CHAPTER 06

Project Description

CALVERT TO KAGARU ENVIRONMENTAL IMPACT STATEMENT

INLAND RAIL

ARTC

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

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6. Project description

6.1 Project overview

The Project is a new single track, dual gauge railway, approximately 53 kilometres (km) in length, connecting the existing Queensland Rail (QR) West Moreton System rail corridor with the existing Interstate Line at Kagaru. The Project starts within the existing QR West Moreton System rail corridor to the east of Calvert where it heads to the south-east, traversing through the localities of Lanefield, Rosewood, Lower Mount Walker, Ebenezer, Willowbank, Purga, Peak Crossing and Washpool. The Project then deviates to the north of the Southern Freight Rail Corridor (SFRC) through the Teviot Range until it again realigns with the SFRC on the eastern side of the Teviot Range, and traverses through Undullah until it joins the existing Interstate Line at Kagaru.

Where feasible, the Project has been designed to be within the existing SFRC, which was protected in November 2010 as a future railway corridor under Section 242(1) of the *Transport Infrastructure Act 1994* (Qld) (TI Act).

The Project is one of the missing links within the Inland Rail Program. As part of the broader Inland Rail Program, this Project provides a more direct route between Melbourne and metropolitan Brisbane in comparison with 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 includes four crossing loops to accommodate double-stack freight trains up to 1,800 metres (m) long and a 1,015 m long tunnel through the Teviot Range to facilitate the required gradient across the undulating topography.

The design has been developed in response to environmental, engineering and social constraints. The design objective is to minimise environmental and social impacts, minimise disturbance to existing infrastructure and utilities, meet the engineering design criteria and realise Project benefits.

The EIS includes an estimated capital cost profile of approximately $648 million, consistent with the *Inland Rail Programme Business Case* (ARTC, 2015a) and is an estimate of direct construction costs—including, but not limited to: delivering environmental and heritage commitments; fencing and earthworks; tunnels and tunnel services; formation and roadworks; structures; track works (loops and crossings); delivery works (incidentals and utilities); and supply of track, sleepers and turnouts.

The Project is expected to represent an investment of up to $1.2 billion—this figure includes both direct construction costs and indirect costs. Indirect costs include items such as: design services, Contractor overhead and margins, contingency, and escalation.

The total investment figure also includes ARTC Program costs such as project management, train control systems, property requirements and insurances.

The total investment figure makes provision for expected Project contingency and risk.

Further detail on the economic impact assessment is located in Chapter 17: Economics and Appendix S: Economic Impact Assessment Technical Report.

6.1.1 Relationship to the Inland Rail Program

The Project is one of 13 projects that make up the Inland Rail Program for the delivery of a 1,700 km rail line by 2026. It is one of five Inland Rail projects in Queensland.

The Project connects to the Helidon to Calvert (H2C) project in the north-west and Kagaru to Acacia Ridge and Bromelton (K2ARB) project in the south-east, as shown in Figure 6.1.

The Project also connects to the existing operational QR West Moreton System at Calvert and to the existing operational Sydney to Brisbane Interstate Line at Kagaru.

Refer Chapter 2: Project Rationale for more detailed discussion regarding the relationship of the Project to other projects, including those in the Inland Rail Program.

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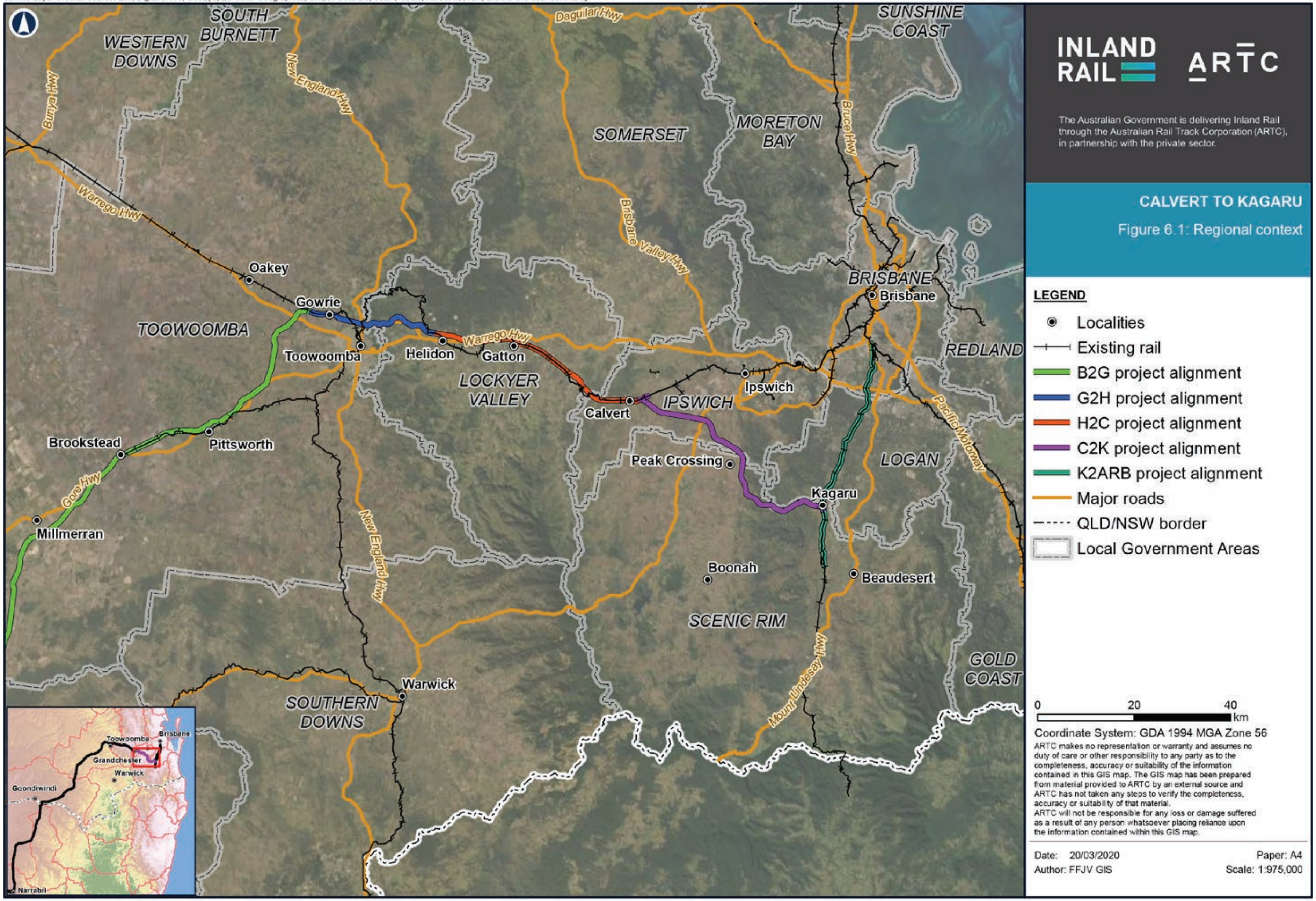

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6.1.2 Corridor selection

The rail corridor and associated disturbance footprint is the product of corridor selection studies and multi-criteria analysis (MCA) in addition to ongoing optimisation and refinement (refer Chapter 2: Project Rationale). The corridor selection studies considered the following aspects:

- Compliance with the design criteria (refer Section 6.2.1)
- Maximising use of existing rail corridors
- Minimising use of private land
- Minimising severance of land parcels
- Avoiding sensitive environmental and social areas
- Avoiding challenging topography and geological conditions
- Minimising watercourse crossings
- Minimising interfaces with existing infrastructure
- Minimising impact to existing commercial and agricultural operations
- Optimising railway operation such as reliability and availability by reducing track maintenance requirements through design.

The findings of the studies provided an understanding of the onsite constraints within the corridor of interest that ultimately influence the alignment development process and final location. For additional discussion regarding the corridor selection, including previous studies and alternative route options considered for the Project, refer to Chapter 2: Project Rationale.

Investigations for the purposes of this Environmental Impact Statement (EIS) and ongoing engineering design, including field surveys, were generally undertaken within the EIS investigation corridor (or as required by the individual technical assessments) to ensure a robust assessment and to allow for potential future design changes. The EIS investigation corridor is an approximate 2 km wide study area, 1 km either side of the proposed rail alignment. It is slightly wider around chainage (Ch) 38 km to Ch 45 km to accommodate for the options analysis that was undertaken for the Teviot Range crossing.

Some technical assessments used a different study area to the EIS investigation corridor depending on the requirements of the environmental aspect being assessed. Study area descriptions for each of the environmental aspects investigated as part of the EIS are discussed in Chapter 4: Assessment Methodology and included in the methodology sections of chapters 8 to 21.

6.1.3 Key components

The key components of the Project include:

- Approximately 53 km of single-track dual-gauge rail line with four crossing loops initially 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
- An approximately 1,015 m long Teviot Range tunnel, and bridges to accommodate topography and Project crossings of waterways and other infrastructure
- Tie-in to the existing QR West Moreton System at the Project boundary near Calvert
- Allowance for a future connection to the Ebenezer Industrial Area at Willowbank
- The construction of associated rail infrastructure including maintenance sidings and signalling infrastructure to support the Advanced Train Management System (ATMS)
- Rail crossings including level crossings, grade separations/road overbridges, occupational/private crossings, fauna crossing structures
- Tie-ins to the existing operational Sydney to Brisbane Interstate Line at Kagaru
- Significant embankments and cuttings will be required along the length of the alignment to suit the terrain
- Ancillary works including road and public utility crossings and realignments, signage and fencing and provision of services within the corridor (excluding those undertaken as enabling works)
- Construction worksites, laydown areas and access roads
- Defined watercourses under the *Water Act 2000* (Qld) intercepted by the proposed alignment include:
  - Western Creek—at chainage locations Ch 1.20 km and Ch 3.10 km
  - Bremer River—at chainage location Ch 6.30 km
  - Warrill Creek—at chainage location Ch 17.60 km
  - Purga Creek—at chainage location Ch 23.40 km
  - Sandy Creek—at chainage location 28.70 km
  - Un-named tributary of Purga Creek—at chainage locations Ch 36.60 km, Ch 37.50 km and Ch 37.90 km
  - Teviot Brook—at chainage location Ch 52.80 km.

6.1.4 Environmental design

The design for the Project has progressed in parallel to the development of this EIS to ensure that those environmental aspects that require a design response are incorporated into the design in order to minimise or avoid environmental and social impact.

Corridor selection accounted for environmental constraints in the identification of options and subsequent MCAs. The specific metrics assessed were chosen to align with Australian Rail Track Corporation's (ARTC) established MCA criteria, which were as follows:

- Technical viability
- Safety assessment of the proposed alignment
- Operation approach
- Constructability
- Schedule
- Environmental and heritage impacts
- Community and property impacts
- Approvals and stakeholder risk.

The alignment options considered as part of this process are summarised in Chapter 2: Project Rationale.

Potential impacts that have been avoided or mitigated through the development of the design are identified in the impact assessment discussions included in chapters 8 to 21.

Environmental design considerations that are to be further developed during the detailed design process and adopted, where possible, are also presented in chapters 8 to 21.

6.1.5 Cost and timing

Capital expenditure (CAPEX) for construction of the Project, including all ancillary infrastructure, is expected to be approximately $648 million.

The anticipated timing of phases for the Project are shown in Table 6.1. Early works are scheduled for commencement in late 2021, with construction scheduled to be completed by 2026. Inland Rail, and the Project, are scheduled to be operational in late 2026.

While construction is planned to start in late 2021, a number of factors could potentially impact the Project and delay the start of construction to 2022, with the commencement of detailed design and construction of the Project subject to EIS approvals and the successful procurement of a contractor. An indicative construction program is shown in Section 6.5.2.

TABLE 6.1: ANTICIPATED TIMING OF PROJECT PHASES

Project phase	2021	2022	2023	2024	2025	2026
Detailed design	■ (late)	■	■			
Pre-construction and early works		■				
Construction		■	■	■	■	■ (early)
Commissioning					■ (late)	■ (early)
Operation						■ (late)

6.1.6 Property and tenure

Between Calvert and Kagaru, the permanent disturbance footprint traverses 175 properties and 19 interests. The temporary disturbance footprint traverses 190 properties and 19 interests. Of the 19 interests:

- Fifteen interests are easements throughout both the permanent and temporary disturbance footprints. These easements are associated with rights to use land for purposes such as crossing land or allowing services to be located on or under the land.
- Three parcels have depth restrictions, which have been identified on the title and registered plans. Below the Depth Plans, tenure is a registered right or interest where the location is identified as below a depth or to a depth below the surface and relate to the underground coal mines in the area. This type of Below the Depth tenure was common before volumetric titles were introduced.
- One parcel is subject to a Carbon Abatement Interest. Carbon Abatement Interests are registered interests in land and form part of the Emissions Reduction Fund developed and managed by the Australian Government Department of Agriculture, Water and the Environment (DAWE) (formerly Department of the Environment and Energy (DotEE)) and the Clean Energy Regulator.

Further details on property and tenure is discussed in Chapter 8: Land Use and Tenure. The extent of area associated with these properties within the permanent and temporary disturbance footprints, as well as tenure and existing land uses of these properties, are detailed in Appendix G: Impacted Properties.

6.1.7 Regional and local context

The Project is located within the local government areas (LGAs) of Ipswich City Council (ICC), Logan City Council (LCC) and the Scenic Rim Regional Council (SRRC) in South East Queensland. The Project is the second-most northern package of the Inland Rail Program. The location of the Project and its regional and local context are shown in Figure 6.1 and Figure 6.2 respectively.

Land use in the Calvert area is typically of a rural nature, with most properties consisting of large-lot grazing areas. Ebenezer (east of Calvert) is characterised by predominantly rural and rural-residential land uses, with a considerable amount of remnant vegetation. The former Ebenezer coal mines are in proximity to this section of the Project. An existing high-voltage transmission line owned by Powerlink as well as the Santos Moonie–Brisbane high-pressure oil pipeline intersect the Project.

The area south of Purga towards Peak Crossing contains a mixture of land uses, including a number of rural-residential properties and agricultural estates, poultry farms, Purga Quarry, Yackatoon Grazing Co feedlot, and Ivory's Rock Conventions and Events Centre. Washpool is characterised by predominantly vegetated mountainous areas in the east and rural land uses in the west. The Purga Nature Reserve is also located in this region.

Throughout the Woolooman area and the Teviot Range (Flinders Peak Conservation Park), terrain is of a rugged nature and there is minimal development. Wyaralong Dam is located to the south. Kagaru is predominantly rural with the Greater Flagstone Priority Development Area (PDA) located to the north of the Project in this area. The Project also intersects the Bromelton State Development Area (SDA) when joining the existing Interstate Line at Kagaru.

The intended land use for the Project is rail and associated infrastructure, including road realignments, grade separations and ancillary infrastructure.

The existing land use of the Project is shown in Figure 6.3 and further discussion is provided in Chapter 8: Land Use and Tenure.

To minimise impact on significant land uses, the alignment has, where possible, avoided them and minimised severance impacts.

6.1.8 Land requirements

Figure 6.4a–k illustrates the key construction and operation components of the Project. These requirements will be further refined through future design phases and proposed changes will be reassessed in line with the Terms of Reference (ToR) requirements and the existing assessments.

The disturbance footprint includes the rail corridor and other permanent works associated with the Project (e.g. where changes to the road network are required) as well as the construction footprint where only temporary disturbance is proposed (e.g. laydown areas and compound sites).

The rail corridor is a minimum of 40 m wide; however, it is wider, as required, to accommodate the earthworks associated with large cuts and fills, drainage works, rail infrastructure, access roads and fencing. The rail corridor width also allows for future possible upgrades of the crossing loops to accommodate trains up to 3,600 m in length. The corridor will extend to a maximum width of 340 m in the undulating terrain between the eastern end of the tunnel and the Undullah Road crossing. The corridor is generally wider through this area due to large earthwork cut-and-fill sections, and the allowance for a tunnel access road to the eastern portal.

Also, in this area, the land is mountainous and then becomes moderately undulating as the alignment skirts around the foothills of Flinders Peak and interfaces in many locations with Woollaman Creek and Wild Pig Creek Road. The corridor requirements in this area will be refined during detailed design, as requirements for access, haulage routes and an emergency service access road are developed.

The disturbance footprint also provides for the roadworks associated with the construction of the railway, including realigned and new roads. A 20 m road corridor has typically been allowed for all new and realigned roads.

The disturbance footprint allowance provides for a minimum 5 m beyond the permanent works for fencing, temporary drainage structures, erosion and sediment control, and utilities connections.

There is an allowance for temporary construction access and laydown areas approximately every 5 km, avoiding areas that are within the 1% Annual Exceedance Probability (AEP) floodplains where possible.

Specific laydown areas are also proposed to the support of bridge construction with a minimum area of 2,500 square metres (m^2) (smaller in core fauna/flora habitat). In addition, some sites will include an area to support of Flash Butt Welding (FBW)/rail assembly of minimum of 1,000 m x 200 m in area.

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

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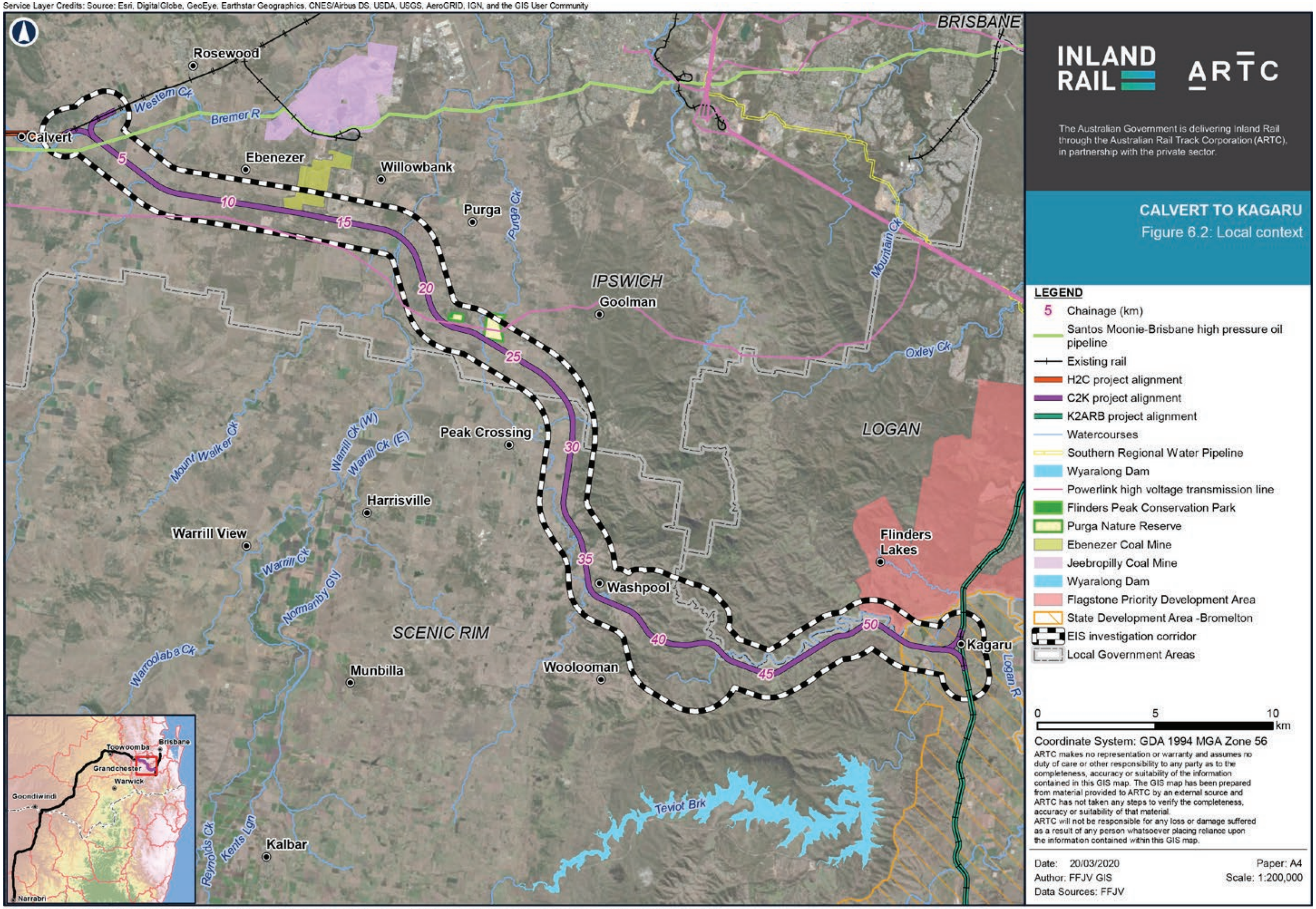

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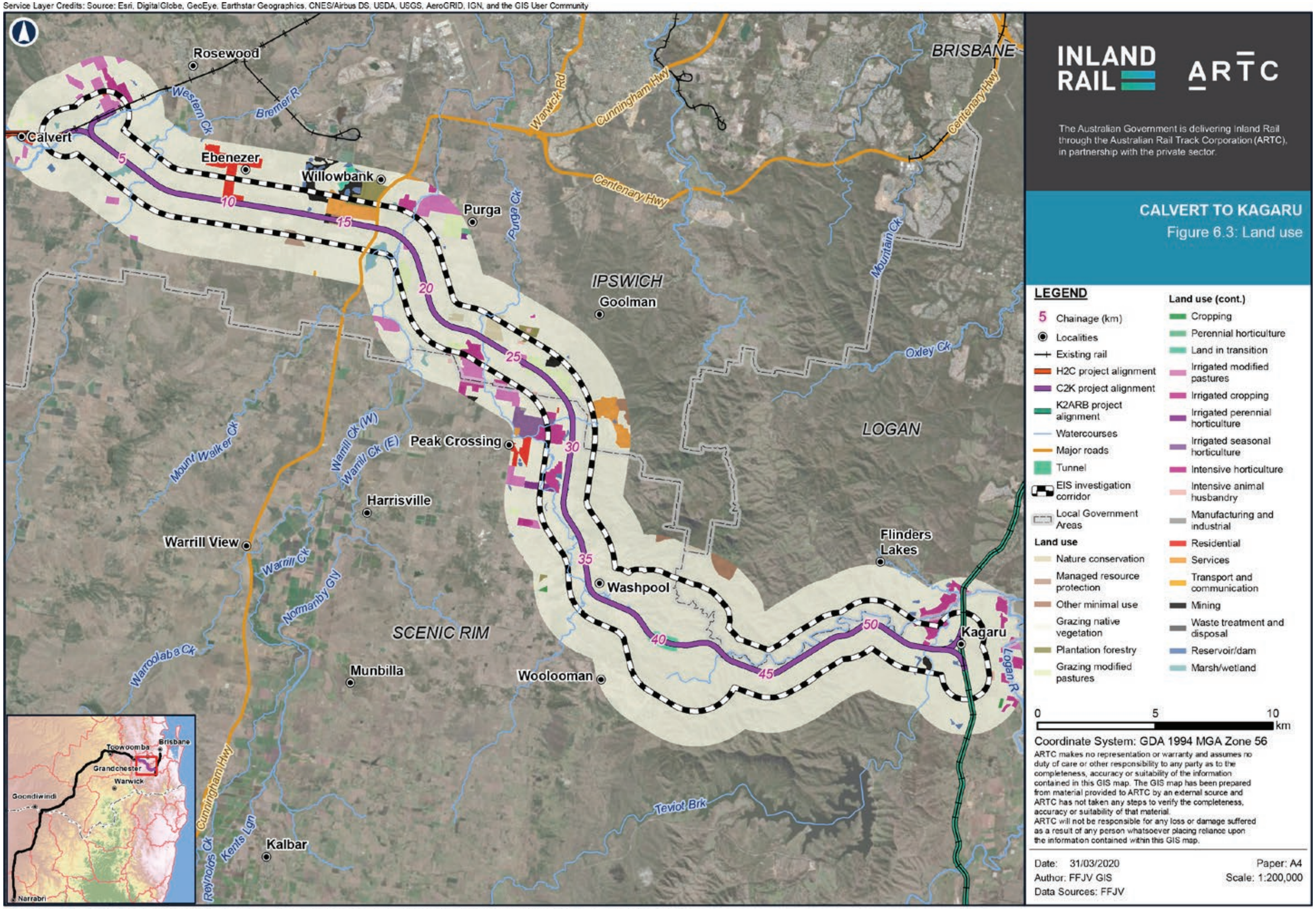

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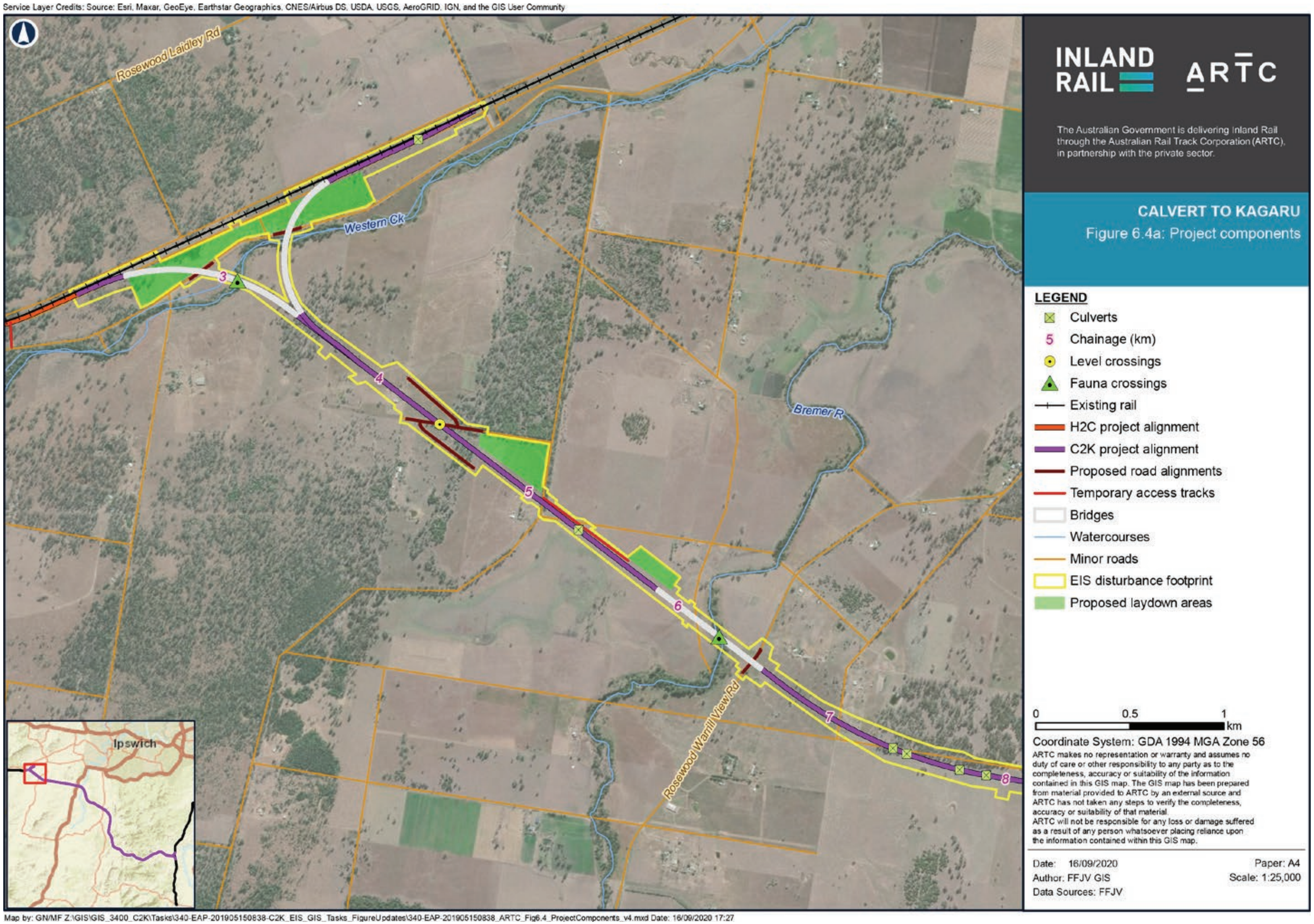
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Western Ck
Bremer R
Rosewood Warrill View Rd
Ipswich
3
4
5
6
7
8
INLAND RAIL
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The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
CALVERT TO KAGARU
Figure 6.4a: Project components
LEGEND
Culverts
Chainage (km)
Level crossings
Fauna crossings
Existing rail
H2C project alignment
C2K project alignment
Proposed road alignments
Temporary access tracks
Bridges
Watercourses
Minor roads
EIS disturbance footprint
Proposed laydown areas
0
0.5
1
km
Coordinate System: GDA 1994 MGA Zone 56
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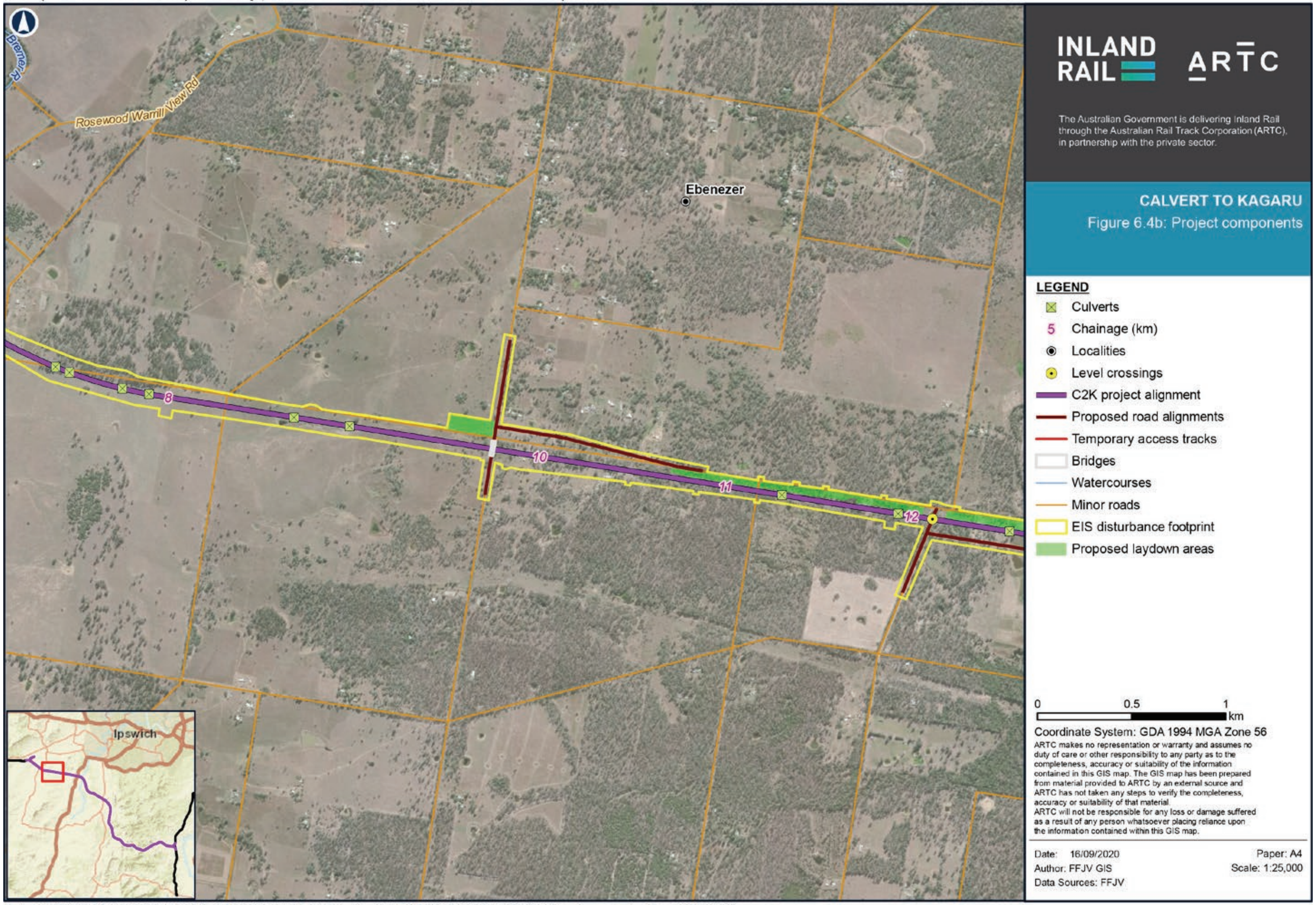

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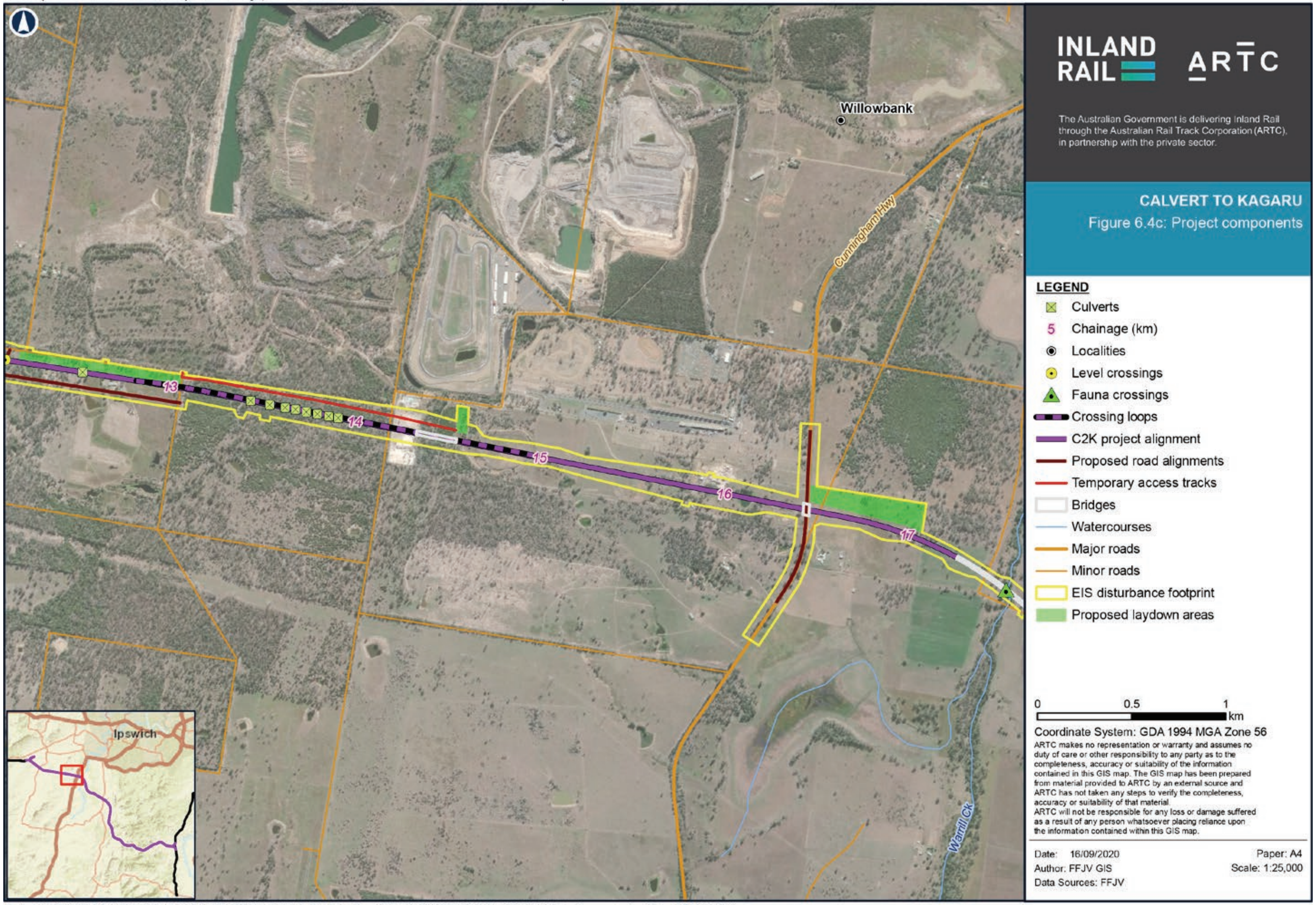

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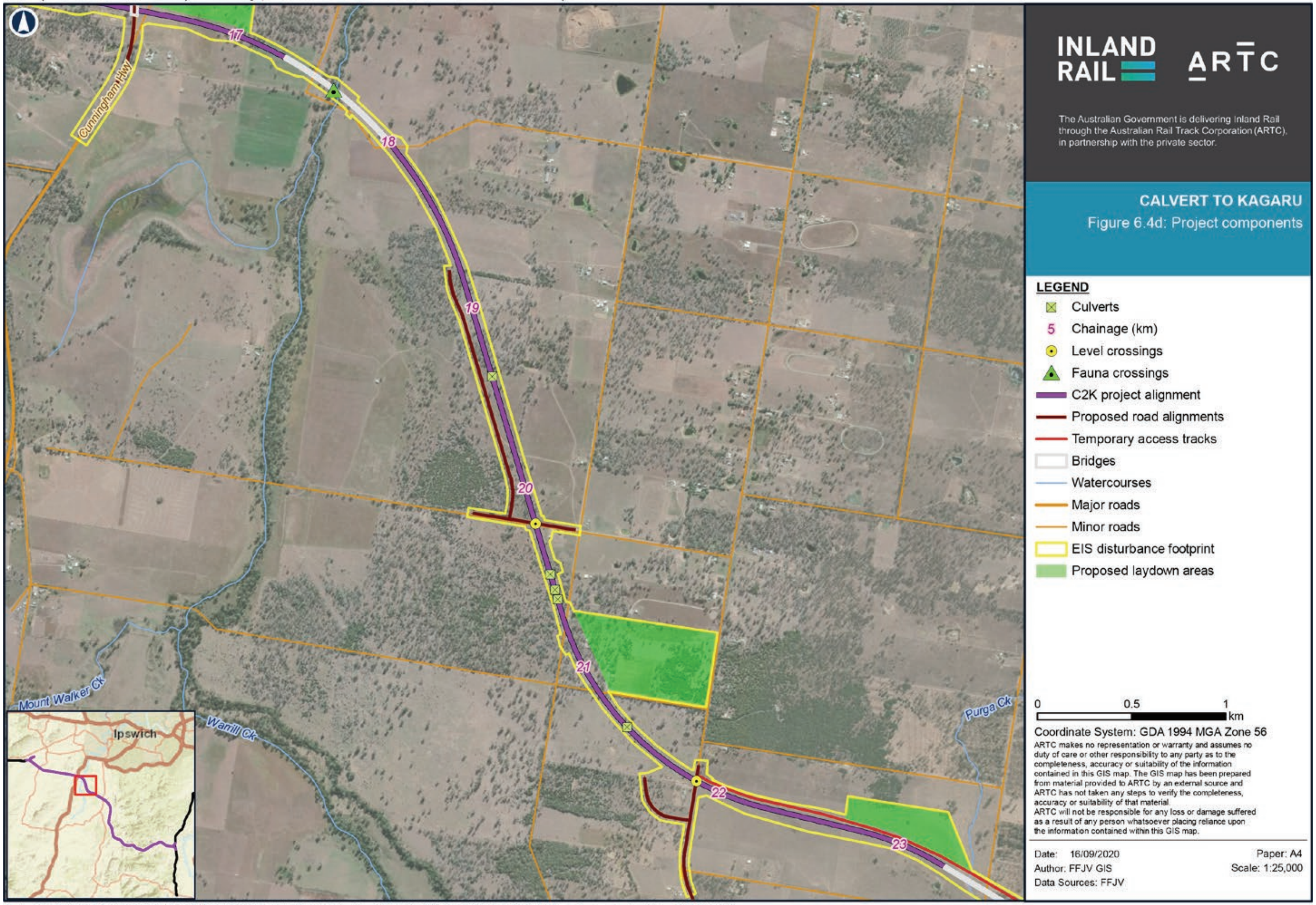

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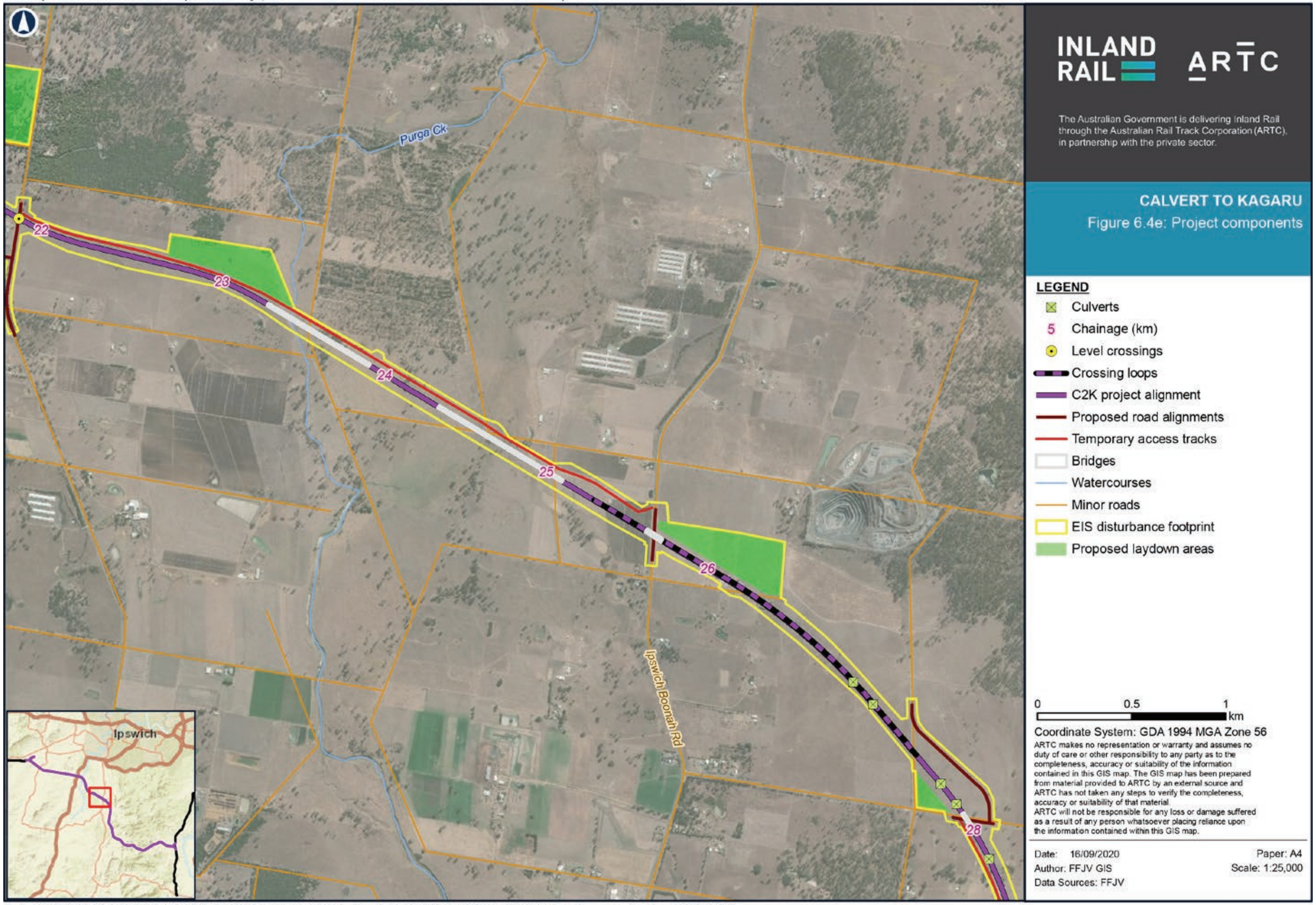

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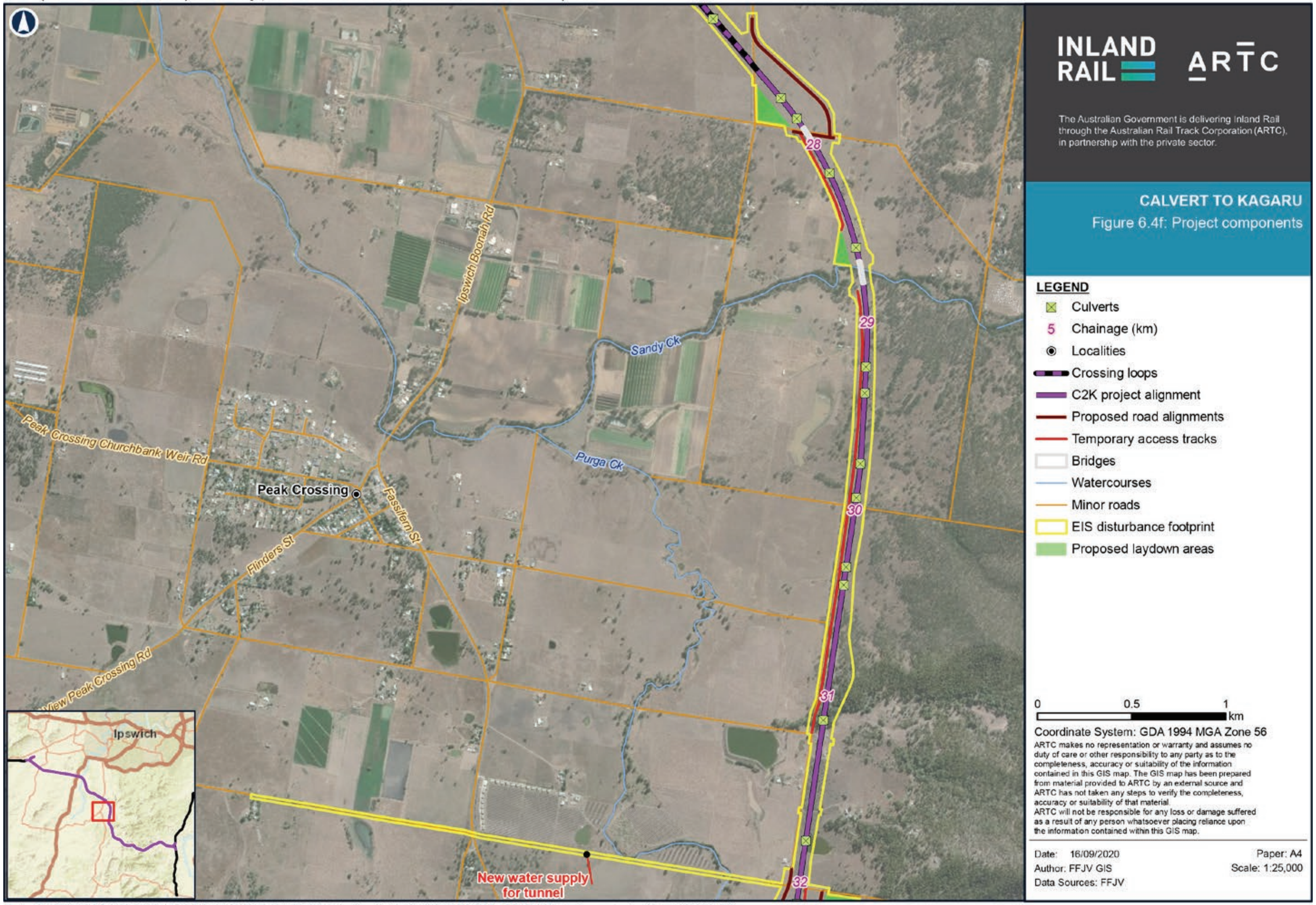

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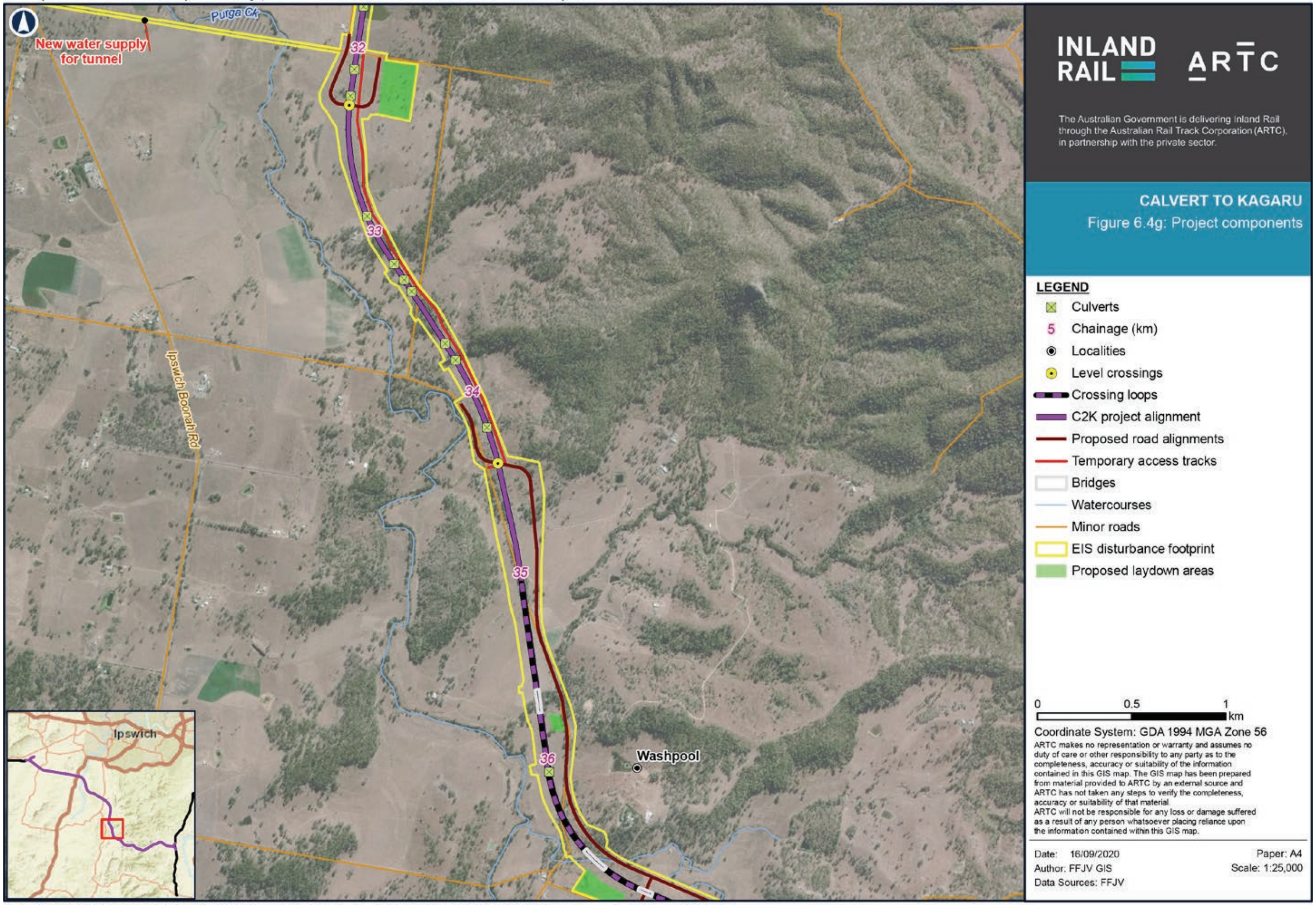

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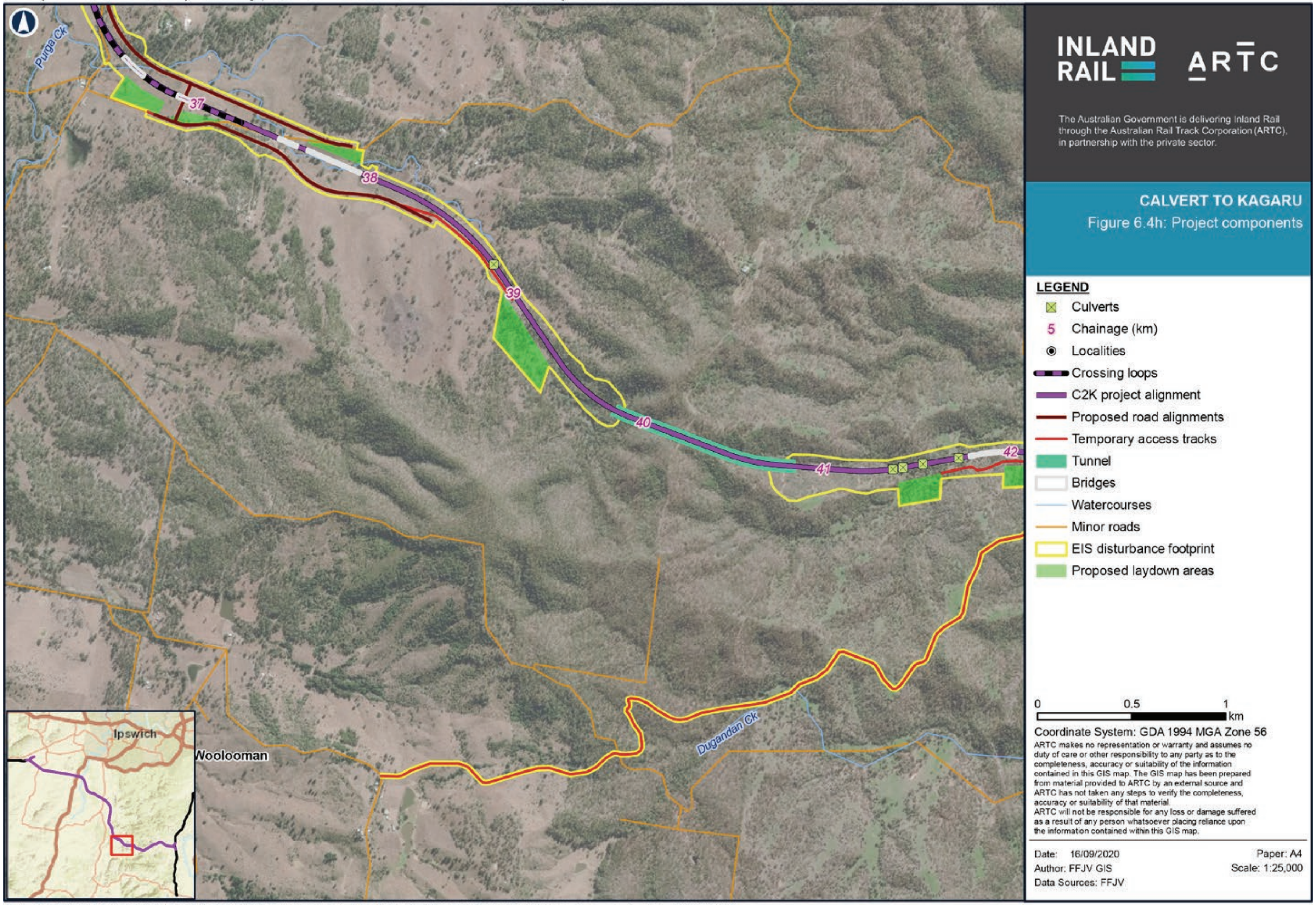

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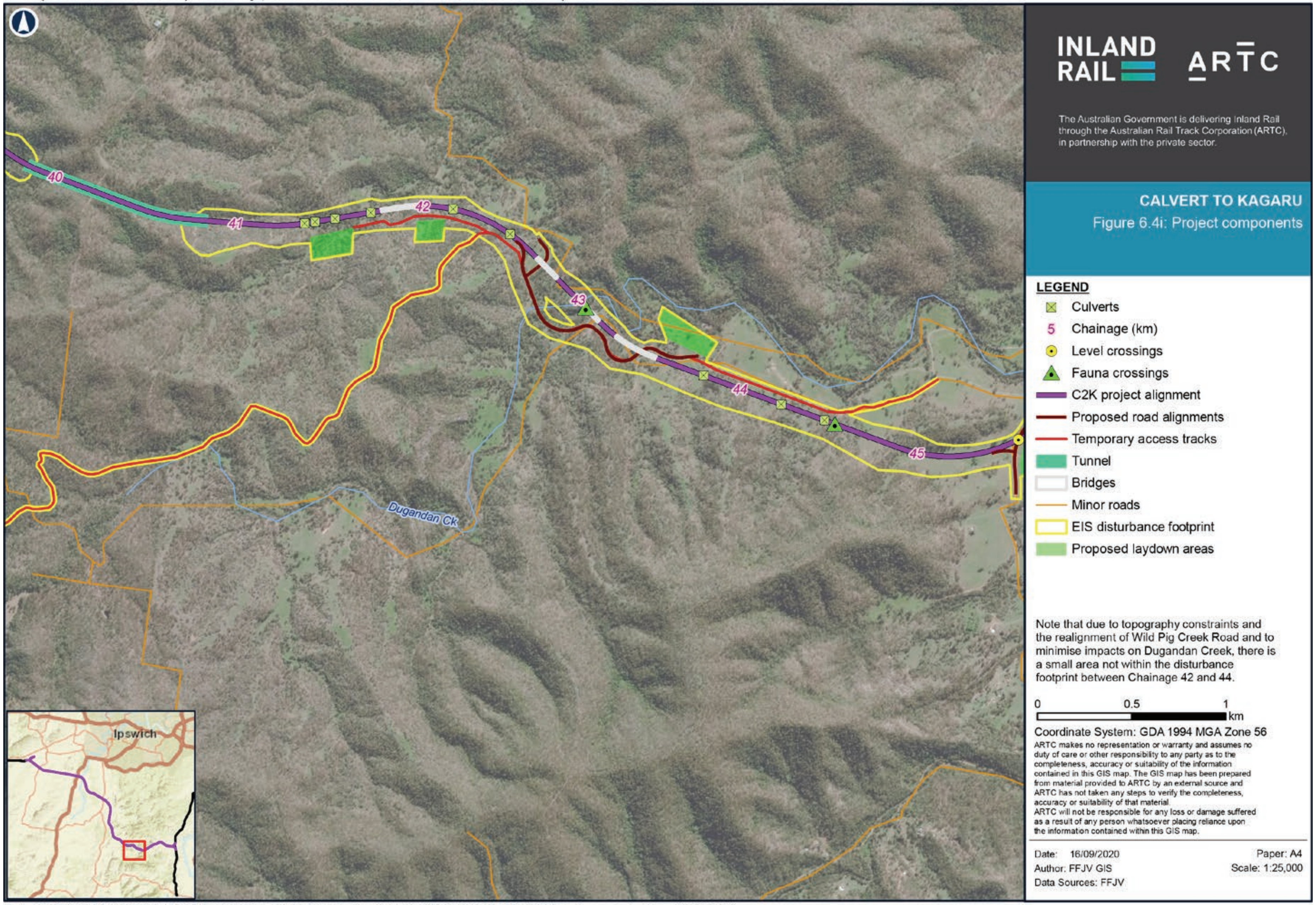

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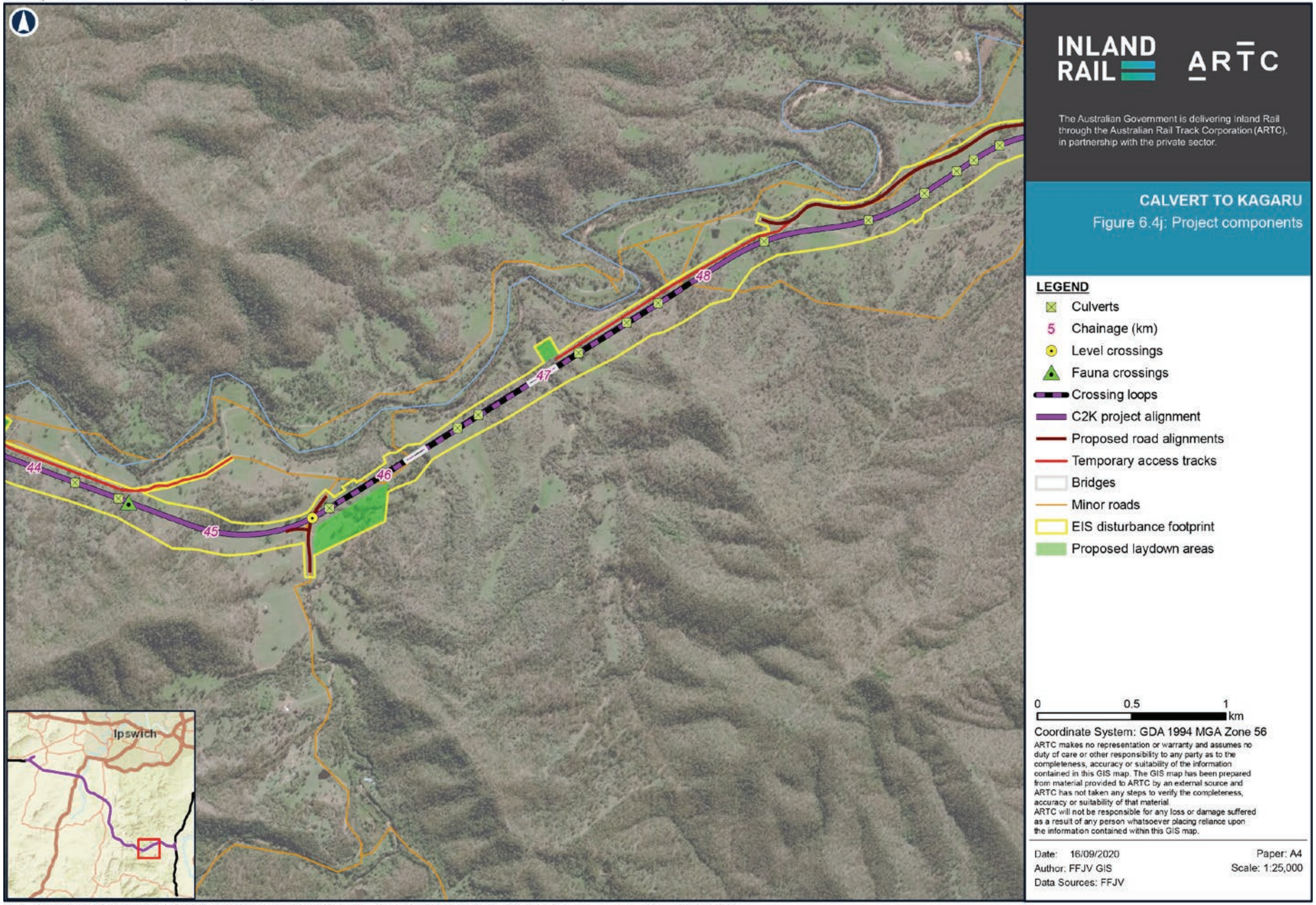

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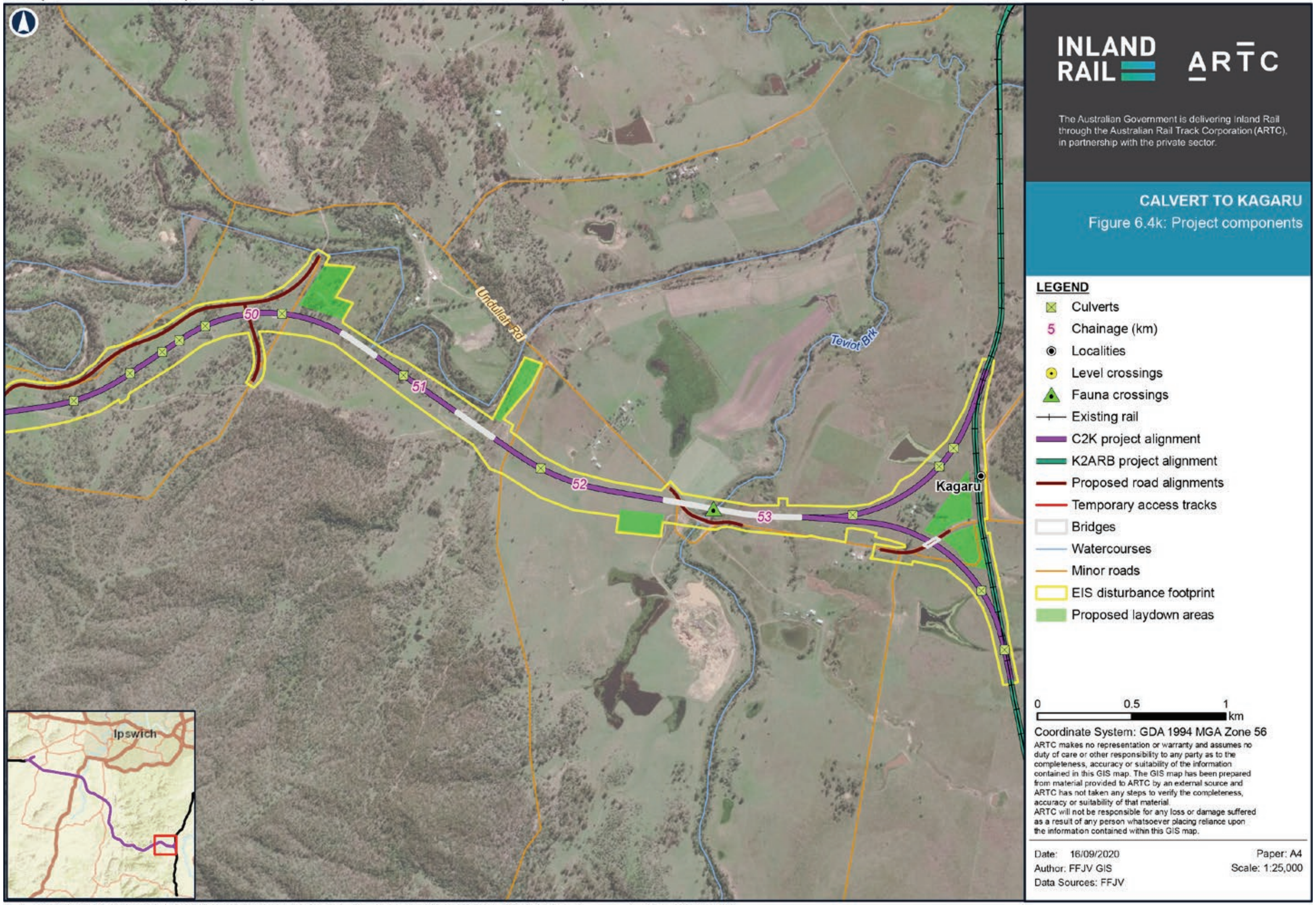

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6.1.9 Cumulative impacts

A cumulative impact assessment (CIA) has been undertaken in accordance with the ToR for the Project, which identifies cumulative impacts arising from, and interactions with other major projects. The CIA includes consideration of:

- Projects that have been approved but construction has not commenced
- Projects that have commenced construction
- Projects that have completed construction since 16 June 2017, when the Project was declared a 'coordinated project' under the provisions of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act)
- Projects that are currently being assessed as coordinated projects under the SDPWO Act.

The CIA area is defined as the spatial area of influence that is determined by the specific nature of the environmental value being assessed.

Table 6.2 summarises the projects that have been included in the CIA. Further detail on the major projects included and excluded from the assessment is discussed in Chapter 22: Cumulative Impacts.

TABLE 6.2: PROJECTS INCLUDED IN THE CUMULATIVE IMPACT ASSESSMENT

Project and proponent	Location	Description	Source	Project status
K2ARB (ARTC)	Rail corridor from Kagaru to Acacia Ridge and Bromelton	Enhancing and connecting the existing rail corridor (approximately 49 km) from north-east of Kagaru to Acacia Ridge and from south of Kagaru to Bromelton.	Application for coordinated project status currently under consideration by the Coordinator-General	Proponent awaiting coordinated project decision by the Coordinator-General
H2C (ARTC)	Rail alignment from Helidon to Calvert	The H2C project will include the following: - 47 km single-track dual-gauge freight rail line to accommodate double-stack freight trains up to 1,800 m long - Tunnel through the Little Liverpool Range - Construction of rail infrastructure, culverts, bridges, viaducts and crossing loops - Connection to the existing West Moreton Railway Line - Ancillary works including road and public utility crossings and realignments.	**eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Helidon%20to%20Calvert/IAS/h2c-initial-advice-statement.pdf**	Proponent currently preparing EIS
Greater Flagstone PDA (Queensland Government)	Located within LCC, west of Jimboomba and the Mount Lindesay Highway, along the Brisbane–Sydney rail line	When fully developed, it is anticipated that the Greater Flagstone PDA will provide approximately 50,000 dwellings to house a population of up to 120,000 people.	**dsdmip.qld.gov.au/edq/greater-flagstone.html**	PDA declared by the Queensland Government on 8 October 2011

Project and proponent	Location	Description	Source	Project status
Bromelton SDA (Queensland Government)	South of Kagaru in Bromelton	Delivery of critical infrastructure within the Bromelton SDA will support future development and economic growth. This includes a trunk water main and the Beaudesert Town Centre Bypass. This infrastructure provides opportunities to build on the momentum of current development activities by major landowners in the SDA.	**statedevelopment.qld.gov.au/resources/project/bromelton/bromelton-sda-development-scheme-dec-2017.pdf**	The current version of the *Bromelton SDA Development Scheme* was approved by Governor in Council, December 2017 The Development Scheme is managed by the Coordinator-General
Ripley Valley PDA (Queensland Government)	Approximately 5 km south-west of the Ipswich central business district (CBD) and south of the Cunningham Highway	The Ripley Valley PDA covers a total area of 4,680 ha and is an opportunity to provide approximately 50,000 dwellings to house a population of approximately 120,000 people. It is located in one of the largest industry growth areas in Australia and offers opportunities for further residential growth to meet the region's affordable-housing needs.	**dsdmip.qld.gov.au/edq/ripley-valley.html**	PDA declared by the Queensland Government on 8 October 2011
South West Pipeline: Bulk Water Connection to Beaudesert (Seqwater)	East of Kagaru, running north from Beaudesert	The proposal is investigating a bulk water pipeline connection from the Southern Regional Water Pipeline to Beaudesert, connecting Beaudesert to the South-East Queensland Water Grid. The pipeline will pass through the site of the future Wyaralong Water Treatment Plant.	**buildingqueensland.qld.gov.au/projects/south-west-pipeline-bulk-water-connection-to-beaudesert/**	Currently completing Detailed Business Case
RAAF Base Amberley future works (Department of Defence)	RAAF Base Amberley	White paper dedicated future upgrades to RAAF Base Amberley at a cost of $1 billion.	**defence.gov.au/id/_Master/docs/Economic/KPMGRAAFAmberleyReport.pdf**	N/A
Cross River Rail (Queensland Government)	Brisbane City	A new north–south rail line connecting Dutton Park to Bowen Hills under the Brisbane River and CBD.	**statedevelopment.qld.gov.au/assessments-and-approvals/cross-river-rail-project.html**	EIS Complete New lapse date for the Coordinator-General's EIA evaluation report on 31 December 2025 at the time of writing.
Remondis Waste to Energy Facility (Remondis)	Swanbank Industrial Estate	Remondis has announced plans to build a $400 million energy-from-waste facility in Swanbank, south of Ipswich.	**statedevelopment.qld.gov.au/assessments-and-approvals/remondis-waste-to-energy-facility.html**	Proponent awaiting draft terms of reference for EIS

6.2 Design

The following sections describe the key components of the Project.

6.2.1 Design criteria

The key characteristics of the Inland Rail Program service offering are reliability, price, transit time and availability. To help achieve this service offering, ARTC have implemented a consistent set of design requirements and parameters to be applied across the Inland Rail Program. Establishing consistent design criteria normalises designs, delivering an asset that meets the business and operational requirements and is consistent along its length, that will subsequently simplify asset maintenance.

The design criteria acts as a primary point of reference for the design of the Project, forming a baseline for design criteria and design standards.

The design criteria for Inland Rail and the Project are summarised in Table 6.3.

TABLE 6.3: PERFORMANCE SPECIFICATIONS FOR INLAND RAIL

Attribute	Specification
Reference train	
Intermodal	21 tonne axle load (TAL), 115 kilometres per hour (km/h) maximum speed, 1,800 m length (initial) 2.7 horse power per tonne (hp/tonne) power:weight ratio
Coal/bulk	25 TAL (initial), 80 km/h maximum speed, length determined by customer requirements within maximum train length
Operational specification	
Freight train transit time (terminal to terminal)	Target driven by a range of customer preferences and less than 24 hours Melbourne-Brisbane for the intermodal reference train. Flexibility to provide for faster (higher power:weight ratio) and slower (lower power:weight ratio) services to meet market requirements
Gauge	Standard (1,435 millimetres (mm)) with dual standard/narrow (1,067 mm) gauge in appropriate QLD sections
Maximum freight operating speed	115 km/h @ 21 TAL
Maximum axle loads (initial)	21 tonnes @ 115 km/h 23 tonnes @ 90 km/h 25 tonnes @ 80 km/h
Clearance (terminal to terminal)	As per ARTC Plate F for double stacking (7.1 m above rail)
Maximum train length (initial)	1,800 m
Minimum design standards	
General alignment	
Design speed	115 km/h
Maximum grade	1:100 target, 1:80 maximum (compensated) 1:200 maximum at arrival or departure points at loops
Curve radius	1,200 m target, 800 m minimum
Cant/cant deficiency	Set for intermodal reference train
Medium speed alignment (mountainous terrain)	
Design speed	80 km/h minimum
Maximum grade	1:100 target, 1:50 maximum (compensated) 1:200 maximum at arrival or departure points at loops
Curve radius	800 m target, 400 m minimum
Corridor width	40 m minimum

Attribute	Specification
Rail	Minimum 53 kilogram per metre (kg/m) on existing track; 60 kg/m on new or upgraded track
Concrete sleepers	Rated @ 30 TAL
Sleeper spacing	667 mm spacing (1,500/km)—existing track 600 mm (1,666/km)—new corridors/track or re-sleepering existing track
Turnouts	Tangential, rated at track speed on the straight and 80 km/h entry/exit on the diverging track
Crossing loops (initial)	1,800 m (clearance point to clearance point) plus signalling overlap No level crossing across loops
Future proofing	
Train length	To provide for future extension of maximum train length to 3,600 m
New structures	Capable of 30 TAL @ 80 km/h minimum
Formation	Formation on new track suitable for 30 TAL @ 80 km/h
Crossing loops	Loops designed and located to allow future extension for 3,600 m trains. The approval for the construction of future 3,600 m crossing loops will be subject to separate approval applications in the future.
Reliability, availability, price and transit time	Competitive with road. Key characteristics of the Inland Rail service offering include: ▶ Reliability: 98 %, defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised ▶ Availability: services available with convenient departure and arrival times for customers, which depends on cut-off and transit times ▶ Price: cheaper relative to road transportation, as a combined cost of access to the rail network, rail haulage and pick-up and delivery ▶ Transit time: 24 hours or less Melbourne to Brisbane. Further information is contained in Chapter 2: Project Rationale.

Project design elements are described in greater detail in the following sections.

6.2.2 Rail

The Project includes the establishment of 53 km of new single-track dual-gauge railway (standard (1,435 mm) and narrow (1,067 mm) gauge). The Project commences from the H2C project to the east of Calvert and also has a narrow gauge track connection to the QR West Moreton System in this location. The alignment then travels east and slightly south to provide connections to the existing ARTC Sydney to Brisbane Interstate Line at Kagaru.

The mainline track structure is typically a ballasted track system consisting of continuously welded 60 kg/m rail, resilient fasteners, rail pads and concrete dual-gauge full-depth sleepers at 600 mm centres. Figure 6.5 shows a typical section for a dual-gauge ballasted track.

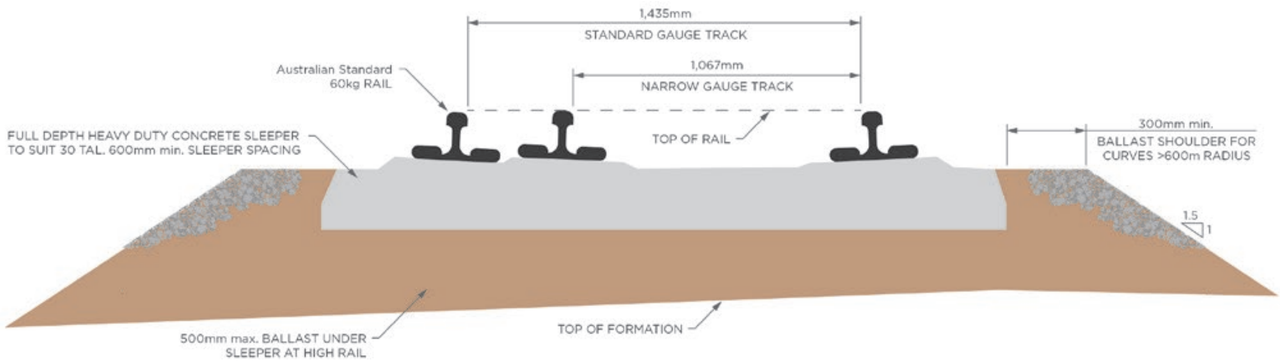

FIGURE 6.5: INDICATIVE DESIGN FOR NEW TRACK

The various elements of the track are further described in Table 6.4.

TABLE 6.4: ELEMENTS OF THE TRACK

Elements	Description and purpose
Rails	▸ Continuously welded 60 kg/m steel rails ▸ Due to there being fewer joints, trains can travel faster on continuously welded steel rails than on jointed rails. Continuously welded rails also require less maintenance.
Fasteners	▸ Fasteners are the method of fixing the rails to the sleepers.
Rail pads	▸ Rail pads are plastic or rubber mats that are inserted between the rails and the sleepers. Their purpose is to evenly distribute the load from passing trains onto the sleepers ▸ Rail pads also act to reduce noise and vibration impacts from passing trains.
Sleeper	▸ Concrete, rectangular, sleepers, laid perpendicular to the rails ▸ Sleepers distribute the load from passing trains to the ballast and subgrade. They also function to hold the rails upright and keep them spaced to the correct gauge.
Ballast	▸ Ballast typically consists of crushed stone that is packed between, below and around the sleepers ▸ The purpose of the ballast is to: ▸ Bear the load from the sleepers ▸ Hold the track structure in place as trains pass by ▸ Facilitate the drainage of water ▸ Keep down vegetation that might interfere with trains passing by.
Subgrade	▸ The subgrade consists of a capping layer (restricts the upward migration of wet clay and silt), a layer of structural fill, and a layer of general fill ▸ The subgrade is illustrated in Figure 6.6.

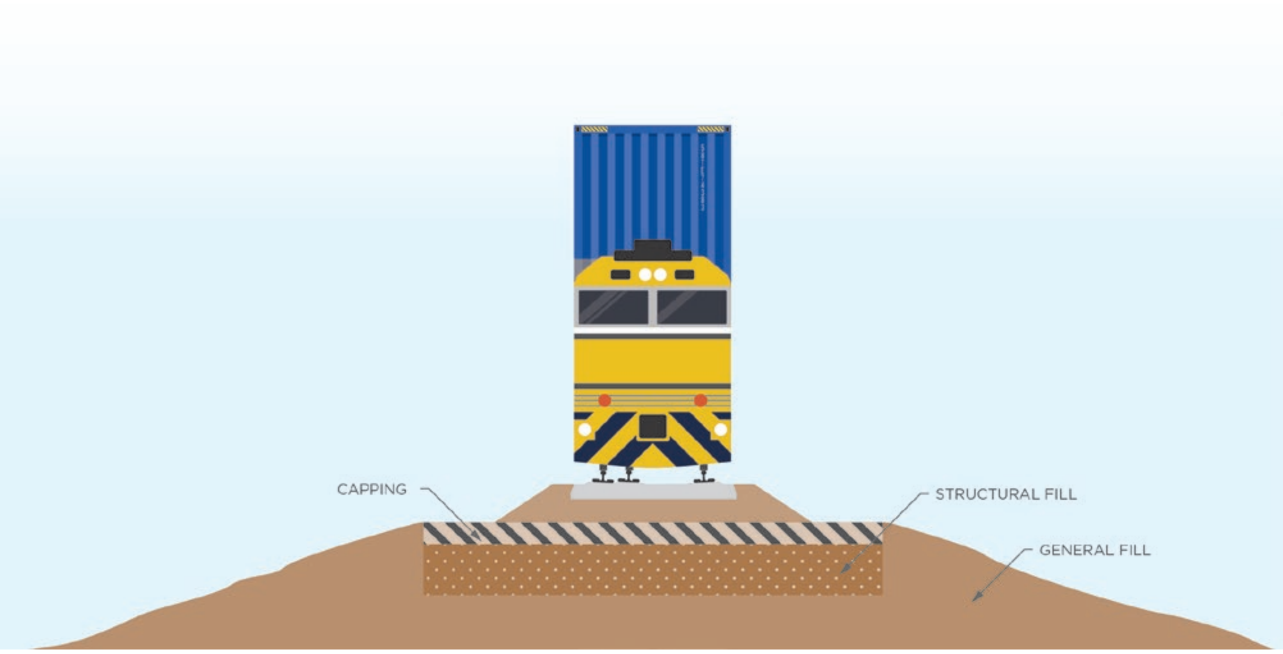

FIGURE 6.6: STRUCTURE OF THE SUBGRADE

6.2.3 Tunnel infrastructure

The Project includes a 1,015 m tunnel through the Teviot Range to facilitate the required gradients for this area due to the undulating terrain.

The tunnel will require a substation building for power supply and distribution to electrical equipment, fire water tanks and a pump station for the tunnel hydrant system and an emergency services staging area. A tunnel control centre will be required at one of the tunnel portals that will be predominantly unmanned. Most of the tunnel services facilities are proposed at the western portal area.

The rail alignment in the tunnel area is designed so that all stormwater and runoff is directed away from the tunnel. Any water collected inside the tunnel (groundwater, washdown, firefighting etc) will be collected via drainage pits throughout the tunnel, connected longitudinally by a drainage pipe.

Provision has been made for the collection and treatment of water from the tunnel. Collected water will be conveyed via gravity to a sump located at the western portal. Water quality will be monitored, and it is likely that this water will be processed through a water treatment plant, which will include hydrocarbon separation.

The tunnel will have internal jet fans approximately 150 m inside the portal that will provide forced ventilation for maintenance activities only. No other ventilation requirements are proposed.

In case of the train stopping in the tunnel due to fire or other emergency, there is a fire-rated longitudinal egress passage provided. Communication facilities to the operator will be provided.

The tunnel will likely only have minimal internal lighting, with only low-level lighting and emergency lighting expected.

There is limited existing power infrastructure at the proposed tunnel portal locations. Although not part of this EIS, it is proposed that supply of power to the tunnel will be provided via a 11kV power line from a third-party provider, with a secondary supply via a standby 11kV generator. These works will be undertaken by the relevant asset owner and are required to comply with the relevant environmental/regulatory framework applicable to the particular works or public utility.

As the generator will normally be on standby, there will be a short time lag (≈30 seconds) between a loss-of-power event and the generator starting up. Critical systems will still be supplied via an uninterruptable power supply (UPS) system during this short outage time so impacts are minimal.

6.2.4 Crossing loops

Crossing loops are places on a single line track where trains in opposing directions can pass each other. These are double ended and connected to the main track at both ends. Crossing loops are typically a little longer than any of the trains that might need to cross at that point. In operation, one train enters a crossing loop through one of the turnouts and idles at the other end, while the opposing train continues along the mainline track to pass the now stationary train.

The Project includes four new crossing loops. The selection of crossing loop locations was informed by the operational modelling for the Inland Rail Program and has taken into consideration proximity to sensitive receptors, interferences with existing infrastructure and flexibility for future extension. The proposed locations for the crossing loops are:

- Ebenezer (allowance for future extension to west)
- Purga Creek (allowance for future extension to east)
- Washpool Road (allowance for future extension to west)
- Undullah (allowance for future extension to east).

The loops would be constructed as new sections of track parallel to the main track. They range in length to accommodate the surrounding area and topography and are a minimum of 2,200 m to fit the design length of the train (1,800 m).

The disturbance footprint has made allowance for future extension of all loops to accommodate future 3,600 m trains; however work this will be subject to a separate approval application in the future. Crossing loop tracks have currently been assumed at 4.5 m spacing from the main track and incorporate a 250 m maintenance siding to enable maintenance of rolling stock without obstructing the track. It is proposed that the maintenance siding orientation be provided such that the maintenance vehicles would exit the siding on a falling grade. A typical layout of a crossing loop is shown in Figure 6.7.

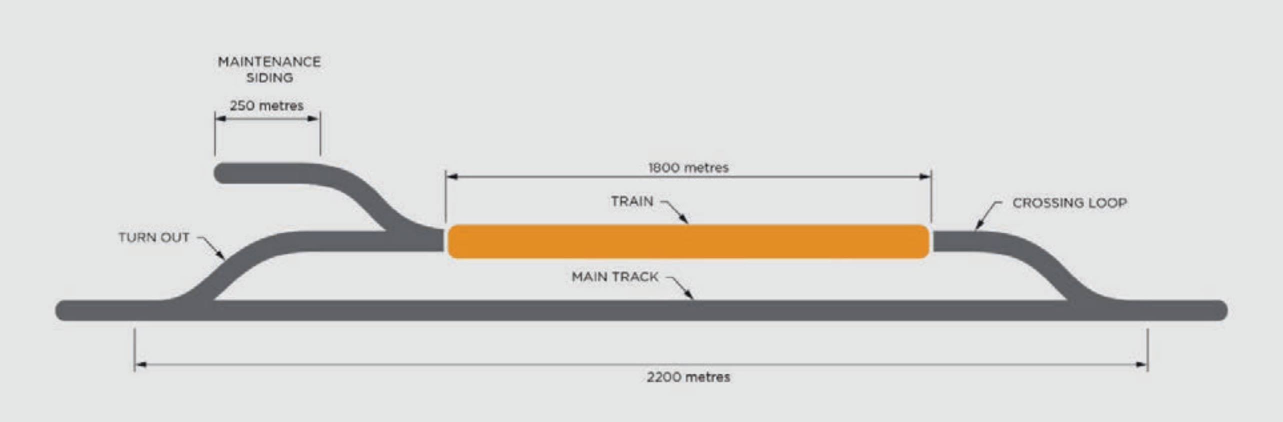

FIGURE 6.7: INDICATIVE DESIGN FOR CROSSING LOOP AND MAINTENANCE SIDING

6.2.5 Turnouts

Turnouts allow the train to be guided from one track to another. The anticipated locations for turnouts are detailed below:

- QR West Moreton System connection near Calvert towards Rosewood

  The Project alignment connects with the QR West Moreton System between Calvert and Rosewood. A 1 in 16 narrow-gauge turnout will be installed for the Project to connect to the existing narrow-gauge track in the easterly direction towards Rosewood.

- Sydney to Brisbane Interstate Line at Kagaru

  The Project alignment connects with the Sydney to Brisbane Interstate Line at Kagaru. A 1 in 16 dual-gauge turnout will be installed for the Project to connect to the existing dual-gauge track in the northerly direction towards Acacia Ridge. A 1 in 16 dual-gauge turnout with standard-gauge turnout leg will be installed for the Project to connect in the southerly direction towards Bromelton.

- Turnouts to crossing loops

  A 1 in 16 dual-gauge turnout will be provided at both ends of the four crossing loops. An additional turnout (1 in 10) will be required for provision of a maintenance siding at each crossing loop.

6.2.6 Bridges

Bridge structures are required so that water, vehicles, and, in some cases, stock and pedestrians may cross the proposed rail corridor. Bridge structures may either be rail over watercourse or road, or road over rail, depending on local topography and rail or road alignment requirements.

The Project requires 27 new bridge structures. These structures are summarised in Table 6.5. The Project does not involve the reinstatement or reconstruction of any existing bridge structures.

TABLE 6.5: SUMMARY OF BRIDGE STRUCTURES FOR THE PROJECT

Crossing type	Number
Rail over watercourse	16
Rail over road	3
Rail over watercourse and road	5
Road over rail	3

The type of bridge proposed for a location depends on a range of factors, including the local topography, road usership, rail and road alignments at the crossing point, and access requirements. Bridges have been provided at all major watercourse crossings along the Project alignment to minimise impacts to the local riverine system, and to avoid having to divert watercourses.

The new bridge structures are typically founded on piles supporting in-situ reinforced concrete substructures. Bridge superstructures are typically formed from pre-stressed concrete girders (pre-stressed concrete slab span and pre-stressed concrete Super-T) with in-situ reinforced concrete decks incorporating walkways, guardrails and barriers as appropriate. The bridges are of various lengths and spans to suit the alignment and topography.

Typical section of piers with pre-stressed concrete Super-T girders are illustrated in Figure 6.8. Typical section of piers with pre-stressed concrete slab span are illustrated in Figure 6.9.

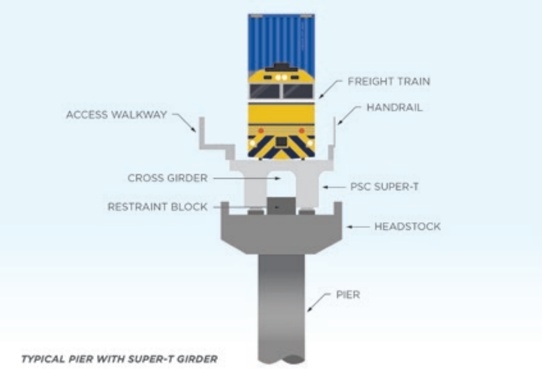

FIGURE 6.8: TYPICAL PIER WITH PRE-STRESSED CONCRETE SUPER-T GIRDER

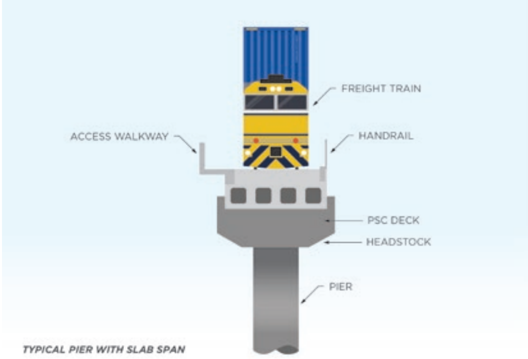

FIGURE 6.9: TYPICAL PIER WITH PRE-STRESSED CONCRETE SLAB SPAN

6.2.6.1 Rail bridges

New rail bridges that are proposed to cross watercourses or roads are summarised in Table 6.6 Typical elevations of rail bridges are illustrated in Figure 6.10 and Figure 6.11.

TABLE 6.6: SUMMARY OF RAIL BRIDGES

Bridge name	Crossing type	Bridge length
Western Creek #1 Rail Bridge	Watercourse and road	966 m
Western Creek #2 Rail Bridge	Watercourse and road	782 m
Bremer River Rail Bridge	Watercourse and road	684 m
Upper Tributary Ebenezer Creek Rail Bridge	Watercourse	207 m
Warrill Creek Rail Bridge	Watercourse	713 m
Purga Creek #1 Rail Bridge	Watercourse	621 m
Purga Creek #2 Rail Bridge	Watercourse	759 m
Ipswich–Boonah Road Rail Bridge	Road	88 m
Mount Flinders Road Rail Bridge	Road	69 m
Sandy Creek Rail Bridge	Watercourse	115 m
Upper Tributary #1 Purga Creek Rail Bridge	Watercourse	115 m
Upper Tributary #2 Purga Creek Rail Bridge	Watercourse	138 m
Washpool Road Rail Bridge	Road	69 m
Upper Tributary #3 Purga Creek Rail Bridge	Watercourse	98 m
Upper Tributary #4 Purga Creek Rail Bridge	Watercourse	299 m
Upper Tributary #3 Dugandan Creek Rail Bridge	Watercourse	184 m
Upper Tributary #1 Dugandan Creek Rail Bridge	Watercourse and road	138 m
Dugandan Creek #1 Rail Bridge	Watercourse	161 m
Dugandan Creek #2 Rail Bridge	Watercourse and road	230 m
Wild Pig Creek Rail Bridge	Watercourse	115 m
Upper Tributary #2 Dugandan Creek Rail Bridge	Watercourse	161 m
Upper Tributary #1 Woollaman Creek Rail Bridge	Watercourse	207 m
Upper Tributary #2 Woollaman Creek Rail Bridge	Watercourse	230 m
Teviot Brook Rail Bridge	Watercourse and road	722 m

6.2.6.2 Road bridges

New road over rail bridges are summarised in Table 6.7. A typical elevation of a road over rail bridge is illustrated in Figure 6.12.

TABLE 6.7: SUMMARY OF ROAD BRIDGES

Bridge name	Bridge length
Mount Forbes Road Bridge	72 m
Cunningham Highway Bridge	53 m
Undullah Road Bridge	70 m

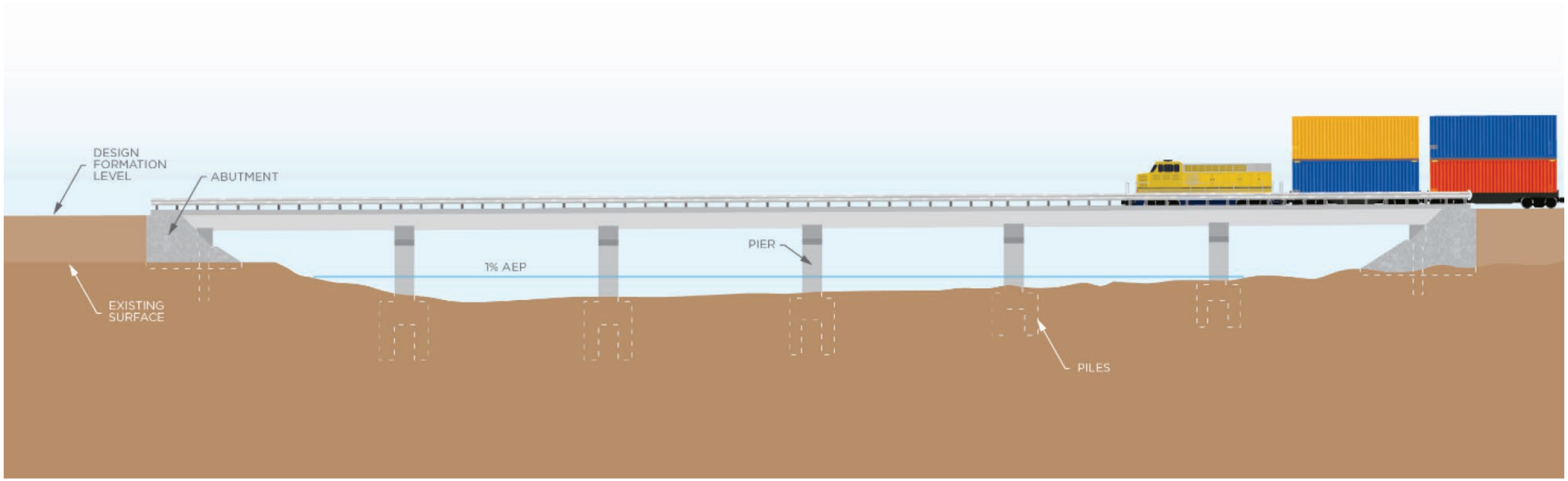

FIGURE 6.10: TYPICAL SECTION OF RAIL OVER WATERCOURSE BRIDGE STRUCTURE

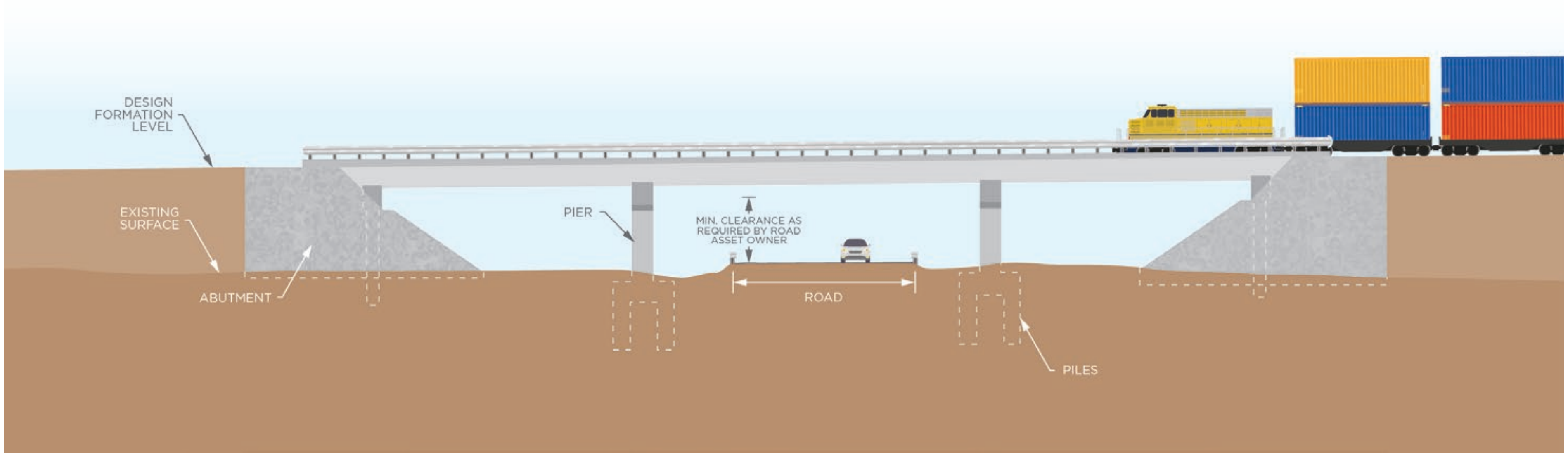

FIGURE 6.11: TYPICAL SECTION OF RAIL OVER ROAD BRIDGE STRUCTURE

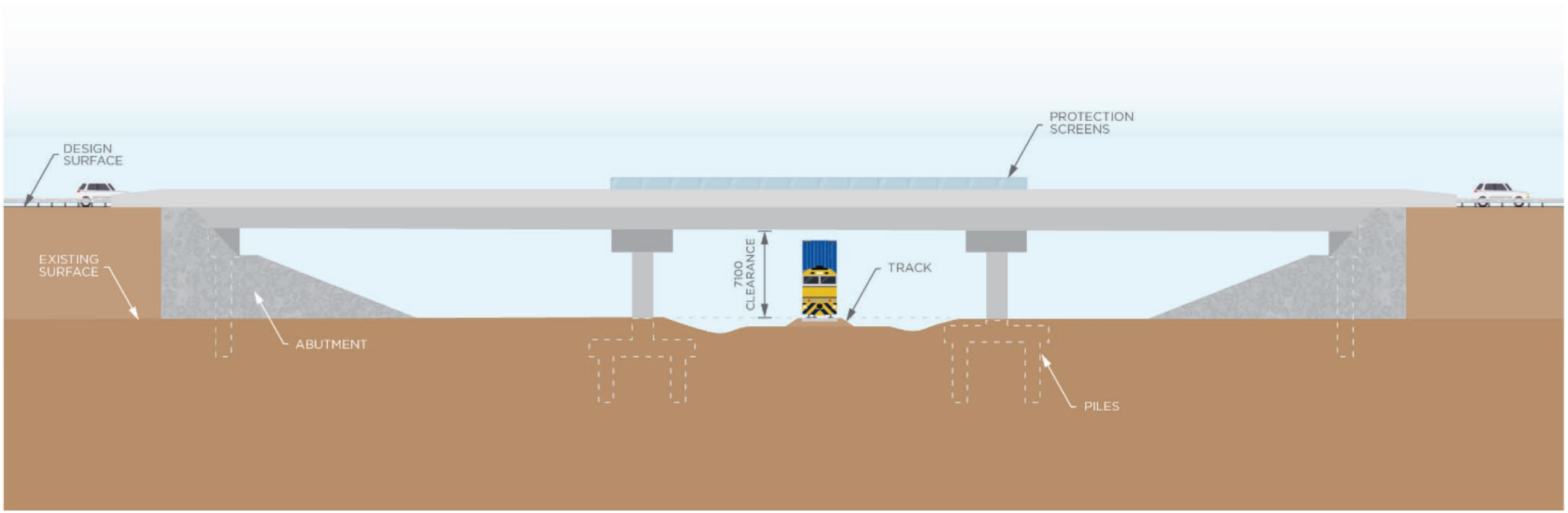

FIGURE 6.12: TYPICAL SECTION OF ROAD OVER RAIL BRIDGE STRUCTURE

6.2.7 Drainage infrastructure

6.2.7.1 Cross-drainage

Cross-drainage structures have been incorporated into the design where the alignment intercepts existing drainage lines and watercourses. The type of cross-drainage structure depends on various factors such as the natural topography, rail formation levels, design flow and soil type. Bridges are proposed at selected waterway crossings to avoid disturbance to the existing riverine system. Cross-drainage structures, including culverts, have been designed to meet the design criteria of 1% AEP event.

Culverts are structures that allow water, whether in a watercourse or drainage line, to pass under the rail alignment. Culverts are incorporated into the design as a component of the cross-drainage solution to ensure that no additional permanently ponded areas will be created upstream of the Project and to maintain overland flow paths.

Cross-drainage structures, including culverts, have been designed to meet the design criteria of 1% AEP event. Afflux has been determined and assessed against impact criteria for the design AEP event at the upstream and downstream rail corridor boundaries where flows have been diverted, refer Chapter 13: Surface Water and Hydrology. The design and location of culverts will be refined during the detailed design phase.

Culverts associated with the proposal will be a mix of reinforced concrete pipe (RCP) culverts and reinforced concrete box culverts (RCBC). Scour protection measures will generally be installed around culvert entrances and exits, on disturbed stream banks, and around waterfront land to avoid erosion. A typical section of a cross drainage culvert is shown in Figure 6.13.

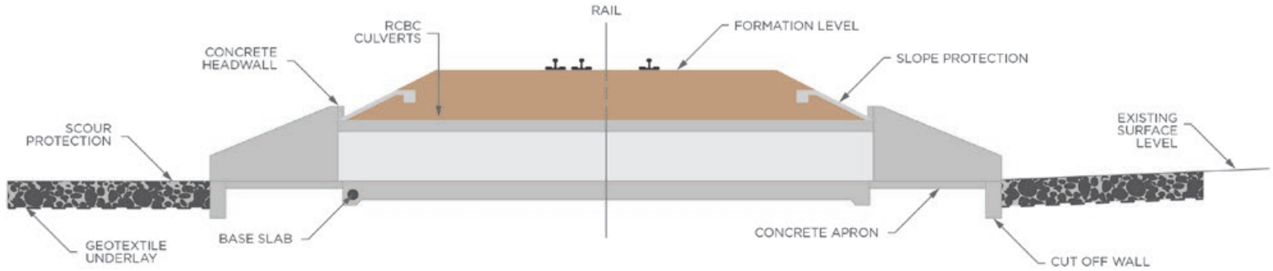

FIGURE 6.13: TYPICAL SECTION OF A CROSS-DRAINAGE CULVERT

6.2.7.2 Longitudinal drainage

The purpose of longitudinal or track drainage is to remove water that has percolated through the track ballast, and to divert surface runoff to the nearest bridge or culvert location before it reaches the subgrade (refer Figure 6.6, which shows the structure of the subgrade). Without adequate track drainage, the subgrade may become saturated leading to weakening and subsequent failure of the subgrade.

Two types of track drainage are proposed:

- Embankment drains—longitudinal drains adjacent to the track in embankment conditions (refer Figure 6.14)
- Catch drains—longitudinal drains on the uphill side of cuttings (refer Figure 6.15).

With due consideration to topographic constraints, track drainage is proposed at specific locations along the alignment where the gradient is steep enough to divert surface runoff to the nearest bridge or culvert location. As with culverts, the design and location of track drainage will be refined during the detailed design phase to minimise potential impacts.

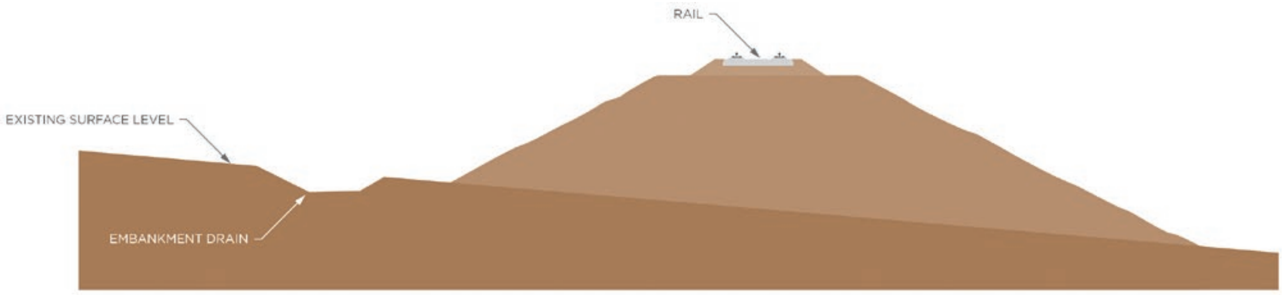

FIGURE 6.14: TYPICAL LONGITUDINAL DRAINAGE FOR RAIL FORMATION ON TOP OF EMBANKMENT

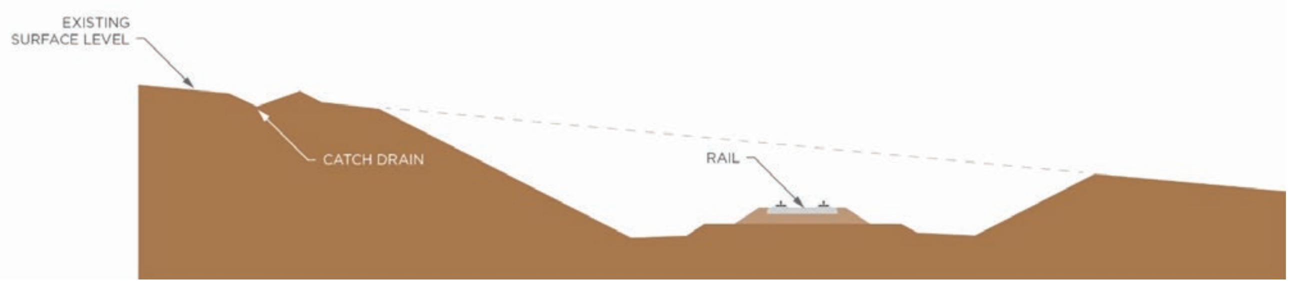

FIGURE 6.15: TYPICAL LONGITUDINAL DRAINAGE FOR RAIL FORMATION WITHIN A CUT

6.2.8 Road rail interfaces

6.2.8.1 Public road–rail interfaces

Road–rail interfaces are points at which the rail alignment crosses a public road. The Project requires the crossing of both State-controlled roads (managed by the Department of Transport and Main Roads (DTMR)) and local government (ICC, SRRC or LCC) roads. A summary of the number of existing public road interfaces by road manager is presented in Table 6.8.

TABLE 6.8: SUMMARY OF PUBLIC ROAD INTERFACES FOR THE PROJECT

Road type	Number of interfaces
State-controlled	3
Ipswich City Council	11
Scenic Rim Regional Council	12
Logan City Council	0

A desktop assessment has also identified that the Project interfaces with 26 unformed road reserves. ARTC have liaised with the relevant road authorities to determine where there are requirements to create crossings at these locations.

For public crossings, ARTC is undertaking, and will continue to undertake, the necessary consultation with DTMR and local councils in relation to the preferred road rail interface treatments for each location. Part of this process is to work with the relevant road manager to understand the local environment and gather information on future development plans, which can be used to inform the design.

The appropriate road rail interface treatment has been assessed on a case-by-case basis for design purposes, with consideration given to current and future usage of the existing asset, its location relative to other crossings of the rail corridor and the road and rail geometry at the crossing location.

In the development of the proposed treatments, ARTC have also taken into consideration State and national guidelines and strategies. Both the Office of the National Railway Safety Regulator (ONRSR) and DTMR have policies that focus on avoiding building any new level crossings or minimising any proposal to construct a public level crossing on a new rail line.

Treatments for public road rail interfaces can be categorised as:

- Grade-separated crossings—road and rail cross each other at different heights so that traffic flow is not affected. Grade separations are either road over rail, or rail over road.
- Level crossings—road and rail cross each other at the same level. Level crossings have either passive or active controls to guide road users:
  - Passive—have static warning signs (e.g. stop and give-way signs) that are visible on approach. This signage is unchanging with no mechanical aspects or light devices
  - Active—flashing lights with or without boom barriers for motorists, and automated gates for pedestrians. These devices are activated prior to and during the passage of a train through the level crossing.
- Crossing consolidation, relocation, diversion or realignment—existing road rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted. Roads will only be closed where the impact of 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.

To assess potential level crossings locations, ARTC used a national system called Australian Level Crossing Assessment Model (ALCAM), which considers factors such as future road traffic numbers, vehicle types, train numbers, speeds and sighting distances. Further explanation of the methodology used in determining road rail interfaces treatments is included in Chapter 19: Traffic, Transport and Access.

Preferred options for formed public road rail interface treatments currently applied over the length of the Project are summarised in Table 6.9 and may involve a mix of active and passive level crossings, crossing consolidation, realignments or diversions and grade separation.

TABLE 6.9: PREFERRED TREATMENT OPTIONS FOR PUBLIC ROAD RAIL INTERFACE TREATMENTS REQUIRED FOR THE PROJECT

Road type	Road name	Treatment
State-controlled	Rosewood Warrill View Road	Grade separated: rail over road
State-controlled	Cunningham Highway	Grade separated: road over rail
State-controlled	Ipswich Boonah Road	Grade separated: rail over road
Ipswich City Council	Waters Road	Grade separated: rail over road
Ipswich City Council	Waters Road	Grade separated: rail over road
Ipswich City Council	Hayes Road	Level crossing
Ipswich City Council	Coveney Road	Crossing consolidation
Ipswich City Council	Mount Forbes Road	Grade separated: road over rail
Ipswich City Council	M Hines Road	Level crossing
Ipswich City Council	Glencairn Road	Level crossing
Ipswich City Council	Middle Road	Level crossing
Ipswich City Council	Castle Hill Lane	No crossing required as no through access
Ipswich City Council	Truloff Road	Realignment
Ipswich City Council	Mount Flinders Road	Grade separated: rail over road
Scenic Rim Regional Council	Dwyers Road	Level crossing
Scenic Rim Regional Council	Washpool Road	Level crossing
Scenic Rim Regional Council	Washpool Road	Realignment
Scenic Rim Regional Council	Washpool Road	Realignment
Scenic Rim Regional Council	Washpool Road	Grade separated: rail over road
Scenic Rim Regional Council	Washpool Road	Realignment
Scenic Rim Regional Council	Wild Pig Creek Road	Grade separated: rail over road
Scenic Rim Regional Council	Wild Pig Creek Road	Level crossing
Scenic Rim Regional Council	Wild Pig Creek Road	Level crossing
Scenic Rim Regional Council	Wild Pig Creek Road	Relocation
Scenic Rim Regional Council	Undullah Road	Grade separated: rail over road
Scenic Rim Regional Council	Undullah Road	Grade separated: road over rail

Further consultation with DTMR, local governments and the local community will inform the location and preferred treatment for each road-rail interface. The consultation strategy is described in Appendix C: Consultation Report.

6.2.8.2 Occupational (private) crossings

The Project interfaces with 96 occupational (private) accesses. The impact on each individual property will differ and ARTC will continue to engage with landholders to find ways that minimise the disturbance to their property, which includes access.

The final number of occupational crossings within private property will be determined during detailed design. ARTC has consulted with landholders to be impacted by the final rail corridor to gather their property access requirements and present potential private access solutions based on the current design. Each property solution will be negotiated on a case-by-case basis through ongoing consultation with landholders and further design refinement.

Where level crossings are required, ARTC will work with landholders to agree on the design which best fits their requirements. For example, in areas where farmers use large farm machinery, the design of the level crossing, including gate widths, crossing surfaces and approach grades will need to accommodate this. On the other hand, where there is stock on a property, the focus will be on putting the appropriate fencing and gates in place to keep the stock out of the corridor.

As the State and national rail safety guidelines and policies are safety focused, ARTC will work with each landholder to find solutions that minimise the number of level crossings across the Project alignment.

Consultation to identify potential occupational crossing solutions is described in Appendix C: Consultation Report.

Design and layout of occupational crossing will be determined based on the following considerations:

- Feedback from consultation with landholders on specific property requirements
- Safety standards (criteria for minimum sight distances for trains and vehicles)
- Alternative access arrangements
- Rail design and landform
- Stock movements
- Vehicle access requirements (for example farm machinery, frequency of use).

Typical treatments include:

- Underpass (stock passage, multiple use vehicles). This will be subject to topography of the specified area
- At grade level crossing
- Diversion to adjacent public road/ public road crossing.

6.2.8.3 Stock route interfaces

The Project does not interface with the gazetted State stock route network; however, local stock routes may be impacted. These will be managed as occupational (private) crossings.

6.2.9 Rail maintenance access road

A rail maintenance access road (RMAR) is required to facilitate maintenance for critical infrastructure (e.g. turnouts), and to provide access for emergency recovery. Formation level access has been proposed for all turnout locations and, where reasonably practical, for the full extent of crossing loops.

For the considerable number of bridge abutments requiring access for inspection and maintenance, a surface level access road has been proposed unless there are other reasons for providing a formation level access road. Where surface-level access has been provided, access to the formation-level at abutments can be achieved by provision of stairs and use of bridge walkways. This has been proposed to avoid the need to provide turnarounds at each bridge abutment, and considerable lengths of formation level roads and ramps, and additional service roads to connect with public roads.

A diagram showing the positioning of a typical formation of a RMAR is shown in Figure 6.16.

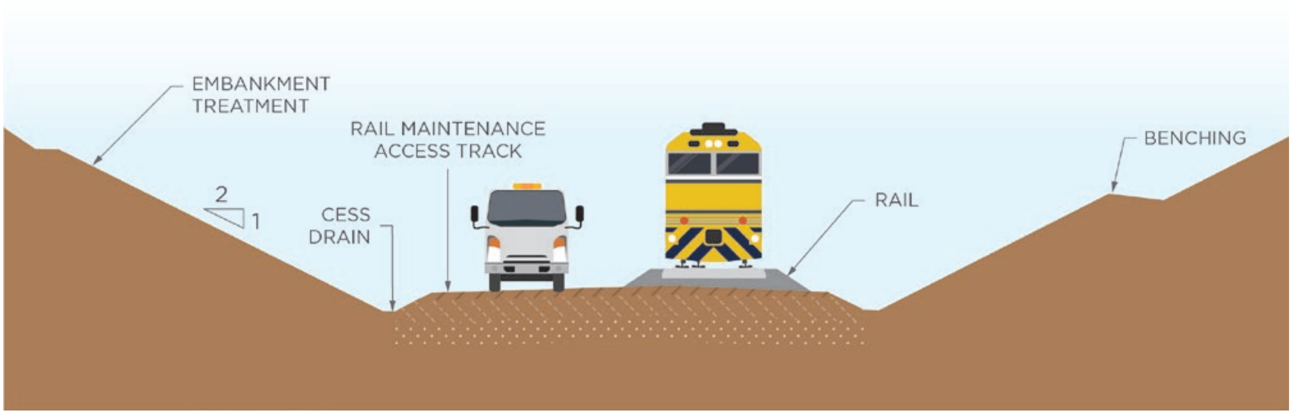

FIGURE 6.16: TYPICAL SECTIONAL DIAGRAM OF RAIL FORMATION SHOWING RAIL MAINTENANCE ACCESS TRACK

6.2.10 Utility/service crossings

All utilities located within the disturbance footprint have been identified as potentially impacted. Table 6.10 provides a summary of utility interactions (i.e. potential impacts or clashes) identified in the assessment. Existing local services and utilities are shown in Figure 6.17 with exception to minor and privately owned services.

Utility owners have different requirements and drivers related to treating impacted assets. It is also common for impacted assets owned by the same utility owner to have varying requirements depending on the characteristics and criticality of each asset to the owner. Consultation has commenced with the various utility providers and gas and petroleum pipeline owners regarding their requirements for relocation or protection of the services impacted by the Project. Consultation with utility and service owners will continue through the detailed design phase of the Project.

TABLE 6.10: SUMMARY OF IMPACTED UTILITIES BY TYPE OF SERVICE AND UTILITY TYPE

Utility owner	Communication	Electricity	Oil	Water	Groundwater bore	Recycled water
Energex	-	60 (3)	-	-	-	-
Powerlink	-	4 (2)	-	-	-	-
Queensland Urban Utilities	-	-	-	1	-	-
Santos	-	-	1 (1)	-	-	-
Telstra	111	-	-	-	-	-
TPG	3	-	-	-	-	-
Private	-	-	-	-	2	1
Sub-total	114	64 (5)	1 (1)	1	2	1
Total utilities			**183 (6)**			

Table notes:
The number of high-risk utilities is shown in brackets. High-risk utilities have been categorised through a risk-rating matrix that considers the cost of the impact, the time requirements to relocate, rehabilitate or protect the asset and any operational requirements (access, serviceability, specific tools/equipment) relating to the utility.

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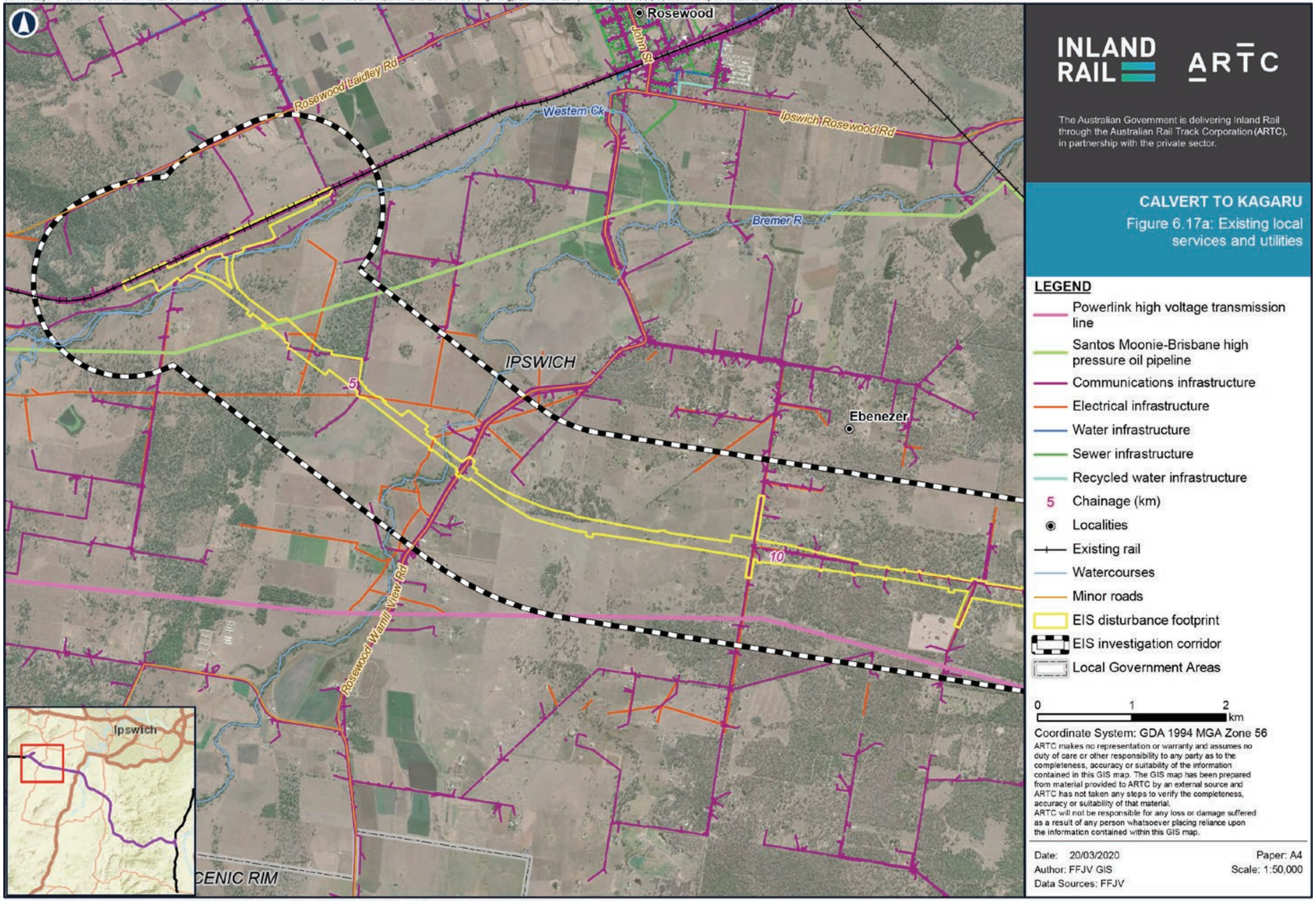

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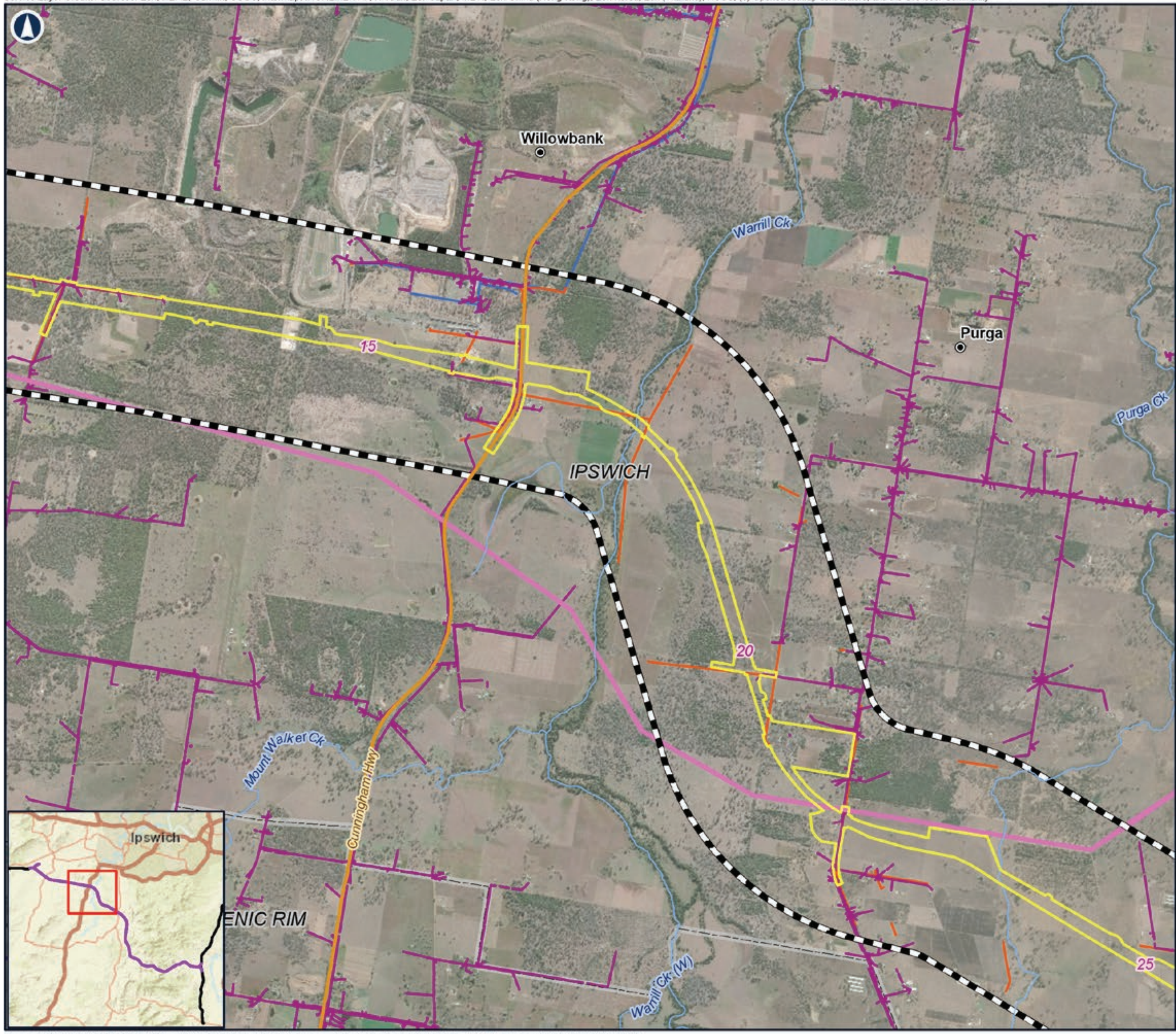

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CALVERT TO KAGARU

Figure 6.17b: Existing local services and utilities

LEGEND

- Powerlink high voltage transmission line
- Communications infrastructure
- Electrical infrastructure
- Water infrastructure
- 5 Chainage (km)
- Localities
- Watercourses
- Major roads
- EIS disturbance footprint
- EIS investigation corridor
- Local Government Areas

0 1 2 km

Coordinate System: GDA 1994 MGA Zone 56

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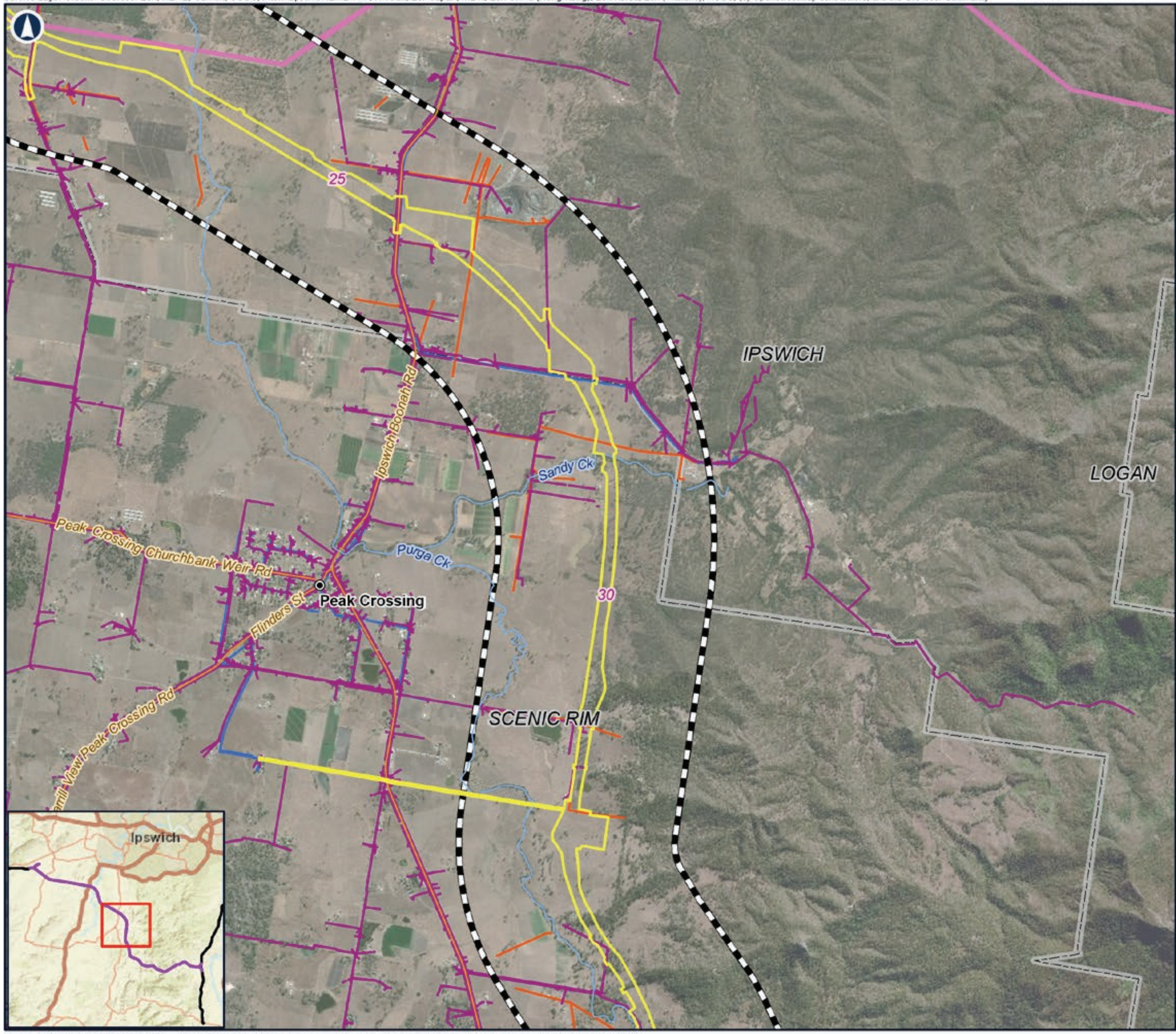

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CALVERT TO KAGARU

Figure 6.17c: Existing local services and utilities

LEGEND

- Powerlink high voltage transmission line
- Communications infrastructure
- Electrical infrastructure
- Water infrastructure
- 5 Chainage (km)
- Localities
- Watercourses
- Minor roads
- EIS disturbance footprint
- EIS investigation corridor
- Local Government Areas

0 1 2 km

Coordinate System: GDA 1994 MGA Zone 56

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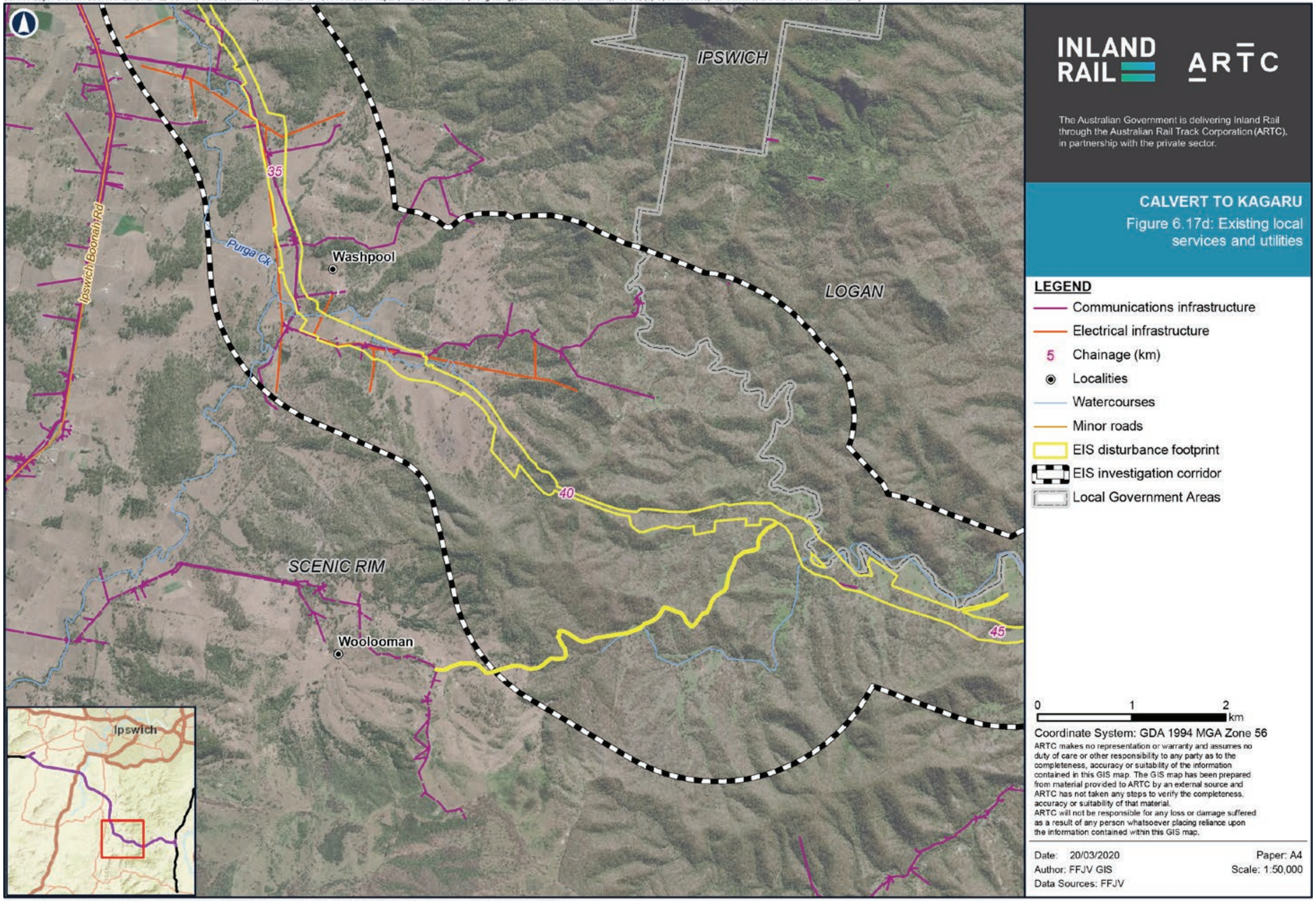

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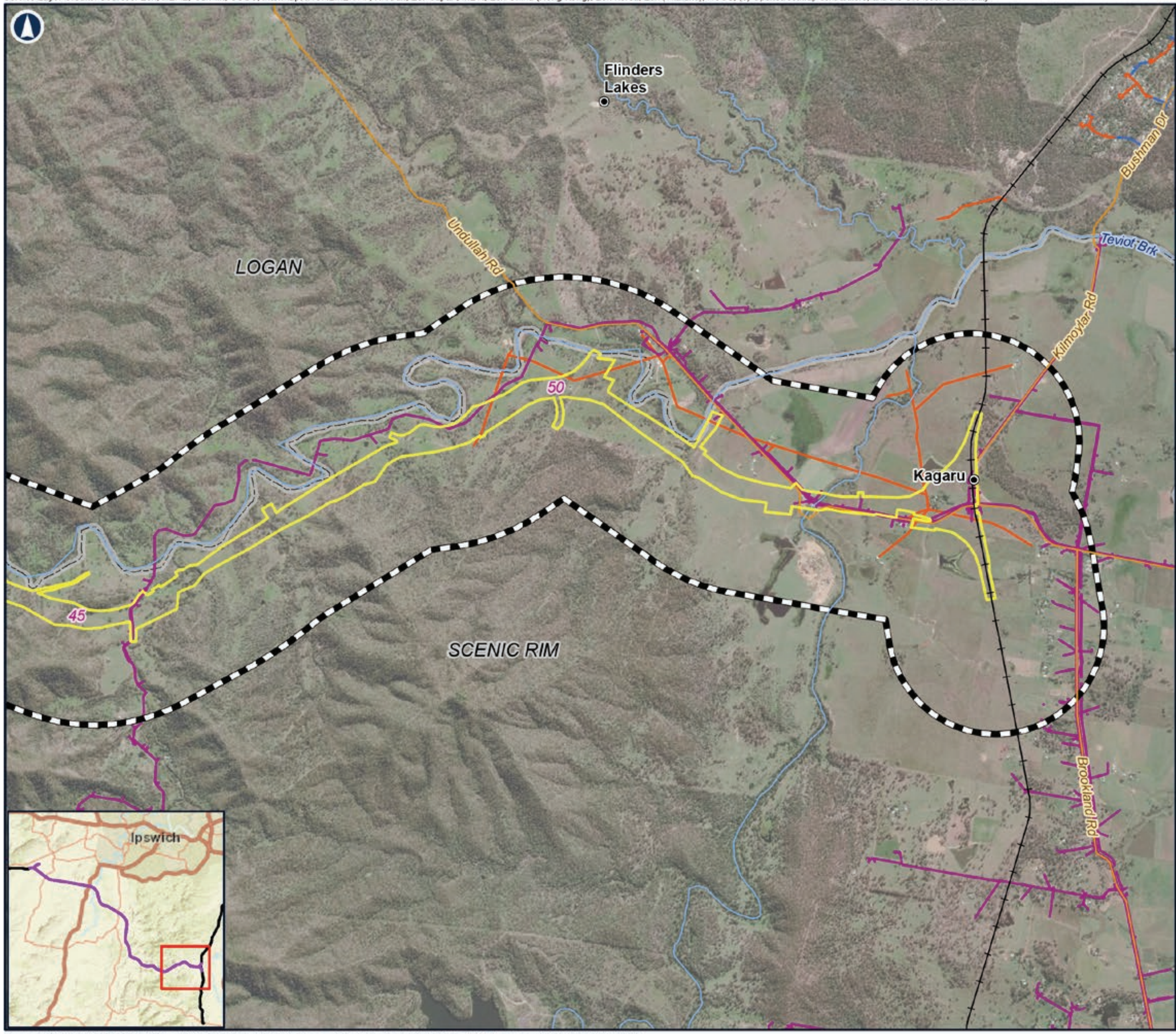

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Figure 6.17e: Existing local services and utilities

LEGEND

- Communications infrastructure
- Electrical infrastructure
- Water infrastructure
- 5 Chainage (km)
- Localities
- Existing rail
- Watercourses
- Minor roads
- EIS disturbance footprint
- EIS investigation corridor
- Local Government Areas

0 1 2 km

Coordinate System: GDA 1994 MGA Zone 56

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6.2.11 Fencing

Fencing will be provided for the extent of the rail corridor and its primary purpose is to limit access to the railway. Fencing is to extend between the corridor and lands of owners or occupiers adjoining the railway, with any specific requirements to be designed in consultation with the adjoining landholder.

As the Project comprises substantial greenfield works in rural agricultural and grazing areas, standard rural fencing will typically be provided according to ARTC fencing procedure, Boundary Fencing ETM-17-02. Fencing will act to protect adjoining lands from trespass and to prevent stock on adjoining land from gaining access to the railway. Where superior fencing is required (for example where tracks are in close proximity to roads and/or communities, or where trespass is anticipated to occur) a 1.8 m chain-link boundary fence may be provided.

Gates will be provided at suitable corridor entry/exit locations to allow convenient access to infrastructure for maintenance purposes, and at private level crossings and stock crossings.

Six fauna crossings are proposed. These include:

- Five rail bridges over waterways, which include sufficient span to allow for dryland crossing
- One rope bridge across a deep cutting.

The six locations have been assessed as providing movement opportunities for the greatest number of species requiring the least amount of additional infrastructure, and being the most cost-effective solution for their intended purpose. These requirements and locations will be refined and confirmed during detailed design. The requirement for specific fauna fencing at these locations will also be assessed and determined during detailed design.

An appropriate clearance buffer will be maintained between adjacent vegetation and fauna fences, to minimise opportunities for fauna to climb over the exclusion fence.

Further information on fauna fencing can be found in Chapter 11: Flora and Fauna and Appendix J: Terrestrial and Aquatic Ecology Technical Report.

6.2.12 Environmental treatments

Environmental treatments refer to the response of design to environmental and social constraints. Examples of environmental treatments included in the Project design are as follows:

- Fauna-exclusion fencing—refer Section 6.2.11
- Sediment basins—refer Section 6.5.15.3
- Scour protection—refer Section 6.2.7.1
- Noise mitigations—refer Section 6.2.12.1
- Waterway crossings considerate of fish passage requirements—refer Section 6.2.12.2.

6.2.12.1 Noise mitigation

A range of noise mitigation options or property treatments, will be investigated by ARTC during detailed design and construction, if noise criteria are predicted to be exceeded.

6.2.12.2 Fish passage

Culverts, bridges (under both rail and road) and any other cross-drainage structures have been designed to accommodate fish passage requirements.

A review of the Department of Agriculture and Fisheries (DAF) *Queensland Waterways for Waterway Barrier Works mapping* (2018) is included in Appendix J: Terrestrial and Aquatic Ecology Technical Report. The rail alignment crosses a total of 30 waterways for waterway barrier works. These waterways are classified as follows:

- Low risk of impact (category 1): nine waterways mapped as 'low risk of impact' are intercepted by the rail alignment
- Moderate risk of impact (category 2): ten waterways mapped as 'moderate risk of impact' are intercepted by the rail alignment
- High risk of impact (category 3): four waterways mapped as 'high risk of impact' are intercepted by the rail alignment
- Major risk of impact (category 4): seven waterways mapped as 'major' are intercepted by the rail alignment.

The Project may trigger the requirement to obtain a Development Permit for Operational Works involving constructing or raising temporary and permanent waterway barrier works. The design of each cross-drainage and bridge structure will be verified at the detailed design stage to confirm compliance with the accepted development criteria. Engagement with the DAF will be undertaken to confirm whether the proposed works constitute a waterway barrier (refer Chapter 3: Project Approvals).

6.2.12.3 Signalling and communications

A safeworking system consisting of signalling and communications equipment to ensure the safe movement of trains will be delivered as part of the Inland Rail Program. This system will consist of signals, indicators, signs, detection, monitoring and control equipment on track, beside the track and in enclosures in the rail corridor. The safeworking system will likely be monitored and controlled from an existing ARTC train control centre.

6.3 Infrastructure alternatives

The design has been developed to include infrastructure components that can be feasibly, safely and efficiently constructed and operated, is compliant with design criteria (refer Section 6.2.1) and is optimised with consideration for the overarching principles of ecologically sustainable development, including:

- Precautionary principle
- Intergenerational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation, pricing and incentive mechanisms.

Infrastructure alternatives will continue to be assessed for viability through the detailed design process and as construction approaches are refined.

Sustainability considerations, including defined preferences, in relation to sources of water, waste management and utility requirements are discussed in the following sections:

- Potential water sources—refer Section 6.5.6
- Management of waste and resource use—refer Section 6.5.10 and Chapter 21: Waste and Resource Management
- Management of waste water from the tunnel—refer Section 6.5.11
- Provision of utilities—refer Section 6.5.9.

Route and associated infrastructure alternatives considered for the Project are discussed in Chapter 2: Project Rationale. The four principles of ecologically sustainable development are further considered in Appendix K: Matters of National Environmental Significance Technical Report. Chapter 11: Flora and Fauna discusses how the precautionary principle and promotion of conservation of biological diversity and ecological integrity have been incorporated into both the assessment methodologies and the development of mitigation measure.

6.4 Ongoing activities, early works, pre-construction activities, and enabling works

Some activities are required before the start of construction. These activities have been classified as ongoing activities, early works, pre-construction activities and enabling works.

6.4.1 Ongoing activities

6.4.1.1 Corridor acquisition

The Project traverses multiple lots, the majority of which were identified as part of the future railway land gazetted under the TI Act by the QLD Government in 2010. Chapter 8: Land Use and Tenure details the properties traversed by the Project disturbance footprint.

The majority of land required for the rail corridor will be acquired by a constructing authority that has compulsory acquisition powers. Where compulsory acquisition of land is required, the process outlined in the *Acquisition of Land Act 1967* will be followed. Arrangements between ARTC and a constructing authority are yet to be finalised. Temporary and permanent access to State land tenures such as unallocated State land, reserves and roads will be undertaken in accordance with the *Land Act 1994* (Qld) (Land Act). The extent of property impacts will be refined and confirmed during detailed design in consultation with landholders.

6.4.1.2 Environmental and planning approvals

Following approval of the EIS under the SDPWO Act, the Project will require additional post-EIS approvals under State environmental and planning legislation. The majority of approvals will be required before the start of construction or any ground-disturbing activities.

Under Section 51(2) of the *Planning Act 2016 (Qld)* to support applications for a material change of use, reconfiguring a lot, or works below the high water mark evidence of owner consent is required. Consent is required for land that is:

- Subject to a permit to occupy or subject to a licence
- Unallocated State land
- A road (other than a State-controlled road) or stock route
- Subject to a lease, including a freeholding lease or a reserve or deed of grant in trust, where the land is administered on behalf of the State as the lessee or trustee of the land
- Subject to a lease, including a freeholding lease, or a reserve or deed of grant in trust, where the lessee or trustee is not or does not represent the State.

Owners' consent will be required prior to the making of some planning applications, for example environmentally relevant activities (ERAs) and development approvals on any of the aforementioned land types during construction.

The Project may involve the following ERAs during construction, as defined in Schedule 2 of the Environmental Protection Regulation 2019 (EP Regulation):

- Chemical storage (ERA 8)—threshold to be determined following refinement of construction methodology
- Extractive and screening activities (ERA 16)—threshold to be determined following refinement of construction methodology
- Cement manufacturing (ERA 41)—manufacturing 200 tonnes or more of cement in a year
- Regulated waste transport (ERA 57)—transporting regulated waste in a vehicle
- Water treatment (ERA 64)—threshold to be determined following refinement of construction methodology.

The Project may involve the following development approvals:

- Operational work that is constructing or raising waterway barrier works (unless the works comply with the requirements of the document *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018)
- Operational work for clearing native vegetation (unless the clearing is accepted development or exempt clearing work under the Planning Regulation 2017)
- Operational work that involves taking or interfering with water in a watercourse, lake or spring.

A summary of the potential post-EIS approvals is in Chapter 3: Project Approvals. These approvals are subject to change during refinement of the construction approach and the detailed design process and will need to be reviewed further at that stage.

Unless determined by the contractor, all construction activities, including pre-construction and early works, will remain within the disturbance footprint. If works outside the disturbance footprint are required, the contractor will be responsible for undertaking further investigations of the disturbance area, obtaining relevant owners' consent and securing all necessary approvals or changes to approvals before scheduling any ground disturbance.

6.4.1.3 Survey and geotechnical investigations

The construction of Project infrastructure requires adherence to survey control plans and procedures to ensure spatial correctness and quality of construction. The Project will engage reputable and competent surveying teams who will, among other things, control and guide the following:

- All elements of survey and survey control
- Survey mark preservation and compliance with Queensland legislation
- Development and nomination of survey control points to feed into Inspection and Test Plans for delivery, including:
  - Topsoil stripping
  - Quantity measurement (usually before and after all materials are used)
  - Setting out of all alignment and structural elements.

The contractor will comply with ARTC survey requirements for the delivery of the Project.

6.4.2 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 are expected to include, but are not limited to:

- Establishment of access tracks
- Relocation or protection of QR assets (excluding those undertaken as enabling works)
- Utility or service relocations (excluding those undertaken as enabling works)
- Installation of temporary fencing
- Establishment of site compounds
- Delivery of materials to site.

Pre-construction activities may be scheduled before the main construction works or undertaken under a separate contract, and be managed under a Construction Environmental Management Plan (CEMP).

6.4.2.1 Establishment of access tracks

Temporary access tracks will be required along the alignment to allow drainage, earthworks and bridge structure crews to access work fronts. The temporary access roads will be designed and constructed or upgraded with appropriate consideration to minimising disruption to landholders and public infrastructure.

Construction access is proposed to be provided adjacent to working fronts along the Project corridor and will be sized to allow free-flowing and unhindered access for all construction and support traffic vehicles, while minimising the disturbance footprint. During this phase of the Project, materials including rail, sleepers, ballast, concrete, culverts, fill material (general and structural) and construction water will be delivered and stockpiled or stored in designated construction laydown areas.

In general, the access roads will also cater for the movement of:

- Construction equipment and vehicles
- Personnel transport for staff and labour to access the works
- Maintenance vehicles
- Material deliveries
- Servicing temporary construction facilities along the route.
- Emergency vehicles.

Construction access roads will be designed and constructed with appropriate consideration to minimising disruption to landholders and public infrastructure. The final number of tracks required and the location of access tracks will be determined during the development of detailed design.

Several access tracks, outlined in Table 6.11, will be developed to facilitate access to the laydown and construction sites located along the length of the Project. These access tracks will be developed with a proposed pavement treatment suitable for the material type to be stored at the locations and vehicle type required to access the location.

Haul routes will be developed considering factors such as separation requirements, one-way or two-way vehicle movements, overtaking requirements and relevant vehicle and plant dimensions and weights.

Haul routes will firstly look to adopt the future RMAR footprint or the formation prior to creating new tracks that will require future restoration once the construction work has been completed. Further information on RMARs is included in Section 6.2.9.

When planning for the exact location of access tracks and haul routes, an assessment will be made of aboveground and underground services that may be affected by oversized loads or weights. This assessment will also consider the asset owner's maintenance access requirements.

TABLE 6.11: TEMPORARY ACCESS TRACKS

Adjoining road	Length (m)	Note
Coveney Road	570	On future RMAR to access the Bremer River Rail Bridge laydown area
Paynes Road	1,500	On future RMAR to access the laydown areas to the east of M Hines Road
Middle Road to Ipswich–Boonah Road	3,700	On future RMAR between Middle Road and Ipswich Boonah Road
Mt Flinders Road	550	New alignment to the western side of the rail embankment to access the laydown area for the northern end of Sandy Creek Rail Bridge
Dwyers Road	2,400	On future RMAR up to the southern end of Sandy Creek Rail Bridge
Dwyers Road to Washpool Road	2,450	On future RMAR for construction access in this isolated area
Washpool Road	2,200	To provide access to the western tunnel portal from Washpool Road Uses future Washpool Road alignment and future RMAR
Wild Pig Creek Road	6,700	To provide access to the eastern tunnel portal from Wild Pig Creek Road Uses a combination of new alignment, future Wild Pig Creek Road alignment and future RMAR
Wild Pig Creek Road	1,110	New alignment on the northern side of the rail embankment to access the laydown area for the eastern abutment of Upper Tributary #2 Dugandan Creek Rail Bridge

6.4.2.2 Relocation or protection of Queensland Rail assets

A survey of existing QR assets within the disturbance footprint will be required after an interface agreement between ARTC and QR, but prior to the commencement of construction. The purpose of this survey will be to locate all existing rail infrastructure components and determine their type, size, materials and condition. QR assets may include turnouts, signalling systems, culverts, sleepers, rail and ballast. This survey will inform Project decisions on the ability to reuse, protect, remove or relocate existing QR assets.

Where an existing asset requires protection, removal or relocation, these works may be conducted as 'enabling works' by QR or as 'pre-construction activities' if it is safe for continued network operation, with prior approval from QR.

6.4.2.3 Utility or service relocations

Site preparation includes modifying, diverting or realigning utility services and infrastructure, some of which may be undertaken as 'enabling works' by a third-party asset owner or manager.

The anticipated methodology for utility clearances and diversions is:

- Site surveys will be undertaken to determine as-built locations and arrangements
- A variety of strategies for the relocations are likely to be appropriate or investigated:
  - Abandonment of redundant services
  - Realignment of existing service where slack or arrangement allows
  - Construction of new services followed by a cut-over
  - Protection of existing services if there will be no impact.

The utility diversion works will likely involve:

- Isolating power sources and creating temporary connections
- Trenching with excavators or trenchless machines
- Construction of new posts and supports for suspended services using auger-rigs or mobile cranes
- Pipe-laying, conduit and cable installation as appropriate into or onto completed trenches or towers or poles
- Testing and commissioning of new or re-located services as appropriate
- Restoring and revegetating disturbed areas.

ARTC has commenced consultation with all owners of utility assets located within the disturbance footprint. The exact methodology for utility diversions and treatment will be determined in consultation with the affected utility owners. All relevant access agreements and approvals will be in place before work commences. Any third-party connections outside of the disturbance footprint will be managed by the service provider in consultation with ARTC and the contractor.

The utilities required for construction are assumed to be temporary and have not been subject to the utilities assessment. When the final locations of site offices are confirmed, the contractor will engage with the utility owners to connect to mains power, water, communications and sewerage, where possible. Temporary requirements will be provided by portable water tanks and gen-sets, where required. The need for mains connections to facilitate construction activities, while beneficial, will not hold up construction.

6.4.2.4 Site offices

Eight laydown areas have been nominated for the location of site offices. Not all locations are required to have site offices; however, the locations proposed in Table 6.12 have been selected as potential locations along the alignment with an area large enough to contain a site office. Final locations of site offices will be determined during the development of detailed design.

TABLE 6.12: POSSIBLE SITE OFFICE LOCATIONS

Adjoining road	Description
Hayes Road	Satellite site office
Paynes Road	Satellite site office
M Hines Road	Satellite site office
Middle Road	Site office
Ipswich–Boonah Road	Satellite site office
Washpool Road	Satellite site office
Wild Pig Creek Road	Site office
Undullah Road	Satellite site office

6.4.3 Works that are not part of Project works

Enabling works are those works 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 under a separate contract, or by the asset owner, and are required to comply with the relevant environmental or regulatory framework applicable to the works or public utility. Enabling works may include:

- Overhead powerline relocations
- Telecommunications relocations
- Relocation or protection of existing QR assets.

6.5 Construction activities

6.5.1 Overview

Construction activities for the Project will include:

- Site set out and pegging, including establishing clearing limits
- Establishment of laydowns and compounds, including vehicle inspection/workshops and washdown facilities as required
- Clearing—using dozers, chainsaws, excavators, trucks and similar equipment
- Bulk earthworks—major cut-to-fill operations include the winning of suitable construction material from sections of cut along the railway alignment or from borrow areas external to the site
- 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
- Construction of tunnel maintenance facilities, administration and amenities buildings, car and truck parking and bulk fuel provisioning and storage areas
- Other miscellaneous activities to complete the works such as reinstatement and rehabilitation of temporary works areas and landscaping in accordance with the Project landscape design.

6.5.2 Construction schedule

The following broad milestone dates for construction are proposed at this stage:

- Construction commences: 2021
- Target completion of construction: 2026
- Six months testing and commissioning phase.

An indicative construction program for the Project is shown in Figure 6.8. This program is subject to change during the detailed design and construction phases as a result of:

- Weather conditions
- Changes to construction methods and materials
- Unexpected finds, such as threatened biodiversity species or cultural heritage values.

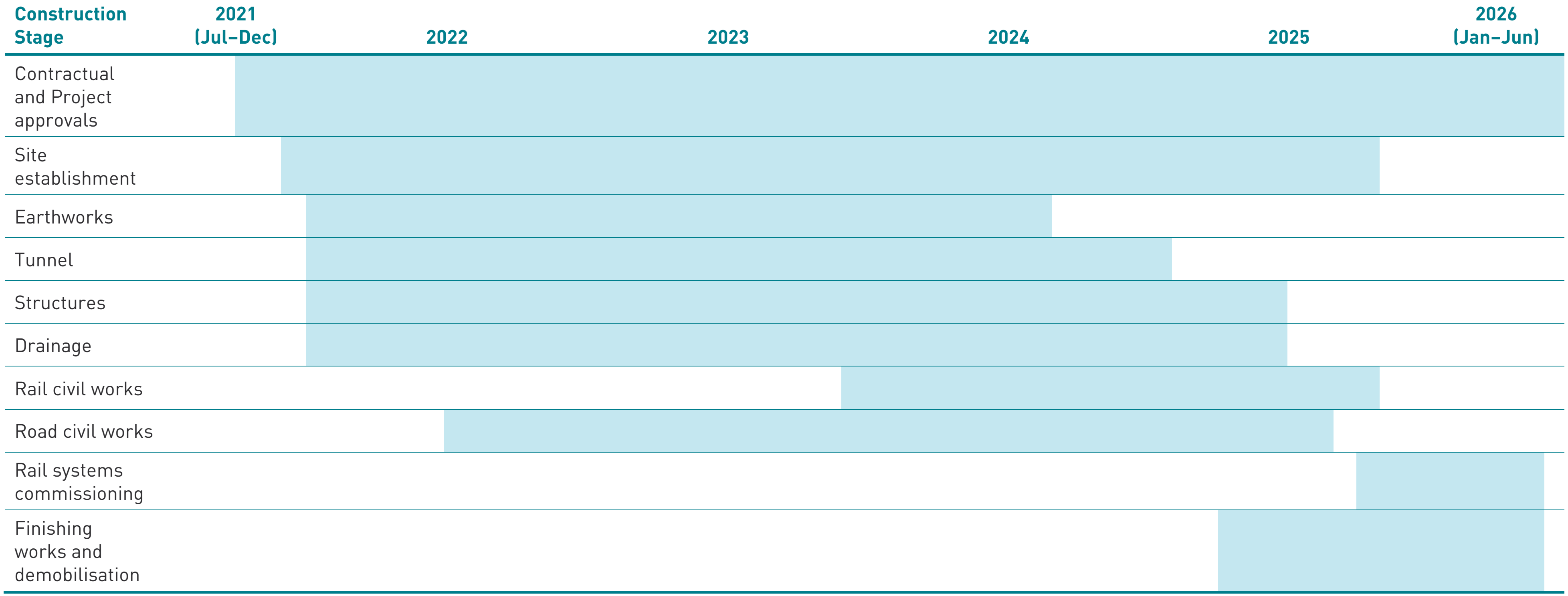


FIGURE 6.18: INDICATIVE CONSTRUCTION PROGRAM

6.5.3 Construction workforce

The Project is part of the larger Inland Rail Program. The Inland Rail Program is expected to generate 16,000 jobs with an average of 800 jobs per annum over the 10-year construction period. An average of 700 additional jobs per annum is anticipated over 50 years of operation.

As part of the procurement and contracting process, primary contractors will be required to document their proposed training strategies for the construction phase. This will form a key input to the tender evaluation process. During the construction period, construction managers will be required to report to ARTC on the delivery and outcomes of training strategies.

Actions undertaken during the construction phase will also address development of capacity of the local and regional workforce for employment in the operational phase. Management of the Project's operational workforce will be in accordance with ARTC's established training, recruitment and employment strategies.

A preliminary estimate of the workforce required to undertake the Project works to the nominated program is shown in Figure 6.19. Construction of the Project is expected to require a workforce of up to 620 personnel. The size and composition of the construction workforce will vary depending on the construction activities being undertaken and the staging strategy adopted. The core construction workforce will consist of professional staff, supervisors, trades workers and plant operators, with earthworks crews, bridge-structure teams, capping and track-work crews working at different periods though the construction phase. Commencing in 2021, the Project's workforce is estimated to peak at 620 full-time equivalents (FTEs) between weeks 65 and 75. The average number of FTE workforce on site across the full construction period is planned to be 271 personnel.[1]

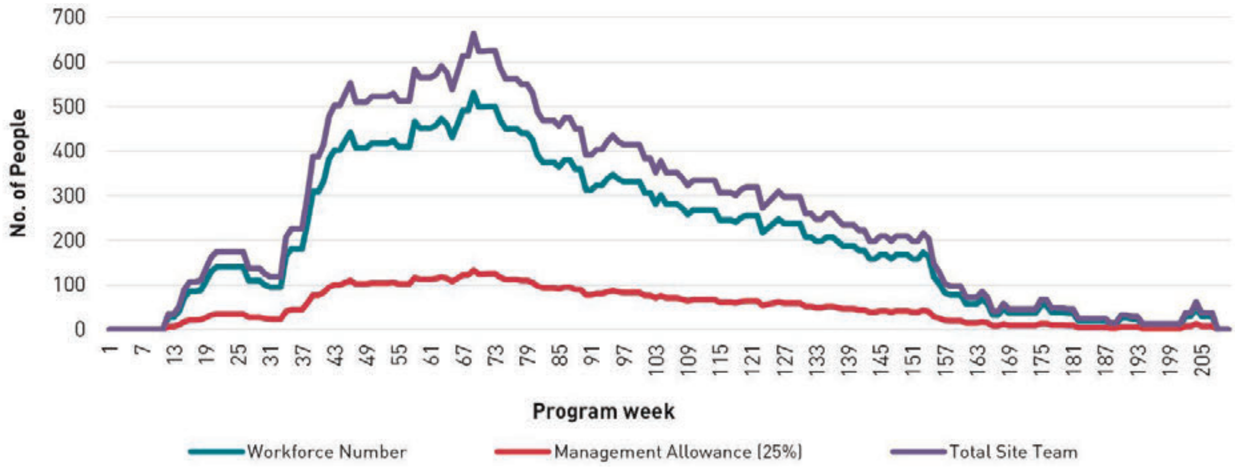


FIGURE 6.19: ESTIMATED SITE WORKFORCE

An accommodation camp is not considered necessary due to the reasonably close proximity of population centres that will offer both workforce and accommodation options. Assessments of available accommodation are summarised in Table 6.13. The location of these population centres in relation to the Project is shown in Figure 6.20.

TABLE 6.13: AVAILABLE ACCOMMODATION

Town/city	Population	No. of hotels/motels[1]	No. of available rentals (as of May 2018)[2]
Brisbane	2,054,000	850	1,500
Ipswich	218,000	30	500
Logan	303,390	20[2]	1,400
Jimboomba	13,201	0	20
Beaudesert	6,395	10	50
Gatton	6,870	5	50
Toowoomba	100,000	100	500

Table notes:

1. Based on available, published data. Rounded estimates
2. Rounded estimates

1. The Initial Advice Statement (ARTC, 2017b) for the Project estimated the workforce to be 1,600 FTEs—a proportional figure based on the overall capital cost for a 10-year program-wide delivery period. As a result of further detailed assessment and design advancement, the Project now estimates an onsite construction workforce of 620 FTEs (peak) with an annual average of 271 FTEs may be required. Over the estimated construction period of 205 weeks, this equates to approximately 1,000–1,100 FTEs. The Project's construction workforce estimate excludes Project planning delivery personnel, the Inland Rail support function, pre-construction design personnel, technical support services and review/verification of labour efforts.

6.5.4 Hours of work

Construction work will typically be undertaken during the following primary Project construction hours:

- Monday to Friday 6.30 am to 6.00 pm
- Saturday 6.30 am to 1.00 pm
- No work Sundays and public holidays.

Track possessions, when the contractor has control over an operating railway, will proceed on a 7 day/24-hour period. Track possession of QR assets will generally be allocated over weekend periods, with extended track possession occurring over holiday periods.

Works outside primary Project construction hours may occur throughout the duration of the construction program and may involve:

- Delivery of concrete, steel, and other construction materials delivered to site by heavy vehicles
- Movements of heavy plant and materials
- Spoil haulage
- Tunnelling activities
- Arrival and departure of construction staff during shift change-overs
- Roadworks to arterial roads
- Traffic-control crews, including large truck mounted crash attenuator vehicles, medium rigid vehicles, and lighting towers
- Incident response including tow-trucks for light, medium, and heavy vehicles.

Where work outside the standard hours, including night works, will be required, for example the delivery of materials, the works will only proceed where consultation with the local community has been undertaken. Furthermore, a site-specific noise risk assessment will be undertaken to identify the environmental risks associated with the works, action required to mitigate these risks and justification as to why the works are required out of standard hours.

Further information on the hours of work is discussed in Chapter 23: Draft Outline Environmental Management Plan.

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

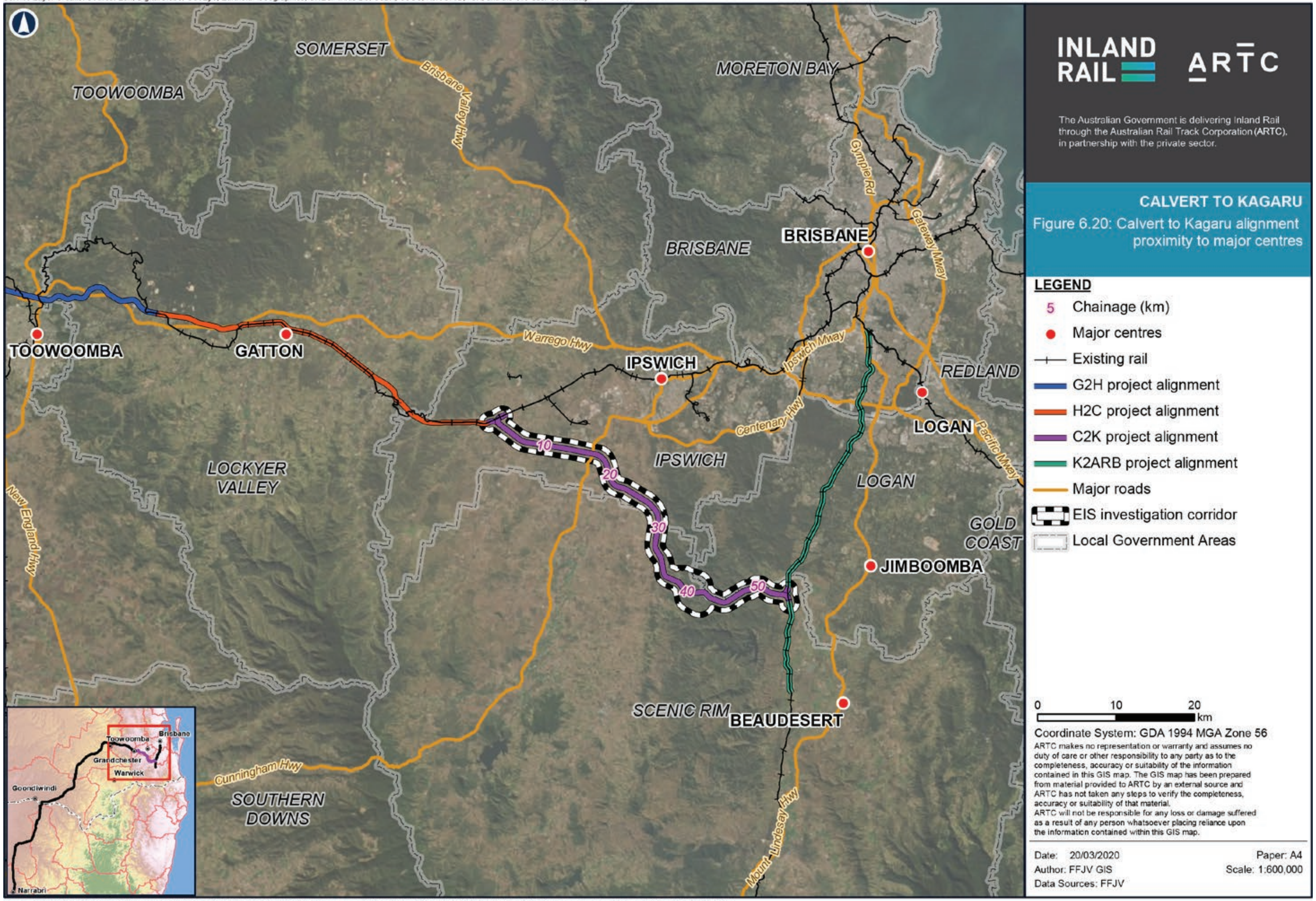


Figure 6.20: Calvert to Kagaru alignment proximity to major centres

Map by: Gn Z:\GIS\GIS_3400_C2K\Tasks\340-EAP-201905150838-C2K_EIS_GIS_Tasks_FigureUpdates\340-EAP-201905150838_ARTC_Fig6.20_Proximity_to_major_cities.mxd Date: 22/03/2020 14:47

6.5.5 Plant and equipment

Table 6.14 provides the indicative plant and equipment required for different stages of the construction phase. These will be refined and confirmed with contractors prior to construction, and in line with consultation with relevant stakeholders.

TABLE 6.14: INDICATIVE PLANT AND EQUIPMENT FOR THE CONSTRUCTION PHASE

Activity	Week		Duration	Plant type	Indicative number
	From	To			
Establishment of site compounds, site facilities and camps	12	20	8	12G Grader	2
				Dump truck—off road (25 T Artic)	4
				Excavator—40 T	2
				Water cart—35 kL	2
Construction of concrete batch plant sites	21	26	6	12G Grader	1
				Dump truck—off road (25 T Artic)	2
				Excavator—40 T	1
				Water cart—35 kL	1
Haul roads and access roads construction (two crews)	12	19	8	Grader 14H	2
				Excavator—40 T	1
				637 Scraper	2
				Dump truck—off road (25 T Artic)	2
				Water cart—35 kL	2
Haul road maintenance	20	187	168	Grader 14H	2
				615 Scraper	1
				Truck—on-road tandem	2
				Water cart—35 kL	2
Clearing and grubbing/topsoil stripping	14	54	41	Dozer D7R	8
				Excavator 40 T	4
				Truck (25 T Artic)	8
				637 Scraper	4
				Water cart	4
				Mulcher	4
Cut to fill—scraper crew (peaking at three crews in total)	18	83	66	Dozer D11—pushing	3
				Dozer D10 – ripping	3
				Scraper – 5 (most likely for a 1.5–2 km cycle),	15
				Water cart 35 kL	6
Compaction crew—scraper matched	18	83	66	Dozer	3
				20 T Padfoot roller	3
				825 Compactor	6
				Grader 14H	6
				Watercart—35 kL	6
Cut to fill—excavator and truck crew (peaking at three crews in total)	19	116	98	Excavator 85 T	3
				Truck 50 T—to match excavator productivity, cycle time: average six trucks per 5 km haul	18
				Watercart 35 kL	6

Activity	Week		Duration	Plant type	Indicative number
	From	To			
Compaction crew—excavator matched	18	104	54	Dozer	3
				20 T Padfoot roller	3
				825 Compactor	6
				Grader 14H	6
				Water cart—35kL	6
Import structural fill	39	116	76	Trucks – on road tandem	10
				960 Loader	1
				Dozer	1
				Excavator 40 T	1
				Watercart—35 kL	2
Place structural fill	39	116	76	Dozer	1
				15 T Roller	1
				Compactor	1
				Grader 14H	2
				Watercart—35 kL	2
Blasting	39	116	76	Top hammer or down-hole hammer	1
	As required through this period			Grade control rig	1
Excavation and primary lining	19	62	44	Drill rig	1
				Excavator fitted with rock breaker	1
				Front End Loader (FEL)	1
				Fork lift	1
				Dump truck	2
				Shotcrete machine	1
				Roadheader	2
Secondary lining and internal structure	63	130	68	Shotcrete machine	1
				Concrete pump	1
Substructure/ foundations construction	34	160	127	Excavator 40 T	5
				Piling rig	5
				Concrete truck	As required
Pier construction	38	163	127	Excavator 40 T	5
				Crane	5
				Concrete truck	As required
Superstructure construction	64	165	102	Crane	5
Install cross drainage	34	122	89	Backhoe (20 T equivalent)	14
				Excavator 30 T	14
				Work truck (hiab)	14
				Small compactor	14
				Concrete truck	As required
				Concrete pump	14
				Franna crane	14

Activity	Week		Duration	Plant type	Indicative number
	From	To			
Capping material import	101	161	61	Truck—on-road tandem	10
				Dozer Caterpillar D7R	1
				Excavator 40 T	1
				Water cart 35 kL	1
Capping material placement	101	161	61	Dozer D7R	1
				Roller 15 T	1
				Compactor	1
				Grader 14G	2
				Water cart 35 kL	2
Bottom ballast	168	179	12	Truck—on-road tandem	6
				Dozer D7R or Grader 14G	1
				FEL L110	1
				Excavator 20 T	1
				14 T Smooth Drum Roller	1
Sleeper installation	175	181	7	Trucks—flat bed	2
				FEL L110	3
				Excavator 20 T	3
Rail	180	191	12	Trucks—flat bed	2
				FEL L110	2
				Excavator 20 T	2
Top ballast	190	193	4	Trucks	6
				FEL L110	1
				Excavator 20T	1
				Ballast train	1
				Water cart	1
Track tamping and regulating	192	203	12	Tamper 4s	1
				Tamper 08-16 or 3 x	1
				Regulator	1
				Excavator 20 T	1
				Water cart	1
Rail stressing	202	204	3	Trucks—flat bed	2
Road works	34	176	143	12G Grader	1
				Excavator 30 T	1
				12 T Compactor	2
				Water cart—15 kL	2
				Trucks—on-road tandems	5
				Bitumen seal sprayer/chip sealer	1

6.5.6 Construction water

Water will be required for dust control, site compaction and reinstatement during construction. A number of potential water sources have been investigated, including extraction of groundwater or surface water, private bores, recycled water and watercourses. These sources will be further explored during detailed design in consultation with regulatory agencies, local governments and landholders. Where water is not available, it will be transported to the site via tanker truck and stored in temporary storage tanks. Potable water for human consumption will be supplied in potable water tanks or as bottled water, as necessary.

Activities during the construction phase with the highest water demand are:

- Soil conditioning
- General dust suppression
- Dust suppression and maintenance of laydown areas and haul roads
- Construction offices and amenities.

Overall, an allowance of 190 litres per cubic metre (L/m^3) of earthworks has been made in building up the estimated water demand requirements.

The following sections provide a discussion on the anticipated water demand for each of the activities specified in Table 6.15.

6.5.6.1 Earthworks

The greatest water demand on the Project will be for the earthworks, which predominately includes conditioning of material, haul road and laydown maintenance and dust suppression. Generally, earthworks operations require low-quality water from sources such as dams and watercourses, and ideally high-quality water sources should be avoided for these construction activities.

Earthworks will comprise the following activities and assumed water application rates:

- Material conditioning is expected to consume approximately 100 L of water per m^3 of fill, however this is variable, dependent on material properties. This equates to 480 megalitres (ML) of water in total for material conditioning.
- General dust suppression across the site will be a constant activity. An allowance of approximately 50 L of water per m^3 of fill has been made which equates to 240 ML of water in total.
- Haul road and laydown area maintenance will also require water and an allowance of 40 L of water per m^3 of fill has been made, which equates to 190 ML of water.

The total earthworks water requirements along the Project (ML vs chainage) are provided in Figure 6.21.

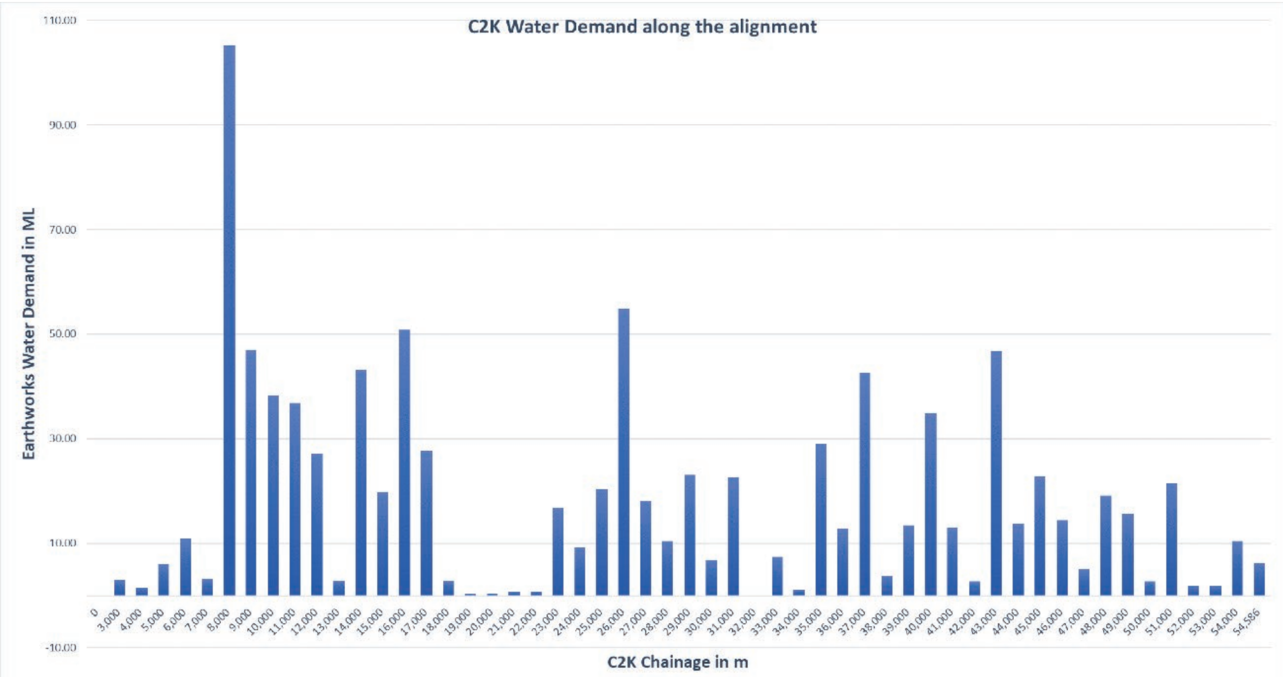


FIGURE 6.21: WATER DEMAND ALONG PROJECT

6.5.6.2 Concrete

Concrete batching has specific water-quality requirements in order to achieve structural integrity and asset life objectives. The water requirements for use in the supply of concrete are specified in *AS 1379: Specification and supply of concrete.*

The Project is expected to rely on a combination of existing commercial concrete batching facilities and, if required, temporary batching facilities established to service the Project.

Established plants are connected into mains water supply and the quality and uninterrupted supply of water is not considered an issue. Therefore, the water requirement for concrete supplied by existing concrete/pre-cast concrete suppliers has not been included in this assessment.

Locations for two temporary batching facilities have been nominated for the Project, one at Ch 39.5 km and another at Ch 53.8 km. While two locations have been nominated, the current assessment indicates that there is sufficient local concrete supply to service this Project. If a temporary batching plant is established, a dedicated water supply sourced from mains water will be required. A temporary concrete batch plant would be established with onsite water storage tanks, which would be filled by water trucks drawing water from mains connections, if capacity is available.

The availability of mains water for the use in a temporary batching facility would be discussed with all relevant local governments as the construction approach is refined during the detailed design process. In the planning of water access, maintaining the uninterrupted supply of potable water to existing residential and commercial users will be the priority.

6.5.6.3 Trackworks

The predominant use of construction water during trackworks is for dust suppression relating to ballasting works, and in particular ballast dropping and ballast regulating works during track tamping activities.

Based on previous rail project experience, a conservative allowance of 6 L per track metre has been assumed for ballast dropping and 4 L per track metre for dust suppression during tamping and regulating activities. Using these allowances, the trackworks activity will consume approximately 28 ML of water.

6.5.6.4 Water sources

The current water demand is expected to be met using existing water sources. Initial consultation with Seqwater has been undertaken to understand potential supply options from Seqwater sources. Further options may need to be investigated depending on engagement with water resource owners and the following aspects:

- Water is available to be provided from existing dams and weirs:
  - Water supply to meet the expected demand is available from the Churchbank Weir (Warrill Creek) and Wyaralong Dam
- Water will be supplied to various points along the alignment for activities including earthworks, trackwork and dust suppression
- If water is to be sourced from local town supplies, then an agreement will have to be made with the local council or utility provider on supply conditions
- If water is to be drawn from creeks and rivers crossing the alignment then approvals will be required from the Department of Natural Resources, Mines and Energy (DNRME)
- Further approvals will also be required to draw from groundwater bores.

Sources of construction water will be finalised during the detailed design and construction phase 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 agreements with local governments for sourcing of water mains for concrete batching purposes.

The hierarchy of preference for accessing of construction water is generally anticipated to be as follows:

- Public surface water storages, i.e. dams and weirs
- Recycled water, where appropriate
- Permanently (perennial) flowing watercourses
- Privately held water storages, i.e., dams or ring tanks, under private agreement
- Existing registered and licensed bores
- Mains water.

An assessment of the suitability of each source will need to be made for each construction activity requiring water, based on the following considerations:

- Legal access
- Volumetric requirement for the activity
- Water quality requirement for the activity
- Source location relative to the location of need.

An appropriate quality of water will be sourced for each use. For instance, non-potable water is suitable for soil conditioning and dust suppression, while potable water must be sourced for the construction offices and amenities. Prior to sourcing any construction water, the necessary approvals and licences will be obtained.

6.5.7 Laydown, stockpile and storage areas

Several laydown areas have been identified along the length of the Project. These laydown areas are situated next to the corridor to facilitate direct access to/from the laydown to the alignment. The laydown areas will act as a centralised point for all material storage. Some laydowns will also consist of fuel storage areas and site office compounds. Establishing temporary laydown areas will generally involve clearing, grubbing, topsoil stripping, installing environmental controls, laying hardstand material, and constructing parking areas and access tracks.

Each bridge location along the alignment will have a dedicated laydown/work area. The area may also include crane pads for the lifting of the bridge members. These areas are primarily for the bridge works; however, larger areas have been provided for locations requiring the storage of other materials that are not associated with the construction of the bridge.

Each laydown has been positioned to avoid or minimise potential impacts to environmental constraints and social receptors. The locations of the laydown areas have been chosen to avoid areas within the 1% AEP floodplains where practical. However, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas must be within floodplains and near water sources. In such instances, the following precautions will be taken:

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

Excess material resulting mainly from the excavation of track formation and cess drains will be stockpiled along the rail corridor. The stockpiles will be located as close as possible to the source of the excavated material and will be formed into permanent spoil mounds, spread out to minimise height.

Proposed laydown areas and their planned utilisation are listed in Table 6.15. Laydown areas are proposed to be located approximately every 5 km (avoiding 1% AEP floodplains where possible). Larger storage sites will be located approximately every 20 km. Additional laydown areas of approximately 2,500 m^2 will support bridge construction. Additional laydown areas will also be required for FBW and rail assembly. Laydown, stockpile and storage areas will be confirmed during the development of detailed design in consultation with the contractor, and will not result in the clearing of additional matters of national environmental significance (MNES) or habitat for MNES.

TABLE 6.15: INDICATIVE LAYDOWN AREAS AND UTILISATION

Location	Size	Laydown utilisation
Waters Road	175,000 m^2	Rail, bridge, culverts, FBW facility
Hayes Road	61,000 m^2	Sleepers, ballast, culverts, aggregates, fuel
Rosewood–Warrill View Road	25,000 m^2	Bridge, culverts
Mt Forbes Road	20,000 m^2	Bridge, culverts
Paynes Road (west of M Hines Road)	49,000 m^2	Sleepers, ballast, culverts, aggregates, fuel
Paynes Road (east of M Hines Road)	46,000 m^2	Sleepers, ballast, culverts, aggregates, fuel
Champions Way	9,000 m^2	Bridge
Cunningham Highway	71,000 m^2	Bridge, aggregates
Middle Road	256,000 m^2	Sleepers, ballast, culverts, aggregates, fuel
Purga Creek	109,000 m^2	Bridge, culverts
Ipswich–Boonah Road	128,000 m^2	Rail, sleepers, ballast, bridge, aggregates, fuel, rail
Mount Flinders Road	17,000 m^2	Bridge, culverts
Sandy Creek	9,000 m^2	Bridge, culverts
Dwyers Road	53,000 m^2	Sleepers, ballast, culverts, aggregates
Washpool Road	6,400 m^2	Bridge, culverts
Washpool Road	26,400 m^2	Bridge, culverts
Washpool Road	11,000 m^2	Bridge
Washpool Road	15,000 m^2	Bridge
Tunnel portal west	65,500 m^2	Culverts, aggregates, fuel, batch plant, tunnel
Tunnel portal east	29,600 m^2	Sleepers, culverts, aggregates, fuel, tunnel
Tunnel access road	18,000 m^2	Sleepers, ballast, bridge, culverts
Tunnel access road	37,000 m^2	Bridge, culverts
Wild Pig Creek Road	67,000 m^2	Sleepers, ballast, bridge, culverts, aggregates
Wild Pig Creek Road	9,000 m^2	Bridge, culverts
Wild Pig Creek Road	39,500 m^2	Sleepers, bridge, culverts
Wild Pig Creek Road	10,000 m^2	Bridge
Brennans Dip Road	28,000 m^2	Bridge
Undullah Road	29,000 m^2	Bridge
Undullah Road/Kilmoylar Road	39,000 m^2	Rail, sleepers, ballast, bridge, culverts, aggregates, fuel, batch plant, FBW facility

6.5.8 Fuel and hazardous materials

Fuel is to be stored at laydown areas along the Project alignment, the indicative locations are outlined in Table 6.14; however, these locations will be confirmed during the detailed design and construction phase (post-EIS). Specification and requirements on the storage of diesel will be in accordance with AS 1940 *The storage and handling of flammable and combustible liquids* and any further approval conditions.

During the construction phase, each laydown area is expected to be used for storage and distribution of construction chemicals. Likely chemical requirements have been determined based on usage on similar rail projects. While the chemical quantities may vary due to refinement of requirements during detailed design, the types and indicative quantities identified in Table 6.16 are considered to represent the usage requirements.

TABLE 6.16: INDICATIVE LIST OF DANGEROUS GOODS AND HAZARDOUS SUBSTANCES

Chemical type	Typical chemicals	Purpose/use	Dangerous good class	Packing group	Indicative rate of use	Expected storage method
Fuel oil	Diesel	Fuel for mobile equipment	9 (C1)*	III	40 kL/ 2 weeks	40 kL bulk storage (fuel depots)
Grease	Rocol Rail Curve Grease	Lubricate plant and equipment	C2**	N/A	Limited	Package storage
	Caltex 904 Grease	Lubricate plant and equipment	C2**	N/A	Limited	Package storage
	Shell GADUS Gauge Face Curve Grease	Lubricate plant and equipment	C2**	N/A	Limited	Package storage
	RS Claretech Biodegradable Grease	Lubricate plant and equipment	C2**	N/A	As required by cutting/ borrow pit activities	Package storage
Blasting chemicals	Ammonium Nitrate[1]	Cuttings and borrow pit operations	5.1	III	Limited	Not stored on site
Concreting	Concrete and Concrete Residue	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries
	Concrete Curing Compound	Concreting for slab construction	N/A	N/A	As required by the local construction team	Truck deliveries
Welding gases	Oxygen	Welding	2.2/5.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage
	Acetylene	Welding	2.1	N/A	Cylinders and/or manifold packs as required by the local construction team	Cylinder storage
Pesticides	Australian Pesticides and Veterinary Medicines Authority Approved Pesticides	Pests and weeds control	6.1 or 9	I, II or III	In accordance with the Australian Pesticides and Veterinary Medicines Authority approved label for the specific pesticide.	Not stored on site

Table notes:

1. Product is a security sensitive explosive defined under Schedule 7 of the Explosives Regulation 2017.

* Class C1—a combustible liquid that has a flashpoint of 150°C or less.

** Class C2—a combustible liquid that has a flashpoint exceeding 150°C.

6.5.9 Utilities and services

Utilities and services such as water, sewer, electricity and telecommunications will need to be supplied to each of the laydown areas and construction compounds for use in site offices and amenities. Where these utilities are located close to construction sites, opportunities to connect to existing sources will be explored with relevant service providers. Where utilities are not located in close proximity to the site offices and amenities, electrical generators and portable amenities will be used. Consideration will be given to the use of solar-power systems, including stand-alone systems, for the provision of power at site offices and for permanent infrastructure associated with signalling.

Where feasible, the Project will share power, water, sewage, construction materials and communications infrastructure with the adjacent H2C and K2ARB projects.

6.5.10 Waste disposal

Construction of the Project is expected to result in the generation of a variety of solid wastes, as classified under the EP Regulation and listed in Table 6.17.

TABLE 6.17: WASTE TYPES, DESCRIPTION AND POTENTIAL PROJECT SOURCES

Waste type	Definition	Potential Project source
Commercial and industrial	Wastes that are produced by business and commerce. In the case of green waste, it includes material delivered by commercial operation.	Site offices
Construction and demolition	Non-putrescible waste arising from the construction or demolition activity. Construction and demolition waste includes materials such as brick, timber, concrete and steel.	Demolition/removal of existing structures Construction work fronts Demobilisation of construction activity facilities (including Project amenities, laydown areas and temporary haul/access roads)
General	Wastes not defined as regulated waste under legislation. General wastes comprise putrescible wastes (easily decomposed, treated by composting) and non-putrescible wastes (not easily decomposed, may be recyclable).	Site offices Construction work fronts Laydown areas Clean, excess spoil
Green	Includes grass clippings, tree, bush and shrub trimmings, branches and other similar material resulting from landscaping or maintenance activities.	Clearing and grubbing Site preparation works
Recyclables	Wastes that can be reconditioned, reprocessed or reused. Recyclables can be recovered from commercial and industrial waste, construction and demolition waste and general waste.	Site offices Construction work fronts Laydown areas
Regulated	Wastes that require specific controls or actions as defined by legislation. Listed hazardous, regulated, controlled or trackable wastes typically have unique handling and disposal requirements in order to manage specific hazards associated with them is waste that is commercial or industrial waste and is of a type or contains a constituent of a type mentioned in Schedule 7 Part 1 Column 1 of the EP Regulation. Regulated waste includes asbestos, pesticides, a range of chemicals and other industrial wastes.	Used containers and residues of hazardous chemicals and dangerous goods Demolition/removal of existing structures

Quantities of wastes have been estimated based on the scale of the Project, with an appreciation for the construction activities that are typically required to establish a freight railway. These details are presented in Table 6.18 and will be subject to further refinement during the detailed design process. Potential opportunities to reuse these wastes have also been highlighted in Table 6.18.

TABLE 6.18: CONSTRUCTION WASTE QUANTITIES

Waste/resource description	Waste classification	Estimated quantity produced over construction duration	Potential reuse
Vegetation clearing and grubbing	Green	6,000,000 m^2	Yes
Topsoil	Construction and demolition	500,000 m^3	Yes All topsoil is expected to be reused on the Project
Rock	Construction and demolition	824,534 m^3	Yes Rock will be reused on the Project
Spoil	Construction and demolition	1,622,504 m^3 excess material	Yes Spoil will be reused where suitable
Site office waste	General (municipal)	20 t	No
Steel (rail)	Construction and demolition	200 t	No
Treated timber sleepers	Regulated	140 t	No
Ballast	Regulated	3,800 t	No
In-situ concrete culverts	Construction and demolition	90 t	No
In-situ concrete (bridges)	Construction and demolition	2,700 t	No
Precast concrete (bridges)	Construction and demolition	490 t	No
Spent pavement and hardstand material from temporary accesses and construction compounds	Construction and demolition and/or regulated (if contaminated through leaks and spills during construction)	4,800 t	No

In the area surrounding the Project, wastes are generated from domestic, commercial and agricultural sources. Local governments provide waste collection, recycling and disposal facilities and services for residential properties. However, it is likely that licensed contractors will be used for collection, treatment and disposal of wastes.

The management of waste activities associated with the Project will be underpinned by the 2018 National Waste Policy and *Waste Reduction and Recycling Act 2011* (Qld) waste and resource management hierarchy, as listed below in the preferred order to be considered:

- Avoid or reduce
- Reuse
- Recycle
- Recover energy
- Treat
- Dispose.

Details of the existing waste management facilities in proximity to the Project that have potential to accept waste from commercial operations are listed in Table 21.3 of Chapter 21: Waste and Resource Management. These waste management facilities have been considered based on the industry accepted haul route distance of 50 km for bulk waste and 15 km for municipal waste.

Confirmation of waste acceptance criteria and available/permissible annual disposal rates will be undertaken in consultation with the relevant operator once the timing for construction of the Project is determined. These investigations will consider:

- Landfill airspace
- Volume of waste generated by the Project requiring disposal
- Other project/industry needs within the surrounding area.

Further details on the potential sources, impacts, mitigation measures and management strategies (including efficiency of resource use) pertaining to Project wastes are discussed in Chapter 21: Waste and Resource Management.

Chapter 7: Sustainability provides an assessment of the Project against sustainability objectives and identifies opportunities to improve sustainable outcomes.

6.5.11 Waste water

The tunnel construction is expected to produce a constant volume of waste water that will either be treated or disposed of according to further testing. Provision has been made for the collection and treatment of water from the tunnel. Collected water will be conveyed via gravity to a sump located at the western portal. Water quality will be monitored, and it is likely that this water will be processed through a water treatment plant that will include hydrocarbon separation.

6.5.12 Sewage treatment

Portable toilet facilities will be located along the alignment during construction for workers. A suitably qualified contractor will be engaged for the removal and transport of the sewage to an approved treatment site. The total 'daily peak design capacity' for sewage treatment works will remain less than 21 equivalent persons (4,200 L/day), which will mean that the Project will not require an environmental authority application for ERA 63 (1)—Sewage treatment under the EP Regulation.

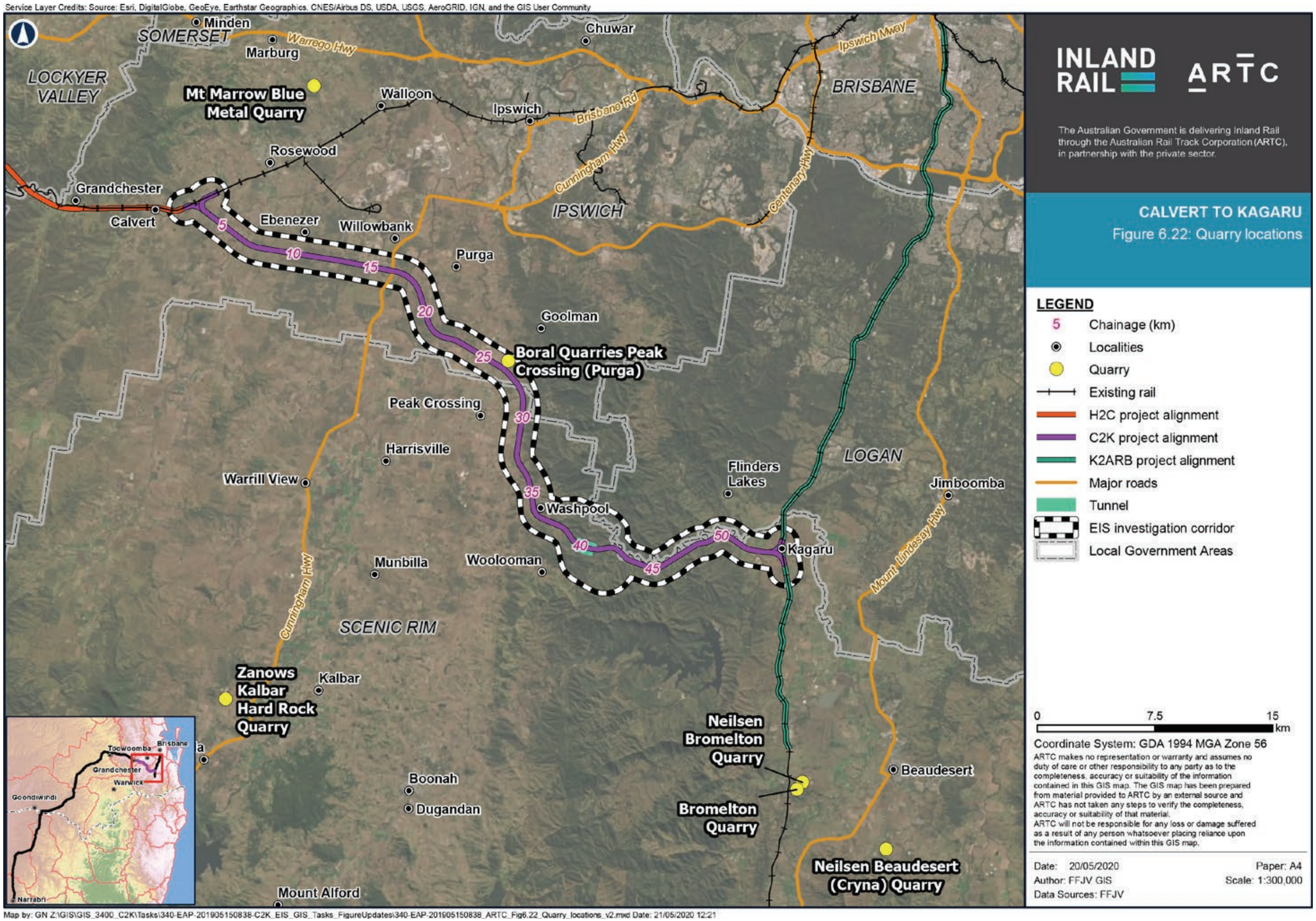
6.5.13 Quarries

Six operational quarries have been identified as potentially suitable for use as material source locations during construction activities. Investigations into further potential quarry materials sources will continue throughout the detailed design phase. The viability and feasibility of accessing material from these locations will also be confirmed during the detailed design phase of the Project (post-EIS).

The six operational quarries currently identified as suitable are listed in Table 6.19 and shown in Figure 6.22

TABLE 6.19: QUARRIES

Quarry name	Location
Zanows Kalbar Hard Rock Quarry	Frazerview, QLD 4309
Mount Marrow Blue Metal Quarry	Mount Marrow, QLD 4306
Boral Quarries Peak Crossing (Purga)	Purga, QLD 4306
Bromelton Quarry	Bromelton, QLD 4285
Neilsen Bromelton Quarry	Bromelton, QLD 4285
Neilsen Beaudesert (Cryna) Quarry	Beaudesert, QLD 4285


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
CALVERT TO KAGARU
Figure 6.22: Quarry locations
LEGEND
Chainage (km)
Localities
Quarry
Existing rail
H2C project alignment
C2K project alignment
K2ARB project alignment
Major roads
Tunnel
EIS investigation corridor
Local Government Areas
Mt Marrow Blue Metal Quarry
Boral Quarries Peak Crossing (Purga)
Zanows Kalbar Hard Rock Quarry
Neilsen Bromelton Quarry
Bromelton Quarry
Neilsen Beaudesert (Cryna) Quarry
Minden
SOMERSET
Marburg
LOCKYER VALLEY
Walloon
Chuwar
Ipswich
BRISBANE
IPSWICH
Rosewood
Grandchester
Calvert
Ebenezer
Willowbank
Purga
Goolman
Peak Crossing
Harrisville
Warrill View
Flinders Lakes
LOGAN
Jimboomba
Washpool
Kagaru
Munbilla
Woolooman
SCENIC RIM
Kalbar
Boonah
Dugandan
Beaudesert
Mount Alford
Warrego Hwy
Ipswich Mway
Brisbane Rd
Cunningham Hwy
Centenary Hwy
Mount Lindesay Hwy
0 7.5 15 km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
Data Sources: FFJV
Paper: A4
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6.5.14 Construction traffic

During the construction phase, transporting materials, equipment and personnel will mainly occur via existing State-controlled roads and local government roads. Further information is provided below on:

- Laydown area delivery points
- Quarry routes
- Ready mix and pre-cast concrete traffic routes
- Consolidated sleeper routes
- Rail routes
- Parking facilities.

For additional detail regarding construction traffic volumes and proposed routes refer Chapter 19: Traffic, Transport and Access.

6.5.14.1 Laydown area delivery points

It is currently assumed that most construction material deliveries will be made to the key laydown area delivery points along the rail alignment (refer Table 6.15). These delivery points will be centralised locations for further construction laydown areas. From these locations, construction material will be distributed by road to the surrounding construction laydown areas.

6.5.14.2 Quarry routes

It is currently assumed that the existing quarries in the vicinity of the Project will be used to provide the necessary fill materials. Haul routes to and from quarries have been based on the location of the quarries and routes most likely to be used for the transportation of material to construction access points.

6.5.14.3 Ready mix and pre-cast concrete traffic routes

Routes have been based on the location of concrete supplier. Roads most likely to be used for the transportation of precast concrete to the construction access point will be identified in consultation with the National Heavy Vehicle Regulator journey planner, which provides guidance in identifying suitable roads for heavy vehicles.

For the transportation of some of the larger precast concrete girders, it is expected that police escort will be required.

6.5.14.4 Consolidated sleeper routes

It is currently assumed that concrete sleepers will originate from Grafton in NSW and be distributed via the road network to various laydown area delivery points. Sleepers may originate from alternative locations. However, an existing production facility for the sleeper configurations required is operational in Grafton.

Road transportation routes will be formulated using the National Heavy Vehicle Regulator journey planner which provides guidance in identifying suitable roads for heavy vehicles. The sleeper routes will then be consolidated where feasible to minimise the number of roads used.

Two overarching sleeper routes have thus far been identified for the Project:

- North of the tunnel using the Pacific Highway
- South of the tunnel using Summerland Way and the Mount Lindesay Highway.

6.5.14.5 Rail routes

It is assumed rail will be supplied by a single source and will be distributed from the closest existing QR and ARTC rail network to various points along the alignment, where possible, for the constructability assessment. Road networks have been identified to achieve this where further rail transportation is required to distribute rail to designated areas along the alignment.

Rail will be delivered to three locations via the rail network: Rosewood, Lanefield and Kagaru. Thereafter, rail will be transported through the Project rail corridor and via the road network where appropriate.

The rail routes that use road networks were formulated using the National Heavy Vehicle Regulator journey planner, which provides guidance in identifying suitable roads for heavy vehicles.

Police escorts are anticipated to be required for transporting the rail via the road network.

6.5.14.6 Parking facilities

Parking requirements will be defined during detailed design with due consideration of conditions of employment and community expectations.

Temporary parking facilities for construction workers will be located predominantly within the designated construction laydown areas, with the number of carparks at each laydown area being proportional to the size and use of the facility.

Parking requirements will include emergency service access considerations.

6.5.15 Site preparation

6.5.15.1 Clearing and grubbing

The site clearing includes removal of vegetation and debris. Site clearing will occur prior to mobilisation of the main earthworks construction teams. The clearing of vegetation will be supported by the necessary permits and approvals, with clearing limits clearly demarcated prior to clearing activities commencing.

All turf, topsoil and other organic and unsuitable material will be stripped from the site. Wherever possible and appropriate, this material will be stockpiled and recycled within the immediate construction footprint.

The clearing and grubbing activities would commence on multiple work-fronts and should always be ahead of the primary earthworks operations, but not so far ahead that exposed soil is left open for long periods of time. Clearing and grubbing activities will be preceded by:

- Flora and fauna surveys
- Appropriate flora and fauna treatments/re-locations
- Identification of any underground utilities or pipelines
- Appropriate utility/pipeline works (i.e. protection/re-location)
- Erection of temporary and permanent fencing
- Any requirements under relevant Cultural Heritage Management Plans (CHMPs)
- Installation of erosion and sediment control measures, including the proposed sediment basins.

The clearing and grubbing operation will be performed across the proposed cut and fill footprint. Protective measures will be enabled around creek and river banks to ensure that the existing profiles are preserved. Cleared vegetation ready for mulching will be stockpiled outside the earthworks footprint but inside the disturbance footprint ready for mulching. Mulched material will be stockpiled and managed to facilitate re-use, and to prevent combustion.

Possible alternatives to mulching of vegetation matter will be considered and appropriately assessed. The most appropriate option to manage cleared vegetation to be adopted for specific locations throughout the temporary disturbance footprint will be determined after further detailed site assessment processes are undertaken as part of the future detailed design.

6.5.15.2 Topsoil stripping

Topsoil stripping of laydown areas, access tracks, and haul roads will be undertaken as part of the initial site clearances. Stripping of the main alignment and road-works footprints will typically be undertaken by the bulk earthworks fleet. Stripping will proceed ahead of the earthworks at a controlled rate, to ensure that excessive areas are not stripped and left exposed to the weather for too long. Stockpiles will typically be located within the rail corridor, outside flood-prone areas, and be neatly formed to prevent erosion.

6.5.15.3 Erosion and sediment control basins

Temporary site drainage and water management controls will be installed to minimise the impacts of runoff and sedimentation from construction activities on adjacent receptors.

Temporary site drainage and water runoff management will be in line with the International Erosion Control Association's *Best Practice Erosion and Sediment Control* (IECA, 2008) document and will:

- Minimise any runoff and sedimentation from Project activities to existing waterways
- Minimise disturbance to the water quality of existing waterways along the alignment.

An allowance has been made in the disturbance footprint for these erosion and sediment control structures.

6.5.16 Civil works

The following activities comprise the civil works for the Project:

- Bulk earthworks, such as the construction of embankments and excavation of cuttings
- Permanent drainage controls
- Bridge construction
- Roadworks
- Rail corridor works.

6.5.16.1 Bulk earthworks

The construction of the foundation of the railway line will require earthworks and engineering fill to provide a platform designed for the rail construction. The earthworks will predominantly be made up of constructing embankments and excavating cuttings. This work will be carried out using heavy earthmoving plant and equipment.

Where required, material stockpiles will be located within the disturbance footprint, outside flood-prone areas, and will be neatly formed to prevent erosion. Spoil management, reuse and disposal is discussed in Appendix V: Spoil Management Strategy.

Cuttings

Cuttings in the existing ground profile will be made where the final design level is lower than the surrounding land. Cutting construction will progress over the width at the top of the batters. Catch drains will be installed to separate water from the construction corridor. Excavation will then progress depending on the in-situ material types. If the material is of sufficient quality and is rippable (rock that is able to be broken down using mechanical means) and does not contain oversized rocks, then dozers and scrapers will move the material along the alignment to embankment construction. If the material contains a high percentage of rock, it may be necessary to use excavators and trucks to move the material. This material may require some processing prior to use in embankment construction, dependent upon meeting the earthworks specifications.

Non-rippable rock will be broken via drill and blast or by hydraulic rock-breakers. Broken rock will be loaded onto trucks by front-end loaders and excavators for placement at its required location.

Cuts and embankments are required along multiple sections of the Project alignment. The total cut estimated for the Project, excluding the tunnel, is 5,768,166 cubic metres (m^3). Thirteen cuts along the alignment are required to maintain the required track elevations for the proposed rail line. A combination of heavy ripping, rock hammering, drilling and blasting will be required during this scope of works. Material will be transported by dump trucks or truck and dog trailers.

Significant volumes of non-rippable rock are anticipated within some of the cuttings along the alignment, particularly through the Teviot Range. The extent to which drilling and blasting will be required is subject to further geotechnical investigation. Based on the preliminary geotechnical information, it is anticipated that blasting may be required in the more significant cuttings.

Where drilling and blasting is to be undertaken, a Blasting Management Plan will be developed as part of the Construction Environmental Management Plan (CEMP).

Embankments

The initial phase in embankment construction is the preparation of the subgrade. Subgrade inspection and testing will be carried out as embankment foundations are exposed, following which the appropriate treatments will be specified. Three broad treatment strategies to prepare the subgrade are anticipated:

- Compact existing subgrade, if deemed suitable
- Dig out and replace unsuitable materials with suitable fill, which is then compacted
- Lime treatment: spreading lime, mixing material into the soil with a reclaimer/stabiliser, compacting lime treated subgrade, rolling of subgrade.

Embankment construction will follow the preparation of the subgrade. The embankment will be constructed in layers, with zones designated for:

- Placement of material directly via scrapers or trucks, or spread from stockpiles via bulldozers and graders
- Compaction of material with roller compactors, and plate compactors for confined working
- Rolling and grading to final level and finish.

Approximately 4,255,382 m^3 of fill material will be needed for the construction of embankments along the Project alignment. The current construction methodology includes utilising the material from the cuts in the embankments works.

Embankment fill will be delivered to the rail alignment via either trucks or scrapers. This material will be laid out in the maximum lift depths by a grader or dozers prior to compaction. The moisture conditioning required for compaction will be determined by further geotechnical investigations. The compacting effort required for the fill material will be determined so that compaction equipment can be effectively matched to requirements.

Access ramps onto the embankment will be located at regular intervals to facilitate concurrent activities of placement and compaction and continued delivery of materials.

Embankments have been designed and constructed to minimise erosion during flood events. The steepness of embankments will also be minimised as much as possible to encourage vegetation growth, which will further prevent erosion.

Structural fill and capping

Where use of excess material is not suitable for structural fill and capping, capping material is currently planned to be transported by existing road network from commercial quarries. If there is a lack of suitable structural fill it is expected that structural fill will also be sourced from the same quarry as the capping material.

The key strategies have been identified with regards to transport, handling, and placement for structural fill and capping material:

- Suitable material will be transported to the corridor and delivered directly to the alignment or stockpiled within the nominated laydown areas of the corridor
- The materials will be moisture conditioned and tipped directly on the formation in suitable volumes to deliver the required thicknesses for compaction
- Spreading and compaction of the material will be undertaken using graders and compactors
- Final trimming and profiling will be undertaken to allow rail construction.

Mass haul

The current data suggests an excess cut of approximately 1,500,000 m^3 is available from the Project.

Different options have been identified for the reuse of excess cut material within the Project. Detailed mass-haul assessments will be carried out in the detailed design and construction stage (post-EIS) to assess the possibility of the following options:

- Use excess rock material for scour protection at bridge and culverts, if suitable
- Use material for structural fill and capping, if suitable
- Use for temporary works construction, such as access roads, laydown areas, etc.
- Construct RMAR at rail formation
- Extend rail formation for future passing loops
- Stock and use for other developments near the Project
- Rehabilitate existing quarries, borrow sites and mines
- Transport to designated spoil sites within the rail corridor.

6.5.16.2 Permanent drainage controls

The proposed rail alignment crosses a number of drainage features of different catchment areas that contribute flows to the cross-drainage structures. Cross-drainage structures will be constructed where the rail intercepts existing drainage lines. The type of cross drainage structure depends on various factors such as the natural topography, rail formation levels, design, design flow and soil type. Cuts and embankments will also require drainage treatments such as catch drains, diversion drains and culverts.

The cross-drainage structures will incorporate the installation of permanent drainage controls as they cross the floodplain areas and drainage lines. Construction of these drainage structures will require several full-time installation crews throughout the construction period. Longitudinal drainage, including embankment drains and catch drains, will be constructed to protect the rail formation from surface runoff.

The construction will be a mix of installation before and after the bulk earthworks, so as not to delay the overall earthmoving program. It will also be necessary to capture overland flow and transfer it to the cross drainage structures. The sizing of the longitudinal drainage will be dependent on the hydrology and it is important that these drains are capable of efficiently moving overland flow to dedicated drainage lines to reduce the likelihood of water ingress to the permanent works.

Culverts

Culverts will be a mix of reinforced concrete pipe (RCP) culverts and reinforced concrete box culverts (RCBC). The supply and installation of RCP and RCBC will be as per respective Australian Standards. Drainage components will be delivered to the nominated construction laydowns and then further distributed to the required installation locations with trucks. Culvert installation will generally involve the following activities:

- Excavating to the required depth
- Placing and compacting the culvert bedding material
- Placing the pre-cast culvert structures on the bedding material and fastening them together
- Proceeding with track works over the top of the culvert
- Restoring and revegetating disturbed areas
- Lining the drain to prevent erosion (if required).

Once installed, either side of the culverts will be backfilled with support material for the culvert. Scour protection measures may also be installed upstream.

There are 109 RCP culvert locations (with multiple cells in certain locations) and 17 RCBC identified for the Project. Of these:

- 59 RCPs and 10 RCBCs will be constructed along the rail alignment
- 50 RCPs and 7 RCBCs will be constructed along roadways.

Longitudinal drainage

Embankment and catch drains will be constructed along the rail corridor where design requires their incorporation into embankments and cuts. It will be necessary to capture overland flow and transfer it to the cross-drainage structures. As such, the sizing of the longitudinal drainage will be dependent on the hydrology and it is important that these drains are capable of efficiently moving overland flow to dedicated drainage lines to reduce the likelihood of water ingress to the permanent works.

The construction of longitudinal drainage will generally involve the following:

- Preparing survey control points for planned excavations
- Excavating material from the drain location
- Trimming and compacting the base and sides of the drain
- Lining the drain to prevent erosion (if required).

Existing drainage paths will be maintained where possible; however, diversion of existing drainage paths is typically required where a rail cutting intersects an existing drainage path as the rail level is lower than the existing ground level and a cross drainage structure cannot be installed. In these locations, the existing drainage path will be intersected upstream of the cutting and diverted to the nearest cross drainage structure location.

6.5.16.3 Bridge construction

Bridges are proposed at all major waterway crossings to avoid disturbance to the existing riverine system. Bridge structures will also be constructed to allow for road, farm track or stock crossings. The Project proposes 27 bridges, of which 21 are over waterways. The remaining are road rail grade separations. As a number of these bridges also interact with public roads, construction will be subject to traffic management and temporary works restrictions to ensure the safety of the travelling public. The bridge structures for the Project are summarised in Table 6.6 and Table 6.7.

All bridge structures proposed will be formed from precast prestressed concrete and in-situ concrete with galvanised steel ancillary elements. Bridge foundations are proposed as either bored cast in place or driven piles based on the anticipated subsurface profiles. It is envisaged that all materials for concrete bridge structures will be delivered by road.

The anticipated methodology and approach are outlined as follows:

- Establishment of bridge construction laydown areas
- Construction of working platforms for access, piling rigs and cranes
- Substructures:
  - Large diameter bored cast in place or driven piles to be installed
  - Plant required will include trucks, excavators and roller compactors for working platforms for piling and piling rigs, cranes and concrete delivery trucks for cast in-situ piles
- Pile caps and piers: conventional construction of reinforced concrete structures in successive lifts using re-usable forms, cranes, concrete pumps and trucks
- Headstock and abutment construction using re-usable forms and conventional reinforced concrete
- Bridge superstructure and deck construction
  - Deck structures are expected to be constructed via lifting pre-cast beams into place with a conventional crawler crane.

6.5.16.4 Road works

Due to the location of the rail alignment, a number of road rail interfaces have been identified. The relevant roads are either local government roads (SRRC or ICC) or State-controlled roads. Construction works on these roads will comply with the asset owner's approved safety requirements and temporary works procedures. The highest standard to be complied with will be DTMR's *Manual of Uniform Traffic Control Devices* (DTMR, 2019c).

For works on, over or adjacent to State-controlled roads, such as the railway crossing of the Cunningham Highway, the proposed construction methodology and traffic-management arrangements will be subject to approval by the Chief Executive, DTMR.

The road-work requirements identified to accommodate the rail alignment are summarised in Table 6.20.

TABLE 6.20: ROAD WORK REQUIREMENTS

Asset owner	Road	Road work requirement
DTMR	Rosewood–Warrill View Road	Minor works to accommodate Bremer River Rail Bridge
DTMR	Cunningham Highway	Realignment to accommodate Cunningham Highway Bridge
DTMR	Ipswich–Boonah Road	Minor works to accommodate Ipswich–Boonah Road Rail Bridge
Ipswich City Council	Waters Road	Minor works to accommodate Western Creek Rail Bridges #1 and #2
Ipswich City Council	Hayes Road	Minor works to accommodate level crossing
Ipswich City Council	Coveney Road	Road closure
Ipswich City Council	Hallam Road	Road closure
Ipswich City Council	Mount Forbes Road	Realignment to accommodate Mount Forbes Bridge
Ipswich City Council	Paynes Road	Realignment of intersection with Mount Forbes Road to accommodate rail corridor and Mount Forbes Bridge
Ipswich City Council	M Hines Road	Realignment to accommodate level crossing
Ipswich City Council	Glencairn Road	Minor works to accommodate level crossing
Ipswich City Council	Middle Road	Realignment to accommodate level crossing
Ipswich City Council	Castle Hill Lane	Road closed at interface with rail corridor
Ipswich City Council	Shepherds (Truloff) Road	Realignment to east of rail corridor
Ipswich City Council	Mount Flinders Road	Minor works to accommodate Mount Flinders Road Rail Bridge
Scenic Rim Regional Council	Dwyers Road	Realignment to accommodate level crossing
Scenic Rim Regional Council	Washpool Road	Roadworks to accommodate level crossing for realignment of road to eastern and northern side of rail corridor as well as roadworks to accommodate Washpool Road Rail Bridge to provide connection to existing Washpool Road alignment and properties to the south of the rail corridor as well as a connection to the Tunnel Access Road
Scenic Rim Regional Council	Wild Pig Creek Road	Realignment to accommodate Dugandan Creek Rail Bridges #1 and #2, minor works to accommodate level crossing at the western end of Wild Pig Creek Road and realignment to northern side of rail corridor and to accommodate a level crossing at the eastern end of Wild Pig Creek Road
Scenic Rim Regional Council	Brennans Dip Road	Realignment to the southern side of the rail corridor
Scenic Rim Regional Council	Undullah Road	Minor works to accommodate Teviot Brook Rail Bridge and realignment to accommodate Undullah Road Bridge

6.5.16.5 Rail corridor works

A minor interface with the existing QR West Moreton System rail corridor is required at the western end of the Project. The works will be the subject of an interface agreement with QR.

There is also an interface with the existing ARTC Brisbane to Sydney Interstate Line at the eastern end of the Project. The staging of these works and their impacts will require coordination with the ARTC possession calendar so that the short-term works can be carried out with minimal disruption to the existing operational network.

6.5.17 Tunnel

6.5.17.1 Tunnel excavation

The proposed tunnel will be constructed through the Teviot Range. The tunnel will be approximately 1,015 m long and has a maximum cover of approximately 95 m. The tunnel excavated cross section is approximately 135 m^2 and the internal space requirements are driven by ventilation requirements.

Two techniques are being considered for excavation/rock-breaking:

- Roadheaders and/or
- Drill and blast.

Roadheader excavation offers considerable versatility and flexibility as a tunnelling technique in suitable conditions and is used to excavate tunnels of various shapes and sizes. It is anticipated that multiple roadheaders would commence excavation from a single portal or both portals simultaneously.

The drill and blast method of excavation may also be suitable. Drill and blast is a controlled use of explosives to break rock for excavation. Drill and blast for tunnels relies on the precise drilling of a collection of holes into the face and the precise detonation of the blasting agent. After blasting, the loose pieces of rock that have been dislodged from the working face are removed from the tunnel.

The excavated material from either the roadheaders or drill and blast will be loaded into dump trucks and taken from the tunnel to an outside stockpile area. The material will then either be reused onsite or transported via trucks from the site for re-use or disposal.

6.5.17.2 Tunnel liner

The design of the tunnel includes a flexible sheet-type membrane which is constructed to waterproof the tunnel. For a drained tunnel, the purpose of this waterproof membrane is to control groundwater inflows over the crown and walls of the tunnel down to invert level, where the water would be collected by drainage systems. The other purpose of the waterproof membrane is to assist with the long-term durability of the concrete secondary lining, including all fixings installed into the concrete.

A two-staged support construction sequence is likely to be adopted that uses sheet waterproof membranes – consisting of temporary support (primary) and permanent support (secondary). Once the temporary support is constructed, a waterproof membrane can be installed.

The temporary tunnel support generally consists of temporary rock bolts and sprayed concrete that may be reinforced with fibres or steel mesh. In poor ground conditions, steel sets, forward rock reinforcement and canopy tubes can be used. Permanent support would generally consist of a cast in-situ unreinforced concrete lining.

6.5.17.3 Water treatment

During construction, a temporary water treatment facility will be constructed to support the tunnelling operations. The water treatment facilities design is likely to include, but is not limited to:

- Screening treatment
- Detention tanks
- Aeration/flocculation tanks
- Chemical treatment, where required
- Water-pumping facilities
- Sludge storage.

6.5.18 Track works

The proposed method of track construction will be tailored to maintain maximum flexibility, to not be confined to the use of dedicated plant or equipment. The focus will be to prioritise the use of readily available plant and equipment that is easy to maintain and has a low establishment and operating costs.

6.5.18.1 Bottom ballast

Several options exist for the delivery and installation of bottom ballast. The preferred option would be potentially selected through the direction of track construction i.e., if using a track laying machine (TLM).

Bottom ballast may be delivered and installed by one of the following approaches:

- Delivered by road or rail to designated stockpile locations situated along the length of the corridor. Deliveries would be staged to suit the construction program and minimise disruption on roads and to the travelling public
- Directly discharged onto the formation via truck and trailer or stockpiled and locally moved via 18 tonne dumper trucks
- Installed along with the top ballast via a works train. This means skeleton track will be constructed directly on the formation.

6.5.18.2 Sleepers

Two options exist for the delivery and installation of sleepers. The preferred option would be potentially selected through the direction of track construction i.e. if using a TLM.

Sleepers may be delivered and installed by one of the following approaches:

- Delivered by road or rail to designated stockpile locations situated along the length of the rail corridor. Deliveries will be staged to suit the construction program and minimise disruption on roads and to the travelling public. Sleepers would be installed by excavator, which will place the sleepers using an Octopus sleeper grab, which can pick up to six sleepers at a time and spread them to the correct spacing. Labourers will assist this activity by placing spacers over the last couple of sleepers that have been laid and the first couple that are being placed by the Octopus sleeper grab, to ensure that the correct spacing is maintained between the packs of sleepers
- Delivered to the construction depot to be loaded onto the material train for direct discharge onto the formation by the TLM.

6.5.18.3 Rail

Two options exist for the delivery and installation of rail. The preferred option would be potentially selected through the direction of track construction i.e. if using TLM. Rails may be delivered and installed by one of the following approaches:

- Installed in 27.5 m lengths and FBW in situ or FBW lineside and thimble into the sleeper housing in long welded rail
- Delivered in short lengths (<30 m) to the FBW facility situated within the construction depot. This will allow the short rail to be welded into Long Welded Rail (LWR) and then loaded onto the material train in strings of approximately 400 m. The LWR can then be positioned into the alignment along with the sleepers through the TLM.

A temporary rail handling yard will be required adjacent to the rail alignment.

6.5.18.4 Top ballast

The most efficient method of unloading ballast for track construction will be through a train consist using ballast hopper wagons. Additional land will be required to facilitate the loading of ballast onto a train consisting of ballast hopper wagons along the alignment.

After establishing a ballast-handling facility, ballast can be delivered along the alignment using a train consist. This train consist has the opportunity not only to distribute top ballast but also the option to distribute bottom ballast if installing skeleton track straight onto the formation is the desired method of track construction.

The key drivers of this method are the productivity of the key rail-bound equipment and matching this to the earthworks delivery program. Productivity depends on the number of ballast wagons used and the cycle time of the ballast train against the various ballast loading locations, as well as the productivity of the following rail surfacing fleet.

6.5.18.5 Tamping

To make the rail track more durable, a machine will be used to pack (tamping) the ballast. The process will set the geometry and re-arrange the ballast under the sleeper to keep the track in position and provide it with a homogenous ballast bed.

Plain line tamping will be undertaken by a high-output tamper fitted with WinALC, guidance software, to implement the correct target geometry. Turnout tampers will be used for tamping turnouts and should also be equipped with WinALC.

Depending on the required track construction tolerances and quality of constructed track, tamping operations could take anywhere from three to six passes. Correctly installed bottom ballast levels, adequately compacted bottom ballast and high-quality track installation dramatically reduces tamping operations and follow up tamp requirements.

6.5.18.6 Welding and stressing

To ensure quality of welds, the majority of welding will be undertaken by FBW method. Stressing welds and welds located close to turnouts may be undertaken by approved Alumino Thermic Welding processes. All stressing welds will use rollers (side and under).

Flash butt welding facility

FBW is an electrical resistance welding process used for joining components, where the energy transfer is provided primarily by the resistance heat from the parts themselves (The Welding Institute (TWI), 2020). The components are positioned end-to-end across the full joint area. This process is used for joining a range of section sizes and complex shapes such as railway rims (TWI, 2020). This produces a weld with no melted metal remaining in the joint.

According to the Journal of Materials Processing, the railroad industry uses flash welding to join sections of mainline rail together to create continuous welded rail (CWR), which is much smoother than mechanically joined rail because there are no gaps between the sections of rail (Tawfik et al., 2008). This smoother rail reduces the wear on the rails themselves, effectively reducing the frequency of inspections and maintenance (Tawfik et al., 2008). There are two locations within the proposed rail corridor where allowance has been made for the positioning of temporary FBW facilities. It is assumed that rail will be delivered via the closest rail network.

The rail from this point can be either:

- Positioned along the alignment in short rail lengths (<28 m) via trucks using the local road network or running along the alignment where possible. The rail can then be FBW-ed lineside and thimble into the sleeper housing
- Transported to an established FBW facility to be welded (<400 m). The rail can then be transported down the rail corridor using a rail roller.

The delivery of the rail via an external rail network will require further investigation and consultation with the asset owner of the network.

6.5.18.7 Turnouts

Turnouts connecting to existing operational infrastructure will likely be pre-built and panelled in, if the possession window does not adequately grant the required time to construct in situ. The pre-building and panelling in method will provide the least risk to the rail possession windows, ensures turnout componentry is complete and allows some welding to happen prior to the possession.

All crossing loop turnouts and maintenance sidings can be constructed in situ to reduce lifting of switch and crossing panels. All turnout construction should be undertaken early enough in the program to ensure that any issues caused by incorrect or missing components can be rectified prior to the commissioning of the turnout.

6.5.19 Signalling installation

The design and installation of the safeworking or signalling system will be completed in parallel with the design and construction of the track and civil structures of the Project. The construction, procurement and testing program will be integrated into the track and civil programs to ensure both activities are carried out so commissioning activities can be undertaken at the same time.

6.6 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 (checking) 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 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.

6.7 Clean-up and restoration

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 Landscape and Rehabilitation Management 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 would include the following activities:

- Demobilising temporary site compounds and facilities
- Removing all materials, waste and redundant structures from the works sites

- Forming and stabilising of spoil mounds, where required
- Decommissioning of all temporary work-site signs
- Removal of temporary fencing
- Progressive establishment of permanent fencing in coordination with rehabilitation and landscaping activities
- Decommissioning of site access roads that are no longer required
- Restoration of disturbed areas as required, including revegetation where required.

On 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.

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.

6.8 Operational phase

Operational phase activities will include the use of the railway for freight purposes, operation and maintenance of tunnel ventilation and safety systems, signalling, and general track and infrastructure maintenance.

6.8.1 Hours of operation

The hours of operation are anticipated to be 24 hours/7 day calendar.

6.8.2 Workforce

It is anticipated that the ongoing operation and maintenance of the Project will require a workforce of approximately 20 FTE. The operational workforce will be based at provisioning centres outside the immediate vicinity of the Project. It is anticipated that the operational phase workforce will likely live locally or be accommodated in existing accommodation in the Logan/Ipswich region.

6.8.3 Train operations

Train control will be managed via ARTC's existing control centres. Train services will be provided by a variety of operators. Trains will be a mix of grain, bulk freight (including coal and minerals) and other general transport. Inland Rail as a whole will be operational once all 13 sections are complete, which is estimated to be in 2026.

The Project will involve operation of a single rail track with crossing loops, initially to accommodate double stacked freight trains 1,800 m long and 6.5 m high. Maximum train speeds will vary according to axle loads and track geometry up to 115 km per hour. When Inland Rail starts operation, it is anticipated that the Project will be used by an average of 33 train services per day, increasing up to 47 train services per day in 2040 Electricity supply will be needed for points, signalling, tunnel operations and other infrastructure. It is anticipated that the supply of these services will be delivered by relevant third party providers under the terms of their respective approvals and/or assessment exemptions.

6.8.4 Tunnel operations

The following infrastructure will support the operation of the tunnel:

- Tunnel control system
- Fire pumps and tanks
- Substation, backup generator and transformer
- Ventilation fans
- Workshop.

During the operational phase, tunnel operations will require power and water supplies for ventilation and fire safety.

As discussed in Section 6.2.3, it is proposed that supply of power to the tunnel will be provided via a 11kV power line from a third-party provider, with a secondary supply via a standby 11 kV generator. These works will be undertaken by the relevant asset owner and are required to comply with the relevant environmental/ regulatory framework applicable to the particular works or public utility.

6.8.4.1 Tunnel control system

The tunnel plant will be controlled by programmable logic controllers collecting information of all the plant equipment including instruments, ventilation equipment, lighting control, dewatering, security, train detection, power supply monitoring, metering and fire indication panels.

The interface to the operator will be provided by a supervisory control and data acquisition system which will also provide an interface point for external users to monitor the tunnel systems. The tunnel supervisory control and data acquisition system will incorporate an incident management system.

During normal operation, the tunnel control system will be designed to operate in automatic mode and will require minimal input from the control room operators. Operators will be notified of any abnormal/emergency situation by means of incident prompts (system generated alerts/alarms) generated by the control system.

6.8.4.2 Ventilation

The tunnel includes an internal 100 m^2 tunnel cross-sectional area. The ventilation design for the tunnel allows for natural ventilation of the tunnel for normal, purging and emergency operations and, therefore, does not require any additional tunnel ventilation equipment for operations.

A permanent ventilation system consisting of two jet fans located in the tunnel approximately 150 m from each portal is required for maintenance operations. These fans are located within the clear space on each side of the tunnel and do not impact on the tunnel space proofing requirements.

The design has the following key features:

- Large tunnel cross-section to allow for natural ventilation during normal, purging and emergency operations
- Natural ventilation to reduce capital cost and ongoing operations and maintenance requirements costs
- Natural ventilation to allow for improved operational flexibility and reliability for trains operating through the tunnel
- Jet fans to provide for a ventilation system for maintenance requirements.

6.8.4.3 Water collection and treatment

A sump is required to collect water captured in the tunnel and act as a buffer tank prior to the water being most likely treated through a water treatment plant. The collection sump will also likely include a 'first flush' tank that will collect the first quantity of water which is expected to contain the majority of pollutants. Any separated pollutants will be held for collection by a licensed waste contractor.

The extent of treatment of the water from the tunnel will depend greatly on the quality of the groundwater ingress. Water treatment facilities are likely to include:

- Screening treatment
- Detention tanks
- Aeration/flocculation tanks
- Chemical treatment, if needed
- Water pumping facilities
- Sludge storage.

6.8.5 Operational maintenance

Standard rail maintenance activities will be undertaken during operations. Typically, these activities include:

- Minor maintenance works, such as bridge inspections, culvert cleanout, sleeper replacement, rail welding, rail grinding, ballast profile management, track tamping and clearing/ slashing rail corridor
- Major periodic maintenance such as ballast cleaning, formation works, reconditioning of track, adjustment, turnout replacement and correction of track level and line.

These activities will occur on a scheduled basis, in addition to being in response to unplanned requirements, e.g. maintenance following adverse weather events.

Access requirements for rail maintenance are discussed in Section 6.2.9.

6.8.6 Rolling stock maintenance and provisioning

No provisioning or rolling stock maintenance facilities are proposed to be provided within the Project alignment.

6.8.7 Fuel

No permanent refuelling facilities are proposed within the Project.

6.8.8 Telecommunications

The Project involves new telecommunications and signalling infrastructure including ATMS. The ATMS will interface with the other rail operators signalling and telecommunications infrastructure.

The ATMS will provide significantly upgraded capabilities to the rail industry of Australia. It is designed to support ARTC's objectives of improving rail network capacity, operational flexibility, train service availability, transit times, rail safety and system reliability.

6.8.9 Operation water supply and management

The Project's operational water requirements are anticipated to be minor relative to the construction phase requirements. Water may be required to support localised maintenance activities. The volumes required cannot be quantified at this stage of the Project.

6.8.10 Operation stormwater management

Stormwater will be managed through the drainage structures incorporated into the Project design, as discussed in Section 6.5.16.2.

6.8.11 Road transport

The existing road network will be used to travel to the rail corridor. Once in the rail corridor, the RMAR incorporated into the design of the Project will be used in preference to the existing road network for Project maintenance activities. The RMAR is discussed in Section 6.2.9.

6.8.12 Waste management

Site maintenance will be undertaken during the operational phase of the Project and will typically include inspections of rail track and structures, vegetation management, rail track replacement/ upgrade and asset upkeep. The volumes of waste generated during operation of the Project are expected to be minimal. Quantities of waste would depend on operational frequencies of maintenance regimes. These details are unknown at this stage of the Project.

The wastes anticipated to be generated during the operational phase of the Project are shown in Table 6.21.

TABLE 6.21: OPERATIONAL AND MAINTENANCE WASTE QUANTITIES

Activity	Waste description	Waste type
Vegetation management	Green waste	General waste (non-putrescible)
Re-profiling of landforms, e.g. embankments	Potentially contaminated solid waste	Variable: General waste (non-putrescible) or regulated
General upkeep	Debris, litter/rubbish	General waste (non-putrescible)
Rail track replacement/upgrade	Scrap metal	General waste (non-putrescible)
	Potentially contaminated solid waste	Variable: General waste (non-putrescible) or regulated
Infrastructure maintenance	Waste paints and solvents	Regulated waste
General maintenance of rail corridor	Empty chemical containers	Regulated waste
Maintenance of erosion and control devices and culverts	Silt and sediment	General waste (non-putrescible)
	Vegetative debris	General waste (non-putrescible)

Wastes generated during the operation of the Project would be removed offsite for disposal at an appropriately licensed facility, in accordance with relevant legislation and conditions of approval.

6.9 Decommissioning

The Project is expected to be operational for in excess of 100 years. The design life of structures is 100 years to support this operational objective. The decommissioning of the Project cannot be foreseen at this point in time. If the Project, or elements of it, were subject to plans for decommissioning it is envisaged that the works would be undertaken in accordance with a decommissioning plan, which would be developed in consultation with relevant stakeholders and regulatory authorities.