CHAPTER 06

Project Description

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

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

IR_1536

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6. Project Description

6.1 Purpose of this chapter

This chapter describes the key elements of the Gowrie to Helidon (G2H) Project (the Project), including major associated infrastructure, throughout its design, construction and commissioning; operation; maintenance; and decommissioning phases. Where relevant, design and construction mitigation measures have been identified and integrated into the Project design to minimise the environmental impact of the Project. This chapter also forms the basis for the identification of impacts throughout the Environmental Impact Statement (EIS).

6.2 Project overview

Australian Rail Track Corporation (ARTC) proposes to construct and operate the Project, which consists of a single 28 kilometre (km) long, dual-gauge track through the Toowoomba Range via a 6.24 km long tunnel between the townships of Gowrie and Helidon in Queensland.

The Project is co-located with the existing West Moreton System rail corridor for 5.4 km and connects into the Queensland Rail (QR) Network at Gowrie and Helidon allowing for interoperability between the two networks. Between Morris Road (Gowrie Junction) and Lockyer Creek (Helidon), 22.4 km of greenfield track, including a 6.24 km undrained tunnel though the Toowoomba Range, is proposed.

The Project generally follows the Gowrie to Grandchester future state transport corridor, which was protected as a future public passenger transport corridor under the *Transport Planning and Coordination Act 1994* (Qld) (TPC Act) in 2005.

Inland Rail will be an open access rail service, meaning ARTC will not run trains directly, but will allow access to the rail line by rail operators.

While the Project is specifically designed for freight trains, it does not preclude the use of the track at a future date by passenger services. The current design, and EIS assessment, accommodates the existing QR narrow-gauge rail line, which runs passenger trains, including the Westlander, on the QR West Moreton System.

The Project design does not consider the construction of a high-speed, dedicated passenger rail line, which was the original intent of the Gowrie to Grandchester future state transport corridor, to be delivered by the Queensland Department of Transport and Main Roads (DTMR). Given that the Project accommodates single dual-gauge track and includes significant infrastructure such as the tunnel and large viaducts, the provision of passenger tracks being co-located along the entire Project length at a future date is unlikely. Further details on the interaction between the Project and the Gowrie to Grandchester future state transport corridor are provided in Section 6.2.3.

6.2.1 Project alignment

The significant vertical difference between Gowrie at 500 metres (m) relative level (RL) and the base of the Toowoomba Range, part of the wider Great Dividing Range at 150 m RL at Lockyer Creek creates a significant challenge for the rail alignment design in producing a safe and efficient route for trains to traverse the range. From the western tunnel portal to east of Lockyer Creek, the rail alignment is at a constant grade of 1:64 (or 1.55 per cent). This is achieved via the tunnel, along with a series of viaducts, cuts and embankments. A schematic of the Project alignment relative to the local topography is shown in Figure 6.1, while long sections of the Project alignment are detailed in Appendix C: Design Drawings.

FIGURE 6.1 SCHEMATIC OF THE PROJECT ALIGNMENT RELATIVE TO TOPOGRAPHY

The Project alignment begins approximately 3.7 km west of Gowrie, at Charlton, where it connects with the eastern end of New South Wales/Queensland Border to Gowrie (B2G) Inland Rail project. It then runs east, parallel (southern side) to the existing West Moreton System rail corridor (Western Line), for approximately 4.8 km before diverging from the Western Line and passing into the proposed western tunnel portal within the vicinity of Boundary Street and the Toowoomba Bypass interchange at Gowrie Junction.

A 500 m spur line linking the western tunnel portal to the West Moreton System to allow rail traffic access to and from Toowoomba is also proposed.

The alignment then continues through the Toowoomba Range via an approximately 6.24 km long tunnel with an intermediate ventilation shaft and associated infrastructure at Cranley. On the eastern side of the tunnel, the alignment exits the range through the eastern tunnel portal at Ballard, approximately 1.6 km southeast of Mount Kynoch. This area is recognised under the State Planning Policy (SPP) as a key resource area (KRA) (i.e. Harlaxton).

The alignment deviates to the north-east across the north-west corner of the former Rifle Range at Mount Lofty, before extending across the Roma Brisbane Gas Pipeline and Wallens Road. The alignment crosses over Jones Road and Oaky Creek via a viaduct structure approximately 0.7 km long and 42 m in height. The alignment then extends eastwards via a series of viaducts, cuttings and embankments for approximately 3 km across an undulating landscape parallel to and south of the Toowoomba Bypass and north of Rocky Creek to McNamaras Road.

The alignment then extends north-west under McNamaras Road via a proposed road-over-rail bridge before crossing over the Toowoomba Bypass and Gittins Road via an approximately 1 km long viaduct up to 20 m above the road surface, east of Wards Hill. The alignment then loops around Wards Hill, for approximately 3 km, before extending south-east, parallel to the Toowoomba Bypass to the north for 2 km before crossing over Murphys Creek Road. The alignment, which is primarily on viaduct for approximately 1.79 km, passes to the south of Squires Road and deviates to the south-east, avoiding the main operational area of Withcott Seedlings and the two storage dams, past Ashlands Drive.

The Project crosses the Roma Brisbane Gas Pipeline, Lockyer Creek and the West Moreton Rail System (Main Line) via a 500 m long viaduct, after which it again runs parallel (northern side) to the existing West Moreton System rail corridor (Main Line) for 800 m to connect with the Helidon to Calvert (H2C) Inland Rail project, to the north-west of Helidon.

The Project design has responded to key environmental features and community and land issues and has been developed considering with engineering constraints for a feasible rail design. The rail design is based on balancing environmental impact with disturbances to existing infrastructure and communities and achieving engineering design criteria.

The changes have resulted in the Project alignment deviating outside of the Gowrie to Grandchester future state transport corridor from Project Chainage (Ch) 26.0 km to Ch 28.0 km. The differences between the Project alignment and the Gowrie to Grandchester future state transport corridor are described in Section 6.2.3.

6.2.2 Relationship to other Inland Rail projects

The broader Inland Rail Program meets the Australian Government's objective of providing a long-term rail solution for competitive freight movement. At the commencement of operations, Inland Rail will fulfil the Australian Government's plan to accommodate the use of double-stacked, 1,800 m long trains allowing for the transit of freight volumes equivalent to 110 B-double trucks between Melbourne and Brisbane.

The Project is one of 13 projects that complete the Inland Rail Program for the delivery of 1,700 km of rail line. It is also one of five Inland Rail projects in Queensland. The Project is one of the 'missing links' and is identified as a priority development project within the Inland Rail Program. The Project connects to the eastern end of the B2G project at Charlton and to the western end of the H2C project, north-west of Helidon.

The Australian Government will invest up to $14.5 billion in equity, noting that this Project, along with the H2C and Calvert to Kagaru (C2K) projects will be delivered through a Public–Private Partnership program. The increased investment for Inland Rail will provide greater local investment, support more than 21,500 jobs at the peak of construction and deliver an economic boost of more than $18 billion to Gross Domestic Product during construction and the first 50 years of operation. Capital expenditure for construction of the Project is discussed in Section 6.2.7.

6.2.3 Corridor selection

The corridor generally follows the Gowrie to Grandchester future state transport corridor, which was identified in the *Initial Advice Statement: Inland Rail—Gowrie to Helidon* (ARTC, 2017b) as the preferred corridor, and was endorsed by the Queensland Government.

The Gowrie and Grandchester future state transport corridor, a route initially developed by (the then) Queensland Transport and Queensland Rail and finalised in 2003, was designed with the aim of providing for future higher speed passenger services as well as freight west from Brisbane. Accordingly, the alignment catered for speeds up to 200 km/hour (hr) and to achieve this included two tunnels, long and high viaducts and extensive earthworks. The corridor which is described in Chapter 2: Project Rationale, was protected under the TPC Act in 2005 and has been preserved, along with supporting infrastructure in local government planning schemes (Queensland Rail and Queensland Transport, 2003). However, the corridor is not identifiable in the TRC or the Gatton planning schemes.

Initially, the Gowrie and Grandchester future state transport corridor alignment was not considered to be the optimal solution for the inland railway as outlined in the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010a):

> *The study found that the journey time savings from a superior alignment in this area were more expensive than could be obtained by improving the alignment of other sections of the inland railway. In addition, freight train speeds through this area are more likely to be dictated by train performance, particularly westbound trains up the steep grade, rather than the track curvature. This study also had reservations about the feasibility of operating long, slower freight trains on the same corridor as fast passenger trains.*
>
> *Accordingly, an alternative route was identified for the inland railway between Gowrie and Grandchester, with specifications more appropriate to operation of inter-capital freight trains.*

The initial preferred solution (Murphys Creek option) was a rail line that ran parallel to the existing West Moreton System rail corridor (to the north) and Gowrie Creek from the tie in with the B2G project for approximately 4.2 km. The alignment then deviated to the north-east through a tunnel (at Birnam (East)), for approximately 8 km, under the localities of Birnam (East), Highfields and Ballard before exiting between the West Moreton System at Spring Bluff and Mt Ben Lomond in the locality of Murphys Creek. The proposed alignment then followed Murphys Creek Road for approximately 4.8 km before tying into the existing West Moreton System to the north-west of Murphys Creek township. The initial preferred solution was generally co-located, for approximately 12 km with the existing West Moreton System to Airforce Road where it ties into the H2C project.

In 2015, the Inland Rail Implementation Group noted that the assumptions that drove the Murphys Creek option were significantly impacted by the 2011 floods through the Lockyer Valley (Inland Rail Implementation Group, 2015). The Inland Rail Implementation Group found that the Murphys Creek option and Gowrie to Grandchester future state transport corridor were of comparable capital costs. However, on the basis of non-cost criteria, the Gowrie to Grandchester future state transport corridor is an existing corridor protected under the TPC Act.

As such, it was determined that the preferred route through the Toowoomba Range from Gowrie to Helidon, was the Gowrie to Grandchester future state transport corridor (subject to minor modifications to be agreed with the Queensland Government). This is due to the following:

- It would result in a significant time saving (around two years) relative to proceeding through the statutory processes to formally identify a new corridor for the Murphys Creek option and removes a significant element of planning risk
- Substantial elements of the Gowrie to Grandchester future state transport corridor have already been acquired by the Queensland Government
- Community severance and disruption, noise and dust through Helidon, Murphys Creek valley and in the vicinity of Gowrie Junction will be minimised by following the Gowrie to Grandchester future state transport corridor
- The Gowrie to Grandchester future state transport corridor is substantially a greenfield development, which minimises impacts on the existing operating QR corridor.

As described in Chapter 2: Project Rationale, the Project originally aligned with the Gowrie to Grandchester future state transport corridor, with the exception of an area around Wards Hill. Due to issues with the tunnel flood immunity, changes were made to the vertical alignment which resulted in changes to the horizontal alignment deviating from the Gowrie to Grandchester future state transport corridor, with these differences summarised in the sections below.

The differences between the corridors can be attributed to the following:

- The Gowrie to Grandchester future state transport corridor study considered electrification, along with a design speed of 200 km/h for passenger trains, a minimum grade of 1:60 and a minimum curve radius of 2,200 m. The Project basis of design is different as outlined in Table 6.3
- The Gowrie to Grandchester future state transport corridor study included two tunnels, with the Project design eliminating the need for a second tunnel
- The Gowrie to Grandchester future state transport corridor study proposed to infill across the Roma Brisbane Gas Pipeline, with the design allowing for spanning of the easement which was the preferred option identified by APA Group (APT Petroleum Limited is a subsidiary of APA Group)
- The Project's operational rail disturbance footprint is a minimum of 62.5 m wide and has also considered access to the rail corridor and a temporary construction disturbance footprint resulting in a larger footprint. The Gowrie to Grandchester future state transport corridor study was based on minimum corridor width of 45 m and minimum track centres of 4 m.

6.2.3.1 Western section (Ch -1.76 km to the western tunnel portal)

In the western section of the Project, the Project alignment differs to the Gowrie to Grandchester future state transport corridor primarily due to the source of the traffic, noting that the Gowrie to Grandchester future state transport corridor aimed to facilitate the delivery of a 200 km/hr passenger services to Toowoomba with additional consideration of a future connection with Inland Rail.

Both corridors are co-located with the existing West Moreton System and extend west from the Charlton area, south of the Western Line, for approximately 4.8 km and 2.4 km respectively before diverging southeast from the Western Line, east of Gowrie. The Project alignment start point is dependent on the B2G section of the Inland Rail Program, which is currently subject to an EIS process under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act), while the Inland Rail alignment identified in the Gowrie to Grandchester future state transport corridor was based on a hypothetical alignment.

ARTC proposes a 500 m spur line connecting the ARTC Network to the QR Network east of Gowrie. This spur line is to the east of the Gowrie to Grandchester future state transport corridor, with the Project corridor also extended in this area to accommodate the western tunnel portal and a proposed stockpile. The Gowrie to Grandchester future state transport corridor, which aimed to provide a passenger service to Toowoomba, allowed for a spur line to the east along with the realignment of an approximately 2 km section of the Western Line and a future commuter station about halfway along the realignment.

6.2.3.2 Toowoomba Range tunnel

The Toowoomba Range tunnel alignment and associated portals align with the locations identified in the *Gowrie to Grandchester Rail Corridor Study* (Queensland Rail and Queensland Transport, 2003). . Noting that the eastern tunnel portal footprint extends west and allows for a larger footprint to accommodate measures to mitigate the risk from the surrounding colluvium. This section of the Project alignment was subject to a multi-criteria analysis (MCA), which is discussed in Chapter 2: Project Rationale.

The *Gowrie to Grandchester Rail Corridor Study* (Queensland Rail and Queensland Transport, 2003). did not consider the presence of a KRA at Ballard, where the eastern tunnel portal is located. Wilmott (2002) recommended that the Harlaxton Quarry and surrounds (different to the current KRA) be designated a KRA under the relevant planning instruments, overlapping the current KRA with the Gowrie to Grandchester future state transport corridor ratified under the SPP in December 2013. The impacts of the Project on the current KRA are discussed in Chapter 8: Land Use and Tenure.

6.2.3.3 Eastern tunnel portal to Ch 12.7 km

The Project alignment deviates to the north of the Gowrie to Grandchester future state transport corridor across the Oaky Creek floodplain, with both alignments impacting Wallens Road, the Roma Brisbane Gas Pipeline and providing structures over Oaky Creek.

The Project's vertical and horizontal alignment has been refined to balance cut and fill and to accommodate changes in vertical alignment, resulting in the horizontal alignment moving outside of the Gowrie to Grandchester future state transport corridor. This section of the Project alignment was subject to an MCA, which is discussed in Chapter 2: Project Rationale.

6.2.3.4 Ch 13.5 km to Ch 19.1 km

The Project alignment has been modified to run to the north of Wards Hill, rather than within the Gowrie to Grandchester future state transport corridor, which is south of Wards Hill, removing the requirement for a second small tunnel, minimising the length of viaducts and minimising the volume of earthworks. The additional length of rail alignment also assists in reducing the already steep grade of the alignment through this section, which is beneficial to the operation of freight trains, providing a less skewed crossing of the Toowoomba Bypass. In the section east of Wards Hill, the Project alignment is similar to Option A2 identified in the *Gowrie to Grandchester Rail Corridor Study* (Queensland Rail and Queensland Transport, 2003).

ARTC undertook an MCA in consultation with DTMR to identify a preferred alignment through this area (refer Chapter 2: Project Rationale). The Project alignment also maintains proximity to the proposed location for a commuter station, which was a key element for adopting the Modified Option A2 selection over Option A2 during the MCA process.

6.2.3.5 Ch 19.1 km to Murphys Creek Road

The Project alignment follows the Gowrie to Grandchester future state transport corridor north of the Toowoomba Bypass for approximately 1.5 km.

6.2.3.6 Murphys Creek Road to Lockyer Creek

Changes to the Project alignment to accommodate local constraints such as Withcott Seedlings and the Roma Brisbane Gas Pipeline have resulted in the alignment deviating outside of the Gowrie to Grandchester future state transport corridor in this section.

The *Gowrie to Grandchester Rail Corridor Study* (Queensland Rail and Queensland Transport, 2003). considered impacts on Withcott Seedlings; however in the time since the study, Withcott Seedlings has expanded to the east (onto Lot 20 on SP127094), which constrains both alignments. ARTC undertook an MCA to identify a preferred alignment through this area (refer Chapter 2: Project Rationale), noting that two viaducts (Withcott Seedlings Viaduct and Lockyer Creek Viaduct) are proposed in this area in preference to large embankments identified in the *Gowrie to Grandchester Rail Corridor Study*.

Furthermore, the design has aimed to ensure that no pylons associated with the Lockyer Creek Viaduct are located within the Roma Brisbane Gas Pipeline easement (Petroleum Pipeline Licence (PPL) 2) as discussed with APT Petroleum Limited.

6.2.3.7 Lockyer Creek to H2C project

The Project alignment runs south of the Gowrie to Grandchester future state transport corridor, east of Lockyer Creek, with both projects co-located (northern side) with the existing West Moreton System at the Cattos Road/Airforce Road intersection. The Project alignment, however, extends 500 m east of the Gowrie to Grandchester future state transport corridor where it connects to the H2C project.

The design of the Project also generally aligns with the original Gowrie to Helidon concept (e.g. tunnel and large viaducts to maintain the required gradient and curve radius), although a key difference is that the original concept included provision for electrification and was a dual-track solution.

Given these differences, the land requirements for the Project do not specifically include additional land for a future possible public passenger service (two tracks) to be undertaken at a later date by DTMR. However, the design will not preclude future development of a passenger service along the Gowrie to Grandchester future state transport corridor, including in some areas within the Project's permanent operational corridor.

Furthermore, given that the Project is a single track and includes a tunnel and large viaducts, the provision of a passenger rail line being co-located with the Project at a future date over the full length of the alignment is unlikely.

The design has responded to key environmental features and community and land issues and has been developed in line with engineering constraints for a feasible rail design. The rail design is based on balancing environmental impact, disturbances to existing infrastructure and communities, and meeting engineering design criteria (refer Section 6.3.1). As such, the corridor deviates outside of the Gowrie to Grandchester future state transport corridor in sections of the Lockyer Valley, but will not preclude future development of a passenger service along the future state transport corridor.

Investigations for the purposes of the EIS and design, including field surveys, were generally undertaken within an EIS investigation corridor typically 2 km wide (or as required by the individual technical assessments) to ensure a robust assessment of direct and indirect impacts.

6.2.4 Key components

The key components of the Project include the permanent and temporary features listed in Table 6.1 Key Project components.

TABLE 6.1 KEY PROJECT COMPONENTS

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

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

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

Drainage	▸ Reinforced concrete pipe (RCP) culverts and reinforced concrete box (RCBC) culverts. Scour protection measures will generally be installed around culverts and other drainage structures to minimise the potential for erosion

Aspect	Description
Rail crossings	▸ Rail crossings including grade separations/rail or road overbridges, occupational/private crossings and fauna crossing structures
Embankments and cuttings	▸ Embankments and cuttings will be required along the length of the alignment, including road and rail infrastructure within the alignment such as crossing loops and road-over-rail bridges ▸ The total length of embankments required for the Project will be approximately 15.4 km with a maximum embankment height of approximately 33.3 m ▸ The total length of cut for the Project will be approximately 6.65 km with a maximum cut depth of approximately 45.7 m
Ancillary works	▸ Associated rail infrastructure including maintenance sidings, safe working systems and signalling infrastructure ▸ Ancillary works include signalling and communications, signage and fencing, drainage works, establishment and/or reinstatement of access roads, and installation or modification of services and utilities ▸ Road closures and realignments, including closure of an existing level crossing on the QR West Moreton System at Gowrie
Environmental treatments	▸ Potential noise barriers, fauna crossing structures, instream structures and fish passage design, fauna exclusion fencing, and rehabilitation and landscape treatments
Temporary features	
Land	▸ Temporary access tracks will be used to access construction sites. Where required, these will be retained to serve as a rail maintenance access road (RMAR) during the operation of the Project ▸ Land requirements for construction will include temporary workspace, site offices and laydown facilities ▸ Laydown areas will be located approximately every 5 to 10 km (avoiding 1% annual exceedance probability (AEP) floodplains where possible). Laydown areas will be required for activities such as tunnel construction, flash butt welding, concrete batching, water treatment facilities and rail assembly ▸ Approximately 2,500 square metres (m^2) of laydown areas to support bridge construction (where practicable, smaller near sensitive habitats)
Material sourcing	▸ Use of established quarries for construction materials

Subject to approval of the Project, construction is planned to start in 2022 and is expected to be completed and commissioned in 2027 when the Inland Rail Program is planned to commence operations. The Project is expected to be operational for in excess of 100 years.

6.2.5 Environmental design

The following environmental design principles were adopted for the Project:

- Environmental design standards have been incorporated during design development
- Design criteria for rail formation, waterway crossings and road crossings were developed to avoid, then minimise where feasible, environmental impacts.

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

Environmental design requirements that are to be further developed during the detailed design process and adopted, where possible, are presented in the draft Outline Environmental Management Plan (draft Outline EMP) (refer Chapter 23: Draft Outline EMP).

6.2.6 Timing

Subject to approval of the Project under the SDPWO Act and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), construction is planned to start in 2022 and is expected to be completed and commissioned in 2027. The anticipated timing of phases for the Project are shown in Table 6.2.

TABLE 6.2 ANTICIPATED TIMING OF PROJECT PHASES

Project phase	2021	2022	2023	2024	2025	2026	2027
Detailed design							
Pre-construction and early works							
Construction							
Commissioning							
Operation							

A construction contractor is expected to be appointed in the second half of 2021, with this also coinciding with the commencement of the detailed design phase of the Project. The Toowoomba Range tunnel is the longest single construction task associated with the Inland Rail Program, with a construction duration closely approaching four years.

Train operations are not anticipated to commence until all 13 sections of the Inland Rail Program are completed in 2027. However, subject to relevant infrastructure access agreements there is the potential for West Moreton System rail traffic to access the alignment prior to the completion of the Inland Rail Program.

6.2.7 Cost

The EIS has included an estimated capital cost profile of approximately $1.087 billion (2019), consistent with the *Inland Rail Programme Business Case* (ARTC, 2015a) and is an estimate of direct construction cost including, environmental and heritage, fencing and earthworks, tunnels and tunnel services, formation and roadworks, structures, track works (with loops and crossings), delivery works, incidentals and utilities, and the supply of track, sleepers and turnouts.

The Project is expected to represent an investment of up to $1.35 billion — this includes both direct and indirect costs. Indirect costs include items such as design services, contractor overhead and margin, contingency and escalation, together with ARTC Program costs such as management, train control systems, property requirements, insurances and utilities. The total investment figure makes provision for expected Project contingency and risk.

The total capital expenditure for the five Inland Rail projects in Queensland is estimated to be between $5 billion and $6 billion. This includes both direct and indirect costs.

The total investment figure makes provision for expected Project contingency and risk. Further detail on the economic impact assessment is in Chapter 17: Economics and Appendix R: Economic Impact Assessment.

6.2.8 Regional and local context

The Project is located within the Toowoomba and Lockyer Valley local government areas (LGAs) in South-East Queensland (SEQ). The location of the Project and its regional context is shown in Figure 6.2 Regional context.

The preferred Project alignment as described in Section 6.2.1 is generally consistent with that of the western portion of the Gowrie to Grandchester future state transport corridor. The Project connects the adjacent Inland Rail projects of B2G to the west and H2C to the east, through the Toowoomba Range, while also connecting to the QR West Moreton System at Gowrie and Helidon.

The Project alignment complies with state and regional plans and policies guiding development in Queensland including the *State Planning Policy* (SPP) *(Department of Infrastructure, Local Government and Planning* (DILGP, 2017b)., *Darling Downs Regional Plan* (Department of State Development, Infrastructure and Planning (DSDIP), 2013a), *ShapingSEQ South East Queensland Regional (ShapingSEQ)* (DILGP, 2017a). These plans identify the importance of Inland Rail not only the national and state level, but the importance of an improved modern rail corridor through the Toowoomba Range.

Some state interests in the SPP include assessment benchmarks that apply to certain types of development where a local government planning scheme does not appropriately integrate the relevant state interest. State interests relevant to the Project include:

- Infrastructure integration—The Project supports this state interest through the expansion of existing infrastructure associated with the introduction of a heavy freight rail between Melbourne and Brisbane. The Project will also improve efficiencies and performance of rail infrastructure through the Toowoomba Range and interoperability between the ARTC and QR networks. The Project also is open access so passenger services can use the rail corridor, while the design does not preclude a fast rail passenger service within the Gowrie to Grandchester future state transport corridor at a future date (e.g. the design avoids proposed passenger stations)
- Transport infrastructure—The Project supports this state interest by using the existing West Moreton System rail corridor and the Gowrie to Grandchester future state transport corridor where possible. Furthermore, the Project has considered and assessed potential impacts to surrounding transport networks and land uses.
- Strategic airports and aviation facilities—The Project will not create incompatible intrusions or compromise the safety or function of the Toowoomba Airport. There is also the potential for the better linkage between Inland Rail and the airports in the future.

ShapingSEQ identifies the Inland Rail Program as being able to support increased capacity to manage freight through SEQ generally and provides specific opportunities in major enterprise and industrial areas in Lockyer Valley and Toowoomba LGAs, such as the Toowoomba Enterprise Hub.

The *Darling Downs Regional Plan* (DSDIP, 2013a) identifies a priority outcome sought for the region's transport network to include the prioritisation of transport programs that improve freight movement. The Project will improve access to and from regional markets and may act as a significant catalyst for development, particularly in relation to rail- dependent industries.

Further discussion on the planning framework relevant to the Project is provided in Chapter 8: Land Use and Tenure.

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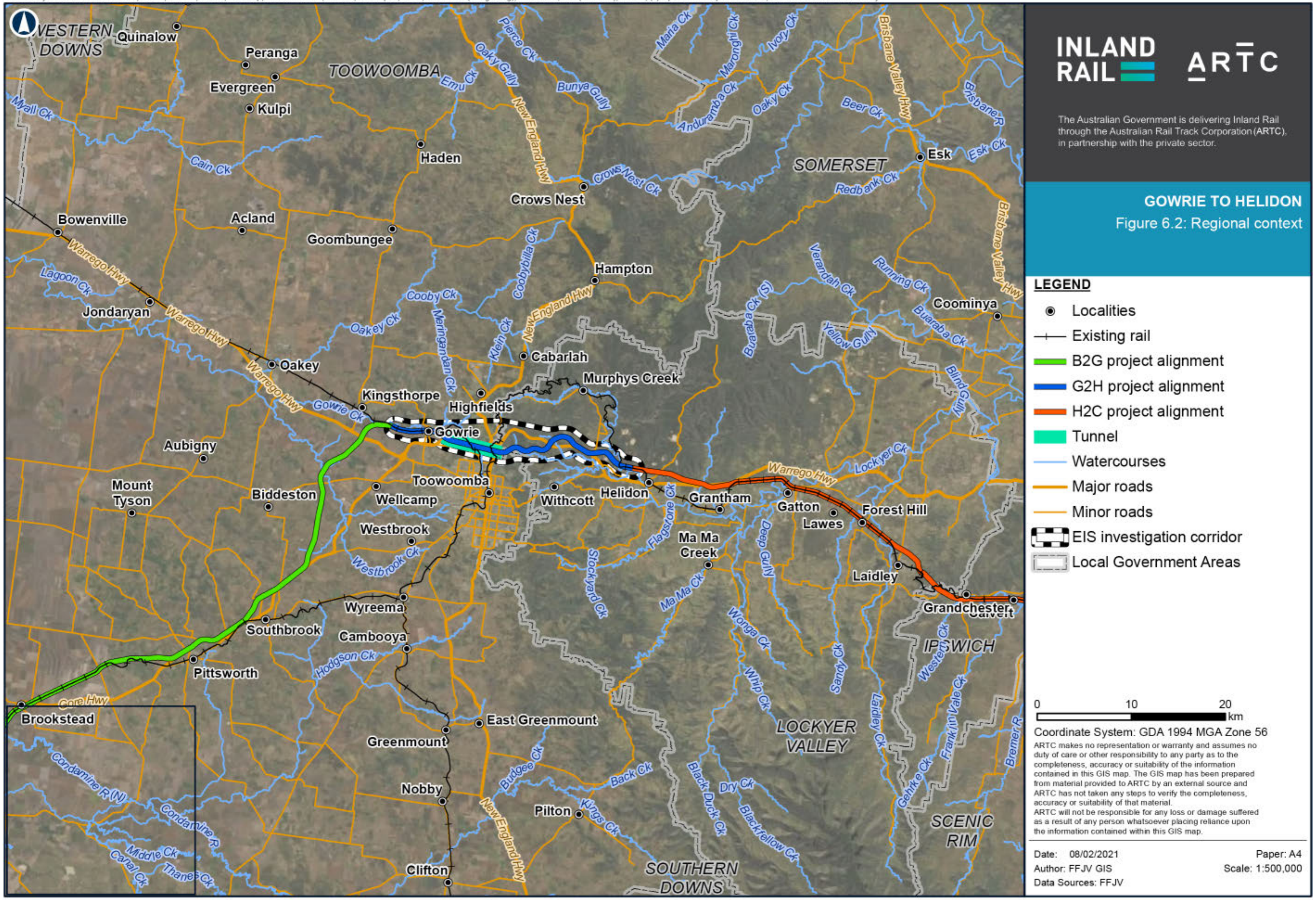

GOWRIE TO HELIDON

Figure 6.2: Regional context

Map by: CB/RB/LCT Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-201807110917_G2H_Project_Figures\320-EAP-201807110917_ARTC_Fig6.2_RegionalContext_rev9.mxd Date: 8/02/2021 16:48

6.2.8.1 Land resources

The Project traverses through the rugged topography of the Toowoomba Range, part of the Great Dividing Range Great Dividing Range.

The landscape from Gowrie approaching the Great Dividing Range consists of a gentle incline before reaching a peak elevation of approximately 644.5 m Australian Height Datum (AHD), as the alignment traverses under the New England Highway and Toowoomba Bypass at Mount Kynoch at a depth of approximately 200 m. A steep drop in elevation occurs after the alignment passes the Great Dividing Range to the east with periodic and isolated peaks featuring with reducing elevation as the alignment reaches Helidon. The lowest elevation for the rail alignment occurs at Lockyer Creek, 1 km to the west of Helidon, with an approximate elevation of 148.5 m AHD.

The geology of the Project corridor comprises rocks and sediments of the Clarence–Moreton Basin, which unconformably overlay the basement rocks. Eight geological layers were found to underlie the EIS investigation corridor between Gowrie and Helidon, which reflect the history and topography of the area that was the centre for volcanic activity during the Tertiary era with large quantities of basaltic lava covering a landscape of flat-lying Mesozoic sedimentary rock (Thompson & Beckmann, 1959).

Surface geology indicates the western tunnel portal will pass through Main Range Volcanics (MRV) and the eastern tunnel portal will pass through colluvium sediments of landslide debris origin. Sediments and poorly consolidated rocks, consistent with the Undifferentiated Tertiary Sediments (UTS) unit, are anticipated to occur either interbedded with the MRV rocks or between the basalt and the underlying sedimentary rocks. Faults and fold axes are mapped to affect the Clarence–Moreton Basin rock both to the east and west of the tunnel. It therefore remains a possibility that some regional structures exist along the tunnel alignment below, hidden by the MRV.

Alluvial and colluvial deposits were the dominant rock type present within the geological layers and can be attributed to recent Tertiary and Quaternary denudation (Willey, 2003). Alluvium deposits in the region will potentially result in deposits of sand, silt or silty clay at the base of hillslopes and along floodplains (Department of Science, Information Technology, Innovation and the Arts, 2012).

There is a high variability of soil types within the Project corridor, with seven distinct soil types identified as occurring: vertosols, dermosols, ferrosols, hydrosols, chromosols, rudosols and sodosols. The presence of acid sulfate soils (ASS) and acid rock has not been identified and there is a medium to high potential of salinity occurring.

Contaminants may be present in the material due to a number of factors including agricultural activity and historic and current land use. There are several properties listed on the Queensland Environmental Management Register within or near the Project disturbance footprint that may present a contamination risk to the Project.

Chapter 9: Land Resources and Appendix W: Geotechnical, provide further details on the land resources relevant to the Project.

6.2.8.2 Land use

Land use in proximity to the Project predominantly comprises grazing land, together with other agricultural uses including cropping and irrigated seasonal horticulture. Other land uses include residential, other minimal use areas (e.g. residual native vegetation) and services. Existing land uses within the Project disturbance footprint and surrounds, based on the Queensland Land Use Mapping Program (Queensland Government, 2019) is shown in Figure 6.3a–b.

Transport infrastructure such as the West Moreton System rail corridor, the Toowoomba Bypass and the other major roads are not reflected in the Queensland Land Use Mapping Program.

The Project does not intersect any protected areas under State and/or Commonwealth legislation, but it does intersect parts of the Great Dividing Range, which is an area of local, regional and state significance.

From west to east, the Project begins approximately 3.7 km west of Gowrie at Charlton and runs parallel (southern side) to the existing West Moreton System rail corridor heading east for approximately 4.8 km, traversing rural/pastoral land, the proposed InterLinkSQ facility and to the north of the rural residential area in the Gowrie Junction Road/Morris Road. The Project alignment then diverts south-east traversing rural/pastoral land, before passing into the western tunnel portal, within the vicinity of Boundary Street and the Toowoomba Bypass interchange at Gowrie Junction. It then continues for 6.24 km within a tunnel through the Toowoomba Range, passing under the localities of Cranley, Mount Kynoch and Ballard and emerging on the eastern side of the Toowoomba Range at Ballard approximately 1.6 km south-east of Mount Kynoch. The eastern tunnel portal is in a rural area predominantly consisting of natural vegetation.

The Project then crosses through the northern edge of an area of Commonwealth land, previously used by the Department of Defence, which is part of the Mount Lofty locality. Continuing east, the Project alignment passes back through Ballard and the northern area of Withcott, and traverses areas of native vegetation and rural properties, with crossings over the valleys of Oaky Creek, Six Mile Creek and the Toowoomba Bypass. The Project alignment loops around Wards Hill in Postmans Ridge and continues southeast parallel to the Toowoomba Bypass across Murphys Creek Road and south of Squires Road, Lockyer. The alignment then intersects the two water storage dams associated with Withcott Seedlings, passing through rural land to the north of Ashlands Drive, Helidon Spa before crossing Lockyer Creek, and the existing West Moreton System rail corridor before tying into the northern side of the existing rail corridor for 800 m to the north-west of Helidon.

Notable land uses in proximity to the Project include recreational and commercial use areas as well as uses of state significance, such as the Wetalla Wastewater Treatment Plant, Baillie Henderson Hospital, Harlaxton KRA, Withcott Quarry, Withcott Seedlings and the Helidon Magazine Reserve. The Project also traverses transport infrastructure, including crossings under and over the Toowoomba Bypass and the West Moreton System, along with water, power and telecommunications infrastructure and other utilities.

The Harlaxton KRA is located on the northern fringe of the built-up area of Toowoomba at Harlaxton. The Harlaxton KRA comprises a thick basalt sequence and is a major quarry that yields a wide range of crushed rock products (Department of Infrastructure, Local Government and Planning, 2016c). The Project, including the Toowoomba Range tunnel traverses both the separation and processing area associated with the Harlaxton KRA on Lot 374 on SP272172. The proposed eastern tunnel portal will also be located in the north eastern corner of the processing area on Lot 374 on SP272172. The Project also traverses the separation area on Lot 20 on CC675 and Lot 1 on RP46221.

The Project intersects one Petroleum Pipeline Licence (PPL 2) (the Roma Brisbane Gas Pipeline) at multiple locations, crossing under the pipeline at Cranley (Ch 7.8 km) and over the pipeline at Harlaxton/Ballard (Ch 11.1 km) and Helidon Spa (Ch 24.5 km). There are no mining tenements within or adjacent to the Project disturbance footprint and no abandoned mines have been identified within the corridor.

Relevant planning instruments that apply to the Project include the *Darling Downs Regional Plan*, SPP, and the *ShapingSEQ*. The Project has been recognised within the SPP, Darling Downs Regional Plan, and *ShapingSEQ* and its design aligns with the land use intent and relevant land use planning principles of these instruments.

Further aspects of the Project's regional and local context and further details of planning schemes and regional plans relevant to the Project are discussed in Chapter 8: Land Use and Tenure.

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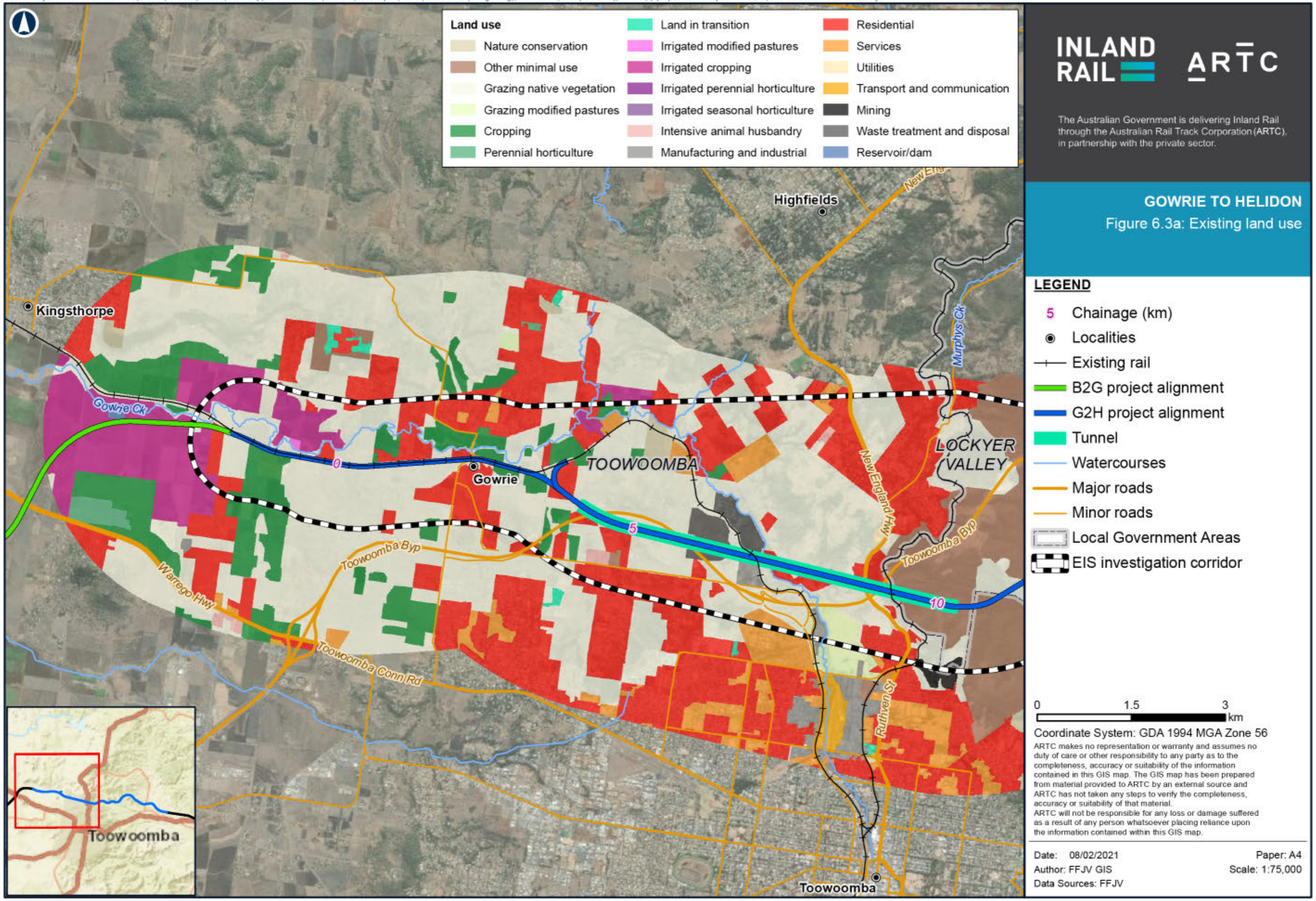

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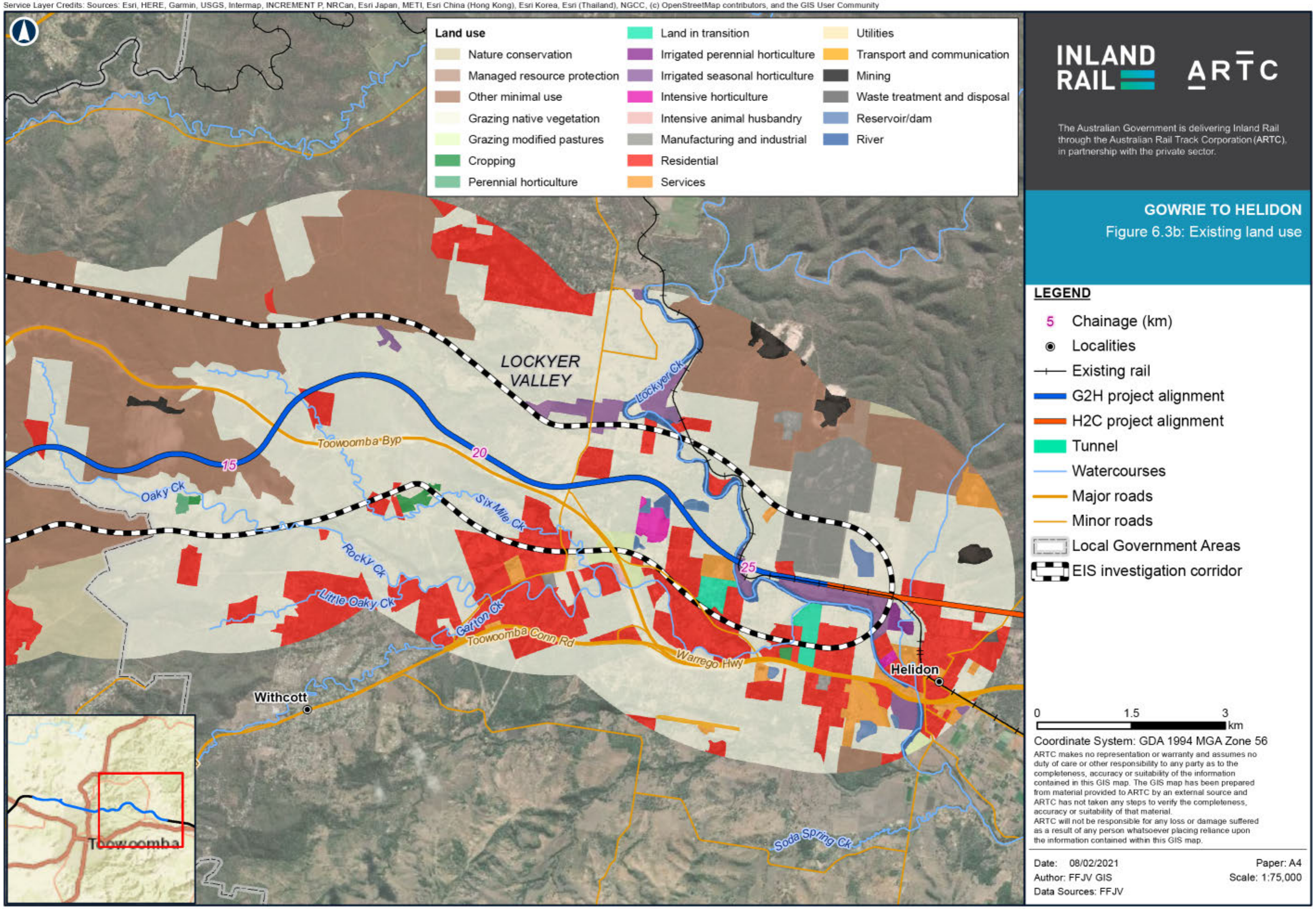

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6.2.8.3 Water resources

The Project is wholly located in an area underlain by the Great Artesian Basin. Further, the Project crosses the Great Dividing Range, which represents the highest point across the alignment, and creates a division in drainage basins between the west (inland) and east (coastal). The Great Dividing Range is a natural surface water and groundwater divide and, as such, is the boundary between Condamine–Balonne rivers catchment and the Lockyer Creek catchment.

To the west of the Great Dividing Range the Project is located within the Gowrie Creek floodplain and parallels Gowrie Creek south of the main channel for approximately 5 km. The tunnel will cross under Gowrie Creek at Cranley, while the proposed Gowrie Junction Road bridge will intersect the main channel. Within this area the creek is considered to be a moderately to highly disturbed ecosystem.

Gowrie Creek catchment is part of the Condamine River Basin and the wider Murray Darling Basin. Surface water and groundwater resources are administered under the *Water Plan (Condamine and Balonne) 2019*, with the Project being subject to the Gowrie and Oakey Creek water management area and the following groundwater management areas (GMA):

- Toowoomba North Basalts—Gowrie Creek is the southern boundary of this GMA and works to the north of the creek will intersect this GMA
- Toowoomba South Basalts—the western extent of the Project is located within this GMA, including the western tunnel portal and the start of the tunnel (i.e. underlying the Toowoomba Bypass)
- Toowoomba City Basalts—the tunnel is primarily located within this GMA, although the eastern portion of the tunnel is located in the Moreton water plan area.

East of the Great Dividing Range, the Project traverses two sub-catchments (Gatton Creek and Upper Lockyer Creek sub-catchments) of the Lockyer Creek Catchment. Within this catchment, the Project traverses the floodplain of three major watercourses: Oaky Creek, Six Mile Creek and Lockyer Creek.

Surface water and groundwater resources within Lockyer Creek Catchment are administered under the *Water Plan (Moreton) 2017*. This catchment is recognised as a Water Resource Catchment under the SPP, with the Project also traversing the Water Supply Buffer Area (WSBA) associated with the Lockyer Creek. Groundwater resources are subject to the Lockyer Valley GMA.

The groundwater table generally follows topography as it gently decreases to the west of the divide and decreases steeply east of the Great Dividing Range, down the escarpment, towards Helidon. The groundwater levels reported within the Walloon Coal Measures and the Koukandowie Formation appear to be beneath the tunnel invert level in the western section and slightly above the alignment in the central and eastern sections. Groundwater resources associated with these units are administered under the *Water Plan (Great Artesian Basin and Other Regional Aquifers (GABORA)) 2017*.

Groundwater flow direction of the alluvial aquifers is typically represented by the surface water catchment boundaries, which reflects the groundwater divide. Local groundwater flow in shallow alluvial aquifers is influenced by surface water–groundwater interaction, where there is a hydraulic connection. This is observed along Gowrie Creek, which flows west into the Condamine River Basin, and it is expected that groundwater in the shallow Gowrie Creek alluvium has a similar trend. East of the Great Dividing Range, the Project crosses Rocky Creek, Oaky Creek, and Six Mile Creek, which flow east and feed Lockyer Creek, and it is expected that groundwater flow in the shallow alluvium follows the surface water pathways.

Water authorisations under the *Water Act 2000* (Qld) (Water Act) will be required under the abovementioned plans, along with the *Water Plan (GABORA) 2017* to interfere with local water resources during construction and operations. Further details are provided in Chapter 3: Projects Approvals, while the water resources are discussed in Chapter 13: Surface Water and Hydrology and Chapter 14: Groundwater.

6.2.9 Land requirements

Land requirements for the Project vary depending on whether the land is located in the greenfield corridor (i.e. new rail corridor between Morris Road and Lockyer Creek), or in the brownfield corridor (i.e. co-located with the existing West Moreton System), or in the tunnel, and also whether the land is required on a temporary or permanent basis. Ultimately, land will be required for the purposes of either rail or road infrastructure, with some of the land requirements associated with existing rail or road corridors.

Figure 6.4 illustrates the key construction and operation components of the Project based on the current design and construction methodology described below. These requirements will be further refined through future Project phases in response to approval conditions, inputs from the constructing authority and the construction contractors and where applicable, local landholders and stakeholders. Any proposed changes will be reassessed in line with the requirements of the SDPWO Act and the EPBC Act and associated regulations, the Terms of Reference (ToR) requirements and the existing assessments.

The land requirements associated with these key components has been defined in terms of the following:

- The Project disturbance footprint is approximately 454 hectares (ha) and it is assumed that all lands within the footprint will be directly impacted by the Project, including land clearing, ground disturbance and land acquisition. This will be confirmed during detailed design in consultation with the construction contractor and the constructing authority and in response to the findings of baseline surveys (e.g. ecological studies, cultural heritage assessments), recommendations from the EIS and any relevant approval conditions.
- The permanent disturbance footprint (approximately 354 ha in area) 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 temporary disturbance footprint outside of the permanent disturbance footprint is approximately 100 ha in area).
- The permanent disturbance footprint (e.g. railway corridor gazetted under the *Transport Infrastructure Act 1994* (Qld) (TI Act)) includes such features as the new rail track, tunnel, bridges, crossing loops and turnouts, drainage structures, road realignments, fencing and signage, along with the relocation of services within the existing West Moreton System rail corridor. The permanent disturbance footprint also includes the existing West Moreton System rail corridor (i.e. forming one railway corridor).
- Within sections of brownfield development, reasonable endeavours have been made to remain within the existing rail corridor, widening the corridor only where required to accommodate new rail infrastructure to support the Project or to accommodate the relocation of existing services associated with the QR Network (e.g. road maintenance access roads). The permanent disturbance footprint also incorporates the existing West Moreton System rail corridor.
- The Project rail corridor is a minimum of 62.5 m wide through the greenfield area of the alignment (excluding the tunnel), to accommodate earthworks, drainage structures, rail infrastructure, access tracks and fencing. The maximum width of the corridor also varies in response to the undulating terrain of Lockyer Valley due to earthwork requirements and the location of RMARs, with the maximum width being approximately 300 m.
- The permanent disturbance footprint also includes a number of access roads linking the corridor to the existing road network, along with the water pipeline linking the Toowoomba Range tunnel to the Toowoomba Regional Council (TRC) water network.
- Preservation of an underground corridor of approximately 50 m wide and 28 ha in area for the Toowoomba Range Tunnel has been included to ensure that the underground land required for tunnel construction and operation, along with the long-term integrity of the tunnel can be guaranteed and protected from future development. The tunnel area also includes additional land required for infrastructure at the western and eastern portals, and the intermediate ventilation shaft at Cranley.
- Changes to the existing road networks as a result of the Project are also considered as part of the permanent disturbance footprint. Reasonable endeavours have been made to ensure that the changes remain within the existing road reserves, wherever possible. Following construction, these roads will be managed by the relevant road authority (i.e. DTMR or local council).

The Project disturbance footprint also includes approximately 100 ha of land required on a temporary basis to enable the safe construction of the Project referred to as the temporary construction disturbance footprint. This land is required for construction purposes and includes, for example, the following:

- Five metres outside the rail corridor for fencing construction
- Laydown areas
- Construction access roads where these lie outside the permanent disturbance footprint
- Utilities works due to relocation/removal of services crossing the rail corridor
- Erosion and sediment controls including sediment ponds.

Although ARTC is 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 extensions with the initial land acquisition. The construction of future 3,600 m crossing loops will be subject to separate approval applications in the future.

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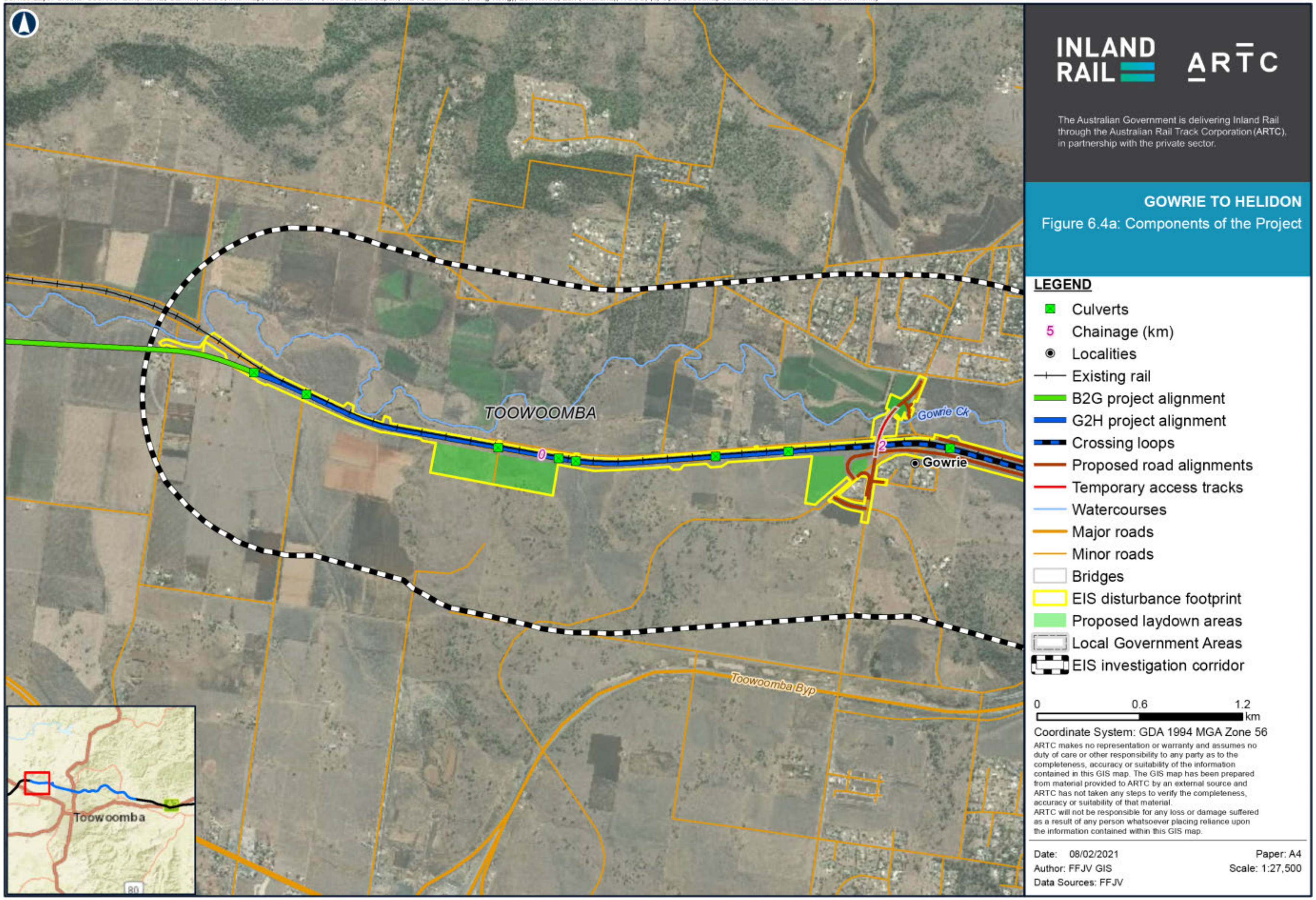

GOWRIE TO HELIDON
Figure 6.4a: Components of the Project

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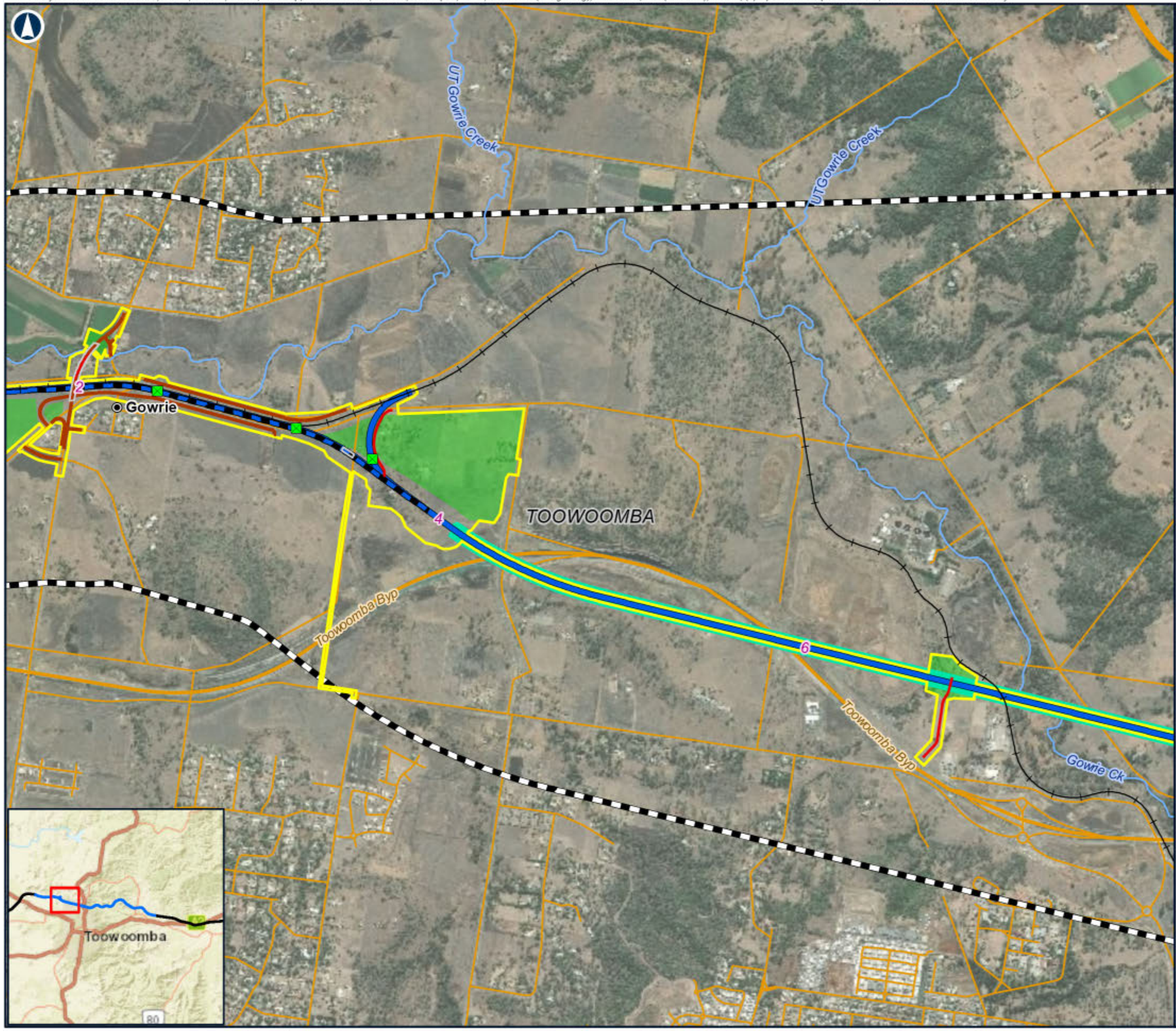

INLAND RAIL

ARTC

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

GOWRIE TO HELIDON

Figure 6.4b: Components of the Project

LEGEND

- Culverts
- 5 Chainage (km)
- Localities
- Existing rail
- G2H project alignment
- Crossing loops
- Proposed road alignments
- Temporary access tracks
- Watercourses
- Major roads
- Minor roads
- Bridges
- Tunnel
- EIS disturbance footprint
- Proposed laydown areas
- Local Government Areas
- EIS investigation corridor

0 0.6 1.2 km

Coordinate System: GDA 1994 MGA Zone 56

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Data Sources: FFJV

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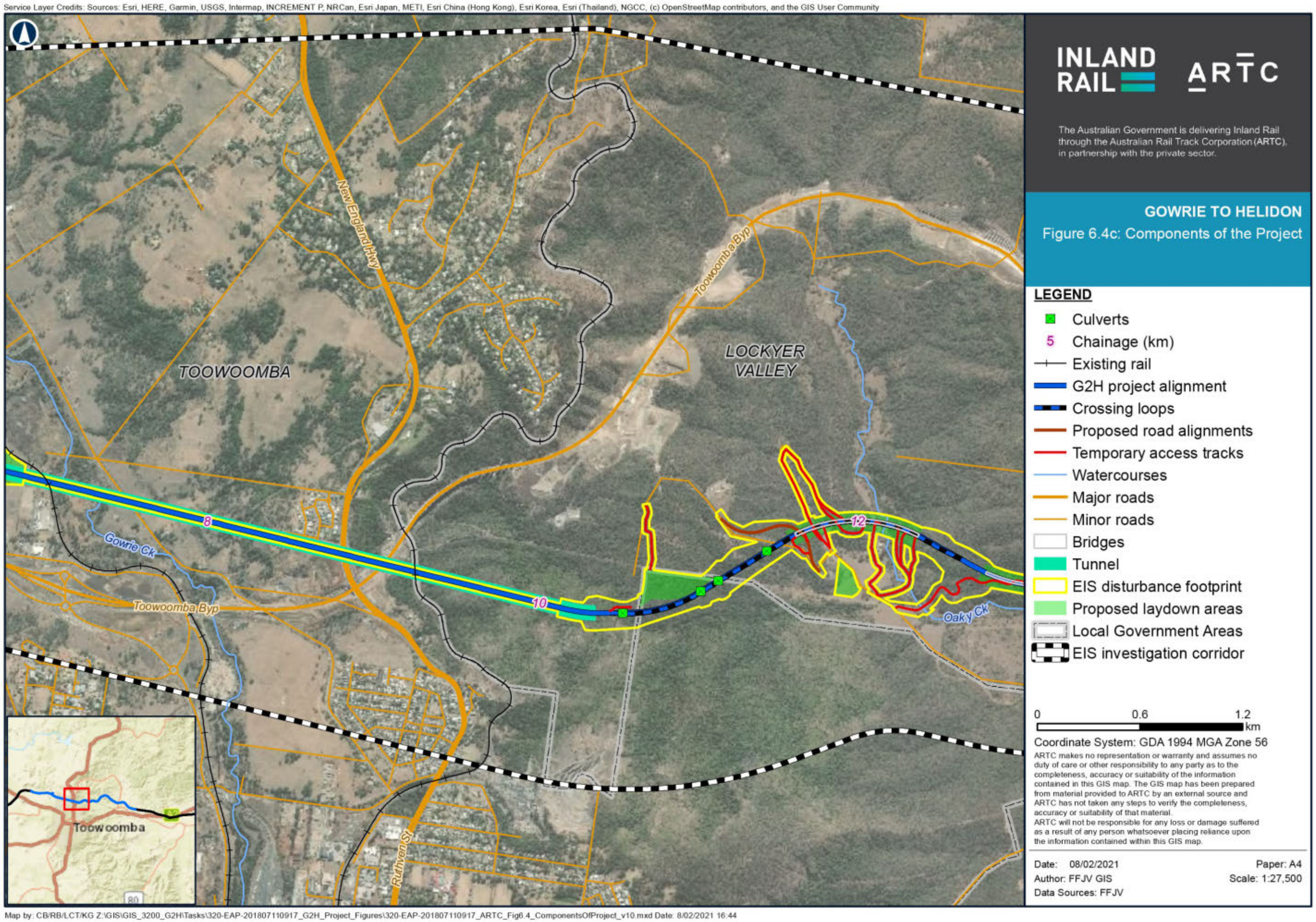
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INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
GOWRIE TO HELIDON
Figure 6.4c: Components of the Project
LEGEND
Culverts
Chainage (km)
Existing rail
G2H project alignment
Crossing loops
Proposed road alignments
Temporary access tracks
Watercourses
Major roads
Minor roads
Bridges
Tunnel
EIS disturbance footprint
Proposed laydown areas
Local Government Areas
EIS investigation corridor
0
0.6
1.2
km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:27,500
TOOWOOMBA
LOCKYER VALLEY
New England Hwy
Toowoomba Byp
Gowrie Ck
Oaky Ck
Ruthven St
8
10
12
Toowoomba
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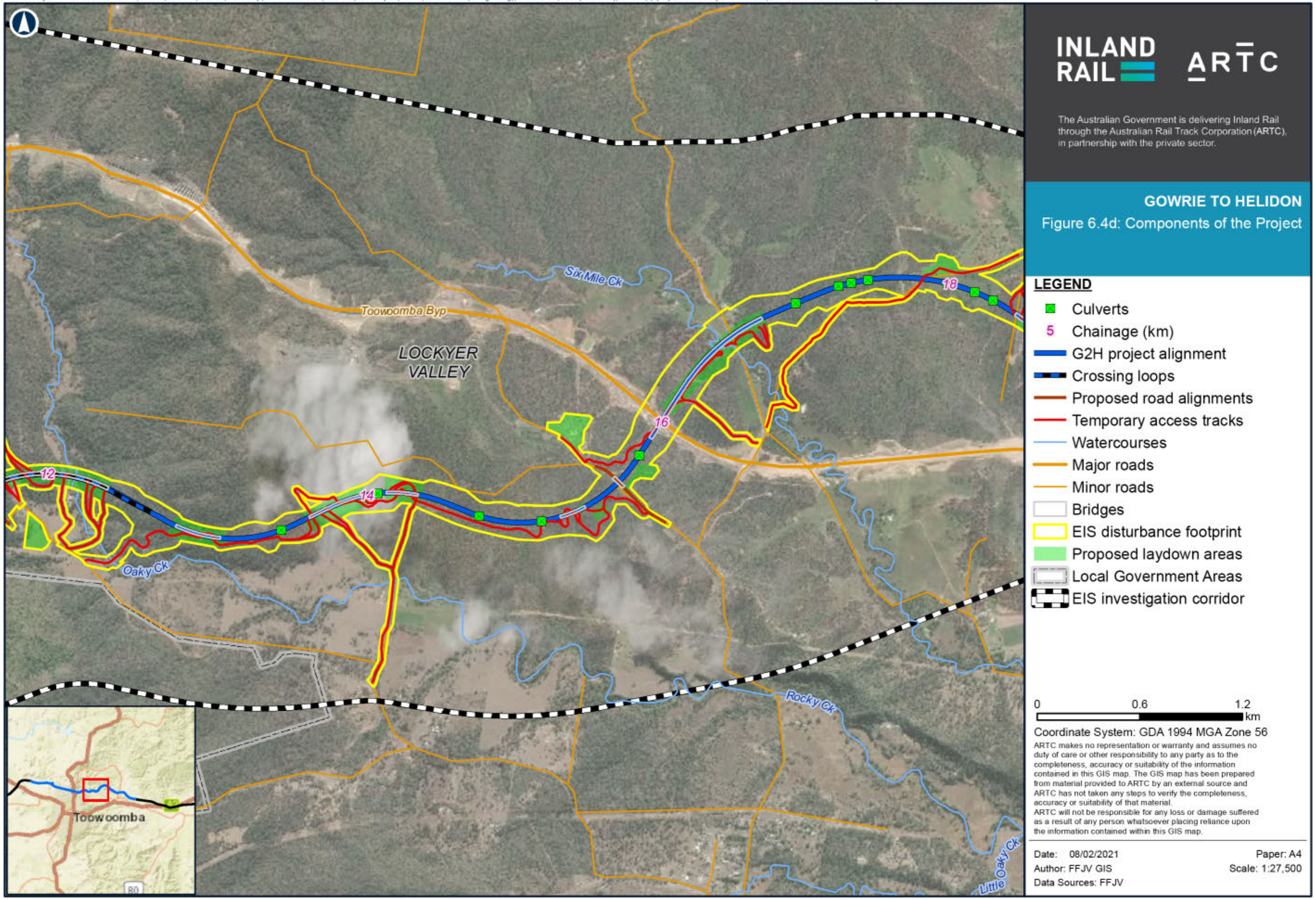

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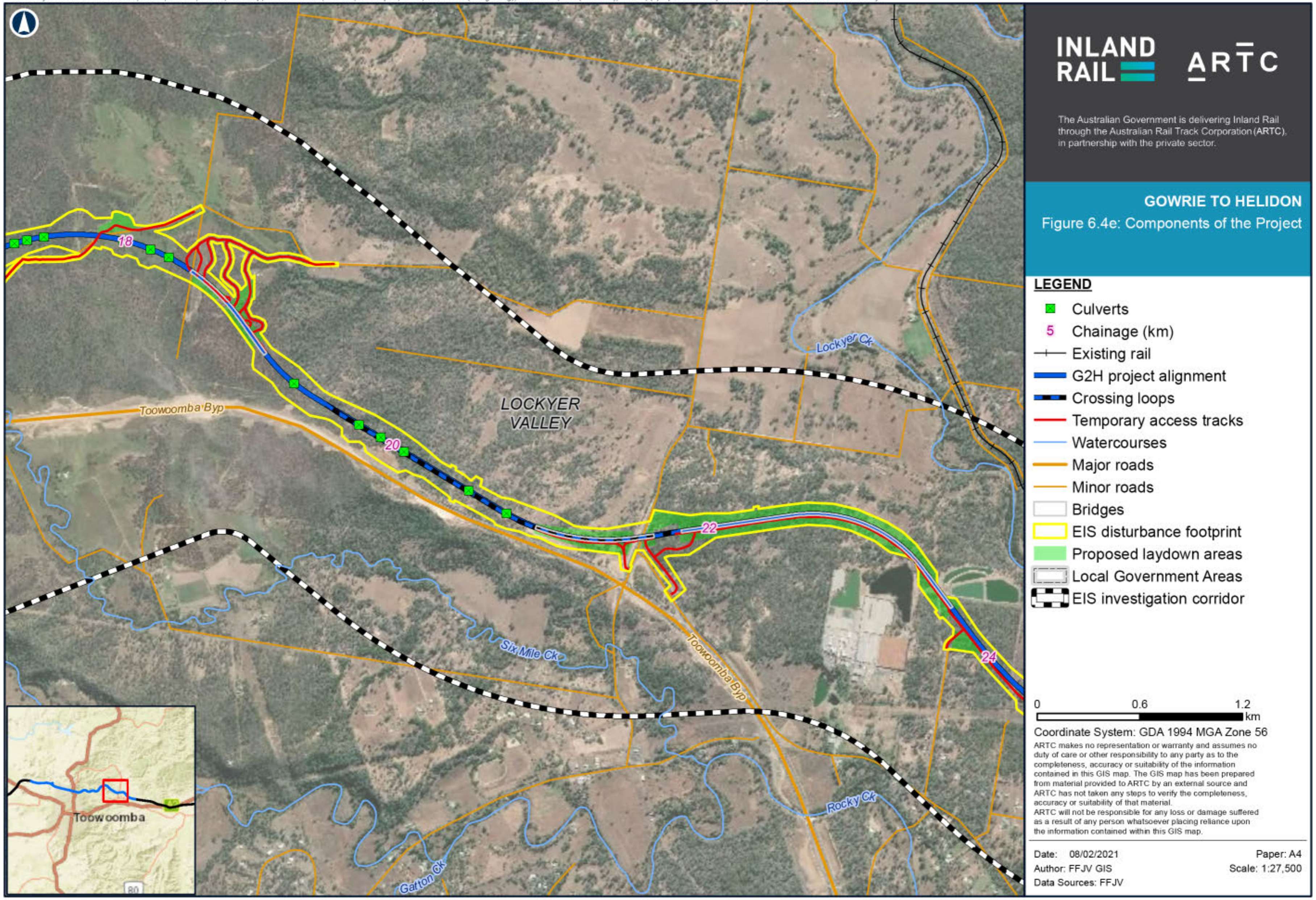

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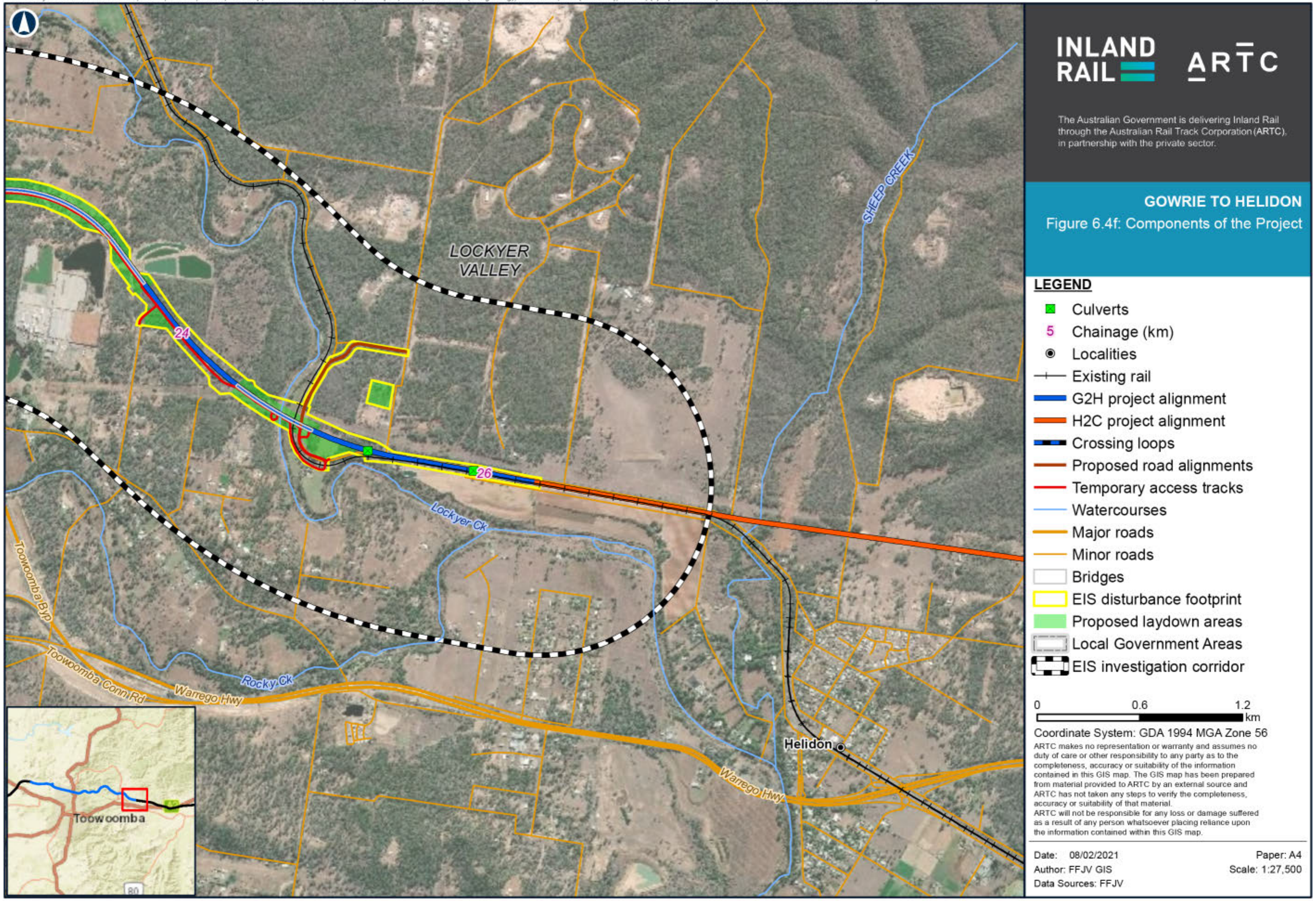

GOWRIE TO HELIDON
Figure 6.4f: Components of the Project

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6.2.10 Land acquisition

The Project disturbance footprint, excluding untenured land such as road reserves and waterways, traverses 151 land parcels. This includes 94 land parcels within the Toowoomba LGA and 57 land parcels within Lockyer Valley LGA, along with 41 interests (e.g. easements, strata parcels, etc.).

The Project has been intentionally aligned to use the existing transport corridors including the West Moreton System rail corridor, the Gowrie to Grandchester future state transport corridor, where possible, and where necessary existing local and state road corridors, minimising the extent of 'new' land parcels to be acquired.

The Project traverses 20 land parcels (~13 per cent) associated with the existing West Moreton System rail corridor, including the Toowoomba Range Tunnel passing under a property on Western Line and the Main Line. Ten of these land parcels are also within the Gowrie to Grandchester future state transport corridor. It is envisaged that the existing QR rail corridor will not be acquired for this Project, with the existing rail corridor likely to be expanded to incorporate the land required for the Project's rail corridor, and a sublease between the state and ARTC (i.e. land lease tenure).

Of the 151 land parcels:

- 82 land parcels (~54 per cent) are located within the Gowrie to Grandchester future state transport corridor, including 28 land parcels associated with the Toowoomba Range Tunnel
- 59 land parcels (~39 per cent) are located outside of both the West Moreton System rail corridor and the Gowrie to Grandchester future state transport corridor, including seven land parcels associated with the Toowoomba Range Tunnel
- 109 land parcels are required for the rail and road infrastructure (i.e. intersected by the permanent disturbance footprint), with 21 land parcels entirely within the permanent disturbance footprint. This includes 15 land parcels associated with the existing West Moreton System rail corridor and six freehold land parcels (2 owned by TMR at the intermediate ventilation shaft)
- 36 land parcels will be subject to volumetric resumption associated with the Toowoomba Range Tunnel, including six properties where surface acquisition is also required. Of the 30 land parcels 28 of these land parcels are located within the Gowrie to Grandchester future state transport corridor. DTMR has acquired 12 of these parcels, including where the western tunnel portal is located, 7 land parcels associated with the Toowoomba Bypass and 3 land parcels where the intermediate ventilation shaft is located
- The temporary disturbance footprint traverses an additional 12 freehold land parcels (78 in total), including 3 within the Gowrie to Grandchester future state transport corridor will only be required for construction.
- In addition to be privately held, a number of these land parcels are owned by QR (26 land lease parcels), DTMR (35 land parcels, mainly associated with the Toowoomba Bypass) and TRC (3 land parcels).

The majority of the land intersected by the Project (123 land parcels) is in freehold title (including parts of Toowoomba Bypass). The Project also traverses 28 lands lease land parcels associated with the existing (and in some areas former) rail corridor. State land also includes road reserves including unlinked parcels; waterways (Gowrie Creek and Lockyer Creek) and two reserves.

It is expected that the impacted properties will be acquired (freehold) or leased (state land) by the relevant constructing authority, converted to Unallocated State Land (USL) and dedicated as 'railway corridor land' under the TI Act, or in some cases a road under the *Land Act 1994* (Qld) (Land Act). The land acquired for 'railway corridor land' will be subject to similar lands lease tenure arrangements to that of the existing West Moreton System rail corridor (e.g. head lease between ARTC and DTMR).

Preservation of an underground corridor of approximately 50 m wide for the tunnel has been included to ensure that the underground land required for tunnel construction and operation, along with the long-term integrity of the tunnel can be guaranteed and protected from future development. For land intersected by the tunnel, a volumetric parcel for the purposes of 'railway corridor land' under the TI Act will be required for the subsurface area. Volumetric acquisitions allow for the resumption of land below the surface of the property with no change of surface ownership, change to the base tenure or relocation of occupier required. A schematic of a volumetric resumption is in Figure 6.5.

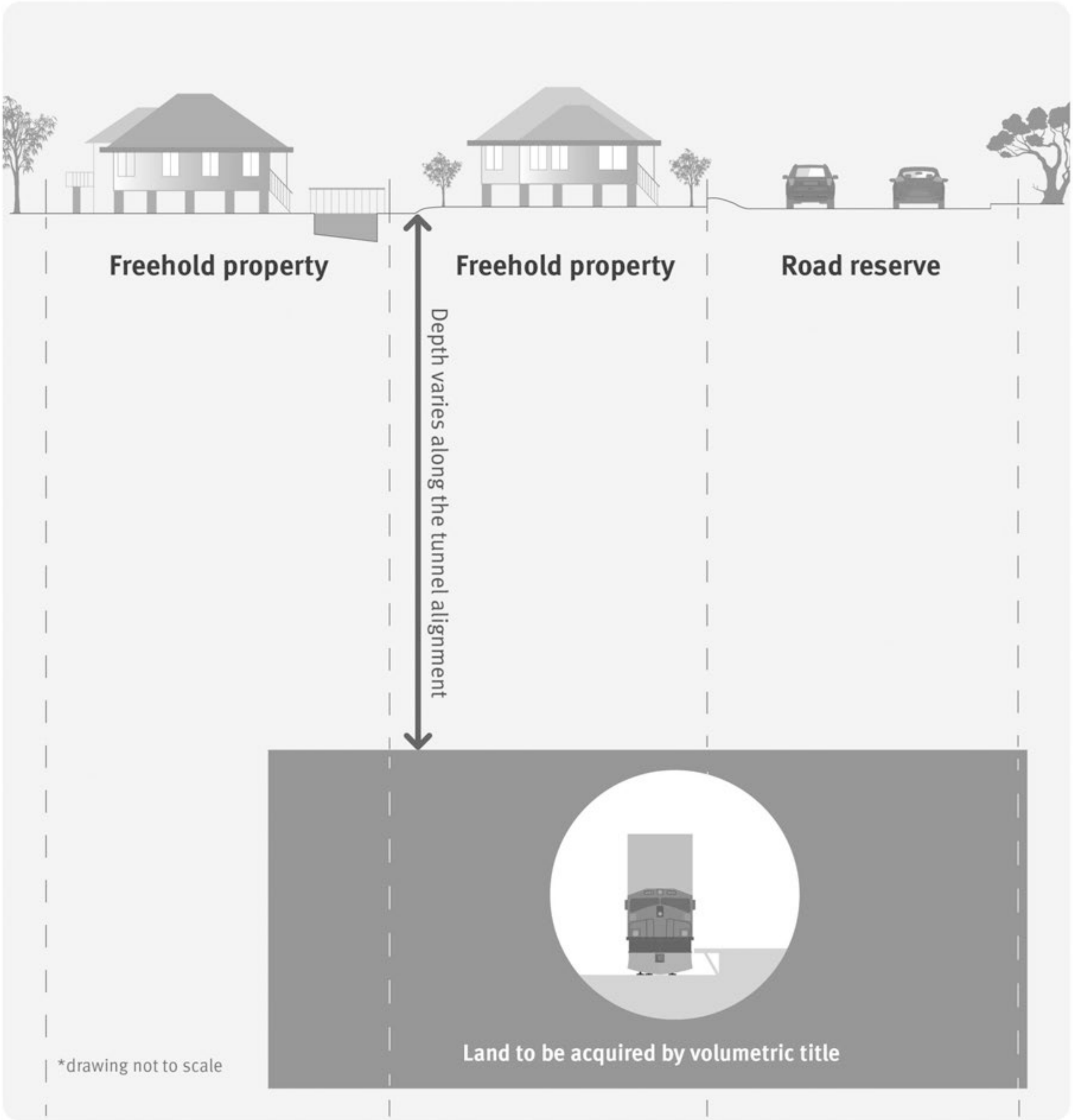

FIGURE 6.5 SCHEMATIC OF A VOLUMETRIC ACQUISITION

A volumetric acquisition may also be required for bridge structures, for example where a road bridge crosses existing freehold property, or the space above the ground surface may be subject to such a resumption if both the property owner and the construction authority or lessor (under a head lease) have a need for continued operation and maintenance of their respective areas.

Within sections of brownfield development, reasonable endeavours have been made to remain within the existing rail corridor, widening the corridor only where required to accommodate safe operation of the Project. Land associated with the existing rail corridor is unlikely to be acquired for the Project, with the existing rail corridor to be expanded and a new head lease created for the purposes of the Project. ARTC also has considered land requirements for the proposed road network changes required to facilitate the Project. The majority of the proposed road network changes are to occur within existing road reserves; however, there will be a requirement to acquire land for the purposes of a road under the Land Act.

The land requirements for the Project are described in Chapter 8: Land Use and Tenure, with a list of impacted properties in Appendix V: Impacted Properties. The Project’s land requirements will be confirmed during the detailed design phase in consultation with the Constructing Authority and the construction contractor.

State land required temporarily for construction is likely to be made available from existing state land parcels. After construction, each parcel would return to its pre-existing tenure arrangement. If any land is required for freehold land, it would be acquired by the state and leased to the relevant transport manager for construction. After construction, land not required for the Project would be sold and returned to freehold tenure.

6.2.11 Sensitive receptors

Sensitive receptors can be a place, natural feature, structure, person or organism that is susceptible to impact. Throughout this EIS, sensitive receptors are identified for the purpose of establishing the likelihood and consequences of potential impacts. Sensitive receptors differ between technical aspects. For example, a sensitive receptor to noise impacts will be different to a sensitive receptor for groundwater impacts. As a consequence, sensitive receptors have been identified for each separate assessment discipline, where relevant, and are discussed in the corresponding chapters of this EIS.

As discussed in Chapter 2: Project Rationale, the Project alignment has been developed to minimise impacts on sensitive receptors, including, for example, vine thicket on the eastern side of the Great Dividing Range escarpment, Indigenous cultural heritage sites associated with Upper Rocky Creek, the Gowrie township and the Withcott Seedlings farm.

6.3 Design

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. Sections 6.3.1 to 6.3.13 provide greater detail on the key components of the Project. Design drawings are provided in Appendix C: Design Drawings, including layouts of the tunnel portal

6.3.1 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 developed a consistent set of design requirements and parameters to be applied across the Inland Rail Program. Establishing consistent design criteria will normalise designs, delivering an asset that meets the business and operational requirements, is consistent along its length, and subsequently simplifies asset maintenance.

Table 6.3 details the performance specifications for the Project and the wider Inland Rail Program, serving as the primary point of reference for the design of the Project to meet the operational requirements, therefore forming a baseline for the design along with the appropriate design standards. The medium speed alignment standards (mountainous terrain) are applicable to the greenfield area of the Project.

TABLE 6.3 PERFORMANCE SPECIFICATIONS FOR THE PROJECT AND THE WIDER INLAND RAIL PROGRAM

Attribute	Specification
Reference train	
Intermodal	21 tonne axle load (TAL), 115 kilometres per hour (km/hr) maximum speed, 1,800 m length (initial) 2.7 horsepower per tonne (hp/tonne) power:weight ratio
Coal/bulk	25 TAL (initial), 80 km/hr 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 Queensland sections including the Project.
Maximum freight operating speed	115 km/h @ 21 TAL
Maximum axle loads (initial)	21 tonnes @ 115 km/hr 23 tonnes @ 90 km/hr 25 tonnes @ 80 km/hr

Attribute	Specification
Clearance (terminal to terminal)	As per ARTC Plate F for double stacking (7.1 m above rail)
Maximum train length (initial)	1,800 m
Braking curve	G40 for intermodal reference train
Minimum design standards	
General alignment standards	
Design speed	115 km/hr
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 standards (mountainous terrain) applicable to the greenfield area of the Project	
Design speed	80 km/hr 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
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 or within road vehicle sighting distance from 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/hr minimum
Formation	Formation on new track suitable for 30 TAL @ 80 km/hr
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 and availability	Competitive with road

6.3.2 Rail track

The Project alignment is a new single line of dual-gauge track, standard (1,435 mm) and narrow (1,067 mm) gauge with crossing loops.

The mainline track structure is a ballasted track system consisting of continuously welded rail. Figure 6.6 shows a typical section for a dual-gauge ballasted track. Within the tunnel, a track slab will be used, which comprises a continuously welded rail on a continuous concrete slab.

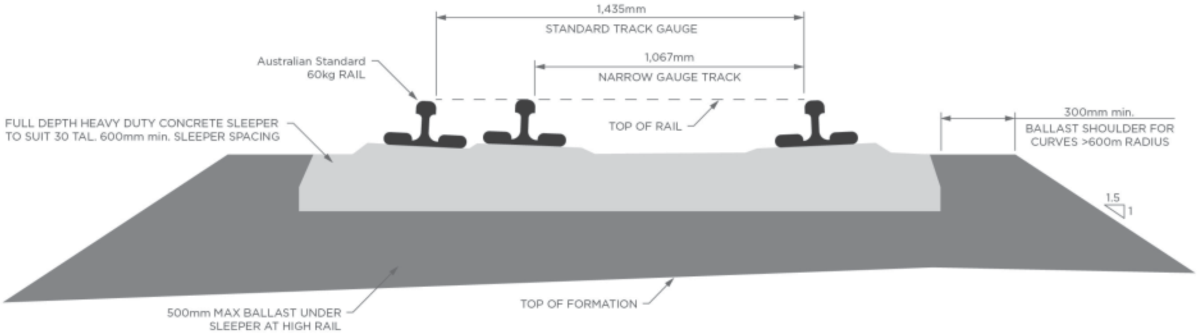

FIGURE 6.6 INDICATIVE DESIGN FOR NEW TRACK

The various elements of and terminology associated with the track are 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 and produce less noise as wheels do not thud over track joints. Continuously welded rails also require less maintenance
Sleeper	▸ Concrete, rectangular, sleepers, laid perpendicular to the rails ▸ Sleepers distribute the load from passing trains to the ballast and subgrade. Together with fasteners, they also function to hold the rails upright and 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 dispersal of water away from the formation
	  ▸ Reduce potential for vegetation growth that might interfere with trains passing by

Formation	▸ The rail formation consists of a capping layer and subgrade; which consists of a layer of structural fill and general fill ▸ The formation is designed to restrict the upward migration of wet clay and silt, which would foul the ballast and affect free drainage of the track structure. The impervious capping layer impedes upwards motion of fine particles through pumping and protects the formation by avoiding water ingress and allowing effective drainage at the ballast–formation interface ▸ The rail formation is illustrated in Figure 6.7

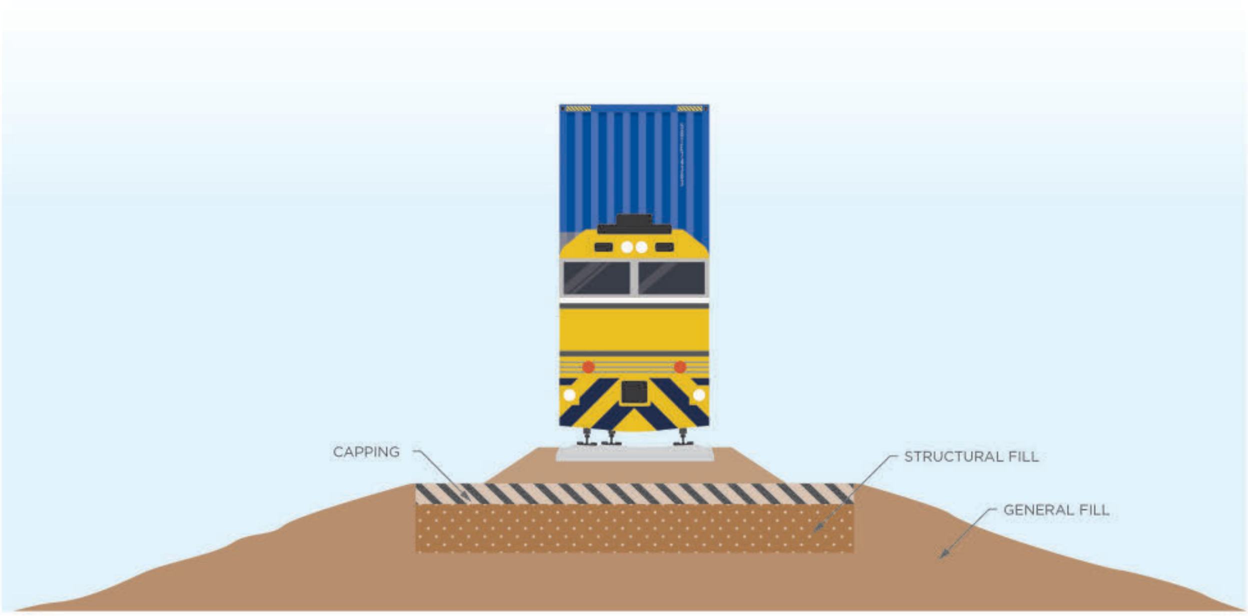

FIGURE 6.7 STRUCTURE OF THE RAIL FORMATION

6.3.3 Signalling and communications

A safe working 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, cabling trenches between equipment, monitoring and control equipment on track, beside the track and in enclosures in the rail corridor.

The design has considered space-proofing for this infrastructure relevant to the existing and future operations associated with the QR Network and other stakeholders in the area. In addition, the land requirements have also considered impacts on the existing QR signalling infrastructure and any potential relocations. Any alterations to the signalling infrastructure or current access arrangements will be subject to detailed discussions between ARTC and QR during detailed design.

The safe working system will be monitored and controlled by one or more of ARTC's network control centres currently located in Adelaide, Junee and Newcastle.

6.3.4 Tunnel infrastructure

The Project proposes a 6.24 km long undrained tunnel through the Toowoomba Range (refer to Figure 6.8 for a sketch of the conceptual Toowoomba Range Tunnel). The tunnel is oriented west-north-west to east-south-east at an approximate grade of 1 in 64.

The western tunnel portal (Ch 4.10 km) is located within the Gowrie to Grandchester future state transport corridor near the Boundary Street/Toowoomba Bypass interchange and has been designed to ensure a flood immunity of 1:10,000 AEP (refer Chapter 2: Project Rationale). The surface level is 510 m AHD and the rail level is 490 m AHD. The approximately 600 m long western approach box cut will be up to 26 m in height at the western tunnel portal face, gradually reducing in height towards the west.

The eastern tunnel portal, location within the Gowrie to Grandchester future state transport corridor south-west of Mount Kynoch, involves a 100 m long cut and a portal face that is approximately 13 m in height. The portals are drained and there is the potential for groundwater inflows during construction and operations (refer Chapter 14: Groundwater).

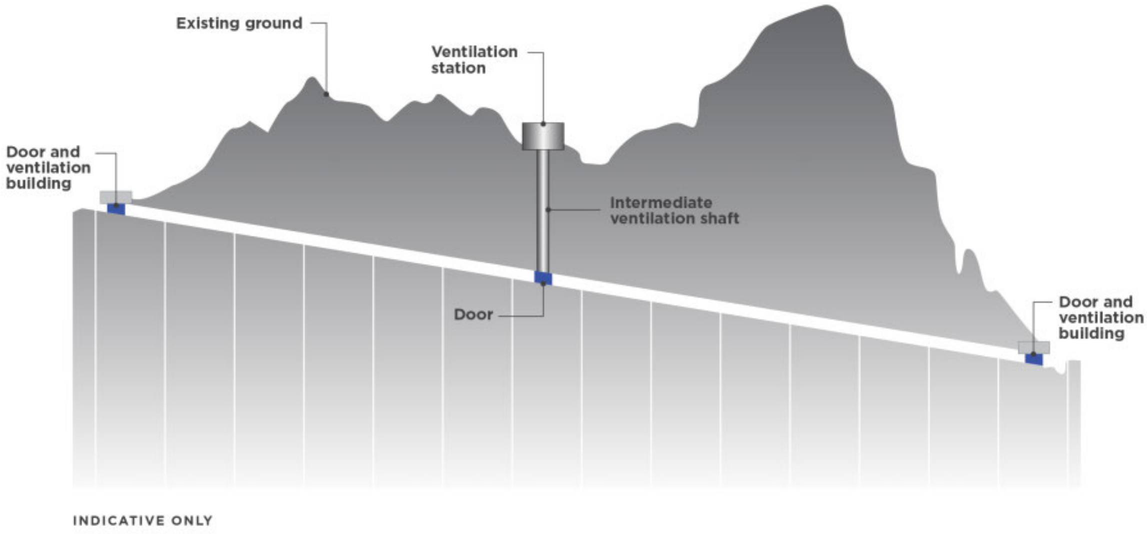

FIGURE 6.8 CONCEPTUAL TUNNEL CROSS SECTION SKETCH THROUGH THE TOOWOOMBA RANGE

The tunnel would have a bored diameter of approximately 12.2 m and a finished internal diameter of approximately 10.8 m, with a cross-section area of 73 m^2 (refer Figure 6.9). The tunnel will include rail tracks, emergency systems and services such as communication power, drainage and egress lighting. As noted in Section 6.3.2, a track slab will be used in the tunnel. An intermediate ventilation shaft at Cranley, approximately 100 m deep and approximately 17 m in diameter, is also proposed as part of the tunnel ventilation system.

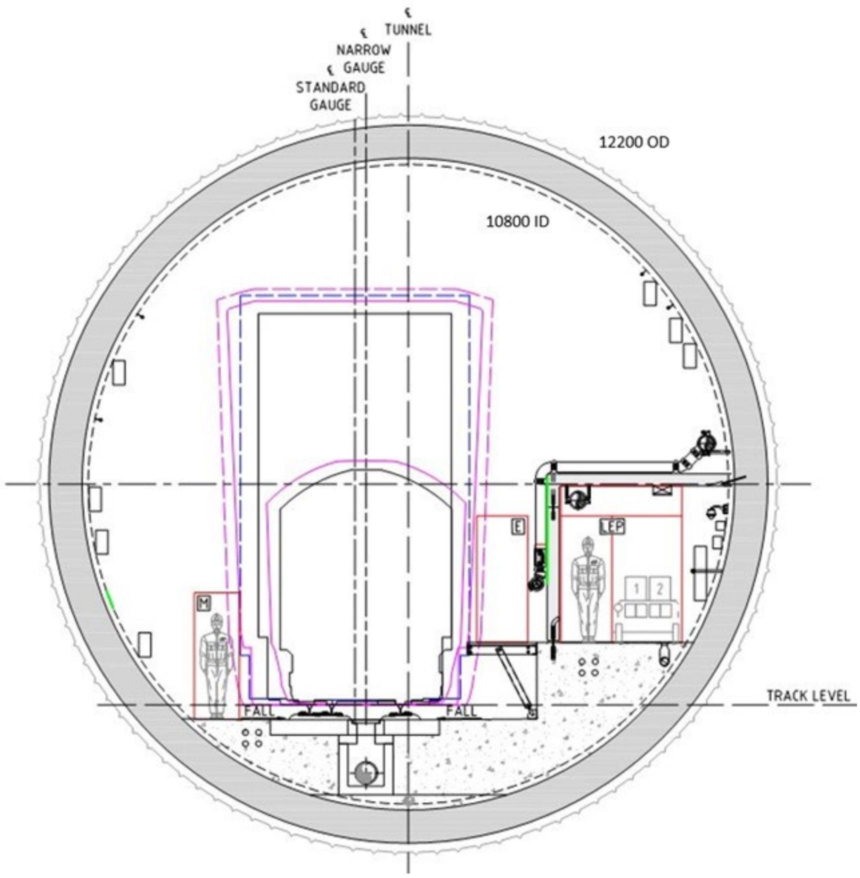

FIGURE 6.9 INTERNAL CROSS SECTION OF THE TOOWOOMBA RANGE TUNNEL

The tunnel will be relatively uncluttered, assisting to minimise maintenance requirements. Essential instrumentation and communications equipment would be provided throughout the tunnel as well as the fire hydrant ring main. The internal lighting would also be minimal, limited to only low-level egress and emergency lighting.

The tunnel provides a longitudinal egress passage (LEP) as a conventional evacuation passage for drivers and crew, providing access for operational maintenance activities and communication facilities to contact the operator at the tunnel control centre. The ventilation design, duty/standby axial fans, will provide ventilation during normal operation and pressurisation during emergency operations (i.e. prevent smoke entering into the LEP from a fire incident in the tunnel, which was a requirement identified by the Queensland Fire and Emergency Services (QFES)).

The tunnel services facilities are primarily located at the western tunnel portal and include the tunnel control centre, intake substation, fire water tanks, fire pumps and emergency services staging area. The fire management system is based on Australian Standard (AS) 2419 Fire Hydrant Installations—System Design, Installation and Commissioning and includes two 450 kilolitre (kL) tanks, standby pumps that will tie into TRC water network via a 1.2 km water pipeline south under the Toowoomba Bypass to Hermitage Road. The water network will deliver 30 litres per second (L/s) sufficient for the fire management system. This water pipeline will also link to the other areas of the tunnel, with any other dedicated water pipelines required to support the Project to be confirmed during detailed design.

A visualisation for the western tunnel portal has been prepared and is shown in Figure 6.10.

The eastern tunnel portal will accommodate a substation, water treatment plant, sites office and associated amenities. Access and parking facilities for the tunnel portals consider access requirements for staff and also for QFES vehicles.

Each tunnel portal will require a substation building for power supply and distribution to electrical equipment. Due to the length of the tunnel and limitations of cable voltage drop, it is envisaged that there would also be two in-tunnel substations to supply lighting, power and communications equipment in the tunnel. There will also be a substation at the intermediate shaft to supply the ventilation loads located at the intermediate shaft.

Ergon Energy has been consulted regarding providing the necessary power supply for the tunnel operations. Ergon Energy provided a number of options to ARTC for consideration and once a solution is agreed, an Application to Connect to Ergon Energy will be submitted. These works will be undertaken by Ergon Energy and will be subject to their approval processes and legislative requirements independent of the EIS process.

FIGURE 6.10 CONCEPTUAL VISUALISATION OF THE WESTERN TUNNEL PORTAL

6.3.4.1 Ventilation

The east to west alignment on approach and through the tunnel includes a constant 22 km sustained approximate grade of 1:64 from Helidon to the west of the tunnel. This presents significant challenges for rail operations and tunnel ventilation to aspirate the locomotives on the climbing grade in the tunnel and to purge the tunnel of heat and emissions.

The tunnel ventilation system has been designed to the following requirements:

- Provide sufficient train cooling by using airflow induced by the piston action from the portal doors
- Maintenance of acceptability of air quality inside the tunnel and at portals for the purposes of human exposure (refer Chapter 12: Air Quality)
- Compliance with statutory requirements in terms of air pollutant discharge from the tunnel portals, such as the Environmental Protection (Air) Policy 2019 (Qld) (refer Chapter 12: Air Quality)
- Manufacturers required air intake quality for the diesel locomotives
- Limitation of tunnel operating temperatures suitable for the operation of locomotives in accordance with manufacturers operating conditions and the service operating patterns
- Control of smoke during fire incidents to prevent back layering of smoke.

The tunnel ventilation system, including the intermediate ventilation shaft, which will draw in the air from the surrounds, would provide purging capability to flush pollutants from the tunnel after passage of the freight trains, or in response to exceeds detected by in-tunnel air quality monitoring devices.

There are three ventilation buildings proposed for the tunnel, one at each tunnel portal and one at the intermediate shaft. The portal ventilation buildings sit directly over the track and house the smoke control fans and LEP (maintenance and evacuation route) fans. The intermediate ventilation shaft building houses both smoke control fans and purge fans. The intermediate ventilation shaft of the tunnel is to be located approximately 2,700 m from the western tunnel portal, and 3,650 m from the eastern tunnel portal.

Doors are also provided at the two tunnel portals and at the intermediate ventilation shaft, which allows one door to be closed during train movement to maintain the required airflow across the locomotives for operations. The design also allows the intermediate shaft door to close earlier after the train passes the mid-point and start the purge for the first tunnel section during purging operations out of the relevant portal doors.

6.3.4.2 Water management

The tunnel design, including the intermediate ventilation shaft, is based on an undrained tunnel design that aims to limit groundwater ingress into the tunnel and to minimise groundwater level drawdown. Unlike the tunnel design, the tunnel portals and the cut and cover section of the tunnel are based on a drained design.

The tunnel will be lined with precast concrete segments with a water tightness rating of class 3 (Haack, 1991). To achieve a class 3 rating, the allowable limit of leakage rate is 0.3 L/s (assuming even distribution across the tunnel) while for the intermediate ventilation shaft it is assumed to be 0.0062 L/s. Predictive modelling indicates that groundwater inflow could be up to 10 ML per annum during operations (refer Chapter 14: Groundwater).

The water collected inside the tunnel (groundwater seepage, stormwater carry-in, wash-down, firefighting etc.) will be collected through a common tunnel drain and stored in a sump at the eastern tunnel portal.

Groundwater inflow at the western tunnel portal will be diverted via the drainage system directly to a tributary of Gowrie Creek near UT1 Gowrie Creek Rail Bridge. The water quality of the groundwater is considered suitable to be diverted directly into this tributary, which is considered to be a moderately to highly disturbed ecosystem. The groundwater and surface water baseline monitoring (in progress) will confirm this and where it is deemed that treatments are required (e.g. vegetation swales or water treatment plant) they will be developed during detailed design. Further information on the groundwater resources relevant to the Project is in Chapter 14: Groundwater and Appendix N: Groundwater Technical Report.

Similarly, the drainage system will also divert the majority of the stormwater away from the western tunnel portal and tunnel to the surrounding environment. This will be achieved through longitudinal drainage proposed along the northern extent of the western tunnel portal, allowing stormwater flows to be diverted from an existing drainage line, along with overland flow away. A smaller longitudinal drain, approximately 120 m long, is also proposed to the south of the western tunnel portal to manage stream flow associated with a drainage line under the Toowoomba Bypass. Where applicable relevant approvals will be obtained under the Water Act to authorise the works. Further information on the proposed drainage system is provided in Chapter 13: Surface Water and Hydrology.

Groundwater inflow and stormwater that cannot be diverted away from the western tunnel portal will be collected into a sump, preventing flow from occurring down the tunnel. Water collected in the sump will be discharged to the surrounding environment (in accordance with relevant approval conditions and/or water quality objectives) and/or collected by a licensed waste contractor for disposal at a water treatment plant (WTP).

Groundwater inflow from the colluvium at the eastern tunnel portal is predicted to be 0.7 ML per annum. As with the western tunnel portal, this inflow and any stormwater will be directed away from the portal. Where groundwater inflow or stormwater cannot be diverted away from the portal, the water will be collected and diverted to the sump prior to release to the surrounding environment (in accordance with relevant approval conditions and/or water quality objectives) or collected by a licensed waste contractor for disposal at a WTP.

During detailed design, ARTC will investigate design solutions to further reduce the volume of groundwater ingress during operations, as well as identify measures to capture water for reuse onsite, such as for rehabilitation works, washdown, and for the potential dilution of groundwater inflow into the tunnel to achieve relevant water quality objectives prior to discharge.

6.3.4.3 Water treatment

The collection sumps will include a hydrocarbon separator and a 'first flush' tank that will collect the first quantity of water, which is expected to contain the majority of pollutants, allowing the rest of the water to be discharged in accordance with relevant approval conditions and/or water quality objectives. Each sump has a maximum capacity of 150 cubic metres (m^3), which is expected to be sufficient to store water collected from the tunnel prior to being released to the surrounding environment in accordance with relevant approval conditions and/or water quality objectives or collected by a licensed waste contractor for disposal at a WTP.

For water collected in the tunnel, further treatment may be required, with a WTP proposed at the eastern tunnel portal. The level of treatment required (if any) will be confirmed by baseline monitoring of groundwater along the tunnel alignment.

As part of the detailed design geotechnical investigations completed post the current design, 14 groundwater bores were established along the tunnel alignment intercepting both the MRV and the Koukandowie Formation. These bores will be continually assessed prior to construction and as part of the Groundwater Management and Monitoring Plan to be implemented during construction and where applicable operations.

Subject to confirmation during detailed design, the WTP is currently anticipated to include the following elements:

- Screening treatment
- Detention tanks (treated and untreated water, wastewater)
- Aeration/flocculation tanks
- Chemical treatment
- Water pumping facilities
- Sludge storage.

Groundwater modelling indicates that the WTP will need capacity to treat up to 10 ML/annum, with the source of groundwater predominantly from the Koukandowie Formation (refer Chapter 14: Groundwater).

Treated water will either be reused onsite or discharged (in accordance with relevant approval conditions and/or water quality objectives) into a tributary of Oaky Creek at the eastern tunnel portal (a drainage feature under the Water Act), directly downstream of the Project. Any separated pollutants, including sludge, will be held for collection by a licensed waste contractor.

Based on the current monitoring data (groundwater and surface water) the main risks to discharge water to the surrounding environment relate to salinity, as well as changes to the environmental values of the tributary of Oaky Creek, which is an ephemeral drainage line.

Further discussion on groundwater resources is provided in Chapter 14: Groundwater and Appendix N: Groundwater Technical Report.

6.3.4.4 Lighting

With the exception of signalling, no continuous lighting is proposed along the rail corridor.

Lighting will be provided for the tunnel substations (including the in-tunnel substations), the control room and ventilation buildings. Compound lighting will be provided at the portals and intermediate ventilation shaft building location. This lighting is likely to be a combination of linear fluorescent and/or light-emitting diode (LED) lighting with exterior lighting to consider Australia Standard and New Zealand Standard *AS/NZS4282:2019 Control of the obtrusive effects of outdoor lighting* (Standards Australia, 2019b) where applicable.

There are no relevant standards for lighting of rail tunnels; however, within the tunnel, emergency lighting will be provided adjacent to the egress walkway and exit signs at LEP entry doors, and within the LEP to allow for emergency egress. Emergency lighting will be designed to Australia Standard *AS2293.1:2005 Emergency escape lighting and exit signs for buildings* (Standards Australia, 2005).

6.3.5 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 incorporates three crossing loops, designed to accommodate 1,800 m train lengths, with consideration of future provision for 3,600 m train lengths. The proposed locations of the crossing loops are:

- Western end of the Toowoomba Range tunnel
- Eastern end of the Toowoomba Range tunnel
- Postmans Ridge—located in the vicinity of Murphys Creek Road.

The loops would be constructed as new sections of track parallel to the mainline track and are generally at a non-curve compensated grade of 1:64. The loops 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 Project disturbance footprint under the current proposal (crossing loops to accommodate 1,800 m trains) is expected to have sufficient space for the future extension of all three crossing loops to accommodate trains up to 3,600 m (i.e. the disturbance footprint does not need to be any wider than the approximate 65 m width required for the 1,800 m train corridor). However, the assessment of impacts (e.g. vegetation clearing) is based on the area required for crossing loops to accommodate 1,800m trains. Any impacts, including additional vegetation clearing for the extension of the crossing loops, will be assessed and confirmed through a separate future approval process. These works will be subject to a separate approval process at a future date. Maintenance sidings and turnouts have been incorporated at each crossing loop location, along with catchpoints. An indicative schematic of a crossing loop is shown in Figure 6.11.

FIGURE 6.11 INDICATIVE DESIGN FOR CROSSING LOOP AND MAINTENANCE SIDING

6.3.6 Connections

Connections are provided to allow trains to move between the existing QR Network (narrow gauge) and Inland Rail (dual gauge). A connection is also proposed with the InterLinkSQ facility. The anticipated locations for connections for the Project are:

- InterLinkSQ connection to the Project approximately 1 km east of Draper Road, Gowrie Junction
- West Moreton System connections to the Project at:
  - Approximately 1 km west of Gowrie Junction Road, Gowrie Junction
  - Spur line, approximately 1.5 km east of Gowrie Junction Road, Gowrie Junction (allowing trains to access Toowoomba)
  - Approximately 2.5 km west of Helidon train station along Airforce Road, Helidon.

6.3.7 Structures

6.3.7.1 Bridges and viaducts

No existing bridges require reinstatement or reconstruction along the alignment as a result of the Project, including two existing rail bridges associated with the Western Line. No rail works are proposed next to these structures, although some road upgrades will occur. The rail bridges associated with the Main Line are located more than 5 km upstream.

The Project traverses the steep slopes through the Toowoomba Range at Ballard, Withcott and Lockyer, which requires significant earthworks and structures to maintain the operational gradient. The Project requires 3 new bridges and 10 new viaduct structures (refer Figure 6.4 and Appendix C: Design Drawings).

Viaducts are a type of bridge that are made up of multiple small spans that cross waterways, terrain, roads or transport infrastructure. The heights of the viaducts will vary between 16 m and 45 m in response to the local terrain. Bridges, within the context of this Project, are shorter structures with a simpler design that span waterways, roads or rail, but not terrain.

Bridge and viaduct structures also allow drainage across the corridor; access for roads and rail, farm tracks, stock crossings or pedestrians; span waterways, riparian zones and large valleys provide for native fauna connectivity; and replace large height embankments where required to reduce the operational footprint.

New rail bridges and viaducts proposed are summarised in Table 6.5. The visual amenity of these structures is discussed in Chapter 10: Visual Amenity.

TABLE 6.5 SUMMARY OF RAIL BRIDGES AND VIADUCTS

Project chainage	Bridge name	Type	Crossing type	Length (m)	Maximum height (m)
Ch 3.40 km	UT1 Gowrie Creek Rail Bridge	Rail bridge	Watercourse	56	4
Ch 11.63 km	Oaky Creek Viaduct	Rail viaduct	Terrain, road and watercourse	736	41
Ch 12.83 km	Withcott Viaduct 1	Rail viaduct	Waterway	261	16
Ch 13.64 km	Withcott Viaduct 2	Rail viaduct	Terrain and waterway	322	35
Ch 14.12 km	Withcott Viaduct 3	Rail viaduct	Terrain and waterway	174	23
Ch 15.15 km	Withcott Viaduct 4	Rail viaduct	Waterway	145	24
Ch 15.89 km	TSRC and Six Mile Creek Viaduct	Rail viaduct	Terrain, road and watercourse	966	45
Ch 18.44 km	Postmans Ridge Viaduct	Rail viaduct	Terrain, road and watercourse	644	35
Ch 20.98 km	Murphys Creek Road Viaduct	Rail viaduct	Terrain, road and watercourse	690	36
Ch 21.84 km	Withcott Seedlings Viaduct	Rail viaduct	Terrain and watercourse	1,794	35
Ch 24.45 km	Lockyer Creek Viaduct	Rail viaduct	Road, rail and watercourse	506	28

Table notes:
TSRC: Toowoomba Second Range Crossing now referred to as Toowoomba Bypass
Watercourse: a river, creek or other stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events, as defined in Section 5 of the (Water Act)
Waterway: refers to a 'drainage feature' as defined in Schedule 4 of the Water Act, as opposed to a 'watercourse' as defined in Section 5 of the Water Act

New road-over-rail bridges are summarised in Table 6.6.

TABLE 6.6 SUMMARY OF ROAD BRIDGES

Project chainage	Bridge name	Type	Crossing type	Length (m)	Maximum height (m)
Ch 1.93 km	Gowrie Junction Road Bridge	Road bridge	Road, rail and waterway	311	12
Ch 15.54 km	McNamaras Road Bridge	Road bridge	Rail	74	17

Bridge and viaduct superstructures are typically formed from pre-stressed precast concrete girders with in-situ decks incorporating walkways, guardrails and barriers as appropriate. The bridges and viaducts are of various lengths and spans to suit the alignment and topography. These structures are generally not considered to be waterway barriers as identified in *What is a waterway barrier work?* (DAF, 2021a).

The structures are typically founded on driven precast or bored in-situ piled foundations supporting in-situ reinforced concrete substructures. For structures with very tall piers in valleys with rough steep terrain, longer span structural options have been investigated and compared with recommendations made for each location.

Structure lengths have been determined by considering hydraulic requirements, width of roads below (including future widening and services corridors), cost effectiveness of structures versus embankments in deep valleys and environmental conservation requirements.

For road bridges, the general approach to defining the configuration has been to adopt standard pre-stressed concrete deck units and 'Super T' girders, to appropriate lengths, as per general practice in Queensland when designing for DTMR.

6.3.7.2 Retaining walls

Due to the tight constraints of the alignment between the existing QR tracks and Airforce Road at the eastern end of the Project, the alignment embankment will be supported on a varying height reinforced soil slope retaining wall. The reinforced soil slope wall comprises two sections. The section to the north of the alignment is approximately 470 m long (Ch 25.46 km to Ch 25.93 km) and has an average height of 2.85 m and a maximum height of 5.5 m. The section to the south of the alignment is approximately 660 m long (Ch 25.35 km to Ch 26.01 km) and has an average height of 3.25 m and a maximum height of 6.3 m.

No change to the width of Airforce Road is proposed as part of the works, although there may be some disruptions to traffic during construction.

6.3.8 Drainage infrastructure

Drainage structures are provided to maintain flows across the Project alignment, while ensuring the Project flooding and hydraulic design criteria are met (refer Chapter 13: Surface Water and Hydrology). There will, however, be a requirement to infill some drainage lines, with the flows diverting longitudinally along the Project alignment to the nearest culvert and/or drainage line.

The reference design was undertaken considering the *Guide for the determination of waterways using the spatial data layer Queensland waterways for waterway barrier works* (DAFF, 2013c), where watercourses that are not coloured on the Queensland Waterways for Waterway Barrier Works spatial data layer are not considered waterways. Under this guide, waterway barrier works on these streams do not require approvals or assessment under the Fisheries Act.

Based on the Queensland Waterways for Waterway Barrier Works spatial data, only 24 waterways for waterway barrier works intersect the Project disturbance footprint. Where the Project intersected a mapped waterway the design was undertaken in accordance with *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b). For example, fish passageway culverts have been upsized by 300 mm height for box culverts and 300 mm diametre for pipes from the calculated hydraulic sizes to submerge the culverts beneath the existing bed level by 300 mm at the upstream and downstream ends to comply with the fish passage requirements.

6.3.8.1 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 in the design depends on various factors such as the natural topography, rail formation levels, design flow and soil type. The type of cross-drainage structure may also be dependent on the requirement to facilitate fish passage through a culvert in order to minimise environmental impacts, where possible.

Cross-drainage structures, including culverts, have been designed to meet the design criteria of 1% AEP event. Culverts are structures that allow water (in a watercourse or drainage line/overland flow) to pass under the rail line or roads.

There are 23 RCPs culvert locations (with multiple cells in certain locations) and 11 RCBCs identified for the Project (refer Appendix C: Design Drawings and Chapter 13: Surface Water and Hydrology).

Where the Project is co-located within the West Moreton System rail corridor, the following is proposed:

- The existing culverts under the Western Line at Ch -1.42, Ch 1.46 and Ch 2.41 km will be extended under the Project alignment
- The existing culverts under the Western Line at Ch -0.25, Ch 0.11, Ch 0.21 and Ch 1.03 km will be upgraded (number of cells or size) and extended under both alignments. This aims to improve the flood immunity of the Western Line during a 1% AEP flood event (refer Chapter 13: Surface Water and Hydrology)
- Culverts will also be provided under the Project alignment Ch -1.76 km and on the spur line connection, with no change to the QR drainage infrastructure under the Western Line proposed
- An existing culvert under the QR Main Line will be upgraded and extended under both alignments (i.e. at Ch 25.94 km an existing RCBC (1 cell) will be upgraded to 5 cells)
- A new culvert under the Project alignment is also proposed at Ch 25.31 km, with no change to the QR drainage infrastructure under the Main Line proposed.

The proposed changes to the road network will also require new drainage structures (e.g. East Paulsens Road). Scour protection measures will generally be installed around culvert entrances and exits and on disturbed stream banks to avoid erosion.

The locations of the new culverts and existing QR culvert extensions will be confirmed during detailed design (in consultation with QR) to maintain the existing flow paths and minimise the potential impacts to flood depths upstream and downstream of the culverts. A typical section of a cross-drainage culvert is shown in Figure 6.12.

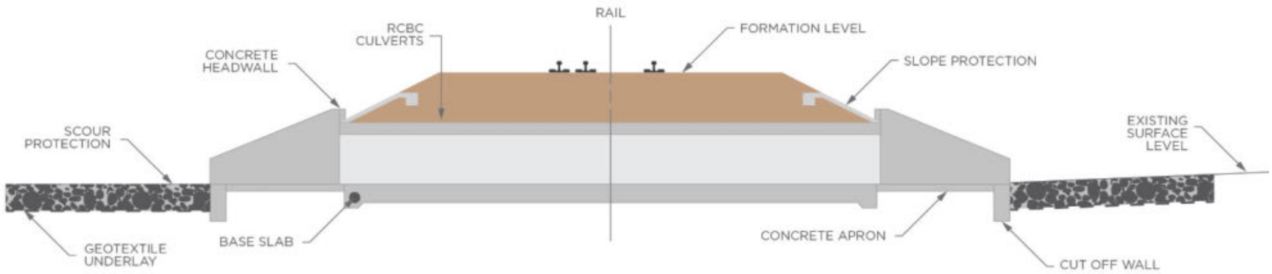

FIGURE 6.12 TYPICAL SECTION OF A CROSS-DRAINAGE CULVERT

6.3.8.2 Longitudinal drainage

The Project will include the following types of longitudinal drainage:

- Cess drains running directly adjacent to the rail formation in cuts
- Embankment drains—longitudinal drains adjacent to the track in embankment conditions
- Catch banks—longitudinal banks on the uphill side of cuttings.

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. The design and location of track drainage will be refined during the detailed design phase to minimise potential impacts.

Longitudinal drainage will also be included on new and or upgraded roads to connect with the existing drainage environment.

To facilitate the Project, the current design includes the following alterations to existing unmapped watercourses. These works are illustrated in Appendix C: Design Drawings:

- The western tunnel portal area (Ch 4.10 km) overlays two unmapped watercourses that travel from west to east, draining to Gowrie Creek. One waterway is identified as an 'amber' waterway under the Queensland Waterways for Waterway Barrier Works spatial data layer.
- Two trapezoidal diversion drains are proposed, one to the south (125 m long) and one to the north (600 m long). Based on aerial imagery, these features are likely to be drainage features under the Water Act and as such, the works are unlikely to constitute a diversion under the Water Act. These watercourses have been impacted by the Toowoomba Bypass directly upstream of the western tunnel portal.
- From Ch 17.25 km to Ch 17.44 km, the rail embankment will be placed over an existing flow path and a diversion of the flow path will be required. This flow path is a drainage feature under the Water Act. The waterway is not mapped under the Queensland Waterways for Waterway Barrier Works spatial data layer.

In addition to the connections outlined in Section 6.2.5, the Project will involve grade separation (i.e. Lockyer Creek Viaduct) over the West Moreton System between Lockyer Creek and Airforce Road, Helidon. The Toowoomba Range Tunnel will also cross under, at a depth of over 100 m, the Western Line at Cranley and the Main Line at Ballard. Details of the rail–rail interfaces are provided in Appendix C: Design Drawings.

6.3.9 Road–rail interfaces

Road–rail interfaces are a point at which the rail intersects with public roads or private accesses. No level crossings are associated with the Project. One existing QR level crossing has been eliminated through the Gowrie Junction Road grade separation.

6.3.9.1 Public road–rail interfaces

The Project crosses both State-controlled roads and local government road reserves (TRC and Lockyer Valley Regional Council (LVRC)). All road–rail interface locations have been treated with either closure or grade separation, meaning that there are no level crossings (passive or active) located along the Project alignment.

A summary of the number of existing public road interfaces, collated by road manager, along with the proposed treatment is presented in Table 6.7 (excluding roads over the Toowoomba Range tunnel).

TABLE 6.7 SUMMARY OF PUBLIC ROAD–RAIL INTERFACES FOR THE PROJECT

Road name	Road manager	Treatment
Toowoomba Bypass	DTMR	Grade separation (rail over road)—TSRC and Six Mile Creek Viaduct
Murphys Creek Road	DTMR	Grade separation (rail over road)—Murphys Creek Road Viaduct
Draper Road	TRC	Road closure
Gowrie Junction Road/Old Homebush Road Level Crossing	TRC	Level crossing closure and road realignment with grade separation (road-over-rail)—Gowrie Junction Road Bridge
Morris Road (Inland Rail main line)	TRC	Road closure
Morris Road (Inland Rail connection to QR)	TRC	Road closure
Ganzer Morris Road (Inland Rail main line)	TRC	Road closure (unformed road corridor)
Wallens Road	LVRC	Road realignment with grade separation (rail over road)—Oaky Creek Viaduct
Jones Road	LVRC	Grade separation (rail-over-road)—Oaky Creek Viaduct
McNamaras Road	LVRC	Grade separation (road-over-rail)—McNamaras Road Bridge
Gittins Road	LVRC	Grade separation (rail-over-road)—TSRC and Six Mile Creek Viaduct
Howmans Road	LVRC	Road closure (unformed road corridor)
Unnamed Road	LVRC	Road closure (unformed road corridor)
Cattos Road	LVRC	Road realignment with grade separation (rail-over-road) and closure of the existing intersection—Lockyer Creek Viaduct.

Table notes:
TSRC: Toowoomba Second Range Crossing now referred to as Toowoomba Bypass

For public road crossings, ARTC is undertaking, and will continue to undertake, consultation with DTMR and local councils about 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. The design has also ensured that the relevant separation distance between the formation of the rail and the roads surface level is sufficient for current and future traffic.
- Crossing consolidation, relocation, diversion or realignment—existing road rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted. The road network alterations would mainly consist of road realignment whereby existing traffic patterns will be maintained. This is envisaged not to have an impact on existing traffic operations whereby existing geometric lane configurations can be maintained within the newly proposed road realignments.
- 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.
- Road closures—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 ARTC will request, under the Land Act, for the road to be closed and re-gazetted as part of the railway corridor.

6.3.9.2 Occupational (private) crossings

The Project interfaces with 36 private accesses, with no level crossings proposed. Of the 36 interfaces, 18 are proposed to be grade separated (i.e. rail over), with six to be consolidated and the remainder with no action proposed. As the state and national rail safety guidelines and policies are safety focused, ARTC will work with each landholder and relevant stakeholder during detailed design to find solutions that provide optimal access on a case-by-case basis.

Design and layout of occupational crossing solutions 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), subject to topography
- Diversion to adjacent public road–public road crossing
- The most common solution for the private access treatments based on topography and rail vertical alignments will be an underpass provided by viaducts. Consultation undertaken to date and plans for ongoing discussions to confirm potential occupational crossing solutions is described in Appendix D: Community Consultation.

6.3.10 Road network changes

To facilitate the Project, changes to the local road network are required to safely accommodate the railway and maintain local and regional connectivity. The majority of road network changes are within Gowrie Junction, with the road authority being TRC. The proposed road network changes, outlined below, will be undertaken in accordance with relevant DTMR, TRC or LVRC design standards.

The elimination of the existing Paulsens Road level crossing, which is in line with *Queensland Level Crossing Safety Strategy 2012–2021* (DTMR, 2012a), requires a new grade-separated crossing to maintain north–south connectivity. To safely meet road and rail standards, Gowrie Junction Road would be realigned (~500 m) with a road-over-rail bridge proposed approximately 400 m west of the existing level crossing. The new grade separation will encroach onto private land and will cross over the existing rail corridor, along with the Project's rail alignment, Paulsens Road, a realigned section of Morris Road and Gowrie Creek. The bridge is approximately 350 m in length and provides a minimum clearance between 5.4 m and 7.1 m.

To accommodate clearances, Gowrie Junction Road will be raised starting near McMahons Road, which will impact the existing Gowrie Junction Road/Krienke Road intersection, while some properties along Gowrie Junction Road will no longer be able to directly access Gowrie Junction Road.

To the north of Gowrie Creek, Gowrie Junction Road will tie into Old Homebush Road south of the existing roundabout. There will also be provision of access directly off Gowrie Junction Road onto Old Homebush Road to the south. This will ensure access to Old Homebush Road to the south, along with Paulsens Road (both East and West) from Gowrie Junction is maintained.

To mitigate impacts from the realignment of Gowrie Junction Road, the following is proposed:

- Krienke Road/Gowrie Junction Road intersection will be relocated approximately 300 m south, adjacent the existing Gowrie Junction Road/Ganzer Road intersection. The intersection solution is to be determined and is discussed in Appendix U: Traffic Impact Assessment. A new section of road approximately 200 m long will also be required to connect Gowrie Junction Road to Krienke Road, with the road primarily located in an undeveloped road reserve.
- Morris Road will be extended to the west under the proposed road-over-rail bridge and will provide access via the existing and realigned section Krienke Road to Gowrie Junction Road. This will ensure access is maintained to the properties fronting Gowrie Junction Road and Morris Road.
- McMahons Road will also be slightly raised at the existing intersection with Gowrie Junction Road to maintain access.
- New access, to the south, from Krienke Road will be provided to the houses that front the existing Gowrie Junction Road.

The rail corridor deviates to the south-east from the existing West Moreton System, within the future public passenger transport corridor, east of Gowrie. Within this area, a new rail connection to the east is also proposed. Morris Road will be closed, approximately 750 m east of Gowrie Junction Road and 650 m west of Boundary Street, to facilitate the rail corridor at this location. No provision for access over the rail corridor is proposed due to the presence of a crossing loop and because the realigned Gowrie Junction Road provides north-south connectivity. East–west connectivity will also still possible via Hermitage Road. To the west of the Project, Morris Road will be realigned to the south and west to ensure access is maintained to properties within this area.

It is also proposed to close the existing rail underpass linking East Paulsens Road to Morris Road. Access will be maintained through the upgrade of East Paulsens Road (for approximately 1 km) between Old Homebush Road and the underpass. The works will also include improved drainage works noting this area is impacted by flooding.

Other proposed changes to the road network include:

- Closure of Draper Road, where the section runs east–west parallel to the existing West Moreton System rail corridor. This road is also subject to the InterLinkSQ intermodal development
- Closure of a section of Ganzer Morris Road, currently an unformed road corridor and is not required for property access (access via Ganzer Road) or to maintain network connectivity
- Realignment of an approximately 700 m section of Wallens Road to the east (~300 m) under the proposed Oaky Creek Viaduct (i.e. grade separation)
- Closure of a 400 m wide undeveloped section of Howmans Road near Ch 17.8 km. The eastern section of Howmans Road will also be extended at least 250 m to the rail corridor. The western section from Gittins Road, approximately 1.3 km, will also upgraded

- Closure of an Unnamed Road near Ch 18.4 km, currently an unformed road corridor and is not required for property access or to maintain network connectivity
- Realignment of the existing Cattos Road near the intersection with Airforce Road. The road currently services one property and it is proposed to realign the road to the west and extend it north parallel to the West Moreton System and under the Lockyer Creek viaduct. The road will then link back to Airforce Road with a new intersection approximately 1.2 km from the existing intersection (the existing intersection will be closed). The change, a new 1.2 km section of road, is located within the existing road reserve
- Installation of a water pipeline, approximately 1.2 km in length, along Ganzer Morris Road reserve, south under the Toowoomba Bypass to Hermitage Road. The water pipeline will connect the tunnel fire management system into the TRC water network.

There will also be a requirement to upgrade or create new access points to the rail corridor from the local road network, including access from Boundary Street to the western tunnel portal, access from Hermitage Road to the intermediate ventilation shaft at Cranley and at multiple points along Jones Road at Withcott. Other changes may include fencing along the road reserve and temporary construction works in the road reserve.

Street lighting is not proposed for any of the road network changes.

6.3.11 Rail maintenance access roads

RMARs are proposed to facilitate maintenance for the rail corridor and critical infrastructure (e.g. turnouts, tunnel operation infrastructure, etc.) 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. RMARs will also be provided following natural surface level where deemed necessary outside of critical infrastructure locations.

The Project design allows for RMARs, which are a minimum of 3.5 m and a maximum of 6 m wide, and with a maximum grade of 10 per cent. It is proposed that access points to RMARs will be provided at the frequent locations and connecting directly with the public road network, including Boundary Street, Gittins Road, Murphys Creek Road and Airforce Road. The location of the RMARs, including access points will be confirmed during detailed design and will consider access requirements identified by QFES, such as being traversable in wet conditions, signage and capable of accommodating a Type 3 vehicle.

A hyrail is a road vehicle that is also capable of travelling on rail fitted with special retractable steel flanged wheels. Hyrail access locations have been proposed:

- A both tunnel portals
- On the mainline mid-way between the eastern tunnel portal crossing loop and the Postmans Ridge crossing loop, at McNamaras Road
- At the eastern extent of the Project close to the tie-in point with the H2C project.

Due to the steep terrain and remote location of the rail alignment east of the Toowoomba Range tunnel, the design of the RMAR was investigated to determine where the terrain was too steep for a surface level RMAR. In these instances, the formation has been widened to accommodate a formation level RMAR, with the aim of providing a road of suitable standard, minimising construction effort and minimising corridor width while achieving the required corridor access.

A diagram showing the typical positioning of a formation level RMAR is shown in Figure 6.13.

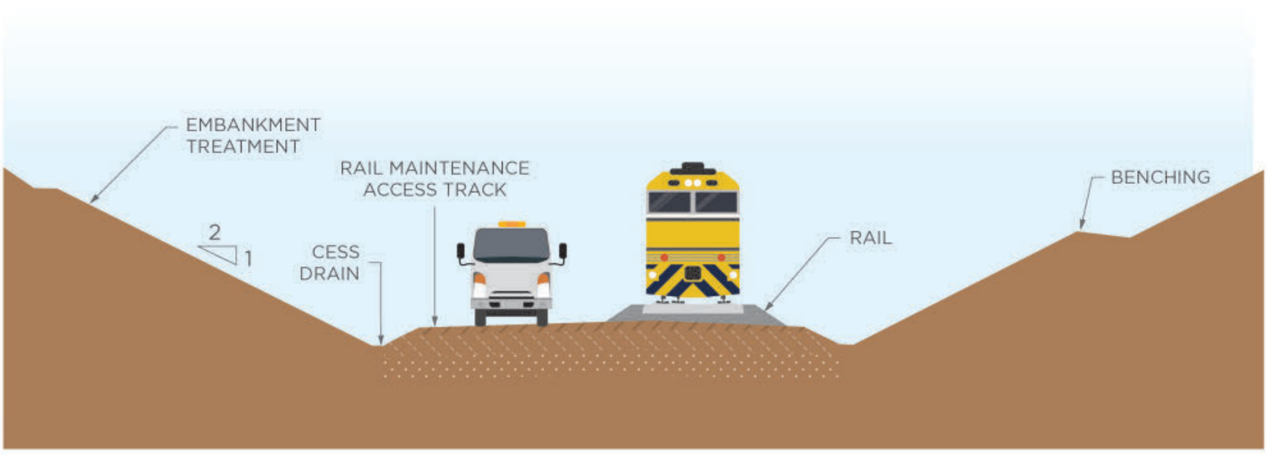

FIGURE 6.13 TYPICAL SECTIONAL DIAGRAM OF RAIL FORMATION SHOWING RAIL MAINTENANCE ACCESS TRACK

ARTC have also relocated a number of RMARs currently associated with the QR Network. This includes maintaining access across Gowrie Creek from Lesson Road, Charlton.

6.3.12 Utility and service crossings

There are currently 184 identified potential clashes with existing utilities associated with the rail line and all associated infrastructure including road realignments. Table 6.8 provides a summary of the potential clashes of utilities identified in the assessment, with the majority of the clashes occurring within the Gowrie area. Some of the clashes are associated with the tunnel alignment thus impacts are unlikely, while other potential clashes will be temporary (e.g. construction traffic crossings).

Figure 6.14 illustrates the existing utility crossings associated with the Project, with the Project disturbance footprint catering for the relocations or removals, where applicable.

TABLE 6.8 SUMMARY OF IMPACTED UTILITIES BY TYPE OF SERVICE AND UTILITY TYPE

Utility owner	Communications	Electricity	Gas	Water	Groundwater bore	Recycled water	Sewer
APA	-	-	6	-	-	-	-
Energex	-	21	-	-	-	-	-
Ergon Energy	-	26	-	-	-	-	-
Millmerran Operating Co.	-	-	-	-	-	6	-
NBN Co.	13	-	-	-	-	-	-
New Hope Group	-	-	-	-	-	5	-
Nextgen	9	-	-	-	-	-	-
Optus Uecomm	2	-	-	-	-	-	-
Powerlink	-	3	-	-	-	-	-
Private	-	-	-	-	2		-
Urban Utilities	-	-	-	3	-	-	-
Telstra	61	-	-	-	-	-	-
TRC	-	-	-	6	-	-	21
Sub-total	85	50	6	9	2	11	21

Utility owners have different requirements and drivers related to treating impacted assets, which is also dependent on whether the impacts are temporary or permanent. 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 started with the various utility providers about their requirements for relocation or protection of the services impacted by the Project, on matters such as approval pathways, timing of the works and responsibilities. Consultation has also included discussions on how these services may facilitate the construction and operation of the Project (e.g. water and power). Consultation with the various utility owners will continue through the detailed design phase.

Infrastructure relocations for utilities will be established through a third-party arrangement in parallel to the detailed design phase of the Project (i.e. enabling works) with enabling works not considered part of the Project (i.e. works will be undertaken under existing approval process and legislative requirements).

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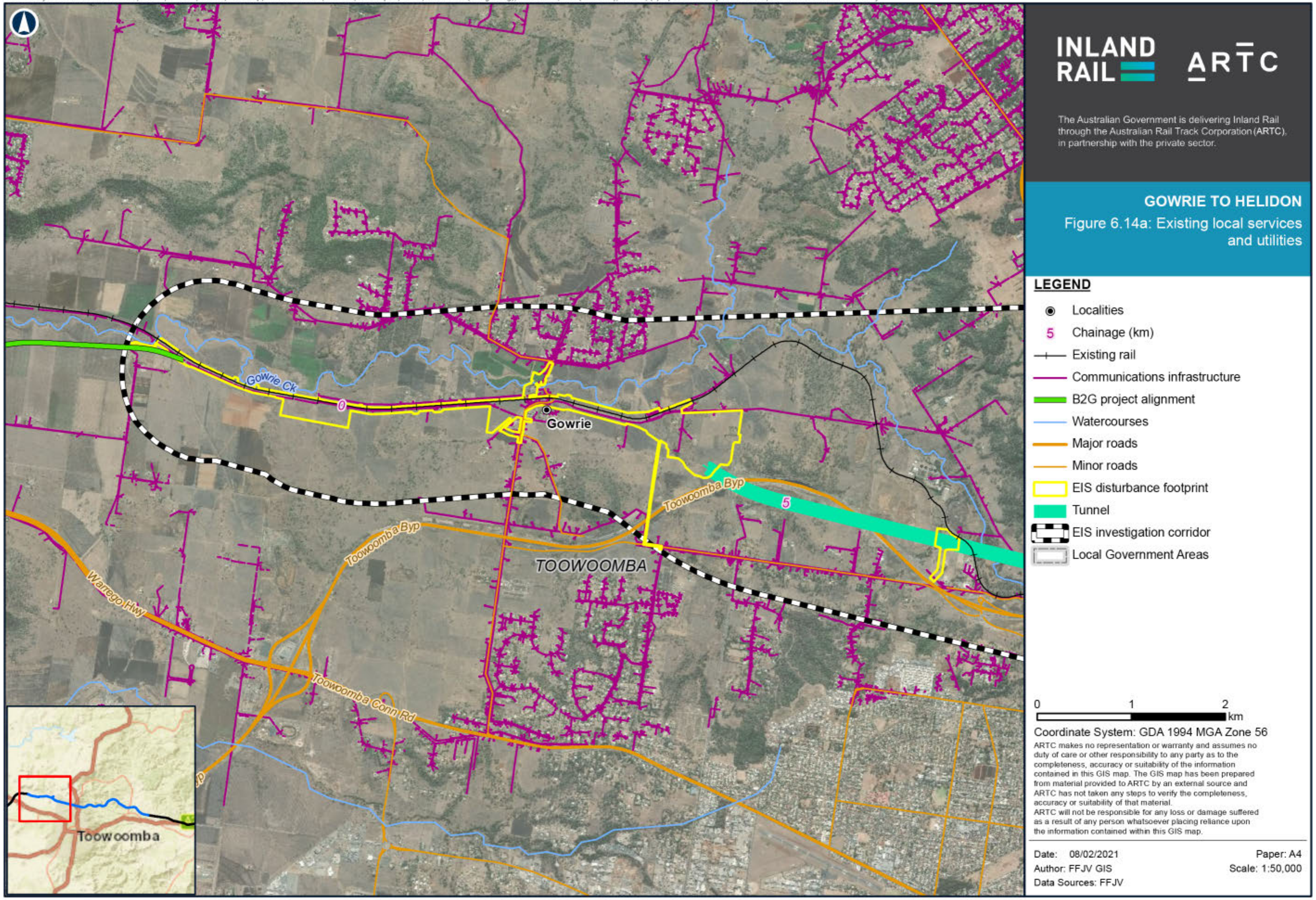

Figure 6.14a: Existing local services and utilities

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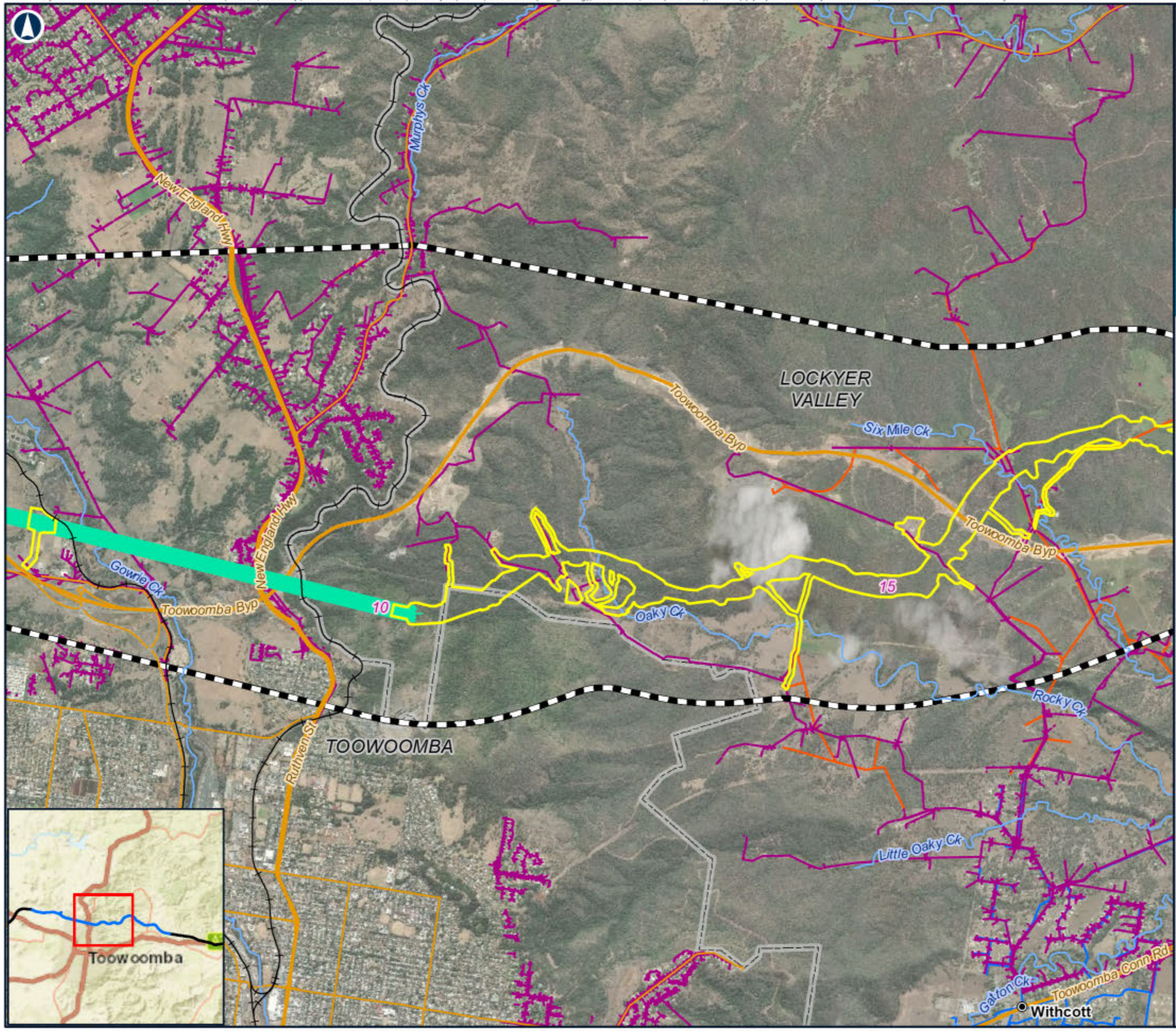

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GOWRIE TO HELIDON

Figure 6.14b: Existing local services and utilities

LEGEND

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

0 1 2 km

Coordinate System: GDA 1994 MGA Zone 56

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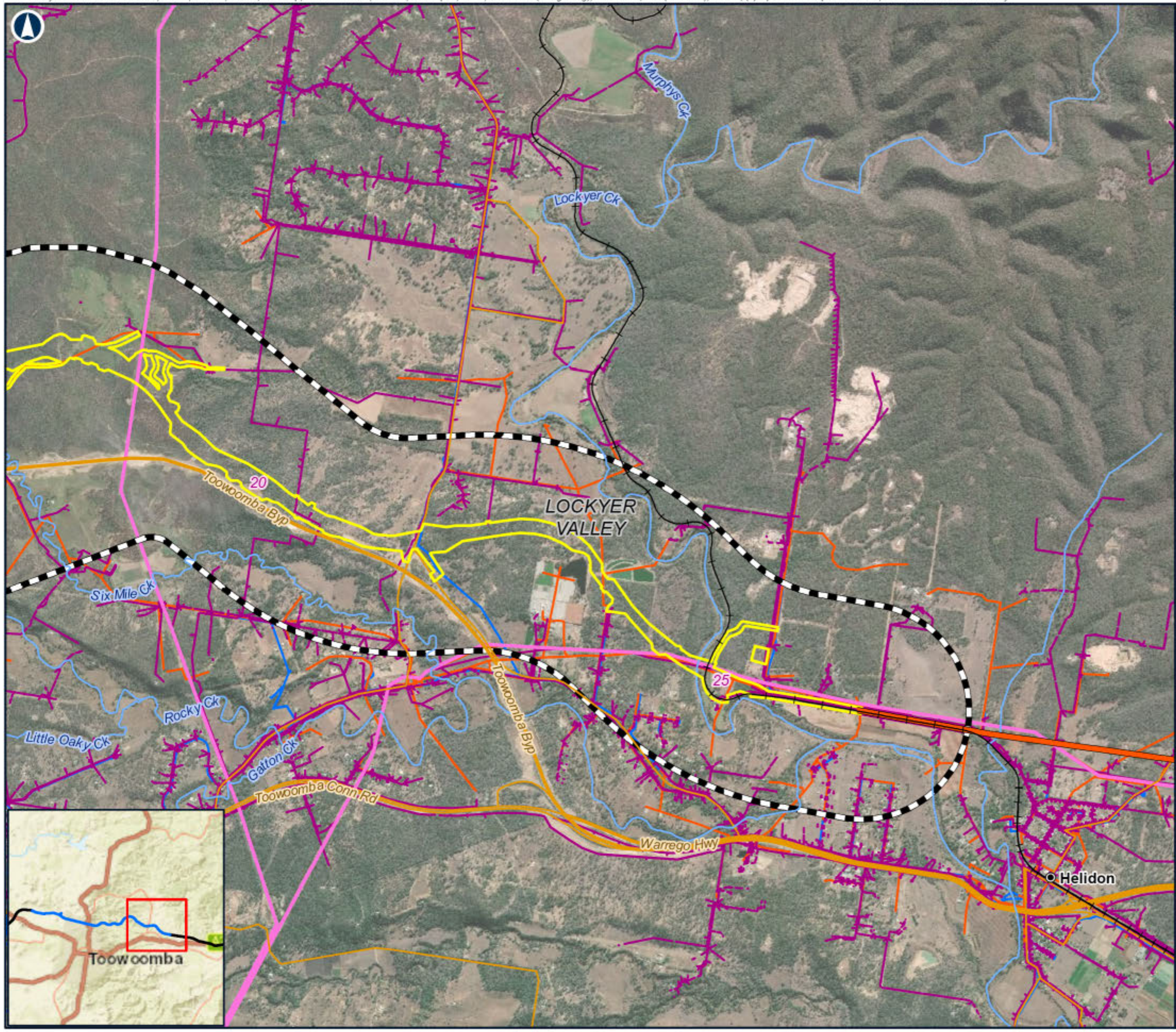

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GOWRIE TO HELIDON

Figure 6.14c: Existing local services and utilities

LEGEND

- Localities
- Chainage (km)
- Existing rail
- Powerlink high voltage transmission line
- Communications infrastructure
- Electrical infrastructure
- Water infrastructure
- H2C project alignment
- Watercourses
- Major roads
- 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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6.3.13 Fencing

Fencing will be provided for the extent of the Project alignment (excepted where noted otherwise). Fencing is to extend between the corridor and the lands of owners or occupiers adjoining the railway, with any specific requirements associated with the neighbouring land use to be undertaken in consultation with the adjoining landholder.

As the Project comprises greenfield works in forested, rural areas east of the Toowoomba Range tunnel and semi-rural areas west of the Toowoomba Range Tunnel, standard rural fencing will typically be provided. In areas of higher ecological significance, fauna exclusion fencing will be used to prevent access to the operational rail corridor and guide fauna to safe crossings such as fauna underpasses and/or viaducts and bridges.

The location of the fauna fencing and fauna passages will be confirmed during detailed design following comprehensive fauna surveys and further consultation with DTMR. Consultation with DTMR is required around the Project interfaces with the Toowoomba Bypass in the Lockyer Valley. This includes the potential for existing fencing to be removed and reinstated, ensuring that planning considers fauna movement strategies across both features, including using the existing structures under the Toowoomba Bypass and ensuring that passages do not result in fauna being directed to isolated patches of vegetation and or habitat. Where superior fencing is required, for example where tracks are in close proximity to roads or communities, or where trespass is anticipated to occur, a 1.8 m chain link boundary fence may be provided. Typical fencing design is provided in Appendix C: Design Drawings.

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

6.4 Infrastructure alternatives

The design has been developed to include infrastructure components that can be feasibly, safely and efficiently constructed and operated, are compliant with design criteria (refer Section 6.3.1) and are 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 6.6.6.5
- Management of waste and resource use—refer Section 6.6.10 and Chapter 21: Waste and Resource Management
- Management of wastewater from the tunnel—refer Section 6.6.6.4
- Provision of utilities—refer Section 6.6.9.

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 J: Matters of National Environmental Significance. 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 measures.

6.5 Pre-construction activities

Pre-construction activities are required to enable construction of permanent infrastructure components of the Project to commence. The location and extent of pre-construction activities and early works will be subject to confirmation during the detailed design phase, when detailed design has been substantially progressed. Detailed design is expected to be conducted before the beginning of pre-construction activities; however, elements of detailed design may continue into the pre-construction phase. Pre-construction activities are expected to include such works as:

- Early works
- Enabling works that are undertaken by or on behalf of a third party, in accordance with the relevant legislative requirements, independent of the EIS process.

6.5.1 Ongoing activities

6.5.1.1 Corridor acquisition

The majority of land required for the rail corridor will be acquired through negotiation 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* (Qld) (AL Act) 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 USL, reserves and roads will be undertaken in accordance with the Land Act. The extent of property impacts will be refined and confirmed during detailed design in consultation with landholders, construction contractor and the constructing authority.

Further information on land acquisition is provided in Chapter 8: Land Use and Tenure.

6.5.1.2 Baseline surveys

ARTC is committed to undertaking a number of environmental studies, including pre-clearing ecological surveys in accordance with Queensland and/or Commonwealth guidelines, soil surveys, surface water monitoring and groundwater monitoring.

These surveys will supplement the surveys undertaken as part of the EIS and will inform such matters as water quality objectives, design and environmental and planning approvals and rehabilitation requirements and performance indicators. Further information on the proposed baseline surveys required for the Project is provided in the relevant technical chapters and reports.

6.5.1.3 Environmental and planning approvals

Following approval under the SDPWO Act and the EPBC Act, the Project will be required to obtain secondary environmental and planning approvals, licences and permits under relevant state legislation to enable works to lawfully proceed. The applications for these approvals will be required to be supported by further information based on the detailed design of the Project along with associated detailed environmental studies and assessments. These approvals include, for example, environmental authorities for environmentally relevant activities and operational work permits. The majority of approvals will be required to be obtained prior to the commencement of construction or ground disturbance activities.

Under Section 51(2) of the *Planning Act 2016* (Qld) (Planning Act), applications made under the Planning Act must be accompanied by the written consent of the owners of the land to the application, to the extent that the applicant is not the owner and the application is for a material change of use, reconfiguration of a lot, or works on premises below the high-water mark. Further, consent is required to be obtained from the state for land that is:

- Subject to a permit to occupy or subject to a licence
- USL
- 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.

Approvals currently anticipated to be required by the Project include, for example:

- Environmental Authority under the *Environmental Protection Act 1994* (Qld) and material chance of use under the Planning Act for the following environmentally relevant activities (ERAs) defined in Schedule 2 of the Environmental Protection Regulation 2019 (Qld) (EP Regulation):
  - Chemical storage (ERA 8)—threshold to be determined following refinement of construction methodology
  - Electricity generation (ERA 14)
  - Extractive and screening activities (ERA 16)—threshold to be determined following refinement of construction methodology
  - Regulated waste transport (ERA 57)—transporting regulated waste in a vehicle
  - Water treatment (ERA 64)—threshold to be determined following refinement of construction methodology
- Development Permit for operational work that is constructing or raising waterway barrier works, unless the works comply with the requirements of *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Agriculture and Fisheries, 2018b)
- Development Permit for operational work for clearing native vegetation (unless the clearing is accepted development or exempt clearing work under the Planning Regulation 2017 (Qld))
- Authorisations under the Water Act and Planning Act:
  - Operational works that involves taking or interfering with water in a watercourse, lake or spring
  - Water licence (including amendments to existing licenses/authorisations) to take underground water in groundwater areas under the *Water Plan (Condamine and Balonne) 2019*, *Water Plan (Moreton) 2017* and the *Water Plan (GABORA) 2017*.
- A summary of the potential post-EIS approvals is in Chapter 3: Project Approvals. These approval requirements 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 construction contractor, all construction activities, including pre-construction and early works, will remain within the Project 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.

6.5.1.4 Survey and geotechnical investigations

The construction of all infrastructure requires the adherence to survey control plans and procedures to ensure spatial correctness and quality reporting. The implementation of this survey scheme will require engaging reputable and competent surveying teams. These teams will, among other responsibilities, control and guide the following:

- All elements of survey and survey control
- Survey mark preservation and compliance with mark destruction legislation in Queensland
- 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.

6.5.2 Early works activities

Early works are required for construction mobilisation and to support the permanent infrastructure components. These activities are expected to include, for example:

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

These works may require clearing of vegetation and other ground disturbance activities and will need to comply with relevant legislative requirements, approvals conditions and other overarching guidelines and plans. Pre-construction activities may be scheduled before the main construction works or undertaken under a separate contract and be managed under the Construction Environmental Management Plan (CEMP).

The pre-construction activities may also include works within the local road reserves, including establishing new access points and/or to facilitate the future upgrades and road closures subject to agreement between ARTC and the relevant local councils.

6.5.2.1 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 use the future RMARs where possible, or be designed, constructed or upgraded with appropriate consideration to minimising disruption to landholders, public infrastructure, and environmental matters.

Construction access is proposed to be provided adjacent to all working fronts along the Project corridor and will be sized to allow free flow and unhindered access for all construction and support traffic vehicles. In general, the access roads will provide for the movement and delivery of:

- Construction equipment and vehicles (including piling rigs, gantry travellers and/or earthmoving equipment)
- Personnel transport for staff and labour to access the works
- Maintenance vehicles
- Material deliveries
- Servicing temporary construction facilities along the route.

Access tracks, outlined in Table 6.9 and illustrated in Figure 6.4, have been identified along the Project alignment and incorporated into the Project design. Access tracks have been identified based on vehicle and equipment requirements, having regard to local topography (i.e. access tracks were confined to areas with a slope less than 10 per cent in grade), the location of existing roads and access tracks, and land parcel information.

Some of the required access tracks will be developed as part of the early works 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 each location and vehicle type required to access the location. The required access tracks and the extent of surface treatment proposed will be confirmed during detailed design, once the construction contractor is appointed and in consultation with the constructing authority.

Construction haul routes will be developed considering several factors such as separation requirements, one-way or two-way vehicle movements, overtaking requirements and vehicle weights to use the road.

Construction haul routes will firstly seek to adopt the future RMAR footprint or the formation prior to creating tracks in locations that will require future restoration once the construction work has been completed. Further information on RMARs is included in Section 6.3.11.

When planning access tracks and construction haul routes, an assessment will be made of above and underground services that may be affected by oversized loads or weights. This assessment will also consider the asset owners maintenance access requirements.

TABLE 6.9 TEMPORARY ACCESS TRACKS

Location	Project chainage	Length (m)	Note
Paulsens Road	Ch 2.00 km	152	Bridge access off Paulsens Road
Western tunnel portal	Ch 3.70 km	380	Tunnel portal access off Gowrie Junction Road
Intermediate tunnel ventilation shaft	Ch 6.80 km	440	Ventilation shaft access sing future RMAR
Eastern tunnel portal	Ch 10.40 km	306	Tunnel portal access
Eastern tunnel portal	Ch 10.60 km	305	Laydown access off Jones Road
Oaky Creek Viaduct Abutment A access	Ch 11.63 km	150	Abutment A access utilising future RMAR
Oaky Creek Viaduct Pier 1 access	Ch 11.68 km	200	Access through laydown area

Location	Project chainage	Length (m)	Note
Oaky Creek Viaduct Pier 2 access	Ch 11.73 km	100	Access off Jones Road
Oaky Creek Viaduct Pier 3, 4 access	Ch 11.80 km	140	Access off Jones Road
Oaky Creek Viaduct Pier 6, 7, 8 access	Ch 11.90 km	210	Access off Jones Road
Oaky Creek Viaduct Pier 5, 9 access	Ch 12.00 km	1,430	Access off Jones Road, existing dirt track will require upgrade
Oaky Creek Viaduct Pier 10, 11 access	Ch 12.10 km	500	Access from Jones Road along existing dirt track, upgrade required
Oaky Creek Viaduct Pier 12, 13, 14 access	Ch 12.25 km	575	Access off Jones Road to avoid gas main, creek upgrade required
Oaky Creek Viaduct Pier 15 Access	Ch 12.30 km	200	Access off Jones Road to avoid gas main, creek upgrade required
Oaky Creek Viaduct Abutment B access	Ch 12.35 km	250	Access off Jones Road to avoid gas main, creek upgrade required
Withcott Viaduct 2 Abutment A access	Ch 13.55 km	160	Using future RMAR
Withcott Viaduct 1,2,3,4 access	Ch 13.60 km	4,700	Using future RMAR
Withcott Viaduct 2 Pier 2,3 access	Ch 13.7 km	270	Using future RMAR
Withcott Viaduct 2 Pier 4 to 11 access and Withcott Viaduct 3 Pier 2,3,4 access	Ch 13.8 km	1,240	Using future RMAR
Withcott Viaduct 2 Abutment B access	Ch 14.00 km	100	Using future RMAR
Withcott Viaduct 3 Pier 1 access	Ch 14.20 km	100	Using future RMAR
Withcott Viaduct 3 Abutment A, B and Pier 5 access	Ch 14.30 km	683	Access off Bells Road
Withcott Viaduct 4 Abutment A, Pier 1, 2 access	Ch 15.20 km	45	Using future RMAR
Withcott Viaduct 4 Pier 3, 4 access	Ch 15.30 km	71	Using future RMAR
Withcott Viaduct 4 Abutment B access	Ch 15.40 km	118	Using future RMAR
TSRC and Six Mile Creek Viaduct Abutment A access	Ch 15.70 km	694	Using future RMAR
TSRC and Six Mile Creek Viaduct Pier 1, 2 access	Ch 15.90 km	105	Utilising future RMAR, clashes with Toowoomba Bypass embankment
TSRC and Six Mile Creek Viaduct Pier 3,4,5,6 access	Ch 16.10 km	686	Access off Gittins Road, existing track may require upgrading
TSRC and Six Mile Creek Viaduct Pier 7 to 14 Access	Ch 16.40 km	441	Access off Gittins Road, existing track may require upgrading
TSRC and Six Mile Creek Viaduct Pier 15, 16 access	Ch 16.60 km	70	Access off Gittins Road, existing track may require upgrading
TSRC and Six Mile Creek Viaduct Pier 17, 18, 19, 20 access	Ch 16.70 km	419	Access off Gittins Road, existing track may require upgrading
TSRC and Six Mile Creek Viaduct Abutment B access	Ch 16.80 km	131	Access off Gittins Road, existing track may require upgrading
Hodges Road	Ch 17.00 km	1,584	Access off Gittins Road
Howmans Road	Ch 18.00 km	600	Using future RMAR
Postmans Ridge Viaduct Abutment A access	Ch 18.30 km	1,036	Access off Howmans Road
Postmans Ridge Viaduct Pier 1 access	Ch 18.40 km	189	Access off Howmans Road
Postmans Ridge Viaduct Pier 2 to 6 access	Ch 18.50 km	523	Access off Howmans Road
Postmans Ridge Viaduct Pier 7 access	Ch 18.70 km	461	Access off Howmans Road
Postmans Ridge Viaduct Pier 8, 9 ,10 access	Ch 18.80 km	574	Access off Howmans Road
Postmans Ridge Viaduct Pier 11, 12, 13 and Abutment B access	Ch 19.00 km	395	Access off Howmans Road

Location	Project chainage	Length (m)	Note
Murphys Creek Viaduct Abutment A and Piers 1 to 11 access	Ch 21.30 km	659	Access off Murphys Creek Road utilising future RMAR
Murphys Creek Viaduct Pier 12, 13 access	Ch 21.60 km	120	Access off Murphys Creek Road utilising future RMAR
Murphys Creek Viaduct Pier 14 and Abutment B access	Ch 21.70 km	444	Using future RMAR
Withcott Seedlings Viaduct Abutment A and Pier 1 to 2 access	Ch 22.00 km	120	Using future RMAR
Withcott Seedlings Viaduct Pier 3 to 39 and Abutment B access	Ch 22.60 km	2,323	Using future RMAR
Lockyer Creek Viaduct Abutment A and Piers 1 to 6 access	Ch 24.40 km	1,060	Access off Ashlands Drive utilising future RMAR
Lockyer Creek Viaduct Abutment Piers 7, 8 access	Ch 24.70 km	506	Access off Cattos Road
Lockyer Creek Viaduct Piers 9, 10 access	Ch 24.80 km	331	Access off Cattos Road
Lockyer Creek Viaduct Abutment B access	Ch 24.90 km	85	Access off Cattos Road

Table notes:
TSRC: Toowoomba Second Range Crossing now referred to as Toowoomba Bypass
Where a track is noted as utilising a future RMAR then it is within the rail corridor and using the footprint of the future RMAR.

6.5.2.2 Service relocations

Site preparation includes modification, diversion or realignment of utility services and infrastructure, some of which may be undertaken as 'enabling works' by a third-party asset owner or manager (refer Section 6.5.3).

ARTC has commenced consultation with all owners of utility assets located within the Project disturbance footprint, with 184 interactions associated with the Project (refer Section 6.3.12 and Chapter 8: Land Use and Tenure). As part of the interactions, ARTC has provided the feasibility design drawings relevant to the interactions to the asset owners for comment on matters such as the design, protection requirements, approvals, responsibilities, and costs.

The anticipated methodology for utility clearances and diversions is:

- Additional site surveys (e.g. potholing) to determine as-built locations and arrangements
- A variety of strategies are likely to be appropriate and further investigated including:
  - Abandonment of redundant services
  - Re-alignment of existing service where slack/arrangement allows
  - Construction of new service followed by cut-over
  - Protection of existing services if 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/supports for suspended services using auger-rigs, mobile cranes
- Pipe-laying, conduit and cable installation as appropriate into/onto completed trenches or towers/poles
- Testing and commissioning of new/re-located services as appropriate
- Restoring and revegetating and stabilising disturbed areas.

The exact methodology for utility diversions will be determined in consultation with the affected utility owners. All the relevant access arrangements and approvals will be in place prior to works commencing. Any third- party connections outside of the Project disturbance footprint will be managed by the service provider in consultation with ARTC and the construction contractor. This includes utilities managed by Ergon, TRC and Urban Utilities.

6.5.2.3 Site offices

The site office locations proposed in Table 6.10 have been selected as potential locations along the alignment with an area large enough to contain a site office.

TABLE 6.10 PROJECT SITE OFFICE LOCATIONS

ID	Location	Adjoining road	Project chainage
G2H-LDN003.7	Western tunnel portal	Gowrie Junction Road and Boundary Street	Ch 3.70 km
G2H-LDN010.5	Eastern tunnel portal	Wallens Road	Ch 10.50 km
G2H-LDN018.8	Postmans Ridge Viaduct	Howmans Road	Ch 17.90 km
G2H-LDN025.1	Airforce Road	Airforce Road and Cattos Road	Ch 25.10 km

Site office locations will be revisited during the detailed design phase in order to determine the optimal location on a case-by-case basis. Additionally, a proposed site batch plant/precast facility is proposed to also be located at the western tunnel portal specifically for tunnel construction activities. This will also be confirmed during the detailed design process. During construction, the construction contractor will engage with the utility owners to connect to mains power, water, communications and sewerage where possible. Power and water supply for the tunnel investigations are being undertaken in accordance with the supply services process. Temporary requirements will be provided by portable water tanks and gen-sets, where required.

The site office located at G2H-LDN025.1 (Airforce Road) is located within the WSBA under the SPP. The layout and works within this area will consider, where applicable, the *State Planning Policy—State Interest Guideline Water Quality* (DILGP, 2016d) and the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (as the identified performance objective for the *Development Guidelines for Water Quality Management in Drinking Water Catchments* (Seqwater, 2017)) to ensure drinking water quality is protected. Further information is provided in Chapter 13: Surface Water and Hydrology and Appendix L: Surface Water.

6.5.3 Enabling works

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

For example, Powerlink has undertaken a feasibility study to relocate a section of the Middle Ridge and Tarong transmission line east of Wards Hill, with the study determining that the transmission line towers can be raised to mitigate any interactions. Further, it has been confirmed that the works can also occur within the existing easement and will be subject to Powerlink's existing environmental management systems and approval processes. Similar assessments to identify potential amendments to other existing assets, together with required approval pathways, costs and land requirements have also been undertaken by Energex, Ergon, TRC and the APA Group.

6.6 Construction activities

6.6.1 Overview

Construction is expected to commence in 2022 and to be completed in 2026, and will include the following construction activities:

- Site set out and pegging, including establishing clearing limits and no-go zones
- 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 for reuse in embankments and/or rail formations
- Construction of drainage infrastructure—cut-off drains, table drains and culvert structures
- Construction/installation of bridges and viaducts
- Ballast—supply, delivery and installation

- Concrete sleepers—supply, delivery and installation
- Installation of rail track and other items of rail infrastructure using rail mounted equipment
- Installation of railway signalling and communications equipment, RMARs and access roads
- Construction of the Toowoomba Range tunnel and tunnel maintenance facilities, administration and amenities buildings, parking facilities and bulk fuel provisioning and storage areas
- Construction of new and/or updated of road infrastructure, including access points in local and State controlled road reserves
- Other miscellaneous activities to complete the works, such as site restoration and landscaping works.
- The land requirements for the Project have considered the abovementioned activities (refer Section 6.2.9).
- The construction methodology, land requirements and schedule will undergo refinement once a construction contractor is appointed and in response to approval conditions, implementation of the mitigation measures and commitments outlined in the Draft Outline EMP (refer Chapter 23: Draft Outline Environmental Management Plan), infrastructure agreements and the final design.

It is currently proposed that the majority of the construction workforce will be sourced from the LGAs close to the Project, negating the need for accommodation camps.

6.6.2 Construction schedule

Construction of the Project will commence once the detailed design is complete and the necessary approvals have been obtained. The following broad milestone dates for construction are proposed at this stage:

- Construction commences: 2022
- Target completion of construction: 2026
- Six months testing and commissioning phase.

The tunnel construction timeline of approximately four years includes the procurement and set up of the tunnel boring machine (TBM), which is approximately 12 months. The construction phase of the tunnel including cut and cover, mined tunnel construction (at the eastern tunnel portal) and operation of the TBM is expected to be approximately 24 months. Following the tunnel construction phase, decommissioning of the TBM and fit-out of the tunnel and associated buildings will occur.

An indicative construction program for the Project is shown in Table 6.11 and is subject to change during the detailed design and construction phases as a result of:

- Land acquisition processes
- Weather conditions
- Changes to construction methods, materials and land requirements
- Unexpected finds, such as threatened species or cultural heritage values
- The need for additional or different mitigation measures that result in changes to the construction program.

TABLE 6.11 INDICATIVE CONSTRUCTION PROGRAM

Construction stage	2021 (Dec.)	2022	2023	2024	2025	2026	2027
Contractual and Project approvals							
Site establishment							
Earthworks							
Tunnel							
Structures							
Drainage							
Rail civil works							
Road civil works							
Rail systems commissioning							
Finishing works and demobilisation							

6.6.3 Construction workforce

The Project is part of the larger Inland Rail Program. The Inland Rail Program is expected to generate 21,500 jobs with an average of 800 jobs per annum over the 10-year construction period.

A preliminary estimate of the workforce required to undertake the Project works to the nominated program is shown in Figure 6.15. Workforce on site for the Project is estimated to peak at 596 full time equivalents (FTE) at week 60, and maintain a high staff load of approximately 465 FTE between weeks 40 and 122. Throughout the course of the construction period, the average number of FTE workers required is approximately 264 persons.[1]

1. The Gowrie to Helidon Initial Advice Statement (ARTC, 2017b) for the Project estimated the workforce to be similar in quantum to the Toowoomba Second Range Crossing, which had a construction workforce of 1,800 FTEs. As a result of further detailed assessment and design advancement, the Project now estimates an onsite construction workforce of 596 FTEs (peak) with an annual average of 264 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.

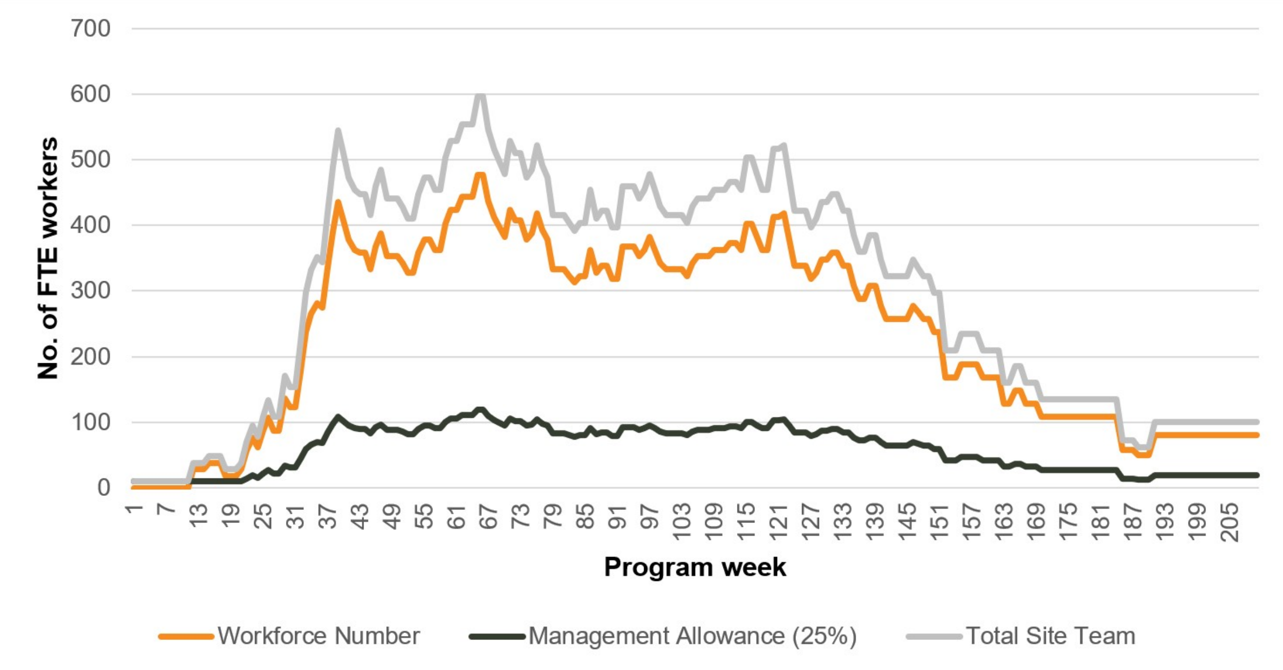

FIGURE 6.15 ESTIMATED SITE WORKFORCE

Despite this number of personnel onsite, an accommodation camp is not considered necessary due to the reasonably close proximity of the Project to population centres that will offer both workforce and accommodation options. That is, the workforce will be drawn from the Toowoomba and Lockyer Valley LGA, and, where applicable, Brisbane and surrounds. Although it is recognised that specialist works may need to be sourced from Australia or internationally to support the operation of the TBM.

Rental vacancy rates were very low in local communities during 2020, with vacancy rates generally below 1.0 per cent. At June 2020, a total of 135 rental dwellings were advertised as vacant (the Toowoomba suburbs of Cotswold Hills, Wilsonton Heights, Rockville, Harlaxton, Mount Lofty, Blue Mountain Heights, Cranlye and Mount Kynoch, as well as the areas of Helidon/Helidon Spa, Kingsthorpe and Gowrie Junction/Postmans Ridge/Withcott), which was a decrease of 173 dwellings or more than 56 per cent since June 2019. By December 2020, this had increased to 180 dwellings reflecting the end-of-year turnover in University of Southern Queensland students in Toowoomba. If low rental vacancy rates continue throughout 2021–2022, stimulation of investment in rental housing is possible, increasing the availability of rental housing by the peak of the Project's workforce in 2022–2023.

The Project may result in occasional demands for short-term accommodation (i.e. hotels, motels and short stay units) during the construction phase, which would be experienced as a welcome increase in trade for accommodation providers.

Should a demand for short-term accommodation occur, it would most likely be experienced in Toowoomba, which has a range of accommodation options. If the Project required an average of 60 rooms (equating to 10 per cent of the peak workforce) to accommodate non-local workers, this may equate to approximately 13.5 per cent of the short-term accommodation rooms assumed to be available in the Project region. This is unlikely to have to have a significant impact on tourists' access to accommodation, as there is a significant supply of short-term accommodation in Toowoomba, with other options in Helidon Spa and in nearby Gatton.

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.

Further discussion on workforce accommodation is provided in Chapter 13: Social and Appendix Q: Social Impact Assessment.

6.6.4 Hours of work

The construction program for the Project will be based on the following primary construction hours (unless approved otherwise):

- General construction/surface works activities:
  - Monday to Friday: 6.30 am to 6.00 pm
  - Saturday: 6.30 am to 1.00 pm
- The following additional hours for general construction/surface works activities where the works comply with the performance criteria set out in Section 23.15.8.2 of the draft Outline EMP (refer Chapter 23: Draft Outline Environmental Management Plan):
  - Monday to Friday: 6.00 pm to 10.00 pm
  - Saturday: 1.00 pm to 5.00 pm
- No work on Sundays or public holidays
- Tunnel construction activities
  - 24 hours a day, 7 days a week.
- Track possessions[2] will proceed on a 24-hour/7-day calendar basis.

QR and ARTC track possessions will generally be allocated over weekend periods, with extended track possessions occurring over holiday or non-seasonal periods (i.e. outside of grain movement periods).

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

- Works in a rail corridor associated with track possessions including tamping, ballast profiling, earthworks and formation works
- Transport, assembly, or decommissioning of oversized plant, equipment, components or structures
- Delivery of 'in time' material such as concrete, steel, and other construction materials delivered to site by heavy vehicles
- Works that require continuous construction support such as continuous concrete pours, pipe-jacking or other forms of ground support necessary to avoid a failure or construction incident
- Movements of heavy plant, materials and equipment. Arrival and departure of construction staff during shift change-overs
- Works in a road
- Traffic control crews, including large truck mounted crash attenuator vehicles, medium rigid vehicles, and lighting towers
- Emergency works and incident response including tow-trucks for light, medium, and heavy vehicles
- Blasting:
  - Monday to Friday: 9.00 am to 5.00 pm
  - Saturday: 9.00 am to 1.00 pm
  - No blasting on Sundays or public holidays
- Alternative construction rosters to suit delivery and industrial relations issues may be investigated by the construction contractor
- Various low-intensity activities.

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.

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2. Means the temporary closure of a section of the railway corridor for the purposes of carrying out construction or maintenance work and will be subject to relevant approvals from the railway manager.

6.6.5 Plant and equipment

Table 6.12 provides the indicative plant and equipment required for different stages of the construction phase. The extent and location of this plant and equipment will be refined and confirmed with construction contractors before construction, and in line with consultation with relevant stakeholders.

TABLE 6.12 INDICATIVE PLANT AND EQUIPMENT FOR THE CONSTRUCTION PHASE

Activity	Indicative plant and equipment	
Site establishment	‣ Trucks ‣ Cranes ‣ Excavators ‣ Bulldozers ‣ Water carts	‣ Clearance equipment such as chainsaws and chippers/mulchers ‣ Light vehicles ‣ Graders ‣ Scrapers
Utility relocations	‣ Excavators ‣ Rigid and articulated trucks ‣ Jackhammers ‣ Cranes ‣ Concrete pumps ‣ Welding equipment	‣ Light vehicles ‣ Concrete saws ‣ Concrete trucks ‣ Oxy-cutting equipment ‣ Generators
Earthworks and drainage	‣ Excavator ‣ Jackhammers ‣ Rock drills ‣ Rigid and articulated trucks ‣ Compactors ‣ Water carts ‣ Generators	‣ Bulldozers ‣ Boring machines ‣ Graders ‣ Profilers ‣ Vibrating and pad foot rollers ‣ Trucks and trailers ‣ Scrapers
Roadworks	‣ Excavator ‣ Jackhammers ‣ Rigid and articulated trucks ‣ Compactors ‣ Water carts ‣ Vibratory and pad foot rollers ‣ Paving machines ‣ Asphalt laying equipment including: ‣ Bitumen seal sprayer ‣ Chip sealer	‣ Bulldozers ‣ Graders ‣ Profilers ‣ Trucks and trailers ‣ Bulldozer ‣ Lighting ‣ Skid steer loader ‣ Front end loader ‣ Light vehicles ‣ Road marking machine ‣ Concrete trucks and pumps
Track works	‣ Works trains (ballast) ‣ Tampers and regulators ‣ 40 tonne dump truck ‣ Vibratory roller ‣ Water cart ‣ Cranes ‣ Welding equipment (flash-butt welding)	‣ Trucks and trailers ‣ Graders ‣ Bulldozer ‣ Lighting ‣ Skid steer loader ‣ Front end loader ‣ Track laying machine

Activity	Indicative plant and equipment	
Viaducts, bridges and permanent works	‣ Excavators ‣ Rigid and articulated trucks ‣ Drilling rigs and boring machines ‣ Cranes ‣ Concrete trucks and pumps ‣ Generators ‣ Welding equipment	‣ Trucks and trailers ‣ Compactors ‣ Graders ‣ Paving machines ‣ Slip-forming machines ‣ Vibratory rollers ‣ Water carts
Tunnelling	‣ Support materials storage including: ‣ Tunnel segments ‣ Spoil handling and storage (e.g. conveyor belt, water treatment plant, spoil separators) ‣ Temporary ventilation equipment ‣ Eastern tunnel portal cut and cover ‣ Piling rigs, cranes, excavators, articulated trucks ‣ Eastern tunnel portal mined tunnel ‣ Tunnel excavator and roadheader, drill rig, shotcrete rig, rock bolter, articulated trucks	‣ Tunnel portal operation buildings ‣ Intermediate ventilation building ‣ Ventilation building construction plant ‣ Intermediate ventilation shaft ‣ Excavation via rock and hammer excavation and the use of explosives ‣ TBM launching requirements ‣ TBM including assembly cranes

6.6.6 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 the use of recycled water, extraction of groundwater or surface water, private bores and watercourses. Water sources will be further explored prior to construction in consultation with state government agencies, local councils, stakeholders and landholders. Where a water source or connection is not available or practical, it will be transported to the site via tanker truck. Potable water for human consumption will be supplied via bottled water or potable water tanks.

Overall an allowance of approximately 700 megalitres (ML) of water, excluding potable water for the workforce and precast structures such as culverts and bridges, has been made for the Project.

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

- Material and soil conditioning
- General dust suppression
- Dust suppression and maintenance of laydown areas, haul roads and track works
- Concrete batching plant at the western tunnel portal
- Tunnelling, including the cooling and operation of the TBM
- Construction offices and amenities.

The main construction activities requiring water are identified in Table 6.13 with further detail provided regarding the quantity, quality and flow rate needed, and estimated usage.

Water quality is an important consideration when assessing the supply and demand of water, as the quality of the water, depending on its use in the construction of the Project, will need to be monitored for health and environmental impact reasons.

TABLE 6.13 CONSTRUCTION WATER REQUIREMENTS

Construction activity/ process/phase	Uses/requirement	Quantity	Quality	Flow rate	Supply	Estimated usage
Earthworks	Material conditioning and general dust suppression	High	Low	High	Recycled water, dams or bores[1]	190 L/m^3 or 480 ML

Construction activity/ process/phase	Uses/requirement	Quantity	Quality	Flow rate	Supply	Estimated usage
Concrete (by concrete supplier)	Bridge and culvert locations	Medium	High	Low	Town mains (Gowrie area) or urban utilities (Lockyer Valley) due to quality requirements	200 L/m^3 or 30 ML
Track works	Ballast dust suppression during ballasting and regulating activities	Medium	Low	Low	Recycled water, dams or bores	10 L/ track metre or 285 kL
Tunnelling	Material conditioning, machinery requirements (e.g. TBM cooling), general dust suppression and general maintenance	High	Low	High	Recycled water, dams or bores	200 kL/day or 190 ML

Table notes:
L/m^3 = litres per cubic metre
[1] Recycled water intended to be applied to soil (topsoil and subsoil) and vegetation treatments will comply with DTMR's *Main Roads Technical Standard (MRTS) 16: Landscape and Revegetation Works* requirements for non-potable water testing and assessment reporting.

The following sections provide a discussion on the anticipated water demand for each of the activities specified in Table 6.13. Water demand across the Project alignment is illustrated in Figure 6.16, with the majority of the water required within the Lockyer Valley (Ch 8.8 km to Ch 28 km), where water usage is administered under the *Water Plan (Moreton) 2017*. While the *Water Plan (Condamine and Balonne) 2019* (west of Ch 8.8 km) details the main demand for water is the operation of the TBM. The Project also overlies the groundwater areas under the *Water Plan (GABORA) 2017*, with the other plans applicable to groundwater where this plan does not apply.

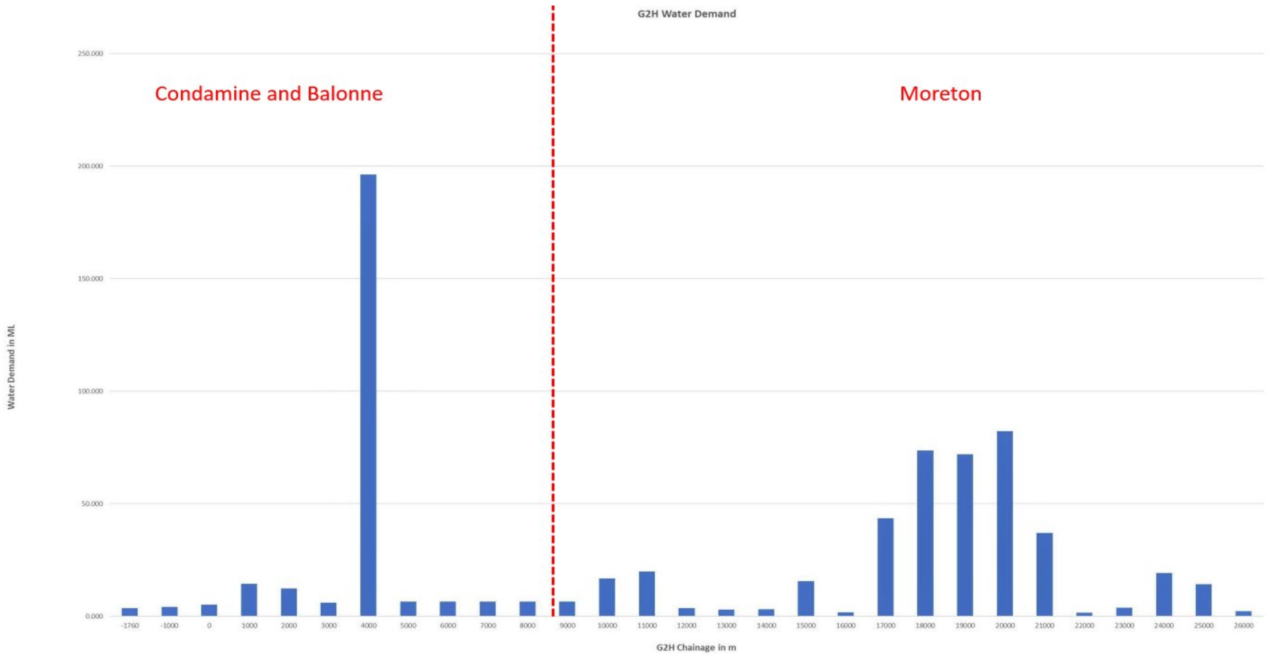

FIGURE 6.16 WATER DEMAND IN RELATION TO THE PROJECT ALIGNMENT (MEGALITRE PER CHAINAGE)

Figure note:
Dashed vertical line indicates boundary between respective water plan areas

Construction water requirements, including water authorisations, are further discussed in Chapter 13: Surface Water and Hydrology, Appendix L: Surface Water and Chapter 3: Project Approvals.

6.6.6.1 Earthworks

Earthworks will have the greatest water demand on the Project, which predominately includes conditioning of material and soil, dust suppression, and haul road and laydown maintenance. Generally, earthworks operations require low-quality water from sources such as dams and watercourses.

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

- Material and soil conditioning is expected to consume approximately 100 L/m^3 of fill, however this is variable and dependent upon material properties. This equates to 236 ML of water in total (including water conditioning for proposed roadworks).
- General dust suppression across the site will be a constant activity. An allowance of approximately 50 L/m^3 of fill have been made, which equates to approximately 110 ML of water in total.
- Haul road and laydown area maintenance will also require water. An allowance of 40 L/m^3 of fill has been made which equates to approximately 90 ML of water.

An additional allowance of approximately 44 ML of water has been made for haul-road maintenance required after earthworks are completed and due to the extensive use of these haul roads for the construction of the bridges.

6.6.6.2 Concrete

Any water supply associated with concrete works will be required to be provided in accordance with *AS1379-1997 Specification and Supply of Concrete* (Standards Australia, 1997b). Established batch plants exist in Toowoomba and these established plants are connected into mains water supply. The quality and uninterrupted supply of water is not considered an issue. The volume of water required for concrete supplied by existing batch plants has not been quantified in this report.

If the Project establishes and uses the proposed site batch plant at the western tunnel portal, then a dedicated water supply, sourced from mains water, will be required. The requirement for the use of mains water in this instance is based on the quality of the water to be used. It is important to use good quality mains water as this will ensure good quality concrete. If this option is progressed, then water storage tanks will form part of the batch plant design and will be filled by water trucks drawing water from mains connections in local towns. An allowance of 200 L/m^3 of concrete has been made for bulk concrete batched at the proposed site batch plant/precast facility at the western tunnel portal area. It is assumed that only concrete required at the western tunnel portal will come from the proposed concrete batch plant/precast facility. Concrete batching at the western tunnel portal will consume approximately 30 ML.

Concrete used for the construction of the tunnel shaft and the eastern tunnel portal is assumed to come from existing suppliers in Toowoomba.

6.6.6.3 Track works

The predominant use of construction water during track works is for dust suppression relating to ballasting works, in particular ballast dropping and ballast regulating works during track tamping activities. An approximate allowance of 10 L per track metre has been considered for ballast dropping, tamping and regulating activities, by adopting this allowance the track works activity will consume approximately 285 kL of water. The consideration for crossing loops and the associated water usage for track works is expected to create an additional necessity for approximately 66 kL of water for track works.

6.6.6.4 Tunnelling

The construction of the tunnel requires a significant amount of water. The TBM will use water for boring, cooling and dust suppression. The majority of this water will be recycled groundwater collected from the tunnelling construction activities, reducing the volume of water required from external sources.

Water will also be required for the construction of the intermediate ventilation shaft and eastern tunnel portal, dust suppression within laydown areas, site compounds, on stockpiles, access tracks and general maintenance and cleaning of tunnelling plant and equipment. The water requirement for tunnelling is approximately 200 kL/day. In addition to this, an allowance has been made for compaction of the tunnel spoil. The total allowance for tunnelling activities is 190 ML.

6.6.6.5 Potable water

At an estimate of 40 L/person/day and given the Project workforce over the construction period, the potable water demand is estimated to be approximately 15 ML or just over 4 ML/annum.

Potable water for human consumption will be supplied via bottled water and potable water tanks (e.g. 1.4 ML steel or concrete tanks) at relevant laydown areas across the Project. As part of the design, a potable water pipeline will service the western tunnel portal and this pipeline could support the construction potable water requirements depending on the staging of the works. Where a connection including standpipes managed by TRC and Urban Utilities is not available or practical, potable water will be transported to the site via tanker truck.

6.6.6.6 Water sources

The current water demand for the Project is expected to be met using existing water sources, although there are challenges in some areas (e.g. between the eastern tunnel portal and Murphys Creek Road). Construction water sources identified for the Project include:

- Use of recycled water:
  - Water intercepted from the tunnelling activities and treated by onsite water treatment plants
  - Existing recycled water sources (e.g. TRC's Wetalla Wastewater Treatment Plant or Withcott Seedlings), which will require a commercial agreement with relevant stakeholders.
- Drawing water from local dams and reservoirs. This will be subject to approval from the relevant asset manager, as well as sourcing limitations identified through consultation with the asset manager to date:
  - Cooby Dam (closest dam to the Project)
  - Lake Perseverance
  - Cressbrook Dam. Dewatering activities from dams directly impacted by the Project, along with water licences (surface water and groundwater) acquired as part of any resumption processes. Water authorisations under the Water Act, with consideration to the relevant water plans are considered likely, including amendment to existing water licences to change the purpose (use) of the relevant water entitlement.
- Drawing groundwater from existing or new groundwater bores within the Project disturbance footprint. This will require authorisations under the Water Act administered by the Department of Regional Development, Manufacturing and Water (DRDMW) or a commercial arrangement with the relevant landholder.
- Draw water from creeks and rivers crossing the alignment. An approval will be required from the Department of Resources prior to undertaking this activity.
- It is likely that water supply for the Project will be made up of a combination of the supply options described in the bullet points above, with the main preferences in the Gowrie area being sourcing recycled water, along with the capture and reuse of groundwater inflow during tunnel construction. While in Lockyer Valley, sourcing water from the Urban Utility network is the main option; the network will be impacted by the Project.
- Potable and/or high-quality water sources will include:
  - TRC water network, which will need an agreement on supply conditions. It is also proposed to connect into this network for the tunnel fire management system via a new water pipeline along the Ganzer Morris Road reserve, south under the Toowoomba Bypass to Hermitage Road. Depending on when this pipeline is constructed, this may be used to source potable water at the western tunnel portal.
  - Urban Utilities water network, which will need an agreement on supply conditions.

As detailed design is progressed, these avenues for water supply will be further investigated including where applicable obtaining the relevant approvals and/or executing commercial agreements with due consideration of the Water Act and relevant water plans. Further options may need to be investigated depending on engagement with DRDMW and water resource owners, taking into account the following aspects:

- Volumetric requirements for the activity
- Water quality requirements for the activity
- Source location relative to the location of need

Further detail is provided in Chapter 13: Surface Water and Hydrology.

6.6.7 Laydown, stockpile and storage areas

Laydown areas have been identified along the length of the Project alignment and form part of the Project disturbance footprint and will be confirmed during detailed design. These laydown areas will act as a centralised point for all material storage and are situated within or adjacent to the permanent disturbance footprint to facilitate direct access to/from the laydown to the alignment.

A large laydown area (G2H-LDN003) at the western tunnel portal is required to support tunnelling activities, including the TBM commissioning activities and a permanent spoil stockpile area, in addition to the concrete batching/precast plant. The permanent stockpile at the western tunnel portal is proposed as an alternative way to manage large volumes of material and spoil from the excavation of the Toowoomba Range Tunnel. The stockpile would be a mound between 6 m to 7 m high of compacted tunnel spoil, and it is expected the mound would be shaped to suit the landscape and vegetated. The stockpile will also aim to mitigate noise and visual impacts during construction and operation.

Some laydown areas will also consist of fuel storage areas and site office compounds. A dedicated laydown area will also be required at each of the bridges or viaducts, with larger laydown areas provided for locations requiring the storage of other materials or for construction facilities.

Where possible the laydown areas have been sited to minimise environmental impacts, including using existing laydown areas or cleared lands and where applicable maximising separation distances from watercourses/overland flow paths. Where possible, laydown areas have been located on government owned land.

Establishing laydown areas will generally involve the pre-construction activities such as survey and environmental studies, erosion and sediment control, vegetation clearing, grubbing, topsoil stripping, installing environmental controls, laying hardstand material, and constructing parking areas and access tracks.

Laydown areas are expected to be used only during the construction of the Project, with some of the land transitioning to the railway corridor (e.g. G2H-LDN003.7), while the remainder will be stabilised and rehabilitated or returned as per the land agreement with the relevant landholder.

The proposed size and use of the larger laydown areas are listed in Table 6.14.

TABLE 6.14 LAYDOWN AREAS AND UTILISATION

ID	Location	Project chainage	Size (m^2)	Laydown utilisation
G2H-LDN001.7	Krienke Road	Ch 1.7 km	48,000	Bridge laydown for Gowrie Junction road bridge
G2H-LDN001.9	Krienke Road	Ch 1.9 km	6,600	General construction, road realignment site
G2H-LDN002.1	Old Homebush Road	Ch 2.1 km	10,600	Bridge laydown for Gowrie Junction road bridge
G2H-LDN003.7	Western tunnel portal	Ch 3.7 km	338,000	Tunnel construction site offices, segment storage, spoil stockpile, fuel storage, bridge laydown areas for UT1 Gowrie Creek rail bridge
G2H-LDN006.8	Intermediate tunnel ventilation shaft	Ch 6.8 km	44,500	Intermediate tunnel ventilation shaft construction site
G2H-LDN010.5	Eastern tunnel portal	Ch 10.5 km	52,000	Tunnel and bridge construction site, offices, segment storage, fuel storage
G2H-LDN011.9	Jones Road	Ch 11.9 km	20,000	Bridge laydown for Oaky Creek Viaduct
G2H-LDN012.0	Jones Road	Ch 12.0 km	82,000	Bridge laydown for Oaky Creek Viaduct/Pier access
G2H-LDN12.8	Jones Road	Ch 12.8 km	34, 000	Bridge laydown for Withcott Viaduct 1
G2H-LDN13.8	Bells Road	Ch 13.8 km	47,000	Bridge laydown for Withcott Viaduct 2
G2H-LDN014.2	Bells Road	Ch 14.2 km	28,800	Bridge laydown for Withcott Viaduct 3
G2H-LDN015.2	Withcott Viaduct 4	Ch 15.2 km	6,500	Bridge laydown for Withcott Viaduct 4
G2H-LDN015.5	McNamaras Road	Ch 15.5 km	14,700	Bridge laydown for McNamaras Road bridge
G2H-LDN015.6	McNamaras Road	Ch 15.6 km	29,000	Currently vacant laydown area previously associated with the construction of the Toowoomba Bypass
G2H-LDN016.4	Gittins Road	Ch 16.4 km	90,000	Currently vacant bridge laydown previously associated with the Toowoomba Bypass and Six Mile Creek Viaduct
G2H-LDN017.9	Howmans Road	Ch 7.9 km	16,500	General construction laydown
G2H-LDN018.4	Howmans Road	Ch 18.4 km	13,600	Bridge laydown for Postmans Ridge Viaduct
G2H-LDN018.8	Howmans Road	Ch 18.8 km	31,800	Bridge laydown for Postmans Ridge Viaduct, fuel storage, site offices
G2H-LDN021.2	Murphys Creek Viaduct	Ch 21.2 km	60,000	Bridge laydown for Murphys Creek Viaduct

ID	Location	Project chainage	Size (m^2)	Laydown utilisation
G2H-LDN022.5	Bridge	Ch 22.5 km	237,000	Bridge laydown for Withcott Seedlings Viaduct
G2H-LDN023.8	Unnamed	Ch 23.8 km	15,000	General construction
G2H-LDN024.8	Lockyer Creek Bridge	Ch 24.8 km	60,400	Bridge laydown for Lockyer Creek Viaduct
G2H-LDN025.0	Cattos Road	Ch 25.0 km	22,300	Bridge laydown for Lockyer Creek Viaduct, general construction laydown
G2H-LDN025.1	Cattos Road	Ch 25.1 km	18,700	General construction laydown, site offices, road realignment site

The laydown areas associated with Lockyer Creek Bridge and Cattos Road are located within the WSBA under the SPP. The layout and works within this area will consider, where applicable, the *State Planning Policy—State Interest Guideline Water Quality* (DILGP, 2016d) and the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (as the identified performance objective for the *Development Guidelines for Water Quality Management in Drinking Water Catchments* (Seqwater, 2017)) to ensure drinking water quality is protected. Further information is provided in Chapter 13: Surface Water and Hydrology and Appendix L: Surface Water.

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. There is potential to integrate these stockpiles into the landscape to mitigate visual impacts associated with visually sensitive locations. The opportunity for this mitigation measure is discussed in Chapter 10: Landscape and Visual Impact Assessment.

6.6.8 Fuel and hazardous material

Fuel is proposed to be stored at laydown areas along the Project alignment at the locations identified in Table 6.15. Final fuel storage locations will however be confirmed during the detailed design and construction phase. Project specifications and requirements on the storage of diesel will be in accordance with *AS1940:2017 The storage and handling of flammable and combustible liquids* and any relevant approval conditions.

TABLE 6.15 POTENTIAL PROJECT FUEL STORAGE LOCATIONS

ID	Adjoining road	Project chainage	Fuel capacity (L)
G2H-LDN003.7	Gowrie Junction Road and Boundary Street	Ch 3.7 km	< 40,000
G2H-LDN010.5	Wallens Road	Ch 10.5 km	< 40,000
G2H-LDN011.9	Jones Road	Ch 11.9 km	<20,000
G2H-LDN018.8	Howmans Road	Ch 18.8 km	< 20,000
G2H-LDN025.1	Cattos Road	Ch 25.1 km	<20,000

Fuels will be stored in self-bunded, relocatable fuel pods with a nominal capacity of approximately 10,000 L. During refilling, the fuel pods will be placed in an area with a drainage system capable of isolation from the surrounding area so as to contain spills. Refuelling of mobile plant will be conducted using a mobile service truck with an appropriate spill control kit on board. During the detailed design and pre-construction phase ARTC and the construction contractor will investigate alternative opportunities for the bulk storage of fuel along the corridor, including mobile refuelling mechanisms.

During construction, laydown areas will be used for the storage and distribution of hazardous materials required for construction purposes. 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 currently considered to represent indicative usage requirements have been identified in Table 6.16.

TABLE 6.16 INDICATIVE LIST OF DANGEROUS GOODS AND HAZARDOUS SUBSTANCES

Chemical type	Typical chemicals	Example of purpose/use	Australian Dangerous Goods Code class	Packing group	Indicative rate of use	Expected storage method
Fuel oil	Diesel	Fuel for mobile equipment	Combustible liquid (C1)*	III	40 kL/2 weeks	Maximum 40 kL bulk storage (fuel depots)
Grease	Rocol rail curve grease	Lubricate plant and equipment	Combustible liquid (C2)**	N/A	Limited	Package storage
	Caltex 904 grease	Lubricate plant and equipment	Combustible liquid (C2)**	N/A	Limited	Package storage
	Shell gadus gauge face curve grease	Lubricate plant and equipment	Combustible liquid (C2)**	N/A	Limited	Package storage
	RS Claretech biodegradable grease	Lubricate plant and equipment	Combustible liquid (C2)**	N/A	Limited	Package storage
Explosives	Ammonium nitrate***	Land clearing and tunnel construction	Oxidising substances (C5.1)	III	As required for construction	Not stored for Project
	Blast caps, detonators, boosters, etc.	Land clearing and tunnel construction	Explosives (C1)*	N/A	As required for construction	Not stored for Project
Concreting	Concrete and concrete residue	Concreting for slab construction	N/A	N/A	As required for construction	N/A
	Concrete curing compound	Concreting for slab construction	N/A	N/A	As required for construction	N/A
Welding gases	Oxygen	Welding	Non-flammable, non-toxic gases (C2.2)/Oxidising substances (C5.1)	N/A	As required for construction	Cylinder storage
	Acetylene	Welding	Flammable gases (C2.1)	N/A	As required for construction	Cylinder storage
Pesticides	Australian pesticides and veterinary medicines authority approved pesticides	Pests and weeds control	Toxic substances (C6.1) or Miscellaneous dangerous substances and articles (C9)	II or III	As required	Not stored for Project

Table notes:

* 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:
C2.1— Flammable gases
C2.2—Non-flammable, non-toxic gases
C5.1— an oxidizing substances
C6.1—Toxic substances: these are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact
C9—Miscellaneous dangerous substances: substances and articles (miscellaneous dangerous substances and articles) are substances and articles that, during transport, present a danger not covered by other classes

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

6.6.9 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 preferred.

As part of the design, a potable water pipeline will service the western tunnel portal and this pipeline could support the construction potable water requirements depending on the staging of the works. Similarly, at each of the tunnel portals, plus the intermediate ventilation shaft, a substation will be constructed and connected to the Ergon network to supply power for the tunnel operation. The power supply will also have the potential to support construction activities in particular the TBM.

The permanent services and utilities required for the Toowoomba Range Tunnel are discussed in Section 6.9.4.

6.6.10 Waste disposal

Construction activities have the potential to result in significant and diverse waste streams for the Project. The application of the waste hierarchy to generate waste minimisation and management strategies underpins the Project's natural resource use efficiency, with reference to the Project's activities and land use. 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, where the emphasis is placed on adhering to the waste management hierarchy. Chapter 7: Sustainability provides an assessment of the Project against sustainability objectives and identifies opportunities to improve sustainable outcomes.

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

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. The capacity of the existing waste management facilities will be investigated following detailed design (post-EIS), in consideration of landfill airspace, the volume of waste generated by the Project requiring disposal and other Project and industry needs within the LGAs.

The Project is anticipated to generate an excess of 1 million m^3 of material (other than rock) during the construction phase, with the majority of the excess material associated with the tunnel construction. Discussions with TRC confirmed that the current landfills under their jurisdiction do not have capacity to receive this material as spoil, with ARTC proposing to manage the material within the rail corridor.

The excess tunnel material will be stockpiled at the western tunnel portal within the Project operational disturbance footprint (i.e. railway corridor), where the material will be profiled and vegetated. The material may be reused by the Project (e.g. ballast rock intersect by the tunnel may be suitable for capping and ballast material) or other projects in the area at a later date. The quality of the tunnel material will be determined as part of the detailed geotechnical investigations, with consideration to ARTCs Earthworks Material Specification (refer Appendix T: Spoil Management Strategy).

A Construction Spoil Management Plan will be developed and implemented as part of the CEMP to document and manage the stockpiling and storage, onsite removal, transport and disposal of excavated material.

Appendix T: Spoil Management Strategy and Chapter 23: Draft Outline Environmental Management Plan contain further information regarding the specific management measures in place to consider spoil generated throughout the construction of the Project, including the development and implementation of a Construction Spoil Management Plan.

6.6.11 Wastewater

The tunnel construction is expected to produce wastewater as a result of the following:

- Groundwater infiltration into tunnel and shaft
- TBM operation
- Stormwater collection
- Further detail on the management of water during tunnel construction is provided in Section 6.6.18

- Other potential sources of wastewater include erosion and sediment controls, vehicle and plant washdown, stormwater captured within storage/containment bunds, onsite ablutions etc. Opportunities may exist to use wastewater generated during construction; however, this will be dependent on the type and quality of the wastewater and required treatments
- A suitably qualified contractor will be engaged for the removal and transport of wastewater to an approved disposal and/or treatment site.

6.6.12 Sewage treatment

Portable ablution 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.

Where ablution facilities are located within the WSBA, the location and type of facility will consider, where applicable, the *State Planning Policy—State Interest Guideline Water Quality* (DILGP, 2016d) and the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld), as the identified performance objective for the Development *Guidelines for Water Quality Management in Drinking Water Catchments* (Seqwater, 2017) to ensure drinking water quality is protected.

The total 'daily peak design capacity' for sewage treatment works will remain less than 21 equivalent persons (4,200 L/day), which is below the design capacity threshold for which an environmental authority for ERA 63—Sewage Treatment is required under the EP Regulation.

6.6.13 Quarries

Seven operational quarries have been identified as potentially suitable for use as material source locations during construction activities. These quarries are identified in Table 6.17 and shown in Figure 6.17.

The viability and feasibility of accessing material from these locations will be confirmed during the detailed design of the Project. For the purposes of the traffic impact assessment, it has been assumed that a number of these quarries will provide material to the Project, refer to Appendix U: Traffic Impact Assessment for further details.

TABLE 6.17 IDENTIFIED REGIONAL QUARRIES

Quarry name	Location
Harlaxton Quarry	Harlaxton, Queensland 4350
Mount Marrow Blue Metal Quarry	Mount Marrow, Queensland 4306
Boral Wellcamp Downs	Wellcamp, Queensland 4350
Wagner Airport Quarry Wellcamp	Wellcamp, Queensland 4350
Holcim Australia Toowoomba Quarry[1]	Toowoomba, Queensland 4350
Boral Quarry Malu[1]	Malu, Queensland 4403
Jondaryan Quarry[1]	Jondaryan, Queensland 4403

Table note:

1. Not included in the traffic impact assessment because it is used for other Inland Rail sections or is located too far from proposed alignment. Refer to Appendix U: Traffic Impact Assessment for further details.

It is anticipated that sufficient usable material will be generated through cut (2,380,000 m^3) to meet the necessary fill (2,120,000 m^3) requirements for the Project. However, there may be localised instances where the haulage of material from the point of source to the location of need is prohibitive. In such instances, the Principal Contractor may elect to obtain general fill from borrow pits or from widening earthworks cuttings to supplement the general fill requirement for the Project.

It is estimated that approximately 90,000 m^3 of capping material and 87,000 m^3 of ballast will be required for the Project. The abovementioned quarries have the capacity to provide the required volumes, with a capacity to extract and screen up to 1,000,000 tonnes per annum based on their respective environmental authorities.

The volume of material for the Project to be sourced from third-party quarry operations will be confirmed during detailed design and subject to the detailed geotechnical investigations.

6.6.14 Construction traffic

During the construction phase, the transporting of material, equipment and personnel will primarily occur via existing State-controlled roads and local government roads. Construction traffic routes required for the Project area described below, with a detailed description of the construction traffic routes for the Project provided in Chapter 19: Traffic, Transport and Access and Appendix U: Traffic Impact Assessment.

The construction and haulage routes will be confirmed during detailed design by the construction contractor, including consolidation of routes with the adjacent Inland Rail projects in consultation with the relevant road authorities, rail managers and other stakeholders.

6.6.14.1 Mass haul routes

Mass haul routes outside of the Project disturbance footprint are required for the movement of material along the Project alignment, including:

- From the eastern tunnel portal and the intermediate shaft to the storage area at the western tunnel portal. The proposed mass haul route primarily follows State-controlled roads such as the Toowoomba Bypass and Toowoomba Connection Road, but also the local road network within the vicinity of these areas (e.g. Jones and Morris Roads)
- Mass haul routes are required to balance earthworks in the Lockyer Valley, with material to be moved by internal haulage routes including across Murphys Creek Road and the local road network. Mass haul along Gittins Road is constrained by the Toowoomba Bypass underpass and further investigations are required in consultation with DTMR and LVRC.

The impact of these routes on the local road network are discussed in Appendix U: Traffic Impact Assessment.

6.6.14.2 Laydown areas and delivery points

It is currently assumed that most construction material deliveries will be made to the key laydown area delivery points along the Project (refer Table 6.14). These delivery points will be centralised locations for further construction laydown areas. From these locations, construction material will be distributed by internal haulage routes and/or the road network to the required locations within the Project disturbance footprint.

6.6.14.3 Quarry routes

It is currently assumed that existing quarries in the vicinity of the Project will be used to provide capping and ballast material only. 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. The impact of these routes on the local road network are discussed in Appendix U: Traffic Impact Assessment.

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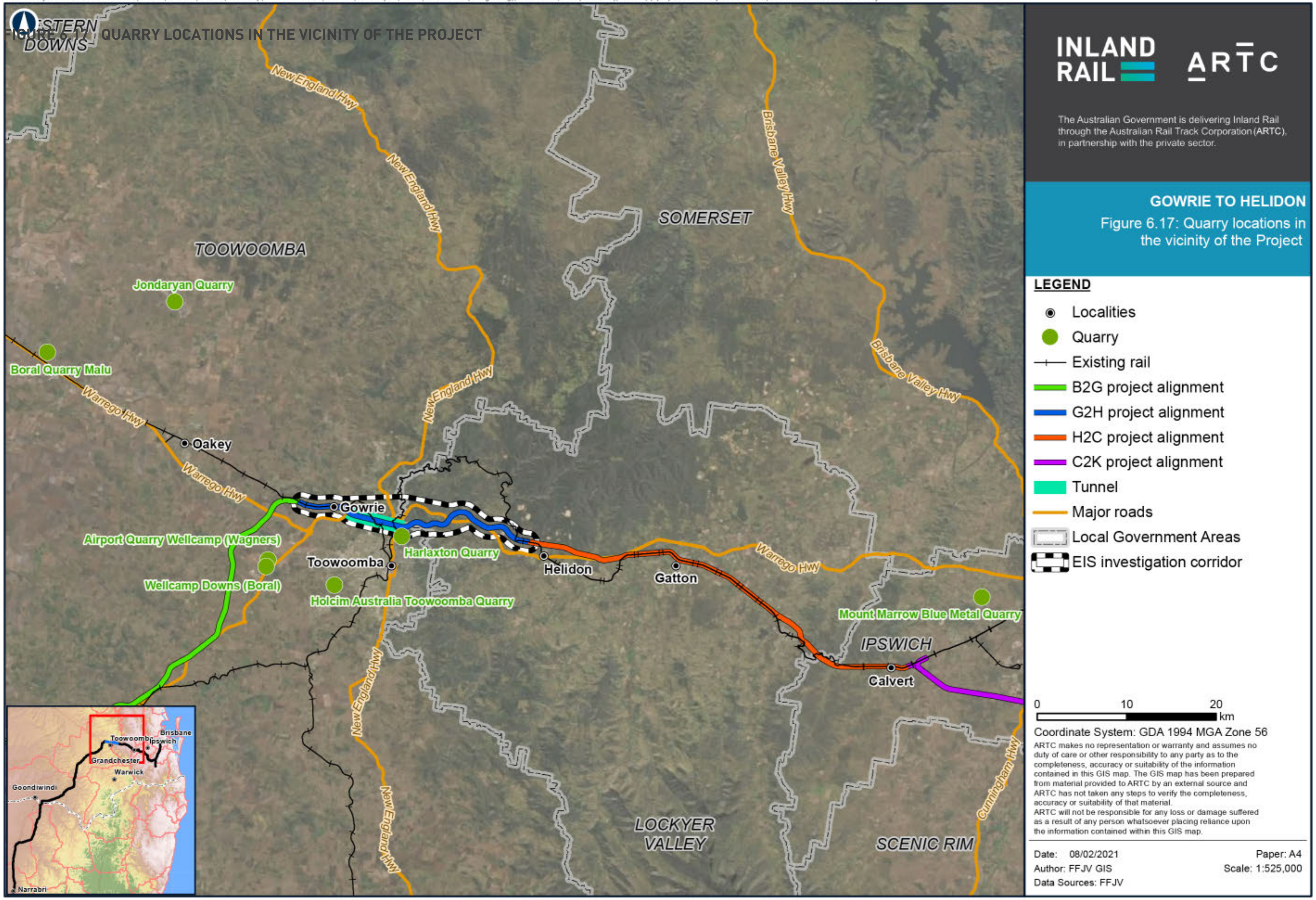

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6.6.14.4 Ready-mixed and precast concrete traffic routes

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 have been identified in consultation with the National Heavy Vehicle Regulator journey planner, which provides guidance in identifying suitable roads for heavy vehicles.

Heavy vehicles (vehicles or trailers with a gross vehicle mass or aggregate trailer mass over 4.5 tonnes) operating on Queensland roads must not exceed the Heavy Vehicle (Mass, Dimension and Loading) National Regulation mass limits. Where the vehicle exceeds regulation mass limits:

- Operate under a Heavy Vehicle National Law mass exemption notice
- Operate under an access permit specific to the vehicle type.

The transportation of precast bridge girders by road will most likely require police escort due the size of the individual girders. To reduce traffic impact transportation these will occur outside busy daytime hours, where practical, and will be subject to further approvals.

6.6.14.5 Consolidated sleeper routes

The concrete sleepers are assumed to originate from Grafton in New South Wales (i.e. dual-gauge sleeper supplier) and will be transported via the road network to various laydown areas.

Sleeper routes were formulated using the National Heavy Vehicle Regulator journey planner, which provided guidance in identifying suitable roads for heavy vehicles. They were then consolidated where feasible to minimise the number of roads affected.

Sleeper routes primarily use the State-controlled road network in New South Wales and Queensland, including the Pacific and Warrego Highways and locally the Toowoomba Bypass and Murphys Creek Road. There will also be requirement for the use of local road networks to access the Project disturbance footprint and laydown areas.

6.6.14.6 Rail routes

It has been assumed that rail will be supplied by a single source and will be distributed by rail via the closest existing QR rail network (i.e. West Moreton System). The rail will be temporarily stored within temporary rail handling yards located within the Project disturbance footprint, prior to transport to final locations via trucks along internal haulage routes and/or the local road network.

It is assumed that a rail handling yard, approximately 13 ha, will be constructed on agricultural land at Drapers Road, Charlton adjacent the West Moreton System rail corridor. The location of the rail handling yard(s) will be confirmed during detailed design, including consolidation of handling facilities with the adjacent B2G project.

The delivery of the rail via QR rail network will require further investigation and consultation with the asset owner of the network and where applicable relevant rail operators.

6.6.14.7 Construction workforce

The construction workforce will be sourced predominantly from the nearby LGAs and, as such, there is not likely to be dedicated routes, with the exception of the road network close to the Project.

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.

In accordance with the traffic impact assessment and ARTC's commitment to mitigate impacts on the local road network and community, further measures, including the consolidation of parking and use of buses to reduce construction traffic, will be investigated during detailed design in consultation with relevant local councils (refer Chapter 19: Traffic, Transport and Access).

6.6.15 Site preparation

6.6.15.1 Clearing and grubbing

Site preparation includes removal of vegetation and debris, which will occur before the main earthworks program.

The clearing of vegetation will be undertaken in accordance with the necessary permits, approvals and management plans, with clearing limits and no-go zones clearly demarcated before clearing activities start. Further detail on permits and approvals for vegetation clearing is in Chapter 3: Project Approvals.

All groundcover, topsoils, and other organic and/or unsuitable material will be stripped from the site. Wherever possible and appropriate, this material will be stockpiled and recycled within the Project footprint.

Clearing and grubbing activities would start on multiple work fronts and would always be kept 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:

- Environmental approvals
- Environmental surveys (ecology, soils etc.)
- Appropriate pre-clearing flora and fauna management implementation
- Physical and spatial identification of any underground utilities, clearing extents and no-go areas
- Appropriate utility works (i.e. protection/re-location)
- Any requirements under the approved Cultural Heritage Management Plans
- Installation of erosion and sediment control measures, including the proposed sediment basins.

Clearing and grubbing operations will be performed across the proposed cut and fill footprint. Protective measures will be in place around creeks and riverbanks to ensure that existing profiles are preserved. Cleared vegetation ready for mulching will be temporarily stockpiled within the Project disturbance footprint. The 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 will be determined during detailed design.

6.6.15.2 Topsoil stripping

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 roadworks 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 wet weather for too long. Stockpiles will be located within the Project disturbance footprint, typically outside flood prone areas, and will be neatly formed and appropriately managed to prevent erosion.

Soil and ecological surveys along the Project alignment will inform topsoil management, including with regards to the soil stripping process, separation and stockpiling of the topsoil, suitability for reuse in rehabilitation works and management of risks such as the presence of weeds.

6.6.15.3 Erosion and sediment control basins

Temporary site drainage and water quality management controls will be installed in accordance with the *Best Practice Erosion and Sediment Control Document* (International Erosion Control Association, 2008) and will:

- Minimise the potential for any material to leave the Project disturbance footprint into neighbouring environments
- Minimise the potential for concentrated flows from the Project construction activities to reduce the potential for erosion and scouring
- Minimise the risk of impacts to the water quality of existing waterways along the alignment.

Eleven temporary sediment basins have been identified along the Project alignment to support the construction activities (refer Table 6.18 and Appendix C: Design Drawings). All the sediment basins are passive, which allows surface runoff from a catchment to flow into the sediment basin without the need for pumping.

The sediment basins are located on drainage lines under the Water Act, with the number of sedimentation basins, their location and the size to be confirmed during detailed design, with consideration given to the nature of the works, local topography and hydrology, and the findings of the soil surveys.

TABLE 6.18 EROSION AND SEDIMENT CONTROL BASINS

Name	Catchment/ watercourse	Project chainage	Catchment size (m²)	Settling volume (m³)	Total volume (m³)
Sediment Basin 1	Gowrie Creek	Ch -1.0 km	27,000	314	471
Sediment Basin 2	Gowrie Creek	Ch 2.0 km	22,000	256	383
Sediment Basin 3	Gowrie Creek	Ch 3.7 km	95,200	1,106	1,659
Sediment Basin 4	Oaky Creek	Ch 11.0 km	64,000	744	1,115
Sediment Basin 5	Rocky Creek	Ch 13.4 km	34,000	395	593
Sediment Basin 6	Six Mile Creek	Ch 15.8 km	50,000	581	871
Sediment Basin 7	Six Mile Creek	Ch 17.4 km	62,000	720	1,081
Sediment Basin 8	Lockyer Creek	Ch 18.2 km	50,000	581	871
Sediment Basin 9	Lockyer Creek	Ch 19.9 km	19,250	224	335
Sediment Basin 10	Lockyer Creek	Ch 20.4 km	52,000	604	906
Sediment Basin 11	Lockyer Creek	Ch 24.6 km	50,400	586	878

6.6.16 Civil works

The activities that will be undertaken during civil works include:

- Bulk earthworks
- Construction of earthworks cuts and embankments
- Installation of temporary and permanent drainage controls
- Construction of temporary haul roads
- Construction of temporary and permanent access roads
- Road and rail bridge, viaduct and culvert construction
- Construction of the tunnel and intermediate ventilation shaft
- Construction of operational tunnel infrastructure including the tunnel control centre, ventilation systems, sub-stations, etc.

6.6.16.1 Bulk earthworks

The construction of the rail formation will require earthworks and engineered fill, including the use of suitable material won from site, to provide a surface designed for the rail construction and operation. The earthworks will be made up of constructing batters, embankments, excavating cuttings, bridge/viaduct abutments and road realignment formations. This work will be carried out using heavy earthmoving plant and equipment. In some cuttings, there is the potential for the use of explosives.

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

Cuttings

Cuttings in the existing ground profile will need to 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 banks 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 and does not contain oversized rocks, then dozers and scrapers will move the material along the alignment to embankment construction areas. 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 (rock that is not able to be broken down using mechanical means) will be broken via drill and blast or by hydraulic rock-breakers. Significant volumes of non-rippable rock are anticipated within some of the cuttings along the alignment, particularly through the Toowoomba 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, including the western and eastern tunnel portals.

Thirteen cuts, approximately 6.65 km total length, with a maximum cut depth of 45.7 m, along the Project disturbance footprint are required to maintain the required track elevations for the proposed rail line. The total volume of cuttings across the disturbance footprint, excluding the tunnel, has been estimated to be approximately 2,380,000 m^3. West of the Toowoomba Range tunnel, cuts are associated with basalt overlying Jurassic materials, while east of the eastern tunnel portal cuts are mainly through Jurassic material. The basalt material has the potential to be reused as capping, rockfill, select fill, structural fill or general fill. The other material may be used as general fill and potential structural fill (e.g. Gatton Sandstone).

Where drilling and blasting is to be undertaken, the construction contractor will develop a Blasting Management Plan, which will detail the adoption of appropriate and safe mitigation measures and be approved by DTMR. Further information of impacts from blasting is provided in Chapter 12: Air Quality, Chapter 15: Noise and Vibration and Chapter 20: Hazard and Risk.

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 and potentially moved offsite depending on size and management requirements
- 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 embankments 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. The moisture conditioning required for compaction will be determined by further geotechnical investigations
- Rolling and grading to final level and finish.

Approximately 2,120,000 m^3 of fill material will be needed for the construction of embankments for the Project with a total length of approximately 15.4 km with a maximum embankment height of 33.3 m. The current construction methodology includes using the material from the cuts in the embankments works.

Embankments have been designed and constructed to minimise erosion and afflux 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

Capping material is currently planned to be transported by the existing road network from commercial quarries. It is estimated that approximately 90,000 m^3 of capping material and 87,000 m^3 of ballast will be required for the Project.

Opportunities to use suitable material won from site as structural fill will be identified during detailed design, with basalt located at the western and eastern tunnel portals. The following are the key strategies with regards to transport, handling, and placement of structural fill and capping material:

- Suitable material will be transported to the Project and delivered directly to the alignment or stockpiled within the nominated laydown areas
- 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 total fill requirement for the Project is estimated to be 2,120,000 m^3. If all the material from the cuttings and the excavation of the tunnel is able to be treated for re-use, there will be approximately 1,000,000 m^3 of excess material for the Project. With the exception of an area in the eastern extent of the Project, most of the excess material is associated with the tunnel excavation, which will be stockpiled at the western tunnel portal.

Different options have been identified for the re-use of the excess material. A detailed mass haul assessment will be carried out in the detailed design and construction stages to assess the possibility of the following options:

- Use excess rock material for scour protection at bridge and culverts, 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 including adjoining Inland Rail projects such as H2C and B2G
- Rehabilitate existing landfills, quarries, borrow sites and mines
- Transport to designated spoil sites.

6.6.16.2 Permanent drainage controls

Cross-drainage structures will be constructed where the rail corridor or the proposed road network changes intercept existing drainage lines. The type of cross-drainage structure depends on various factors such as the natural topography, rail formation levels, relevant design standards, design flow and soil type. Cuts and embankments will also require drainage treatments such as catch banks, diversion drains and culverts. Longitudinal drainage including embankment drains and catch banks will be constructed to protect the rail formation from surface runoff.

Culverts

Culverts associated with the Project will be a mix of RCP culverts and RCBC, depending on environmental, engineering, topography, and fish passage requirements as discussed in Section 6.3.8.1. 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/laying concrete bedding material for RCBCs
- Placing the precast culvert structures on the bedding material and fastening them together
- Once installed, either side of culverts will be backfilled with support material for the culvert
- Proceeding with track works over the top of the culvert including earth works and formation works
- Restoring and revegetating disturbed areas.

Scour protection measures may also be installed upstream and downstream where appropriate.

There are 23 RCPs culvert locations and 11 RCBCs (associated with the rail alignment) that are proposed to be constructed along the Project alignment. It is also proposed that some of these culverts will be extensions of the existing culverts under the existing West Moreton System and potentially new culverts under the existing line. Any works within the existing rail corridor and under the existing rail line will be subject to approval from QR. Likewise, any works associated with road realignments will be subject to approval and consultation with the relevant local councils and DTMR.

Construction of these drainage structures will require several full-time installation crews throughout the construction period. The construction will be a mix of installation before and after the bulk earthworks, so as not to delay the overall earthmoving program.

Longitudinal drainage

Embankment and catch banks will be constructed parallel to the rail corridor and road realignments where required and in accordance with the relevant design standards. These drains will be capable of capturing and efficiently moving overland flow to dedicated cross-drainage structures 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 cutting intersects an existing drainage path. In these locations, the existing drainage path will be intersected upstream of the cutting and diverted to the nearest cross-drainage structure location.

6.6.16.3 Bridge and viaduct construction

Bridge and viaduct structures are provided along the Project alignment to allow drainage across the corridor; allow access for roads and rail, farm tracks, stock crossings or pedestrians; to span across large valleys; allow for native fauna connectivity; and replace large height embankments where required to reduce the operational footprint.

The Project requires 13 new bridge and viaduct structures comprising 10 viaducts and three bridges. As a number of these bridges also interact with public roads and rail, the construction will be subject to traffic management and temporary works restrictions to ensure the safety of the travelling public and workforce. The bridge and viaduct structures for the Project are summarised in Table 6.5 and Table 6.6.

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

The anticipated methodology and approach is as follows:

- Establishment of bridge and viaduct construction access tracks and 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
- Superstructure and deck construction.

6.6.16.4 Roadworks

Due to the location of the Project alignment, there are a number of road rail interfaces identified that will require consideration.

The road authorities are either local council (TRC and LVRC) or DTMR. Construction works on these roads will comply with the asset owners approved safety requirements and temporary works procedures. The highest standard to be complied with will be the DTMR Manual of Uniform Traffic Control Devices. For works on, over or adjacent to DTMR roads, such as the TSRC and Six Mile Creek Viaduct, the proposed construction methodology and traffic management arrangements will be approved by DTMR prior to works commencing.

The following road-work requirements were identified to accommodate the proposed Project alignment:

- Between approximately Ch 1.70 km to Ch 3.40 km:
  - Construction of Gowrie Junction Road Bridge
  - Major re-alignment of Gowrie Junction Road
  - Re-alignment of Old Homebush Road
  - Re-alignment of Krienke Road
  - Construction of property access road off Krienke Road
  - Re-alignment of Junction Street
  - Construction of road between Gowrie Junction Road and Krienke Road

- Re-alignment of Paulsens Road
- Re-alignment of Wallens Road at approximate Ch 11.60 km
- Re-alignment of McNamaras Road at approximate Ch 15.60 km
- Construction of road off Airforce Road and connecting in with Cattos Road at approximate Ch 25.00 km.

6.6.17 Rail corridor works

Key interfaces with existing QR corridors are required as part of the Project scope. Of the total 28 km length of the Project alignment, approximately 5.6 km of the alignment runs adjacent to the existing QR West Moreton System rail corridor with connections proposed at Gowrie and Helidon (refer Section 6.3.6). In addition, ARTC proposes to extend or upgrade the existing drainage structures associated with the West Moreton System, along with a road-over-rail and rail-over-rail grade-separated crossings. The staging of the works and associated impacts will be the subject of an interface agreement between ARTC and QR. Coordination with QR will be necessary to maintain access to existing assets for maintenance.

It is currently assumed that the majority of the works can occur outside of the zone (3 m away from the nearest running track) and that ARTC can occupy sections of existing corridor to avoid the need for constrained, short-term possession works. In accordance with Section 255 of the TI Act, works cannot commence within the existing rail corridor without QR's written approval. If the construction of Project components within the existing rail corridor is completed during a temporary possession of the rail corridor, then works will be completed in accordance with the conditions of the temporary possession and/or wayleave agreement granted to ARTC by QR.

6.6.18 Tunnel

6.6.18.1 Tunnel excavation

The proposed tunnel to be constructed through the Toowoomba Range will be approximately 6.24 km long with a maximum cover of approximately 220 m at Mount Kynoch. The tunnel will have a bored diameter of approximately 12.2 m and a finished internal diameter of approximately 10.8 m.

The Toowoomba Range Tunnel will intersect the following geological units:

- Tertiary age Main Range Volcanics consisting mainly of basalt
- Undifferentiated Tertiary Sediments
- In-filled Paleo Valley sediments consisting of basalts, tuffs, sandstones to mudstones
- Jurassic sandstones and siltstones of the Koukandowie Formation
- Basaltic colluvium mainly on the eastern side of the range and
- Quaternary alluvium.

The suitability and extent of the material intercepted by the Toowoomba Range Tunnel cannot be estimated with accuracy due to the variable nature of basalt flows deposited on the undulating Jurassic sedimentary paleo topography.

The construction methodology is based on a shielded TBM, allowing for undrained construction. The methodology is based on the following:

- The TBM is estimated to provide a faster program with less schedule risk compared to mined tunnel techniques (e.g. excavation rate for a mined tunnel is in the order of 50 m/week, while for a TBM is up to 80 m/week for a single shield)
- The geology and hydrogeology of the area is a significant challenge and a TBM is considered more favourable than mined tunnel techniques (roadheader or drill and blast)
- Construction of an undrained lining is facilitated by the TBM possessing a segmental lining erection system. Construction of an undrained lining with mined tunnel techniques is more difficult and involves a time delay between the initial, primary support and the subsequent secondary support
- A mined tunnel uses the open face method which drains groundwater during construction prior to construction of the waterproofing and secondary lining. A TBM can be closed face using face pressure to minimise groundwater disturbance during erection of the segmental lining.

It is expected that the TBM will be driven from west to east mainly due to availability of early access to the portal, an appropriate road network, and the availability of power supply. The western tunnel portal is also located in terrain more conducive to the use of a TBM as the land can readily accommodate the setup and operation of the TBM. During operation the TBM requires a large worksite to accommodate materials storage including tunnel segments, spoil handling and storage, temporary ventilation equipment, and TBM launching requirements.

The presence of the colluvial sediments at the eastern tunnel portal represents a significant risk for the construction of the tunnel, and therefore a mined tunnel and cut and cover construction method is anticipated. This approach will establish the portal and a section of tunnel (less than 500 m) before the TBM finishes the tunnel.

The cut-and-cover approach is preferred due to the steep terrain and presence of colluvium geometry, with a driven tunnel requiring longer and wider excavations to obtain a stable face, which will also be prone to future landslides, compared to the cut-and-cover approach. The cut-and-cover section will include contiguous bored pile walls and a roof slab, with seepage likely to occur (i.e. drained structure).

The mined tunnel and cut-and-cover construction method approach will establish the eastern tunnel portal and a section of tunnel (approximately 600 m) before the TBM finishes the tunnel. That is the TBM will breakthrough into the mined tunnel and continue to erect the segmental lining as it pushes forward with the annulus between the segmental lining and the mined tunnel to be grouted as soon as possible to provide support and waterproofing. The TBM is planned to be removed following construction.

The duration of the tunnelling activities, particularly for the TBM, is not known at this stage of the Project and will be dependent on the type of TBM procured for the Project during detailed design.

Excavation by TBMs in Sydney Sandstone (double-shield) resulted in an average advance rate in the order of 15-20 m/day with peak performances up to 30 m/day (Camus et al., 2015). When crossing underneath the Sydney Harbour (clay with high water pressure), the average advance rate reduced to 8 m/day (**www.tunneltalk.com**). Jain et al. (2013) noted low advance rates in porphyritic basalt (7 m/day) due to their very high strength, which have similar properties to the basalts likely to be encountered during the excavation of the Toowoomba Range Tunnel.

For the purposes of the EIS it is assumed that a slurry TBM will be used due to the groundwater conditions and that the excavation rate for the TBM is 10.5 m/day and 1.7 m/day for the mined tunnel area.

6.6.18.2 Intermediate tunnel ventilation shaft

The intermediate tunnel ventilation shaft connected to the tunnel at Cranley, approximately 17 m internal diameter and 100 m deep, will be excavated prior to the tunnel construction.

A conventional shaft sink construction method has been adopted with staged excavation through the MRV, UTS and Jurassic materials. Temporary supports will be installed from the top down, with a permanent reinforced concrete lining constructed from the bottom up. Extensive ground treatment such as grouting may be required to achieve the allowable inflow of 0.0062 L/sec, with the tunnel to intersect several water tables (e.g. shallow and deep MRV) and stabilise the ground.

A ventilation infrastructure operations building along with car park facilities will also be provided at this location.

6.6.18.3 Tunnel lining

The design of the Toowoomba Range Tunnel is undrained, noting that the portals and the cut and cover section of the tunnel (approximately 600 m) will be drained). Undrained tunnels are designed as watertight structures, which aim to limit groundwater ingress into the tunnel and minimise groundwater level drawdown, as a result of the tunnel operation, via diminished groundwater seepage allowed into the tunnel. Undrained tunnels constructed by mined tunnel methods typically comprise a groundwater resisting membrane and cast in-situ reinforced concrete lining. To withstand the hydraulic pressures from the groundwater on the watertight tunnel lining, undrained tunnels are typically circular in cross section, or some form of elliptical shape with significant amounts of reinforcement required.

The proposed tunnel requires TBM and mining (road header) techniques. A single pass precast reinforced concrete segmental lining will be used for support of an excavated tunnel constructed by a shielded TBM.

It is likely a flexible sheet type water resistant membrane will be used to waterproof the tunnel. The 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.

6.6.18.4 Tunnel portals

The western tunnel portal involves a 400 m long box cut and up to 26 m in height at the western tunnel portal face, gradually reducing in height towards the west. The portal is likely to be constructed using conventional mining technique and potentially some blasting. The eastern tunnel portal involves a 100 m long cut and a portal face that is approximately 13 m in height.

The portals are drained and there is the potential for groundwater inflows during construction and operations (refer Chapter 14: Groundwater).

6.6.18.5 Water management and treatment

The Toowoomba Range Tunnel will be designed as undrained; however, some groundwater ingress is expected during construction. For the cut-and-cover and mined tunnel, approximately 600 m will be drained, while the TBM is based on an undrained construction. Similarly, the intermediate ventilation shaft will also be constructed based on an undrained approach.

Based on the groundwater modelling (refer Chapter 14: Groundwater) there is the potential for up to 1,700 ML of groundwater to inflow into the Toowoomba Range Tunnel (including the portals and intermediate ventilation shaft) during the construction period. The majority of the groundwater inflow is associated with the following aquifer types, MRV (50 per cent), Colluvium (40 per cent) and Koukandowie Formation (10 per cent). This water will need to be captured for reuse during construction and/or diverted to the surrounding environment.

The extent of treatment of the water from the tunnel will depend greatly on the quality of the groundwater and the environmental value adopted for the discharge of water to the local receiving environment.

During construction, water treatment facilities will be constructed to support the tunnelling operations. The water treatment facilities design is likely to include, for example:

- Screening treatment
- Detention tanks
- Aeration/flocculation tanks
- Chemical treatment, where required
- Water pumping facilities
- Material separation
- Residual excavated material storage.
- As part of detailed design, the water treatment facilities will be investigated for potential use during both construction and operation of the Project.

6.6.19 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 low establishment and operating costs and is efficient and minimises emissions and construction times.

However, given the long, linear nature of the Project there will be significant advantages in using a track laying machine (TLM) for track construction works. This will increase productivity and reduce the cost per track metre installed. This approach will require specialist plant, equipment and supporting infrastructure. Furthermore, to support material logistics in this approach, a construction laydown will have to be adequately sized to accommodate the majority of sleeper and rail deliveries.

A flash butt weld (FBW)[3] facility will be required to facilitate the welding of short (27.5 m) rail into long-welded rail (LWR), approximately 400 m in length. An FBW has been assumed to be located at Drapers Road, Charlton, along with the rail handling yard. Locations for FBW facilities within the Project disturbance footprint will be confirmed during detailed design.

3. 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.

6.6.19.1 Bottom ballast

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.

It is estimated that 57,000 m^3 of bottom ballast will be sourced from a third party, with the volume and source of material to be confirmed during detailed design and with consideration of the findings of the detailed geotechnical investigations and ARTC earthworks material and construction specifications.

6.6.19.2 Sleepers

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 Project 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.

6.6.19.3 Rail

Rails may be delivered along the Project alignment from the temporary rail handling yard and installed by one of the following approaches:

- Delivered via truck in 27.5 m lengths and installed along the alignment and FBW in-situ and/or FBW lineside and thimble into the sleeper housing in long welded rail
- Delivered to the FBW facility situated within relevant laydown areas. This will allow the short rail to be welded into long welded rail and then loaded onto the material train in strings of approximately 400 m. The rail long welded rail can then be positioned into the alignment along with the sleepers through the TLM.

6.6.19.4 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, which 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.

It is estimated that 29,000 m^3 of bottom ballast will be sourced from a third party within the local region (e.g. Toowoomba LGA).

6.6.19.5 Tamping

To make the rail track more durable, a tamper machine will be used for the packing (tamping) of the ballast under the sleepers. The process will set the geometry and re-arrange the ballast 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 guidance software, to implement the correct target geometry. Turnout tampers will be used for the tamping of turnouts equipped with guidance software.

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.

6.6.19.6 Welding and stressing

To ensure quality of welds, the majority of welding will be undertaken using the FBW method. The railway industry uses flash welding to join sections of mainline rail together to create continuous welded rail, 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).

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).

6.6.19.7 Connections and turnouts

All turnouts connecting to existing operational infrastructure (e.g. QR Network) will be pre-built and paneled in if the track possession window does not adequately grant the required time to construct in-situ. The pre-building and paneling in method will provide the least risk to the track possession windows, ensure turnout componentry is complete and allow some welding to happen prior to the possession.

All crossing-loop turnouts and maintenance sidings will be constructed in-situ to reduce lifting of switch and crossing panels. All turnout construction will 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.

6.6.20 Signalling installation

The design and installation of the safe working 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.

6.7 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 (checking) of the track and systems is programmed for approximately six months after the completion of construction works.

Testing and commissioning of the rail line and communication/signalling systems will be undertaken to ensure that all systems and infrastructure are designed, installed, and operating according to ARTC's operational requirement.

For the connections to the existing QR and ARTC networks, a rail systems testing and commissioning plan will be required and must include the existing QR and ARTC signalling system and also be approved by ARTC and QR. Commissioning of the track works will require completed inspection and test plans, clearance reports, weld certification, rail stressing records, as-built documentation and track geometry reports.

6.8 Clean up and restoration

Where not required for the ongoing operation of the Project, all construction sites, temporary laydown areas, compounds and access routes will be returned to pre-existing conditions, unless otherwise agreed with the relevant landholder. Site reinstatement, rehabilitation and/or stabilisation will be undertaken progressively during the works and would include the following activities:

- Demobilising site compounds and facilities
- Removing all materials, waste and redundant structures from the works sites
- Forming, and stabilising of spoil mounds
- Decommissioning all temporary work site signs

- Establishing permanent fencing
- Removing temporary fencing
- Decommissioning site access roads that are no longer required
- Restoration of disturbed areas as required, including reuse of topsoil and mulch stockpiled during construction, along with targeted revegetation where required, to return ecological structure and functioning, along with any proposed monitoring and maintenance works.

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 operational phase. The proposed monitoring and maintenance works may extend into the operational 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.

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

6.9 Operational phase

As discussed in 6.2.10, DTMR will be the owner of the land (i.e. holder of the perpetual lease) subject to the railway corridor under the TI Act, with ARTC sub-leasing the railway corridor from DTMR. As the railway manager[4] for the Project alignment, ARTC will be responsible for railway operations, for managing the railway infrastructure, along with a 'duty of care' for the land.

Operational phase activities will include the use of the railway for freight purposes and potential future use for passenger services provided by a third-party operator, operation and maintenance of tunnel ventilation and safety systems, signalling, and general track and infrastructure maintenance.

The Inland Rail Program as a whole will be operational when all 13 sections are complete; however, existing QR Network traffic may use the Project alignment, subject to relevant infrastructure agreements, if the alignment is completed prior to the other 13 sections of the Inland Rail Program.

Road network changes as a result of the Project will be managed and maintained by the relevant local road authority (i.e. TRC and LVRC).

6.9.1 Hours of operation

The hours of operation are anticipated to be 24-hours a day, 7-days a week on a variable schedule.

6.9.2 Workforce

It is anticipated that the operational phase will require a workforce of approximately 20 FTE. As with the construction phase, the workforce will likely be sourced locally.

6.9.3 Train operations

The Project will form part of the rail network managed and maintained by ARTC, which currently includes 8,500 route kilometres of track in New South Wales, Queensland, South Australia, Victoria and Western Australia.

The Project will involve operation of a single rail track with crossing loops, to accommodate double-stacked freight trains up to 1,800 m long and 6.5 m high. The track will also facilitate the movement of existing rolling stock along the West Moreton System, with connections at the western and eastern extents of the Project.

4. Has the meaning given to that term in the TI Act and refers to the person accredited for managing the railway under Chapter 7, Part 3 of the Act.

Inland Rail will be an open access rail service, meaning ARTC will not run trains directly but will allow access to the rail line by rail operators. Operational train modelling for the Project estimates that the Gowrie to Helidon section of Inland Rail will involve an annual average of approximately 33 train services per day in 2027. This is likely to increase to approximately 47 train services per day in 2040.

These numbers include existing traffic on the West Moreton System, which currently accounts for 26 trains per day. The majority (24) of these current train services consist of coal trains with two freight services from the South Western System. The proposed spur line allows trains to access Toowoomba from the Project alignment, including the South Western System and trains requiring access to Toowoomba (e.g. Westlander and coal trains accessing Willowburn Rail Facility). The spur line also allows for trains from Toowoomba to access Brisbane via the Project alignment.

It is expected that the source of the train services will be evenly split across both the ARTC and QR Networks in 2040. This is in response to the Project alignment catering for larger train sizes and axle loads, reducing the likely number of coal services per day, while allowing for additional agricultural rail movements along the QR Network.

Train services will be provided by a variety of rail operators and will be a mix of grain, bulk freight, livestock, coal, other general transport services, along with the Westlander passenger service. The future use of the Project alignment by passenger trains would be dependent on the rail operators ensuring that the train configurations are suitable to use the alignment, including the current tunnel design, noting that the Project basis of the design is for freight services (refer Table 6.3).

The changes to rail traffic in terms of both the type and source of rail traffic cannot be confirmed at this stage, however assumptions based on the operational train modelling including train movements, train consists, locomotive types and numbers, along with train speeds are provided in Appendix K: Air Quality Technical Report and Appendix P: Operational Railway Noise and Vibration.

Train control will be managed via ARTC's existing control centres, with a new control centre proposed at the western tunnel portal to manage tunnel operations. The safe working systems, including the Australian Train Management System, a digital train management solution with real-time monitoring of trains with GPS and mobile technology, will support ARTC's objectives of improving rail network capacity, operational flexibility, train service availability, transit times, rail safety and system reliability.

Train movements within this section of the QR Network are controlled and communicated via QR's Control Centre in Brisbane, while the corresponding signalling system is Direct Traffic Control.

Interfaces between the ARTC and QR Network, including signalling systems will be subject to detailed discussions between ARTC and QR during detailed design.

6.9.3.1 Rollingstock maintenance and provisioning

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

6.9.3.2 Fuel

No permanent refuelling facilities are proposed within the Project disturbance footprint.

6.9.4 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
- Water treatment plant
- Workshops and other amenities.

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

The power supply has been designed with a primary and secondary power supply considered. Should either supply fail, the alternative has the capacity to maintain operations for the Toowoomba Range Tunnel including the tunnel control system, fire pumps, sub stations, and ventilation buildings. It is anticipated that the supply of these services will be delivered by relevant providers and is to be determined during the detailed design phase based on investigations into the available infrastructure supply companies that operate in the area, with these services providers to source the relevant approvals.

As outlined in Section 6.3.4.4, lighting will be limited around tunnel portals and associated infrastructure.

6.9.4.1 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, including remote tunnel operators, 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.

The telecommunication requirements for the tunnel are based on the use of 4G mobile network coverage. It is yet to be determined whether a permanent data line is required to be connected to the tunnel control centre (proposed to be located in the western tunnel portal operational infrastructure) and the bandwidth requirements and this will be confirmed in the next phase of works. The final design of the telecommunications system will incorporate emergency services requirements. Confirmation of the location of tunnel control centre will also be part of the telecommunications detailed design phase process.

6.9.4.2 Ventilation

As outlined in Section 6.3.4.1, the tunnel ventilation system includes portal doors located at both ends of the tunnel and at the intermediate shaft location. This allows one door to be closed during train movement to maintain the airflow across the locomotives in normal operations and allows the intermediate shaft door to close earlier after the train passes the mid-point and start the purge for the first tunnel section during purging operations.

Three smoke control ventilation buildings are proposed, one at each portal location and one at the intermediate shaft located at Cranley. These ventilation buildings will provide sufficient velocity for purging of the tunnel during operations. Refer Figure 6.18 for a schematic of the proposed western tunnel portal, showing a train entering the ventilation building.

FIGURE 6.18 SCHEMATIC OF THE PROPOSED WESTERN TUNNEL PORTAL, WITH A TRAIN ENTERING THE VENTILATION BUILDING

Future stages of the Project design development may be further optimised to remove the requirement for the intermediate ventilation shaft and supporting aboveground infrastructure. If further tunnel ventilation design optimisations occur during the detailed design phase, additional assessment of the associated environmental aspects at the tunnel portals would be required to assess if any potential negative impacts are likely to occur and, if so, develop appropriate mitigating design requirements and environmental management strategies.

6.9.4.3 Water collection and treatment

As outlined in Section 6.3.4, the design allows for groundwater and stormwater to be diverted away from the tunnel portals to the surrounding environment. Where water cannot be diverted away from the tunnel portals the water will be collected by sumps, which will include hydrocarbon separators and 'first flush' tanks.

Groundwater inflow at the western tunnel portal will be diverted directly to a tributary of Gowrie Creek downstream near the UT1 Gowrie Creek Rail Bridge, with the predicted inflows up to 80 ML per annum from the MRV. The water quality of the groundwater is considered suitable to be directly 'discharged' into this tributary, which has been assessed to be a moderately to highly disturbed ecosystem, with the groundwater from the MRV also known to influence water quality and environmental flows of Gowrie Creek. Groundwater inflow, from the Colluvium, at the eastern tunnel portal is predicted to be 0.7 ML per annum and will be diverted to a drainage line, directly downstream of the eastern tunnel portal, associated with Oaky Creek.

Water collected inside the tunnel (groundwater, washdown, firefighting etc.) will be collected via drainage pits throughout the tunnel and connected longitudinally by a drainage pipe. Collected water will be conveyed via gravity to the tunnel collection sump(s) located at the eastern tunnel portal. This water will likely be processed through a WTP at the eastern tunnel portal.

ARTC will confirm the design of the WTP during detailed design, including whether the water can be directly discharged into the surrounding environment or whether water should be collected at the western tunnel portal and mixed with the water from the tunnel (i.e. dilution) or a combination of all three options. Any separated pollutants will be held for collection by a licensed waste contractor.

The extent to which water from the tunnel is treated will depend largely on the quality of the groundwater ingress. Groundwater modelling indicates that the majority of the groundwater inflow into the tunnel, predicted to be up to 15 ML/annum, will be from the Koukandowie Formation, where salinity levels are generally higher than the MRV. Baseline monitoring of groundwater bores established along the tunnel alignment will confirm the quality of groundwater resources intersected by the tunnel.

The volume and quality of inflow will vary spatially and temporarily, with detailed design to further consider measures to manage groundwater inflow, together with the requirement to obtain authorisations under the Water Act. Further discussion on groundwater resources is provided in Chapter 14: Groundwater and Appendix N: Groundwater Technical Report.

During operation, stormwater will be diverted away from the tunnel portals and the ventilation building and any water that falls within the tunnel portals will be captured by purpose-built sumps and directed to the surrounding environment and not directed through the tunnel. 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.

Water quality will be monitored and if water quality objectives cannot be achieved for waters to be released, alternate treatment/disposal options will be implemented in accordance with any relevant conditions of approval or legislation. Additional detail regarding water collection and treatment is provided in Chapter 13: Surface Water and Hydrology.

6.9.4.4 Operational 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, along with firefighting activities at the tunnel. The volumes required cannot be quantified at this stage of the Project, though as noted in Section 6.3.4, the tunnel's fire management system incorporates two 450 kL tanks at the western tunnel portal.

As outlined in Section 6.6.6, a water pipeline will be constructed along Ganzer Morris Road, road reserve, running south under the Toowoomba Bypass to Hermitage Road, enabling the Project to connect into the TRC water network. This new connection will ensure that the fire management system has the required pressure (e.g. 30 L/s). ARTC may also be able to reuse water collected from the tunnel portals and the tunnel itself to support operations.

An assessment of the suitability of each water source will need to be made for each maintenance 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.

6.9.5 Operational maintenance

Maintenance activities will be undertaken during operations. Typically, these activities include minor maintenance works, such as bridge and culvert inspections, sleeper replacement, rail welding, rail grinding, ballast dropping and track tamping, through to major periodic maintenance, such as ballast cleaning and reconditioning of track.

In addition to minor maintenance works, there will, however, be a requirement for large-scale maintenance works along the Project alignment, including ballasting and culvert conditioning, as the design life of some materials and structures is less than the operational design life of the Project. These activities are to be managed in accordance with ARTC's operational maintenance procedures and management systems, including where necessary notify adjacent landholders and/or the wider community.

The maintenance operations will also include management and maintenance of rehabilitation and reinstatement works within the railway corridor.

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

6.9.6 Signalling and telecommunications

The Project involves new telecommunications and signalling infrastructure that will be managed by ARTC's existing control centres and the new tunnel control centre at the western tunnel portal. The systems will interface with the other rail operators signalling and telecommunications infrastructure.

Interfaces between the ARTC and QR Network, including signalling systems will be subject to detailed discussions between ARTC and QR during detailed design.

6.9.7 Operational stormwater management

Stormwater, with the exception of the tunnel portals, will be managed through the drainage structures incorporated into the Project design, as discussed in Section 6.6.16.2.

6.9.8 Road transport

The existing road network will be used to travel to the rail corridor along with the infrastructure associated with the eastern and western tunnel portals along with the intermediate ventilation shaft. Access to the rail corridor will be via dedicated access points approved by the relevant road authority during detailed design, including potentially on Boundary Street and Bedford Road, Gowrie Junction and Murphys Creek Road, Lockyer. 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. RMARs are discussed in Section 6.3.11. Parking facilities will also be provided at the tunnel portals and the intermediate ventilation shaft at Cranley.

Changes to the existing road network, including any new local roads, as a result of the Project will be managed by the relevant road authority (i.e. DTMR or local council).

6.9.9 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 insignificant in comparison to the construction phase. Quantities of waste would depend on operational frequencies of maintenance regimes, as well as design life, given some of the features of the Project will have a design life of more than 20 years. These details are unknown at this stage of the Project and as such, quantities of operational phase waste cannot be accurately determined at this time.

The wastes anticipated to be generated during the operational phase of the Project are summarised in Table 6.19.

TABLE 6.19 OPERATIONAL AND MAINTENANCE WASTE QUANTITIES

Activity	Waste description	Waste type
Vegetation management	Green waste	General waste
General maintenance of rail corridor	Debris, litter and packaging	General waste
Tack repair	Timber, steel, sleepers, contaminated soil, paint, diesel	Construction and demolition/regulated waste
Embankment/landform re-profiling	Soil	Construction and demolition/regulated waste
Infrastructure maintenance including tunnel and tunnel operational facilities	Chemical containers, scrap metal, oil spills	Construction and demolition/regulated waste
Site visit	Oil spills, solvent spills	Regulated waste

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

6.10 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.