMR, police, emergency services and affected property owners/occupiers to inform of Project status, likely traffic disruptions and temporary road closures. ▸ Directional signage and line marking around construction sites and the surrounding network to be implemented as per the relevant traffic management plan, including using Variable Message Signs (VMS) if appropriate. ▸ Relevant emergency services will be notified in advance prior to the movement of all hazardous/dangerous or oversize construction material and equipment. ▸ Secondary alternative construction route activities will be determined as part of the TMP, in the event that the primary route is blocked off by an emergency/accident. ▸ Consolidation of construction routes and access points, with due consideration of the other Inland Rail projects.
	Intersection	▸ Traffic management plans, traffic control plans and temporary road works will be implemented and reviewed to ensure effectiveness. ▸ TMP will be implemented and reviewed periodically by stakeholders to ensure intersection operations are effective.
	Pavement	▸ Install wheel washers on all Project vehicles and/or equipment that exit onto sealed roads from unpaved roads. ▸ A rock bed may be installed, as appropriate, at vehicle/equipment site exit points. ▸ Install shaker grids or rumble pads at site exit points from construction disturbance footprint. ▸ For local control roads, a condition assessment will be undertaken (e.g. NAASRA roughness count) at ongoing intervals during construction and at the conclusion of construction activities, as agreed with local councils prior to construction commencing ▸ The use of a SCR and LGR owner-approved maintenance contractor to maintain impacted roads for the duration of the construction period. This may entail works such as crack sealing, pothole patching, edge repairs, resealing and grading (of gravel roads), etc.
	Access	▸ RMARs to be reviewed and updated once detail around the planned construction methodology is known, which will occur during the detailed design stage. RMARs will facilitate maintenance for critical infrastructure (e.g. turnouts) and provide access for emergency recovery. ▸ Access roads to be left in-situ or rehabilitated subject to agreements with landholders.

23.15.10.4 Monitoring

Requirements for monitoring will be documented in the Traffic, Transport and Access Sub-plan.

In the event that traffic transport and access management conditions vary from those documented in detailed design, a review of compliance with conditions of the CEMP will be undertaken by the Service Provider and revised as required.

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP Sub-plan will be captured in the processes identified in Section 23.9.

23.15.11 Hazard and risk

23.15.11.1 Environmental outcomes

Appropriate measures will be implemented to avoid or minimise the risk of health, safety or environmental incidents during construction works.

Emergency management plans are in effect to manage potential natural hazards, including flooding, fire, cyclone or heatwave events during Project works.

23.15.11.2 Performance criteria

- A safe working environment is maintained for the construction workforce, near neighbours and other stakeholders
- A Project Hazard and Risk Register is maintained to record and implement appropriate systems and procedures to manage and respond to both natural and man-made hazards and risks during construction
- Comply with relevant Australian Standards for the handling and storage of hazardous goods.

23.15.11.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.23.

TABLE 23.23: MITIGATION MEASURES—HAZARD AND RISK

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design	Natural	Bushfire	▸ Design to maintain appropriate access during construction and operation, ensuring local roads allow emergency access, first response firefighting, access to water supply for firefighting purposes and safe evacuation routes. ▸ The landscaping design will include a wide strip of land on either side of the tracks to be clear from vegetation, to provide a suitable fire break.
	Natural	Flooding and flash flooding	▸ Work with stakeholders, including directly impacted landholders, relevant community stakeholders, local councils, State departments and local flood specialists, to inform and refine assessments and design. ▸ Continue to refine Project design in response to hydraulic modelling. This includes consideration of peak water levels, flow distribution, velocities and duration of inundation. This will inform bridge lengths, culvert sizing and numbers, scour and erosion protection measures for both rail, road and other permanent Project infrastructure. ▸ Review flood risk assessment to inform the siting and scale of temporary construction areas (including stockpiles, construction compounds, access roads, laydown areas, etc.).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design [continued]	Natural [continued]	Flooding and flash Flooding [continued]	▸ Locate plant and equipment maintenance activities and refuelling facilities, in accordance with a risk assessment, at an appropriate distance from riparian vegetation and waterways, with appropriate measures in place to avoid impacts to waterways and aquatic habitats, as per water quality management plans. The Project is located in the upper reaches of most catchments and elevated structures are designed where the Project intersects floodplains.
	Natural/ unknown previous land use	Landslide, sudden, subsidence, movement of soil or rocks	▸ Incorporate batter slopes and scour protection into design. ▸ The geotechnical data collected from the construction of the Toowoomba Bypass allows for a greater understanding of the geotechnical profile for the design of the tunnel. ▸ Site-specific investigation to establish colluvium characteristics, depths and extents. ▸ Rigorous inspection of slopes to map out slope stability. ▸ Cut-and-cover tunnel and mined tunnel to be adopted at the eastern tunnel portal.
	Natural	Climate conditions	▸ Optimise tunnel ventilation to reduce energy requirements during operation. ▸ Continue to refine the cut/fill balance for earthworks to minimise material transport requirements. ▸ The Project design will implement safety measures for the potential damage of tracks and assets as a result of extreme hot weather events, such as considering the use of elastic fasteners or heavier sleepers to reduce the risk of track buckling, selection of materials and colour to reduce heat load on trackside equipment. ▸ The design has been developed to achieve a design life of 100 years. In doing so, designs for formation, track and structures have been developed in accordance with the ARTC Codes of Practice. The management of temperature fluctuation will be assured by sourcing components that have the assurance from manufacturers that the components maintain integrity at the required or envisaged temperatures. ▸ Factor for the potential increase in flood risk arising from any increase in extreme rainfall as a result of climatic conditions. Adaption strategies, such as installing an early flood warning system to alert ARTC to impending flood risks, locating critical electrical systems (signalling, communications huts, etc.) above potential flood zones, and considering the use of solar and battery devices to ensure uninterrupted operation of signalling and network communication in the event of power failure, will be incorporated into the detailed design. ▸ Design for future climate, including consideration of existing ARTC protocols for operating in extreme temperatures. ▸ Sustainability initiatives, particularly in relation to energy consumption and savings throughout the Project lifecycle will be incorporated into the detailed design.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures

Detailed design [continued]	Project	Rail incidents	▸ Track detailed design will incorporate trackside monitoring systems, which will detect faults in the wheel set and monitor rail wheel condition and defects at locations (e.g. shifting of freight containers within the tunnel) deemed necessary by the design team.
			▸ ARTC has undertaken, and will continue to undertake, technical meetings with QR and DTMR in regard to interfaces between the Project and the West Moreton System with the aim of resolving measures/process during construction and operations, including such items as:
			  ▸ Design elements, such as track spacing, rail-over-rail structures and tie-ins
			  ▸ Operational elements, such as signalling and control integration, communications protocols, etc.
			  ▸ Disruptions to existing rail traffic and maintenance operations during construction.
			▸ Tenure arrangements and responsibilities within the future rail corridor, including network rules and procedures, rail safety processes in each company's (ARTC, QR) safety management systems.

	Project	Road–rail interfaces	▸ Detailed design of 1.8 m chain fencing is required near roads or where trespass risk is identified.
	Project	Emergency access	▸ Emergency access will be addressed by the development and implementation of an access strategy. Consideration of the use of the rail maintenance access road by emergency vehicles will be made when evaluating the position of corridor access points. To facilitate emergency egress, multiple access points into and out of the rail corridor will be provided. This will include the consideration for the access of three pumpers, one rescue/incident control appliance, one Urban Rescue Tender and one Urban Hazmat Medium in the event of a major train tunnel incident. ▸ Safe corridor access and vehicle turnaround points will be provided for maintenance work to ensure sufficient setback while working adjacent to live railway. Maintenance and emergency access roads will be designed such that it will allow separation to prevent interaction between trains and vehicles without impeding escape or rescue activities.
	Project	Tunnel	▸ The fire and life safety controls for the tunnel will include detailed design fire resistance level (load bearing elements to achieve 120-minute structural adequacy when exposed to the Rijkswaterstaat (RWS) temperature time curve, while non-load bearing elements are to achieve a Fire Resistance Level (FRL) of -/120/120, safety equipment and devices, such as emergency phones, emergency exits, emergency lighting, fire doors, hydrants and extinguishers. ▸ The tunnel design has incorporated fire and life safety mitigation measures, to ensure appropriate facilities are available. These mitigation measures include limiting the amount of combustible materials used in construction, providing fire detection systems, preventing derailed trains from entering the tunnel and preventing trains that are on fire from stopping in the tunnel.
	Project	Abandoned mines and underground collieries	▸ Further mapping and surveys will be undertaken to investigate and identify any collieries. ▸ The Project will continue to engage with the Abandoned Mines Program in the Department of Resources. In the event an interface is determined, develop a construction management strategy to minimise risk and identify rehabilitation opportunities and responsibilities in consultation with the Department of Resources.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction	Project	Underground and overhead services	▸ The Project has identified (and will continue to confirm) known services that require relocation or protection prior to construction, and has commenced in consultation with the relevant service provider. ▸ Overhead transmission lines and buried telecommunication cables will be identified before construction to ensure that construction and operation do not interfere or damage the utilities as per the requirements of the *Electrical Safety Act 2002* (Qld) and subordinate legislation and Safe Work Australia's *Model Code of Practice— Managing Electrical Risk in the Workplace* (2018c). The Project has considered alignment to minimise the potential interference with these overhead utilities . ▸ The Project will lodge a Dial Before You Dig enquiry prior to excavation or drilling work, which provides information about underground services on the worksite. Procedural control for the Project will ensure that excavation work will comply with the Safe Work Australia *Excavation Work—Code of Practice* (2015). ▸ Consultation with APT Petroleum Pipelines Pty Ltd has commenced with respect to the Roma to Brisbane Pipeline (PPL 2). In relation to service disruptions during construction, procedures will be developed and implemented to minimise the potential for service interruptions. Affected businesses and residences will be notified in advance of any planned interruptions.
	Project	Contaminated land	▸ Contaminated land assessments, and investigations for land identified as having known or suspected contaminated areas, will be undertaken (noting some preliminary assessment have commenced) and a Contaminated Site Management Plan will be prepared to document management controls for works on the relevant contaminated areas and outline the process to identify, document and manage each of the contaminated sites.
	Project	Asbestos	▸ Older infrastructure and previously disturbed land within the disturbance footprint may contain asbestos. The Project will adhere to *How to Manage and Control Asbestos in the Workplace* (Safe Work Australia, 2018a) and *How to Safely Remove Asbestos* (Safe Work Australia, 2018b). ▸ Survey of infrastructure that will be removed or disturbed by the Project will be conducted to potentially identify asbestos-containing materials. For the existing West Moreton Rail System, consultation with QR will also inform asbestos management strategies. ▸ Construction activities likely to disturb asbestos will review the presence and requirement for specific controls. ▸ The Project will engage with competent contractors who are appropriately licensed for asbestos disturbance work.
	Project	Existing infrastructure and utilities	▸ The Roma to Brisbane gas pipeline is 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.
	Project	Bridges/viaducts	▸ Ground surveys will be carried out with boreholes at all pier locations and abutments during construction early works, to mitigate against bridge collapse.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction [continued]	Project	Road–rail interfaces	▸ 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 and road closure permits.
	Project	Abandoned mines and underground collieries	▸ A preliminary ground inspection for open shafts/adits and any other mine working features will be conducted as a precaution. Additionally, geotechnical surveys are conducted during detailed design and construction. ▸ Measures for encountering unrecorded historic collieries or abandoned mines will be developed under the 'Unexpected Finds Protocol/Procedure' as part of the CEMP; noting that no collieries or abandoned mines were detected during the two rounds of geotechnical investigations, during ecological surveys or noted by landholders, or from historical imagery.
Construction and commissioning	Natural	Bushfire	▸ High fire-risk activities, such as hot works including flash-butt welding, will be carried out in accordance with ARTC's Fire Prevention Management Procedure (ARTC, 2006a) and Total Fire Bans Procedure (ARTC, 2018d).. These procedures establish processes to manage hot work/high fire-risk activities, including observation of relevant QFES directives, check extent of work site vegetation prior to hot work, and ensure appropriate firefighting equipment and trained personnel are available.
	Natural	Flooding	▸ Construction staging to include construction of drainage structures before embankment sections to mitigate flooding potential during construction. ▸ Locate laydown areas away from creeks (such as Gowrie Creek, Rocky Creek, Six Mile Creek, Upper Lockyer Creek and Oaky Creek). ▸ Overland drainage modifications will be incorporated, as required, at the western portal of the Toowoomba Range Tunnel.
	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ A Soil Management Plan will be implemented to manage the topsoil within the project disturbance footprint such that it can be reused in rehabilitation and landscaping activities; soil stockpiles will be managed in accordance with the Erosion and Sediment Control Plan (ESCP). ▸ Regular earthworks inspections will be implemented to identify defects and conditions that may affect or indicate problems with the stability of earthworks. ▸ The period that soil is exposed will be minimised through progressive ground cover revegetation, to minimise erosion. ▸ Temporary construction facilities will be sited to avoid flood areas, overland flow paths and minimise clearance of established vegetation where possible. ▸ Rigorous inspection of slopes prior to construction and, where applicable, instrumentation and monitoring before and during construction. ▸ The geotechnical data collected from the construction of the Toowoomba Bypass allows for a greater understanding of the geotechnical profile for the construction of the tunnel.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Natural	Climate conditions	▸ Opportunities for the reduction of greenhouse gas generation during construction will be considered as per the Sustainability Management Plan developed during the detailed design/pre-construction phases. ▸ Laydown areas have been nominated along the length of the Project and at strategic locations, such as near the tunnel portals and bridge structures. These will act as a centralised point for material storage, with some storing hazardous materials such as fuel. The locations of laydown areas have been chosen to avoid areas that are within the 1% AEP floodplains where possible; however, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas will be within flood plains and near water sources. ▸ ARTC will work towards minimising future risk in emergencies and engage with local councils and the local Disaster Management Groups for Toowoomba and Lockyer Valley. ▸ Weather station environmental monitoring for all areas especially those subject to high winds. ▸ Construction water will be obtained from sustainable sources, with the necessary water entitlement, water allocation, water licence or water permit. Current water demand can be met through the use of existing water sources; however, further options may need to be investigated depending on engagement with water resource owners and water availability.
	Natural	Wildlife	▸ Construction works will be undertaken in accordance with the Flora and Fauna Sub-plan.
	Natural	Biosecurity	A Biosecurity Management Plan will be prepared as part of the CEMP to include: ▸ Requirements for pre-clearing surveys to determine the risk of weeds or pest animals being present. ▸ Maps of the existing extent and severity of weed infestation and weed management requirements. ▸ Pest animal management (including fire ants). ▸ Project works site hygiene and waste management procedures to deter pest animals. ▸ Weed surveillance and treatment during construction and rehabilitation activities. ▸ Requirements in relation to pesticide and herbicide use and documentation, including any limitations on use, such as restrictions on use in sensitive environmental areas, drainage lines that flow to waterways and aquatic habitats, and ensuring that broad-scale use does not result in an increased erosion and sediment risk. ▸ Vehicle, machinery and imported fill hygiene protocols and documentation. ▸ Erosion and sediment control risks associated with broad-scale weed removal or treatment.
	Project	Fatigue and heat stress management	▸ Construction management plans, systems, workplace conditions and facilities will align with requirements of the *Work Health Safety Act 2011* (Qld) and will follow Safe Work Australia's *Managing the risks of working in elevated heat conditions to manage heat stress* (Safe Work Australia, 2017).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Project	Asbestos	▸ Depending on the type and amount of asbestos-containing materials, if they are disturbed by the Project, the Project will engage with a Class A or Class B licensed asbestos removalist for the handling and disposal of asbestos. In the event of uncertainty as to whether exposure standards will be exceeded, or work will generate airborne fibres by any method, air monitoring will be carried out by appropriately qualified personnel.
	Project	Dust, respirable silica and other airborne contaminants	▸ Direct construction worker exposure to respirable silica and other airborne contaminants will be controlled through the use of appropriate personal protective equipment. ▸ Where sensitive receptors, agricultural land uses or protected vegetation are located within 150 m of construction works, or visible dust is generated from vehicles using unsealed access roads, road watering or other appropriate controls will be implemented. ▸ Vehicles transporting potentially dust and/or spillage generating material to and from the construction site will be covered immediately after loading (prior to traversing public roads). ▸ Visually inspect vehicles entering/exiting the site and implement and maintain additional controls such as wheel wash and or rumble grids. ▸ Limit clearing to the Project disturbance footprint. ▸ Where practical, clearing, grubbing and construction activities will be undertaken to minimise exposure to erosive processes. ▸ Implement controls to prevent and/or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast (i.e. use water sprays or water carts for dust suppression as required).
	Project	Dust, respirable silica and other airborne contaminants [continued]	▸ Avoid ground-disturbing activities during windy conditions (i.e. winds >10 metres per second (m/s) or when prevailing winds are likely to result in dust impacts to sensitive receptors. ▸ Implement additional dust suppression controls prior to the onset of adverse weather, including covering of temporary stockpiles and additional treatment of access roads. ▸ Longer-term material stockpiles will be treated with temporary organic or biodegradable cover (such as mulch, grass seeding/hydro-mulch, soil binder, etc.) to prevent risk of windborne erosion and dust.
	Project	Noise and vibration	▸ The Project will develop and implement a Noise and Vibration Sub-plan as part of the CEMP. ▸ Noise and vibration sources from construction involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers. The Project will reduce and manage noise as much as is possible through a range of noise management measures. Noise disruption from night works are kept to a minimum and work will be undertaken as quickly and efficiently as possible. ▸ Sensitive receptors with the potential to be affected by noise will be notified prior to the commencement of relevant works. ▸ Construction progress and upcoming activities will be regularly communicated to local residents/stakeholders; particularly, when noisy or vibration-generating activities are planned, such as vibratory compaction and piling.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Project	Road incidents	▸ A TMP under the CEMP will be developed and implemented to identify the impacts that construction traffic is likely to have on transport infrastructure and detail ameliorative measures required to mitigate Project impacts. ▸ Specific hazard-control measures will be applied, including clearly defined access for vehicles and pedestrians along the rail corridor, and the provision of fencing and gating for all corridor access points to prevent unauthorised entry. ▸ Access roads and laydown areas established for construction that will have no permanent use will be decommissioned following construction, unless otherwise agreed with relevant landholders. ▸ Storage areas and equipment laydowns will be maintained in good condition to maintain visibility for vehicles.
	Project	Rail incidents	▸ QR's written approval will be obtained prior to commencement of work in accordance with section 255 of the *Transport Infrastructure Act 1994* (Qld) to ensure coordination between ARTC and QR is established for reduction of rail incidents between the operations. ▸ If construction of Project components within 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. ▸ 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, 2016a). ▸ All work performed on QR property, or when directed by QR, will be under the supervision of a Possession Protection Officer or Protection Officer and will be carried out only at times authorised by QR or the QR-appointed Project manager.
	Project	Tunnel	▸ Tunnel portal, intermediate ventilation shaft and cut construction may potentially involve blasting work. If blasting occurs as part of the detailed design construction methodology, the use of explosive substance will comply with the *Explosive Act 1999* (Qld). ▸ The geotechnical lessons learnt from the Toowoomba Bypass will be reviewed and applied, as relevant, for the Project.
	Project	Underground and overhead services	▸ Procedural control for the Project will ensure that excavation work will comply with *Excavation Work—Code of Practice* (Safe Work Australia, 2015). ▸ The ARTC *Engineering Standard for Requirements—Electric Aerials Crossing ARTC Infrastructure* (ARTC, 2005b) requires that all structures supporting a span of electric aerials over ARTC railway track or sidings be located so that, in the event of failure, no part will fall within 1.8 m outside of any railway track.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning [continued]	Project	Contaminated land (including UXO and land contamination)	▸ Construction personnel involved in ground-disturbing works will be trained in the identification of potential contaminated soil/material and the relevant controls that will be put in place in the event of its discovery. ▸ Waste generation from construction activities can potentially contaminate the surrounding land and will be managed in accordance with the Waste and Resource Management Sub-plan and ARTC *Environmental Policy* (policy provided in Appendix G: Corporate Policies). ▸ Identification of UXO will be subject to a risk assessment. Where there is a risk of encountering known or possible UXO, a suitably qualified person will assess and identify management options. ▸ Implementation of a Contaminated Site Management Plan if contaminated land is suspected.
	Project	Existing infrastructure and utilities	▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project footprint (APA's Roma–Brisbane Gas Pipeline) will continue throughout the Project in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and *AS 2885 Pipelines—Gas and liquid petroleum* (Standards Australia 2008b) to ensure that there are no unsafe incidents during Project activities. ▸ ARTC and APA have evaluated the risk associated with the five interactions between the Project alignment and the Roma to Brisbane Gas Pipeline, and proposed specific design and construction mitigations for each interaction location.
	Project	Emergency access	▸ The maintenance of emergency access will be managed through the development and implementation of a Project Access Strategy. Access for emergency vehicles during construction of the Project will be discussed with services providers during development of the strategy. In instances where construction-phase emergency access is affected, use of the RMARs by emergency vehicles may be appropriate. Multiple access points into and out of the rail corridor will be provided. ▸ A TMP under the CEMP will be implemented to minimise impacts to surrounding land users.
	Project	Abandoned mines and underground collieries	▸ If an unrecorded historic colliery is encountered during construction, the measures outlined under the 'Unexpected Finds Protocol/Procedure' in the CEMP will be followed.
	Dangerous goods and hazardous chemicals	Chemicals spillage and loss of containment	▸ Construction facilities where hazardous materials may be used or stored have been located outside of floodplains and away from areas of social and environmental receptors, in accordance with the Queensland *State Planning Policy* (DILGP, 2017b). Additionally, the locations of construction facilities where vehicle maintenance and refuelling activities are expected will be selected to achieve appropriate separation to riparian vegetation and waterways. ▸ During the construction phase of the Project, dangerous goods will be required at construction sites and facilities. Licensed transporters operating in compliance with *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2008) will be used for dangerous goods deliveries. ▸ Construction chemicals stored and handled will be managed in accordance with the *Work Health Safety Act 2011* (Qld) and Regulation, the relevant Australian Standards and the requirements of chemical safety data sheets. Safety data sheet information will be obtained from the supplier of these chemicals and stored in an easily accessible location.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures

Construction and commissioning [continued]	Dangerous goods and hazardous chemicals	Explosives	▸ Where explosives are used for significant cuttings during construction, the works will be undertaken by licensed shotfirers in accordance with the *Explosives Act 1999* (Qld) and *AS 2187 Explosive—Storage, Transport and Use* (Standards Australia, 2006a).
			▸ The shotfirer or blasting contractor will provide the Hazardous Material Management Sub-plan to the Explosive Inspectorate as part of the notification process of blasting activity at least seven days before the proposed blasting activity is carried out.
			▸ Chemicals stored and handled as part of construction activities will be managed in accordance with:
			  ▸ AS 2187.2: 2006 *Explosives—Storage and use of explosives for explosives use* (Standards Australia, 2006a)
			  ▸ AS 2187.1: 1998 *Explosives—Storage, transport and use storage for explosives storage* (Standards Australia, 1998)
			  ▸ *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission, 2008) for explosives transport by road and rail.
			▸ Develop and implement a Blast Management Plan as part of the Noise and Vibration Sub-plan within the CEMP.
			▸ At all times, the handling and use of explosives will follow procedures to:
			  ▸ Prevent misfire
			  ▸ Minimise the risk associated with material projected by a blast
			  ▸ Minimise adverse effects of ground vibration and shock waves caused by a blast
			  ▸ Ensure explosives are not used after either the manufacturer's recommended shelf life or the approved, extended shelf life
			  ▸ Ensure public safety, vehicular access and security
			  ▸ Identify other activities in proximity of explosive use
			  ▸ Identify the environment of explosive use, including flood, bushfire, landslide zones, etc.
			▸ WH&S Management Plans will include appropriate measures to manage risk associated with blasting, such as consultation with service providers, comply with separation requirements and access controls, exclusion zones, trails and buffers. Additionally, WH&S Management Plans will seek to minimise interruption to mine explosive transport routes, by communicating with mine management in regard to the schedule and activities of the Project.

23.15.11.4 Monitoring

Track design will incorporate trackside monitoring systems, which will detect faults in the wheel set and monitor rail wheel condition and defects at various locations deemed necessary by the design team.

Regular earthworks inspections will be implemented to determine defects and conditions that may affect or indicate problems with the stability of earthworks, such as fissures, rocks or debris on or near tracks, loss of track geometry, track subsidence, water seepage and damage to embankments.

Inspections and assessments will be carried out regularly to identify mud holes, wet spots, sleeper condition and excessive track vibration, which indicate potential defects that may affect the integrity of the track structure and ballast profile.

Monitor actual hours of work and take action to reduce risk of fatigue where required.

Monitoring and reporting on compliance with the mitigation measures identified in this draft Outline EMP Sub-plan will be captured in the processes identified in Section 23.9.

23.15.12 Waste and resource management

23.15.12.1 Environmental outcomes

All wastes generated during the construction are stored, handled, treated, reused, recycled and/or disposed of lawfully and to reduce environmental harm.

Measures are implemented to reduce the amount of waste generated by the Project works.

23.15.12.2 Performance criteria

- Adopt the waste hierarchy (avoid/reduce, reuse, recycle, recover, treat, dispose) across the Project
- Assess, classify, manage, and dispose of waste in accordance with the relevant State regulatory requirements and guidelines
- Establish and meet construction waste targets
- Implementation of opportunities identified for beneficial reuse of spoil and other materials during detailed design and construction in accordance with appropriate management procedures and relevant applicable legislation and regulations
- Minimise the import and disposal of fill material.

23.15.12.3 Proposed mitigation measures

Relevant environmental aspects and proposed mitigation and management measures for the detailed design, pre-construction, and construction and commissioning phases of the Project are included in Table 23.24.

TABLE 23.24: MITIGATION MEASURES—WASTE AND RESOURCE MANAGEMENT

Delivery Phase	Aspect	Proposed design objectives and mitigation measures
Detailed design	Waste	▸ Cut-and-fill balance and minimisation of transport requirements for the import/disposal of spoil will be considered further during detailed design by implementing the spoil management hierarchy presented in Appendix T: Spoil Management Strategy. ▸ Aim to maximise the reuse of local sources of aggregate and treatment of dispersive and reactive materials to improve mass haul. ▸ Aim to maximise the reuse of material excavated below the rail embankment for less critical parts of infrastructure. ▸ Aim to maximise the reuse of excavated material as a stabilised structural fill. ▸ Optimise the number, width and depth of cuts to avoid the generation of material that would be considered surplus to Project requirements. ▸ Continue to investigate the viability of the reuse of basalt material from the excavation of the tunnel as capping and structural material. ▸ Continue to investigate the viability of the reuse of excavated material as high-quality general fill or structural fill, to minimise the import of rock amour. ▸ Continue to investigate the viability of the reuse of dispersive and sodic soils as general fill in embankments and/or formations. ▸ Continue to investigate the viability of the material within the Project disturbance footprint for reuse as per the ARTC Earthworks Material Specification and the Earthworks and Material Management Framework, including extent of material that may need treatment (e.g. soil sampling and, where applicable, additional contaminated land surveys in accordance with relevant guidelines and procedures (refer Chapter 9: Land Resources). ▸ Establish waste reduction targets for design and construction. ▸ A waste reduction review will be undertaken to identify opportunities to meaningfully achieve the waste reduction targets through detailed design and construction of the Project.

Delivery Phase	Aspect	Proposed design objectives and mitigation measures
Detailed design [continued]	Waste [continued]	▸ Consideration of alternative approaches to materials used, construction and operational techniques, and maintenance of a process to achieve a less resource-intensive and more efficient process, in accordance with relevant design standards. For example, material specifications will consider aspects such as use of prefabricated materials, percentage of recycled content and percentage of material rejection to reduce waste generation from the Project. ▸ Establish water quality objectives for the water treatment plant, along with the capacity of the treatment plant, including waste storage areas and any proposed discharge points. ▸ Establish waste reporting requirements for the pre-construction, construction and commissioning phases of the Project for incorporation into the Waste and Resource Management Sub-plan.
Pre-construction	Waste	▸ A Waste and Resource Management Sub-plan will be developed and implemented as part of the CEMP, which complies with the Project conditions of approval and relevant regulatory requirements, including: ▸ Waste targets (or waste reduction targets) to be achieved for the Project ▸ Waste reporting requirements ▸ General protocols and performance objectives for keeping the work site clean and tidy ▸ Describe potential waste impacts, waste streams and estimated volumes ▸ Identify temporary waste storage areas and disposal locations on and off site (including stockpiles and landfilling) ▸ Ensure waste disposal is undertaken in line with the National Environmental Protection Measure criteria for disposal sites ▸ Requirements for waste segregation, e.g. green waste, spoil, construction and demolition waste, general waste, regulated waste and recyclables ▸ Requirements for secure temporary storage, collection frequency and disposal/recycling requirements ▸ Effluent management for construction staff amenities ▸ Procedures and reporting/documentation requirements for ensuring waste transporters and receivers are appropriately licensed according to the type of waste ▸ Requirements for training, inspections, audits, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.
	Hazardous Waste	▸ A contaminated and hazardous material survey will be undertaken prior to demolition of structures. In the event that asbestos or other hazardous materials are identified in these structures, a Contaminated and Hazardous Materials Management Plan will be developed and implemented as part of the Waste and Resource Management Sub-plan. ▸ Where identified, asbestos-containing materials will be removed prior to the commencement of construction. Asbestos removal and handling will be conducted in accordance with: ▸ *National Environmental Protection (Assessment of Site Contamination) Measure 2013* (National Environment Protection Council, 2013) ▸ Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia or equivalent ▸ *Model Code of Practice—How to Manage and Control Asbestos in the Workplace* 2016 (Safe Work Australia, 2018a) ▸ *Model Code of Practice—How to Safely Remove Asbestos* (Safe Work Australia, 2018b).

Delivery Phase	Aspect	Proposed design objectives and mitigation measures
Pre-construction [continued]	Hazardous Waste [continued]	▸ 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 licensed service provider and disposed of at an appropriately licensed facility, in accordance with the requirements of the WRR Act, *Work Health and Safety Act 2011* (Qld) (WHS Act) and the EP Act.
Construction and commissioning	Waste	▸ Identify opportunities to achieve waste reduction targets appropriate to the scope of the construction works. ▸ Reduce the amount of spoil generated through construction methodology, e.g. the use of roadheader in tunnelling construction allows for accurate cut while maintaining efficient spoil management. ▸ Avoid disposal of excavated material to landfill by implementing the spoil management hierarchy presented in Appendix T: Spoil Management Strategy. ▸ All cut material of appropriate suitability for reuse will be stockpiled separately and reused onsite, where possible. ▸ Careful specification of construction material requirements to avoid overestimation. ▸ Source good quality construction materials, in accordance with relevant design standards. ▸ Purchase construction materials in bulk to minimise packaging waste. ▸ Develop and implement administrative controls on the transportation of waste materials from the Project, within the disturbance area and offsite. ▸ Plant and equipment used in the Project is appropriately maintained. ▸ Maintenance activities, refuelling, concrete washout will be carried out at an appropriate distance (relative to task risk assessment) from riparian vegetation and waterways, with appropriate measures in place to reduce the potential for impacts to waterways, aquatic habitats, and groundwater. ▸ Portable toilets and amenities to be serviced and maintained to ensure efficient operation and minimise environmental risks associated with their operation and decommissioning. ▸ Contractors to adhere to the practices of the *Waste Reduction and Recycling Act 2011* (Qld) waste and resource management hierarchy, which sets out an order of preference for options for managing waste from avoiding, to reusing, recovering, treating and disposing of waste. ▸ Appropriate waste bins, facilitating segregation of waste, to be located at key site compounds to facilitate segregation and prevent cross contamination. ▸ Comply with the waste reporting requirements established in the Waste and Resource Management Sub-plan.
	Hazardous Waste	▸ Contaminated waste will be classified and disposed in accordance with the Waste and Resources Management Sub-plan. ▸ Hazardous or dangerous waste (e.g. asbestos, chemicals, oils) to be correctly stored, managed and disposed of by a licensed contractor or facility, and in accordance with the relevant occupational health and safety legislative and regulatory obligations, including wastes generated as a result of demolition.

23.15.12.4 Monitoring

Monitoring compliance of the development and implementation of the waste and resource management processes and performance criteria identified in this draft Outline EMP Sub-plan will be captured in the processes identified in Section 23.9.