Inland Rail

Melbourne to Brisbane Inland Rail **2015**

INLAND RAIL IMPLEMENTATION GROUP REPORT TO THE AUSTRALIAN GOVERNMENT

ATTACHMENT A: ARTC 2015 INLAND RAIL PROGRAMME BUSINESS CASE

pwc

ARTC

InlandRail

The Australian Government's priority freight rail project

Note: Throughout this Programme Business Case there may be references to ARTC's ongoing role in delivery and operations of Inland Rail or the network. It may also be applicable that in the future an alternate entity, Statutory Authority or Government Owned Corporation with similar legislative powers to ARTC could also perform these functions. The Programme Business Case has been prepared assuming Inland Rail can leverage ARTC's existing development, delivery and operating experience.

1 Liability limited by a scheme approved under Professional Standards Legislation.

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KEY FINDINGS

- Inland Rail is a nationally significant transport initiative. This Programme Business Case provides the most detailed assessment to date of why Inland Rail is needed and how it can be delivered.
- The national vision for the east coast freight network is for high productivity and effective interstate rail and road networks with low cost and efficient regional connections to port and urban freight destinations.
- The east coast of Australia comprises 79 per cent of Australia's population, 78 per cent of Australia's national employment and contributes 75 per cent of the nation's GDP. The freight task on the east coast is significant, with the interstate freight task alone projected to increase by 70 per cent by 2030 to 140 billion tonne kilometres. With Australia's east coast population forecast to increase by 60 per cent over the next 40 years, accompanied by comparable growth in employment, there will be significant pressure on freight infrastructure and services:
    - Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
    - Current north–south freight infrastructure (road and rail) is already constrained and this will increasingly impact negatively on freight productivity.
    - Continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
    - Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities.
    - Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability.[2]
- Inland Rail provides a strategic opportunity to make a decisive step change in the capacity, capability and interoperability of the national freight rail system. It strategically builds the backbone of the national freight rail network creating a direct standard gauge rail connection between Queensland, Victoria, rural New South Wales, South Australia and Western Australia, providing both economic and social benefits throughout the country.
- Extensive consultation with key market participants and other industry stakeholders has been undertaken to develop the service offering and scope of the Inland Rail Programme to ensure the infrastructure meets market needs in terms of service specification and performance.
- Based on consultation with industry, the proposed alignment and scope of Inland Rail:
    - Optimises the use of existing rail infrastructure:
    - Is compatible and interoperable with high productivity train operations in the east-west corridor (to Adelaide and Perth).
    - Bypasses bottlenecks on the congested metropolitan Sydney rail network.
    - Optimises connections with regional and local rail and road networks.
    - Maximises value for money in meeting the needs of the market.

2 Reliability is defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised.

- The key benefits of Inland Rail to the freight industry and the broader community are:[3]
    - Improved linkages within the national freight network: Enhances the National Land Transport Network by creating a rail linkage between Parkes in New South Wales and Brisbane, providing a connection between Queensland and the southern and western States.
    - Improved access to and from regional markets: Two million tonnes of agricultural freight attracted from road, with a total of 8.9 million tonnes of agricultural freight more efficiently diverted to Inland Rail.
    - Reduced costs for the market: Reduces rail costs for intercapital freight travelling between Melbourne and Brisbane by $10 per tonne.[4]
    - Improved reliability and certainty of transit time: Less than 24 hour rail transit time between terminals in Melbourne and Brisbane and reliability matching current road levels.
    - Increased capacity of the transport network: Additional rail paths for freight (160 round trip paths per week) a 105 per cent increase on current freight paths on the coastal route alone, along with releasing capacity for passenger services in Sydney and Brisbane, and removing 200 000 truck movements (5.4 billion net tonne kilometres of freight) from roads each year.
    - Reduced distances travelled: 200 kilometre reduction in rail distance between Melbourne and Brisbane, and 500 kilometre reduction between both Brisbane and Perth and Brisbane and Adelaide.
    - Improved road safety: 15 fewer serious crashes each year avoiding fatalities and serious injuries.
    - Improved sustainability and amenity for the community: More than 750 000 fewer tonnes of carbon and reduced truck volumes in over 20 regional towns.
    - It provides an alternative north-south freight path to counter weather, climactic or other disaster disruption to the transport network.
- The Programme will be a catalyst for complementary supply chain investments that exploit the enhanced logistics capability of Inland Rail, including fleet upgrades, new metropolitan and regional terminals and integrated freight precincts.
- The Programme Business Case demand assessment has found there would be strong market appetite to leverage the enhanced capabilities of Inland Rail with a significant uplift in rail market share. Rail's share of the Melbourne to Brisbane market is projected to increase by 36 percentage points by 2049–50 which translates into an additional 3.1 million tonnes (64 per cent increase) of freight on rail between Melbourne and Brisbane compared to a future without Inland Rail. Significant increases in rail market shares are also expected between Brisbane to Adelaide (28 percentage points) and Brisbane to Perth (7 percentage points) over the same period.
- Significant volumes of existing grain movements (approximately 5.8 million tonnes in 2049–50) to east coast ports would utilise Inland Rail for part of their journey.
- A P50 (P90) construction cost of $9.9 ($10.7) billion has been estimated over a 10 year delivery programme.
- The Programme Business Case finds that an investment in Inland Rail has positive net economic benefits, using a cost benefit methodology that is conventionally applied to major transport infrastructure projects in the context of a very long-term horizon for program delivery and inter-generational benefits realisation given the 100 year asset life.

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[3] Result of PwC economic analysis - estimated for 2049-50 when Inland Rail is fully developed. The number of truck movements removed from roads is estimated to increase as the total freight task increases post 2049-50.

[4] Current 2014–15 prices.

- An economic benefit cost ratio of 2.62 at a four per cent discount rate (1.02 at a seven per cent discount rate) has been estimated for the Programme.
- Economy-wide modelling indicates the Inland Rail Programme will increase gross domestic product (GDP) by $16 billion over the 10 year construction period and 50 years of operation. The Programme is also expected to deliver 16 000 additional jobs at the peak of construction, and an average of 700 additional jobs per annum over the entire period.
- Financial analysis indicates that Inland Rail would not generate sufficient access revenues to cover the full costs of the Programme, including capital, operations and maintenance costs. Excluding capital charges, however, Inland Rail would be cash flow positive from commencement of operations with access revenues sufficient to cover ongoing operations and maintenance costs plus a margin.
- Planning and environmental approvals will be required for both development and operation of the Inland Rail Programme. This will consist of greenfield alignments where new corridors are required to be defined and protected, and existing rail corridors where upgrade/enhancement works are required. Works outside of existing rail corridors will require detailed planning and environmental impact assessments.
- An estimated 1900 to 2000 property transactions would need to be undertaken with approximately 51 per cent in Queensland and 49 per cent in New South Wales.
- Supplementary analysis of a dedicated freight line extension from the existing interstate line in Brisbane to the Port of Brisbane identified two potential options, with the lowest cost option estimated to cost around $2.5 billion (P50, $2015, excluding escalation). Further planning is required before a preferred option (and associated corridor) can be selected.
- The analysis indicated the economic case for the new line to the port was marginal and up until around 2040-41 projected demand could be met with smaller incremental capacity investments (depending on government policy decisions). Action to preserve the preferred corridor would be prudent as the line would eventually be required.
- As the Inland Rail Programme would act as a catalyst for complementary private sector investment, it requires a firm early commitment to proceed and deliver the project in its entirety so as to create an environment where the private sector can invest with sufficient certainty that the anticipated service outcomes will be realised in the committed timeframes. Without such a commitment, the risk is that companies will not be incentivised to invest in rail supply chains and Australia's east coast may be locked into road-based logistics options which undermine future efforts to attract freight to rail.

Executive summary

EXECUTIVE SUMMARY

0.1. Introduction

Melbourne to Brisbane Inland Rail (Inland Rail) is a nationally significant transport initiative. Inland Rail provides the opportunity to deliver a step change improvement in rail service quality across the critical north–south corridor between Melbourne and Brisbane that is compatible and interoperable with high productivity train operations in the east–west corridor (e.g. long trains with capability to double stack containers).

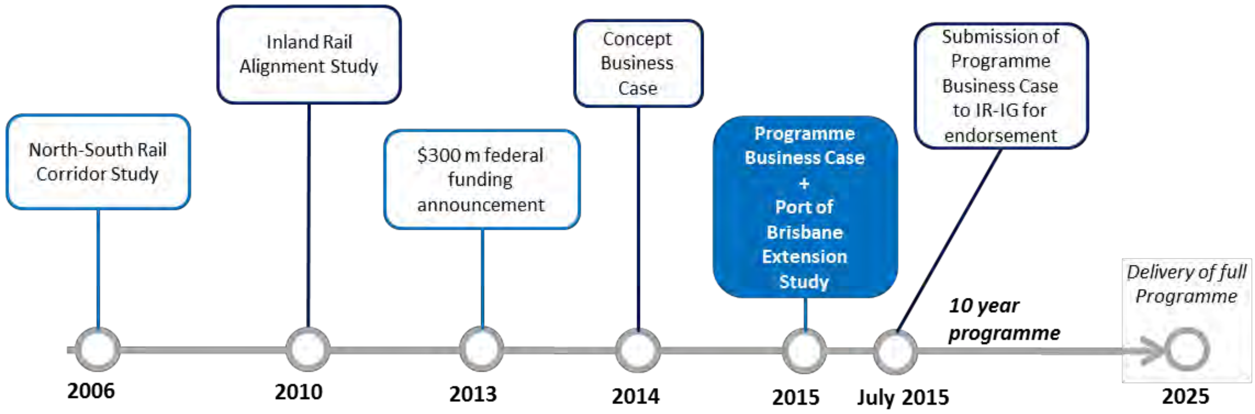
The Australian Government has engaged the Australian Rail Track Corporation (ARTC) to develop a 10 year delivery programme for Inland Rail. The Inland Rail Implementation Group (IR-IG) chaired by the former Deputy Prime Minister, the Hon John Anderson AO, has overseen development of the Inland Rail Programme (the Programme).

This Programme Business Case provides the most detailed assessment to date of why Inland Rail is needed and how it can be delivered. The viability, benefits, costs and risks associated with the Programme have been assessed, although further development of designs, costs and other technical and economic data is expected. The intention is for this Programme Business Case to be submitted to the Australian Government for endorsement and approval to proceed with the delivery of the Inland Rail Programme.

At the request of the Australian Government, ARTC has also undertaken preliminary planning and a strategic assessment of possible options for a 24/7 dedicated freight rail link from Acacia Ridge to the Port of Brisbane (the Port of Brisbane Extension). The Port of Brisbane Extension would link the Port to the existing interstate line, and other regional and interstate rail connections, in a dedicated rail freight corridor, avoiding the need for freight trains to share the Brisbane metropolitan network with passenger services.

This Programme Business Case will be provided to the IR-IG for consideration and endorsement prior to being submitted to the Australian Government. The investigation and approval timelines for the Inland Rail Programme are shown in Figure 0.1.

Figure 0.1 Inland Rail Programme investigation and approval timelines



Source: PwC, 2015.

NB: Subject to the timing of Australian Government decision to proceed with Inland Rail.

0.2. Strategic rationale for the Programme

THE CHALLENGES AHEAD

Australia is heavily reliant on efficient supply chains to provide competitive domestic freight links and gateways for international trade. Freight transport services between major population centres, particularly our capital cities, deliver millions of tonnes of freight each year and provide for the distribution of goods throughout the country. Efficient and effective domestic supply chains that are internationally competitive against import chains, support economic growth and help keep down the cost of the products we buy. It is estimated the transport and logistics sectors of the Australian economy contribute 14.5 per cent of Gross Domestic Product (GDP), with Australia's supply chain worth an estimated $150 billion every year.[5] Efficient transport of Australian exports to world markets maximises the economic returns to the Australian economy.[6]

Productive ports, freight networks and other critical infrastructure are the key to efficient supply chains and to Australia's competitiveness. Better infrastructure has a critical role in lifting our nation's wealth and prosperity[7] and the effective operation of national freight is integral to the wellbeing of all Australians.[8] Inefficient infrastructure networks are one of the key reasons why Australia's productivity has declined and a key driver of the cost of living pressures affecting Australians.[9]

The east coast of Australia comprises 18 million residents (79 per cent of Australia's population), nine million jobs (78 per cent of Australia's national employment) and contributes $1.1 trillion in Gross State Product (GSP) (75 per cent of GDP).[10] The freight task on the east coast is significant, with the interstate freight task alone projected to increase by 70 per cent by 2030 to 140 billion tonne kilometres. The Melbourne to Brisbane corridor already supports 17 per cent of these interstate movements.[11] Export trade through the east coast ports is estimated to contribute approximately $260 billion in exports annually.[12]

With Australia's east coast population forecast to increase by 60 per cent over the next 40 years, the need for efficient and effective freight transport will continue to increase in importance.[13] Strong forecast population growth, accompanied by comparable growth in employment, is likely to place significant pressure on existing infrastructure and services. Changing demographics, in particular an ageing population, could also lead to changing settlement patterns and changing travel propensities increasing the need for additional capacity in the nation's passenger and freight networks, particularly in our capital cities.[14]

The vision for the east coast freight network is to have the right infrastructure in place to support highly productive and low cost freight services

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5 DIRD, A study of the potential for dedicated freight infrastructure in Australia, 2014.

6 Infrastructure Partnerships Australia, Meeting the 2050 Freight Challenge, Page 4, Section 1, Economic Impacts, 2009.

7 DIRD, Inland Rail Website, https://www.infrastructure.gov.au/rail/inland/, 2015.

8 Infrastructure Partnerships Australia, Meeting the 2050 Freight Challenge, 2009.

9 The Coalition's Policy to Deliver Infrastructure for the 21st Century, September 2013.

10 Sources: Estimated Resident Population: ABS 31.104, Table 4, December 2013 (NSW, VIC, QLD and ACT comprise 18.3 m of 23.3 m Australian residential population); Employment: ABS 6202012 Table 12, July 2014 (NSW, VIC, QLD and ACT comprise 9.06 m of 11.59 m Australian employed persons); GSP: ABS 5220001, Table 1, Chain volume measures and current prices, 2012–13 (NSW, VIC, QLD and ACT comprise $1139 b of $1521b GDP).

11 BITRE Research Report 120: Interstate Freight in Australia, 2010.

12 Note: This value is based on analysis of trade through Australia's ports in 2001–2002, which found that approximately 35% of Australian exports by value were shipped from Australia's east coast ports. This proportion was subsequently applied to 2012–13 data relating to the total value of Australia's exports in order to show the estimated current value. See Australian Bureau of Statistics, Trade Through Australia's Ports, available at: http://www.abs.gov.au/Ausstats/abs@.nsf/0/f49771da3cb0567dca256c750079144a/$FILE/Trade%20through%20Australia's%20ports.pdf.

13 Australian Bureau of Statistics, Population Projections Australia 2006–2101, 2008 (Series B forecasts updated).

Without additional investment in infrastructure capacity, the repercussions will be felt at state and national levels.

Much of the forecast population growth will occur in cities.[15] Australian cities have historically relied on accommodating a large proportion of an increasing population in new developments on their periphery, increasing their urban footprint. This creates challenges for urban transport systems as increased activity leads to increasing congestion and pressure on capacity for all transport modes. Sydney, Melbourne and Brisbane are the three largest contributors to the cost of urban transport congestion in Australia and are likely to remain so, with the cost of congestion on the road network forecast to rise to around $20 billion a year by 2020.[16]

Strong growth in passenger transport demand over the past decade is also progressively eroding surplus capacity on urban rail and road networks, increasing the competition between passenger services and freight services.
The pressure on passenger transport will continue to increase in line with the growth in urban population and employment requiring governments to continue to expand capacity. Significant investment will be required to ensure services efficiently meet future demand.

Connecting people and businesses on the east coast to cities, regions and export ports with efficient and effective freight transport services is important for the economic development and vitality of regional communities.
Regional communities rely on freight networks of rail and road services, although road transport presently dominates the regional freight market. In Victoria and New South Wales alone, there are over 40 000 kilometres of state, regional and local roads and so it will be an ongoing challenge for governments to ensure the regional road system is well maintained, safe and efficient with a growing freight and passenger transport task.[17]

Inefficient infrastructure networks are one of the key reasons why Australia's productivity has declined and are also a key driver of the cost of living pressures affecting Australians

Source: The Coalition's Policy to Deliver the Infrastructure for the 21st Century, 2013.

FUNDAMENTAL PROBLEMS FACING NORTH-SOUTH CORRIDOR FREIGHT

As the regional and interstate freight tasks grow, rail and road infrastructure in the north–south corridor in particular will face progressive challenges in meeting future demand and there will be increasing pressure on freight capacity between capital cities and from the regions to export ports and urban freight destinations.[18] The ability of current freight infrastructure in the corridor to cater for growth and offer efficient, cost effective freight transport services for the east coast of Australia into the future is characterised by the following problems:

- **Capacity:** Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand. The primary road freight route between Melbourne and Brisbane is shared by mix of local traffic, private vehicles and freight vehicles expected to increasingly compete for road space, and the Newell Highway in particular is expected to reach capacity and experience delays.[19] The existing rail freight network through Sydney is largely shared track with dedicated freight infrastructure from the Port of Botany to Macarthur. Growth in metropolitan, regional and interstate rail services will mean the Southern Sydney Freight Line and the Northern

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14 The Transport for NSW Long Term Transport Masterplan Discussion Paper, 2012, for example, discusses the implications of an ageing population on transport, including a greater reliance on buses, trains and community transport services.

15 Australian Bureau of Statistics, Population Projections Australia 2006-2101, (Series B forecasts updated), 2008.

16 BITRE, Estimating urban traffic and congestion cost trends for Australian cities, Working Paper 71, 2006.

17 In NSW, there is over 18 000 km of state roads and almost 3000 km of regional and local roads. In Victoria, VicRoads manages over 22 000 km of roads.

18 Coastal shipping and air freight have been considered but given their market characteristics and inability to be considered as scalable, efficient and cost-effective have not been identified as alternative options to Inland Rail in terms of their ability to address east coast and north-south corridor freight problems.

19 NSW Government, 'Draft Newell Highway Corridor Strategy'.

Sydney Freight Corridor, with the latter being shared with passenger services, are expected to reach capacity (in the absence of Inland Rail) in 2020–21 and 2049–50 respectively.

- **Productivity:** Current north–south freight infrastructure (road and rail) is constrained and this will increasingly impact negatively on broader transport network performance and freight productivity. The Melbourne to Brisbane intercapital freight task is currently dominated by road comprising an estimated 100 000 truck trips per annum. [20] Given the shared nature of road infrastructure, the level of congestion created by road freight has flow on productivity implications for freight and other users of the road network. In contrast, rail transport provides the opportunity to remove 161 trucks for every train between Melbourne and Brisbane, and to minimise network congestion.[21]
  Rail transport also provides more cost effective options for the freight sector, with the cost differential expected to widen in the future. Road freight is more susceptible to driver shortages, rising fuel prices and the level of broader road network congestion resulting in stop-start conditions and longer, more costly trips.
- **Social and environment:** The continued reliance on road for freight transport will result in increasing safety, environmental and social impacts with associated costs to the community. Key roads used to transport the freight task in the north-south corridor are characterised by higher than average severity of incidents of similar classes of roads, including on the Newell Highway and Warrego Highway. This can be attributed to a number of factors including high speeds and a higher percentage of heavy vehicles along the highway. Furthermore road accidents causing death or serious injury are nearly three times more likely relative to rail. Similarly the environmental externality cost of heavy vehicles is far greater compared to rail in particular related to fuel emissions and start-stop conditions.
- **Regional and growth:** Existing north–south freight infrastructure is impacting regional producers and industries access to efficient supply chain networks, inhibiting productivity and economic growth. The east coast regional rail network, in its current state, reflects a legacy of poor alignments and inadequate investment, limited capacity and low productivity, rather than a purpose built highly productive rail freight network.
- **Resilience:** Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability. There are limited options for rail freight to bypass incidents on the existing Melbourne to Brisbane coastal rail corridor, which means that incidents have the potential to impact freight along the entire length of the route. During incidents such as floods, freight operators may experience considerable delays, or must allocate freight movements to road (which may also be constrained depending on the incident). In addition, the shared nature of the coastal rail infrastructure between passenger and freight significantly impacts on freight reliability.

THE NEED FOR A STRATEGIC APPROACH

The policy, service and investment solutions to these problems will be multi-faceted. The vision for the east coast freight network is to have the right infrastructure in place to support highly productive and low cost freight services. The interstate rail and road networks are the backbone of the national freight network, providing the arterial means of moving freight between our cities and through our international gateways. The interstate network needs to be integrated with regional and local freight networks via efficient and effective connections.

Capital city transport networks will increasingly need to be dedicated to the growing passenger and freight needs of the urban population. Uses that do not directly support the needs of the urban population, such as transiting through-

[21] Estimate of 161 trucks is based on 3600 metre trains and is equivalent to 149 B-double or 240 semi-trailer trips

freight, should be diverted to other routes. The growth and livability of regional towns will also increasingly require separation and management of growing freight traffic.

A balance of freight transport capabilities, where the right mode is used to fulfil the right freight task at the right price, will support the delivery of government's economic, environmental and social objectives. Rail transport, particularly along the north–south backbone, has a significant role to play in realising the future vision for an efficient east coast freight network. International and Australian experience supports the proposition that rail is the most efficient mode for the transport of bulk freight travelling from regional areas to export ports and urban destinations and for containerised freight travelling long distances.

An efficient rail network and competitive rail services will reduce the nation's reliance on road transport, and as a consequence, reduce road congestion, lower carbon emissions, reduce noise, reduce deaths and injuries from road accidents, improve amenity in urban and regional centres and enable mines and agricultural businesses in regional areas to remain productive.

Much of the regional rail network, however, reflects a legacy of low capacity and inefficient services unsuited to the needs of contemporary freight markets. Current rail infrastructure only supports low capacity trains and in some instances there is simply no rail infrastructure supporting our supply chains (e.g. northern New South Wales agricultural freight access to Port of Brisbane to target export markets is only possible by road).

Progressive upgrades of the existing north–south rail corridor have delivered significant improvements in capacity, performance and reliability but structural limitations of the existing rail alignment will constrain rail's capacity to support the future transport task on the east coast.[22] The coastal route will always have limitations of gradient due to steep topography, particularly between Sydney and Brisbane. The route is likely to remain limited to single-stacked trains due to the electrified track through the Sydney metropolitan area, a vast network of overbridges and many tunnels, and is never likely to have a dedicated freight rail corridor in northern Sydney due to conflicts with the existing passenger infrastructure.

A range of potential regulatory, policy and operational reforms would enhance the productivity of freight services and better utilise existing freight capacity (e.g. heavy vehicle pricing, labour efficiencies) but the scale and significance of the expected growth in the freight task will mean that ongoing investment in freight network infrastructure will nevertheless be required.

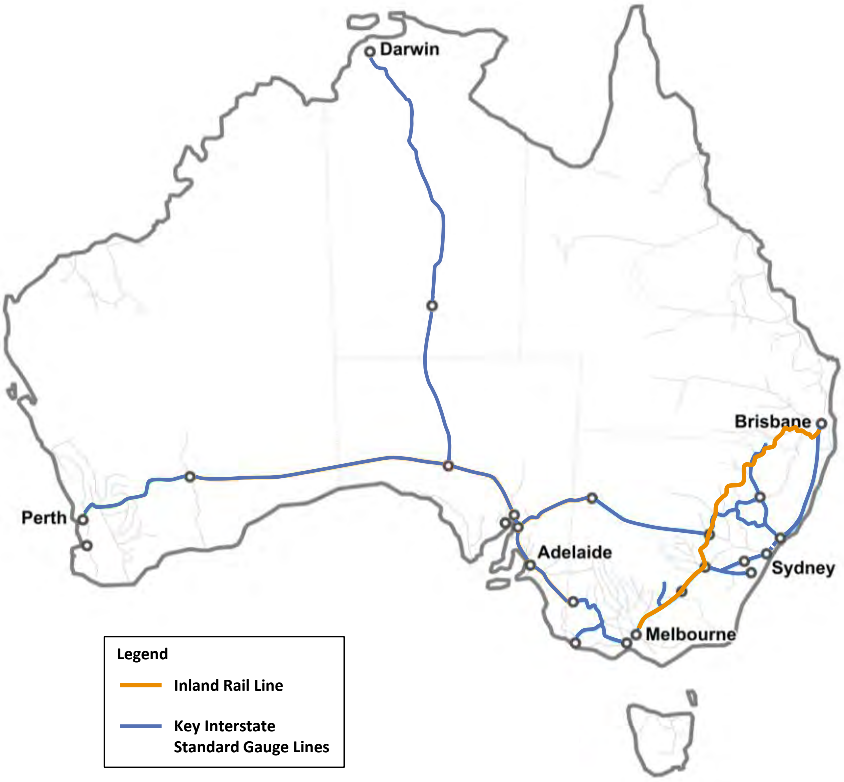
A commitment from both federal and state governments is now required to proceed with Inland Rail to realise the vision for Australia's east coast freight network and an efficient national freight supply chain. An incremental approach which progressively augments existing rail and road networks is unlikely to deliver the outcomes for freight that will support our aspirations for national productivity and economic development. Inland Rail provides a strategic opportunity to make a decisive step change in the capacity and capability of the national rail system.

BUILDING THE BACKBONE OF THE EAST COAST RAIL NETWORK

Upgraded and competitive rail services will deliver significant benefits to the freight market and to state and national economies. Inland Rail provides an opportunity to create a step change in efficiency and performance by enhancing the north–south freight backbone along the east coast. Inland Rail's infrastructure will facilitate reliable, and cost and journey time competitive rail services between Brisbane and Melbourne, Perth and Adelaide with capacity available at times that suit the needs of the market. Inland Rail's connection to the national standard gauge network is shown in Figure 0.2.

22 Reliability is defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised.

Figure 0.2 Australia's Standard Gauge Network – Inland Rail connection



Source: ARTC rail network maps, PwC analysis, 2015.

The new rail alignment west of the Great Dividing Range offers significant performance and cost advantages over the existing coastal route, including fast transit times, efficient alignment and optimal grades and facilities, double stacking and longer, heavier axle load trains. It would improve the reliability and resilience of the freight network and improve access to export ports and urban freight destinations, free up east coast rail for passenger and local freight, and free up road space for private vehicles.

The diversion of Melbourne to Brisbane regional rail freight from the Sydney and Brisbane metropolitan rail networks, and the transfer of road freight (which currently largely transits along the Newell Highway through regional towns in Victoria, New South Wales and Queensland) onto Inland Rail will reduce the competition for scarce capacity on the rail and road networks of these major cities and regional centres. It is predicted that Inland Rail will remove up to 200 000 truck movements from roads on the east coast.[23]

More effective and low cost supply chains would in turn provide an impetus for regional growth and help to unlock the full potential of Australia's east coast regions, including Australia's four richest farming regions and abundant mineral, energy and building resources. Low cost supply chains also support the expansion and development of associated service industries and other value adding businesses in the regions.

The Programme will be a catalyst for complementary supply chain investments that exploit the enhanced logistics capability of Inland Rail

[23] Result of PwC economic analysis, estimated for 2049-50 once Inland Rail is fully developed. The number of truck movements removed from roads includes intercapital and agricultural freight and is estimated to increase as the total freight task increases post 2049-50.

Inland Rail complements and further builds upon other significant infrastructure investments of state and federal governments and the private sector. Examples include the expansions of the Ports of Melbourne and Brisbane and improvements in the reliability and performance of the interstate rail network by the Australian Government through ARTC and Transport for New South Wales (TfNSW). The Productivity Commission has recognised that Australian governments should ensure infrastructure project selection takes explicit and detailed account of, among other things, the enhanced use of existing infrastructure.[24]

Inland Rail will also provide the backbone infrastructure for complementary private sector investment in more efficient supply chains serving capital city, regional and global markets. Expected complementary investments will include:

- Upgraded and enhanced rollingstock to exploit the capability of Inland Rail to deliver longer and heavier trains.
- Double stack terminal capacity in Melbourne and Brisbane with an ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Ability to establish Parkes as a national freight hub given its location on the intersection of the north–south and east–west corridors.
- Regional, fit-for-purpose terminals and loading facilities for regional/agricultural/coal freight.
- Investment in connecting coal and agricultural rail lines from the Surat Basin in south west Queensland to the Port of Brisbane and in other regional locations on the east coast.

Further transformative opportunities enabled by Inland Rail include the creation of new and expanded regional industries, including rail based warehousing and associated freight precincts, that are able to exploit the enhanced logistics capability and efficient supply chains enabled by Inland Rail. Because these benefits are more speculative, they have not been captured in the quantitative feasibility analysis presented in this business case, yet they represent real opportunities for industry and regional communities.

The 10 year delivery schedule would support economic activity in the regions and create regional jobs in Queensland, New South Wales and Victoria during both construction and operations.

An early commitment to an enhanced and competitive east coast rail network will be an important signal to the market and to the freight industry, allowing private sector investment to be progressively directed towards complementary projects that leverage the enhanced logistics capabilities of Inland Rail. Without such a commitment, companies will not be incentivised to invest in rail supply chains and may potentially lock into road-based logistics options which undermine future efforts to attract freight to rail.

CONSEQUENCES OF INACTION

The potential consequences of inaction are significant. Without a decision to make a step change in rail performance by implementing Inland Rail, the growth in freight demand will likely see increasing pressure on road networks, increased freight costs and a loss of economic opportunity. Road will increasingly become the dominant mode with rail becoming less market relevant.

An over reliance on road transport to deliver the future east coast freight task will increase potential vulnerabilities to demographic changes which are already driving shortages of long distance truck drivers, increasing costs and locking in future outcomes that are economically, environmentally and socially inferior.

[24] Productivity Commission, Inquiry Report on Public Infrastructure, Volume 1, No 71, May 2014.

A future without Inland Rail would see:

- More trucks on both urban and rural roads and a greater number of larger trucks (e.g. B-triples) mixing with passenger vehicles on major highways.
- An increased requirement for significant investment in major arterial and rural roads to accommodate the growth in road traffic.
- Lack of incentives for companies to invest in rail supply chains potentially locking them into road-based logistics options.
- An increase in road maintenance and rehabilitation requirements as a result of an increase in the number and size of heavy vehicles.
- A potential deterioration of safety on the road network because of the greater truck volumes, with more accidents, deaths and injuries.
- Greater environmental impacts as the freight task grows, with more congestion, carbon emissions and noise.
- Loss of community amenity, both in cities and the regions, from more and larger trucks sharing road networks.

Governments have already invested heavily in the road network on the east coast, including investments in the Hume Highway between Melbourne and Sydney, the Warrego Highway between Toowoomba and Miles, and the Pacific Highway between Sydney and Brisbane. The Toowoomba Second Range Crossing is being planned to address a key bottleneck on the Warrego Highway through Toowoomba.[25] The Hume Highway duplication between Melbourne to Sydney (approximately 810 kilometres) took more than 50 years to complete and there are estimates that if the entire project was carried out today, the total cost of the duplication would be $15–$20 billion ($2013).[26] The cost of the four-lane divided highway between Sydney and Brisbane on the Pacific Highway is expected to have an out turn cost of more than $15 billion.[27]

Significant duplication and capacity investment on the Newell Highway in Victoria and New South Wales which comprises approximately 1060 kilometres (60 per cent) of the road freight journey between Melbourne and Brisbane, are not yet part of funding commitments. However, in the absence of Inland Rail, they are likely to be required under a scenario of continued investment in road as the dominant freight mode on the corridor.

0.3. Programme definition

Extensive consultation with key market participants and other industry stakeholders has been undertaken to develop the service offering and scope of the Inland Rail Programme to ensure the infrastructure meets market needs in terms of service specification and performance.

Based on consultation with industry, the proposed alignment and scope of Inland Rail:

- Optimises the use of existing rail infrastructure.
- Is compatible and interoperable with high productivity train operations in the east-west corridor (to Adelaide and Perth).
- Bypasses bottlenecks on the congested metropolitan Sydney rail network.
- Optimises connections with regional and local rail and road networks.
- Maximises value for money in meeting the needs of the market.

25 Queensland Government, Warrego Highway Upgrade Strategy, p 10, 2012.

26 Engineers Australia, Hume Highway duplication complete, available at: http://www.engineersaustralia.org.au/news/hume-highway-duplication-complete, 2013.

27 Estimated based on past expenditure and estimates of the cost of sections yet to be completed ($2010 dollars and partly unescalated). Source: NSW Government, Pacific Highway Upgrade Submission to Infrastructure Australia, November 2011 (considering the $7.8 billion estimated cost of sections yet to be completed and Figure 3 indication of past expenditure 2006–2014).

MEETING MARKET NEEDS

To reflect the priorities of freight customers, the Inland Rail scope has been defined based on a target service offering to ensure a customer focus on outcomes as opposed to an infrastructure or engineering focus on outcomes. The target service offering was developed in consultation with key market participants, stakeholders and potential users (rail operators, freight forwarders and end customers).[28]

There are four key service attributes that have been identified as underpinning the market requirements for improved rail freight services in the corridor, namely reliability, transit time, price and availability. Availability relates to the availability of suitable train paths at the times that suit the needs of the market. In addition, improved interoperability and an ability to align the performance and capabilities of the north–south corridor with the east–west corridor (in terms of train lengths, axle loads and ability to double stack containers) is also important to improve connectivity, asset utilisation and efficiency.

The new line would be a faster, more efficient route that bypasses the congested north–south network through Sydney, resulting in an almost 10 hour transit time saving between Melbourne and Brisbane. Inland Rail would also enable the use of double stacked, 1800 metre and 21 tonne axle load (tal) trains along its entire length, with potential for 3600 metre, 30 tonne axle load trains into the future, delivering significant cost benefits.

The new and upgraded infrastructure would enable road competitive rail services with a less than 24 hour linehaul transit time between Melbourne and Brisbane, 98 per cent reliability, competitive costs and freight availability in line with market needs. A comparison of the existing coastal service offering for Melbourne to Brisbane and the proposed Inland Rail service offering is provided in Table 0.1.

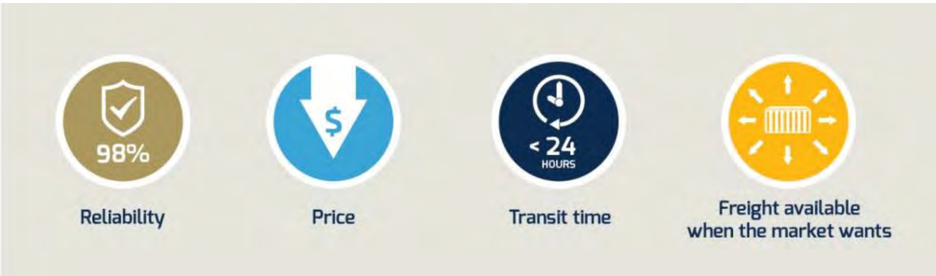


Table 0.1 Comparison of Melbourne to Brisbane coastal and Inland Rail service offering

SERVICE OFFERING	COASTAL RAIL 2014–15	INLAND RAIL	IMPROVEMENT
Transit time (linehaul)	32-34 hours	Up to 24 hours	10 hours
Reliability[1]	83%	98%	15%
Availability[2]	61%	95%	34%
Relative price (to road)[3]	85%	57-65%[29]	20-28%

Notes: 1) Reliability is defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised; 2) Availability refers to the percentage of available departure and arrival services that are convenient for customers, which depends on cut-off and transit times; 3) Relative price is presented for non-bulk inter-capital freight (door to door) indicating the range over the period 2024-25 to 2049-50.

Source: ARTC, 2015.

[28] These categories are not mutually exclusive. There is considerable vertical integration of rail operators, freight forwarders and end customers.

[29] 65 per cent in 2024-25 and 57 per cent in 2049-50 once Inland Rail is fully developed with 3600 metre trains.

DELIVERING AN OPTIMISED BACKBONE RAIL LINK

An optimised alignment has been developed that maximises the use of existing rail infrastructure whilst ensuring market needs are satisfied. Only 40 per cent of the proposed approximate 1700 kilometre route comprises new greenfield links, or upgraded links from narrow gauge to dual gauge in Queensland. The proposed works by category are summarised in Table 0.2.

Inland Rail will provide a new freight rail connection between Melbourne and Brisbane via regional Victoria, New South Wales and Queensland. Spanning approximately 1700 kilometres, it will create direct standard gauge rail connections between Queensland, New South Wales, Victoria, South Australia and Western Australia. The proposed route opens up opportunities for new purpose built freight terminals along the corridor serving national and local freight markets, including an east–west rail hub at Parkes in New South Wales.

Table 0.2 Proposed works by category

CATEGORY	SECTION	DISTANCE (KILOMETRES)	% TOTAL
Missing Links *New greenfield sections, and sections in Queensland upgraded from narrow to dual gauge*	Illabo to Stockinbingal	37	41
	Narromine to Narrabri	307	
	North Star to Oakey	239	
	Gowrie to Grandchester	73	
	Grandchester to Kagaru	54	
	Sub-total	**709**	
Upgrading works *Upgrading of existing sections to main line standards*	Parkes to Narromine	107	18
	Narrabri to North Star	186	
	Sub-total	**293**	
Enhancement works *To enable double stacking, and some capacity enhancement with new passing loops*	Tottenham (Melbourne) to Illabo	490	41
	Stockinbingal to Parkes	173	
	Oakey to Gowrie	11	
	Kagaru to Acacia Ridge	35	
	Sub-total	**709**	
TOTAL		**1710**	**100**

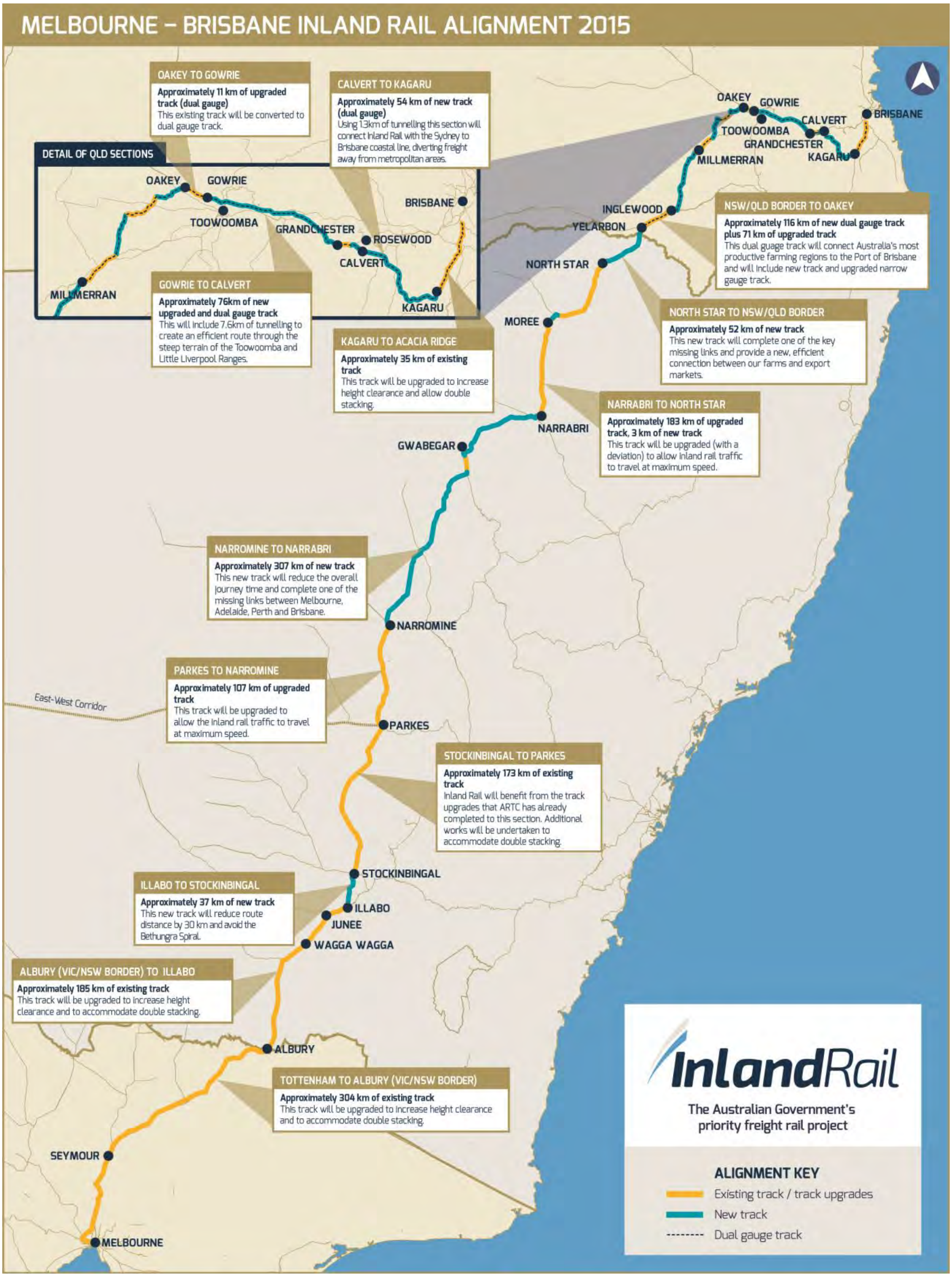
Note: distances subject to refinement and final alignment. Totals may not sum due to rounding.

Source: ARTC, 2015.

Delivery of complementary infrastructure, such as metropolitan and regional terminals, upgraded fleet and complementary land use and freight precinct developments are outside the scope of the Inland Rail Programme.

The Inland Rail alignment, sections and technical features developed to meet the target service offering are outlined in Figure 0.3.

Figure 0.3 Inland Rail alignment



Source: ARTC, 2015.

0.4. Programme feasibility

OVERVIEW

The nature of the Inland Rail Programme, being a strategic investment with broad and long-term impacts, requires assumptions and forecasts that extend well into the future. It is therefore necessary to develop a logically consistent set of assumptions that reflect the likely future without Inland Rail, based for the most part on existing policy directions.[30]

Similarly, a logically consistent set of assumptions must be developed that reflects a likely future, with Inland Rail integrated into freight networks across the east coast and nationally. In developing these alternative sets of assumptions that underpin the appraisal of a future investment in Inland Rail, it is important to maintain strategic coherence. This means the base and option cases should be focused against the problems and challenges the nation's future investment in transport services and infrastructure will seek to address. The cases with and without Inland Rail reflect alternative policy responses to tackling these future challenges.

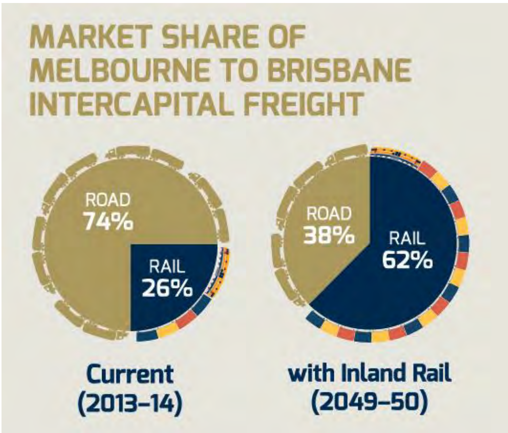
Within the Programme Business Case, each scenario has been constructed in a logical way. For instance, it is assumed that competition between rail operators will ensure that rail freight efficiency gains facilitated by the investment in rail infrastructure are passed on to customers. It also assumes that government does not invest in high productivity road vehicle (B-triple) access across the corridor in direct competition to Inland Rail. Access charges have been assumed to be set to encourage rail volumes (and thus the economic benefit of Inland Rail) rather than to maximise financial revenue (and thus the financial performance of Inland Rail).

Many of the benefits of Inland Rail flow from the development of purpose built backbone infrastructure integrated commercially and operationally into the national rail network, including integration with the existing coastal route. The notion of setting up Inland Rail as a competing route to the coastal route so as to deliver competitive choice to transport operators would lead to fragmented service delivery, the creation of additional operational and commercial interfaces and overall loss of efficiency. The investment in Inland Rail would be optimised by ensuring it is fully integrated into the national rail network and offers interoperability which is strongly desired by train operators.

DEMAND AND MARKET TAKE UP

The Programme Business Case demand assessment has found there would be strong market appetite to leverage the enhanced capabilities of Inland Rail with a significant uplift in rail market share:

- Rail's share of the Melbourne to Brisbane market is projected to increase by 36 percentage points by 2049–50 which translates into an additional 3.1 million tonnes (64 per cent increase) of freight on rail between Melbourne and Brisbane compared to a future without Inland Rail.
- An additional two million tonnes of agricultural freight would be attracted from road to rail, particularly grain and cotton from New England, and grain from the Darling Downs. Significant volumes of existing grain movements (approximately 5.8 million tonnes in 2049–50) to east coast ports would utilise Inland Rail for part of their journey.



[30] For example, it is assumed no comprehensive road pricing system is in place.

- Growth in coal exports from the Surat and Clarence-Morton Basins—up to 19.5 million tonnes compared with the existing eight million tonnes, could become viable as a result of Inland Rail, subject to prevailing coal prices and sufficient capacity at the Port of Brisbane and upgrades to feeder lines.[31]

The estimated market take-up of Inland Rail by key market segment is provided in Table 0.3 and Figure 0.4 presents forecast volumes (net tonne kilometres) by freight type in 2049–50.

Table 0.3 Forecast Inland Rail combined north and southbound volumes

		2024–25	2029–30	2039–40	2049–50	2059-60	2069-70
NET TONNES (000)							
Intercapital/ intermodal	Melbourne to Brisbane	3195	4008	5674	7906	10 522	13 986
	Brisbane to Adelaide	560	690	997	1412	1951	2701
	Brisbane to Perth	878	1034	1398	1815	2303	2906
Regional	Coal (SEQ-Brisbane)*^	12 900	19 500	19 500	19 500	19 500	19 500
	Agricultural products	6750	7129	7954	8873	9899	11 043
Total		**24 283**	**32 361**	**35 523**	**39 507**	**44 175**	**50 137**
NET TONNE KILOMETRES (MILLIONS)							
Intercapital/ intermodal	Melbourne to Brisbane	5527	6934	9817	13 677	18 204	24 197
	Brisbane to Adelaide**	573	707	1021	1447	1998	2767
	Brisbane to Perth**	900	1059	1432	1860	2360	2978
Regional	Coal (SEQ-Brisbane)*^	3973	6292	6292	6292	6292	6292
	Agricultural products	1687	1782	1988	2218	2475	2761
Total		**12 660**	**16 774**	**20 550**	**25 494**	**31 328**	**38 994**

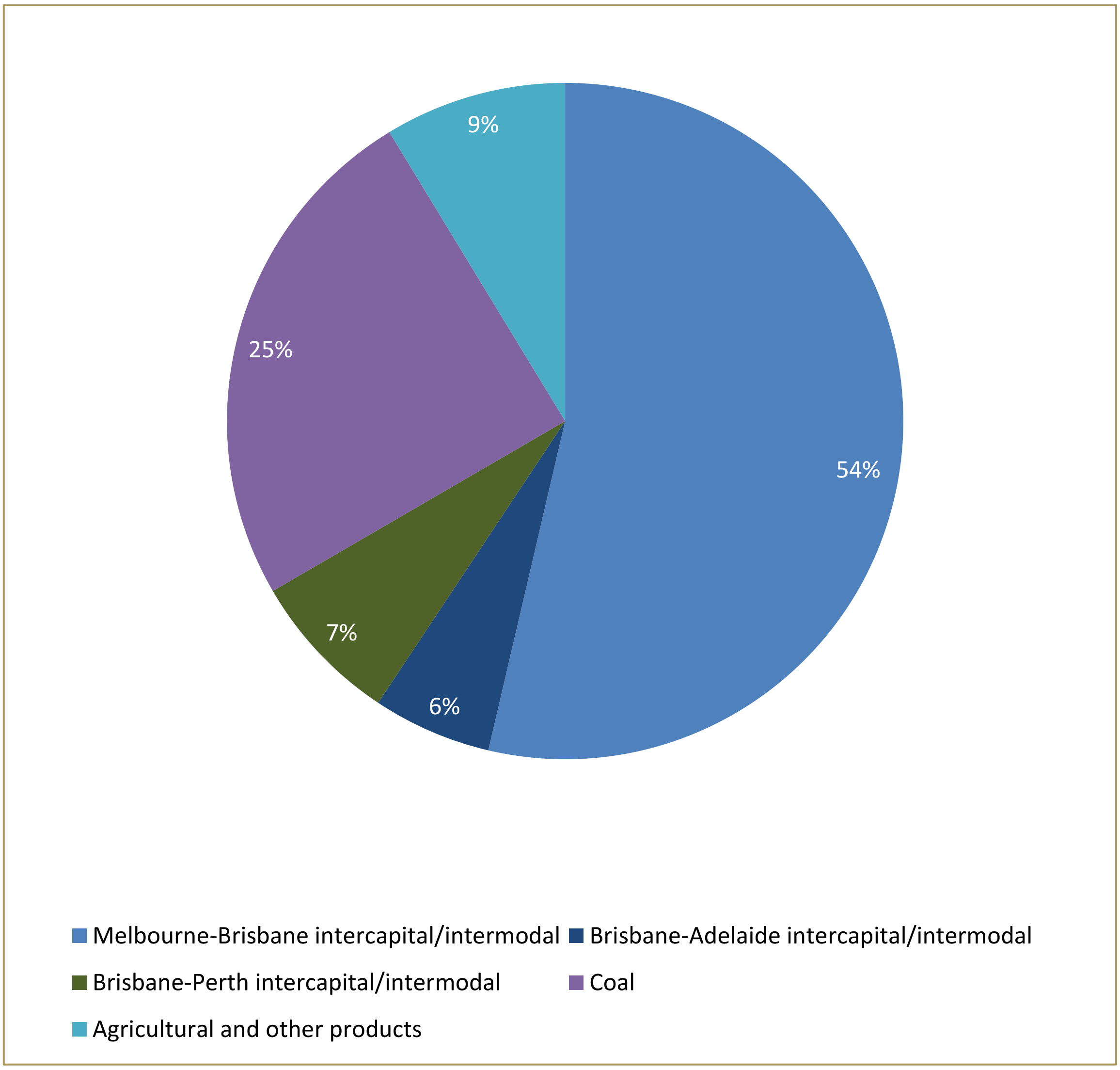
Note: SEQ is an abbreviation for South East Queensland.*Excludes net tonne kilometres for intercapital freight travelling between Adelaide to Brisbane and Perth to Brisbane that occurs beyond Inland Rail (i.e. from Parkes to Adelaide and Perth respectively).
^ These forecast volumes are within the existing maximum 87 coal paths per week that can potentially be contracted on the Metropolitan Network (set by QR).[32] These volumes would require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: ACIL Allen, 2015.

[31] Preliminary analysis suggests a thermal coal price of US$75 per tonne would be required to support the expansion of coal tonnages.

[32] Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 2, May 2015.

Figure 0.4 Inland Rail combined north and southbound volumes by freight in 2049–50 (net tonne kilometres)



Source: PwC, ACIL Allen, 2015.

CONSTRUCTION COSTS

The 10 year programme costs for Inland Rail have been developed by a team of internal ARTC and external independent experts. A total P50 (P90) construction cost of $9.9 ($10.7) billion has been estimated. A qualitative and quantitative risk assessment process was followed to determine the P50 and P90 contingency allowances to be included in the cost estimate.

The P50 and P90 cost breakdown for Inland Rail over the 10 year programme is provided in Table 0.4. The base cost estimate excludes passing loop costs assumed to occur later in the Inland Rail operational period outside of the 10 year programme.[33]

[33] For instance, to facilitate 3600 metre trains.

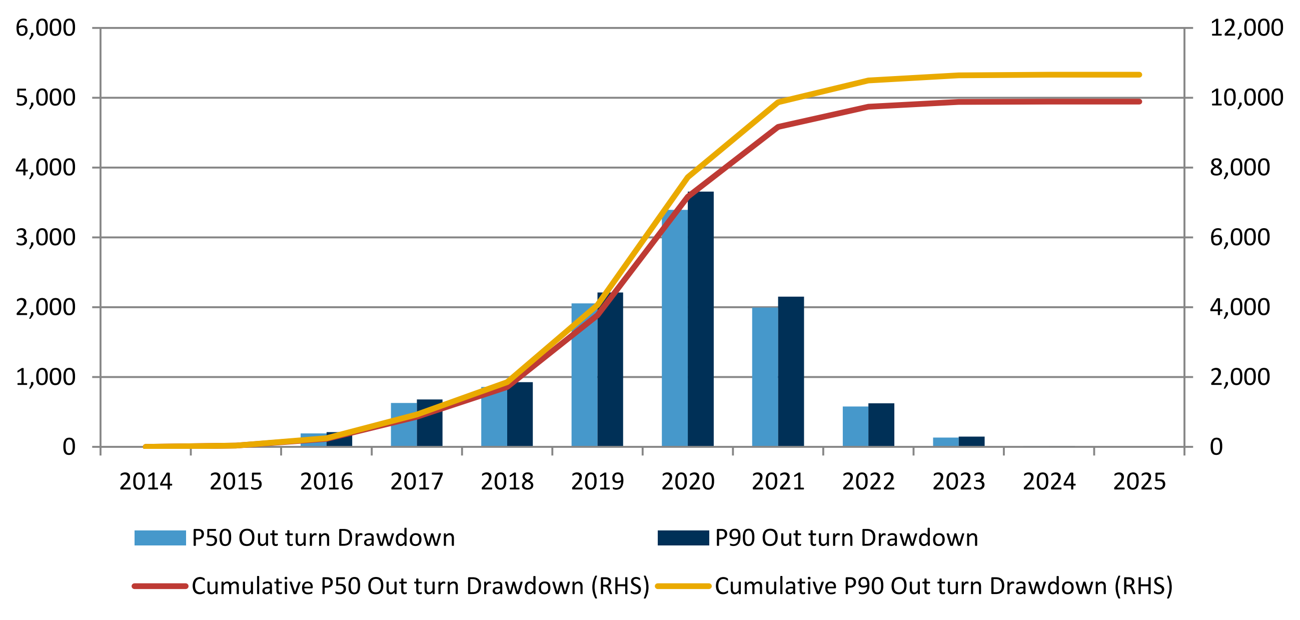
Table 0.4 Inland Rail P50 and P90 out turn capital cost over 10 year programme ($ million, nominal, undiscounted)

ITEM	P50 COST ESTIMATE ($ MILLION)	P90 COST ESTIMATE ($ MILLION)
Base Costs (Real 2015)	6926	6926
Contingency (P50 - 26%) (P90 – 36%)	1811	2490
Escalation Component	1152	1241
Total out turn cost	**9889**	**10 657**

Source: ARTC, 2015

A summary of the annual construction costs over the 10 year programme is outlined in Figure 0.5.

Figure 0.5 Annual out turn construction costs over the 10 year programme ($ millions) – P50 and P90 estimate



Source: PwC, 2015.

FINANCIAL ANALYSIS

A financial analysis has been undertaken to assess the indicative financial feasibility of Inland Rail assuming it is delivered solely by the Australian Government. In this way the financial appraisal assesses Inland Rail as a Public Sector Comparator as defined in *National Public Private Partnerships Guidelines* which assumes the Programme is procured, constructed, owned and operated by the Australian Government. It does not include any consideration of financing costs, taxation considerations or the potential involvement of any private sector party (including associated contracting structures), therefore does not capture the full range of potential costs. Tax, ownership and procurement options are being considered separately by the Department of Infrastructure and Regional Development (DIRD).

The appraisal has been undertaken on a standalone basis. As such, it does not take into account any dilution of ARTC revenue (and hence Government dividends) from freight services transferring from the ARTC controlled coastal route to Inland Rail.

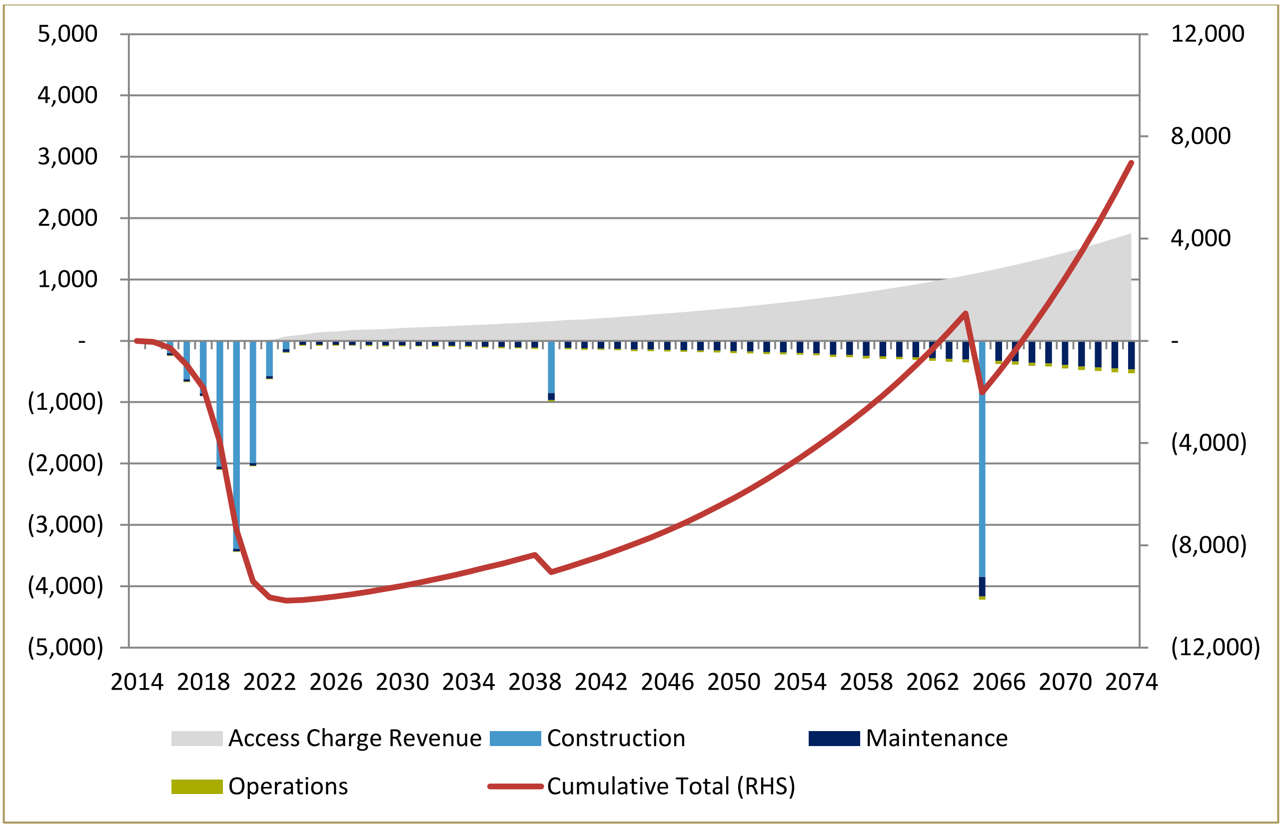
The financial analysis indicates that initially, Inland Rail would not generate sufficient access revenues to cover the full costs of the Programme, including capital, operations and maintenance costs. Excluding capital costs, however, Inland Rail would be cash flow positive with access revenues sufficient to cover on-going operations and maintenance costs plus a margin. Financial analysis based on project costs (P50) and revenues over the construction and subsequent 50 years of operation is summarised in Figure 0.6. The following additional capital costs are included in the financial analysis:

- Costs scheduled to occur 15 years into operation of Inland Rail to accommodate the extension of passing loops and all major periodic maintenance and other required costs.
- Costs scheduled to occur 40 years into operation of Inland Rail relating to additional loops required to meet future capacity.

Inland Rail would eventually generate enough cash flow to offset the large capital outlay in nominal terms after approximately 42 years from construction.

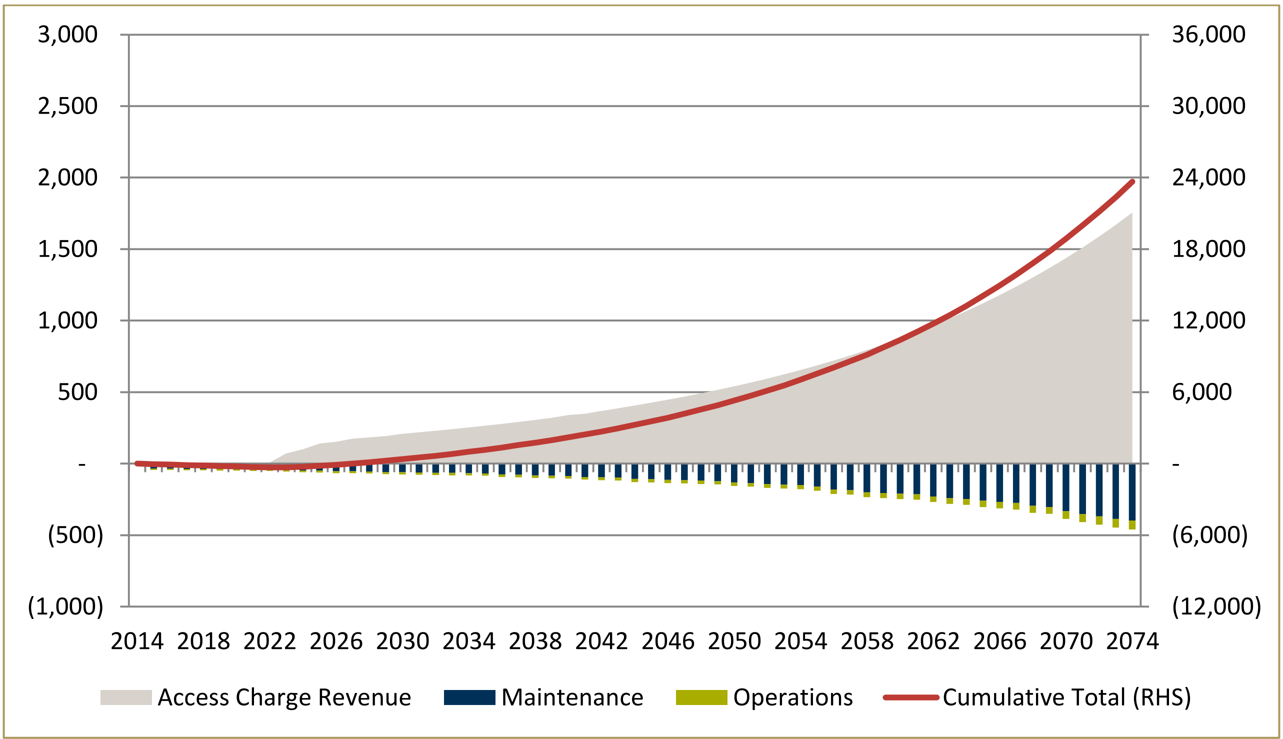
The ongoing operating costs and revenues (i.e. excluding the initial capital outlay) is provided in Figure 0.7. Inland Rail is cash flow positive from commencement of operations and by the end of the evaluation period, it generates substantial positive cash flow.

Figure 0.6 Inland Rail financial assessment: Summary of Inland Rail costs and revenue ($ million – nominal)



Source: PwC, 2015.

Figure 0.7 Inland Rail Financial assessment: Summary of Inland Rail ongoing costs and revenue ($ million – nominal)



Source: PwC, 2015.

In the financial analysis, access charges have been set to maximise rail volumes rather than to maximise financial revenue. For example, charges per tonne have been matched with coastal route charges and coal access charges have been set to maximise the volume of coal that can be accommodated within the assumed cap of 87 coal train paths while providing sufficient revenue to cover Inland Rail below rail operating and maintenance costs. This approach favours rail mode shift thereby maximising economic benefits.

Intercapital revenue represents approximately 75 per cent of the total revenue estimated to be generated by Inland Rail business. Coal and agricultural revenues are still important contributors. Given coal demand volumes and resulting revenue have been developed based on achieving the long term Newcastle benchmark spot coal price of US$75, the ability to achieve estimated coal revenue is dependent on realising the long term coal price in any one year.

The net present value (NPV) and net present costs (NPC) for Inland Rail cash flows (before financing) over a 50 year operational period is shown in Table 0.5. Although Inland Rail is unable to recover the full costs, revenue is sufficient to recover on-going operations and maintenance costs and generate a positive margin.

Table 0.5 Public Sector Comparator financial appraisal results for Inland Rail (Programme NPV (NPC), $ million, discounted, pre-tax nominal cash flows excluding financing costs, 2014–15 dollars)

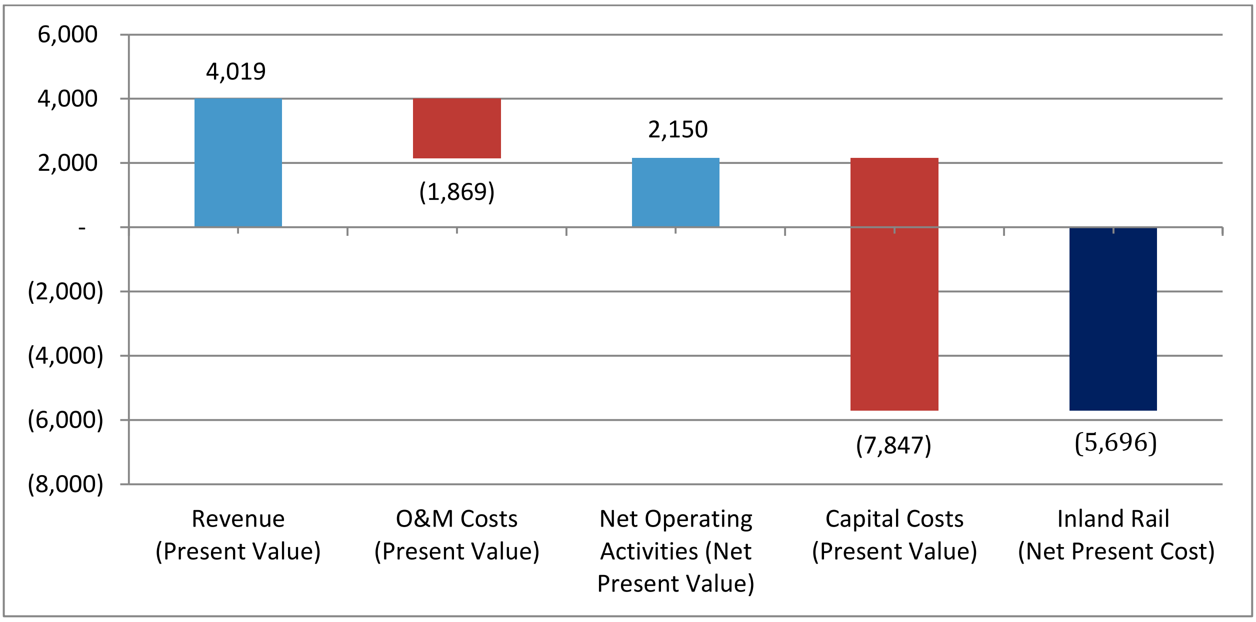
INLAND RAIL PROGRAMME COSTS AND REVENUES (50 YEAR OPERATIONAL PERIOD)	NPV / NPC ($ MILLIONS)
Costs	
Capital costs^	(7847)
Operating costs	(294)
Maintenance costs	(1574)
Total recurrent/ongoing costs	**(1869)**
Total costs	**(9716)**
Revenues	
Steel	29
Grain	127
Intercapital/intermodal	2819
General Freight	59
Passenger	4
Coal^	968
Minerals	13
Total revenues	**4019**
Programme: operating cash flows only (excluding capital costs)	**2150**
Programme: total cash flows	**(5696)**

Notes: Totals may not sum due to rounding; analysed over 50 year operating period and discounted applying 5.6% pre-tax, nominal discount rate; based on P50 cost certainty; excludes Port of Brisbane Extension; requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

The financial assessment results in Table 0.5 are shown graphically in Figure 0.8 below.

Figure 0.8 Inland Rail financial assessment: summary of Inland Rail costs and revenue ($ million)



Source: PwC, 2015.

ECONOMIC ANALYSIS

A conventional economic cost benefit analysis (CBA) methodology has been applied to provide an assessment of the costs and benefits of Inland Rail that can be valued in monetary terms taken from the perspective of the community as a whole. It also includes an assessment of externalities, such as environmental impacts and accident cost savings. The CBA helps to establish the overall economic merit of a potential future investment in Inland Rail.

The nature of the Inland Rail Programme is such that the economic impacts are broad and long term, and not easily measured. The Programme is also a critical enabler for complementary investments in land use and supply chains that leverage the enhanced logistics capabilities of Inland Rail. These benefits are also not easily identified or measured as they will in practice evolve and change over time with changes in a complex domestic economy.

To establish a rigorous economic assessment of measurable benefits, the CBA has focused on direct user benefits in core markets, such as the intercapital/intermodal market, and relevant externality impacts that arise from a mode shift to rail. However, in recognition of the broad and long term nature of the Programme, a four per cent discount rate has been adopted in preference to a more conventional seven per cent discount rate, although both have been included for comparative purposes. A lower discount rate of four per cent is consistent with international practice for large scale long lived infrastructure projects. A 50-year appraisal period has also been applied, consistent with Australian Transport Council (ATC) guidance.

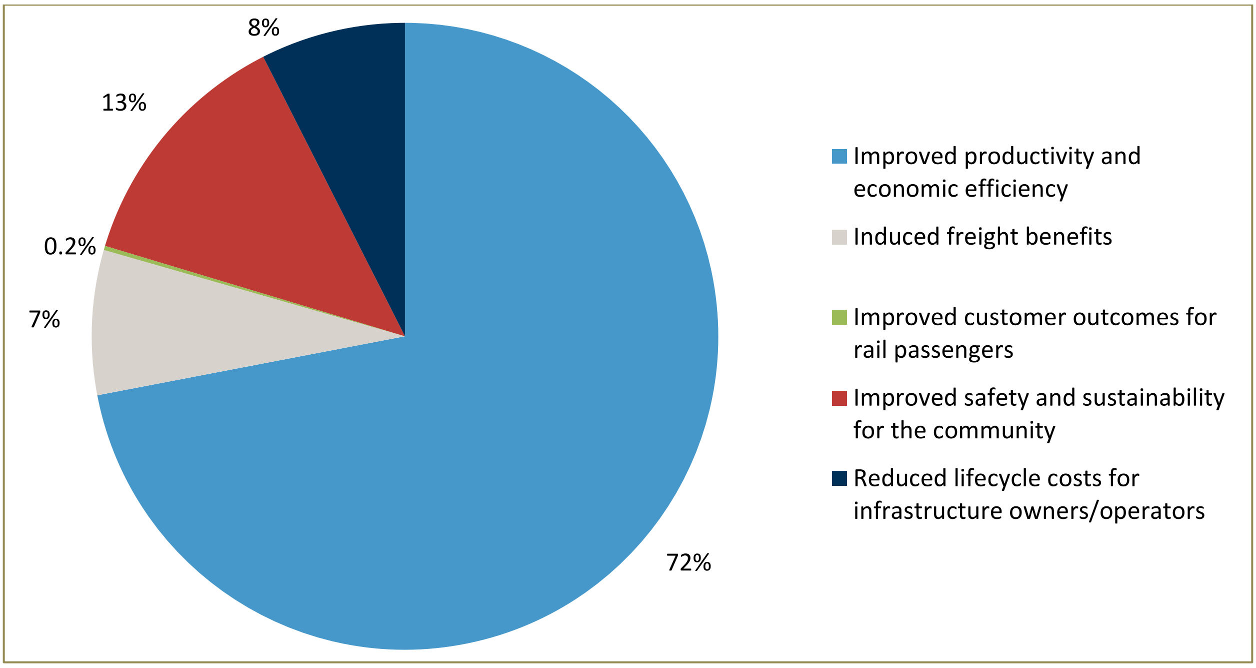
Quantified benefits included in the CBA are as follows:

- Improved productivity and economic efficiency as a result of operating cost savings, shorter transit times, improved reliability, improved availability and avoided incidents on the coastal route. It is assumed these benefits will flow onto consumers of freight services through lower prices and improved services.
- Induced freight benefits which result from new demand being created because of the improved accessibility and efficiency of Inland Rail.

- Improved customer outcomes for rail passengers in Sydney and Brisbane because unused freight paths on the coastal route are returned to passenger services and the increased frequency of services reduces average wait time.
- Safety and sustainability benefits for the community as a result of removing heavy vehicles from the road network, reducing the distance travelled for rail freight and separating freight and passenger rail, including reduced road traffic congestion, fewer emissions of carbon/pollution and less noise.
- Reduced lifecycle costs for infrastructure owners/operators on the coastal route and road network as a result of lower freight volumes which reduce maintenance costs and enable investments in capacity to be avoided or deferred.

A summary of the distribution of quantified Inland Rail benefits as a proportion of total benefits is provided in Figure 0.9. A residual value has also been calculated reflecting an assumed 100 year economic life for rail assets and the future stream of net benefits beyond the 50 year appraisal period.[34] The residual value has been captured in net terms as a lump sum discounted to the final year of the appraisal and amounts to about 35 per cent of total benefits.

Figure 0.9 Distribution of Inland Rail benefits (discounted at four per cent), excluding the residual value



Source: PwC, 2015.

It is important to note, any benefits associated with terminals have not been captured in the economic appraisal as intermodal terminals are outside of the scope of the Inland Rail Programme.

Below rail operating, maintenance and major periodic maintenance cost were developed for Inland Rail by ARTC. These have been prepared from a first principles assessment considering the asset base, geographical layout and applying current ARTC business principles and developed on a standalone basis for Inland Rail.

[34] ATC, National Guidelines for Transport System Management in Australia, Volume 4, p 44, 2005.

The Programme Business Case has found that an investment in Inland Rail has positive net economic benefits which are positive using both a four and seven per cent discount rate. The CBA economic appraisal results are summarised below in Table 0.6.

Table 0.6 Economic appraisal results for Inland Rail (incremental to the base case, discounted, real 2014–15 dollars)

INLAND RAIL PROGRAMME COSTS AND BENEFITS (50 YEAR OPERATIONAL PERIOD)	PV AT 4% DISCOUNT RATE ($ M)	PV AT 7% DISCOUNT RATE ($ M)
COSTS		
Capital costs (excluding escalation)	7650	6590
Operating costs	133	66
Maintenance costs	793	380
Total costs	**8575**	**7036**
BENEFITS ^		
Freight user benefits	10 525	4450
Induced freight benefits	1090	528
Improved customer outcomes for rail passengers	32	14
Improved safety and sustainability for the community	1828	776
Reduced lifecycle costs for infrastructure owners/operators	1106	550
Residual value of assets (future stream of ongoing benefits and costs reflecting 100 year asset life)	7921	833
Total benefits	**22 503**	**7152**
RESULTS		
Net present value of costs and benefits	**13 928**	**116.1**
Benefit cost ratio	**2.62**	**1.02**

Notes: Totals may not sum due to rounding; analysed over 50 year appraisal period to 2073–74 and discounted applying 4% and 7% real discount rates; based on P50 cost certainty; excludes Port of Brisbane Extension; requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Computable general equilibrium modelling of the national, state and regional impacts has been undertaken to estimate broader economy-wide impacts of Inland Rail's construction and operation. The estimated economy-wide impacts of the Inland Rail Programme are provided in Table 0.7. The Inland Rail Programme is expected to have a net positive impact of $16 billion on gross domestic product (GDP) over its 10 year construction period and 50 year operation. The Programme is also expected to deliver an additional 16 000 jobs at the peak of construction, and an average of 700 additional jobs per annum over the entire period.

The Programme would have a strong positive impact on the gross state product (GSP) of Victoria, New South Wales and Queensland. During construction, Queensland and New South Wales receive the largest shares of the stimulus due to most of the Inland Rail corridor being developed within these states, however Victoria will also benefit as it contains a significant share of the construction workforce. Once operational, Queensland and Victoria benefit most as they are the origin or destination for all intercapital freight or coal freight, while New South Wales also benefits as it is the most significant origin for agricultural freight, and is the point where Brisbane/Perth and Brisbane to Adelaide intercapital freight joins/leaves Inland Rail.

Table 0.7 Australia-wide economic impacts from Inland Rail (incremental to the base case, discounted, real 2014–15 dollars)

MEASURE		TOTAL CHANGE 2014-15 TO 2073-74	CONSTRUCTION 2014-15 TO 2023-24	OPERATION 2024-25 TO 2073-74
GDP (2014-15 dollars, $B) (discounted using four per cent discount rate)		16.4	1.0	15.4
Annual employment ('000 FTEs)	Average	0.7	0.8	0.6
	Peak	15.9	15.9	3.5

Source: PwC, 2015.

SENSITIVITY OF PROGRAMME FEASIBILITY

The core demand, financial and economic results presented in this business case have been developed from a range of assumptions. Where a range of assumptions has been considered, the outcome considered most plausible has been selected for the core results. Sensitivity testing has been undertaken on numerous key assumptions and drivers of viability. Economic appraisal results have been found to be impacted by factors such as the scale of programme capital costs, demand price elasticity and broader policy decisions such as level of road pricing and enabling B-Triple/high productivity vehicles between Melbourne and Brisbane. Financial results have been found to be impacted by capital costs, the level of intercapital access charges assumed, and the world coal price.

Analysis has been undertaken to test the sensitivity of the results to changes in individual assumptions and to packages of concurrent downside and upside assumptions.

The package of downside scenarios tests the impact of simultaneously reducing the long term coal price from US$75 to US$55/tonne, halving of the price elasticity of intercapital freight, introducing B-triples on the Hume, Pacific or Pacific Highway corridors between Melbourne and Brisbane and a 30 per cent increase in capital costs. This was estimated to lower the economic BCR to 1.37 at a 4 per cent discount rate (0.59 at a 7 per cent discount rate). Financial viability also lowers with the Net Present Cost (including Inland Rail capital costs) increasing to $9502 million and the operating cash flows (excluding capital costs) decreasing to a Net Present Value of $560 million.

The package of upside scenarios tests the impact of simultaneously increasing the long term coal price from US$75 to US$95/tonne, doubling the price elasticity of intercapital freight, introducing road pricing based on depreciated optimised replacement cost values and a 10 per cent reduction in capital costs. This was estimated to increase the economic BCR to 4.06 at a 4 per cent discount rate (1.49 at a 7 per cent discount rate). Financial viability was estimated to increase with the Net Present Cost of Inland Rail decreasing to $3990 million and operating cashflows increasing to $3118 million.

ENVIRONMENTAL AND PLANNING APPROVALS, CORRIDOR PROTECTION AND LAND ACQUISITION

Planning and environmental approvals are required for both development and operation of the Inland Rail Programme which will consist of greenfield alignments where new corridors are required to be defined and protected, and existing rail corridors where upgrade/enhancement works are required. Works outside of existing rail corridors will require detailed planning and environmental impact assessments. A preliminary environmental risk assessment has been undertaken to develop a strategy for the assessment and management of key environmental impacts.

Planning and environmental approvals are prerequisites to the commencement of construction for major projects. There are no specific planning or environmental approvals currently in place for Inland Rail, although existing rail corridors and some future corridors in Queensland have corridor protection. The protection of the entire Inland Rail corridor is a crucial step in enabling the delivery of Inland Rail as it can preserve land acquisition and tenure opportunities and provide some planning and land use protection from other development around the rail corridor.

In Queensland, there has already been a substantial amount of corridor protection work on the Southern Freight Rail Corridor (SFRC), which is to be adopted for the Calvert/Rosewood to Kagaru section.[35] The Gowrie to Grandchester section of the alignment is also gazetted and Inland Rail would use this alignment. However, in other cases, Inland Rail greenfield alignments will need to be gazetted (at the state level) to secure corridor status. In Victoria the Programme is generally within the existing rail corridor and there is unlikely to be a need for corridor protection.

There is no uniform national law or process for securing planning and environment approvals or for securing corridor protection. Each state has its own environment and planning laws, and there are Australian Government approval requirements which overlay state laws. The planning and environment approvals and corridor protection strategy for Inland Rail must therefore be developed in close consultation between the Australian and state governments.

An estimated 1900 to 2000 property transactions would need to be undertaken over the 10 year Inland Rail Programme, with approximately 51 per cent in Queensland and 49 per cent in New South Wales. Access to land for investigation purposes (environmental investigations, survey and monitoring, geotechnical samples and bore holes) would also be required.

MANAGING RISKS

A number of strategic risks have been identified for the Programme. Strategic risks are those that may affect progress of the Inland Rail development. The key strategic risks are:

- The estimated cost of Inland Rail exceeds available funding, recognising that the major benefits will only flow if Inland Rail is fully completed.
- Stakeholder expectations influenced by previous Inland Rail studies, forums and communication result in a mismatch with the current Inland Rail Programme objectives.
- Lack of integration in the development of appropriate terminals, rollingstock and complementary policy frameworks that underpin the benefits of the Inland Rail Programme.
- Market appetite/freight user demand changes considerably during the Inland Rail Programme delivery and/or operational phase leading to lower utilisation than anticipated.
- Lack of certainty or clarity of governance arrangements and lack of informed and timely decision making by key stakeholders (Australian Government, Victoria, New South Wales and Queensland Governments, ARTC and any other funding/delivery partners).
- Changes to stakeholder priorities impacting on Inland Rail Programme staging.

A range of Programme level risks have also been identified which relate to risks in delivering the Programme outcomes. Mitigation strategies and risk management plans have been developed to manage or treat both strategic and Programme risks.

[35] Further consideration is required to determine the priority and staging of sections within Queensland.

0.5. Programme delivery

A STAGED APPROACH

Analysis of possible packaging options, contracting models and potential staging of works from an engineering perspective has been undertaken. DIRD is separately considering taxation, financing, ownership and procurement aspects of the Programme, including possible funding options. Relevant considerations for packaging options, contracting models and staging include:

- A number of geographic and discipline based work package options and contracting models are potentially available to deliver Inland Rail.Market engagement is required to inform and validate the procurement delivery strategy and any revisions to the completion schedule. Current market conditions are expected to drive value for funded projects with favourable pricing and risk transfer.
- A revised completion schedule may bring forward delivery of the critical path enabling Inland Rail, including the tunnel section and the missing links, to be completed within an eight year timeframe.
- There may be opportunities to improve affordability for government with regard to cashflows, funding requirements and budgetary impacts of investing in the Inland Rail Programme.

AFFORDABILITY CONSIDERATIONS

To assist affordability a range of opportunities have been identified, including accelerated delivery, progressive de-risking of the Programme, value engineering and effective market engagement.

The Australian Government requested development of a 10 year programme to deliver Inland Rail, however an accelerated eight year delivery schedule may deliver greater value for money and improve affordability for the Programme through reduced construction out turn cost and reduced Programme overhead and management costs resulting from a shorter delivery schedule, including the associated reduced escalation impact, and from bringing forward the full benefits of the Programme including additional revenues.

As further work is undertaken to better understand engineering, design, property and stakeholder requirements, the allocation of risk and associated allowances for contingency could potentially be reduced. Value engineering could also identify opportunities to deliver greater value as scope and design are refined. De-risking of the Programme better informs the funding requirements and enables the market to better price works packages to be delivered within the 10 year programme, improving value for money. Throughout the procurement, effective market engagement can drive innovation, improve the understanding and effective allocation of key Programme risks, and similarly improves value for money.

0.6. Port of Brisbane Extension

In mid-2014, ARTC commenced a study at the request of the Australian Government to identify the most appropriate corridor for a 24/7, dedicated freight rail route from the existing interstate line to the Port of Brisbane. This would result in possible extension of Inland Rail from its planned end point at the Acacia Ridge Intermodal Terminal, 15 kilometres south of Brisbane's central business district, to the Port of Brisbane.[36]

[36] This Programme Business Case incorporates a strategic assessment of the Port of Brisbane Extension. The Port of Brisbane Extension strategic assessment is at an earlier stage of the project lifecycle, therefore the costs, economic and financial analysis have not been developed to the same level of detail as Inland Rail.

Although a railway line to the port already exists, it is part of a shared network with commuter passenger services, restricting the number of freight paths available. The route's alignment and location through busy inner city suburbs further limits its capacity by reducing train speeds, trip frequencies and scope to accommodate longer and heavier axle load rollingstock.

The analysis considered a number of alternatives and identified two potential options:

- The Eastern Freight Rail Corridor (from the interstate standard gauge line at Algester to the Port of Brisbane, including two tunnels of 4.8 kilometres and 4.4 kilometres and broadly following the Gateway Motorway). Estimated capital costs are lower than alternatives and this route presents more opportunities for operational flexibility and future staging. The preliminary estimate of the cost to design and construct the Eastern Freight Rail Corridor is $2.51 billion ($2014-15, excluding escalation).
- The Long Tunnel (an alternative option incorporating a 17 kilometre tunnel from Acacia Ridge to near Hemmant). This remains a feasible alternative but it carries greater cost and more risk than the Eastern Freight Rail Corridor.

Further planning is required before a preferred option (and associated corridor) can be selected.

Potential demand includes the opportunity to attract current road transfers to and from the Port, along with demand that would be shared with Inland Rail (agricultural demand from northern New South Wales and southern Queensland, and coal demand from the Surat and Clarence-Morton Basins in southern Queensland).

A key issue is when the new dedicated freight link to the Port will be needed. With Inland Rail in operation, a staged investment of $54 million (strategic, $2014-15, excluding escalation), commencing in 2022–23 when the Calvert/Rosewood to Kagaru section of Inland Rail is completed, could lift the capacity of the existing route, enabling it to meet demand for some years to come, especially if the full Cross River Rail proposal is delivered. Modest expenditure on the existing route is included in the Inland Rail economic evaluation to enable the demand estimate of 19.5 million tonnes of coal per annum to be realised.

Even with these upgrades, at some point in the future, a new, dedicated route will be required. Passenger services will inevitably grow over time and progressively 'squeeze out' freight paths on the shared network. Based on development of a Port Extension medium demand scenario for port shuttles and applying the core Inland Rail coal and agricultural demand, it is estimated that the number of paths required to support that demand requires construction of the Port of Brisbane Extension in 2040–41 or by 2029–30 if more aggressive land use and complementary investment policies are applied. Policy changes impacting the frequency of the passenger services within Brisbane's rail network could justify earlier freight rail capacity enhancements.

The preliminary CBA suggests the Port of Brisbane Extension and Inland Rail combined result in a slightly reduced Benefit Cost Ratio relative to Inland Rail alone. As shown in Table 0.8 and comparing with the Inland Rail economic results in Table 0.6, the Inland Rail Benefit Cost Ratio (BCR) is 2.62 without the Port of Brisbane Extension reducing marginally to 2.40 with the Port of Brisbane Extension. Economic viability is further reduced without complementary QR network investment to enable coal train lengths to increase to take advantage of the Inland Rail and Port of Brisbane Extension improved train capacity offering.

Table 0.8 Impact of the Port of Brisbane Extension on Inland Rail BCR

DESCRIPTION	WITH WESTERN LINE UPGRADE		WITHOUT WESTERN LINE UPGRADE	
	BCR (4%)	BCR (7%)	BCR (4%)	BCR (7%)
Inland Rail without the Port of Brisbane Extension	2.62	1.02	2.56	0.96
Inland Rail with the Port of Brisbane Extension	2.40	0.96	2.32	0.90

Source: PwC, 2015.

Notwithstanding the marginal economic result, timely action to preserve a corridor for the Eastern Freight Rail Corridor could be a prudent measure. Further investment in the existing route would postpone, but not remove, the eventual need for the new route.

Progression of the Port of Brisbane Extension would require community consultation and the preparation of an Environmental Impact Statement (EIS).

0.7. Conclusions

Existing north–south freight infrastructure is inhibiting the productivity and economic growth potential of regional communities and the lack of resilience of existing freight infrastructure exposes east coast supply chains to disruptions and sub-optimal reliability

Inland Rail has a sound strategic rationale and will build the backbone of the national freight network creating a direct standard gauge rail connection between Queensland, rural New South Wales, Victoria, South Australia and Western Australia. It provides the opportunity to deliver a step change improvement in rail service quality across this critical north–south corridor that is compatible and interoperable with high productivity east–west train operations.

The fundamental problems that Inland Rail is expected to address include:

- Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
- Current north–south freight infrastructure is constrained and this will increasingly impact negatively on freight productivity.
- Reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
- Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities.
- Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability.

The interstate rail and road networks are the backbone of the national freight network providing the arterial means of moving freight between our cities and through our international gateways. Inland Rail provides a strategic opportunity to make a decisive step change in the capacity and capability of the national rail system. Maintaining an incremental approach which progressively augments existing freight capacity but retains the legacy of sub-optimal alignments, low productivity infrastructure and mixed passenger/freight networks is unlikely to deliver the outcomes for freight that will support our aspirations for national productivity and economic development.

The key benefits of the Inland Rail Programme to the freight industry and broader community include:[37]

- Improved linkages within the national freight network: Enhances the National Land Transport Network by creating a rail linkage between Parkes in New South Wales and Brisbane, providing a connection between Queensland and the southern and western States.
- Improved access to and from regional markets: Two million tonnes of agricultural freight attracted from road, with a total of 8.9 million tonnes of agricultural freight carried on Inland Rail.
- Reduced costs for the market: Reduces rail costs for intercapital freight travelling between Melbourne and Brisbane by $10 per tonne.[38]
- Improved reliability and certainty of transit time: Less than 24 hour rail transit time between terminals in Melbourne and Brisbane and reliability matching current road levels.
- Increased capacity of the transport network: Additional rail paths for freight (160 round trip paths per week) a 105 per cent increase on current freight paths on the coastal route alone, along with releasing capacity for passenger services in Sydney and Brisbane, and removing 200 000 truck movements from roads each year.
- Reduced distances travelled: 200 kilometre reduction in rail distance between Melbourne and Brisbane, and 500 kilometre reduction between both Brisbane and Perth and Brisbane and Adelaide.
- Improved road safety: 15 fewer serious crashes each year avoiding fatalities and serious injuries.
- Improved sustainability and amenity for the community: More than 750 000 fewer tonnes of carbon and reduced truck volumes in over 20 regional towns.

The Programme Business Case finds that an investment in Inland Rail has positive net economic benefits, using a cost benefit methodology that is conventionally applied to major transport infrastructure projects in the context of a very long-term horizon for benefit realisation given the 100 year asset life. That long-term future is inherently uncertain and the decision on whether to proceed with the Inland Rail Programme will be dependent on weighing up factors that cannot be known with certainty and in the context of risks, which cannot be perfectly controlled.

Working within these uncertainties is however necessary if public policy makers are to take a strategic and long-term approach to addressing the challenges on the east coast and establishing a national freight system that will ultimately meet the aspirations of the community.

Finally, the nature of the commitment to the development of Inland Rail needs careful consideration. As the Inland Rail Programme would act as a catalyst for complementary private sector investment, it requires a firm early commitment to proceed and deliver the project in its entirety to create an environment where the private sector can invest with sufficient certainty that the anticipated service outcomes will be achieved within the committed timeframes. Without such a commitment, the risk is that companies will not be incentivised to invest in rail supply chains and may potentially lock into road-based logistics options which undermine future efforts to attract freight to rail.

The Programme Business Case provides the most detailed assessment to date of why Inland Rail is needed and how it can be delivered. Further work will be required to prepare detailed designs and to better understand engineering, property and stakeholder requirements. As a consequence, benefit and cost estimates will continue to be refined. The Programme Business Case presents a strong case to proceed.

[37] Estimated for 2049-50 once Inland Rail is fully developed. The number of truck movements removed from roads is estimated to increase as the total freight task increases post 2049-50.

[38] Current 2014–15 prices.

Glossary

GLOSSARY

This glossary defines the key terms used throughout the document including both technical and commercial terminology.

TERM	DEFINITION
AA1000 Stakeholder Engagement Standard	International principles-based standard for stakeholder engagement.
ABS	Australian Bureau of Statistics.
ACCC	Australian Competition and Consumer Commission.
ACIL	ACIL Allen: Demand and Supply advisors to the Inland Rail Programme.
Advisian	Provided risk advisory services to the Inland Rail Programme. Part of WorleyParsons Group and formerly known as Evans&Peck.
ALCAM	Australian Level Crossing Assessment Model.
alignment	The exact positioning of track; may be compared with 'route', which gives only a very general indication of the location of a railway.
AMP	Asset Management Plan.
AMS	Authority Management System.
Aquenta	Aquenta Consulting Pty Ltd have provided cost estimation services and continue to provide risk management services to the Inland Rail Programme.
ARA	Australasian Railway Association.
ARTC	Australian Rail Track Corporation.
ATC	Australian Transport Council.
ATMS	Advanced Train Management System. Communication-based safe working system currently being developed by ARTC.
Australian Government	The Government of the Commonwealth of Australia.
axle load	The load transmitted to the track by two wheels of one axle of a bogie.
BCR	Benefit cost ratio.
BITRE	Bureau of Infrastructure, Transport and Regional Economics (formerly BTRE and BTE).

TERM	DEFINITION
bogie	Two axles with wheels and a sub-frame under each end of a wagon.
break of gauge	Where a line of one track gauge meets a line of a different track gauge.
Broad gauge	Railway track gauge of 1600 mm; used in Victoria except on interstate main lines and some other lines.
BTRE	Bureau of Transport and Regional Economics; now the BITRE.
CAD	Computer aided design.
cant	Difference in the height of two rails comprising the railway track; cant may also be described as super elevation. It allows a train to travel through a curve at a speed higher than otherwise. Camber on the curve of a road has a similar function.
Capex	Capital expenditure.
CBA	Cost benefit analysis.
CGE	Computable general equilibrium.
CID	Critical Infrastructure Designation – NSW. Community Infrastructure Designation – QLD.
coastal route	The existing rail route from Melbourne to Brisbane via Sydney.
compensated grade	Where a grade is eased on curves so the total resistance to a train is constant, irrespective of the degree of curvature of the track.
corridor	A strip of land with a width measured in kilometres that is suitable for a railway. Study of a corridor leads to the identification of route options. [Corridor has another meaning for an operating railway: it describes the railway and adjacent land between boundary fences, or if unfenced, to a distance of 15 metres from each outside rail].
CPESC	Certified Professional in Erosion and Sediment Control.
CPI	Consumer Price Index.
CRN	Country Rail Network, New South Wales.
CSA	Cross sectional area.
CTC	Centralised Train Control.
D&C	Design and Construct. The contractor takes responsibility for both design and

TERM	DEFINITION
	construction in order to achieve specified performance requirements.
DBM	Design, build, maintain.
DBO	Design, build and operate.
DBYD	Dial Before You Dig.
DCOM	Design, Construct, Operate, Maintain. Model contemplates design and construction and then, for a specified term, the operation and maintenance of infrastructure.
DEEDI	Department of Employment, Economic Development and Innovation.
DERM	Department of Environment and Resource Management.
DIRD	Department of Infrastructure and Regional Development.
Discount rate	The factor used to convert future costs and benefits into current equivalents for the purpose of the economic and financial appraisal.
DORC	Depreciated optimised replacement cost; regulatory building block approach using DORC valuation.
double stacking	Placement of one intermodal freight container on top of another in a specially designed well-wagon.
DP	Delivery Partner. Involves an organisation that partners with a client for the delivery of a project or program of works.
DTMR	Department of Transport and Main Roads (Queensland).
ECI	Early Contractor Involvement.
EIA	Environmental Impact Assessment.
EIG	Everything Infrastructure Group.
EIS	Environmental impact statement.
energy efficiency	Ratio of the transport task to the energy input; a measure of energy efficiency is tonne/km per MegaJoule (MJ).
energy intensity	Ratio of energy input to transport task; the inverse of energy efficiency; a measure of energy intensity is MJ/net tonne/km.

TERM	DEFINITION
EPBC Act	*Environment Protection and Biodiversity Conservation 1999 (Cth) Act.*
EPCM	Engineering Procurement Construction Management. A contract management organisation manages the design, procurement and construction on behalf of the Principal.
FoS	Factor of safety.
FPDS	Final procurement delivery strategy.
FTE	Full-time equivalent.
fuel consumption	Measured in litres per gross tonne kilometre (litres/gtk) or sometimes litres per 1000 gross tonne kilometre (litres/1000 gtk); sometimes net tonnes are used instead of gross tonnes.
GDP	Gross Domestic Product.
GIS	Geographic information system.
gross	Total mass of a wagon and its payload.
Greenfield	New development that occurs outside established urban areas where the site or development has not previously been used for urban development. Also applies for railway construction on new alignments.
GRP	Gross Regional Product.
GSP	Gross State Product.
GSQ	Geological Survey Queensland.
gtk	Gross tonne kilometres; a standard measure of track usage; the gross weight of a train multiplied by kilometres travelled.
hr	Hour.
Headway	The difference in time or distance between two trains travelling in the same direction.
HV	High voltage.
IA	Infrastructure Australia.

TERM	DEFINITION
ILM	Investment logic map.
IR-IG	The Inland Rail Implementation Group (IR-IG), chaired by the former Deputy Prime Minister, the Hon John Anderson AO, has overseen the development of the Programme Business Case.
IR-PCG	Inland Rail Project Control Group.
IR-PRG	Inland Rail Peer Review Group.
Inland Rail Programme	Programme to deliver Inland Rail.
IR-SC	Inland Rail Steering Committee.
Intercapital	Non-bulk freight (e.g. containerised manufactured goods) transported between Australian capital cities.
International Association for Public Participation (IAP2)	International organisation advancing the practice of public participation.
ICOMOS	International Council for Monuments and Sites.
kg	Kilogram(s).
kg/m	Kilograms per metre.
Km	Kilometre(s).
Km/h	Kilometres per hour.
KPI	Key Performance Indicator.
L	Litre(s).
Land Act	*Land Act 1994 (QLD).*
LEP	Local Environmental Plan.
loading gauge	The maximum permissible height and width dimensions for a rail vehicle and its load; see structure gauge.
LEP	Longitudinal Egress Passage.
Logit model	A logit model used by ACIL Allen to forecast demand of the Australian east coast freight market.

TERM	DEFINITION
Lycopodium	Lycopodium developed below rail operating and maintenance costs for the Inland Rail Programme.
MC	Managing Contractor. Involves the engagement of a single contractor to manage the design and construction on behalf of the client (owner).
m	Metre.
M-B	Melbourne to Brisbane.
mass	The mass of an object is measured in kilograms; mass and weight are used interchangeably in the Programme Business Case.
MJ	MegaJoule: a unit of both energy and work.
mm	Millimetre(s).
MMRF	Monash Multi Regional Forecasting Model.
MoU	Memorandum of understanding.
MPM	Major Periodic Maintenance; planned maintenance on infrastructure assets at intervals of more than once a year.
mt	Million tonnes.
mtpa	Million tonnes per annum.
narrow gauge	Railway track gauge of 1067 mm; used in Queensland except on the interstate line from Sydney to Brisbane.
Northern Sydney Freight Corridor Program	Northern Sydney Freight Corridor Program; capacity increases for freight currently being implemented for the railway between Strathfield and Broadmeadow.
NPC	Net Present Cost.
NPV	Net Present Value.
NSW	New South Wales.
NTCS	National Train Communications System.
ONRSR	Office of the National Rail Safety Regulator.
Opex	Operational expenditure.

TERM	DEFINITION
Origin/destination	Where trips tips start and end.
Output Specification	Document that sets out the service requirements and associated performance requirements of the Project.
pa	Per annum.
PAN	Preliminary Acquisition Notice.
payload	Weight of products and containers carried on wagons.
PAYGO	Pay-as-you-go; under the current road access pricing regime, heavy vehicle road users are charged for access and use of Australia's arterial and local road infrastructure. These charges are set nationally using a pay-as-you-go (PAYGO) approach, which means that capital and maintenance expenditure is recovered from road users around the same period.
PB	Parsons Brinckerhoff, Lead Technical Consultant.
Peak hour	Represents the hour(s) of greatest demand anywhere on a network.
PERA	Preliminary environmental risk assessment.
Port of Brisbane Extension	A strategic assessment of the Port of Brisbane Extension, considering a dedicated freight rail line from Acacia Ridge to the Port of Brisbane. The assessment is at an earlier stage of the project lifecycle, therefore the costs, economic and financial analysis have not been developed to the same level of detail as Inland Rail.
PMO	Programme Management Office.
PMP	Programme Management Plan.
PPP	A Public Private Partnership (PPP) is a long-term contract between the public and private sectors where government pays the private sector to deliver infrastructure and related services on behalf, or in support, of government's broader service responsibilities. PPPs typically make the private sector parties who build infrastructure responsible for its condition and performance on a whole-of-life basis.[39]
PPR	Project Proposal Report.
Programme	Also known as Inland Rail Programme (refer to definition above).

[39] National Public Private Partnership Guidelines, Overview, Infrastructure Australia, December 2008.

TERM	DEFINITION
Programme Business Case	This document, the Programme Business Case, is a preliminary assessment of the Inland Rail Programme and is based on concept layouts and high level technical information and assumptions which have flowed through the cost estimates and feasibility assessment as at April 2015. This document has been prepared in line with the Queensland Government's Project Assessment Framework, Victoria's Department of Treasury and Finance's Investment Lifecycle Guidelines (Strategic Assessment) and NSW Treasury Guidelines for Capital Business Cases documents. Its role is to encapsulate consideration of the Project to enable decision makers to confirm Project viability, affordability and the preferred delivery model.
ProjMP	Separate project management plans.
PSC	Public Sector Comparator. A financial model used to assess Inland Rail as a stand alone business owned and operated by the government.
PUD	Pick-up and delivery.
PV	Present value.
PwC	PricewaterhouseCoopers: Financial, Commercial and Economic advisors to the Inland Rail Programme.
QLD	Queensland.
QR	Queensland Rail a corporation owned by the Queensland Government.
RailCorp	RailCorp (Rail Corporation of NSW); owns rail track in the Greater Sydney region, operates passenger trains in that region and to Melbourne and Brisbane and regional NSW.
RBA	Reserve Bank of Australia.
RBM	Risk Based Management.
RCM	Reliability Centred Maintenance.
RCRM	Routine corrective and reactive maintenance; comprises maintenance, inspections and unplanned minor maintenance that is carried out annually or at more frequent cycles.
Reference Project	Project description and scope based on the most likely and efficient form of delivery that would traditionally be adopted that satisfy all elements of the Output Specification.
Reference train	A notional train specification used in developing the Inland Rail alignment and operational analysis.

TERM	DEFINITION
RIM	Railway Infrastructure Manager.
RISSB	Rail Industry Safety and Standard Board.
RNAP	Rail Noise Abatement Program.
route	In the context of the Programme Business Case, primary description of the path which a railway will follow.
RPDS	Reference procurement delivery strategy.
RSNL	Rail Safety National Law.
RSO	Rolling Stock Operator.
RTO	Rail Transport Operator.
SA	South Australia.
safeworking	Signalling system and associated rules that keep trains a safe distance apart.
SEPP	State Environmental Planning Policy.
SEQ	South East Queensland.
SFRC	Southern Freight Rail Corridor.
SHR	State Heritage Register.
SIMP	Social Impact Management Plan.
SMS	Safety Management System.
SSFL	Southern Sydney Freight Line; independent track used by freight trains between Macarthur and Chullora.
SSI	State Significant Infrastructure (SSI).
standard gauge	Railway track gauge of 1435 mm; used on the ARTC network and for the NSW railway system.
structure gauge	Specification for the position of structures such as overhead bridges, tunnels and platforms relative to a railway track to allow adequate clearance for the passage of trains.
t	Tonne(s).

TERM	DEFINITION
tal	Tonne axle load.
tpa	Tonnes per annum.
TfNSW	Transport for New South Wales.
TI Act	*Transport Infrastructure Act 1994 (Qld).*
TIU	Trackside Interface Unit.
TEU	20 foot equivalent unit, the standard unit measure of shipping container size.
Programme	Melbourne to Brisbane Inland Rail Programme.
TPC Act	*Transport Planning and Coordination Act 1994 (Qld).*
UPS	Uninterruptable Power System.
VIC	Victoria.
VicTrack	VicTrack, owner of Victorian Government rail network; interstate track and certain other lines are leased to ARTC.
WA	Western Australia.
WEB	Wider economic benefits.
well-wagon	A wagon where the central loading deck is lower than the bogies at either end, to allow higher loads to be carried within the loading gauge.
WHS	Workplace Health and Safety.

Chapter 1

Introduction and approach

1. INTRODUCTION AND APPROACH

1.1. Introduction

Inland Rail is a nationally significant transport initiative and the Australian Government has engaged ARTC to develop a 10 year delivery programme. The IR-IG, chaired by the former Deputy Prime Minister, the Hon John Anderson AO, has overseen the development of the Programme Business Case.

In November 2013, the Deputy Prime Minister and Minister for Infrastructure and Regional Development, the Hon Warren Truss MP, re-affirmed the Australian Government's commitment to Inland Rail and commitment of $300 million to finalise planning, engineering design, environmental assessments and pre-construction activities including land acquisition. This funding was subsequently confirmed in the 2014–15 Federal Budget paper entitled Building Australia's Infrastructure.

Inland Rail will build the backbone of Australia's freight rail network, providing economic and social benefits throughout the country

The viability, benefits, costs and risks associated with Inland Rail have been packaged into this strategic Programme Business Case. The intention is for this document to be submitted to the Australian Government for endorsement and for further approval to proceed with the targeted investigation and delivery of the Programme.

At the request of the Australian Government, ARTC has also undertaken preliminary planning and strategic assessment of the most appropriate dedicated rail freight link from the existing interstate line to the Port of Brisbane (the Port of Brisbane Extension), thereby bypassing the existing urban Queensland Rail (QR) passenger network.

1.2. Purpose of this chapter

This chapter provides an outline of Inland Rail, its background and the nature and extent of the analysis undertaken during development of the Programme Business Case.

1.3. What is Inland Rail?

Inland Rail is a proposal to provide a dedicated freight railway between Melbourne and Brisbane via regional Victoria, New South Wales and Queensland. The route utilises existing corridors (1100 kilometres) and builds new greenfield missing links where there is currently no standard gauge (600 kilometres) with a total route length of approximately 1700 kilometres.

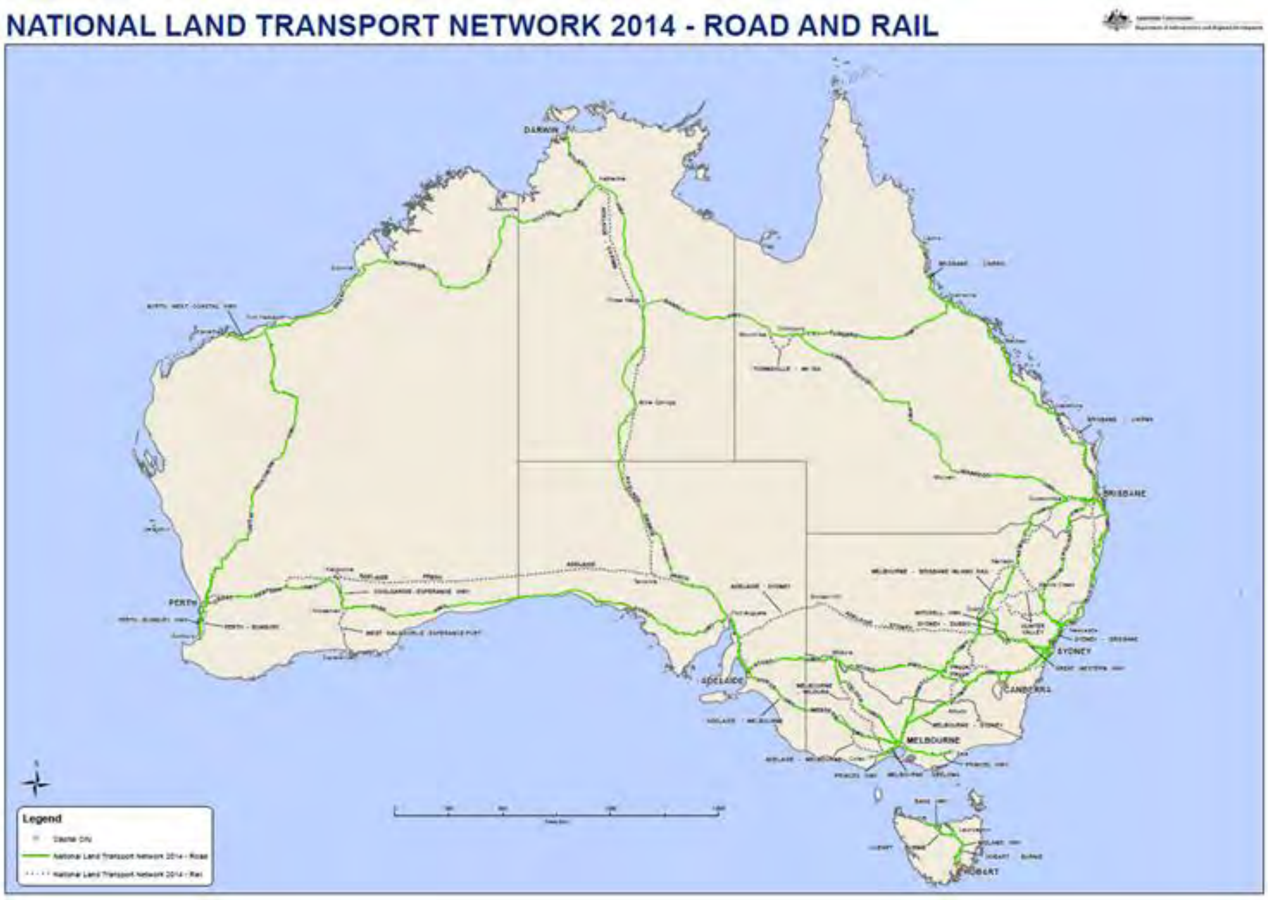
It will build the backbone of Australia's freight rail network, creating a direct standard gauge rail connection between Queensland, New South Wales, Victoria, South Australia and Western Australia, providing both economic and social benefits throughout the country.

The completed line would be a faster, shorter, higher capacity route that bypasses the current congested north–south network through Sydney, resulting in a 10 hour rail time saving between Melbourne and Brisbane (not subject to passenger curfews and restricted line access). It will also enable the use of double stacked containers, 1800 metre and 21 tonne axle load trains along the entire length—outstanding since 1901—and an improvement that will drive significant productivity and efficiency benefits.

Based on the objectives of Inland Rail, a target service offering has been developed to cater to the priorities of freight customers. The new infrastructure will enable a road-competitive service with a sub-24 hour linehaul transit time between Melbourne and Brisbane, 98 per cent reliability, door-to-door train costs competitive with road, and freight availability in line with market requirements. It is expected to attract intercapital, agricultural and coal freight to rail, providing capacity to meet future freight and broader east coast growth challenges.

Australia's current land transport network, presenting the key rail and road links comprising the existing east coast freight network that would be expanded by Inland Rail is illustrated in Figure 1.1.

Figure 1.1 National land transport network – rail and road (2014)



Source: DIRD, http://investment.infrastructure.gov.au/whatis/network/, 2015.

1.4. Background and context

Freight transport services between major population centres, particularly our capital cities, deliver millions of tonnes of freight each year and provide for the effective distribution of goods across the country. Efficient domestic supply chains support economic growth and help keep down the costs of products.

Inland Rail provides the opportunity to deliver a step change improvement in rail service quality for the east coast, improving the north–south corridor rail offering and interoperating with train operations in the east–west corridor.

An inland railway between Melbourne and Brisbane has been considered for more than a hundred years, first being formally considered in 1902.[40] The most recent studies involved investigations to identify a preferred corridor then alignment, which led to the development of a Concept Business Case in 2014 and this Programme Business Case considering the viability, benefits, costs and risks associated with Inland Rail. Other studies include:

40 Submission from Philip Laird, University of Wollongong to the IR-IG, June 2014.

North–South Rail Corridor Study – September 2006

The North–South Rail Corridor Study was announced by the Minister for Transport and Regional Services, the Hon Warren Truss MP on 17 September 2005. The study was commissioned by the Federal Department of Transport and Regional Services.

The findings, released in September 2006, examined the adequacy of the existing Melbourne to Sydney to Brisbane rail corridor to meet future freight demand. The study examined different options for an enhanced, existing coastal route or alternative inland routes.

Key issues identified in the study included infrastructure links, engineering, environmental, urban and regional planning issues. A financial and economic analysis was also undertaken on each of the route options. The study identified the 'far western corridor' through Parkes as the preferred corridor.[41]

Melbourne to Brisbane Inland Rail Alignment Study – July 2010

The second study, the Melbourne to Brisbane Inland Rail Alignment Study was announced by the Minister for Infrastructure, Transport, Regional Development and Local Government, the Hon Anthony Albanese MP on 28 March 2008.

The study examined the far western corridor and developed the alignment for the Inland Rail line. The outcome was a determination of a preferred alignment, based on consideration of the economic benefits and key commercial considerations. It provided the government and private sector with information that would help guide future investment decisions, including likely demand, estimated construction costs, and a range of possible private financing options.

The report recommended the project should be considered again in the future as new details became available of the cost of coastal railway upgrade proposals, the capacity and reliability improvements they provide, and/or demand achieved.

Melbourne to Brisbane Inland Rail Concept Business Case – December 2014

The Concept Business Case completed by ARTC in December 2014 was developed as a precursor to this Programme Business Case and outlined key scope and scheduling assumptions, identified key risks and environmental and planning considerations, and preliminary updates to demand, economic and financial analysis. The Concept Business Case was reviewed by the IR-IG, prior to undertaking further analysis and developing more detailed content for this Programme Business Case.

The Concept Business Case identified key areas for further consideration and/or analysis. These areas included demand, costs, risks, technical and operational requirements, and refined financial and economic analysis, which have been addressed within this Programme Business Case.

Both the Concept Business Case and this Programme Business Case build upon the most recent studies, continuing analysis of the far western corridor recommended in 2006 and the preferred alignment identified in 2010.

41 North-South Rail Corridor Study Executive Report http://investment.infrastructure.gov.au/publications/reports/pdf/north_south_rail/executive_report.pdf.

1.5. Programme Business Case – 2015

ARTC has prepared this Programme Business Case to progress the work completed in the Concept Business Case and provide further detailed costings, risks, opportunities, stakeholder, financial and economic impacts and environmental considerations that are key to developing a 10 year programme to deliver Inland Rail.

ARTC has also been asked to identify the most appropriate route for a new dedicated freight line to the Port of Brisbane.

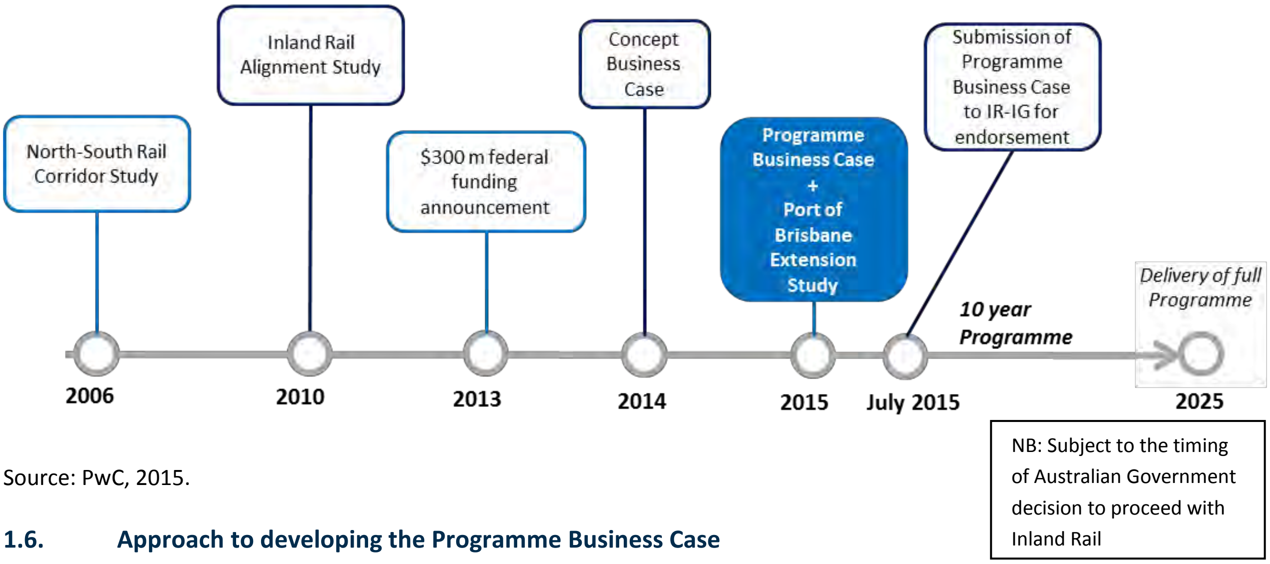
Purpose of the Programme Business Case

The purpose of the Programme Business Case is to present analysis of viability, benefits, costs and risks associated with Inland Rail to inform Australian Government decision making processes by:

- Identifying the problem and vision for the east coast corridor.
- Confirming the scope, opportunities and costs.
- Identifying a 10 year schedule of works that satisfies the service offering developed for freight customers.
- Presenting estimates of market take up.
- Analysing economic and financial implications.
- Identifying governance arrangements to support effective delivery of Inland Rail.

The role of the Programme Business Case is shown in Figure 1.2.

Figure 1.2 Inland Rail Programme context



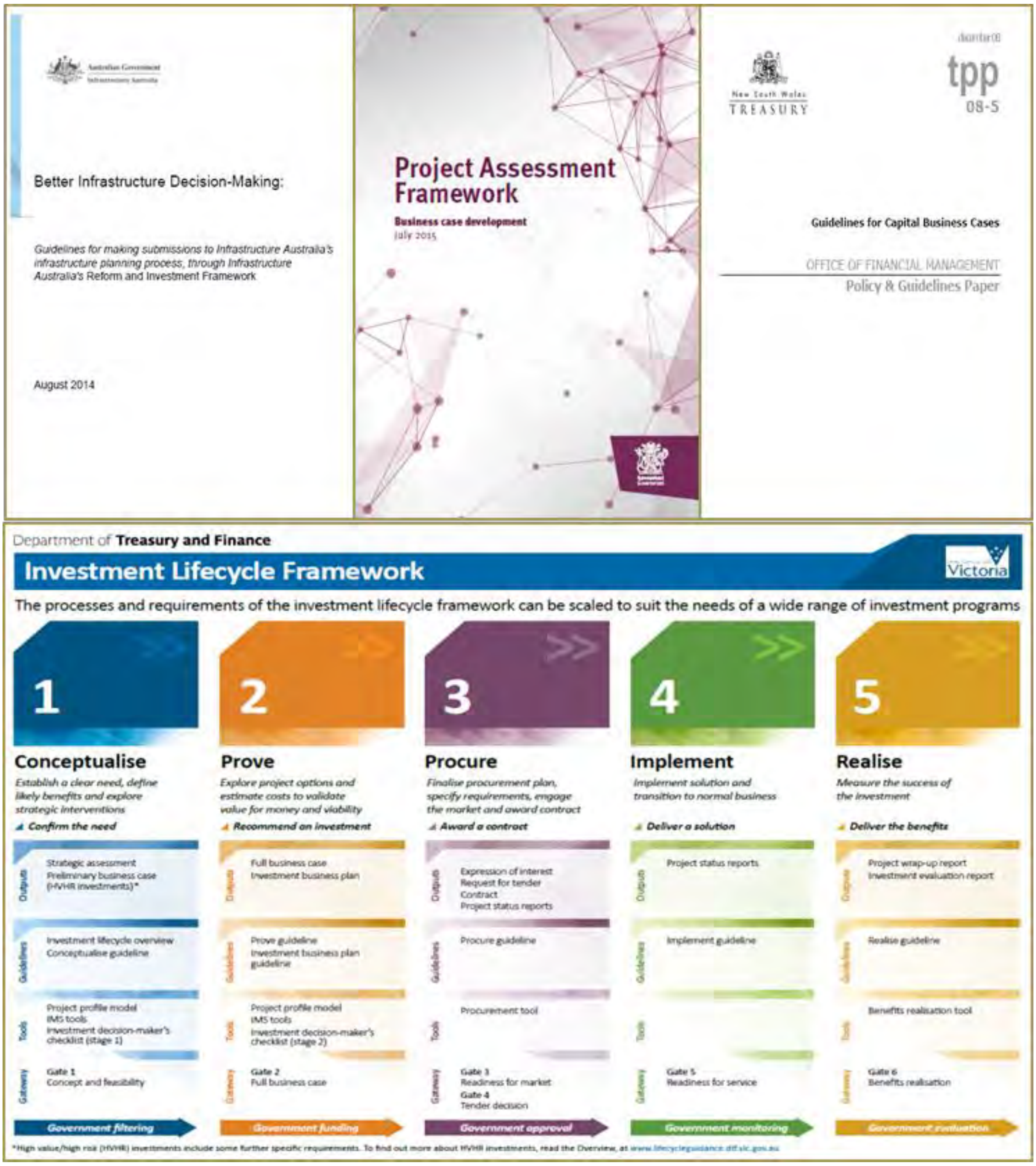
Source: PwC, 2015.

1.6. Approach to developing the Programme Business Case

The Programme Business Case has been developed to meet the requirements of relevant jurisdictional frameworks and guidance for the development of an infrastructure business case.

The Programme Business Case aligns with the Australian Government DIRD manuals and Infrastructure Australia's Reform and Investment Framework and gives consideration to infrastructure business case guidelines from the Victorian Department of Treasury and Finance, New South Wales Treasury and Queensland Treasury (see Figure 1.3).

Figure 1.3 Key relevant Australian and state government guidelines



Source: See footnote[42]

An overview of key relevant Australian and state government requirements is provided in Table 1.1.

42 Infrastructure Australia, Better Infrastructure Decision-Making, Guidelines for making submissions to Infrastructure Australia's infrastructure planning process, through Infrastructure Australia's Reform and Investment Framework, August 2014.

Department of Treasury and Finance, Victorian Government, Investment Lifecycle and High Value/High Risk Guidelines, Prove Stage, 2010.

New South Wales Treasury, Guidelines for Capital Business Cases, Office of Financial Management, Policy and Guidelines Paper, December 2008.

Queensland Government, Queensland Treasury, Project Assessment Framework, Business Case Development, 2015.

Table 1.1 Australian and state government business case frameworks – key requirements by jurisdiction

INFRASTRUCTURE AUSTRALIA'S REFORM AND INVESTMENT FRAMEWORK	VICTORIA'S INVESTMENT LIFECYCLE FRAMEWORK	NEW SOUTH WALES' GUIDELINES FOR CAPITAL BUSINESS CASES	QUEENSLAND'S PROJECT ASSESSMENT FRAMEWORK
Identify a nationally significant problem and support this with a well-developed problem assessment and analysis.	Comprehensive project option analysis, with clear risks, assumptions, constraints and dependencies leading to the best value for money solution which clearly identifies all business changes and assets.	A description of a legitimate service need, service priority and key benefits.	Outcome sought defined in clear and measurable terms.
Consider a comprehensive list of reform and investment options with considerable work undertaken.	Appropriate and attractive procurement strategy with consideration of alternative sources of funding.	Outline key stakeholders that have influenced the service scope and describe how this has been integrated, along with an engagement and management plan.	Project organisation and governance arrangements.
Develop and analyse potential options with the selection of preferred options clearly justified.	Risk assessment and management plan which provides risk adjusted costs.	Realistic options for meeting the service need clearly outlining any sustainability issues with associated strategies to mitigate any impacts.	Options evaluated to identify the project option most likely to produce the best value for money outcome.
Use risk based cost estimates in cost benefit analysis and in the funding request.	Robust project management strategy considering organisation capability, benefits management, change management, stakeholder management and governance structure.	Analysis of cost, benefits, financial viability and risks of the options that clearly meet measurable objectives; analysis of the financial impact of the proposed project or program as well as the broad implications for other agencies.	For each option, conduct detailed risk, financial and economic analysis; market sounding; legislative requirements; whole of government policy issues; regulatory requirements; public interest assessment; and procurement strategies.
A delivery plan in an advanced stage of development.	Reasonable timelines and investment milestones.	Description of how technical standards or legislative requirements impact on the performance of the options.	Rank options in terms of their cost, risk and ability to meet the outcome sought; provide justification for the recommended option.
Where government funding is likely to be sought, analysis of scope for private funding is at an advanced stage of development.	Consideration of transition from construction to operation.	A plan to deliver the major components of the project, including a procurement and delivery strategy, governance, change management, risk management, benefits realisation strategy and resourcing.	A project implementation plan for the recommended option.

Source: See footnote [45]

The Programme Business Case has been aligned with the DIRD mandate to:

- Promote, evaluate, plan and invest in infrastructure and regional development (the broader Programme Business Case).
- Foster an efficient, sustainable, competitive, safe and secure transport system (Chapter 5, Service offering, scope and opportunities and Chapter 11, Environmental, planning and legislative strategy).
- Facilitate local partnerships between all levels of government and local communities (Chapter 6, Communication and stakeholder engagement).

1.7. Structure of the Programme Business Case

The Programme Business Case has been structured into five sections. The five parts and individual chapters are shown in Table 1.2.

Table 1.2 Programme Business Case section and chapter summary

NO.	CHAPTER HEADING	CONTENT SUMMARY
Part A – Introduction, need and strategic context		
1.	Introduction and approach	An outline of the purpose of the document and approach to the Programme Business Case.
2.	Vision and strategic context	A description of the vision, objectives and the strategic context of Inland Rail.
3.	Problem identification and analysis	Defines and analyses the fundamental problems Inland Rail is seeking to address.
4.	Strategic options assessment	An outline of the high level business requirements and strategic options that have been considered.
Part B – Programme definition		
5.	Service offering, scope and opportunities	Provides confirmation of the alignment that forms the foundation of the assessment, the service offering and opportunities to be generated by Inland Rail.
6.	Communication and stakeholder engagement	Details the proposed engagement strategy and roles and responsibilities of stakeholders.
Part C – Programme feasibility		
7.	Demand	Details potential current and future demand underpinning the economic financial analysis.
8.	Costs	The cost elements (capex/opex) and other assumptions.
9.	Economic analysis	Outlines the economic impact of Inland Rail over its assessment life.
10.	Financial analysis	Provides a summary of the financial implications of Inland Rail including a number of key scenarios.

NO.	CHAPTER HEADING	CONTENT SUMMARY
11.	Environmental, planning and legislative strategy	Details environmental considerations for Inland Rail and provides a summary of the legislative and regulatory environment, as well as some identification of potential issues.
12.	Property acquisition	Details the property acquisition requirements.
13.	Risks	Risks including process risks, quantified risks and mitigation strategies for the broader Inland Rail Programme.
Part D – Programme delivery		
14.	Packaging, procurement and delivery	Qualification of the packaging, staging, procurement and delivery strategy for Inland Rail.
15.	Affordability	A discussion of the options available to improve, affordability and budgetary impacts of Inland Rail.
16.	Benefits realisation	Outlines the process to realise anticipated benefits and defines how success will be measured.
17.	Programme management	The operational changes required for a new operating model with Inland Rail including governance arrangements moving forward through delivery.
Part E – Port of Brisbane Extension		
18.	Port of Brisbane Extension	Provides a description of the need, demand, economic and financial impacts of the Port of Brisbane Extension as a stand-alone project and with Inland Rail.

Note: In addition to the chapters outlined in Table 1.2, an overview of the technical and operational requirements for Inland Rail are provided in Appendix A, Technical specifications and Appendix B, Operational analysis.

Source: PwC, 2015.

1.8. The approval and funding process

At this stage the approval and funding process for delivery of the entire Inland Rail Programme will align with construction stages and affordability considerations.

The Programme Business Case will be provided to the IR-IG for consideration and endorsement prior to being submitted to the Australian Government.

Should the Australian Government decide to release further funding for development or construction, it is envisaged that this would occur through Individual Project Proposal Reports (PPRs) for each stage of the Inland Rail Programme. The individual PPRs for development or construction funding will provide investment level information on costs, risks and delivery strategy, effectively being a proxy for individual business cases for each discrete phase of work.

Chapter 2

Vision and strategic context

2. VISION AND STRATEGIC CONTEXT

2.1. Purpose of this chapter

This chapter sets out the vision and strategic context for Inland Rail and demonstrates the importance of the national freight sector and the significance of the Melbourne to Brisbane freight corridor. It details the challenges faced by the Australian and state governments to meet the needs of east coast and national growth and connectivity, and the role of the rail freight sector in achieving this. This chapter also describes the strategic alignment of Inland Rail with key government strategies, policies and plans. Importantly, it details the consequence of not progressing Inland Rail now.

2.2. Approach

A vision for the national freight supply chain and for the future freight transport needs of the east coast of Australia was developed through a strategic assessment of economic and policy drivers along with consideration of Australian and state government plans and policies.

The vision and strategic context have been refined through a series of internal workshops focusing on their relationship with the Inland Rail objectives, drivers for efficient freight transport and the risks of not progressing Inland Rail.

2.3. The vision

Inland Rail's overarching vision is for the east coast freight network to have the right infrastructure in place to support highly productive and low cost freight services. The interstate rail and road networks are the backbone of the national freight network providing the arterial means of moving freight between our cities and through our international gateways.

As the regional and interstate freight tasks grow, and growth in our capital cities continues, there will be increasing pressure on freight capacity between capital cities and from the regions, as competition between urban passenger services and freight services for scarce road space and rail network capacity increases.

Rail transport has a significant role to play in realising the vision for an efficient national freight supply chain in Australia. The north–south transport corridor is a major backbone for freight between capital cities and locations along the east coast and to other national destinations.

2.4. Importance of the national freight sector

Freight transport services between major population centres, particularly our capital cities, deliver millions of tonnes of freight each year and provide for the effective distribution of goods across the country. Efficient domestic supply chains and global competitiveness supports economic growth and helps keep down the cost of the products we buy.

The efficiency of supply chains are directly reflected in the price consumers pay for goods and efficient internal freight networks ensure the competitiveness of our exports.

The efficient transport of Australian exports to world markets maximises economic returns to the economy and provides a source of taxable revenue to support the provision of public services.[43]

Australia is heavily reliant on efficient ports, freight networks and supply chains to provide competitive links and gateways for international trade. It is estimated that the transport and logistics sectors of the Australian economy contribute 14.5 per cent of GDP, with Australia's supply chain worth an estimated $150 billion every year.[44]

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[43] Infrastructure Partnerships Australia, Meeting the 2050 Freight Challenge, Page 4, Section 1, Economic Impacts, 2009.

[44] DIRD, Australian Government, A study of the potential for dedicated freight infrastructure in Australia, October 2014 Update.

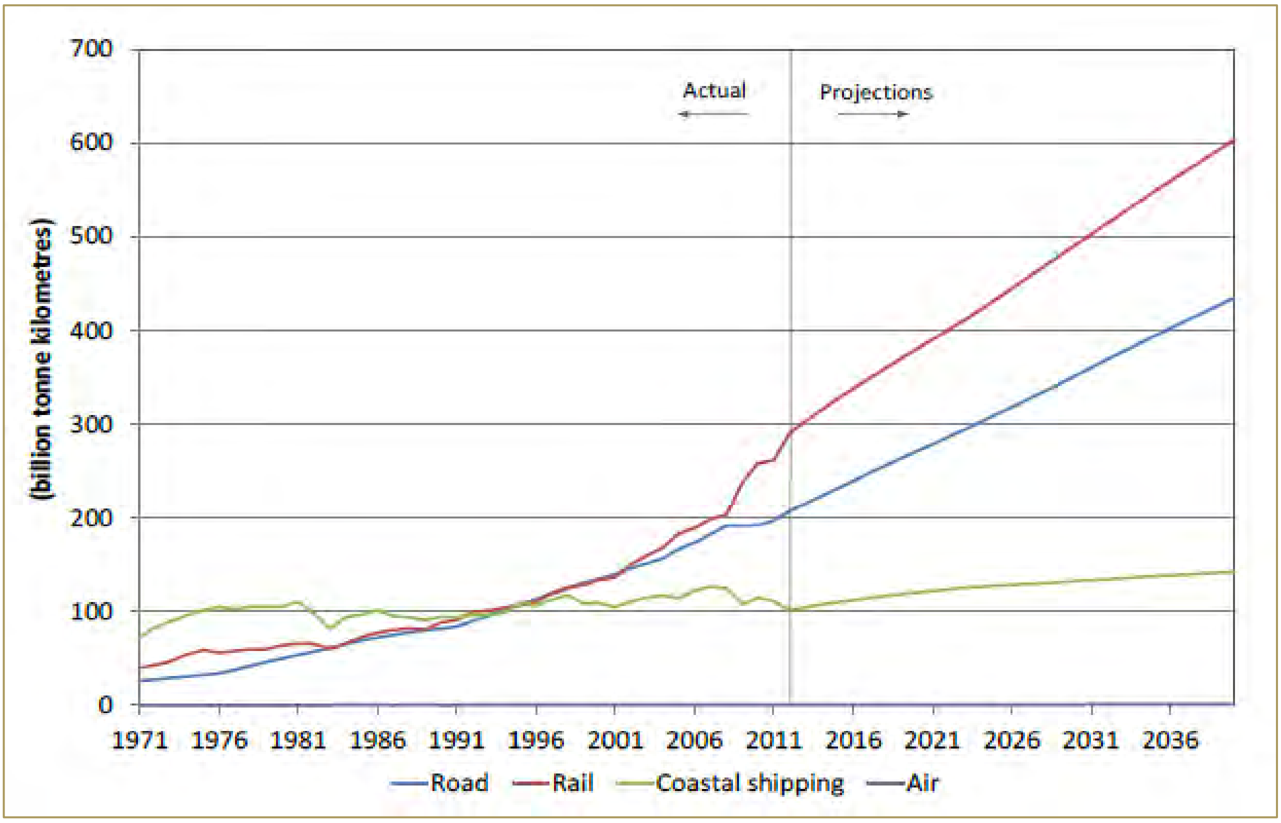
The freight industry is of particular importance to the economy, given Australia's unique geographic and demographic characteristics. Australia's remoteness from other countries, its size, and highly dispersed population add to the price of imports and locally manufactured goods, placing greater emphasis on the need for efficient internal freight networks.

National freight task by mode

In 2011–12, the domestic freight task totalled almost 600 billion tonne kilometres, which is equivalent to about 26 000 tonne kilometres of freight moved for every person in Australia.

Rail transport accounts for 48.5 per cent of total domestic freight hauled, dominated by iron ore and coal exports which account for over 80 per cent of the rail task. Road freight accounts for 34.6 per cent of total freight and coastal sea freight accounts for 16.8 per cent. Air freight comprises less than 0.01 per cent of total freight by weight (see Figure 2.1).

Figure 2.1 Actual and projected domestic freight task, by mode, 1971–2040



Note: Air freight is shown as the purple line at the bottom of the horizontal axis, which reflects less than 0.01 per cent of total freight by weight.

Source: DIRD, Australian Government, Freightline 1 – Australian Freight Transport Overview, 2014.

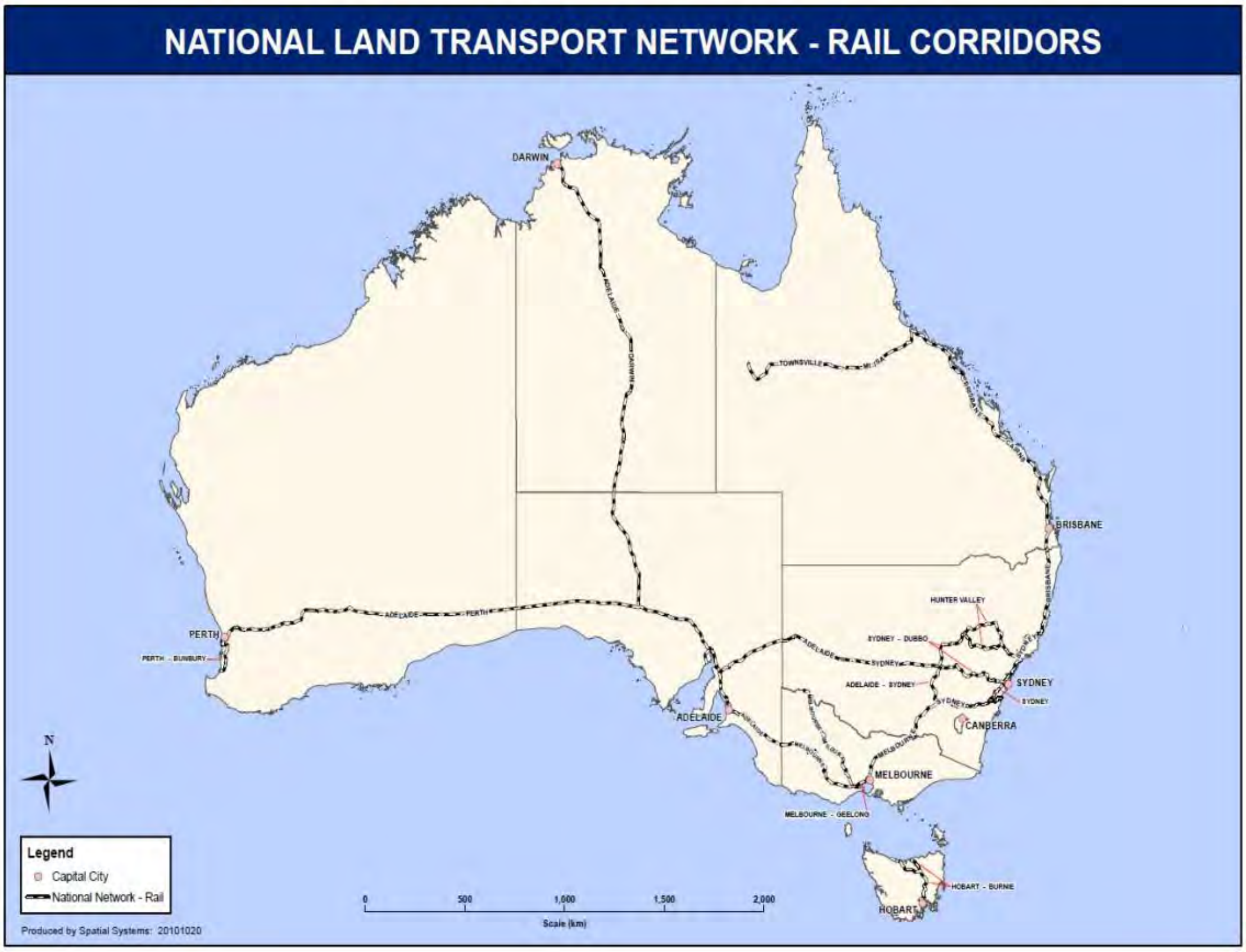
Rail freight

Rail is generally the most productive and efficient mode for bulk freight travelling from regional areas to export ports and urban destinations. Rail freight is suited to high volume, bulk commodities over both long and short distances. Rail has traditionally dominated the freight market for mining and agricultural commodities, particularly iron ore, coal, grains, rice, cotton, and sugar for processing or export.

Iron ore and coal together account for more than 80 per cent (in tonne kilometre terms) of all rail freight, while grains, sugar, fertilisers and other bulk products account for a further eight per cent. Non-bulk rail freight comprises around eight per cent of total rail freight.[45] Rail also plays a specialised role in servicing ports and other dedicated facilities where operators favour rail over road.

An overview of the current national rail corridor network is shown in Figure 2.2.

Figure 2.2 National rail corridor network

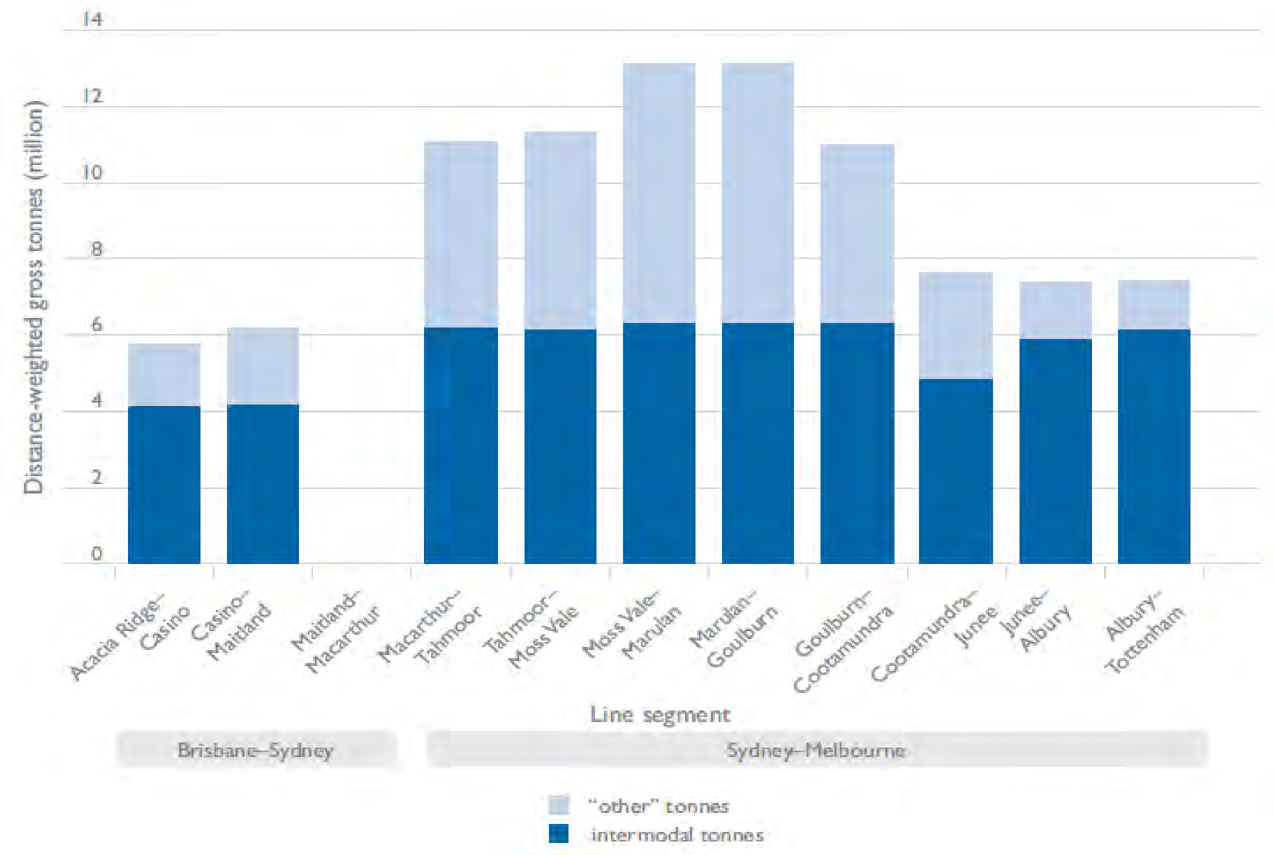


Source: DIRD, Australian Government, http://investment.infrastructure.gov.au/whatis/network, 2015.

45 DIRD, Australian Government, Freightline 1 - Australian Freight Transport Overview, 2014.

The distance-weighted gross tonnage on the east coast corridor by line segment is provided in Figure 2.3.

Figure 2.3 Distance-weighted gross tonnage on north–south corridor, by line segment, 2009–10



Note: Maitland to Macarthur information not available.

Source: DIRD, Australian Government RE, Trainline 1, June 2012.

Road freight

Road freight is the key domestic transport mode for non-bulk (containerised, packaged or palletised) freight, hauling nearly 80 per cent of the annual task and covering urban, regional and intercapital routes.

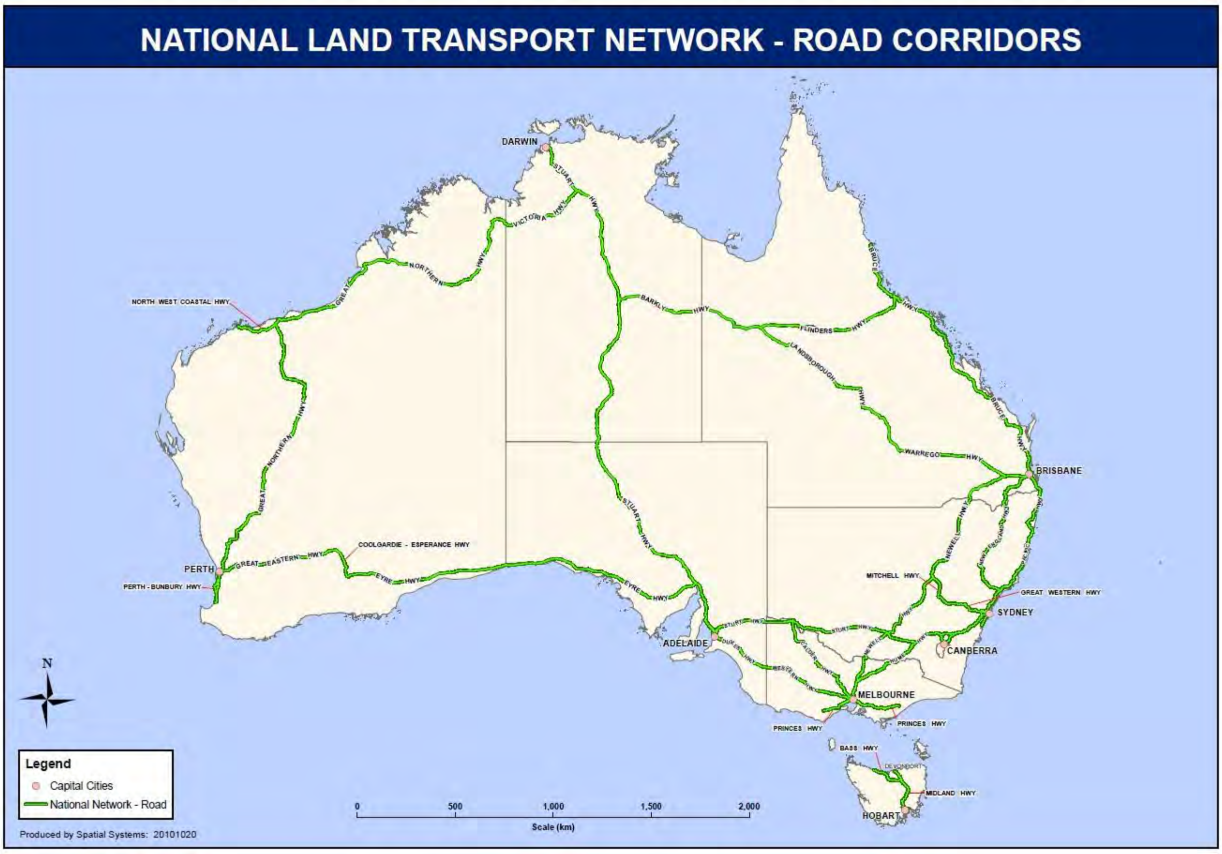
Road transport has traditionally been suited to servicing markets that have dispersed origins and destinations, and as a result, road transport tends to dominate intercity freight on the shorter corridors. The introduction of larger freight vehicles and associated investments in road capacity, for example enabling B-doubles, has increased viability over longer distances, allowing road to compete with rail for long-haul freight tasks such as Melbourne to Brisbane.

B-double heavy vehicle combinations are now the most significant road freight vehicle combination, accounting for around 40 per cent of total road freight in 2011–12.[46]

[46] DIRD, Australian Government, Freightline 1 - Australian Freight Transport Overview, 2014.

An overview of the national road corridor network is provided at Figure 2.4.

Figure 2.4 National road corridor network



Source: DIRD, Australian Government, http://investment.infrastructure.gov.au/whatis/network, 2015.

Sea freight

Sea freight dominates transit of freight internationally. It represents a relatively small proportion of the domestic freight task, though plays an important role in some domestic bulk commodity segments of the freight industry, such as bulk freight transport between Western Australia and Queensland.

Coastal shipping market share is around 17 per cent of total domestic freight movements (measured in mass distance terms) and comprises 10 per cent of total freight volumes through Australian ports. Bulk commodities such as aluminium ores, iron ore and petroleum account for more than 70 per cent of domestic coastal shipping movements. Transport of bauxite between Weipa and Gladstone, Queensland, and iron ore from the Pilbara to Port Kembla alone accounted for 30 per cent and 20 per cent, respectively, of total domestic sea freight in 2011. Eastern states to Perth and Bass Strait shipping account for more than 18 per cent of total coastal shipping movements. In 2011–12, the volumes of merchandise imports and exports totalled approximately 1110 million tonnes—exports of 1014 million tonnes and imports of 99 million tonnes—with a total trade value of $528 billion free on board (FOB)—exports $264.2 billion and imports $264.4 billion.[47]

[47] DIRD, Australian Government, Freightline 1 - Australian Freight Transport Overview, 2014.

Sea freight is not considered a viable competitor to rail and road for north–south corridor freight movements along the east coast. Coastal shipping is generally not competitive over shorter distances, such as those in the north–south corridor, because of relatively high loading and unloading costs (e.g. port handling charges), which are multiplied with coastal shipping. The cost per kilometre for coastal shipping generally reduces as travel distance increases, making longer coastal shipping journeys more attractive.[48] As such, it is more suitable for longer journeys such as those on the east–west corridor. Coastal shipping also results in significantly longer transit times than road or rail, making it unsuitable for time sensitive container freight on the north–south corridor (e.g. manufactured goods). In terms of the top 10 routes for domestic freight (million tonnes) carried by coastal shipping in 2012–13, these are dominated by longer distance transport of commodities (e.g. between Weipa and Gladstone and Port Hedland to Port Kembla) and there are currently no significant volumes between Melbourne and Brisbane.[49]

Air freight

Air freight is highly specialised due to the inherent constraints on aircraft size and the nature of goods that can be carried. Air freight provides efficient freight services in areas that require high speed services or delivery to remote areas, however is considered expensive for transport of bulk goods. Air freight therefore has a limited role along the north-south corridor and is more suited to providing freight services for small, high value goods in remote areas and emergency supplies. It has also traditionally played a significant role in the transport of mail.

As with sea, air freight is not considered a viable competitor to rail and road for north–south corridor freight movements along the east coast.

2.5. National significance of the Melbourne to Brisbane freight task

The Melbourne to Brisbane north–south transport corridor is a major backbone for freight between capital cities and locations along the east coast and to other national destinations. The Melbourne to Brisbane freight route is one of the most important and dense general freight routes in Australia. It supports highly significant population, employment, economic areas and export tasks in Australia, contributing billions of dollars in domestic and export income annually.[50]

The east coast of Australia comprises 18 million residents (79 per cent of Australia's total population), nine million jobs (78 per cent of Australia's national employment) and contributes $1.1 trillion in GSP (75 per cent of GDP).[51]
Export trade through east coast ports is estimated to contribute approximately $260 billion annually.[52]

Key freight sectors underpinning resources, jobs and export markets for the east coast are nationally significant. For example:

- Interstate road freight travelling to and from Victoria, the Australian Capital Territory, New South Wales and Queensland comprises 60 billion tonne kilometres each year (or 84 per cent of total interstate freight in Australia) and is expected to double by 2030.[53]

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48 NSW Government, 'NSW Freight and Ports Strategy', p 82, 2013.

49 DIRD, Australian Government, 'Freightline 1', available at: https://www.bitre.gov.au/publications/2014/files/Freightline_01.pdf, 2014.

50 Infrastructure Australia, Communicating the Imperative for Action, A report to the Council of Australian Governments, June 2011.

51 Sources: Estimated Resident Population: ABS 31.104, TABLE 4, December 2013 (NSW, VIC, QLD and ACT comprise 18.3m of 23.3m Australian residential population); Employment: ABS 6202012 Table 12., July 2014 (NSW, VIC, QLD and ACT comprise 9.06m of 11.59m Australian employed persons); Gross State Product: ABS 5220001, Table 1, Chain volume measures and current prices", 2012–13 (NSW, VIC, QLD and ACT comprise $1,139b of $1,521b GDP).

52 Note: This value is based on analysis of trade through Australia's ports in 2001–2002, which found that approximately 35% of Australian exports by value were shipped from Australia's east coast ports. This proportion was subsequently applied to 2012–13 data relating to the total value of Australia's exports in order to show the estimated current value. See Australian Bureau of Statistics, 'Trade Through Australia's Ports', available at:
http://www.abs.gov.au/Ausstats/abs@.nsf/0/f49771da3cb0567dca256c750079144a/$FILE/Trade%20through%20Australia's%20ports.pdf.

  - Agricultural and other goods travelling within the corridor (including grain, cotton and steel) support the 18 million residents on the east coast and are valued at $34 billion per annum across Victoria, the Australian Capital Territory, New South Wales and Queensland (70 per cent of the total value of agricultural commodities produced in Australia).[54]
  - Southern Queensland (the Surat, the Queensland portion of Clarence-Moreton, Ipswich and Tarong Basins) contains significant thermal coal resources of about 8.4 billion tonnes, and at current export volumes and prices contributes up to $700 million in revenue annually.[55]
- Freight between Queensland and Victoria alone account for $10 billion tonne kilometres or 14 per cent of the national interstate road freight task.

Relevant freight infrastructure in the Melbourne to Brisbane corridor

The main commodities accessing the north-south corridor for part or all of their journey are manufactured (non-bulk) products, bulk steel, paper, coal and grain. The most significant flows involve coal transport in New South Wales, with other products moving between capital cities or between intermediate points on the main Melbourne to Sydney and Sydney to Brisbane corridor. Relatively little freight moves between inland points in the corridor.[56]

In the north–south corridor, freight is served by a network of rail and road infrastructure including:

- **Rail**
  - **Existing coastal railway:** Connects Melbourne to Brisbane via Sydney and the east coast, serving intercapital container freight between the major cities (Perth, Adelaide, Melbourne, Sydney and Brisbane) along with bulk freight along the route.
  - **Other railways:** Branch and main lines in New South Wales and southern Queensland connect coal and agricultural freight to domestic destinations as well as to ports along the coast.
- **Roads**
  - **The Hume Highway:** The major highway connecting Melbourne and Sydney and the major road route in Victoria for vehicles travelling between Melbourne and Brisbane.
  - **The Newell Highway:** The major road route for freight vehicles travelling between Melbourne and Brisbane and along the corridor in New South Wales. The Goulburn Valley Highway connects the Hume Highway at Seymour with the Newell Highway at Tocumwal.
  - **The Warrego Highway and Ipswich Motorway:** Highways in Queensland connecting the Newell Highway to continue the road freight journey to Brisbane via Toowoomba.
  - **The Pacific Highway:** The major route for north–south passenger transport on the east coast which accommodates Melbourne to Brisbane freight if it travels via Sydney.

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53 BITRE Research Report 121: Road freight estimates and forecasts in Australia: interstate, capital cities and rest of state (2008 and 2030 forecasts).

54 ABS 75030 Value of Agricultural Commodities Produced, 2012–13.

55 ACIL Allen Consulting, 2014; estimates assume approximately 8mt pa and a coal price of A$80 per tonne. By way of comparison, the resources in the Surat and Clarence–Moreton Basins are comparable with the Western Coal Field and about half of the resources in the internationally significant Hunter Coal Field. The current 2014 US$ f.o.b. price for Newcastle 6300 kcal/kg GAR benchmark coal is under US$70 per tonne. A price of US$69.05 converts to $A79.36 at an exchange rate of $A1=US$0.87. The corresponding price for Surat and Clarence-Moreton Basins coal is around $A75.40 per tonne f.o.b. At an exchange rate of $A1=US$0.82, which is more consistent with the position of the commodity price cycle at that time, the price of Surat and Clarence-Moreton Basins coal would be around A$80 per tonne.

56 Department of Transport and Regional Services, Australian Government, North-South Rail Corridor Study, Detailed Study Report, 2006.

- **Other roads:** Used by regional and agricultural freight, as well as by intercapital rail freight facilitating pick-up and delivery between each rail intermodal terminal and warehouses, distribution centres or other origin/destinations.

- **Intermodal terminals:** Play an important role facilitating the consolidation, storage and transfer of freight between rail and road at the commencement and conclusion of each rail journey. Key terminals relevant for intercapital freight in the corridor include South Dynon in Melbourne, Parkes in central west New South Wales and Acacia Ridge in Brisbane.
- **Ports:** Enable the import and export of freight, with key container freight ports at Port Melbourne, Port Botany in Sydney and the Port of Brisbane. Key coal export terminals are located at Port of Brisbane, Port of Newcastle and Port Kembla, and agricultural and other regional freight are exported via all of these ports, in particular Port Kembla, Port of Newcastle and Port of Brisbane.

East coast urban rail context

More than three in four Australians live in the 18 cities of 100 000 people or more.[57] Much of the forecast population growth will occur in cities. Australian cities have historically relied on accommodating a large proportion of an increasing population in new developments on their periphery, increasing their urban footprint. This creates challenges for the urban transport system as increased activity leads to increased congestion and pressure on capacity for all transport modes.

Some cities have better segregation between urban passenger and freight services than others. Perth has an extensive dedicated rail freight network linking freight terminals at Forrestfield/Kewdale and the Fremantle Port. Perth has only one kilometre of shared passenger-freight track and 121 kilometres of track dedicated to freight. This is the largest dedicated freight rail network of any Australian city. The dedicated rail freight networks in other capital cities are relatively small, ranging from 69 kilometres in Sydney to 66 kilometres in Melbourne, although all of the capital cities have direct freight rail access to ports.

Melbourne

Melbourne's broad gauge dual passenger network is largely separated from interstate standard gauge freight movements, however some urban and non-urban passenger trains share tracks with broad gauge freight trains. The dedicated, and un-electrified, freight network in the city is relatively large at 66 kilometres in length.

Sydney

Sydney's primary freight and passenger train services operate over the north–south and east–west (via Lithgow) interstate corridors. Historically Sydney has operated a mixed freight and passenger network with a relatively small route length (approximately 70 kilometres) of dedicated freight network. The Sydney network gives passenger services priority with a curfew in place on freight movements in the southern and northern metropolitan areas to ensure freight services do not adversely impact the commuter peaks. These curfews substantially restrict freight capacity as no freight is allowed on the urban system in the peak hours from six am to nine am and from three pm to six pm on weekdays. The freight network also shuts down for two weeks at Christmas and there is a train length limit of 1500 metres.

[57] Department of Infrastructure and Transport, Australian Government, State of Australian Cities, 2013.

Brisbane

As a proportion of the metropolitan network, Brisbane has the highest proportion of shared passenger/freight track in Australia.[58] Much of the shared narrow gauge track is on the Calvert/Rosewood/Ipswich and Caboolture Lines.

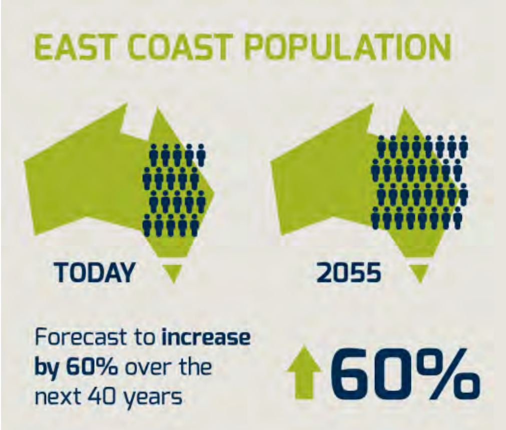
The Calvert/Rosewood/Ipswich line includes bulk freight, such as coal trains from the Surat and Clarence-Moreton Basins, whilst the Caboolture line includes intermodal freight traffic for the main Cairns to Brisbane North Coast Line. During the am and pm peaks there is a five hour curfew applied which means that operations are limited to 19 hours, five days per week. Weekend operations must not impact on timetabled services.

While Brisbane has a dedicated freight network of approximately 80 kilometres,[59] much of this route length is the interstate line between Acacia Ridge and Bromelton, the northern end of the Brisbane to Melbourne north–south corridor.[60]

2.6. The challenges ahead: Drivers for efficient freight transport

Infrastructure is the key to Australia’s competitiveness. Better infrastructure has a critical role in lifting our nation's wealth and prosperity,[61] and the nationally efficient operation of freight is integral to the wellbeing of all Australians.[62]

With Australia’s east coast population forecast to increase by 60 per cent over the next 40 years and with increases in employment also expected, the need for efficient freight transport will grow substantially, placing significant pressure on existing infrastructure and services.[63] Changing demographics, and in particular an ageing population, could also lead to changing settlement patterns and travel propensities, increasing the need for additional capacity in the nation’s passenger networks, particularly in capital cities.



Connecting people and businesses on the east coast to cities, regions and export ports with efficient and low cost freight transport services is important for the economic development and vitality of regional communities. Regional communities rely on freight networks of rail and road services, although road transport presently dominates the regional freight market. In Victoria and New South Wales alone, there are over 40 000 kilometres of state, regional and local roads.[64]

Australian and state governments will face significant challenges to meet the needs of east coast and national growth and connectivity. As the regional and interstate freight tasks grow, there will be increasing pressure on freight capacity to export ports and urban freight destinations. Population growth in Australia’s capital cities will increase the competition between passenger services and freight services for scarce road space and rail network capacity. In some cases this competition is exacerbated by explicit priority given to passenger services.

58 The Urban Context section has been developed using information from Department of Infrastructure and Transport, Understanding Australia’s Urban Railways, Report 131, Canberra, Australia, 2012.

59 Note: the only shared service that could be identified is the XPT (Express Passenger Train) which travels between Sydney, Melbourne and Brisbane.

60 The Urban Context section has been developed using information from Department of Infrastructure and Transport, Understanding Australia’s Urban Railways, Report 131, Canberra, Australia, 2012.

61 DIRD, Inland Rail Website, https://www.infrastructure.gov.au/rail/inland/, 2015.

62 Infrastructure Partnerships Australia, Meeting the 2050 Freight Challenge, 2009.

63 Australian Bureau of Statistics, Population Projections Australia 2006-2101, 2008 (Series B forecasts updated).

64 In NSW, there are over 18 000 km of state roads and almost 3000 km of regional and local roads. In Victoria, VicRoads manages over 22 000 km of roads.

The potential consequences of inaction are significant. Without a decision to make a step change in rail freight efficiency and performance by implementing Inland Rail, the growth in freight demand will likely see increasing pressure on road networks, increased freight costs and a loss of economic opportunity.[65] An over reliance on road transport to deliver the future east coast freight task will increase potential vulnerabilities to demographic changes which are already driving shortages of long distance truck drivers, increasing costs and locking in future outcomes that are economically, environmentally and socially inferior.

Without additional investment in infrastructure capacity, the repercussions will be felt at state and national levels. The strategic response from governments needs to be decisive. An incremental approach which progressively augments existing freight capacity but retains the legacy of sub-optimal alignments, low capacity and mixed passenger/freight networks is unlikely to deliver the outcomes for freight that will support our aspirations for national productivity and economic development on the east coast of Australia.

2.7. Inland Rail strategic context

Evolution of the Australian rail network

The Australian rail network has evolved over the past 100 plus years. The pre-1900 era of railways developed different gauges (width between rails), for example:

- Railways in Queensland, Tasmania and Western Australia were built on the 3’6” (1067 mm) narrow gauge.
- Railways in New South Wales were built on the 4’8½” (1435 mm) standard gauge.
- Railways in Victoria and South Australia were built on the 5’3” (1600 mm) broad gauge.

Since Federation in 1901, Australian Governments have sought to progressively connect the mainland state capital cities with a standard gauge railway system, for example:

- The standard gauge Trans–Australian railway, between Kalgoorlie and Port Augusta was completed in 1917 and was later extended to Port Pirie in 1937.
- A standard gauge line connecting Brisbane with the New South Wales system was completed in 1930. The 156 kilometre link eliminated the previously existing break of gauge, cut 160 kilometres from the previous journey and over six hours from the passenger journey from Sydney.
- The completion of the standard gauge network linking mainland state capital cities was achieved in June 1995, with the conversion of the Adelaide to Melbourne broad gauge track to standard gauge.[66]
- The standard gauge line from Alice Springs to Darwin opened in 2004.

Yet despite all these efforts, Australia still does not have a complete standard gauge railway system.

A step change in the Australian freight network

Inland Rail will deliver a railway connection in the north-south corridor between Melbourne and Brisbane that is interoperable with train operations in the east-west corridor.

[65] Note: Chapter 9 (Economic analysis) provides further details on the costs and benefits attributable to a ‘with’ and ‘without’ Inland Rail scenario to establish the net economic benefits to the community that could be expected from the railway.

[66] Australian Government and ARTC, The Rise, Decline and Rise of Australian Railways http://www.artc.com.au/library/agreement_railwayrise.pdf.

Once complete, Inland Rail will deliver the backbone infrastructure required to achieve a step change in the performance of the east coast domestic and international freight supply chain and will provide significant benefits for the entire country. Inland Rail offers significant performance advantages over the existing coastal route, including faster and more reliable transit times, a shorter route and more optimal grades, the potential for double stacking and longer, heavier axle load trains. It will improve the reliability and resilience of the freight network, improve competition between ports and access to ports, and provide a choice of urban and regional freight destinations.

These operational efficiencies will increase the role rail plays in the broader freight network and will allow rail to compete in the market as a viable alternative to road and sea/air, increasing the overall network capacity and freight mode options available to the market.

Inland Rail has the potential to deliver a range of social and economic benefits within its immediate proximity and along the east coast. These benefits will be able to be measured at a national, state and regional level meaning that support from all levels of government can develop real transformation in the Australian supply chain.[67]

A catalyst for economic development

Inland Rail will future proof Australia's rail freight network to cater for population growth and projected increase in freight demand. This will facilitate increased productivity in major east coast capital cities and regional areas. It will improve the safety of the transport network with a better mix and separation of modes in urban and regional environments, providing options for movement of goods that do not require larger road vehicles than are currently used throughout the passenger vehicle network.

The diversion of Melbourne to Brisbane and regional rail freight from the Sydney and Brisbane metropolitan rail networks, and the transfer of road freight (which currently transits through the Newell Highway or regional towns in Victoria, New South Wales and Queensland) onto Inland Rail will reduce the competition for scarce capacity on the rail and road networks of these major cities. It is predicted that the construction of Inland Rail will remove a significant number of trucks from roads on the east coast, resulting in improved environmental sustainability through reduced road congestion, fewer emissions and less noise.

A balance of freight transport capabilities, where the optimum mode is used to fulfil the freight task, will support the delivery of the Australian Government's environmental and social objectives. An efficient rail freight network and competitive rail services will reduce the nation's reliance on road transport, improving competitiveness of exports, reducing road congestion, lowering carbon emissions, reducing noise, reducing deaths and injuries from road accidents and improving amenity in urban and regional centres.

More efficient and low cost supply chains will in turn provide an impetus for regional growth and help unlock the full potential of Australia's east coast regions, including Australia's four richest farming regions and abundant mineral, energy and building resources. Low cost supply chains also support the expansion and development of associated service industries and other value added businesses in the regions.

The expanded and improved network will provide New South Wales and particularly Sydney with a range of new and expanded opportunities, particularly for the agricultural sector, by reducing the costs of delivering produce to domestic and overseas markets.

In Queensland, Inland Rail will enable mining industries particularly in the Surat and Clarence–Moreton Basins to reach export potential removing restrictions related to high transport costs and provide the Darling Downs agricultural

[67] Note: The economic analysis within Chapter 9 includes a CBA framework which quantifies the direct costs and benefits attributable to Inland Rail. An economic impact assessment has also been undertaken using computable general equilibrium modelling to estimate the impacts of Inland Rail as they flow on and multiply throughout the regional, state and national economies.

region access to more productive, reliable, national network standard rail services, again benefiting the agriculture sector.

The proposed 10 year programme will support economic activity in the regions and create regional jobs in Queensland, New South Wales and Victoria during construction.

An enabler of complementary market driven investments

Inland Rail complements and further builds upon other significant (but independent) infrastructure investments of state and federal governments and the private sector. Inland Rail utilises existing rail network assets, with 35 per cent of the proposed 1700 kilometre route comprising new greenfield links, and opens up opportunities for new purpose built freight terminals serving national freight markets, including an east-west rail hub at Parkes in New South Wales.

Inland Rail will assist in maximising returns from previous and future investments by Government and the private sector including:

- Australian Government and ARTC investments in the interstate rail network, including upgrading of the Melbourne to Illabo, Stockinbingal to Parkes and Parkes to Broken Hill sections of the network with long sections of double track (Seymour to Albury), passing lanes (Albury to Junee), and re-sleepering and re-railing to facilitate improved network performance.
- Port of Melbourne handles around 2.5 million containers annually (equivalent to around 36 per cent of Australia's container trade), and adds $1.8 billion to the Victorian economy annually.[68]
- The Parkes National Logistics report noted that delivery of Inland Rail will be the catalyst for more than $200 million of private investment within Parkes in the transport and logistics industry.[69]
- Expansions of the Ports of Melbourne and Brisbane.
- Expansion of Port Botany and investment in the Southern Sydney Freight Line connecting Macarthur, Moorebank and Port Botany.

Inland Rail will support, and in turn need to be supported by, a range of complementary projects and investments including:

- Rollingstock investment in longer, heavier trains along with supporting train operations to take advantage of the improved rail offering (e.g. determination of arrival, departure & transit times) by train operators.
- Double stack terminal capacity in Melbourne and Brisbane and an ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Regional terminals and loading facilities for regional/agricultural/coal freight.
- Investment in connecting coal and agricultural rail lines and sidings from the Surat and Clarence-Moreton Basins in south west Queensland to the Port of Brisbane (the Western Line) and in metropolitan Brisbane.

An early commitment to east coast rail network that is competitive with road freight via delivery of Inland Rail over the next 10 years is an important signal to the market and to the freight industry that will allow private sector investment to be progressively directed towards complementary investments that leverage the enhanced logistics capabilities of Inland Rail. Without such a commitment, companies will change the pattern of investment in their supply chains and potentially lock into road-based logistics options which will undermine future efforts to attract freight to rail.

68 Port of Melbourne Corporation, Quick facts, http://www.portofmelbourne.com.au/about-the-port/quick-facts, 2015.

69 http://www.parkeshub.com.au/index.php/2011-05-04-02-21-57.

2.8. Inland Rail Programme objectives

Based on the vision for the east coast and national freight network, a set of Inland Rail objectives have been defined to inform development of the Programme as part of this Programme Business Case.

Inland Rail aims to achieve the following objectives:

1. Provide a backbone rail link between Melbourne and Brisbane that is interoperable with train operations between Perth and Adelaide in order to serve future rail freight demand and stimulate growth for intercapital and regional/bulk rail freight.
2. Provide an increase in productivity that will benefit consumers through lower freight transport costs.
3. Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor to deliver a freight rail service on the east coast that is competitive with road.
4. Improve road safety, ease congestion and reduce environmental impacts by moving freight from road to rail.
5. Bypass bottlenecks on congested metropolitan rail networks on the east coast and free up train paths for other services on the coastal route.
6. Act as an enabler for regional economic development along the Inland Rail corridor.

2.9. Alignment with national and state strategies, policies and plans

Key national and state strategies, policies and plans have informed and influenced the vision, objectives, and development of the Programme Business Case. These key strategies and policies are shown in Figure 2.5.
The alignment of Inland Rail with the key strategies, policies and plans of the Australian Government and Victoria, New South Wales and Queensland state governments is provided in Table 2.1. The ticks within the table indicate strong alignment.

Figure 2.5 Key national infrastructure strategies, policies and plans

Table 2.1 Alignment of strategies and policies with Inland Rail Programme objectives

STRATEGY/PLAN/POLICY	ALIGNMENT WITH INLAND RAIL PROGRAMME OBJECTIVES					
	1	2	3	4	5	6
	Provide a backbone rail link between Melbourne and Brisbane that is interoperable with train operations between Perth and Adelaide to serve future rail freight demand and stimulate freight growth for intercapital and regional/bulk rail freight	Provide an increase in productivity that will benefit consumers through lower freight transport costs	Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor to deliver a freight rail service on the east coast that is competitive with road	Improve road safety, ease congestion and reduce environmental impacts by moving freight from road to rail	Bypass bottlenecks on congested metropolitan rail networks on the east coast, and free up train paths for other services on the coastal route	Act as an enabler for regional economic development along the Inland Rail corridor
National						
Urban Transport Strategy, Infrastructure Australia, 2013			✓	✓	✓	✓
State of Play Report, Infrastructure Australia, 2013						✓
National Infrastructure Plan, Infrastructure Australia, 2013	✓					✓
National Land Freight Strategy Paper (Update), Infrastructure Australia, 2012	✓	✓	✓	✓	✓	✓
The State of Australia's Cities, Department of Infrastructure and Transport, Australian Government, 2012				✓	✓	
Our Cities, Our Future, DIRD, Australian Government, 2011		✓		✓		✓
National Ports Strategy, Infrastructure Australia, 2011		✓				
Report to the Council of Australian Governments, 2008		✓		✓	✓	✓
State						
Victoria						
Victoria, the Freight State, Victorian Freight and Logistics Plan, Victorian Government, 2013	✓	✓	✓	✓		✓
Job Density, Productivity and the Role of Transport, Victorian Government, June 2012	✓	✓	✓	✓		✓

STRATEGY/PLAN/POLICY	ALIGNMENT WITH INLAND RAIL PROGRAMME OBJECTIVES					
	1	2	3	4	5	6
	Provide a backbone rail link between Melbourne and Brisbane that is interoperable with train operations between Perth and Adelaide to serve future rail freight demand and stimulate freight growth for intercapital and regional/bulk rail freight	Provide an increase in productivity that will benefit consumers through lower freight transport costs	Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor to deliver a freight rail service on the east coast that is competitive with road	Improve road safety, ease congestion and reduce environmental impacts by moving freight from road to rail	Bypass bottlenecks on congested metropolitan rail networks on the east coast, and free up train paths for other services on the coastal route	Act as an enabler for regional economic development along the Inland Rail corridor
New South Wales						
Draft Newell Highway Corridor Strategy, New South Wales Government, 2014				✓		
New South Wales Freight and Ports Strategy, New South Wales Government, 2013	✓	✓	✓	✓	✓	✓
New South Wales Long Term Transport Master Plan, New South Wales Government, 2012	✓	✓	✓		✓	✓
State Infrastructure Strategy (and Update), New South Wales Government, 2012	✓	✓	✓	✓		✓
Queensland						
Delivering an Infrastructure Plan for Queensland, Directions Paper, 2015, Queensland Government	✓	✓			✓	✓
Queensland Ports Strategy, Queensland Government, 2014						✓
Moving Freight Strategy, Queensland Government, 2013	✓	✓	✓			✓
Southern Freight Rail Corridor Study, Queensland Government, 2010	✓	✓	✓	✓		✓
Rail Network Strategy, Queensland Government, 2009	✓	✓	✓	✓		✓

Source: PwC, 2015.

2.10. Risks of not progressing the Programme

A failure to progress Inland Rail will have significant negative impacts on the future growth potential of the national economy and the prosperity of Australians for generations.

The continuing growth in freight demand calls for immediate action. Without a decision to make a step change in rail efficiency and performance, pressure on the road networks will continue to increase, freight costs will continue to rise, consumers will inevitably pay more for products, and productivity in important industrial sectors will decline.

Road will increasingly become the dominant mode with rail becoming less relevant. A continued over-reliance on road transport to meet the future east coast freight task will increase the vulnerabilities to demographic changes which are, even today, driving shortages of long distance truck drivers and increasing costs.

More specifically, if investment in the east coast freight corridor is not undertaken to increase capacity and minimise supply chain costs, the following risks are highly likely to eventuate:

- National productivity and economic growth will be constrained.
- Freight companies and the consumers of products transported along the corridor are expected to experience excessive freight costs.
- There will be an increase in congestion on both rail and road networks, given the reliance on shared freight/passenger corridors.
- There will be an increase in the number of trucks on urban and regional roads required to move the rising freight volumes.
- Larger trucks (i.e. B-doubles, B-triples) will be mixing with smaller passenger vehicles on major highways.
- Governments will be required to make significant investments in major arterial and regional roads to ensure they can support the increase in the number and size of heavy vehicles.
- There will be a deterioration of safety on the road network with existing infrastructure not supportive of changes in vehicle mix.
- Ongoing fuel used and emissions discharged from an increased number and size of heavy vehicles will have environmental impacts.
- An increase in freight road traffic will have major impacts on urban and regional communities on the freight route such as congestion, amenity and noise, resulting in safety and environmental issues. Significant economic impacts associated with the inability of the freight network to meet the demand for goods and services.

2.11. Summary

Inland Rail will connect key production areas in Queensland, New South Wales and Victoria with export ports in Brisbane and Melbourne, and provide linkages between Melbourne, Brisbane, Sydney, Adelaide and Perth. It will reduce freight transit times, reduce congestion on rail and road networks and enable the movement of larger freight volumes via rail by making longer and double stacked trains possible.

Inland Rail will provide the backbone infrastructure necessary to significantly upgrade the performance of the east coast rail freight network to better serve future freight demands, while also diverting demand from an already constrained road freight and rail passenger network.

The expected economic and social costs of not proceeding with the program would be significant and far-reaching.

Inland Rail will make it faster, cheaper and more reliable for Australian producers, farmers, manufacturers and retailers to move goods around the country and the world. It will make a significant contribution to the vision for an efficient interstate rail and road network working together to provide cost effective and sustainable connections from key regional markets to ports and key urban and regional freight destinations.

Inland Rail complements and further builds upon other significant infrastructure investments of Australian and state governments, and the private sector. It aligns with key government strategies, policies and plans, and is designed to deliver what industry has long been advocating—a road-competitive service based on transit time, price, reliability and availability.

Chapter 3
Problem identification and analysis

3. PROBLEM IDENTIFICATION AND ANALYSIS

3.1. Purpose of this chapter

The purpose of this chapter is to define the fundamental problems Inland Rail is seeking to address. It builds upon the vision and strategic context, which outlined impacts for the nation and east coast as a result of inaction to develop freight transport, to focus on freight sector problems specific to the north–south corridor.

The problem analysis and identification influences and underpins the strategic options assessment and ultimately, development of the proposed benefits that Inland Rail will deliver.

3.2. Approach

An Investment Logic Mapping (ILM) process has been adopted to succinctly identify the problems for analysis within this chapter. The ILM process is part of the Investment Management Standard developed by the Victorian Government's Department of Treasury and Finance and is a nationally recognised process to ensure complex project evaluations properly articulate the real need for an investment and the benefits the investment is expected to deliver.

The ILM identifies the strategic problems that Inland Rail is responding to, considering the freight sector in the north–south corridor, rather than just a rail-specific response. This ensures a holistic and rigorous approach to problem identification and analysis. The problem analysis has focused on the most important problems and issues, therefore it is not an exhaustive description of every problem to which Inland Rail will respond.

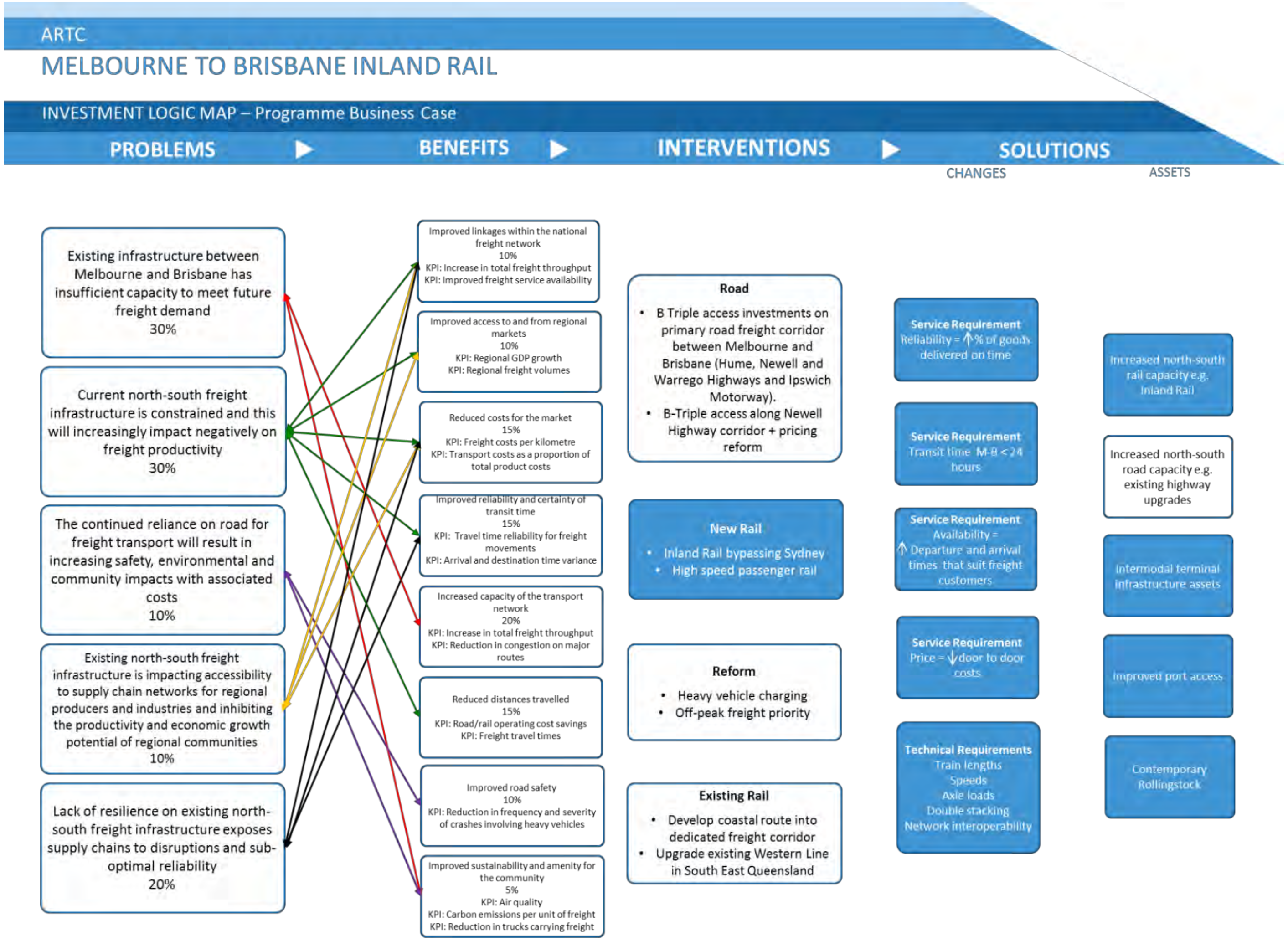
The ILM shows the direct links between the identified problems and the associated benefits (covered further in Chapter 9, Economic analysis and Chapter 16, Benefits realisation). It then examines the overarching interventions and the solutions to address the problems which include the expected changes in overall service outcomes, and the potential assets that may deliver the service outcomes and expected benefits.

The chapter is structured around each of the identified problem statements and breaks these down into further sub-problems for the purposes of targeted, evidence-based analysis.

3.3. Problem identification

An ILM has been developed to reflect the current strategic context and incorporate problem and benefit statements that have been identified as part of this Programme Business Case (see Figure 3.1). The interventions and solutions provide an indication of the strategic options that have been considered and assessed, the changes in service that are expected and also the potential assets that could be invested in to deliver the expected outcomes and benefits.
The ILM is a complementary supporting document to the Programme Business Case and tells the simplified story of how the identified problems link to the recommended solution(s).

Figure 3.1 Investment Logic Map



Source: ARTC, 2015.

3.4. Problem analysis

Significant freight volume growth in the north–south corridor is projected as a result of population, job and export growth along the east coast of Australia. The interstate freight task alone is projected to increase by 70 per cent by 2030 to 140 billion tonne kilometres.[70] The freight network plays a critical role in the national transport task, and needs to cater for this growth.

However, as the analysis in this chapter shows, the ability of current rail and road freight infrastructure in the north–south corridor to cater for future growth and offer reliable, low cost freight transport options is projected to become constrained over time.

Sea and air freight are not considered viable competitors to rail and road for north–south corridor freight movements along the east coast; for sea freight, this is due to high loading and unloading costs and shorter distances travelled relative to the east–west corridor and for air freight this is due to the nature of goods and higher suitability for small, high value goods as well as those to remote areas.

The ability of freight transport infrastructure to cater for growth and offer efficient, cost effective freight transport services in the north–south corridor of the east coast of Australia into the future is projected to become increasingly constrained, characterised by the following problems:

- **Capacity:** Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
- **Productivity:** Current north–south freight infrastructure (road and rail) is constrained and this will increasingly impact negatively on freight productivity.
- **Social and environment:** The continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
- **Regional and growth:** Existing north–south freight infrastructure is impacting regional producers and industries access to efficient supply chain networks, inhibiting productivity and economic growth.
- **Resilience:** Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability.

As rail and road contribute to capacity and freight performance in varying ways, these same problems explained on a mode-by-mode basis, are summarised below:

Road

- Lane capacity along the route will be unable to accommodate future freight and other vehicle demand without deteriorating transit time and reliability.
- The shared nature of road travel between freight and other road users will create increasing conflicts in the future as demand for both increases in line with population and GDP growth.

Rail

- The number of paths available for freight trains will be unable to accommodate future freight demand between Melbourne and Brisbane as well as Melbourne to Sydney to Brisbane.
- The ability to accommodate higher productivity trains (longer, higher axle load and double stacked) will be limited in some sections of the corridor.
- Lack of redundancy and resilience on rail freight networks exposes supply chains to disruptions.

[70] BITRE Research Report 120: Multimodal Interstate Freight in Australia, 2010.

If not addressed these problems are expected to impact:

- Costs of transport flowing through the supply chain to end users.
- Reliability and disruptions to the supply chain impacting customer expectations.
- Passenger rail services with network constraints.
- Environmental and social impacts including safety, emissions and noise.

Each major problem is discussed and analysed further below.

3.4.1. Capacity: Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand

Lane capacity along the Newell Highway

There is a mix of local traffic, private vehicles and freight vehicles on the major roads and highways between Melbourne and Brisbane. This reduces the reliability of traffic flows (e.g. as a result of different average travel speeds between cars and heavy vehicles, and difficulties overtaking heavy vehicles) as well as accident rates.
Conflicts between cars and heavy vehicles also increases stop-start traffic conditions, resulting in higher vehicle emissions and operating costs.

The Hume, Newell and Warrego Highways, and Ipswich Motorway comprise the primary road freight route between Melbourne and Brisbane, with the Pacific Highway increasingly being considered as an alternate route. A significant program of investment has been completed on the Hume and Pacific Highway's. Investment in the construction of the Toowoomba Second Range Crossing is underway to address a key bottleneck on the Warrego Highway. However, the Newell Highway has not yet been duplicated or improved in the same way as the other major road links in the corridor. Trucks travel along the Newell Highway for approximately 1060 kilometres (60 per cent) of this primary freight route between Melbourne and Brisbane, which connects the Hume Highway in Victoria with the Warrego Highway in Queensland, via the Gore Highway.

A number of sections of the Newell Highway corridor are currently operating at 55 to 70 per cent of capacity, resulting in restricted speeds, manoeuvrability and unstable flow conditions.[71]

Under these conditions, minor increases in traffic are expected to result in operational problems, including a restricted selection of desired speed and manoeuvrability and a noticeable decline in the general level of comfort and convenience relative to roads using a lower proportion of capacity.

Demand is forecast to increase to up to 11 000 vehicles per day by 2031—estimated to increase by 59 to 85 per cent at some major locations and town centres over a 25 year period as illustrated in Table 3.1.

Related to increased volume, anticipated transit times for the full length of the Newell Highway corridor are forecast to increase by 48 per cent from around 26 hours to 38.7 hours by 2055.

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71 NSW Government, 'Draft Newell Highway Corridor Strategy', pp. 70–7, 2014.

Table 3.1 Forecast road volumes on the Newell Highway Corridor in 2031 (average all day traffic)

MAJOR LOCATION/TOWN CENTRE	2005	2031	% Increase
Forbes	4597	5100	11%
Trewilga	4490	8319	85%
Parkes	4040	4255	5%
Narromine	4304	6844	59%
Dubbo	4769	6338	59%
Gill Gill Creek Bridge	4686	9368	33%

Source: NSW Government, Draft Newell Highway Corridor Strategy, page 146, 2014.

Road freight contributes to the worsening performance of the Newell Highway as shown in Table 3.1. The percentage of heavy vehicles in rural areas of the Newell Highway corridor in 2011 already ranged from 26 to 52 per cent of total traffic volumes as shown in Table 3.2. On average, rigid and articulated trucks account for around eight per cent of rural highway traffic volumes, while B-doubles account for around five per cent.[72] As a comparison, in capital cities and urban areas, road freight volumes of five per cent of traffic can be considered a high freight proportion.[73] Other road routes along the corridor are also critical freight routes in the national network. There are currently 3000 heavy vehicle movements on the Warrego Highway per day at Ipswich and approximately 2500 heavy vehicles per day through Toowoomba.[74] Heavy vehicle growth on the Pacific Highway has increased by three to five per cent annually between 2001 and 2011.[75]

Table 3.2 Per cent of heavy vehicle traffic in rural areas of the Newell Highway (2011) 2005–2031

HIGHWAY PLANNING SECTION (RURAL)	% OF HEAVY VEHICLES	HIGHWAY PLANNING SECTION (RURAL)	% OF HEAVY VEHICLES
Moree to Boggabilla	52%	Boggabilla to Goondiwindi	37%
Narrabri to Moree	48%	Finley to Jerilderie	37%
Morundah to Narrandera	47%	Jerilderie to Morundah	37%
West Wyalong to Forbes	45%	Parkes to Tomingley	35%
Gilgandra to Gowang	45%	Narrandera to Grong Grong	34%
Gowang to Coonabarabran	44%	Mirrool to West Wyalong	32%

72 TfNSW, 'Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives', p 219, 2013.

73 TfNSW, 'Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives', p 223, 2013.

74 Queensland Government, 'Warrego Highway Upgrade Strategy', p 10, 2012.

75 NSW Government, 'Pacific Highway Upgrade: Submission to Infrastructure Australia', available at: http://www.rms.nsw.gov.au/documents/projects/key-build-programs/pacific-highway/pacific-highway-infrastructure-australia-submission-201111.pdf, p. 6, 2011.

HIGHWAY PLANNING SECTION (RURAL)	% OF HEAVY VEHICLES	HIGHWAY PLANNING SECTION (RURAL)	% OF HEAVY VEHICLES
Coonabarabran to Narrabri	44%	Ardlethan to Mirrool	31%
Grong Grong to Ardlethan	42%	Dubbo to Gilgandra	31%
Tomingley to Dubbo	40%	Forbes to Parkes	30%
		Tocumwal to Finley	26%

Source: NSW Government, Draft Newell Highway Corridor Strategy, p. 69, 2014.

Capacity between Melbourne and Sydney as a result of Moorebank Intermodal terminal demand

The Australian Government's announced interstate and port shuttle intermodal terminal at Moorebank in south west Sydney is expected to significantly increase rail freight demand on the Southern Sydney Freight Line (SSFL). ARTC estimate that this will result in capacity constraints for rail freight travelling through Sydney.

Based on customer advice, ARTC also estimates that existing capacity on the SSFL will be fully utilised by 2020–21, and that total train volumes will reach over 40 trains per direction per day by 2027–28.

Without additional investment in capacity (new and extended passing loops, sections of track duplication and other track work) forecast demand will not be met and instead will shift to the congested urban road network or be supressed.

Capacity between Melbourne and Sydney if coal trains to Port Kembla also use the Southern Sydney Freight Line

Further capacity pressure could also be experienced on the SSFL if increases in passenger service frequencies on the Illawarra line in southern Sydney require diversion of freight to alternative routes. There are currently up to 11 coal train services per day from the coalfields around Lithgow west of Sydney, via the Sydney Trains Western and Illawarra lines, to Port Kembla south of Sydney. A number of steel, grain and aggregate trains are also operating on the Illawarra line.

These freight trains currently use ARTC's Metropolitan Freight Network while transiting through Sydney. Freight services on the Sydney Trains network are already subject to peak curfews, and on the Illawarra Line, there are currently between 11 (Sutherland to Hurstville) and 18 (Hurstville to Bondi Junction) passenger services per hour in the morning peak.[76] Stage Five of Sydney's Long Term Rail Plan, Sydney's Rail Future, proposes more frequent services to Hurstville on the Illawarra Line, providing up to an additional 10 trains per hour.[77] Increased off-peak frequencies could be expected to substantially reduce the availability of freight paths on the Illawarra line.

This would potentially require diversion of freight services to operate via the SSFL and ARTC's southern line (and a future Maldon to Dombarton line, if constructed) to reach Port Kembla. This would further increase capacity requirements on the SSFL.

[76] Sydney Trains website, 'Timetables – T4 Eastern Suburbs & Illawarra Line', available at: http://www.sydneytrains.info/timetables/pdf/Eastern_Suburbs_Illawarra.pdf, 2015.

[77] NSW Government, 'Sydney's Rail Future – Modernising Sydney's Trains', June, pp. 18, 41, 2012.

The Northern Sydney Freight Corridor segment between Sydney and Hornsby

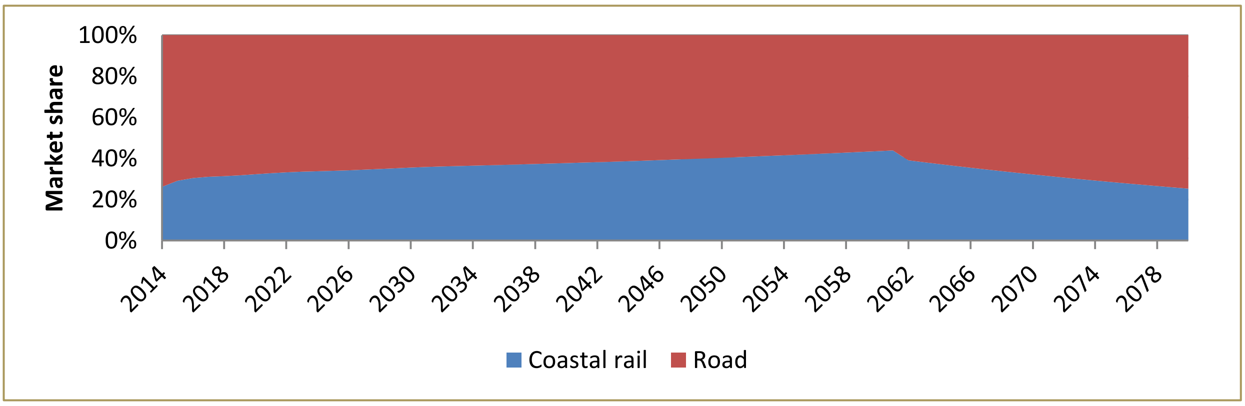
The coastal railway will always have limitations of gradient, is likely to remain limited to single stacked and 1500 metre trains and is never likely to have a dedicated rail corridor in northern Sydney due to conflicts with the existing passenger infrastructure.

The Sydney rail network gives passenger services priority with a curfew in place on freight movements in the southern and northern metropolitan areas to ensure freight services do not adversely impact the commuter peaks. These curfews substantially restrict freight capacity as no freight is allowed on the urban system in the peak hours from six am to nine am and from three pm to six pm on weekdays.

There are currently between 10 (Hornsby to Epping) and 15 passenger services per hour (Epping to Strathfield) in peak periods. The frequency of passenger services is forecast to increase in line with Sydney's long term rail plans, where two services per hour will be added in the short term and additional services will be added to match demand in the longer term.[78]

Based on demand estimates for rail freight growth in the north–south corridor, without Inland Rail, the coastal route is expected to be subject to capacity constraints in terms of the number of paths available for freight trains in northern Sydney from around 2049–50 (shown in Figure 3.2).[79] This time estimate is likely to be understated as it does not consider marketable paths relative to effective paths, with some of the available paths likely to be at undesirable times not demanded by freight customers. This has a major implication limiting the potential rail mode share, which is forecast to peak at approximately 44 per cent in 2060–61 then decline as freight volumes continue to increase despite capacity having been reached.

Figure 3.2 Melbourne to Brisbane intercapital freight mode share without Inland Rail including timing of rail path capacity constraints in Sydney (2013–14 to 2079–80)



Note: The decline in coastal rail mode share post 2060–61 without Inland Rail reflects assumed coastal route capacity in northern Sydney being reached with no further investment.

Source: ACIL Allen, 2015.

[78] NSW Government, 'Sydney's Rail Future – Modernising Sydney's Trains', p 19, available at: http://engage.haveyoursay.nsw.gov.au/document/show/329, 2012.

[79] ACIL Allen Consulting, 2015. Expanding this capacity would require further significant investment in the Northern Sydney Freight Corridor Stages 2 and 3 or alternative projects to provide additional capacity through this section of the corridor.

The Northern Line between Sydney and Newcastle

There are shared passenger and freight services for 155 kilometres through Sydney on the Northern Line between Strathfield and Broadmeadow near Newcastle, used by intercapital freight travelling between Brisbane and Sydney or Melbourne.[80] There are currently nearly 1500 services per week on this line, of which around 70 per cent are during off peak periods outside the peak period curfew.[81]

The Calvert/Rosewood/Ipswich Line in Brisbane

As a proportion of the metropolitan network, Brisbane has the highest proportion of shared passenger/freight track in Australia.[82] Much of the shared narrow gauge track is on the Calvert/Rosewood/Ipswich and Caboolture lines, currently used by coal and agricultural trains from south west Brisbane and the Surat and Moreton Basins. The Caboolture line includes intermodal freight traffic for the main Cairns to Brisbane North Coast Line.

During the am and pm peaks there is a five-hour curfew applied which means that operations are limited to 19 hours, five days per week. Weekend operations must not impact on timetabled services.

3.4.2. Productivity: Current north–south freight infrastructure is constrained and this will increasingly impact negatively on freight productivity

Road freight plus other road users impacting on road congestion

There are currently 3.5 million tonnes of intercapital freight transported by road between Melbourne and Brisbane each year, which is the equivalent of over 100 000 trucks travelling a total of nearly 175 million kilometres. By 2050, it is estimated that without investment in Inland Rail, the number of trucks transporting container freight between Melbourne and Brisbane will increase to over 275 000 to meet the increased freight task. Driven by the volume of freight transported by road, costs of congestion for freight transport are currently estimated to be around $60 million per year for Melbourne to Brisbane intercapital freight alone.[83] The cost of this congestion is expected to increase by 56 per cent to approximately $106 million per annum.

The nature of shared road travel between freight and other road users will increasingly create physical conflicts as demand for both increase in line with population and economic growth. Without creating alternative modes of transport or investing in additional road capacity there may be challenges avoiding congestion through urban locations and towns related to the volume of freight vehicles.

This impacts other users of the road network particularly in urban areas (estimated at approximately 15 per cent of the Melbourne to Brisbane route) in terms of reduced travel speeds and reliability. In addition, stop-start conditions contribute to increased emissions and operating costs.[84] The Royal Automobile Club Queensland (RACQ) estimate that driving in stop-start congested traffic increases fuel consumption and emissions by around 30 per cent.

In contrast, rail transport provides the opportunity to remove 161 trucks for every train between Melbourne and Brisbane, and also has greater ability to separate freight users and thereby minimise network congestion through the allocation of capacity in the form of rail paths.[85]

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80 NSW Government, 'Northern Sydney Freight Corridor Strategic Review Report', p 4, available at: http://www.transport.nsw.gov.au/sites/default/files/b2b/projects/TP_NSFC_Strategic_Review_Report_July_2012.pdf, 2012.

81 The Northern Line timetable was analysed to determine the number of services per hour at Strathfield station in both directions for weekdays and weekends. See Sydney Trains, 'Timetables', available at: http://www.sydneytrains.info/timetables/pdf/Northern.pdf, 2014.

82 The Urban Context section has been developed using information from Department of Infrastructure and Transport, Understanding Australia's Urban Railways, Report 131, Canberra, Australia, 2012.

83 RACQ, 'Submission to the National Land Freight Strategy', April, 2011.

84 PwC analysis of the proportion of the Melbourne to Brisbane route passing through residential areas; based on Google Maps, 2015.

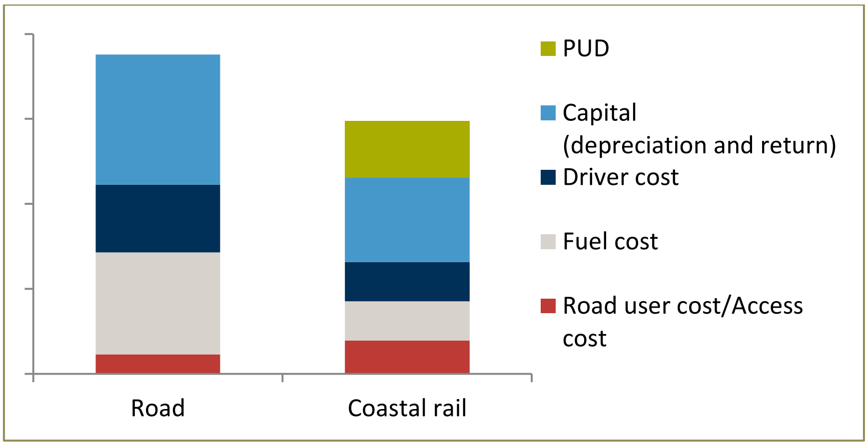
85 161 truck estimate based on 3600 metre trains and is equivalent to 149 B-double or 240 semi-trailer trips.

Untapped rail productivity savings

Rail transport provides potential for significant productivity savings for the freight sector. It is estimated that the coastal railway is already more cost effective for Melbourne to Brisbane intercapital freight, offering a door-to-door price 85% of a road trip for Melbourne to Brisbane intercapital freight.

In the future this differential is expected to widen, reflecting that road freight is more susceptible to driver shortages, rising fuel prices and the level of broader road network congestion resulting in stop-start conditions and longer, more costly trips. A comparison of rail and road operating costs between Melbourne to Brisbane, showing the labour and fuel portion of total costs are detailed in Figure 3.3.

Figure 3.3 Comparison of rail and road operating cost components



Note: Price withheld to preserve the confidentiality of market sensitive pricing.
Source: ACIL Allen, 2015.

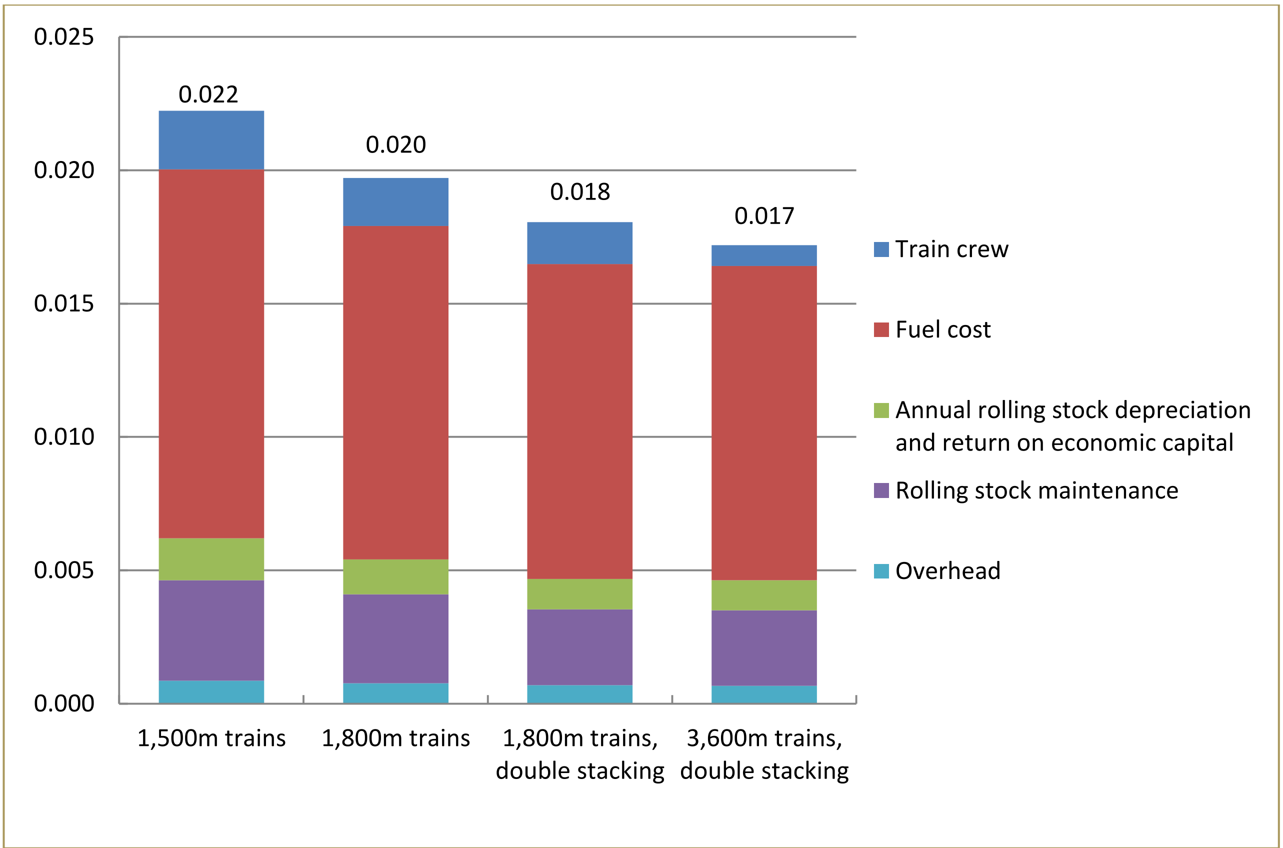
Higher productivity train limitations on the coastal route

To take up potential productivity savings made possible by shifting to rail, however, a comparable service in terms of reliability, transit time and availability is sought by industry yet constrained with current rail infrastructure. Moreover, the scale of productivity benefits made possible by a shift to rail transport is currently constrained by the inability of some sections of the coastal railway to accommodate higher productivity trains (longer, higher axle load and double stacked) between Melbourne and Brisbane, resulting in higher supply chain costs in the corridor.

The coastal route length of approximately 1900 kilometres (200 kilometres longer than Inland Rail), and limits to train capacity to single stacked, 1500 metre trains, result in higher supply chain costs.

Double stacked container services have the potential to reduce above rail operating costs by 10 per cent relative to single stacked services as shown in Figure 3.4. Compared to the current coastal railway (1500 metre trains and single stacking of containers), increasing train lengths to 1800 metres would reduce operating costs by 11 per cent. Combining 1800 metre trains with sufficient clearance for double stacking of containers would reduce operating costs by 19 per cent. Further increasing train lengths to 3600 metres would reduce operating costs by 23 per cent relative to the coastal railway (assuming that only a proportion of 1800 metre trains would be expected to utilise double stacking given practical loading restrictions and container mix).

Figure 3.4 Coastal railway train operating cost with increased train lengths and double stacking (2024–25, $2014 per net tonne kilometre)



Note: Double stacking scenarios assumed 40 per cent of train capacity would be double stacked.

Source: PwC analysis based on: Parsons Brinckerhoff (PB) and ARTC inputs, 2015.

3.4.3. Social and environment: The continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs

Safety

Conflicts between cars and heavy vehicles increase the number and severity of road accidents, which imposes a number of direct and indirect costs on society. Heavy trucks were involved in 165 crashes on the Newell Highway between 2007 and 2011, representing 20 per cent of all crashes. The severity index for the Newell Highway is higher than the average for undivided rural roads in New South Wales (1.25), in all but one section. This suggests that when crashes do occur on the Newell Highway, they tend to be more severe than those occurring on similar classes of roads. This can be attributed to a number of factors including high speeds and a higher percentage of heavy vehicles along the highway.

The most prevalent crash types on the Newell Highway between 2007 and 2011 have been outlined in Table 3.3. There were 828 crashes reported between 2007 and 2011 along the highway, of which 463 were 'casualty crashes' which caused either a fatality or injury to one or more of the people involved. Of the 463 casualty crashes, 36 were fatal and 427 resulted in an injury.

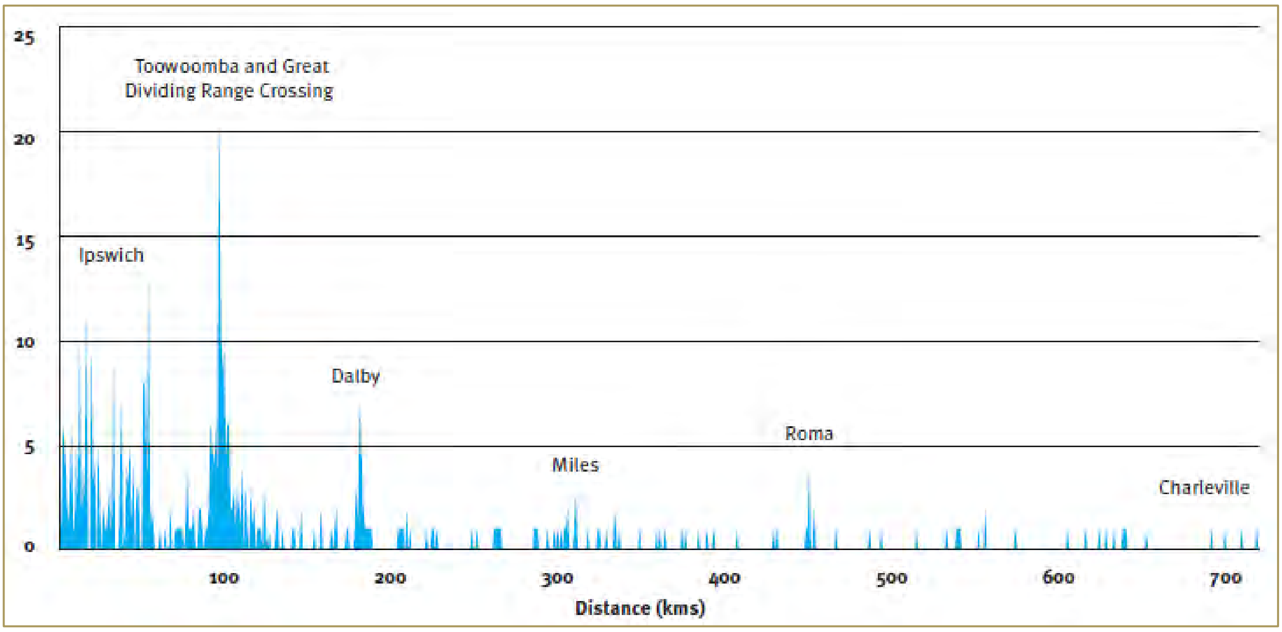
Table 3.3 Crash types on the Newell Highway (2007–2011)

CRASH TYPES	NUMBER OF CRASHES	% OF CRASHES
Off road on straight (include hit object)	272	33%
Off road on curve (include hit object)	106	13%
Head on (not overtaking)	54	7%
Rear end	57	7%
Intersection	110	13%
All other crash types	229	28%

Source: NSW Government, Draft Newell Highway Corridor Strategy, page 64, 2014.

The fatal and serious injury crashes on the Warrego Highway between 2005 and 2009 are shown in Figure 3.5. The Toowoomba and Great Dividing Range crossing shows a significant spike, which is related to the challenging topography and road conditions through the ranges.

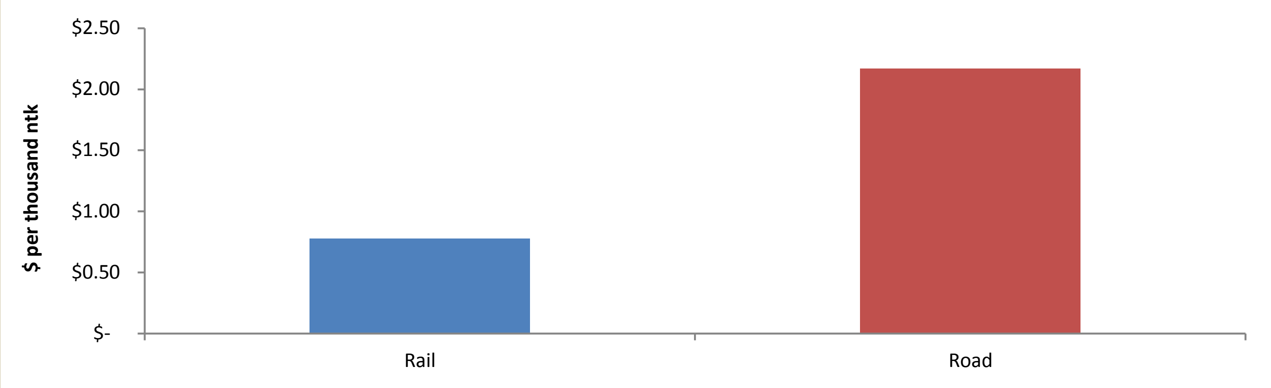
Figure 3.5 Fatal and serious injury crashes on the Warrego Highway (2005–2009)



Source: Queensland Government, Warrego Highway Upgrade Strategy, page 11, 2012.

Estimates of the differences between accident costs for heavy vehicles compared to rail for every thousand net tonne kilometres travelled is shown in Figure 3.6. The figure shows that road accidents causing death or serious injury are nearly three times more likely relative to rail. This imposes a number of costs on society including emergency services, hospital costs, lost workforce productivity and lost household productivity.

Figure 3.6 Australian rail and road accident rates ($2014, per net tonne kilometre)



Source: Bureau of Infrastructure, Transport and Regional Economics (BITRE), 'Road trauma involving heavy vehicles: crash statistics', pages 17 and 41–43, 2014 and Australian Rail Safety Bureau, 'Australian Rail Safety Occurrence Data', pages 3, 4, 2012 and; Austroads 'Guide to Project Evaluation', Part 4, page 35, 2012.

Environment

Conflicts between private cars and heavy vehicles also increases stop-start conditions (e.g. as a result of different average travel speeds between cars and heavy vehicles, and difficulties overtaking heavy vehicles) which increases congestion. This increases travel times as well as vehicle emissions and operating costs (which are inversely related to travel speeds).

Estimates of the differences in rail and road environmental costs which include air pollution, greenhouse gas emissions, water pollution and nature and landscape costs are provided in Table 3.4. Estimates indicate that the total environmental externality cost of heavy vehicles is far greater compared to rail per 1000 tonne kilometre in urban areas ($35.54 and $5.77 respectively).[86] Similar to Inland Rail, approximately 15 per cent of the current Newell Highway road corridor between Melbourne and Brisbane passes through urban areas including Bendigo, Moree, West Wyalong, Parkes, Coonabarabran, Dubbo, Goondiwindi and Toowoomba.

Table 3.4 Rail and road environmental externality costs ($2014, per net tonne kilometre) projections for 2031

EXTERNALITY TYPE	URBAN		RURAL	
	HEAVY VEHICLE	RAIL	HEAVY VEHICLE	RAIL
Air pollution	25.59	4.23	0.25	0
Noise	4.27	1.79	0.43	0
Urban separation	2.85	1.03	0	0
Greenhouse gas emission	5.69	0.38	5.69	0.38
Water pollution	3.84	0.13	1.54	0.13
Nature and landscape	0.42	1.03	4.28	1.03
Total	**42.66**	**8.59**	**12.19**	**1.54**

86 Austroads, 'Guide to Project Evaluation Part 4: Project Evaluation Data', available at: https://www.onlinepublications.austroads.com.au/items/AGPE04-12, p. 33, 2012 and ATC 'National Guidelines Vol. 3', available at: http://www.transportinfrastructurecouncil.gov.au/publications/files/National_Guidelines_Volume_3.pdf, p. 101, 2006.

Source: Austroads Guide to Project Evaluation Part 4: Project Evaluation Data, page 33, 2012 and ATC 'National Guidelines Vol. 3', page 101, 2014.

3.4.4. Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities

Regional rail networks reflect a legacy of low capacity and inefficient services unsuited to the needs of contemporary freight markets. Despite recent upgrades, structural limitations of the existing rail alignment will constrain rail's capacity to support the future transport task on the east coast.

The east coast interstate rail network, in its current state, reflects a legacy of poor alignments and inadequate investment over the last 50 years, limited capacity and low productivity, rather than a purpose built highly productive rail freight network.

Coal and agricultural freight being transported from the Surat and Moreton Basins and South East Queensland to the Port of Brisbane is constrained by the number of train paths available. This impacts the maximum number of freight train movements. There are currently 87 coal paths per week in Brisbane and 27 for other freight (i.e. grain, livestock, cotton and molasses). Each coal path corresponds to a potential train movement, so the volume of freight that can be accommodated within this cap is constrained by the train lengths that can be accommodated.
As passenger traffic grows over time, freight traffic will be progressively 'squeezed out' unless additional capacity is provided.

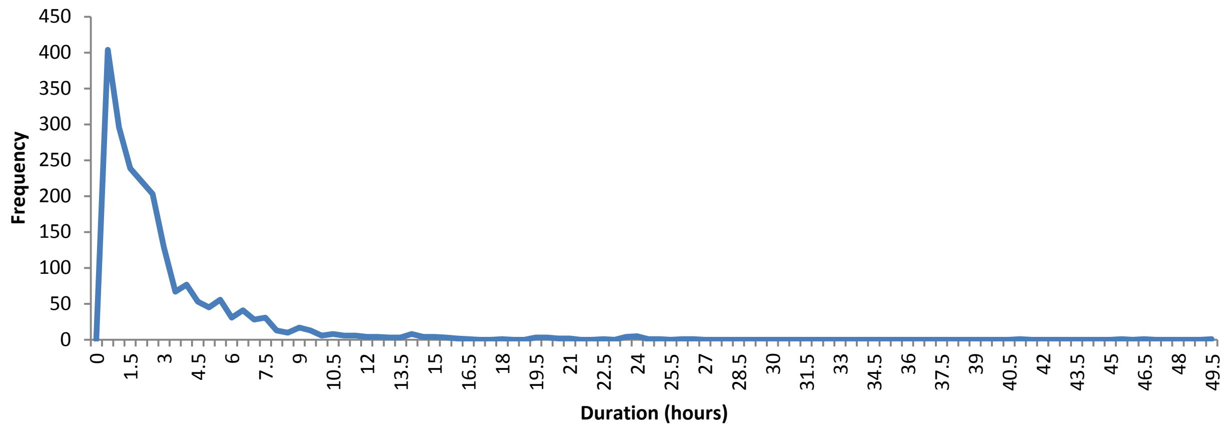
3.4.5. Resilience: Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and suboptimal reliability

There are limited options for rail freight to bypass incidents on the existing Melbourne to Brisbane coastal rail corridor, which means that incidents have the potential to impact freight along the entire length of the route. During incidents, for example floods, freight operators may experience considerable delays, or must allocate freight movements to road. In addition, the shared nature of the coastal rail infrastructure between passenger and freight significantly impacts on freight reliability.

Analysis of historic data on scheduled train arrival (including buffer time) versus actual arrival between Melbourne to Brisbane shows that between October 2009 and June 2014 there were 2065 incidents of trains not arriving on time on the coastal route (28 per cent of all rail trips). The frequency of these incidents by duration is shown in Figure 3.7.

Average delay is estimated to be 2.9 hours, with a maximum delay of 49 hours and three per cent of delays in excess of 12 hours. It is estimated that currently the coastal route reliability is 83 per cent. However, the Inland Rail offering is estimated to increase rail reliability closer to 98 per cent.

Figure 3.7 Scheduled versus actual arrival, Melbourne to Brisbane (October 2009–June 2014)



Source: ARTC, 2015.

3.5. Summary

The ability of freight transport modes to cater for growth and offer efficient, cost effective freight transport services in the north–south corridor of the east coast of Australia into the future is projected to become increasingly constrained. This is characterised by problems relating to capacity, productivity, society and environment, regions and growth, and resilience. The problems can be summarised as:

- Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
- Current north–south freight infrastructure is constrained and this will increasingly impact negatively on freight productivity.
- The continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
- Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities.
- Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and suboptimal reliability.

Chapter 4

Strategic options assessment

4. STRATEGIC OPTIONS ASSESSMENT

4.1. Purpose of this chapter

This chapter builds on strategic options workshops undertaken to identify a range of solutions to the problems identified in Chapter 3 (Problem identification and analysis) and the ILM. This chapter includes consideration of reform as well as capital investment solutions, and presents the results of multi-criteria assessment based on economic appraisal principles to identify a preferred option.

4.2. Approach

A strategic options assessment was undertaken to consider a range of reform and investment options consistent with Infrastructure Australia's Reform and Investment Framework Guidelines.

A range of reform and capital investment options have been developed to address the problems identified. These options have been evaluated against criteria that align with the Inland Rail Programme objectives using a multi-criteria analysis. A multi-criteria approach, applying qualitative (but not quantitative) assessments of each option has been undertaken.

4.3. Options considered

A balance of freight transport capabilities, where the right mode is used to fulfil the right freight task, will support the delivery of government economic, environmental and social objectives. A range of options have been identified, including:

- **Reform options:** Defined by Infrastructure Australia as encompassing options relating to regulatory reform (e.g. access regimes), governance reform (e.g. administrative and institutional frameworks) or better use of existing infrastructure (e.g. economic charging or demand management).
- **Capital investments:** Defined by Infrastructure Australia as expansion of existing infrastructure or new infrastructure.

The options considered are summarised in Table 4.1. These options represent interventions that may assist to address the identified problems on the east coast freight network between Melbourne and Brisbane.

Table 4.1 Reform and investment options considered in the strategic options assessment

OPTION		DESCRIPTION
1	**Reform options:** Options to delay/remove the need for infrastructure investment.	
1a	Demand management	Demand management through utilising policy and pricing mechanisms to influence demand across the transport network, potentially including road pricing and environmental emission pricing.
1b	Productivity	Productivity improvements through better labour/asset allocation, potentially including single crew trains, rostering efficiency and improved truck configurations.
1c	Deregulation	Deregulation, or in this context, a reduction of perceived 'red tape' or items that impact on competition and market activity, potentially including rail curfew relaxation, rail terminal open access, increase in high productivity vehicle access and higher road vehicle axle loads.

OPTION		DESCRIPTION
	Capital investment options: Expansion of existing infrastructure or new infrastructure.	
2	Progressive road upgrades	Investment in the national highway network in the north–south corridor to increase lane capacity whilst also considering traffic mix of heavy vehicles with passenger vehicles, potentially including dual carriageway and improved gradients for heavy vehicles.
3	Upgrade the existing coastal railway	Investment in additional tracks and/or passing loops to separate passenger and freight services on the coastal route (noting that the coastal route represents a longer/slower path and never likely to have a dedicated and efficient rail corridor north of Sydney CBD due to conflicts with passenger rail and other infrastructure).
4	Construction of an inland railway bypassing Sydney	Investment in a new dedicated rail freight line connecting Melbourne and Brisbane located inland from the east coast and avoiding the Sydney metropolitan rail network.

Source: PwC, 2015.

4.4. Assessment methodology

An options assessment process was undertaken to assess the broad range of options available that respond to the key problems. The process adopted linked to IA’s Reform and Investment Framework and included:

- Identifying Reform (Policy or non-asset) options
- Identifying Capital investment options
- Developed a range of criteria that enabled assessment of options across modes including:

Criteria related to the Programme Objectives:

1. Increase capacity to serve future intercapital and regional/bulk freight market needs on the east coast.
2. Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience).
3. Optimise environmental outcomes.
4. Alleviate urban constraints.
5. Enable regional development.

Criteria related to deliverability and cost:

6. Ease of implementation.
7. Cost effectiveness.

The options have been scored between Very High and Very Low with each criteria being weighted equally. The scoring system used for the strategic options assessment is outlined in Table 4.2.

Table 4.2 Scores for strategic options assessment

DEFINITION		
Very High		Very high likelihood of contribution to improved outcomes for the criterion.
High		High likelihood of contribution to improved outcomes for the criterion.
Medium		Moderate likelihood of contribution to improved outcomes for the criterion.
Low		Low likelihood of contribution to improved outcomes for the criterion.
Very Low		Minimal likelihood of contribution to improved outcomes for the criterion.

Source: PwC, 2015.

The strategic options assessment compares options on an incremental basis against the base case scenario. The base case is therefore not a separate option. As demonstrated in Chapter 3 (Problem identification and analysis), maintaining the base case scenario would likely lead to:

- Increased congestion across modes as freight volumes increase.
- Increased costs of moving goods with increased travel times.
- Increased accidents and reduced road safety.
- Increased inventory requirements to compensate for travel times.

All of which are likely to increase costs and reduce productivity throughout the supply chain and will likely be passed on to end users.

4.5. Strategic options assessment

This section presents the assessment of the reform and capital investment options against each of the criteria.

4.5.1. Reform options

Reforms relating to demand management, productivity enhancement or deregulation have the potential to enhance the performance of freight services and better utilise existing freight network capacity. The scale and significance of the expected growth in the freight task will however mean that such options are unable to meet demand requirements comparable with investment in freight infrastructure.

Assessment of demand, productivity or regulatory reforms against each criterion is outlined below:

- **Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast:** Demand, productivity or regulatory reforms could defer the timing of capacity constraints on the existing network. However this may actually result in increased costs for transport of freight where capacity constraints are expected. Also, as these options do not provide additional physical capacity, constraints may still worsen in the longer term.
- **Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience):** Reform could increase freight productivity in the shorter term or encourage freight to be transported by modes with improved service characteristics, thereby fostering some economic growth in the short term. However, as demand increases, freight productivity and performance (particularly reliability) are likely to deteriorate in the absence of investment in additional capacity capping the level of economic growth possible.

- **Optimise environmental outcomes:** Reforms may be implemented to encourage rail mode share or freight customers to reduce environmental emissions for each tonne of freight transported. In the longer term the extent of this could however be limited by the amount of physical capacity available on rail.
- **Alleviate urban constraints:** Demand, productivity or regulatory reforms may be implemented to reduce demand or to enable higher productivity vehicles therefore reducing the number of trucks or trains required to transport the same volume of freight through urban areas. The scale of impact is however expected to be limited relative to a new regional rail corridor.
- **Enable regional development:** Reform options could enable regional development if implemented to support road productivity and therefore road freight volumes along the Newell Highway corridor passing a number of regional towns and locations. This may however be limited in terms of construction related impacts creating jobs and economic activity along the corridor.
- **Ease of implementation:** Implementation of reform options is likely to require significant stakeholder engagement with government agencies, freight companies, road transport industry bodies, and the broader community particularly if reform is implemented beyond freight. The potential to amend regulations could also impact on implementation of these options.
- **Cost effectiveness:** Reform options have the potential to be the most cost effective solutions as the requirement for capital investment may be minimal.

4.5.2. Capital investment options

This section analyses potential investment options which include progressive upgrades to roads, the coastal rail or new rail infrastructure bypassing Sydney.

1. Progressive road upgrades

To date freight capacity on the north-south corridor has largely been developed on an incremental basis which progressively augments existing freight capacity, and with a focus of investment on roads, but generally retains the legacy of sub-optimal alignments, low capacity and mixed passenger/freight networks.

Assessment of progressive road upgrades (defined as continued investment in the national highway network in the north-south corridor to increase lane capacity) against each criterion is outlined below:

- **Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast:** Progressive road upgrades would provide additional physical capacity to meet increased demand in the north-south corridor. Expansion of any road capacity would however continue to be shared with passenger demand thereby limiting future capacity to serve freight.
- Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience): Progressive road upgrades could improve economic growth through additional lane capacity, improved gradients and less stop-start conditions reducing truck operating costs.
- **Optimise environmental outcomes:** Additional road capacity could reduce congestion as a result of improved traffic flows and therefore reduce vehicle emissions which are inversely related to vehicle speeds. However, sustained incremental road upgrades are unlikely to optimise environmental outcomes as a result of attracting freight to road, given road has more significant adverse environmental outcomes relative to rail transporting the same freight task.
- **Alleviate urban constraints:** Progressive road upgrades are not expected to alleviate urban constraints and could potentially result in a negative impact with additional infrastructure being provided within existing corridors through/near residential areas.

- **Enable regional development:** Progressive road upgrades would positively impact regional development along the north-south corridor as a result of additional freight capacity attracting truck journeys along the route. There could also be an increase in investment and jobs in regional areas associated with construction of new infrastructure.
- **Ease of implementation:** While requiring planning, consideration of environmental issues, procurement and construction, progressive road upgrades could be implemented with well-established processes for consultation, planning and delivery of major road upgrades.
- **Cost effectiveness:** Road upgrades, particularly undertaken in a progressive, incremental manner are expected to be relatively high cost. As an indication of the costs of road investments, the Hume Highway duplication between Melbourne to Sydney (approximately 810 km) took more than 50 years to complete and there are estimates that if the entire project was carried out today, the total cost of the duplication would be $15–$20 billion ($2013).[87] In addition, completion of a minimum four-lane divided highway between Sydney and Brisbane on the Pacific Highway is expected to have an outturn cost of more than $15 billion based on past expenditure and estimates of the cost of sections yet to be completed ($2010 dollars and partly unescalated).[88]

2. Upgrade the existing coastal railway

Progressive upgrades of the north-south rail corridor (coastal railway) have delivered significant improvements in capacity, performance and reliability. However, structural limitations of the existing rail alignment and shared track with passenger rail in some locations will constrain rail's capacity to support the future freight task on the east coast, particularly between Sydney and Brisbane. Even with future improvements, the coastal railway will never be able to meet the proposed service offering of Inland Rail.

Assessment of coastal railway upgrades (defined as investment in the coastal route including track duplication and passing loops to expand capacity) against each criterion is outlined below:

- **Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast:** Upgrades can be made to the coastal route to improve capacity. However, there will always be constraints on the coastal route in particular between Sydney and Brisbane including limitation on train lengths, conflicts with passenger services and the inability of the route to accommodate double stacking.
- **Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience):** Upgrades to the coastal route could improve reliability, productivity and availability by way of track duplication or passing loops to expand capacity. The extent of this would however be constrained by other limitations on the coastal route unlikely able to be addressed, including gradients, single stack operations and shared passenger services through northern Sydney.
- **Optimise environmental outcomes:** Upgrades to the coastal route could encourage a shift from road to rail, resulting in improved environmental outcomes, but this shift could be limited due to structural constraints on the coastal route.
- **Alleviate urban constraints:** Upgrades to the coastal route could encourage a shift from road to rail thereby reducing urban road congestion, but this shift could be limited due to other structural constraints on the coastal route between Sydney and Brisbane.
- **Enable regional development:** Coastal rail upgrades are not expected to provide significant regional development opportunities as all centres along the coast would have good highway access for road freight to a capital city within six hours.

[87] Engineers Australia, 'Hume Highway duplication complete', 28 June, available at: http://www.engineersaustralia.org.au/news/hume-highway-duplication-complete, 2013.

[88] NSW Government, Pacific Highway Upgrade Submission to Infrastructure Australia, November 2011 (considering the $7.8 billion estimated cost of sections yet to be completed and Figure 3 indication of past expenditure 2006–2014).

- **Ease of implementation:** Challenges faced when upgrading the coastal route are expected to be of similar scale to those faced during the delivery of an inland railway. While a coastal route would utilise an existing rail corridor minimising land acquisition and some environmental/planning requirements, brownfield construction would require track possession under a live rail environment.
- **Cost effectiveness:** Costs of upgrades to the coastal route may potentially be greater than other capital investment options due to construction primarily in brownfield areas and in parts of the corridor shared with passenger rail or traversing dense urban areas, as well as under an operating rail environment which increases the risks of delivery. Cost per kilometre would be higher along the coast given the hilly topography and frequent water courses requiring bridging.

3. Construct an inland railway bypassing Sydney

The development of a new dedicated freight line connecting Melbourne and Brisbane that is located inland from the east coast provides the opportunity to deliver a step change improvement in rail service quality across the north-south corridor that is compatible and interoperable with high productivity train operations in the east-west corridor and avoids the Sydney metropolitan rail network.

Assessment of an inland railway between Melbourne and Brisbane bypassing Sydney against each criterion is outlined below:

- **Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast:** Construction of a new inland railway that bypasses Sydney provides an opportunity to serve future freight demand through a dedicated freight route. This provides the ability to operate longer and heavier trains, as well as double stacking ability.
- **Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience):** An inland railway has the potential to provide a more direct alignment bypassing shared passenger services in Sydney with the potential for double stacking of containers thereby reducing price, increasing reliability/availability and reducing transit times.
- **Optimise environmental outcomes:** Construction of an inland railway could provide a step change in productivity and freight service quality, attracting additional freight to shift from road to rail, which has better environmental outcomes to transport the same freight task. It could also reduce distances travelled relative to the current coastal route thereby reducing accidents and emissions.
- **Alleviate urban constraints:** Construction of an inland railway presents the potential to alleviate urban constraints (primarily on the Sydney transport network but also in Brisbane and Melbourne and at town centres and regional locations along the corridor) through providing a dedicated freight rail service that bypasses metro areas and the Sydney rail and road network. It would bypass the existing Sydney transport network and could avoid shared sections of the passenger network in Brisbane and Sydney.
- **Enable regional development:** Construction of an inland railway is expected to foster economic development opportunities in regional areas along the route, for example at Parkes where the network connects to east-west movements. Construction would also occur in regional areas inland from the east coast, thereby increasing regional investment and jobs.
- **Ease of implementation:** Implementation of an inland railway bypassing Sydney is expected to be marginally easier to implement due to the significant greenfield component, compared with the upgrades required on an existing operational coastal route. An inland railway will still require a significant construction Programme including tunnelling works, however the impact on existing freight and passenger operations would be minimised.

- **Cost effectiveness:** Construction of an inland railway could incur significant capital costs given the distance between Melbourne and Brisbane. This capital cost is envisaged to be lower than the road upgrade option as an incremental approach to capacity upgrades can be avoided.

4.6. Strategic options assessment outcomes

A summary of the outcomes of the assessment of reform and investment options to address the problems identified in the north–south corridor are shown in Table 4.3.

Table 4.3 Summary of strategic options assessment results

	CRITERION	OPTION				COMMENTS
		1	2	3	4	
		Reform option	**Progressive road upgrades**	**Upgrade coast railway**	**New inland railway**	
1.	Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast	◔	◕	◑	●	A new inland railway provides an opportunity to develop a dedicated freight route with longer and heavier trains as well as double stacking ability. There will always be structural constraints on the coastal railway and road capacity would continue to be shared with passengers.
2.	Foster economic growth through improved freight productivity and service quality (including improved reliability and resilience)	◔	◕	◔	●	Progressive road upgrades could provide additional freight capacity, improved gradients and less stop-start road conditions reducing truck operating costs, however an inland railway has the potential to provide a more direct alignment separated from passenger trains and vehicles.
3.	Optimise environmental outcomes	◔	◔	◑	◕	An inland railway could provide a step change in freight service quality, attracting additional freight to rail, which has better environmental outcomes to transport the same freight task.
4.	Alleviate urban constraints	◔	◔	◔	●	An inland railway provides a dedicated freight rail service that bypasses metro areas and the urban rail and road network.

	CRITERION	OPTION				COMMENTS
		1	2	3	4	
5.	Enable regional development	◔	◕	◔	◕	An inland railway with associated road upgrades would positively impact regional development along the north-south corridor as a result of additional freight capacity attracting truck and train journeys along the route and due to construction activity.
6.	Ease of implementation	○	◑	◑	◔	Progressive road upgrades could be relatively straightforward to implement due to well-established processes for consultation, planning and delivery of major road upgrades.
7.	Cost effectiveness	●	◔	◔	◑	Reform options are expected to be the most cost effective when compared to the other options that require significant capital investment.
	Overall	◔	◑	◑	◕	The ability to provide dedicated freight capacity, avoid urban areas yet foster growth in regional areas and optimise environmental outcomes favours an inland railway overall.

Source: PwC, drawing on ARTC, ACIL Allen and PB advice and inputs, 2015.

4.7. Summary

Key findings of the strategic options assessment include:

REFORM OPTION

- While reform options may be lower in cost, they are likely to be challenging to implement and are expected to be ineffective in improving freight supply chain performance or productivity outcomes for Australia, unless coupled with enhanced infrastructure capacity.

CAPITAL INVESTMENT OPTION

- **Progressive road upgrades:** May be medium term solutions for freight, however are unlikely to meet longer term needs for freight capacity, likely to be high cost, and road capacity would continue to be shared with general traffic.
- **Upgrade coast railway:** Able to deliver improvements in capacity, performance and reliability, however structural limitations of the existing rail alignment and shared track with passenger rail in some locations will constrain future long term capacity.
- **Inland railway bypassing Sydney:** The ability to provide dedicated freight capacity, avoid urban areas yet foster growth in regional areas and optimise environmental outcomes supports an inland railway overall.

Preferred option

An inland railway bypassing Sydney is the preferred option, in particular to service anticipated future freight demand, provide an increase in productivity, act as an enabler for regional development, and improve road safety whilst reducing congestion and environmental impacts. Due to various constraints, the existing coastal railway infrastructure will never be capable of matching the service offering or competitiveness of a new inland railway. An efficient rail network and competitive rail services will reduce the nation’s reliance on road transport. This will reduce road congestion, lower carbon emissions, reduce noise, reduce deaths and injuries from road accidents, improve amenity in urban and regional centres, cost of regional development, and enable new mines and agricultural business in the region to remain productive.

Chapter 5

Service offering, scope and opportunities

5. SERVICE OFFERING, SCOPE AND OPPORTUNITIES

5.1. Purpose of this chapter

The purpose of this chapter is to provide an overview of the service offering, scope and opportunities of the Inland Rail Programme.

5.2. Approach

Key activities and inputs used to develop the service offering, scope and opportunities included:

- Stakeholder communication and engagement (discussed in Chapter 6) and consideration of Inland Rail objectives to develop and consider validity of the service offering.
- Identification of performance requirements such as load limits, gradients, train length and speeds.
- Identification of interdependent and related projects.
- Defining the scope of the 10 year Inland Rail Programme.

5.3. Service offering

To reflect the priorities of freight customers, the Inland Rail scope has been defined based on a target service offering to ensure a customer focus on outcomes as opposed to an infrastructure or engineering focus on outcomes. The target service offering was developed in consultation with key market participants, stakeholders and potential users (rail operators, freight forwarders and end customers).

Inland Rail provides a significant opportunity to change the fundamentals of the freight logistics supply chain in Australia and deliver economic and social benefits long into the future.

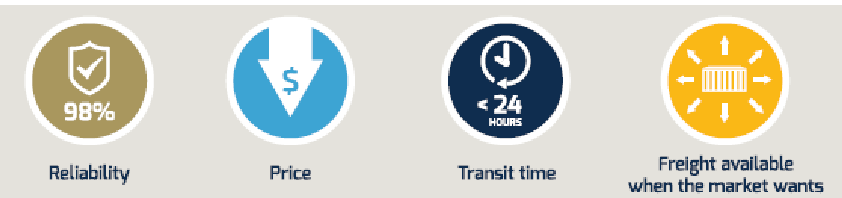
The service offering is central to the delivery and competitiveness of Inland Rail and reflects the priorities of freight customers. It was developed in consultation with key market participants and stakeholders and represents the key elements to be addressed by Inland Rail to enable a competitive and complementary service offering compared to other modes, including road transport.

Engagement included an industry survey, one-on-one interviews and two stakeholder reference forums with key market participants, stakeholders and potential users (rail operators, freight forwarders and end customers) convened by DIRD (see Chapter 6, Communication and stakeholder engagement).

Based on the objectives of Inland Rail, and feedback from freight customers, a target service offering has been defined by reference to the four key service characteristics of reliability, price, transit time and availability.

The key elements of the Inland Rail service offering for linehaul services between Melbourne and Brisbane are shown in Figure 5.1.

Figure 5.1 Inland Rail service offering



Source: ARTC, 2015.

The Inland Rail service offering and scope reflects ARTC's preferred alignment (which also includes the Queensland Government's preferred alignment), however this may change as a result of more detailed on ground investigations. Costs may also need to be refined if an agreement is reached with the Queensland Government on the inclusion of passenger services.

The key service and technical elements of the service offering, along with likely relevance to potential users of Inland Rail categorised as rail operators, freight forwarders and end customers, are identified in Table 5.1.[89]

Table 5.1 Elements of the service offering and relevance to users

SERVICE OFFERING	RAIL OPERATORS	FREIGHT FORWARDERS	END CUSTOMERS
Service characteristics:			
• Reliability*	✓	✓	✓
• Price:			
a. Access price	✓		
b. Rail line haul		✓	
c. Door to door†		✓	✓
• Transit time:			
d. Terminal to terminal	✓	✓	
e. Door to door		✓	✓
• Availability‡	✓	✓	✓
Technical characteristics:			
• Train length	✓	✓	
• Axle load/max. speed	✓	✓	
• Double stacking	✓	✓	
• Interoperability and connectivity with existing interstate and regional networks	✓	✓	✓

* Reliability is defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised.

† Door to door price reflects total door-to-door costs, including local pick up and delivery for rail and sea freight.

‡ Availability refers to services available with departure and arrival times that are convenient for customers, which depends on cut-off and transit times. Most customers want departures during the day or early evening.

Source: ARTC, 2015.

Additional detail of the key Inland Rail service and technical characteristics is provided in Table 5.2.

This has been developed based on historical performance data for the coastal route and road, along with consideration of the performance impact of Inland Rail.

89 These categories are not mutually exclusive. There is considerable vertical integration of rail operators, freight forwarders and end customers.

Table 5.2 Comparison of Melbourne to Brisbane rail and road service characteristics (average 2014–15 to 2045–55)

MELBOURNE–BRISBANE	2014–15	2019–20	2024–25	2029–30	2034–35	2039–40	2044–45	2049–50	2054–55
Transit time (line haul)									
Inland Rail			21.3	21.9	23.1	22.6	23.1	24.1	24.7
Coastal rail	31.3	31.5	32.9	33.8	34.6	35.5	36.4	37.3	38.1
Road	23.8	24.4	25.1	25.8	26.5	27.2	27.9	28.7	29.4
Transit time (door to door)									
Inland Rail			31.0	31.6	32.8	32.3	32.8	33.8	34.4
Coastal rail	40.3	40.5	41.9	42.8	43.6	44.5	45.4	46.3	47.1
Road	25.8	26.4	27.1	27.8	28.5	29.2	29.9	30.7	31.4
Reliability									
Inland Rail			98%	98%	98%	98%	98%	98%	98%
Coastal rail	83%	83%	83%	83%	83%	83%	83%	83%	83%
Road	98%	98%	98%	98%	98%	98%	98%	98%	98%
Availability									
Inland Rail			95%	95%	95%	95%	95%	95%	95%
Coastal rail	63%	61%	54%	48%	44%	37%	32%	27%	22%
Road	95%	95%	95%	95%	95%	95%	95%	95%	95%
Relative price (door to door), non-bulk road freight									
Inland Rail			65%	63%	63%	59%	58%	57%	56%
Coastal rail	85%	83%	81%	80%	79%	78%	76%	75%	74%

Note: Relative price is presented for non-bulk intercapital freight.

Note: Door to door transit time includes pick up (two hours), time between cut off and departure (typically two hours), linehaul transit time, time required to unload, timetable slack to improve reliability, and delivery time (two hours).

Source: ACIL Allen, 2015.

5.4. Performance specification

Building on the service offering and objectives of the Programme, performance specifications were identified and developed by ARTC to achieve and underpin the Inland Rail service offering and development of scope and cost estimates, which is shown in Table 5.3.

Table 5.3 Inland Rail performance specification

ATTRIBUTE	SPECIFICATION
Reference train	
Intermodal	• 21 tal, 115 km/h maximum speed, 1800 m length (initial). • 2.7 hp/tonne power/weight ratio.
Coal / bulk	• 25 tal (initial), 80 km/h maximum speed, length determined by customer requirements within maximum train length.
Operational specification	
Maximum freight train transit time (terminal-terminal)	• Target driven by a range of customer preferences and less than 24 hours Melbourne to 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 gauge (1435 mm) with dual standard / narrow (1067 mm) gauge in relevant Queensland sections to maintain narrow gauge connectivity to Brisbane and regional Queensland lines.
Maximum freight operating speed	• 115 km/h @ 21 tal.
Maximum axle loads (initial)	• 21 tonnes @ 115 km/h. • 23 tonnes @ 90 km/h. • 25 tonnes @ 80 km/h.
Clearance	• Vertical as per ARTC Plate F for double stacking (7.1 m above rail).
Maximum train length (initial)	• 1800 m.
Braking curve	• G40 for intermodal reference train.
Minimum design standards	
General alignment standards	
Design speed	• 115 km/h.
Maximum grade	• 1:100 target, 1:80 maximum (compensated). • 1:200 maximum at arrival or departure points at loops.
Curve radius	• 1200 m target, 800 m minimum.
Cant	• Set for intermodal reference train.
Medium speed alignment standards (mountainous terrain)	
Design speed	• 80 km/h minimum.

ATTRIBUTE	SPECIFICATION
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.
Cant	• Set for coal reference train.
Corridor width	• 40 m minimum.
Rail	• Minimum 53 kg/m on existing track; 60 kg/m on new or upgraded track.
Concrete sleepers	• Rated @ 30 tal.
Sleeper spacing	• 667 mm spacing (1500/km) – existing track. • 600 mm (1666/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)	• 1800 m in length (clearance point to clearance point). • No level crossings across loops or within road vehicle sighting distance from loops.
Future proofing	
Train length	• To provide for future extension of maximum train length to 3600 m.
New structures (greenfield & brownfield)	• Capable of 32 tal @ 80 km/h minimum.
Formation strength	• Formation on new track suitable for 30 tal @ 80 km/h.
Crossing loops	• Loops designed and located to allow future extension for 3600 m trains.

Source: ARTC, 2015.

5.5. Inland Rail scope

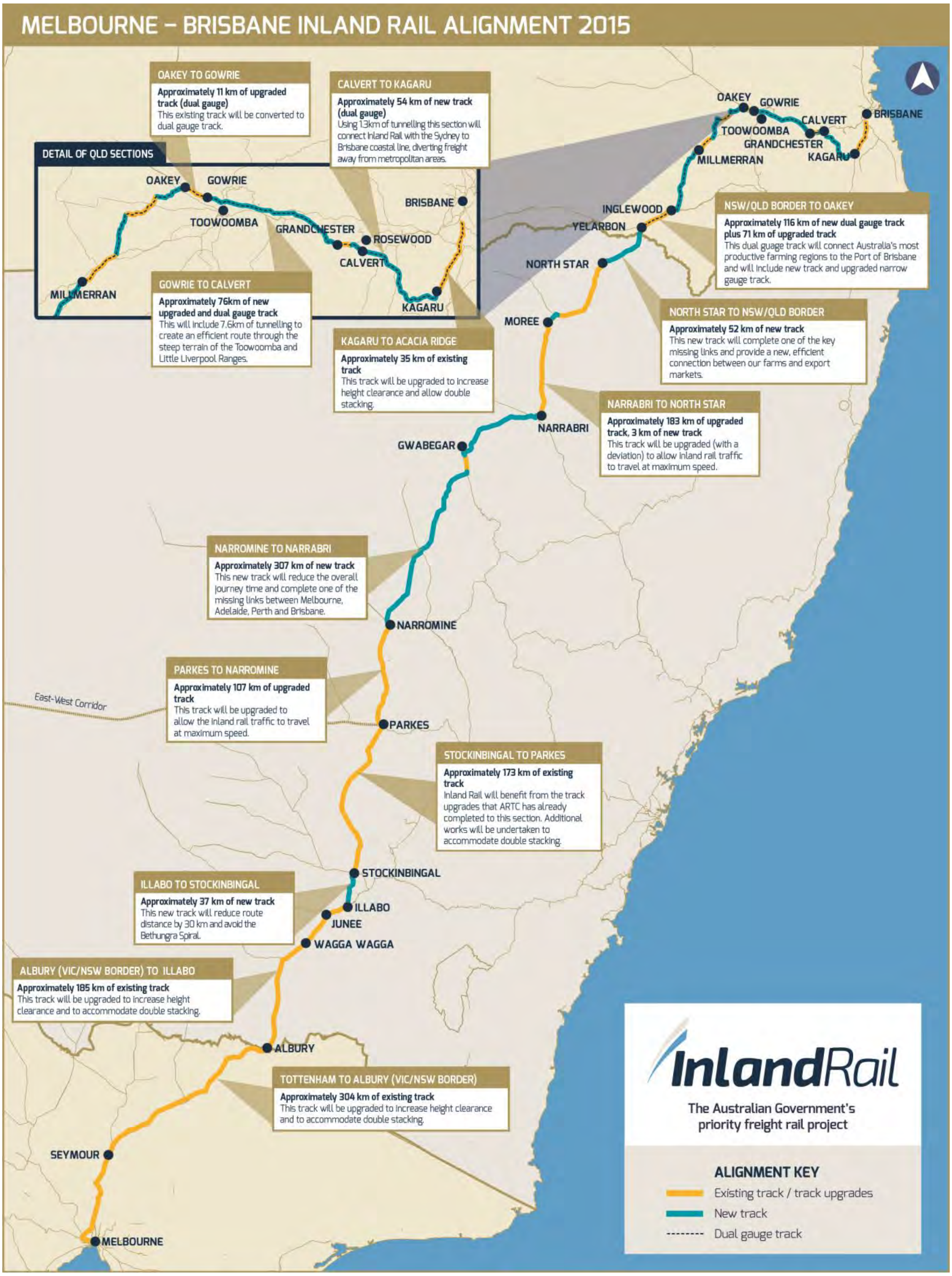
The definition and scope of the Inland Rail Programme has been developed to:

- Ensure delivered infrastructure meets the market needs in terms of service specification and performance.
- Define an optimised backbone rail link between Melbourne and Brisbane that:
    - Is compatible and interoperable with high productivity train operations in the east-west corridor (to Adelaide and Perth).
    - Bypasses bottlenecks on the congested metropolitan Sydney rail network.
    - Optimises connections with regional and local rail and road networks.
    - Maximises value for money in meeting the needs of the market.

The scope of the Programme comprises an approximately 1700 kilometre long alignment between Melbourne and Brisbane with the majority of the works to be delivered within existing corridors.

The Inland Rail scope is presented geographically in Figure 5.2.

Figure 5.2 Inland Rail scope and alignment



Source: ARTC, 2015.

The scope of works of the Inland Rail Programme has been categorised as follows:

- **Missing links:** New greenfield sections and sections in Queensland upgraded from narrow to dual gauge.
- **Upgrading works:** Upgrading of existing sections to main line standards.
- **Enhancement works:** To enable double stacking and some capacity enhancement with new passing loops.

The key sections and their applicable scope category is shown in Table 5.4.

Table 5.4 Alignment sections

<table>
<tr><th>CATEGORY</th><th>SECTION</th><th>DISTANCE (KILOMETRES)</th><th>% TOTAL</th></tr>
<tr><td rowspan="6">Missing Links
New greenfield sections, and sections in Queensland upgraded from narrow to dual gauge</td><td>Illabo to Stockinbingal</td><td>37</td><td rowspan="6">41</td></tr>
<tr><td>Narromine to Narrabri</td><td>307</td></tr>
<tr><td>North Star to Oakey</td><td>239</td></tr>
<tr><td>Gowrie to Grandchester</td><td>73</td></tr>
<tr><td>Grandchester to Kagaru</td><td>54</td></tr>
<tr><td>Sub-total</td><td>709</td></tr>
<tr><td rowspan="3">Upgrading works
Upgrading of existing sections to main line standards</td><td>Parkes to Narromine</td><td>107</td><td rowspan="3">18</td></tr>
<tr><td>Narrabri to North Star</td><td>186</td></tr>
<tr><td>Sub-total</td><td>293</td></tr>
<tr><td rowspan="5">Enhancement works
To enable double stacking, and some capacity enhancement with new passing loops</td><td>Tottenham (Melbourne) to Illabo</td><td>490</td><td rowspan="5">41</td></tr>
<tr><td>Stockinbingal to Parkes</td><td>173</td></tr>
<tr><td>Oakey to Gowrie</td><td>11</td></tr>
<tr><td>Kagaru to Acacia Ridge</td><td>35</td></tr>
<tr><td>Sub-total</td><td>709</td></tr>
<tr><td colspan="2">TOTAL</td><td>1710</td><td>100</td></tr>
</table>

Note: numbers may not add to totals due to rounding.

Source: ARTC, 2015.

5.6. Key scope inclusions

A number of major features included in the scope of the Programme is outlined in Table 5.5.

Table 5.5 Major scope features

MAJOR FEATURES	SUMMARY
Track and sleepers	• 1071 km of track and sleepers.
Fencing	• 1667 km of fencing.
Passing loops	• 35 passing loops.
Bridges	• 22 bridges.
Culverts	• 908 culverts.
Level crossings	• A total of 337 level crossings.
Grade separations	• 25 grade separations.
Viaducts	• 18 viaducts.
Tunnels	• 5 tunnels across almost 9 km, including: - Toowoomba Tunnel at 6380 m long. - Helidon (Six Mile Creek) Tunnel at 170 m long. - Little Liverpool Range at 1100 m long. - Woolooman Tunnel (SFRC1) at 1050 m long. - Woolooman Tunnel (SFRC2) at 200 m long.

Source: ARTC, 2015.

The Inland Rail Programme scope also includes:

- **Future proofing:** The base scope is proposed to accommodate 21 tonne axle load, maximum design speed of 115 kilometres per hour and 1800 metre trains. The scope has been amended to reflect that over time train operators and freight customers will seek further efficiency and productivity enhancements as has been seen overseas (in particular the US), to ensure rail can continue to compete with road freight. Therefore it is assumed that the scope includes new formation and structures to enable 30 tonne axle load at 80 kilometres per hour at a later point in time if required and passing loop spacing and construction to enable 3600 metre trains.[90]
- **Advanced Train Management System:** The assumed signalling system is the Advanced Train Management System (ATMS). This is a communication based system, requiring no lineside signals. ATMS capital costs have been developed for the Inland Rail Programme and included in this assessment.
- **Integrated and enabling investment:** Key sections (Melbourne to Illabo and Kagaru to Acacia Ridge and to a minor extent the Western Line and metropolitan Brisbane) have been included and costed, however are not part of the Inland Rail Programme. Should the Programme commence on 1 July 2015, Inland Rail is assumed to connect to Melbourne via an intermodal terminal or terminals with double stack capability by 2024–25.

[90] The financial and economic analysis presented in this Business Case assumes that investment beyond the 10 year programme occurs in 2038–39 to extend passing loops and achieve this train length.

An overview of the proposed current scope of Inland Rail by segment is provided in Table 5.6.

Table 5.6 Inland Rail scope of works overview by segment

ROUTE SECTIONS (TERMINAL TO TERMINAL AND SOUTH TO NORTH)	KEY SCOPE FEATURES
Melbourne intermodal terminal(s)	• Inland Rail is assumed to connect to Melbourne via an intermodal terminal or terminals with double stack capability. The Victorian Government, with some Australian Government funding, is considering feasibility of the Western Interstate Freight Terminal with a new rail spur to connect to the ARTC network.
Melbourne (Tottenham) to Illabo	• Approximately 490 km of existing track with capacity enhancement (extended passing lanes and potentially additional duplication) as required to meet future demand. • Clearance improvements to permit double stacking.
Illabo to Stockinbingal	• 37 km of new track (standard gauge) reduces route distance by 30 km and avoids the Bethungra Spiral.
Stockinbingal to Parkes	• Approximately 170 km of existing track (ARTC upgraded this track to interstate standard for east west traffic in 2010). • Potential capacity enhancement (additional loops) to be examined.
Parkes to Narromine	• Approximately 100 km of existing track upgraded to the Inland Rail performance spec (115 km/h @ 21 tal).
Narromine to Narrabri	• Approximately 300 km of new track (standard gauge) that reduces overall route distance and journey time. • Utilises 19 km of the existing (but disused) rail corridor near Gwabegar (TfNSW Country Regional Network).
Narrabri to North Star	• Approximately 180 km of existing track between Narrabri and North Star upgraded to Inland Rail performance spec (115 km/h @ 21 tal). • Three km of new track (Camurra deviation).
North Star to Inglewood	• Approximately 60 km of new standard gauge track to Yelarbon. • Approximately 40 km of narrow gauge track upgraded and converted to dual gauge Yelarbon to Inglewood. • Option to use a greater length of existing rail corridor to minimise environmental impacts may be considered in a future EIS.
Inglewood to Oakey	• Approximately 140 km of new standard gauge and existing narrow gauge track upgraded and converted to dual gauge (operating QR lines rebuilt as dual gauge).
Oakey to Gowrie	• Approximately 10 km of existing narrow gauge track upgraded and converted to dual gauge.
Gowrie to Calvert/Rosewood	• Approximately 80 km of new standard gauge and narrow gauge track upgraded and converted to dual gauge.

ROUTE SECTIONS (TERMINAL TO TERMINAL AND SOUTH TO NORTH)	KEY SCOPE FEATURES
	• Includes 5 tunnels. - Toowoomba Tunnel at 6380 m long. - Helidon (Six Mile Creek) Tunnel at 170 m long. - Little Liverpool Range at 1100 m long. - Woolooman Tunnel (SFRC1) at 1050 m long. - Woolooman Tunnel (SFRC2) at 200 m long.
Calvert/Rosewood to Kagaru	• Approximately 55 km of new dual gauge track. • Utilises the SFRC gazetted by the Queensland Government. • Connects to the existing Sydney to Brisbane interstate line at Kagaru.
Existing rail connection Kagaru to Brisbane intermodal terminal (Acacia Ridge)	• Approximately 35 km of existing track upgraded to dual gauge in 2010. • Clearance improvements for double stack operation.
Brisbane intermodal terminal(s)	• Inland Rail is assumed to connect to Brisbane via an intermodal terminal or terminals with double stack capability.
Rail connection from the ARTC interstate line to the Port of Brisbane	• Further consideration to be given to a new dedicated freight rail link from the existing ARTC interstate line to the Port of Brisbane (see Chapter 18).
All route sections, future proofing	• All new structures built to 32 tal (includes two tonne safety tolerance to allow operation at 30 tal). • Provide for future extension of maximum train length to 3600 m (ultimate). • All new structures built to allow operation at 30 tal at 80 km/h. • Formation on new track built to allow operation at 30 tal at 80 km/h. • Crossing loop design and location to allow future extension for 3600 m trains.

Source: ARTC, 2015.

5.7. Interdependent and related investments

The following items have been considered during the definition of the vision, requirements and benefits of Inland Rail, but are outside the direct scope of the Programme and will be delivered by the market or other parties. These include:

- Regional terminals and loading facilities for regional/agricultural/coal freight.
- Rollingstock, delivering longer/heavier trains.
- Double-stack terminal capacity in Melbourne and Brisbane with an ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Investment in connecting coal and agricultural rail lines from the Surat and Clarence-Moreton Basins in south west Queensland to the Port of Brisbane (i.e. additional loops on the Western Line and Brisbane metropolitan network at Clapham and Murarrie to enable coal train lengths to increase from 650 metres to 1500 metres) and in other regional locations in eastern Australia.
- Investment in rail based warehousing and associated freight precincts.

COMPLEMENTARY QR NETWORK INVESTMENT

The forecast coal volumes, financial and economic analysis above assume complementary investment on the Western Line and Brisbane metropolitan QR network is undertaken to take advantage of the Inland Rail improved offering. This relates to investment to enable coal train lengths to increase from 650 metres to 1010 metres along the entire journey from the Western Line (Miles-Oakey), along the Inland Rail, then to the Port of Brisbane. This is estimated to involve a passing loop and loop extensions with estimated costs totalling $65 million (strategic, $2014-15, excluding escalation and undiscounted) along with bringing forward maintenance for replacement of timber underbridges and sleepers on the Western Line required even in the absence of Inland Rail with an estimated present value impact of $45 million ($2014-15, excluding escalation, four per cent discount rate). In the absence of this modest investment, coal volumes are estimated to be lower at nine million tonnes per annum, despite requiring similar train movements. In the financial appraisal, both the costs and associated additional revenues are excluded given they relate to sections of the rail network separately owned by QR. In the absence of this investment, estimated Inland Rail coal revenues decrease by approximately 70 per cent. In the economic appraisal, the costs and associated economic benefits have been included in the results as this investment is not expected to occur in the absence of the Inland Rail, however this assumption is not a significant driver of overall economic viability of Inland Rail.

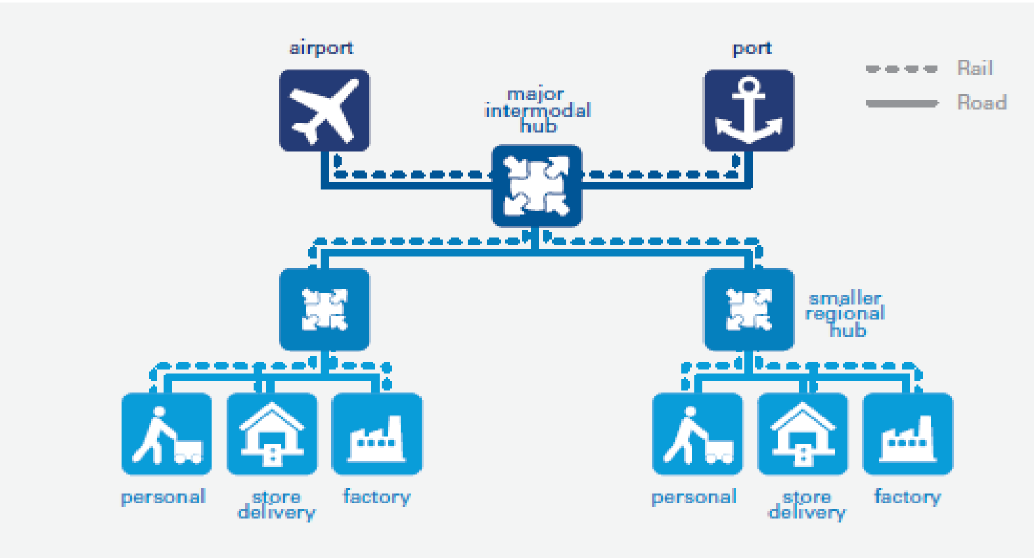
5.8. Opportunities

Inland Rail complements and further builds upon other significant infrastructure investments of state and federal governments and the private sector. Examples include the expansions of the Port of Melbourne and Brisbane, upgrades of the Newell, Hume and Pacific Highways, and improvements in the reliability and performance of the interstate rail network by the Australian Government through ARTC and TfNSW.

5.8.1. Intermodal terminals

Intermodal terminals are critical elements of the freight supply chain network as they enable optimal mix of modes to provide an overall decrease in transport costs to the supply chain. The role of intermodal hubs in the intermodal freight network is shown in Figure 5.3.

Figure 5.3 Role of intermodal hubs in the intermodal freight network

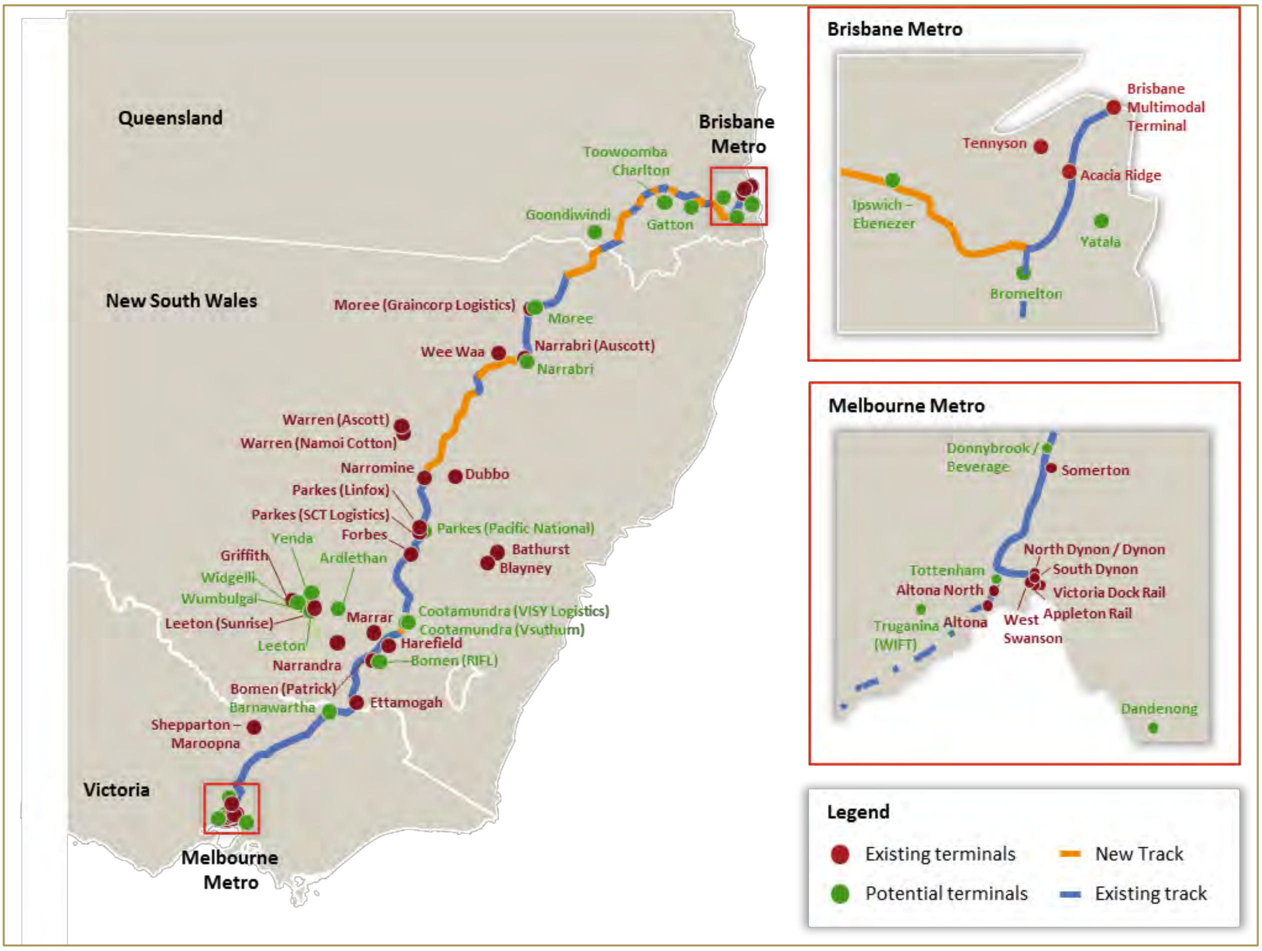


Source: Infrastructure Partnerships Australia, Meeting the 2050 Freight Challenge, 2009.

The Inland Rail scope, as defined, will link metropolitan intermodal terminals in Melbourne and Brisbane as well as regional terminals along the corridor. Inland Rail will also facilitate connectivity beyond intermodal terminals to ports, regional networks, other capital cities, and other locations on the standard gauge track in South Australia, Victoria, Western Australia, New South Wales and Queensland.

A range of possible metropolitan and regional locations for terminals in the corridor are shown in Figure 5.4.

Figure 5.4 Regional areas that are possible freight collection and distribution centres in the Inland Rail corridor



Source: ARTC, 2015.

It has been identified that:

- Inland Rail is a catalysing investment that provides the platform for private sector investment in complementary infrastructure and is an important signal to the market that the east coast rail network will be upgraded to become more competitive over the 10 year programme.
- Inland Rail is required to enable private sector investment that leverages the enhanced logistics capabilities of the interstate network.
- Expansion of terminal capacity and capability along the corridor within the 10 year programme is required to realise the full benefit of Inland Rail.
- There are a range of roles that enable delivery of terminals with relevant risks and returns associated with each role. Further consideration is required to determine appropriate roles of stakeholders to determine who best fulfils the roles including:

  - network connector
  - terminal sponsor
  - terminal owner
  - terminal developer
  - terminal operator.
- Terminal investment is likely to be private funding based on acceptable commercial terms and returns, however the role of government requires further consideration, including:
  - Metropolitan terminals may require governments to play a role in facilitating third party access (to promote above rail competition) and land-use planning (to facilitate the optimal location of terminals).
  - Regional terminals are likely to be market led, with potential for government facilitation of third party access to enable Parkes to fulfil its crucial role in the national freight network with both north–south and east–west distribution.

  Terminals are critical to realising the ultimate benefits of investment of Inland Rail. Chapter 16 (Benefits realisation) outlines how Inland Rail can influence, facilitate and drive appropriate outcomes for terminals.

5.8.2. Rollingstock

Inland Rail will enable operators to develop rollingstock fleets with longer, heavier trains along with supporting train operations to take advantage of the improved rail offering (e.g. determination of arrival, departure and transit times). Rollingstock changes from 1800 metre trains expanding to 3600 metre trains can occur when the network and volumes reach relevant maturity without supporting infrastructure changes. This potentially reduces the need for significant capital investment in the future. Although rollingstock is not specifically considered and costed as part of the scope of Inland Rail it is an opportunity that enables customers and operators to meet their operational and customer needs both now and into the future.

5.8.3. Double stacking in Melbourne and Brisbane

Rollingstock and terminal capability and capacity to process double stacked trains are another opportunity presented by Inland Rail to improve freight volumes within the corridor. Inland Rail will be delivered to provide relevant clearances that enable double stacked rollingstock on the network.

Double stacking has been considered in development of the service offering for Inland Rail. Facility requirements have not been considered or costed as part of the scope of Inland Rail as customers and operators will provide rollingstock and terminal loading/unloading facilities that meet their operational requirements.

In addition to this, double stack terminal capacity in Melbourne and Brisbane and their ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future is currently the responsibility of the market.

5.8.4. Port of Brisbane Extension

Inland Rail also presents the opportunity to improve port access in Brisbane. This could provide access to the port via a dedicated rail freight corridor, allowing trains to travel to the port while avoiding much of the Brisbane metropolitan network, and also providing the potential to accommodate import/export port shuttle trips by rail (currently all port shuttle traffic is carried by road).

Chapter 18 (Port of Brisbane Extension) details the outcomes of the extension assessment, which identified two potential options, with the lowest cost option (being utilised for the purposes of analysis within the business case) comprising:

- **Dual gauge:** The Port of Brisbane Extension proposes dual gauge access, rather than a standard-gauge rail extension only, to cater for Queensland's predominant narrow-gauge rollingstock.
- **80 kilometres per hour speed:** The Port of Brisbane Extension reduces Inland Rail's design speeds from 115 kilometres per hour to 80 kilometres per hour as the proposed corridors pass through a complex urban environment, requiring sensitivity to noise and amenity issues.

Investment in additional loops on the Western Line would enable coal train lengths to increase from the current 650 to 1010 metres and then to 1500 metres in the year the Port of Brisbane Extension becomes available.

5.9. Summary

Inland Rail is a large infrastructure program covering approximately 1700 kilometres across Victoria, New South Wales and Queensland, with a scope developed to ensure the service offering requirements can be met upon completion of the 10 year programme.

The service offering for Inland Rail responds directly to market feedback from the potential users of Inland Rail (i.e. rail operators, freight forwarders and end customers).[91]

Inland Rail aims to deliver:

- Reduced rail linehaul transit time to less than 24 hours (Melbourne to Brisbane).
- Improved reliability.
- Freight available when the market wants.
- Price competitiveness compared with alternate freight modes underpinned by the improved productivity of the Inland Rail route.

Inland Rail complements and further builds upon other significant infrastructure investments of state and federal governments and the private sector. Inland Rail will also provide the backbone infrastructure for complementary private sector investment in more efficient supply chains serving capital city, regional and global markets. Expected complementary investments outside of the defined scope, will include:

- Operators to invest in longer, heavier trains (1800 metres initially and 3600 metres in the future).
- Rollingstock and terminal capability and capacity to process double stacked trains.
- Improve port access through to Brisbane via a dedicated rail freight corridor including the Western Line upgrades.

[91] These categories are not mutually exclusive. There is considerable vertical integration of rail operators, freight forwarders and end customers.

Chapter 6

Communication and stakeholder engagement

6. COMMUNICATION AND STAKEHOLDER ENGAGEMENT

6.1. Purpose of this chapter

Identifying, engaging and effectively communicating with stakeholders has been identified as critical to the successful delivery of Inland Rail. This chapter outlines engagement undertaken to date and describes the communication and stakeholder engagement strategy for Inland Rail, which has played a role in incorporating stakeholder feedback on the service offering that underpins the Inland Rail scope and cost estimates.

6.2. Approach

The approach to Inland Rail communication and engagement has been based on the following principles:

- Build awareness, understanding and support for Inland Rail among customers, stakeholders and the community.
- Harness the sense of ownership through advocates of Inland Rail.
- Create an active dialogue with customers, communities and other stakeholders.
- Identify and manage issues and opportunities.
- Actively seek opportunities to create value for money legacy outcomes for stakeholders while not compromising the scope and budget of Inland Rail. For example, identifying opportunities to improve local rail and road interfaces where it benefits Inland Rail and improves community safety and amenity.
- Support through internal communication and engagement, and knowledge transfer in order to maximise the value of the investment.

The approach is based around the foundations of public participation developed by the International Association for Public Participation (IAP2), which is widely considered best practice in Australia and internationally, and which is used as the standard for stakeholder engagement by state governments and the Australian Government. It also draws on the international standard for stakeholder engagement, *the Accountability AA1000 Stakeholder Engagement Standard*. In particular, the strategy draws on the concepts of materiality in determining when and how to engage.

Other practices, precedents and lessons learnt that have been taken into account in developing the strategy (and broader Inland Rail Programme) include:

- Established engagement practices and precedents from projects including the Southern Sydney Freight Line.
- Recent public and private sector infrastructure projects in Queensland, New South Wales and Victoria including the SEQ Water Grid (Queensland), East–West Link (Victoria) and the Narrabri Gas Project (New South Wales).
- Emerging international practice from other significant rail projects such as High Speed Two (United Kingdom).

6.3. Key stakeholders

The following three dimensions have shaped the identification of stakeholders and determination of the engagement approach:

- **Influence:** people who are, or in the future, may be able to influence the Inland Rail delivery effort, whether their actions are likely to drive or impede performance. These include those with informal influence and those with formal decision-making power.

- **Representation:** the people who are, through regulatory structures or culture and tradition, entrusted to represent other individuals, i.e. local community leaders, MPs, councillors or leaders of membership organisations.
- **Proximity:** those geographically close to the alignment and the diverse group of professional people and employees working within those organisations directly responsible for contributing to the advancement of Inland Rail.

The key stakeholder groups in Table 6.1 have been identified as influencing or being affected by Inland Rail.

Table 6.1 Key stakeholder groups

Government • The Deputy Prime Minister and Minister for Infrastructure and Regional Development. • The IR-IG. • Relevant Australian and State, Ministers, MPs (including key parliamentary committees). • Select local governments, chief executive officers, mayors and councillors. • Relevant Australian and state government departments, agencies and their officers. • Economic regulatory bodies. • Neighbouring and related projects. • Emergency services. **Business and industry** • Customers - Rail companies and their advisors. - Freight logistics chief executive officers, executives and their advisors. - Multimodal freight terminal operators and proponents. • Collaborators - Rail investors and their advisors. • Suppliers - Professional services and advisory firms (engineering, financial, environmental, and legal). - Construction, infrastructure and materials supply companies. - Real estate and rural estate agents.	- Local/regional small to medium businesses and chambers of commerce. • Trade Unions - The Rail Bus and Tram Union. - The Transport Workers' Union. • Industry - Ports. - End users. - Peak industry groups such as the Australian Rail Association, and the Australian Logistics Council. **Community** • Local property owners (positively or negatively impacted). • Community groups and individuals (supportive or critical). **Environment** • Traditional owners. • Peak environmental groups. • Local groups, coalitions or individuals. • Relevant university academics and researchers. **Media** • Local/regional radio, print and television. • Metropolitan/national television, radio and print. • Online newsletters and blogs including social media. • Specialty rail, transport and freight logistics trade media.

Source: ARTC, 2015.

Engagement is anticipated to take place with non-government stakeholders at the inform, consult or involve level. To offer to collaborate or empower would be to overstate the potential for input as, ultimately, public participation must be balanced with the needs of customers and end users, legislative obligations, engineering constraints and budget. Ultimately the decision-making power, which would apply to the empower level of engagement, must remain with the responsible minister.

There have been opportunities to collaborate with industry and customers through the development of the Programme. Other such opportunities are anticipated to deal with specific issues and opportunities throughout the delivery of Inland Rail.

6.4. Engagement activities to date

Inland Rail engagement activities have been undertaken since 2014, increasing significantly since mid-2014 with a range of consultations with all levels of government, peak bodies, potential customers, end users and the logistics industry.

The activities are outlined in Figure 6.1 and include:

- Meetings in regional areas from June 2014 including Ipswich, Toowoomba, Narrabri, Dubbo, Parkes, Wagga Wagga and Wodonga to brief local government leaders, stakeholders and industry representatives on Inland Rail, and to seek local insight and feedback.[92]
- Industry information sessions were held in Sydney and Brisbane in September 2014 to inform potential suppliers about upcoming opportunities, including how and when they can potentially get involved with Inland Rail. These sessions were attended by more than 400 representatives from Australian and international construction, engineering and rail companies.[93]
- Extensive one-on-one meetings with local government representatives, peak bodies, potential customers and key state and federal government agencies.
- The provision of a 1800 Community Info Line to deal with early enquiries from community members and landowners.
- Attendance at industry forums including Heavy Haul (Newcastle), Rail Freight Futures (Melbourne), the Australian Logistics Council Annual Forum (Melbourne), and Murray Now (Albury).
- Inviting key local councils and businesses to contribute their views in terms of the potential benefits of Inland Rail through a submission process which has been complementary but separate from the Programme Business Case.
- Public submissions to the IR-IG which can be viewed at: http://www.infrastructure.gov.au/rail/inland/submissions/.

The most important consultation was with industry, customers and end users which led to the development of the Inland Rail service offering. This consultation included an industry survey, extensive one-on-one interviews with current customers of the national rail freight network and debate at two forums of a Key Stakeholder Reference Group, convened by DIRD. Stakeholders demonstrated keen interest in the project and made clear supportive statements.

[92] Media Release, http://inlandrail.artc.com.au/wp-content/uploads/2014/07/inland-rail-stakeholder-meetings-next-week.pdf, 29 May 2014.

[93] Joint Media Statement Warren Truss, Deputy Prime Minister, Minister for Infrastructure and Regional Development and John Fullerton, ARTC CEO–http://inlandrail.artc.com.au/wp-content/uploads/2014/07/Inland-Rail-Industry-Briefings-Media-Release-WT-JF-2.10.14.pdf, 2014.

The reference group included representatives from:

- AgForce Queensland
- Aurizon
- Australasian Railway Association
- Australian Food and Grocery Council
- Australian Logistics Council
- Australian Trucking Association
- BlueScope Steel
- CEVA Logistics
- Coles
- DB Schenker
- Genesee and Wyoming Australia Pty Ltd
- GrainCorp
- Melbourne Brisbane Inland Rail Alliance
- National Farmers Federation
- NRMA
- New South Wales Farmers
- Pacific National (Asciano)
- Port of Brisbane Pty Ltd
- Queensland Resources Council: New Hope Group
- Queensland Resources Council: Stanmore Coal
- Qube Holdings
- SCT Logistics
- Toll Intermodal
- Victorian Transport Association
- Woolworths Limited
- Yancoal.

6.5. Key findings from engagement activities to date

Engagement activities to date have indicated sustained positive interest in Inland Rail from all key stakeholder groups.

Customers have described Inland Rail as:

- A vital piece of infrastructure that will reduce freight transit times and reduce congestion.
- The best response to the freight challenge.
- Essential infrastructure.

A spokesperson for Woolworths Ltd (2014) stated:

"An inland rail corridor linking Victoria and New South Wales with Queensland has the potential to be Australia's most important piece of logistics infrastructure. Unencumbered by constraints of the existing coastal route, Inland Rail will promote economic benefits through the efficient movement of both manufactured and fresh products between some of Australia's largest domestic markets. The safety and environmental upside of an inland rail link will also be significant"

Local councils and regional businesses have talked about the strong regional development potential and enhanced connectivity that Inland Rail will bring. Farming and mining exporters have commented that Inland Rail will create competition in the logistics supply chain, driving down costs and making them more competitive in world markets. Motoring organisations and councils have identified the potential to reduce the burden on regional road networks and improve road safety outcomes.

Overwhelmingly, stakeholder sentiment toward Inland Rail is strongly supportive and positive, providing confidence that Inland Rail will be able to win and maintain its social license.

Greater detail regarding the themes and outcomes of specific consultation activities is contained in Figure 6.1.

Figure 6.1 Consultation activities

Source: ARTC, 2015.

Communication and engagement activities in the immediate future are planned to focus on working with key stakeholders to inform early refinement of the greenfield alignment for the Gowrie to Kagaru section. Consultation may take place with ARTC's Interstate Customer team to better understand specific customer requirements with regard to connectivity. This may then transition into more formal consultation to support the environmental approvals process ahead of construction. A panel of providers is also being assembled to provide the necessary community engagement capacity for the approvals phase.

6.6. Summary

Effective communication and stakeholder engagement is critical to the successful delivery of Inland Rail.

The most important consultation to date has been with industry, customers and end users that led to the development of the Inland Rail service offering. Key stakeholder groups have shown sustained positive interest in Inland Rail, acknowledging it as a vital piece of infrastructure to reduce freight transit times and congestion, and create competition in the logistics supply chain.

The Inland Rail communication and stakeholder engagement strategy will be continuously refined throughout the Programme's development and delivery phases.

Chapter 7
Demand

7. DEMAND

7.1. Purpose of this chapter

Analysis of the potential demand for Inland Rail has been conducted by ACIL Allen Consulting (ACIL Allen). This work analysed separate markets of intercapital demand, regional demand, agricultural demand and coal demand for Inland Rail.

The resulting demand projections have been used to:

- Estimate the potential revenue of Inland Rail.
- Assess the economic benefits arising from mode shift from road and the coastal route to Inland Rail.
- Determine the appropriate capacity of the railway.
- Determine appropriate service frequency and the impact of this service pattern on capacity utilisation, railway and train operating costs.

7.2. Current demand

The main categories of freight in the north–south corridor expected to comprise the market for Inland Rail are manufactured (non-bulk) products, bulk steel, paper, coal and grain. No bulk freight movements have been identified that traverse the whole of the Melbourne to Brisbane corridor, with goods predominantly containerised (or palletised) and generally classified as non-bulk. There are different drivers of growth:

- **Non-bulk:** Comprising manufactured and retail goods largely transported in containers between capital cities and major regional areas, and the most significant demand segment likely to use Inland Rail for its entire length between intermodal terminals in Brisbane, Parkes, Melbourne, Perth and Adelaide. In the past this freight has grown faster than real GDP, but it is moving towards the GDP growth rate as domestic manufacturing declines and more goods are imported to local ports.
    - Melbourne to Brisbane land freight was 4.7 million tonnes per annum in 2013-14. Total Melbourne to Brisbane freight is forecast to grow by 2.9 per cent per annum, reaching 5.6 million tonnes by 2019-20 and 13.0 million tonnes by 2049-50.
    - Inland Rail will divert existing rail freight involving Adelaide or Perth and Brisbane from its current routes via Melbourne and Sydney to Inland Rail via Parkes as distance savings of 500 kilometres and travel time savings of 10 hours will be made possible. This will also see freight which is currently taken from Brisbane to Parkes by truck (and then loaded on to double stacked trains at Parkes) moving between Brisbane and Parkes by train. The total contestable market is almost 1.2 million tonnes between Brisbane and Adelaide and 0.6 million tonnes between Brisbane and Perth. The total of these markets is forecast to grow to 2.2 million tonnes in 2020 and 3.9 million tonnes in 2040.
    - Some other regional freight has been identified, including freight from the Ettamogah Hub in Albury to Brisbane, and import-export terminals taking advantage of the standard gauge rail connection to the Port of Brisbane.

- **Agricultural products:** Agricultural freight on the corridor mainly comprises grain movements to the export ports at Brisbane, Newcastle and Port Kembla. The choice of export port is dependent on total logistics cost which includes storage, linehaul and terminal charges. Agricultural freight tonnages depend on production, which has shown a long-term growth trend of 1.3 per cent per annum, less domestic demand (which averages around 3.7 million tonnes). Climate change is expected to reduce future yields by 0.33 per cent per annum. Grain freight also tends to move to its closest port for export, and grain grown to the north of the Moree region is expected to take advantage of a standard gauge connection to the Port of Brisbane, diverting approximately 500 kilotonnes from road and road-narrow gauge rail alternatives.
- **Coal:** There is potential for Inland Rail to be a catalyst for additional coal exports from south east Queensland through the Port of Brisbane. Inland Rail will provide a more direct and cost effective route particularly when crossing the Toowoomba Range, and complementary investments in branch lines would further assist to take advantage of Inland Rail capacity improvements in axle load and train length. Up to 19.5 million tonnes of coal is expected to use Inland Rail as a result of offering a more efficient rail connection to the Port of Brisbane, compared with the existing 8 million tonnes,[94] subject to prevailing coal prices and sufficient capacity at the Port of Brisbane and upgrades to feeder lines.[95] This is based on an analysis of individual mine costs and transport costs with Inland Rail, combined with a long run Newcastle coal spot price of US$75 per tonne, a long term Australian-US dollar exchange rate of around 0.85 (AUS$1:USD$0.85), a demand maximising Inland Rail coal access charge of around $9 per thousand gross tonne kilometres on average across the mine to port journey and a cap of 87 coal train paths. Additional detail on key coal demand assumptions are shown in Figure 7.2.

Current freight rail statistics are summarised by freight type below.

Intercapital

The estimated size of the market for intercapital freight in 2013-14 was:

- Melbourne to Brisbane (includes other Victorian and other Queensland destinations): 4.7 million tonnes, 26 per cent currently on rail.
- Adelaide to Brisbane: 1.9 million tonnes, 14 per cent currently on rail.
- Perth to Brisbane: 0.6 million tonnes, 59 per cent currently on rail.

Also relevant to Inland Rail is freight involving Sydney, as Sydney is the major constraint to further volume growth on the coastal route. The current market volumes relevant to this analysis are:

- Adelaide to Sydney: 2.4 million tonnes, approximately 0.1 million tonnes on rail.
- Melbourne to Sydney: 19.5 million tonnes, 14.5 per cent on rail, including 1.8 million tonnes of steel and other bulk movements, market share of containers is only 1.9 per cent on rail.
- Sydney to Brisbane: 10.7 million tonnes, 8.5 per cent on rail, including an estimated 0.7 million tonnes of steel and other bulk movements, market share of containers is only 2.3 per cent.
- Perth to Sydney: 1.4 million tonnes, approximately 1.0 million tonnes on rail.

[94] Over 2.5 million tonnes were shipped in the first quarter of 2013-14, suggesting that coal exports could reach 10 million tonnes in 2013-14. However, shipments subsequently fell away. Closure of the Wilkie Creek Mine at the end of December 2013 and a substantial price decline were contributing factors. Shipments in 2013-14 were just under 8.11 million tonnes, down by 5.6% compared to 2012-13.

[95] Preliminary analysis suggests a long term thermal coal price of US$75 per tonne would be required to support the expansion of coal tonnages assuming a long term Australian/US dollar exchange rate of around 0.85 (AUS$1:USD$0.85), a demand maximising Inland Rail coal access charge of around nine dollars per thousand gross tonne kilometres and a cap of 87 coal paths per week.

Agriculture

Significant agricultural demand for Inland Rail arises from existing export tasks:[96]

- Western and Central New South Wales, Riverina and Southern New South Wales to Port Kembla (up to 3.0 million tonnes, with up to 2.9 million tonnes on rail).
- Western and Central New South Wales and New England to the Port of Newcastle (up to 1.8 million tonnes, with approximately 1.2 million tonnes on rail).
- New England, Darling Downs and Toowoomba to the Port of Brisbane (up to 2.1 million tonnes with approximately 0.4 million tonnes on rail).

There are also southbound agricultural tonnes from the Riverina which would use Inland Rail, but they are unchanged as a result of investment in Inland Rail.

Coal

Just under 8.6 million tonnes of coal were hauled by rail to the Port of Brisbane from the Surat and Clarence–Moreton coal measures in 2012–13. The tonnage fell to about 8.1 million tonnes in 2013–14, following closure of the Wilkie Creek Mine at the end of December 2013. It is expected to decline further in FY2015 in the absence of Wilkie Creek production for a full year, and in the context of a persistent downtrend in thermal coal prices over the past three and a half years.

7.3. Approach to forecast the total market and rail mode share

ACIL Allen's projections are based on demand elasticities developed from stated preference surveys undertaken in 2008 and 2009 of up to 40 companies who operate in the north–south corridor, supplemented with interviews with freight companies and customers undertaken in August and September 2014, analysis of historical actual data to 2014, and estimating total freight between relevant cities and between rural production areas and ports. Thereafter, tailored methodologies were applied to the different freight markets.

Different methodologies were applied for contestable freight (mainly containerised non-bulk goods between state capitals), contestable regional freight, typically goods moving from regional cities to state capitals or ports, and regional bulk freight (grain and coal) moving to ports.

- **Non-bulk intercapital freight:** A logit model of the Australian east coast freight market was developed and used to forecast mode shares under different assumptions about each transport mode's price, reliability, availability and transit time, and assumptions about drivers of freight demand such as GDP, fuel prices and labour costs. Total freight has been forecast, and market shares calculated within the logit model for freight between Brisbane, Melbourne, Sydney, Adelaide and Perth, modelled under the assumption that the long and intermediate distance markets have the same price and service elasticities of demand as the Melbourne to Brisbane market, and that the shorter hauls of Melbourne to Sydney and Brisbane to Sydney have specific preferences as calculated by ACIL Allen.[97]

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[96] While ACIL Allen have included existing domestic grain trains to Manildra and Nowra in Inland Rail volumes, there is not expected to be a significant shift of domestic grain from road to rail reflecting dispersed feedlots and short haul movements where rail is not generally economical.

[97] Price is measured as door-to-door cost, including local pickup and delivery for rail and sea freight. Reliability is the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised. Availability refers to services available with departure and arrive times that are convenient for customers, which relates to cut-off and transit times.

- **Bulk commodities (e.g. paper and steel):** Bulk commodities are typically transported over shorter distances, for example between Melbourne, Sydney and Brisbane. There is little movement of bulk commodities between Melbourne and Brisbane although they were considered in the analysis, particularly because of their effect on capacity on the existing Melbourne to Sydney to Brisbane coastal rail route.
- **Agricultural Freight:** Analysed separately based on data from the Australian Bureau of Statistics (ABS) Agricultural Commodities report and supplemented by ACIL Allen on the basis of freight data from ARTC, previous work by the Bureau of Infrastructure, Transport and Regional Economics (BITRE), discussions with stakeholders, and meetings with train operators, grain and intermodal terminal organisations about the potential agricultural freight tonnages which could be induced by Inland Rail.[98]
- **Coal:** Analysed separately based on development of whole-of-supply chain costs profiles compared against future coal price scenarios to estimate potential export volumes assuming a long term Australian/US dollar exchange rate of around 0.85 (AUS$1:USD$0.85), a demand maximising Inland Rail coal access charge of around nine dollars per thousand gross tonne kilometres and a cap of 87 coal train paths per week.

There are other transport tasks in the area that move across the north–south flow (e.g. Hunter Valley coal and some grain flows to the Ports of Port Kembla and Newcastle) which are largely unaffected by Inland Rail. These tonnes are noted where they contribute to Inland Rail revenue and use of capacity but are otherwise not considered in this study.

7.4. Scenarios analysed

The demand projections and the economic and financial appraisals for Inland Rail presented in this report have analysed the following scenarios:

- **Base case scenario:** Assumes there is no inland railway and freight is transported by road (the Newell, Hume or Pacific Highways, or regional roads) and existing rail lines (the coastal route via Sydney or branch and regional lines). Currently committed and funded investments have been assumed. Key inclusions/exclusions include:

  Policies:

  - ✗ No changes to current policies assumed i.e. no changes to road user charging and no price or tax on carbon during the projection period.
  - ✗ No investment on the Newell Highway and no access decisions on the Hume and Pacific Highway corridors to allow B-triples and Super B-doubles for intercapital freight. This policy decision will have a significant impact on rail reliability unless there is a corresponding significant increase in road pricing (excluded from this assessment).

  Freight rail investment:

  - ✓ Loop extensions and new loops between Sydney and Brisbane to achieve Northern Sydney Freight Corridor Stage one capacity.
  - ✗ Northern Sydney Freight Corridor Stage two or three (excluded from this assessment).

  Road investments:

  - ✓ Hume, Newell and Pacific Highway corridors assume continuation of historic road investment levels, with a similar level of deterioration in road performance over time due to congestion.

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[98] Australian Bureau of Statistics, 7121.0 - Agricultural Commodities, Australia, 2012-2013, Released at 11:30 AM (EST) 30 May 2014.

- ✗ Newell Highway upgrades between Mungle Back Creek and Boggabilla (heavy duty pavement and a widening).[99]
- ✓ Toowoomba Second Range Crossing is completed.

Passenger rail investments:

- ✓ Investment in passenger rail in metropolitan Brisbane (Ipswich Line and Cleveland Line) and Sydney (Main Northern Line and Illawarra Line) with continued focus on peak period capacity.

Queensland investments:

- ✓ Western Line coal and agricultural trains continue to be limited to 650 metres and 15.75 tonne axle load, narrow gauge, and trains limited to 114 movements per week (87 for coal and 27 for agricultural freight).
- ✓ Assume that QR investment of $67 million on Toowoomba Range passing loops/tunnel lowering takes place.[100]
- ✗ Does not assume other Toowoomba Range passing loops or new rollingstock (excluded from this assessment).

Complementary freight investments

- ✓ Intermodal terminal and port capacity is available in Melbourne and Brisbane, with double stack capability at a terminal or terminals in Melbourne by 2024–25.
- ✗ Passing loop extensions to enable 3600 metre trains.

- **Inland Rail core scenario (including Western Line Upgrade):** Assumes Inland Rail is built with a route length of approximately 1700 kilometres and a linehaul (terminal-to-terminal) transit time of below 24 hours (for Melbourne to Brisbane freight) ,[101] and allowing coal and agricultural trains originating on the Western Line in south east Queensland to increase train length to 1010 metres ('Western Line Upgrade').[102] The Inland Rail core scenario assumes an intermodal terminal or terminals in Melbourne with double stack capability from 2024–25, new formation and structures to enable 30 tonne axle load at 80 kilometres per hour at a later point in time if required, and passing loop spacing and construction to enable 3600 metre trains after 2038–39.
- **Inland Rail core scenario (no Western Line Upgrade):** Assumes Inland Rail is built (as described above), except there is no capital investment in loop extensions on the Western Line and Brisbane metropolitan rail network (at Murrarie and Clapham Yard), restricting coal train lengths to 650 metres (noting a different train configuration than 1010 metre trains, which assume higher capacity, heavier wagons).[103] This scenario results in an estimated nine million tonnes per year because there is no change in train length (and therefore operating costs) relative to the base case and the assumed cap of 87 coal train paths becomes binding at lower total volumes (reflecting lower payload per train).

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99 Minister for Infrastructure and Regional Development, $77 million to upgrade the Newell Highway, available at: http://www.minister.infrastructure.gov.au/wt/releases/2015/March/wt064_2015.aspx, 2015.

100 Minister for Transport and Main Roads, Government kick-starts rail freight negotiations, available at: http://statements.qld.gov.au/Statement/2014/3/31/government-kickstarts-rail-freight-negotiations

101 Rail operational modelling undertaken by ARTC suggests 20.3 hours (express service) or 24.8 hours (standard service) in 2024–25.

102 Western Line Upgrade includes additional loops on the Western Line and Brisbane metropolitan network.

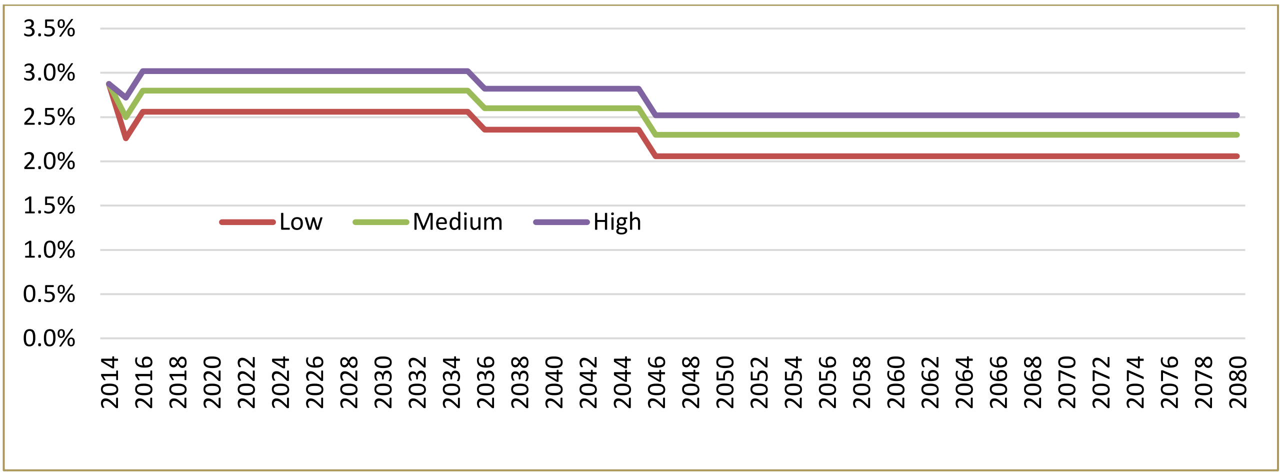
103 Each coal path is a potential train movement, but there can be less volumes per 650 metre train.

7.5. Key demand assumptions

Key assumptions underpinning the demand assessment include:

- **Gross domestic product:** GDP is a key driver to estimate the growth in the total rail and road intercapital freight market on the Brisbane to Melbourne corridor. The demand modelling assumes 2.5 per cent growth of GDP in 2014–15, 2.8 per cent per annum from 2015–16 to 2034–35 and a decline to 2.3 per cent after 2044–45 as Australia's population growth and economic participation slows, consistent with the Department of Treasury and Finance, 2015 Intergenerational Report.[104] High, medium and low scenarios have been considered with minus 0.24 percentage points per annum and plus 0.22 percentage points per annum based on low/high estimates in the intergenerational report, and the medium scenario has been applied in the analysis. Low, medium and high GDP forecast scenarios are provided in Figure 7.1.

Figure 7.1 Real GDP forecast scenarios



Source: ACIL Allen Consulting analysis of Intergenerational Report 2015 (Australian Treasury).

- **Ongoing growth of agricultural freight:** ACIL Allen has estimated that the long run growth in grain volumes will be 1.1 per cent per annum. This incorporates estimates of long term yield growth and the impacts of climate change. The area planted to grains or allocated to other agricultural uses is not expected to change significantly over time.

- **Labour costs and driver shortages:** Road freight is more sensitive than rail freight to labour and fuel costs although increases in truck size and productivity have eroded this difference somewhat over time. A long-term shortage of qualified truck drivers is expected to continue.

- **A long-run trend of rising fuel prices:** ACIL Allen's modelling allows for a wide range of possible oil prices (based on recent US Energy Information Administration and International Energy Agency forecasts), with a central assumption of a real price of US$120 per barrel by 2030 (81 per cent above the average price for the six months to February 2015). Fuel prices are then expected to remain constant in real US dollar terms after 2030. Around this underlying trend there will be considerable volatility.

- **Key rail mode assumptions:** The mode choice for intercapital freight is assumed to be determined by key freight supply chain service characteristics (reliability, availability and transit time) and price characteristics offered by current rail and road options and the potential service and price offering of Inland Rail. In calibrating the model to current service offerings a constant was required to align predicted mode share with actual mode share; this reflects unmeasured service attributes or costs which favour road transport of containers.

[104] Commonwealth of Australia, Intergenerational Report, Canberra, Appendices A and B, 2015.

- **Train operating cost savings from Inland Rail:** Are based on a comparison of rail and road relative pricing along with an estimation of the lower train costs enabled by the shorter route and an ability to carry longer, double stacked trains. Savings are assumed to be fully passed onto rail customers.
- **No competitive price response from road hauliers:** As the road freight industry is highly competitive, profit margins in the industry are low and prices reflect costs. In addition, many major Inland Rail customers would be multi-modal operators. It is assumed that the road freight industry will be unable to sustain a significant price reduction in response to the introduction of Inland Rail and there is not expected to be a significant competitive response from multi-modal operators.
- **Coal prices and exchange rate:** The key assumptions underpinning ACIL Allen's coal demand analysis are long term coal prices and the exchange rate, which are compared to estimated mine and transport costs on a mine-by-mine basis including an assumed return on investment. Preliminary analysis suggests a long term thermal coal price of US$75 per tonne would be required to support the expansion of coal tonnages assuming a long term Australian/US dollar exchange rate of around 0.85 (AUS$1:USD$0.85), a demand maximising Inland Rail coal access charge of around nine dollars per thousand gross tonne kilometres and a cap of 87 coal train paths. Key coal demand assumptions are shown in Figure 7.2.
- **Intercapital/intermodal freight access charges per tonne remain unchanged:** Access charges have been assumed to be set to encourage rail volumes (and thus the economic benefit of Inland Rail) rather than to maximise financial revenue, which have been assumed as follows:
  - The access-charge for Melbourne to Brisbane freight on Inland Rail is assumed to match the current charge for the coastal route (on a terminal to terminal basis) so that existing users will not be disincentivised from switching to Inland Rail to take advantage of operating cost savings and service improvements.
  - The access charge for Brisbane to Perth and Brisbane to Adelaide freight is assumed to match the coastal railway between Parkes and Kagaru. A reduced route distance of approximately 500 kilometres would see significant access cost savings for freight between Brisbane and Adelaide/Perth.
  - Access charges for agricultural freight are assumed to decrease or remain at current levels for agricultural freight in order to offer charges competitive with Hunter Valley agricultural rail freight.

There are a number of mechanisms to ensure prices are set at volume maximising levels if that is decided upon by the Australian Government. As this Programme Business Case is not considering funding options, this has not been considered in detail. However, consideration would be required if and when the Australian Government makes a decision to involve or transfer operations to the private sector.

Figure 7.2 Key coal demand assumptions

Key coal demand assumptions include:

- **Coverage** – ACIL Allen investigated existing thermal coal mines in the Clarence-Moreton and Surat Basins, noting that the annual Coal Industry Profile published by the New South Wales Government has not identified any existing or potential coal mine in the New South Wales portion of the Basin between the border with Queensland and half-way from Moree to Narrabri. The Coal Industry Profile has identified mines and potential mines in the Gunnedah/Boggabri/Narrabri region of the Gunnedah Basin. However, these deposits are much closer to Newcastle than to Brisbane. Coal is currently railed from Gunnedah Basin mines to the Port of Newcastle.
- **Current coal volumes** – The existing rail network and port facility handle thermal coal mined by: New Hope in the Clarence-Moreton Basin at New Acland Mine, near Jondaryn and Oakey, north-west of Toowoomba; New Hope at Jeebropilly Mine in the Clarence-Moreton Basin near Ipswich; and Yancoal at Cameby Downs Mine in the Surat Basin near Miles. In 2012-13, 8.58 million tonnes were shipped. Over 2.5 million tonnes were shipped in the first quarter of 2013-14, suggesting that coal exports could reach 10 million tonnes in 2013-14. However, shipments subsequently fell away. Closure of the Wilkie Creek Mine at the end of December 2013, and a substantial price decline were contributing factors. Shipments in 2013-14 were just under 8.11 million tonnes, down by 5.6 per cent compared to 2012-13. In July and August 2014, shipments totalled less than 1.27 million tonnes. This suggests shipments of around 7.6 million tonnes in 2014-15.[105]
- **Coal prices** – The Newcastle benchmark thermal coal price was below US$70 per tonne in 2014 price terms for approximately 20 years from 1986 to 2006.[106] There is considerable uncertainty regarding future thermal coal prices. Coal price forecasts from various authorities differ significantly. ACIL Allen analysis suggests that, historically, spikes in the thermal coal price above US$100 per tonne have been short-lived. Considering historical trends as well as review of other public forecasts, ACIL Allen suggests a central case long-term price range of US$65 to US$86 per tonne for Newcastle benchmark coal. The middle of this range, US$75 per tonne for Newcastle benchmark coal, has been used as a base or middle case coal price scenario, with sensitivity tests at US$55 and US$95 per tonne. A quality discount of five per cent has been applied to Surat and Clarence-Moreton Coal and a long term exchange rate of around 0.85 (AUS$1:USD$0.85) has been used to convert coal price estimates to Australian dollars.
- **Port capacity** – Coal is exported through facilities operated by Queensland Bulk Handling (QBH) within the Fisherman Islands precinct of the Port of Brisbane. QBH is owned by New Hope Corporation Ltd, which, among other things, mines coal at locations west of Brisbane. As outlined in Section 5.7, it is assumed that there will be sufficient port capacity in Brisbane to accommodate forecast coal demand volumes.
- **Rail capacity** – Current narrow gauge rail capacity potentially available for coal haulage from the Clarence-Moreton and Surat Basins to the Port of Brisbane is up to 8.7 million tonnes per annum, with a potential increase to 10.8 million tonnes contingent upon capacity upgrades at the Port of Brisbane.
- **Train lengths** – Current coal train lengths are assumed to be 650 metres. Two alternative core scenarios have been considered. Including additional loops on the Western Line and Brisbane metropolitan network (Clapham and Murarrie) would enable coal train lengths to increase to 1010 metres. Excluding this Western Line Upgrade would constrain train lengths to the current 650 metre.
- **Coal train paths** – It is assumed that there is a cap of 87 coal train paths, which limits the total volume of coal that can be accommodated at each assumed coal train length given the volume that can be accommodated in each train (i.e. this cap is on train numbers rather than volumes).

[105] Projected shipments in 2014-15 do not include any Wilkie Creek coal, while 2013-14 shipments included Wilkie Creek coal produced until 31 December 2013.

[106] US$ FOB. price for Newcastle 6300 kcal/kg GAR benchmark coal.

- **Coal access charges** – A long term Inland Rail coal access charge has been assumed so as to maximise utilisation of rail capacity (and thus the economic benefit of Inland Rail) rather than to necessarily maximise financial returns. This assumption is consistent with other aspects of the Programme Business Case where prices are assumed to be set at levels which encourage utilisation of the rail network.

In practice, the level of prices and the revenue split between contiguous network owners would be negotiated between the Inland Rail owner/operator and other rail network operators on the Western Line and Brisbane metropolitan network. Inland Rail is expected to deliver a significant increase in both capacity and volume which would likely impact the level of coal access charges that would prevail in the market post-construction considering the existing coal network is highly constrained.

The coal access price most recently proposed by the Queensland Competition Authority (QCA) for the Western System in its draft decision of October 2014 is $14.29 per thousand gross tonne kilometres[107] and the proposal by QR in its May 2015 submission is $19.41 per thousand gross tonne kilometres.[108]

The coal access price assumption should be distinguished from the prices determined in the current regulatory process for the QR Western System which apply to the existing constrained network asset servicing shorter term demand. The Inland Rail scenario includes a new asset with significantly different technical specifications (e.g. a tunnel crossing the Toowoomba Range) that is expected to significantly increase coal volumes from the current 8 million tonnes to 19.5 million tonnes.

As such, there will be significant scale benefits that may be factored into future access charges.

Alternative coal access charging scenarios have been included in sensitivity testing to reflect uncertainty around future coal access charges that might apply post construction of Inland rail.

Source: ACIL Allen and PwC, 2015.

7.6. Future demand estimates

Based on analysis of freight between Melbourne and Brisbane, and vice versa, freight between points along the route including grain and coal freight to ports for export, and freight between points outside the route and points on it (e.g. Perth to Brisbane), the four key drivers representing market priorities and the needs of customers for freight services outlined above were considered based on their relevance to each freight segment—reliability, transit time, price and availability. These factors are all important for non-bulk intercapital freight, with availability and reliability considered essential for express and other just-in time freight (e.g. postal, retail chains). Bulk commodities (e.g. paper and steel) are less sensitive to journey time and more sensitive to price, and as such tend to use rail or sea freight on the domestic legs of international shipping services. The majority of the total market is between these extremes, mainly comprising container freight, which is contestable between rail and road.

Intercapital

Better rail service offered by Inland Rail is about more than faster trains and higher reliability between Melbourne and Brisbane at the same assumed rail access price. Lower transit time, a higher tonne axle load and longer trains flow through to lower train operating costs which are assumed to be passed on to rail customers. Over time, increasing congestion on roads (particularly in urban areas along the route) is likely to increase road transit times and raise operating costs for road freight, this is combined with expectations the oil price will rise over time to approximately US$120 in 2014 prices by 2030.

107 QCA, 'Queensland Rail's 2013 Draft Access Undertaking', October, 2013.

108 Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May, 2015.

Key features include:

- Inland Rail is expected to take all of the Melbourne to Brisbane rail freight from the coastal route (freeing up capacity through Sydney for Melbourne to Sydney and Sydney to Brisbane rail freight as well as rail passenger services) and increase rail freight's share of that market by 18 percentage points compared to the base case (2029–30). This is approximately 50 per cent more volume carried on rail from Melbourne to Brisbane.
  - Overall the tonnage on rail and road moved between Melbourne to Brisbane is estimated to be 6.5 million tonnes in 2024–25 and 7.6 million tonnes in 2029–30, with Inland Rail capturing 3.2 million tonnes in 2024–25 and 4.0 million tonnes in 2029–30. By 2049–50, Inland Rail is forecast to carry 8.3 million tonnes of containerised non-bulk goods between Melbourne and Brisbane.
- Additional intercapital freight from Perth and Adelaide using Inland Rail between Brisbane and Parkes is expected to increase total freight volumes. This freight will be diverted from the longer route via Sydney, shortening the distance by up to 543 kilometres.
  - Brisbane to Perth (0.9 million tonnes in 2024–25 reaching 1.8 million tonnes by 2049–50).
  - Brisbane to Adelaide (0.6 million tonnes in 2024–25 reaching 1.4 million tonnes by 2049–50).
- Inland Rail provides the opportunity to attract significant volumes of road freight from North Queensland to Melbourne, however these volumes are difficult to quantify and are not included in the demand analysis.

Regional

Regional freight between points along the route consists mainly of grain, cotton, pulses and other agricultural products, with some non-bulk (containerised) freight between regional New South Wales (predominantly from the Ettamogah Hub in Albury), Toowoomba and Brisbane, including:

- In 2024–25 approximately 4.2 million tonnes of NSW grain is estimated to traverse sections of Inland Rail en route to the Ports of Port Kembla and Newcastle for export or en route to milling and malting operations in Manildra and Nowra.
- In 2024–25 0.6 million tonnes of grain from northern New South Wales (Moree and the area to its north) is also expected to travel to Brisbane on Inland Rail, diverting from rail and road to the Port of Newcastle.
- Similarly, it is expected that 0.4 million tonnes of containerised cotton and cottonseed from Narrabri will divert from road to rail for its export via the Port of Brisbane by 2024–25.
- Inland Rail may alter the preferred destination ports, with Brisbane receiving grain otherwise exported via the Port of Newcastle, but this is dependent on the pricing of export terminal services at those ports, as well as the transport cost. It is likely that Inland Rail will facilitate greater competition between ports and increased returns to growers as a result.
- The grain production in the Darling Downs is predominantly moved by road to the Port of Brisbane. Cost savings generated by Inland Rail, which will require upgrades to branch lines and the Port of Brisbane Extension, could increase rail mode share to 40 per cent, consistent with rail's share of exports in other east coast ports.
- This would increase grain and pulses freight to one million tonnes on Inland Rail in 2024–25, increasing current rail volumes by 0.6 million tonnes of diverted road freight.
- The Darling Downs and Maranoa produce some 0.3 million tonnes of containerised cotton products and approximately 0.2 million of this is expected to use Inland Rail to be exported via the Port of Brisbane. This would see a doubling of the current rail use for cotton export.

- Approximately 0.4 million tonnes of freight is expected to travel from the Charlton Wellcamp freight precinct to the Port of Brisbane on Inland Rail. This freight is likely to include consolidated agricultural freight from the Toowoomba and Darling Downs regions, and manufactured goods from the on-site industrial precinct.
- Some 0.2 million tonnes of goods between Parkes and Brisbane are expected to divert from road to rail freight in 2024–25. This represents an amount of Brisbane to Perth freight which is carried by road from Brisbane to Parkes before being loaded on to Sydney to Perth trains at Parkes.[109]

Coal

Thermal coal from the Surat and Clarence-Moreton Basins has been assessed to travel to the Port of Brisbane (and is currently the largest single commodity to travel through the port). ACIL Allen analysis suggests that thermal coal would not move south to Newcastle via Inland Rail, as the value of that coal is too low to cover the considerable mining costs and the longer rail distances. No existing or potential coal mines in the New South Wales portion of the Clarence-Moreton Basin between the border with Queensland and half-way from Moree to Narrabri have been identified. Mines and potential mines in the Gunnedah to Boggabri to Narrabri region of the Gunnedah Basin are much closer to Newcastle than to Brisbane and are not considered to be viable for transport to the Port of Brisbane.

Current coal exports of 8 million tonnes are forecast to increase to 19.5 million tonnes with Inland Rail as a result of reduced above rail operating costs from higher axle loads east of Oakey (20 tonne axle loads compared to the current 15.75 tonnes), longer trains (1010 metres compared to the current 650 metres) a more direct alignment in tunnel across the Toowoomba Range that avoids the current crossing where operating speeds are constrained by high gradients and tight curves on a winding track. Capital investment in additional loops on the Western Line and Brisbane metropolitan rail network (at Murrarie and Clapham Yard) are required to enable coal train lengths to increase from 650 metres to 1010 metres. An alternative core scenario has also been presented which excluded upgrades to the Western Line and Brisbane metropolitan network, reducing forecast coal volumes to around 8.8 million tonnes as a result of restricting train lengths to 650 metres, which would mean the assumed cap of 87 coal train paths becomes binding at lower volumes, and not realising operating cost savings that would result from longer train lengths.

Total tonnages on Inland Rail (excluding coal) are estimated to be 11.4 million tonnes in 2024–25 and 12.9 million tonnes in 2029–30. The corresponding net tonne kilometres (excluding coal) are estimated to be 9.7 billion net tonne kilometres in 2024–25 and 11.7 billion net tonne kilometres in 2029–30.

ACIL Allen estimates of the market take up of Inland Rail are shown in Table 7.1. A breakdown of forecast Inland Rail north and southbound volumes by freight type for both tonnes (thousands) and net tonne kilometres (billions) in 2049-50 is illustrated in Figure 7.3.

[109] ACIL Allen, 2015.

Table 7.1 Forecast combined Inland Rail north and southbound volumes (tonnes and net tonnes kilometres)

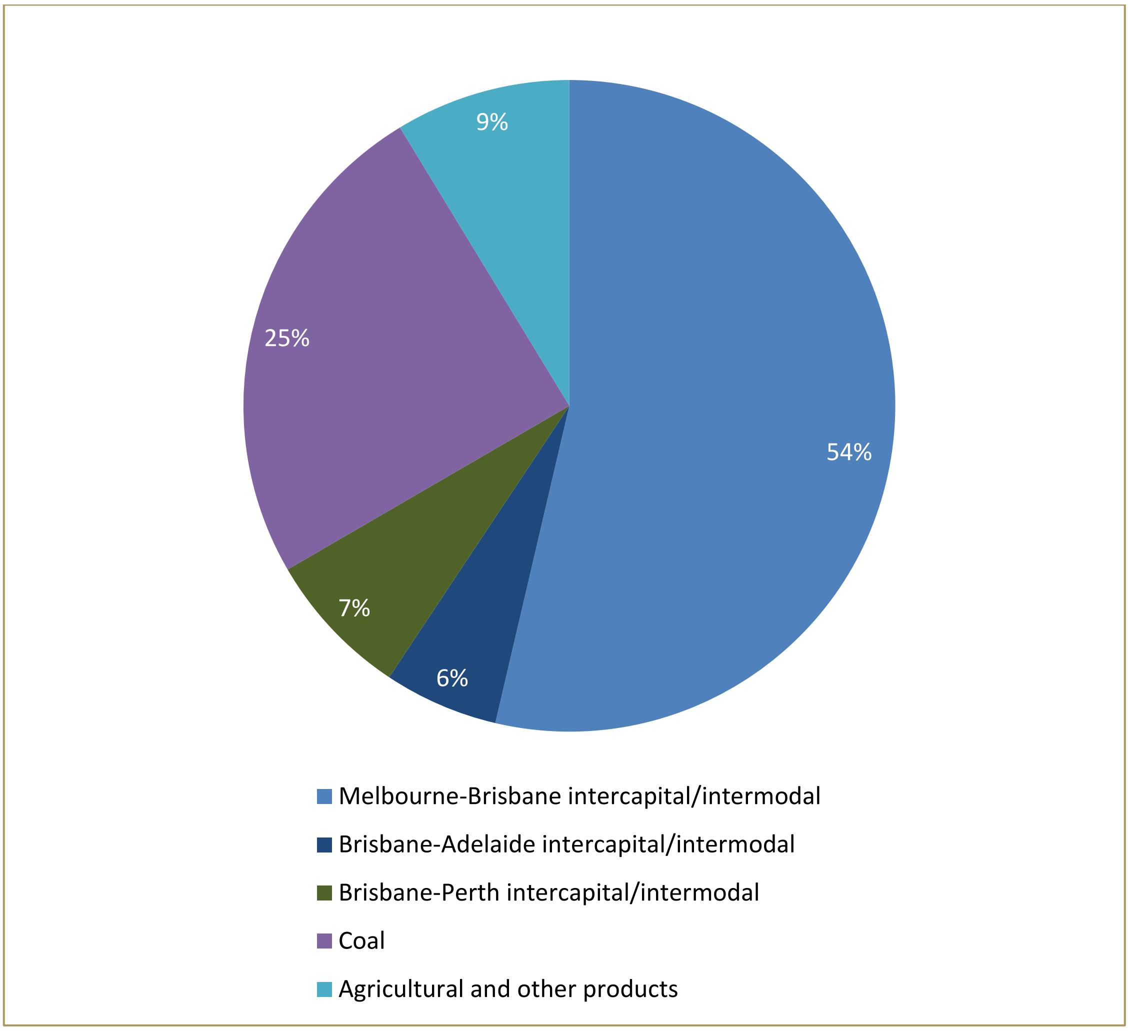
		2024–25	2029–30	2039–40	2049–50	2059-60	2069-70
NET TONNES (000)							
Intercapital/ intermodal	Melbourne to Brisbane	3195	4008	5674	7906	10 522	13 986
	Brisbane to Adelaide	560	690	997	1412	1951	2701
	Brisbane to Perth	878	1034	1398	1815	2303	2906
Regional	Coal (SEQ-Brisbane)*^	12 900	19 500	19 500	19 500	19 500	19 500
	Agricultural products	6750	7129	7954	8873	9899	11 043
Total		**24 283**	**32 361**	**35 523**	**39 507**	**44 175**	**50 137**
NET TONNE KILOMETRES (MILLIONS)							
Intercapital/ intermodal	Melbourne to Brisbane	5527	6934	9817	13 677	18 204	24 197
	Brisbane to Adelaide**	573	707	1021	1447	1998	2767
	Brisbane to Perth**	900	1059	1432	1860	2360	2978
Regional	Coal (SEQ-Brisbane)*^	3973	6292	6292	6292	6292	6292
	Agricultural products	1687	1782	1988	2218	2475	2761
Total		**12 660**	**16 774**	**20 550**	**25 494**	**31 328**	**38 994**

Note: *SEQ is an abbreviation for South East Queensland. ** Excludes net tonne kilometres for intercapital freight travelling between Adelaide to Brisbane and Perth to Brisbane that occurs beyond Inland Rail (i.e. from Parkes to Adelaide and Perth respectively). ^ These forecast volumes are within the existing maximum 87 coal paths per week that can potentially be contracted on the Metropolitan Network (set by QR).[110] These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres. Totals may not sum due to rounding.

Source: ACIL Allen, 2015.

110 Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 2, May 2015.

Figure 7.3 Combined Inland Rail north and southbound volumes by freight in 2049-50 (net tonne kilometres)



Source: PwC, ACIL Allen, 2015.

As intercapital freight is more readily comparable, Table 7.2 (Melbourne to Brisbane), Table 7.3 (Brisbane to Adelaide) and Table 7.4 (Brisbane to Perth) present intercapital freight demand if there is no Inland Rail (the base case) and under a scenario with Inland Rail.

Table 7.2 Melbourne to Brisbane combined north and southbound forecast intercapital tonnes (thousand tonnes and market share)

SCENARIO	MODE	2014–15	2024–25	2029–30	2039–40	2049–50	2059-60	2069-70
Base case (no Inland Rail)	**Grand Total (thousand tonnes)**	**4809**	**6284**	**7178**	**9418**	**11946**	**14839**	**18355**
	Inland (Melbourne to Brisbane only)	-	-	-	-	-	-	-
	Coastal	1400	2135	2551	3553	4816	6458	5911
	Road	3409	4149	4626	5865	7130	8382	12444
	Market share (per cent)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Melbourne to Brisbane only)	0%	0%	0%	0%	0%	0%	0%
	Coastal	29%	34%	36%	38%	40%	44%	32%
	Road	71%	66%	64%	62%	60%	56%	68%
Inland Rail	**Grand Total (thousand tonnes)**	**4809**	**6519**	**7503**	**9961**	**12771**	**16023**	**20047**
	Inland (Melbourne to Brisbane only)	0	3195	4008	5674	7906	10522	13986
	Coastal	1400	1	0	0	0	0	0
	Road	3409	3323	3495	4286	4865	5500	6061
	Market share (per cent)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Melbourne to Brisbane only)	0%	49%	53%	57%	62%	66%	70%
	Coastal	29%	0%	0%	0%	0%	0%	0%
	Road	71%	51%	47%	43%	38%	34%	30%

Note: Totals may not sum due to rounding.

Source: ACIL Allen, 2015.

Table 7.3 Brisbane to Adelaide combined north and southbound forecast intercapital tonnes (thousand tonnes and market share)

SCENARIO	MODE	2014–15	2024–25	2029–30	2039–40	2049–50	2059-60	2069-70
Base case (no Inland Rail)	**Grand Total (thousand tonnes)**	**1258**	**1638**	**1869**	**2445**	**3092**	**3826**	**4712**
	Inland (Brisbane to Adelaide only)	0	0	0	0	0	0	0
	Coastal	189	288	349	494	683	940	1308
	Road	1069	1350	1520	1951	2409	2886	3404
	Market share (%)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Brisbane to Adelaide only)	0%	0%	0%	0%	0%	0%	0%
	Coastal	15%	18%	19%	20%	22%	25%	28%
	Road	85%	82%	81%	80%	78%	75%	72%
Inland Rail	**Grand Total (thousand tonnes)**	**1259**	**1700**	**1951**	**2579**	**3298**	**4136**	**5177**
	Inland (Brisbane to Adelaide only)	0	560	690	997	1412	1951	2701
	Coastal	189	0	0	0	0	0	0
	Road	1069	1141	1261	1582	1886	2186	2476
	Market share (%)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Brisbane to Adelaide only)	0%	33%	35%	39%	43%	47%	52%
	Coastal	15%	0%	0%	0%	0%	0%	0%
	Road	85%	67%	65%	61%	57%	53%	48%

Note: Totals may not sum due to rounding.

Source: ACIL Allen, 2015.

Table 7.4 Brisbane to Perth combined north and southbound forecast intercapital tonnes (thousand tonnes and market share)

SCENARIO	MODE	2014–15	2024–25	2029–30	2039–40	2049–50	2059-60	2069-70
Base case (no Inland Rail)	**Grand Total (thousand tonnes)**	**636**	**856**	**989**	**1317**	**1696**	**2141**	**2690**
	Inland (Brisbane to Perth only)	0	0	0	0	0	0	0
	Coastal	410	676	822	1156	1544	2008	2579
	Road	227	180	167	161	152	133	111
	Market share (%)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Brisbane to Perth only)	0%	0%	0%	0%	0%	0%	0%
	Coastal	64%	79%	83%	88%	91%	94%	96%
	Road	36%	21%	17%	12%	9%	6%	4%
Inland Rail	**Grand Total (thousand tonnes)**	**636**	**928**	**1075**	**1433**	**1845**	**2328**	**2926**
	Inland (Brisbane to Perth only)	0	878	1034	1398	1815	2303	2906
	Coastal	410	0	0	0	0	0	0
	Road	227	50	41	36	30	24	19
	Market share (%)	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	Inland (Brisbane to Perth only)	0%	95%	96%	98%	98%	99%	99%
	Coastal	64%	0%	0%	0%	0%	0%	0%
	Road	36%	5%	4%	2%	2%	1%	1%

Note: Totals may not sum due to rounding.

Source: ACIL Allen, 2015.

Forecasts of agricultural freight diverting to Inland Rail from other regional rail lines or road is provided in Table 7.5.

Table 7.5 Forecast agricultural tonnes diverting to the Inland Rail (thousand tonnes and market share)

	2014–15	2024–25	2029-30	2039-40	2049-50	2059-60	2069-70
Inland Rail (thousand tonnes)	**0**	**6750**	**7129**	**7954**	**8873**	**9899**	**11043**
Diverted from existing rail (thousand tonnes)	0	4998	5279	5889	6570	7329	8177
Diverted from road (thousand tonnes)	0	1752	1851	2065	2303	2570	2867
Inland Rail (%)	**0%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Diverted from existing rail (%)	0%	74%	74%	74%	74%	74%	74%
Diverted from road (%)	0%	26%	26%	26%	26%	26%	26%

Note: Totals may not sum due to rounding.

Source: ACIL Allen, 2015.

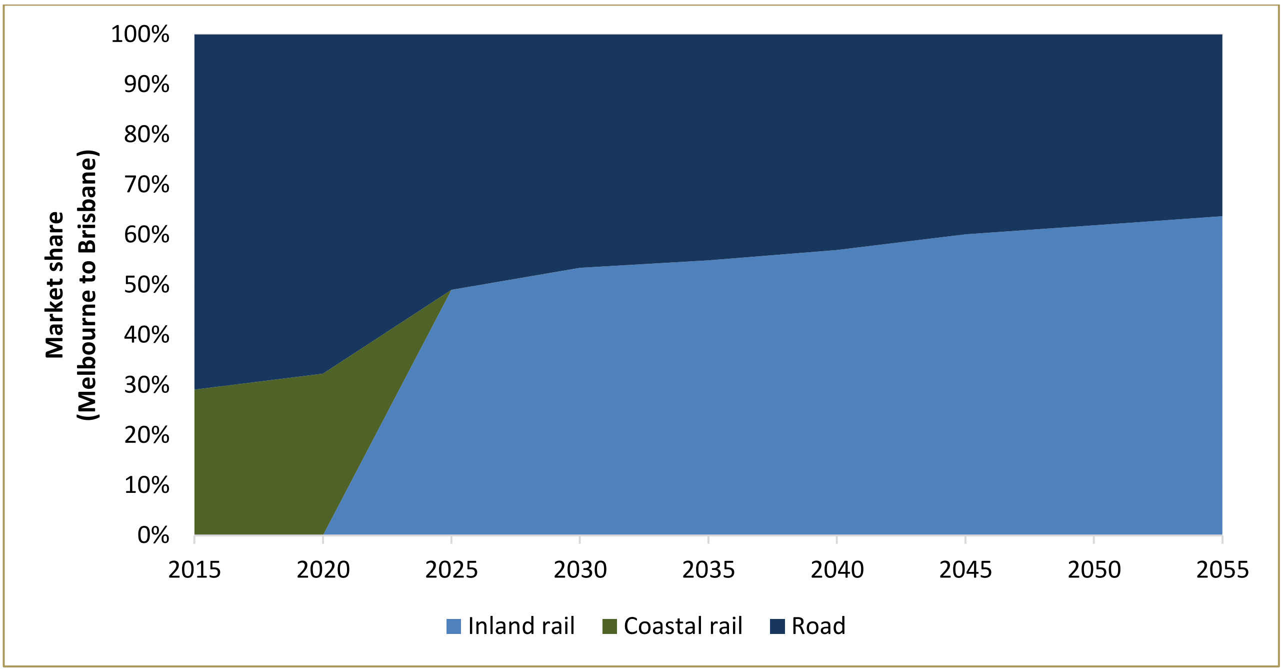
7.7. Road versus rail demand

Inland Rail is expected to offer both cost and service performance advantages over road freight and there is expected to be substantial mode shift from road to Inland Rail for intercapital and some agricultural freight.

Inland Rail is expected to offer service characteristics which are competitive with road, providing the same level of reliability achieved given the assumption that train operators build in a buffer on top of the linehaul transit time. A linehaul transit time of 20.3 hours (express service) is faster than road freight, although pick-up and delivery (PUD) activities add approximately 4 hours to the door-to-door transit time, two hours between cut-off and train departure and the buffer to ensure reliability of delivery is expected to add a further 3.7 hours. Including the buffer and PUD activities, express rail freight is expected to offer a transit time of 28 hours door-to-door and standard rail services an initial transit time of 32.8 hours door to door. This compares to expected door-to-door transit times of 24 hours for road freight in 2024-25. Even the standard rail service is expected to achieve the market's delivery preference to have freight available to pick up at the receiving train terminal by six am (next day plus one) at the latest.

It is apparent from the demand analysis that with similar levels of service, rail cannot expect to capture half the market if priced on a par with road freight. Current market share is not completely explained by a lack of competitiveness of rail freight's service performance or price compared to road. This requires a constant in the demand model to represent factors which were unable to be measured or observed, as well as measurement errors in the data. It may also represent commodities or consignors which have preferences for road over rail. The Melbourne to Brisbane intercapital freight mode share from 2022–23 with Inland Rail is provided in Figure 7.4.

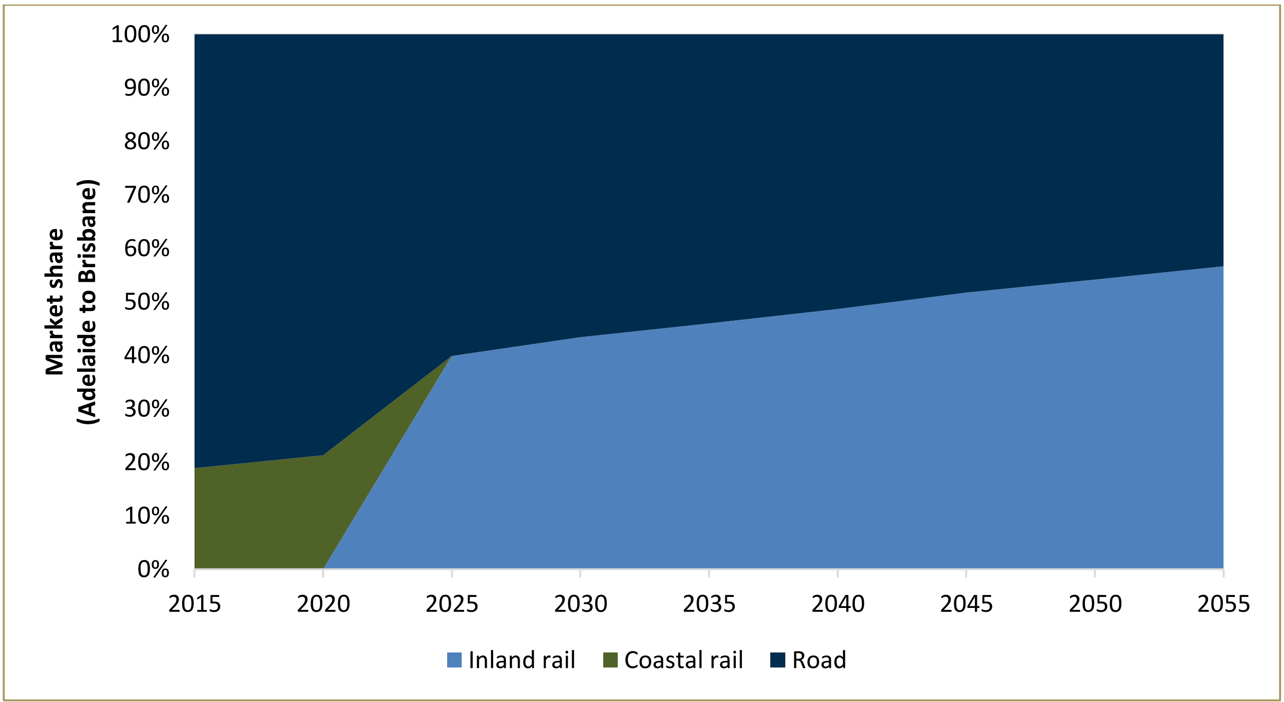
Figure 7.4 Melbourne to Brisbane intercapital freight mode share with Inland Rail



Source: ACIL Allen, 2015

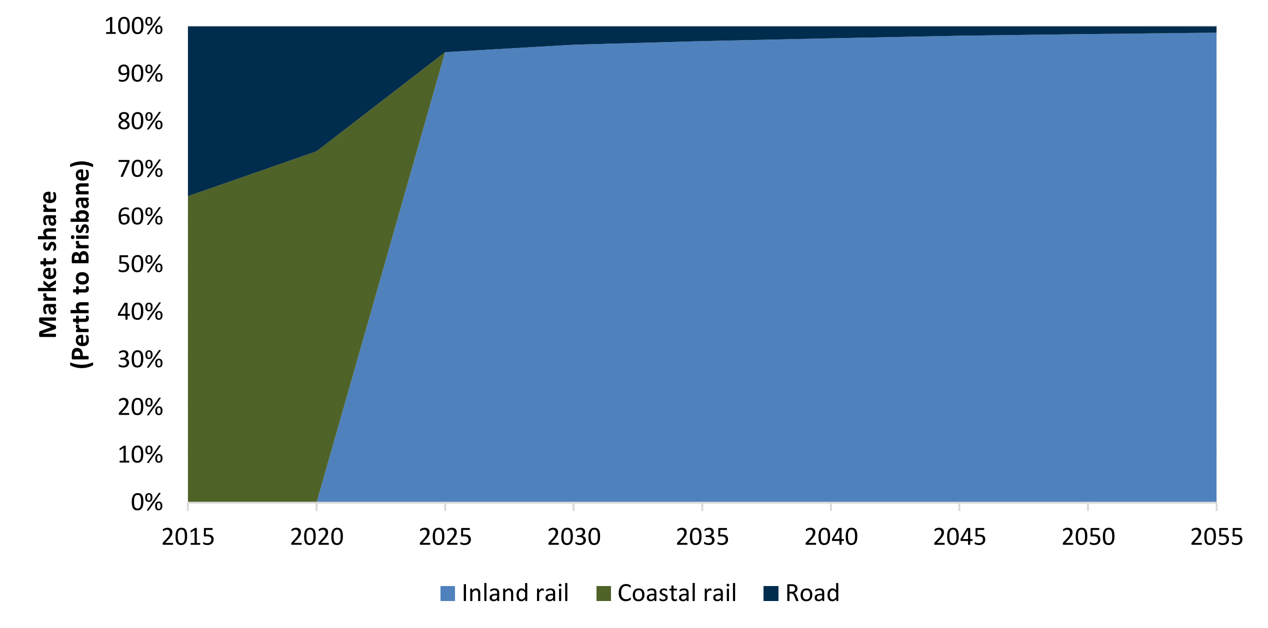
Similarly, the market share impact of Inland Rail on Brisbane to Adelaide and Brisbane to Perth freight is presented in Figure 7.5 and Figure 7.6.

Figure 7.5 Adelaide to Brisbane intercapital freight mode share with Inland Rail



Source: ACIL Allen, 2015

Figure 7.6 Perth to Brisbane intercapital freight mode share with Inland Rail



Source: ACIL Allen, 2015

7.8. Train numbers

Projected train movements determined by the amount of traffic in the most heavily used direction are estimated in Table 7.6. This presents preliminary ARTC analysis comparing the train number per week and by sector of Inland Rail based on ACIL Allen demand volumes, given this is relevant for cost and planning purposes. This presents train numbers (per week, round trip) for volumes used in the economic and financial analysis.

Table 7.6 Forecast Inland Rail train numbers (round trips)

TRAINS PER WEEK	2024–25	2029–30	2034–35	2039–40	2044–45	2049–50
Intercapital/intermodal	36	43	51	36	42	47
Grain	15	15	16	17	18	19
Coal	58	87	87	87	87	87
Others (including steel, mineral and general freight)	15	16	17	19	20	22
Total	**123**	**162**	**171**	**158**	**166**	**174**

Note: Assumes maximum intercapital/intermodal train lengths of 1800 metres with 40 per cent double stacking of containers (net payload 1470 tonnes), increasing to 3600 metres from 2039-40 (net payload 2938 tonnes); 800 metre bulk agriculture trains reflecting an assumed range of 650 metres for narrow gauge to 900 metres for standard gauge trains (net payload 2010 tonnes); and 1010 metre coal trains (net payload 4250 tonnes). Reference train payloads have been adjusted by ARTC to reduce from theoretically efficient trains for planning purposes. Train numbers reflect the maximum across all line sections. Totals may not sum due to rounding.

Source: ARTC, 2015.

7.9. Demand sensitivity analysis

As shown in Table 7.7, a range of demand sensitivity tests have been performed to understand the impact of changes in key variables and assumptions on the demand volumes relative to the core Inland Rail scenario including the Western Line upgrade to enable 1010 metre coal trains. An alternative core scenario has also been presented assuming no Western Line upgrades and 650 metre coal trains, reducing coal volumes from 19.5 million tonnes to 9 million tonnes from 2024-25. The proportional impact on demand is expected to be similar under both scenarios, with the assumed cap of 87 coal train paths becomes binding at lower volumes as a result of 650 metre coal trains.

Results are also presented for sensitivity tests encompassing a package of upside and downside scenarios occurring concurrently.

The following demand sensitivities resulted in increased demand on Inland Rail, with percentages reflecting the estimated change in Melbourne to Brisbane, intercapital and total freight volumes respectively in 2049–50:

- **High price elasticity (+41%, +39%, +11%)** – Doubles the demand responsiveness to the lower rail access price provided by Inland Rail.
- **Road pricing (+9%, +8%, +2%)** – Increases the costs of road freight relative to rail.
- **High GDP growth (+8%, +8%, +2%)** – Increases the size of the total freight task.
- **High oil price (+8%, +8%, +2%)** – Increases above rail operating costs, but by less than the increase in road operating costs where fuel comprises a larger proportion of total operating costs
- **Package of upside scenarios: high price elasticity, road pricing and a high coal price (49%, 48%, 13%)** – Doubles the demand responsiveness to the lower rail access price provided by Inland Rail, increases the costs of road freight relative to rail, and improves the profitability of some coal mines, but with capacity constraints through metro Brisbane restricting the realisation of additional coal exports.

The following demand sensitivities resulted in decreased demand on Inland Rail:

- **Revenue maximising rail access price for intercapital freight (-71%, -55%,-16%)** – Significantly reduces operating cost savings with Inland Rail.
- **B-triple access (-35%, -32%,-9%)** – Reduces the price competitiveness of Inland Rail relative to road.
- **Low price elasticity (-27%, -25%, -7%)** – Halves the demand responsiveness to the lower rail access price provided by Inland Rail.
- **Road pricing and B-triple access (-25%, -22%, -6%)** – The estimated increase in road user charges does not compensate for the efficiency gains from using super B-doubles between Melbourne and Brisbane.
- **Low GDP growth (-8%, -8%, -2%)** – Decreases the size of the total market.
- **High Inland Rail coal access price (0%, 0%, -20%)** – Higher coal transport costs reduce the number of coal mines that are likely to produce at the assumed long term world coal price (US$75 per tonne).
- **Low oil price (-9%, -8%, -2%)** – This decreases above rail operating costs, but by less than the decrease in road operating costs where fuel comprises a larger proportion of total operating costs.
- **Low coal price (0%, 0%, -39%)** – Reduces the profitability and viability for coal mines to produce, with some mines becoming unviable and thus reducing coal demand.

- **Package of downside scenarios: low price elasticity, B-triple access and a low coal price (-42%, -40%, -50%)** – Halves the demand responsiveness to the lower rail access price provided by Inland Rail, reduces the price competitiveness of Inland Rail relative to road and reduces the profitability and viability for coal mines to produce.

The greatest impact on demand would occur if the Inland Rail access price was set to maximise revenue rather than maximise volumes. However, as noted in Section 7.4, there are a number of mechanisms to ensure prices are set at volume maximising levels if the Australian Government decides to do this.

The following demand sensitivities are not expected to have a significant impact on demand on Inland Rail:

- **Decreased Inland Rail access price (+5%, +5%, +1%)** – Reduces magnitude of operating cost savings with Inland Rail. Access prices represent approximately 17 per cent of total linehaul costs and approximately 12 per cent of door-to-door costs. A 20 per cent drop in these leads to approximately a 2.5 per cent decrease in the linehaul price of Inland Rail.
- **Increased Inland Rail access price (-5%,-3%, -1%)** – Reduces magnitude of operating cost savings with Inland Rail.
- **High coal price (0%, 0%,0%)** – Has no additional coal demand. A high coal price typically improves the viability of coal mines which increases coal demand. In this instance, coal demand is constrained by Inland Rail's ability to run more efficient trains and the number of train paths that can run through the metro network, thus remain constant relative to the core demand. Should there be additional capacity available there is potentially 36 per cent more coal available for export when supported by a price of AU$95 per tonne.

Table 7.7 Demand sensitivity analysis: Forecast Inland Rail combined north and southbound intermodal volumes (thousand tonnes)

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
1. Core scenario: Requires capital investment in additional loops on the Western Line or additional loops and Brisbane metropolitan rail network (at Murrarie and Clapham Yard) to enable coal train lengths to increase from 650 metres to 1010 metres.	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	24 283	32 361	35 523	39 507	0%
2. Demand price elasticity†						
2a. High price elasticity: Assumes a negative four per cent price elasticity which is double the core appraisal elasticity and benchmarked against the upper bound of the price elasticity range reported by 2008–09 survey respondents.	M-B only	4448	5679	8071	11 119	+41%
	Intercapital freight (M-B, B-P and B-A)*	6322	7955	11 275	15 485	+39%
	Total	25 972	34 584	38 729	43 858	+11%
2b. Low price elasticity: Assumes a negative one per cent price elasticity which is half of the core appraisal elasticity and benchmarked against the lower bound of the price elasticity range reported by 2008–09 survey respondents.	M-B only	2540	3082	4247	5752	-27%
	Intercapital freight (M-B, B-P and B-A)*	3738	4505	6202	8349	-25%
	Total	23 388	31 134	33 656	36 722	-7%

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
3. Alternative rail access prices‡						
3a. Increased Inland Rail access price: Rail access price assumed to increase by 20 per cent per tonne between Illabo to Kagaru.	M-B only	3007	3790	5382	7531	-5%
	Intercapital freight (M-B, B-P and B-A)*	4443	5505	7761	10 752	-3%
	Total	24 093	32 135	35 214	39 103	-1.0%
3b. Decreased Inland Rail access price: Rail access price assumed to decrease by 20 per cent per tonne between Illabo to Kagaru.	M-B only	3384	4229	5971	8283	+5%
	Intercapital freight (M-B, B-P and B-A)*	4889	6031	8470	11 649	+5%
	Total	24 539	32 660	35 924	40 022	+1.0%
3c. Revenue maximising rail access price for intercapital freight: Revenue maximising rail access price is the access price at which Inland Rail obtains the maximum revenue, which was estimated to be 202 per cent of the core access price.	M-B only	247	499	1016	2331	-71%
	Intercapital freight (M-B, B-P and B-A)*	1379	1876	2949	4956	-55%
	Total	21 029	28 506	30 403	33 330	-16%

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
3d. High Inland Rail coal access price ($14 per thousand gross tonne kilometres): Inland Rail access charge assumed to be $14 per gross tonne kilometre consistent with the QCA's October 2014 draft determination for the Western System- decreasing coal volumes to 11.5 million tonnes. [111]	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	22 883	24 361	27 523	31 507	-20%
3e. High Inland Rail coal access price ($19 per thousand gross tonne kilometres): Inland Rail access charge assumed to be $19 per gross tonne kilometre, consistent with QR's May 2015 submission to the QCA - decreasing coal volumes to 11.5 million tonnes.[112]	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	22 883	24 361	27 523	31 507	-20%
4. Alternative road pricing and access arrangements						
4a. Road pricing based on depreciated optimised replacement cost (DORC) values: Tests impact on Inland Rail if road applies a DORC pricing approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).[113]	M-B only	3572	4437	6236	8587	+9%
	Intercapital freight (M-B, B-P and B-A)*	5128	6292	8801	12 029	+8%
	Total	24 778	32 922	34 472	36 255	+2%

111 QCA, 'Queensland Rail's 2013 Draft Access Undertaking', October 2013.

112 Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May 2015.

113 Increasing Melbourne to Brisbane road user costs by 169 per cent (an estimate of the depreciated optimised user costs of B-doubles and higher productivity vehicles) leads to higher prices for road freight and improved volumes in the base case and with Inland Rail. Under these assumptions, in 2049–50 Inland Rail's total volumes will increase by two per cent and the volume of non-bulk goods between Melbourne and Brisbane will increase by eight per cent.

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
4b. B-triple access: As the core appraisal assumes B-triple access will not be possible between Melbourne and Brisbane, it considers the impact of B-triples on the Hume, Pacific or Newell Highway corridors on Inland Rail demand along with no change in the road pricing approach.[114]	M-B only	2095	2622	3683	5167	-35%
	Intercapital freight (M-B, B-P and B-A)*	3117	3869	5448	7587	-32%
	Total	22 767	30 498	32 902	35 961	-9%
4c. Road pricing based on DORC values and B-triples access: Considers the impact of B-triples on the Hume, Newell or Pacific Highway corridors on Inland Rail demand along with applying a DORC value approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).	M-B only	2440	3039	4259	5932	-25%
	Intercapital freight (M-B, B-P and B-A)*	3647	4486	6270	8641	-22%
	Total	23 297	31 116	33 724	37 015	-6%

[114] B-triples can transport almost 50 per cent more mass than B-doubles, and super B-doubles would allow a prime mover to pull four twenty-foot equivalent units (TEUs) provided that axle limits are not exceeded. These two vehicle configurations significantly improve road freight cost efficiency for mass or volume constrained freight. It is assumed that approximately half of all movements are on these trucks, with a 38 per cent operating cost saving compared to articulated trucks (but that they must travel via the Hume, Newell or Pacific Highway corridors imposing an additional two per cent distance).

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
5. Change in coal price[§]						
5a. High coal price: Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and no change in Inland Rail coal access charge ($5 per thousand gross tonne kilometres).	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	24 283	32 361	35 523	39 507	0%
5b. High coal price ($US95 per tonne) and high Inland Rail coal access charge ($14 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $14 per gross tonne kilometres consistent with the QCA's October 2014 draft determination for the Western System – resulting in coal volumes remaining at 19.5 million tonnes.	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	24 283	32 361	35 523	39 507	0%
5c.High coal price ($US95 per tonne) and high Inland Rail coal access charge ($19 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $19 per gross tonne kilometres Inland , consistent with QR's May 2015 submission to the QCA – resulting in coal volumes remaining at 19.5 million tonnes.[115]	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	24 283	32 361	35 523	39 507	0%

115 Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May 2015.

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
5d. Low coal price: This scenario assumes a lower coal price of US$55 per tonne and no change in Inland Rail coal access charge ($9 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 4 million tonnes.	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	15 383	16 861	20 023	24 007	-39%
5e. Low coal price, low Inland Rail coal access charge: This scenario assumes a lower coal price of US$55 per tonne and a 20 per cent reduction in Inland Rail coal access charge ($7 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 6 million tonnes.	M-B only	3195	4008	5674	7906	0%
	Intercapital freight (M-B, B-P and B-A)*	4633	5732	8069	11 133	0%
	Total	17 383	18 861	22 023	26 007	-34%
6. Change in GDP growth[ll]						
6a. High GDP growth: This scenario assumes that 2013–14 will see 2.8 per cent growth in real GDP followed by 2.7 per cent growth in 2014–15 and 3.3 per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with trend at 3.2 per cent per annum.	M-B only	3277	4156	6015	8563	+8%
	Intercapital freight (M-B, B-P and B-A)*	4751	5944	8553	12 059	+8%
	Total	24 401	32 574	36 007	40 433	+2%

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
6b. Low GDP growth: This scenario assumes that 2013–14 will see 2.7 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and 2.8 per cent in 2015–16. After this period ACIL Allen has assumed that long-run real growth is in line with the projections of Treasury's Intergenerational Report (less 0.6 percentage points).	M-B only	3108	3851	5323	7242	-8%
	Intercapital freight (M-B, B-P and B-A)*	4506	5508	7569	10 199	-8%
	Total	24 156	32 137	35 023	38 572	-2%
7. Change in long term oil price						
7a.High oil price: This scenario assumes an oil price of $US200 per barrel ($2015) by 2030.	M-B only	3354	4335	6181	8541	+8%
	Intercapital freight (M-B, B-P, B-A)*	4848	6163	8734	11 972	+8%
	Total	24 498	32 793	36 188	40 345	+2%
7b. Low oil price: This scenario assumes an oil price of $US 50 per barrel ($2015) by 2030.	M-B only	3003	3666	5158	7221	-9%
	Intercapital freight (M-B, B-P and B-A)*	4364	5267	7380	10 231	-8%
	Total	24 014	31 896	34 834	38 605	-2%

DEMAND SCENARIOS		2024–25	2029–30	2039–40	2049–50	% CHANGE FROM CORE (2049-50)
8. Upside and downside scenarios						
8a.Package of upside scenarios: This scenario assumes high price elasticity, road pricing based on depreciated optimised replacement cost (DORC) values and a high coal price ($US95 per tonne)	M-B only	5083	6284	8749	11763	49%
	Intercapital freight (M-B, B-P and B-A)*	7172	8792	12 232	16 431	48%
	Total	26 822	35 202	39 466	44 584	13%
8b.Package of downside scenarios: This scenario assumes low price elasticity, B-triple access on the Hume, Pacific or Newell Highway corridors and a low coal price ($US55 per tonne)	M-B only	2077	2495	3394	4557	-42%
	Intercapital freight (M-B, B-P and B-A)*	3060	3664	5003	6708	-40%
	Total	13 810	14 793	16 957	19 582	-50%

* Relates to Melbourne to Brisbane, Adelaide to Brisbane and Perth to Brisbane intercapital freight.

† The core demand assumes a price elasticity of two per cent.

‡ The core demand assumes an access price of approximately $17 per tonne for Melbourne to Brisbane intercapital freight in real 2024–25 prices. Intercapital rail access price makes up 15.8 per cent of total door-to-door price in the core demand. Coal access charges are assumed to be $5 per thousand gross tonne kilometres on Inland Rail between Oakie and Acacia Ridge and $14 per thousand gross tonne kilometres on the Western Line and Brisbane metropolitan network. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

§ The core demand assumes a US$75 per tonne Newcastle benchmark coal price. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

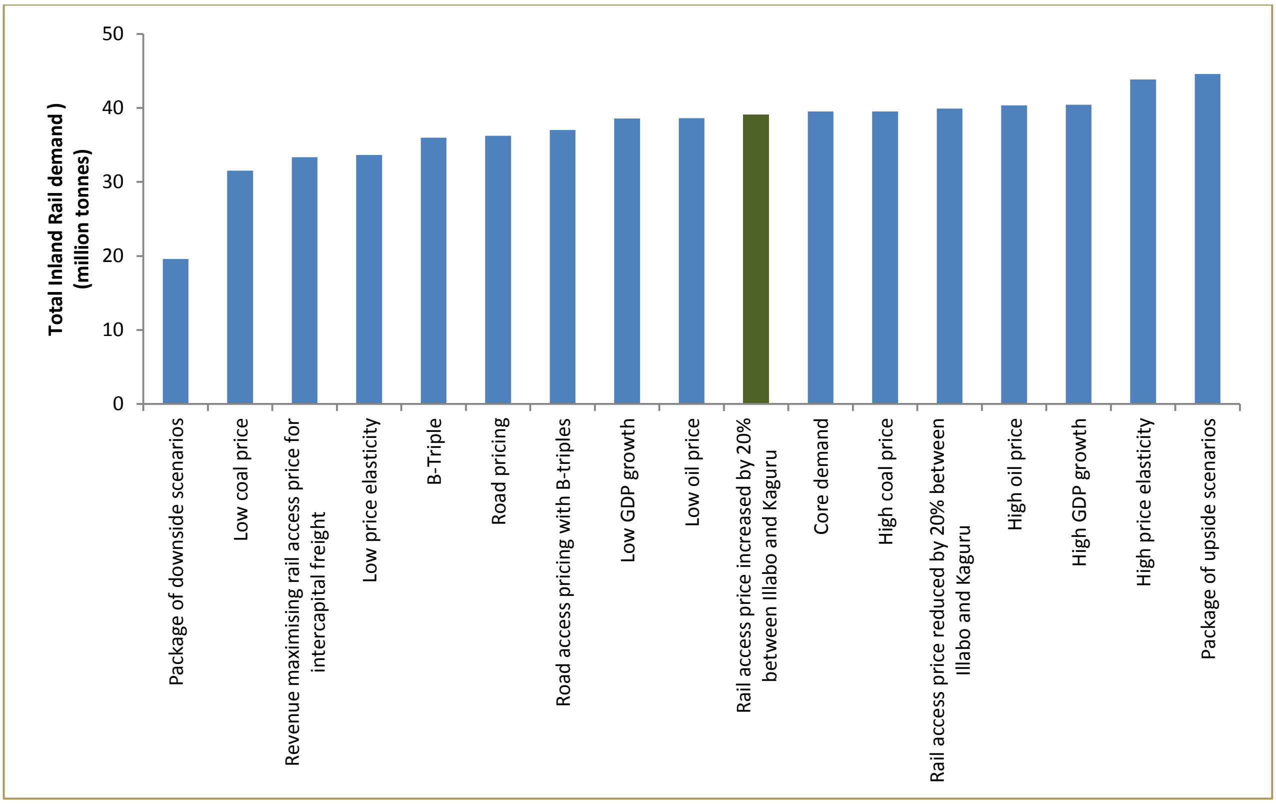
‖ The core demand assumes that 2013–14 will see 2.75 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and three per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with the projections of the Treasury's Intergenerational Report (Source: Department of Treasury and Finance, 2010). The core demand assumes a long term oil price of $US130 per barrel ($2015).

Source: ACIL Allen, 2015.

The following figures compare the intercapital and total Inland Rail demand across the different demand sensitivities in 2049–50. Total freight demand on Inland Rail is relatively insensitive to the changes in demand analysed, with all sensitivities generating total demand within 16 per cent of the core, as shown in Figure 7.7.

Total demand on Inland Rail is most sensitive to high price elasticity, which increases demand, and low coal price which reduces demand, and least sensitive to changes in high coal price.

Figure 7.7 Total demand for Inland Rail in FY 2049–50 (million tonnes per annum)

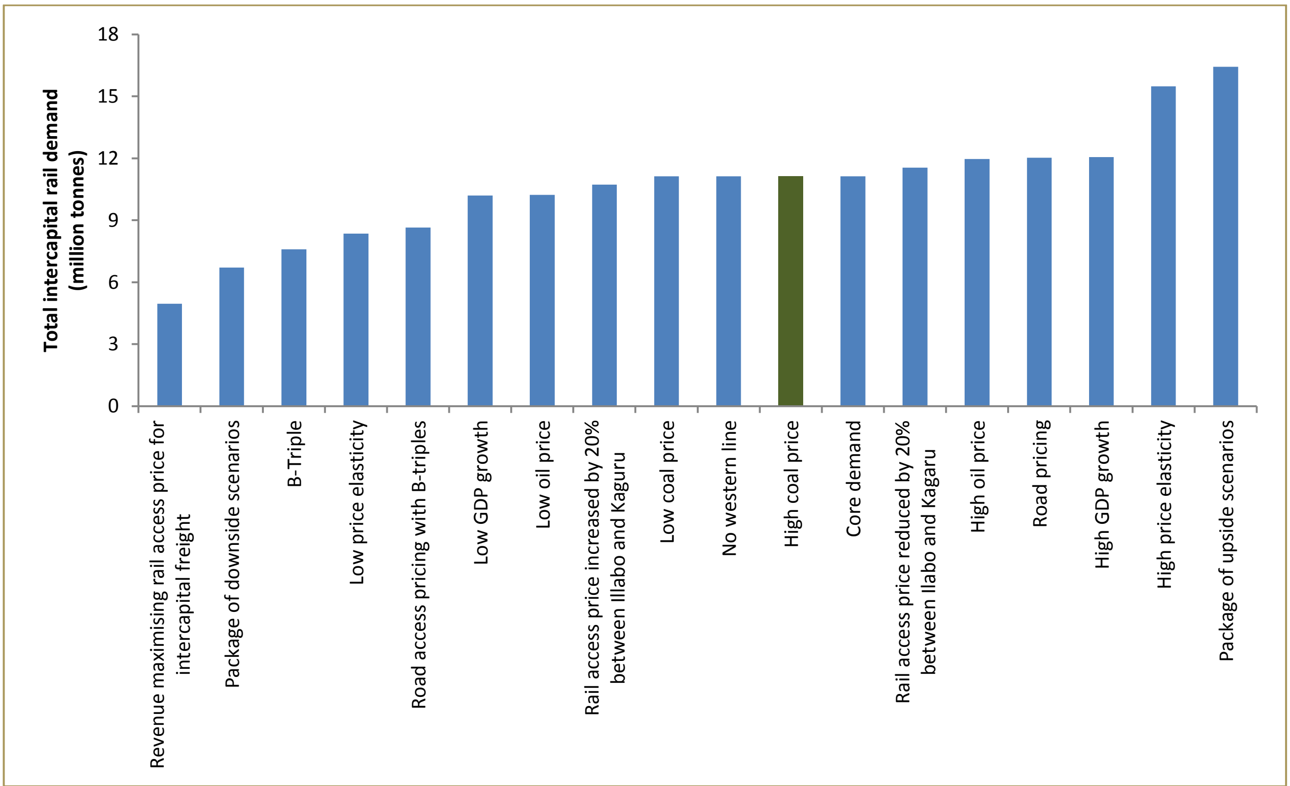


Source: ACIL Allen, 2015.

Intercapital freight (Melbourne to Brisbane, Brisbane to Perth and Brisbane to Adelaide) can be relatively sensitive to changes in key demand assumptions, with demand increasing by as high as +39 per cent relative to the core as shown in Figure 7.8.

Intercapital freight demand on Inland Rail is most sensitive to high price elasticity, which increases demand, and revenue maximising access price which reduces demand, and is least sensitive to changes in coal price.

Figure 7.8 Intercapital demand for Inland Rail in FY 2049–50 (million tonnes per annum)



Source: ACIL Allen, 2015.

Table 7.8 and Table 7.9 present the combined impacts of various scenarios that would change demand on Inland Rail relative to the core scenario, noting that the impact of changes in capital costs are also included for consistency with the sensitivity testing of packages of upside and downside scenarios presented in the economic and financial analyses.

Table 7.8 presents the independent and combined impacts of various scenarios that would lower demand on Inland Rail relative to the core scenario (the package of downside scenarios).

Table 7.8 Incremental and combined impacts on demand in the package of downside scenarios

Scenario		% CHANGE FROM CORE (2049-50)			CUMULATIVE % CHANGE FROM CORE (2049-50)		
		M-B	Intercapital freight (M-B, B-P and B-A)*	Total	M-B	Intercapital freight (M-B, B-P and B-A)*	Total
1	5d: The coal price collapses	0%	0%	-39%	0%	0%	-39%
2	2b: Lower prices have a less than expected effect on non-bulk demand	-27%	-25%	-7%	-27%	-25%	-46%
3	4b: Trucking is more competitive than expected	-35%	-32%	-9%	-42%	-40%	-50%
4	9c: Construction costs are greater than expected*	0%	0%	0%	-42%	-40%	-50%

Note: *Assumes 30 per cent increase in capital costs. Included for consistency with the economic and financial analyses.

Source: ACIL Allen, 2015.

Table 7.9 presents the independent and combined impacts of various scenarios that would lower improve the level of demand on Inland Rail relative to the core scenario (the package of upside scenarios).

Table 7.9 Incremental and combined impacts on demand in the package of upside scenarios

Scenario		% CHANGE FROM CORE (2049-50)			CUMULATIVE % CHANGE FROM CORE		
		M-B	Intercapital freight (M-B, B-P and B-A)*	Total	M-B	Intercapital freight (M-B, B-P and B-A)*	Total
1	5a: The coal price is higher than expected	0%	0%	0%	0%	0%	0%
2	2a: Lower prices have a greater than expected effect on non-bulk demand	41%	39%	11%	41%	39%	11%
3	4a: Trucking is less competitive than expected	9%	8%	2%	49%	48%	13%
4	9d: Construction costs are less than expected*	0%	0%	0%	49%	48%	13%

Note: *Assumes 30 per cent decrease in capital costs. Included for consistency with the economic and financial analyses.

Source: ACIL Allen, 2015.

7.10. Summary

The key underlying drivers of the demand analysis results are underlying economic growth, measured by GDP, for intercapital and agricultural demand, and the world coal price for coal demand. In addition, a number of assumptions influence the forecast level of demand attracted to Inland Rail, namely:

- Road investment along the corridor will continue on an incremental basis.
- B-triple access will not be provided along the entire route (Melbourne to Brisbane).
- The current approach to road user charging will continue.

Demand analysis indicates that Inland Rail is expected to increase rail's share of the Melbourne to Brisbane intercapital freight market by 36 percentage points from the current 26 per cent to 62 per cent by 2049-50. Similarly, Inland Rail would increase rail freight's share of the Adelaide to Brisbane market by 28 percentage points and Brisbane to Perth's share by seven percentage points.

Better connections to the Port of Brisbane would see a shift of freight from road of two million tonnes by 2049–50, particularly grain and cotton from New England, as well as grain on both rail and road from the Darling Downs to the Port of Brisbane. A significant tonnage of grain in New South Wales (approximately 7.5 million tonnes, spread across many railway segments) would also use Inland Rail on its way to New South Wales ports.

Analysis also indicates Inland Rail would attract induced freight such as coal in the Surat and Clarence-Moreton Basins, which would increase from the current 8 million tonnes to 19.5 million tonnes, inducing additional intercapital freight volumes which would otherwise be facing unviable transport costs.[116]

[116] ACIL Allen, 2015.

Chapter 8
Costs

8. COSTS

8.1. Purpose of this chapter

The purpose of this chapter is to outline the quantitative impact of the scope, property, technical and operational requirements of Inland Rail outlined in the preceding chapters in terms of cost estimates for constructing, operating and maintaining Inland Rail.

The quantification of risks is included in this chapter whereas identification and treatment of risks is covered in Chapter 13 (Risks).

8.2. Cost assumptions

In developing the current cost estimates supporting the business case a number of assumptions have been made. This section summarises the key assumptions, including:

- The current scope for infrastructure enables 15 years of operations without additional investment through to design year 2039–40.
- Without detailed design, the costs have been developed against ARTC's and other benchmark projects with an appropriate risk allowance for this stage of the lifecycle.
- Allowance has been made for approvals and other environmental factors, however changes or conditions may alter the cost estimate.
- The scope of Inland Rail is approximately 1700 kilometres and includes the preferred Queensland Government alignment between Gowrie and Kagaru including five tunnels.
- Costs associated with the ATMS have been included.
- A range of materials (i.e. sleepers, rail and ballast) are assumed to leverage existing supply arrangements of ARTC providing better value for money for Inland Rail.
- Rollingstock and operational costs are the responsibility of users of the network and these costs are not part of this assessment.
- Further technical assessments including ground conditions, property requirements and design are required to refine and develop the cost estimate.

8.3. Approach to cost development

Based on the service offering and specifications defined for Inland Rail an estimate of the costs has been developed to understand the whole of life impacts from a financial perspective and to inform the economic analysis of the Programme. Costs have been developed as follows:

- Capital costs which provide an overview of the costs associated with delivering the infrastructure within the 10 year programme from Illabo to Kagaru.[117]
- Operating costs which have been developed based on assumed demand and comprise of costs associated with both below rail operating and maintenance costs. Rollingstock operations and maintenance costs are not included as part of Inland Rail costs.

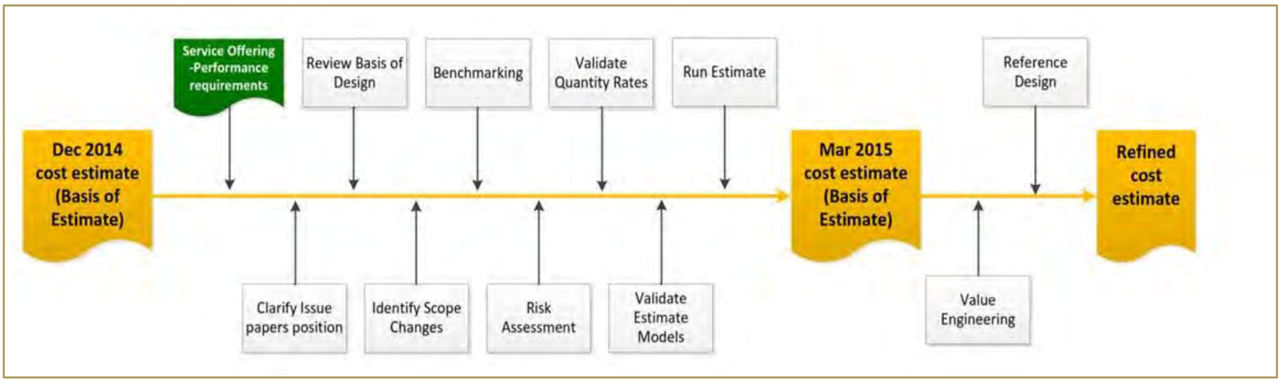
[117] Additional costs are included as part of the economic and financial appraisal of Inland Rail and are discussed in Chapters 9 and 10.

8.4. Capital costs

8.4.1. Approach to capital cost estimates

The ARTC Inland Rail Basis of Estimate Report (June 2015) outlines the process adopted to develop the capital cost estimates, which is summarised in Figure 8.1.

Figure 8.1 Process to deliver capital cost estimates



Source: ARTC, 2015.

A team of internal and external independent experts reviewed the estimate in detail, with a focus on the high cost areas and allowances, and identified changes to improve the estimate, leveraging ARTC's recent experience. The Basis of Estimate Report was developed by ARTC drawing on inputs provided by an extensive list of industry subject matter experts.[118]

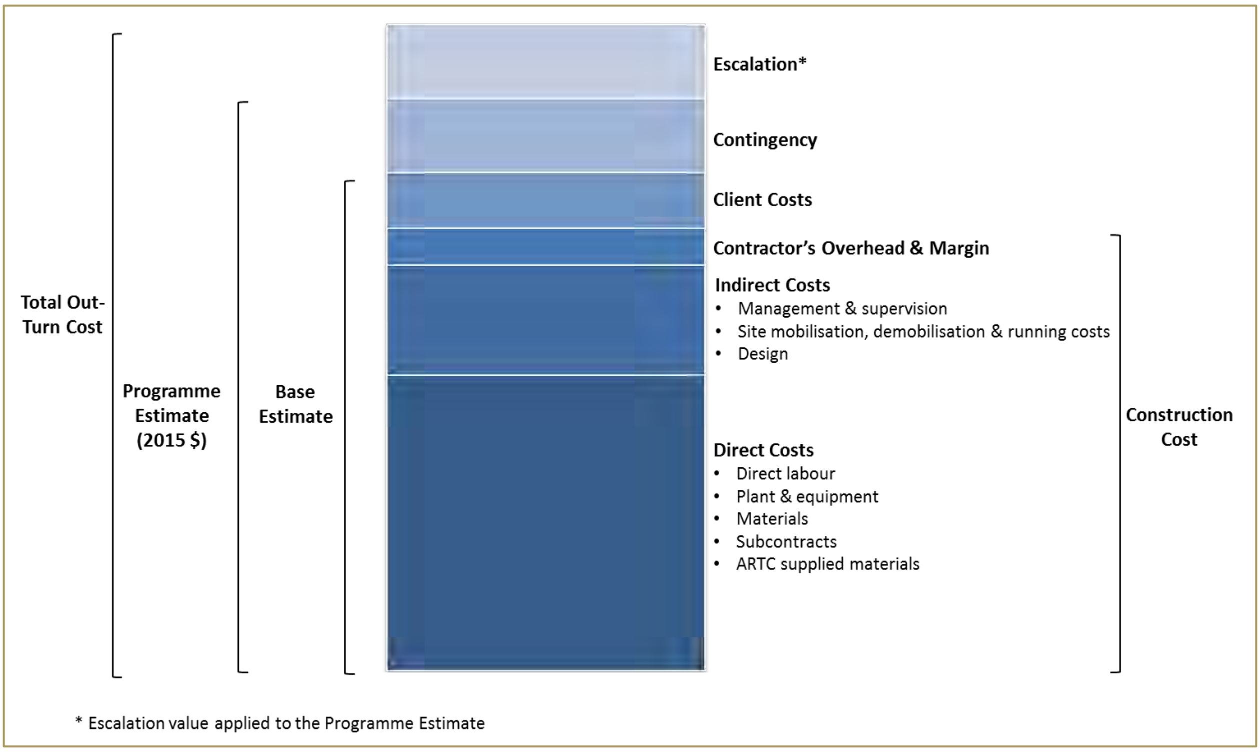
In parallel, further investigation and design work was undertaken to improve the understanding of the scope and provide greater confidence in the estimate and the risks. Specific teams were assigned to high cost areas including the construction and development projects, Parkes to Narromine, Narrabri to North Star and the tunnel sections in Gowrie to Kagaru.

In developing the capital cost estimate over 50 verification and refinement tasks were undertaken to provide a robust cost estimate to inform the business case. Refinement of the cost estimate has been possible as further investigation and design work has been completed on key sections of Inland Rail.

Capital cost estimates have been developed in line with relevant government guidelines. The structure of capital costs are outlined in Figure 8.2.

[118] Experts include PB, Aquenta, Arup, GHD, SLR and Coffey.

Figure 8.2 Structure of Inland Rail capital cost estimates



Source: ARTC, 2015.

8.5. Programme capital cost estimate summary

The capital cost estimate comprises a range of elements. This section provides an overview of key elements and a summary of the capital costs (excluding risk and escalation). All costs reported in this chapter as being identified as 'real' are real in 2014 dollars (i.e. escalation is first applied to costs in July 2015).

Direct costs

Direct costs are related to the scope of Inland Rail and include items required for delivery and construction. They include (real):

- Environmental and heritage ($80 million).
- Fencing and earthworks ($448 million).
- Formation and roadworks ($389 million).
- Tunnels and tunnel services ($485 million).
- Structures ($996 million).
- Track works, loops and crossings ($679 million).
- Delivery works, incidentals and utilities ($146 million).
- Supply of track, sleepers and turnouts ($695 million).

Indirect costs

- Site overheads ($695 million).
- Design ($285 million).
- Contractor's overhead and profit ($435 million).

Client costs

- Management and associated costs ($851 million).

Other provisions

- Construction camps ($87 million).
- ATMS ($132 million).
- Property acquisition costs ($481 million).
- Insurances, noise mitigation and costs to date ($41 million).

Property acquisition costs

Property acquisition requirements have been assessed and estimated by ARTC. Further detail on property acquisition requirements is outlined in Chapter 12 (Property acquisition).

Cashflow and escalation

The cashflow to deliver the Programme over a 10 year period for both P50 and P90, is provided in Table 8.1.
The escalation rate applied to the cashflow is 2.5 per cent for the first five years of the Programme, and 2.75 per cent for subsequent years.

Table 8.1 Total Programme cost ($million, undiscounted)

ITEM	P50 COST ESTIMATE ($ MILLION)	P90 COST ESTIMATE ($ MILLION)
Direct costs	3919	-
Indirect costs	1415	-
Client costs	851	-
Base estimate	**6185**	-
Other Provisions*	260	-
Property acquisition costs	481	-
Total (real) base cost†	**6926**	-
Contingency	1811	2490
Escalation component[119]	1152	1241
Total out turn cost (nominal)	**9889**	**10 657**

Source: ARTC, 2015.

* Other provisions include construction camps, ATMS, noise mitigation, insurances.

† Reported costs include new formation and structures to enable 30 tonnes per axle load at 80 kilometres per hour at a later point in time if required and passing loop spacing and construction to enable 3600 metre trains.

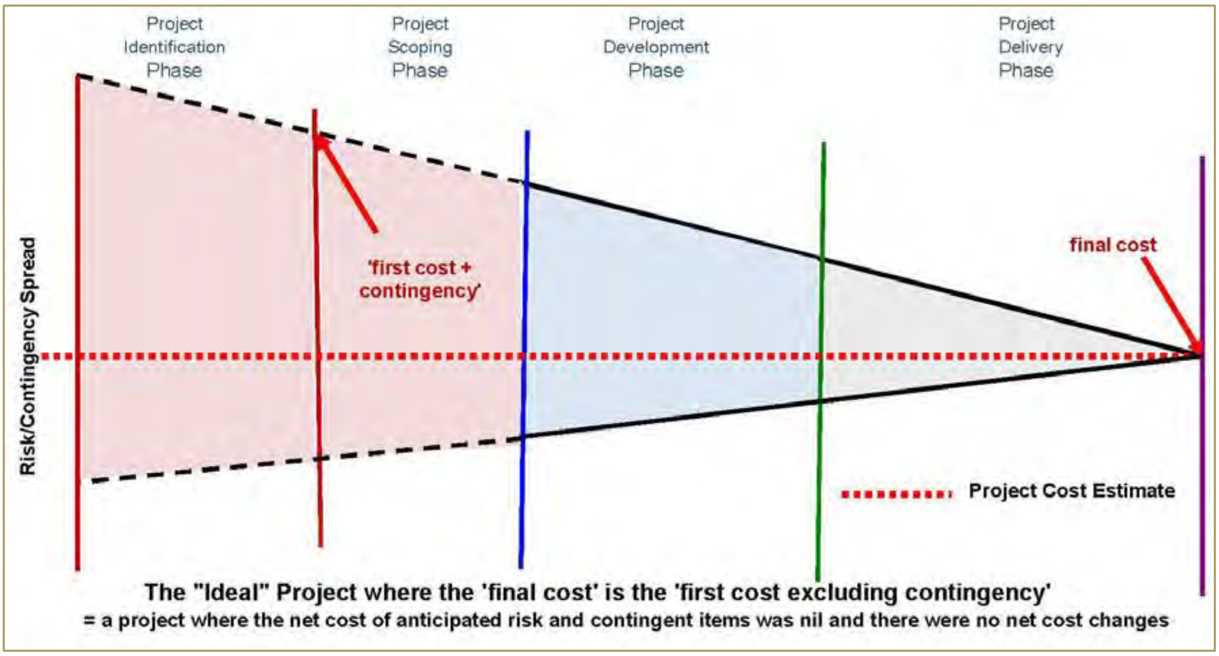
[119] The escalation rate applied for the Inland Rail Programme cost estimate will be 2.5% for the first five years, and 2.75% for subsequent years. The escalation rate applied is based on a report titled *Inland Rail Escalation Report final 03062015* prepared by Turner and Townsend for the Department of Infrastructure and Regional Development.

Risk contingency

A qualitative and quantitative risk assessment process was followed to determine the P50 and P90 contingency allowance to be included in the cost estimate. This process included identifying the inherent and contingent risks present within the individual cost elements.

The Australian Government's cost estimation standard outlines that risk and range estimates become more precise for most projects as they move through their phases, from project identification through project scoping, to development and delivery.[120] The cost estimates developed for Inland Rail are considered at the project scoping phase, with a risk and range allowance that reflects this point. As the Programme's definition improves, this allowance is expected to reduce as represented in Figure 8.3.

Figure 8.3 Representation of risk/contingency allowance across the project lifecycle for an ideal project (cost estimation standard)



Source: ARTC, 2015.

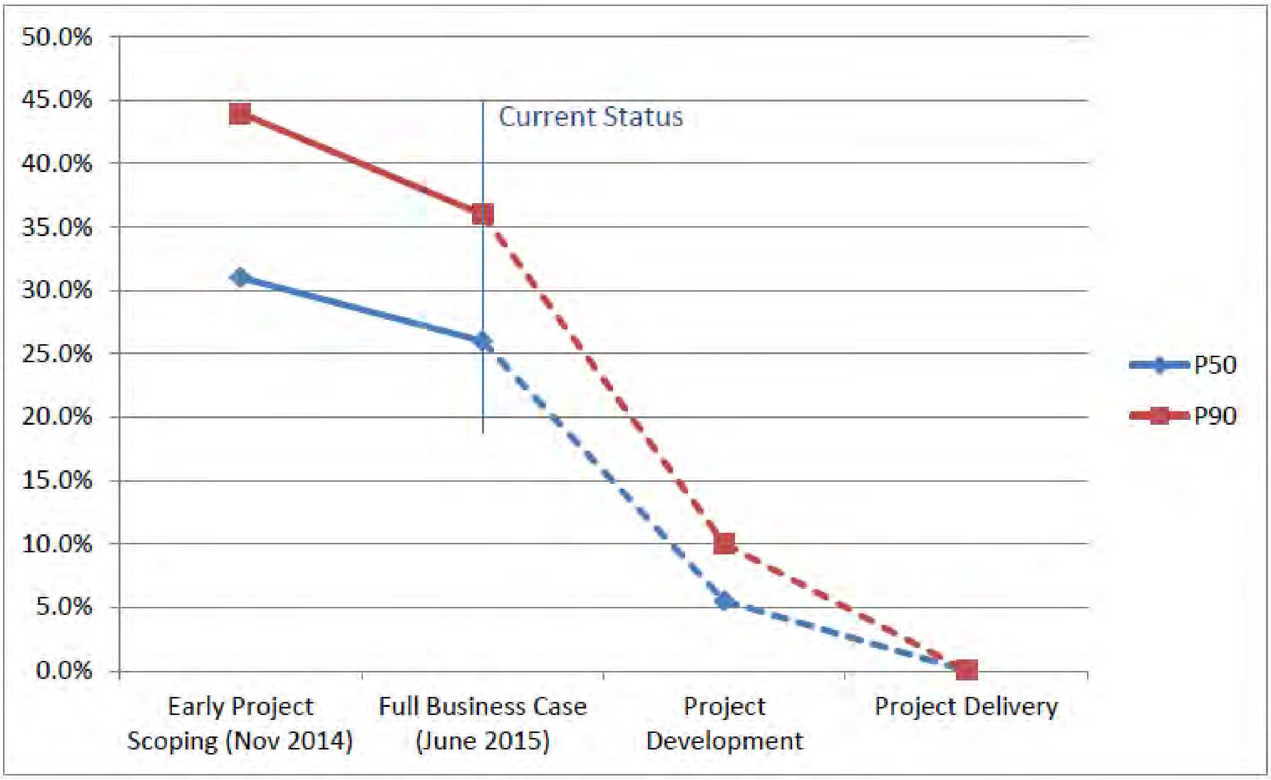
The Australian Government's cost estimation standard also provided indicative ranges for P50 and P90 risk and range figures at project scoping, development and delivery phases, as shown in Figure 8.4.

The current risk and range for the Programme have been calculated to be:

- P50 – 26 per cent.
- P90 – 36 per cent.

[120] Best Practice Cost Estimation Standard for Publicly Funded Rail and road Construction, Australian Department of Infrastructure and Transport, 2011.

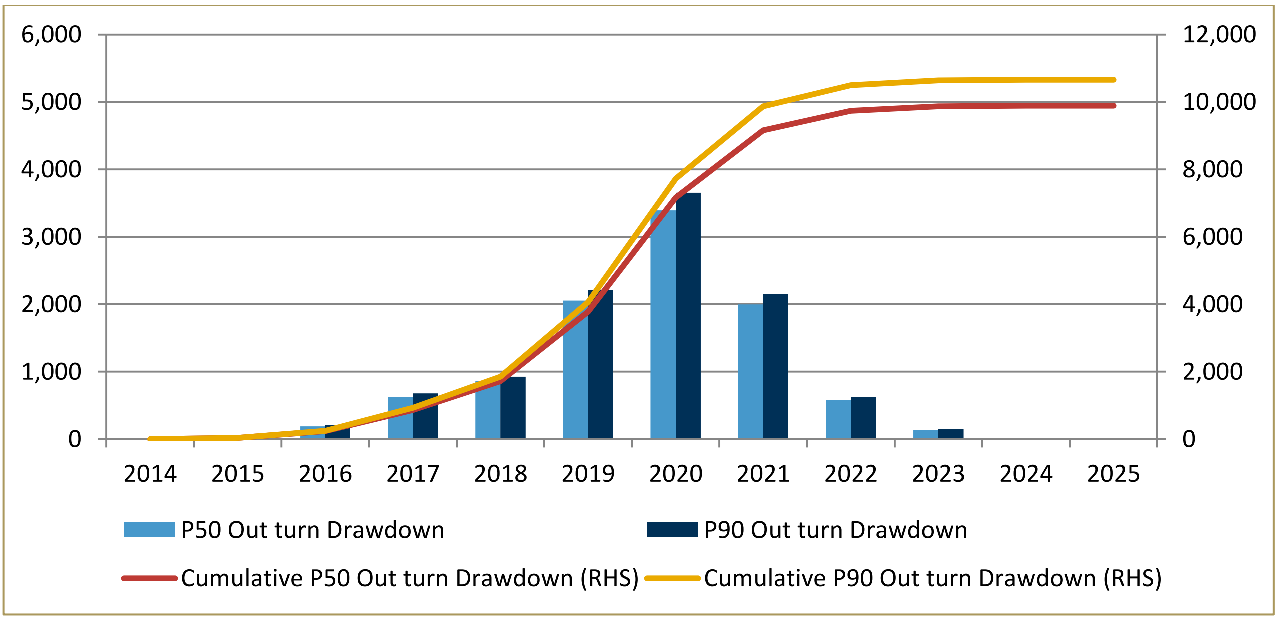
Figure 8.4 Current and projected P50 and P90 allowances for the Programme (based on likely ranges defined in the cost estimation standard)



Source: ARTC, 2015.

A summary of the annual construction costs over the 10 year programme is outlined in Figure 8.5.

Figure 8.5 Annual out turn construction costs over the 10 year programme ($ millions, nominal, undiscounted)



Source: PwC Analysis of ARTC inputs, 2015.

8.6. Interdependent and related investments

In addition to Inland Rail capital costs for the 10 year programme, capital costs have also been estimated for interdependent and related investments not expected to occur in the absence of Inland Rail and beyond the 10 year programme, including:

- **Loops for 3600 metre trains:** Additional loop costs of $431 million (strategic, $2014-15, excluding escalation and undiscounted) in 2038-39 to enable intercapital train lengths to increase from 1800 metres to 3600 metres.
- **Capacity for future Inland Rail volumes:** Additional loops to accommodate future volumes on Inland Rail based on ARTC train modelling: Additional loops (44 x 4 km) in 2064-65 estimated by ARTC to cost $924 million (strategic, $2014-15, excluding escalation and undiscounted); duplication of the long tunnel beneath Toowoomba in 2074-75 estimated by ARTC to cost $400 million (strategic, $2014-15, excluding escalation and undiscounted); and duplication of Inland Rail track between Kagaru and Acacia Ridge in 2084-85 estimated to cost $60 million (strategic, $2014-15, excluding escalation and undiscounted).[121]
- **Western Line and Brisbane metropolitan network upgrades ('Western Line Upgrade'):** Additional loops to enable coal train lengths to increase from 650 metres to 1010 metres between Miles to Oakey and Acacia Ridge to the Port of Brisbane: Western Line loop extensions (3) estimated to cost $24 million (strategic, $2014-15, excluding escalation and undiscounted); passing loop extension at Murarrie estimated to cost $10 million (strategic, $2014-15, excluding escalation and undiscounted); and passing loop at Clapham estimated to cost $20 million (strategic, $2014-15, excluding escalation and undiscounted). These investments are on track operated by third parties and funding for loop extensions on the Western Line and Brisbane metropolitan network still needs to be resolved. In practice, funding of these enabling investments would be negotiated between the Inland Rail owner/operator and other network operators on the Western Line and Brisbane metropolitan network, recognising that Inland Rail is expected to deliver a significant increase in both capacity and volume.

  It is also estimated that a total of $65 million (strategic, $2014-15, excluding escalation and undiscounted) would be required in each of 2022-23, 2027-28, 2032-33 and 2037-38 respectively for replacement of timber underbridges and sleepers on the Western Line. Although it is anticipated that this expenditure would be required in the absence of Inland Rail (i.e. it is related to the age/condition of the assets rather than volumes), the additional coal volumes with Inland Rail may bring forward the timing of this expenditure. The economic appraisal conservatively assumes that all replacement of timber underbridges and sleepers would be required in 2022-23 upon opening of Inland Rail. This has no impact on the incremental costs with Inland Rail, but the reduced discounting from bringing forward the timing of this expenditure is estimated to have a present value impact of $45 million ($2014-15, excluding escalation, four per cent discount rate).

There are also a number of interdependent and related investments which are assumed to be delivered by the market or other parties, reflecting a more advanced stage of development (e.g. the investment is currently being investigated by the Government) or that investment would likely take place without Inland Rail. Costs for the following interdependent and related investments have not been included in the economic appraisal (which similarly excludes all benefits of these investments not directly attributable to Inland Rail):

- Regional terminals and loading facilities for regional/agricultural/coal freight.
- Rollingstock delivering longer/heavier trains.

[121] Costs for duplication of the long tunnel beneath Toowoomba and duplication of Inland Track between Kagaru and Acacia Ridge are expected to be incurred beyond the economic appraisal period of 2014-15 to 2073-74, and have therefore been included in the residual value, calculated as the future stream of net benefits.

- Double-stack terminal capacity in Melbourne and Brisbane with an ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Port capacity expansion in Melbourne and Brisbane.

8.7. Below rail operating and maintenance costs

Operating costs

Operating costs for below rail costs have been calculated from first principles. The below rail operating costs were commissioned by ARTC and prepared by Lycopodium Rail based on rates provided by ARTC. Operating costs include the following cost items:

- **Operations planning:** Operations management and administration along with train planning positions. Typically the organisational structure includes positions from operations manager to train transit manager.
- **Train control:** Network controllers, along with employees to cover the shifts for 24 hour operation.
- **Transit management:** The operational costs of the Network Control Centres.
- **Power supply:** Operating costs for power supply, including supply to locations, depots and active level crossings.
- **Management overheard**: Operating costs relating to operating Inland Rail that are not identified with any particular cost unit.

The costs have been developed from a first principles assessment considering the asset base, geographical layout and applying current ARTC business principles. All assumptions and methodologies are outlined in the Inland Rail Basis of Estimate Report, June 2015. Based on the detailed analysis, the operating costs per kilometre per million gross tonnes (MGT) scenario are shown in Table 8.2.

Table 8.2 Operating costs per kilometre per million gross tonne scenario

$'000 Real per KM	10 MGT	20 MGT	30 MGT	40 MGT	50 MGT	60 MGT	70 MGT	80 MGT	90 MGT	100 MGT
Operating costs per km	4.39	4.39	5.38	5.38	5.51	5.51	6.49	6.69	7.15	7.26
Asset management and overhead per km	1.31	1.31	1.51	1.51	1.78	1.78	1.91	2.11	2.22	2.32

Source: ARTC, 2015.

All operating costs are presented in real terms and are escalated for the purposes of the financial analysis (Chapter 10) at 2.5 per cent per annum, representing the mid point of the Reserve Bank of Australia's target range of two to three per cent.

Maintenance

Maintenance costs are calculated based on a first principles approach. The scope for activities has been determined based on the relevant standards in relation to compliance type activities such as inspections and a maintenance and capital upgrade philosophy in relation to Major Periodic Maintenance (MPM) and capital activities. As the scope for individual activities varies significantly year to year the following approach to scope generation has been applied:

- Utilise ARTC standards to determine scope for inspections and other routine corrective and reactive maintenance (RCRM) activities driven by standards.
- For MPM activities review current and previous ARTC Asset Management strategies as well as the strategies of alternate network owners and approximate a steady state scope for the activity per line segment. Lycopodium have considered applicable benchmarks in calculating an appropriate scope based on sustaining the asset in line with ARTC standards. Typical activities where scope has been approximated based on maintaining the asset against the ARTC standards include tamping, ballasting and turnout maintenance. Frequencies are applied against a strategy of sustaining the asset at tonnages allowing for predicted growth.
- It is assumed that Inland Rail will not require re-sleepering or renewal of upgraded bridges within the planning horizon of 50 years.

Maintenance costs are a function of:

- Mandatory activities such as inspection or scheduled maintenance.
- Reactive corrective maintenance which is driven by tonnage and asset condition and configuration.
- Tonnage driven preventative maintenance which is intended to sustain the asset and extend asset life.

The detailed analysis assessed all the above activities and their frequencies against ARTC standards and industry practice for the proposed asset base of Inland Rail. The below rail first principles estimate has been developed within a previously benchmarked and calibrated maintenance model produced by Lycopodium Rail as reported in the Inland Rail Basis of Estimate Report, June 2015.

A simplification of the detailed cost model with summarised unit rates is provided in Table 8.3.

Table 8.3 Detailed cost model with summarised unit rates

$'000 REAL PER KM	10 MGT	20 MGT	30 MGT	40 MGT	50 MGT	60 MGT	70 MGT	80 MGT	90 MGT	100 MGT
Major periodic maintenance	11.84	19.08	26.32	33.56	40.85	48.59	56.02	66.10	73.75	81.41
Reactive maintenance	8.00	10.33	12.65	14.98	17.34	20.46	22.96	26.81	29.38	31.95

Source: ARTC, 2015.

All maintenance costs are presented in real terms and are escalated for the purposes of the financial analysis (Chapter 10) at 2.5 per cent per annum, representing the mid point of the Reserve Bank of Australia's target range of two to three per cent.

8.8. Above rail (train) operating costs

Below rail operating and maintenance costs tend to be managed and incurred by the track operator, and relate to ongoing costs for the inland railway itself. Above rail costs are those incurred by the train operators using Inland Rail. The potential for Inland Rail to offer lower above rail costs for train operators, which then flows to freight customers and end consumers, is a significant driver of the assumed demand on Inland Rail. These costs form the most significant economic benefits measured in the cost benefit analysis and provide an indication of the scale of potential track access charges, therefore also being a key driver of financial viability.

Train operating costs have been estimated by PwC based on costs parameters and reference train data provided by PB, ACIL Allen and ARTC. The train operating costs have been developed and consider the key technical characteristics required of Inland Rail, including:

- Intercapital trains: 1800 metre initial maximum intercapital train length with future proofing for ultimate 3600 metre length.
- Agricultural trains: Current 650 metre initial agricultural train length, increasing to a maximum of 900 metres as agricultural demand increases.
- Coal trains: Current 650 metre coal train length increasing to a maximum coal train length of 1010 metres for coal mines located west of Oakey.

Costs have been estimated for reference trains for container, agricultural and coal freight. The following cost items have been included:

- Train crew cost: Comprises driver costs, accommodation cost and meal allowances. These costs were estimated by PB based on driver costs per hour, accommodation and meal allowances, applying transit time to estimate crew requirements.
- Fuel cost: Estimated based on forecasts for fuel price (provided by ACIL Allen) and estimated fuel consumption adjusted for gradient and locomotive efficiency (estimated by ARTC). Fuel consumption is made up of a fixed component relating to the fuel consumption of locomotives that increases as distance increases, and variable component relating to consumption driven by the train trailing load.
- Rollingstock maintenance cost: Relates to costs to maintain locomotives and wagons as estimated by PB.
- Annual depreciation and return on economic capital: Estimated based on the capital cost and asset lives of locomotives and wagons developed by ARTC, to which PwC applied a rate of return. The annual depreciation and return on economic capital is distributed by the number of trips travelled per annum to estimate the annual depreciation and return on economic capital per trip and per net tonne kilometre.
- Overhead and administration: Estimated as a proportion of the total cost of other above rail cost items provided by PB.

Based on the approach and assumptions discussed above, Table 8.4 presents average above rail operating cost by cost items for existing rail, road and Inland Rail.

Table 8.4 Inland Rail train and truck operating cost estimates (2024–25, $2014–15 per net tonne kilometres)

COST ITEM	MELBOURNE TO BRISBANE CONTAINER FREIGHT			AGRICULTURAL FREIGHT*			COAL†	
	Road	**Coastal route**	**Inland rail**	**Existing road**	**Existing rail**	**Inland rail**	**Existing rail**	**Inland rail**
Rail operating cost items								
Train crew cost	-	0.0037	0.0017	-	0.0067	0.0061	0.0048	0.0024
Fuel cost	-	0.0138	0.0118	-	0.0176	0.0176	0.0174	0.0157
Rolling stock maintenance cost	-	0.0038	0.0028	-	0.0055	0.0055	0.0061	0.0033
Annual depreciation and return on economic capital	-	0.0019	0.0012	-	0.0017	0.0017	0.0015	0.0011
Overhead and administration	-	0.0009	0.0007	-	0.0013	0.0012	0.0012	0.0009
Total	**-**	**0.0242**	**0.0183**	**-**	**0.0329**	**0.0322**	**0.0309**	**0.0234**
Road operating cost items								
Driver cost	0.018		-	0.018		-	-	-
Vehicle operating cost	0.066		-	0.066		-	-	-
Total	**0.084**		-	**0.084**		-	-	-

Note: Perth and Adelaide freight from Brisbane is expected to experience significant train operating cost savings as they are able to travel directly to Parkes as opposed to via Sydney or Melbourne in the first instance, and saving approximately 500 kilometres of their existing rail journey; road costs are estimated based on equivalent tonnes to Inland Rail.

* As operating cost varies by origin and destinations, operating cost for Moree to Cootamundra has been used to demonstrate differences in operating cost across road, existing rail and Inland Rail.

† As operating cost varies by origin and destinations, operating cost for one particular mine has been used to demonstrate the difference in operating cost between existing rail and Inland Rail.

Source: PwC analysis based on PB and ARTC inputs.

8.9. Inland Rail in context

Inland Rail represents a significant and complex program of staged investment and works across three east coast states. The overall size, cost and complexity is comparable with a number of other large and complex infrastructure programs in Australia as shown in Table 8.5.

Given the step change Inland Rail will provide for the Australian freight task and the nation-wide benefits it will deliver, the cost, whilst significant, is commensurate with other major projects.

Table 8.5 Comparative major projects to Inland Rail

PROJECT	DESCRIPTION	PROJECTED COST	DELIVERY TIMEFRAME	APPROX COST/KM
The Hume Highway duplication between Melbourne and Sydney[122]	Approximately 810 km duplication of road between Melbourne and Sydney. Staged approach to delivery across a complex program.	$15–$20 billion ($2013).	Over 50 years	$24.6m/km
Pacific Highway	Completion of a minimum standard four-lane divided highway between Sydney and Brisbane. Staged approach to delivery across a complex program.	$15 billion ($2010 dollars).[123]	1996 - 2020[124]	$23m/km
Westconnex[125]	A total of 33 km including a widening of the M4 east of Parramatta, a duplication of the M5 East and new sections of motorway to provide a connection between the two key corridors.	$14.5 billion.	2015 - 2023	$439m/km
Sydney Metro Northwest[126]	Sydney Metro Northwest will be the first fully-automated metro rail system in Australia. It is scheduled to open to customers in the first half of 2019. It will deliver eight new railway stations and 4000 commuter car parking spaces. The project will include 15 km of twin tunnels from Epping to Bella Vista.	$8.3 billion	Mid 2014 – Mid 2019	$277m/km

[122] Engineers Australia, 'Hume Highway duplication complete', 28 June, available at: http://www.engineersaustralia.org.au/news/hume-highway-duplication-complete, 2013.

[123] NSW Government, Pacific Highway Upgrade Submission to Infrastructure Australia, November 2011 (considering the $7.8 billion estimated cost of sections yet to be completed and Figure 3 indication of past expenditure 2006–2014).

[124] Roads and Maritime Services, TfNSW, http://www.rms.nsw.gov.au/projects/key-build-program/pacific-highway/index.html, 2015.

[125] Roads and Maritime Services, TfNSW, http://www.westconnex.com.au/about/index.html, 2015.

[126] NSW Department of Transport, Sydney Metro Northwest, http://nwrail.transport.nsw.gov.au/The-Project/Project-Overview.

PROJECT	DESCRIPTION	PROJECTED COST	DELIVERY TIMEFRAME	APPROX COST/KM
The Toowoomba Second Range Crossing (TSRC)[127]	The TSRC is a bypass route to the north of Toowoomba, approximately 41 km in length, running from the Warrego Highway at Helidon in the east to the Gore Highway at Athol in the west via Charlton.	$1.6 billion	Late 2015 to late 2018	$39m/km
The Warrego Highway Upgrade: Toowoomba to Miles[128]	The 714 km Warrego Highway is Queensland's principal east-west route, connecting people and freight from Toowoomba to Brisbane and southern Queensland. Staged approach to delivery across a complex program.	$635 million (nominal)	20 years	$889 000/km
Bruce Highway (Cooroy to Curra)[129]	This involves upgrades 1700 km[130] to the Bruce Highway between Brisbane and Cairns, and is among Queensland's highest priority projects.	$8.5 billion[131]	10 years	$5m/km

Source: PwC, 2015.

8.10. Summary

A thorough process was undertaken to develop the capital cost estimate including:

- Identification of quantities and rates applicable to the current scope.
- Incorporation of applicable provisions for key items and property.
- Inclusion of risk allowance and escalation.

The current capital cost estimate at the P50 and P90 confidence levels is shown in Table 8.6.

127 QLD Treasury, QLD Government, https://www.treasury.qld.gov.au/projects-infrastructure/projects/toowoomba-second-range-crossing/index.php, 2015.

128 QLD Government, 'Warrego is go!', available at: https://www.qld.gov.au/transport/projects/warrego/, 2015.

129 DTMR, QLD Government, http://www.tmr.qld.gov.au/Projects/Name/B/Bruce-Highway-Cooroy-to-Curra.aspx, 2015.

130 Government News, http://www.governmentnews.com.au/2014/03/queensland-applauds-abbotts-6-7-bn-bruce-highway/, 2014.

131 ABC, http://www.abc.net.au/news/2013-07-17/abbott-promises-to-fix-queenslands-bruce-highway/4825422, 2013.

Table 8.6 Capital cost estimate (P50 and P90)

ITEM	P50 COST ESTIMATE ($ MILLION)	P90 COST ESTIMATE ($ MILLION)
Base costs (Real)	6926	6926
Contingency (Real)	1811	2490
Escalation component	1152	1241
Total out turn cost (Nominal)	**9889**	**10 657**

Source: ARTC, 2015

Current below rail operating and maintenance costs for Inland Rail are shown in Table 8.7.

Table 8.7 Below rail operating and maintenance costs

ITEM	At 10 MGT ($'000 PER KM)	At 100 MGT ($'000 PER KM)
Operations (Real)	5.70	9.58
Reactive Maintenance (Real)	8.00	31.95
Major Periodic Maintenance (Real)	11.84	81.41

Note: Costs for rollingstock are not included within the scope of this assessment.

Source: ARTC, 2015.

Chapter 9
Economic analysis

9. ECONOMIC ANALYSIS

9.1. Purpose of this chapter

The purpose of the economic analysis is to compare the benefits and costs of Inland Rail to the community as a whole, against a future scenario where Inland Rail does not exist. This provides an evidence base to decision makers to inform whether the net benefits of Inland Rail are likely to exceed net costs over the life of the Programme.

PwC undertook the economic analysis for Inland Rail, which involved application of a CBA framework which quantifies the direct costs and benefits attributable to Inland Rail. An economic impact assessment has also been undertaken using computable general equilibrium (CGE) modelling to estimate the impacts of Inland Rail as they flow on and multiply throughout the regional, state and national economies.

9.2. The base case

The economic analysis compares a scenario where there is Inland Rail to a 'without Inland Rail' base case. This is undertaken to establish the net economic benefits to the community that could be expected from the railway. In the base case, it is assumed that there is no Inland Rail and freight is transported by road (the Newell, Hume or Pacific Highways, or regional roads) and existing rail lines (the coastal route via Sydney, or branch and regional lines), and that a continuation of existing incremental spend patterns occurs. It is a 'do minimum' base case and assumes currently committed and funded investments and no change to current policies (e.g. road user charging, a price or tax on carbon and no B-triple access on the Hume, Newell or Pacific Highway corridors).

9.3. Economic costs

Capital costs for the Inland Rail 10 year programme are estimated to be $9.9 billion (P50, nominal, undiscounted) and $10.7 billion (P90, nominal undiscounted) based on the ARTC Inland Rail Basis of Estimate Report (June, 2015) which considers cost estimates developed by ARTC, PB and Aquenta. The following adjustments have been made to P50 costs for inclusion in the economic analysis (noting that P90 costs are included as a sensitivity test):[132]

- Exclusion of escalation of $1.1 billion (nominal, undiscounted).
- Addition of related costs of $1.4 billion (strategic, $2014-15, excluding escalation and undiscounted) not expected to occur in the absence of Inland Rail and beyond the 10 year programme, including:
  - **Loops for 3600 metre trains:** Additional loop costs of $431 million (strategic, $2014-15, excluding escalation and undiscounted) in 2038-39 to enable intercapital train lengths to increase from 1800 metres to 3600 metres.
  - **Capacity for future Inland Rail volumes:** Additional loops to accommodate future volumes on Inland Rail based on ARTC train modelling: Additional loops (44 x 4 km) in 2064-65 estimated by ARTC to cost $924 million (strategic, $2014-15, excluding escalation and undiscounted); duplication of the long tunnel beneath Toowoomba in 2074-75 estimated by ARTC to cost $400 million (strategic, $2014-15, excluding escalation and undiscounted); and duplication of Inland Rail track between Kagaru and Acacia Ridge in 2084-85 estimated to cost $60 million (strategic, $2014-15, excluding escalation and undiscounted).[133]
  - **Western Line and Brisbane metropolitan network upgrades ('Western Line Upgrade'):** Additional loops to enable coal train lengths to increase from 650 metres to 1010 metres between Miles to Oakey and Acacia

[132] ARTC, 2015.

[133] Costs for duplication of the long tunnel beneath Toowoomba and duplication of Inland Track between Kagaru and Acacia Ridge are expected to be incurred beyond the economic appraisal period of 2014-15 to 2073-74, and have therefore been included in the residual value, calculated as the future stream of net benefits.

Ridge to the Port of Brisbane: Western Line loop extensions (3) estimated to cost $24 million (strategic, $2014-15, excluding escalation and undiscounted); passing loop extension at Murarrie estimated to cost $10 million (strategic, $2014-15, excluding escalation and undiscounted); and passing loop at Clapham estimated to cost $20 million (strategic, $2014-15, excluding escalation and undiscounted). An alternative core scenario has also been presented excluding this Western Line Upgrade and restricting coal train lengths to 650 metres.

It is estimated that $65 million (strategic, $2014-15, excluding escalation and undiscounted) would be required in each of 2022-23, 2027-28, 2032-33 and 2037-38 respectively for replacement of timber underbridges and sleepers on the Western Line. Although it is anticipated that this expenditure would be required in the absence of Inland Rail (i.e. it is related to the age/condition of the assets rather than volumes), the additional coal volumes with Inland Rail may bring forward the timing of this expenditure. The economic appraisal conservatively assumes that all replacement of timber underbridges and sleepers would be required in 2022-23 upon opening of Inland Rail. This has no impact on the incremental costs with Inland Rail, but the reduced discounting from bringing forward the timing of this expenditure is estimated to have a present value impact of $45 million ($2014-15, excluding escalation, four per cent discount rate).

The treatment of costs for interdependent and related investments in the economic appraisal is outlined in Figure 9.1. In contrast with the economic appraisal, which takes into account all resource costs regardless of how they are funded/financed, the financial assessment presented in Chapter 10 (Financial analysis) is undertaken from the perspective of the Inland Rail track owner/operator. This means that costs and revenues on third party track, such as the Western Line and Brisbane metropolitan network, are excluded from the financial assessment.

Figure 9.1 Costs for interdependent and related investments in the economic appraisal

The economic appraisal includes direct Inland Rail capital costs associated with construction of the 10 year programme, additional loops in 2038-39 to accommodate 3600 metre trains and additional capacity (loops, track duplication and tunnels) to accommodate future growth in Inland Rail freight volumes post 2064-65.

The core economic appraisal scenario includes costs for loop extensions on the Western Line and Brisbane metropolitan network (Clapham and Murarrie) to enable coal train lengths to increase from 650 metres to 1010 metres. These costs are incurred on track owned by third parties but they are not currently funded/committed and have therefore been included as a resource cost in the economic appraisal. These investments are on track operated by third parties and funding for loop extensions on the Western Line and Brisbane metropolitan network still needs to be resolved. Future funding of these enabling investments that would deliver significant increase in capacity and volume are yet to be determined. An alternative core scenario has also been presented excluding this Western Line Upgrade and restricting coal train lengths to 650 metres.

There are also a number of interdependent and related investments which are assumed to be delivered by the market or other parties, reflecting a more advanced stage of development (e.g. the investment is currently being investigated by the Government) or that investment would likely take place without Inland Rail. Costs for the following interdependent and related investments have not been included in the economic appraisal (which similarly excludes all benefits of these investments not directly attributable to Inland Rail):

- Regional terminals and loading facilities for regional/agricultural/coal freight.
- Rollingstock investment delivering longer trains.
- Double-stack terminal capacity in Melbourne and Brisbane with an ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Port capacity in Melbourne and Brisbane.

Source: PwC, 2015.

Below rail operating costs (operations planning, train control, transit maintenance and power supply) and below rail maintenance costs (routine corrective and reactive maintenance and major period maintenance) have been estimated by applying unit costs developed by Lycopodium Rail (by track section and million gross tonnes excluding escalation) to ARTC estimates of gross tonnes by track section based on ACIL Allen demand forecasts. These have been offset by base case operating and maintenance costs on existing track sections taking in to account differences in demand and track so that costs are incremental.

Below rail maintenance costs include annualised estimates of MPM so replacement capital costs have not been included in the economic analysis.

Avoided costs have been included in the cost benefit analysis as a benefit.

9.4. Economic benefits

The direct benefits of Inland Rail captured and measured in the cost benefit analysis (including a description of the benefit drivers and identification of the key beneficiaries) are set out in Table 9.1 which include:

- Improved productivity and economic efficiency as a result of operating cost savings, shorter transit times, improved reliability, improved availability, avoided incidents on the coastal route and an additional north–south rail option to avoid incidents.
- Improved customer outcomes for rail passengers in Sydney and Brisbane because unused freight paths on the coastal route are returned to passenger services, and the increased frequency of services reduces average wait time.
- Safety benefits for the community as a result of removing heavy vehicles from the road network, reducing the distance travelled for rail freight and separating freight and passenger rail.
- Sustainability benefits for the community from removing heavy vehicles off the road network and reducing the distance travelled for rail freight resulting in reduced road traffic congestion, fewer emissions of carbon/pollution and less noise.
- Reduced lifecycle costs for infrastructure owners/operators on the coastal route and road network as a result of lower freight volumes which reduce maintenance costs and enable investments in capacity to be avoided or deferred.

Table 9.1 Benefits captured and measured in the cost benefit analysis

BENEFIT TYPE	BENEFIT DRIVER	BENEFITS QUANTIFIED
Improved productivity and economic efficiency	• Intercapital and agricultural freight currently travelling by road would benefit from reduced operating costs as a result of economies of scale in rail relative to road transport. • Coastal rail freight would benefit from reduced rail transport costs as a result of higher axle loads, longer trains, lower gradients, longer curves, shorter transit times and avoided incidents and flooding. Freight customers would also be willing to pay for improved reliability and availability* with Inland Rail. • Coal freight in the Surat and Clarence-Morton Basins would benefit from reduced above rail operating costs as a result of higher axle loads east of Oakey (20 tonne axle load compared to the current 15.75), longer trains (1010 metre compared to the current 650 metre) a more direct alignment in tunnel across the Toowoomba Range that avoids the current crossing where operating speeds are constrained by high gradients and tight curves on a winding track. • These benefits would induce additional freight volumes that would not have occurred in the absence of Inland Rail.	Freight user benefits: • Operating cost savings. • Value of freight time.** • Improved reliability. • Improved availability. • Redundancy and resilience to incidents.*** • Induced freight benefits.
Improved customer outcomes for rail passengers	• Unused freight paths would be returned to passengers in Sydney and Brisbane during off peak periods (noting that passengers are already given absolute priority in peak periods). • Increased frequency of services would reduce the average wait time.	Passenger benefits: • Reduced average wait time.
Improved safety for the community	• Enhanced road safety from removing heavy vehicles off the road network. • Reduced rail accidents from reducing the distance travelled.	Community benefits: • Reduced rail and road accidents.

BENEFIT TYPE	BENEFIT DRIVER	BENEFITS QUANTIFIED
Improved sustainability for the community	• Reduced road congestion as a result of removing heavy vehicles off the road network. • Reduced environmental costs as a result of removing heavy vehicles off the road network and reducing the rail distances travelled.	Community benefits: • Reduced road congestion. • Reduced environmental costs and improved residential amenity.
Reduced lifecycle costs for infrastructure owners/operators	• Lower volumes on the coastal route and Newell and Pacific Highway reduces ongoing operating and maintenance costs. • Lower volumes on the coastal route will enable $170 million of future investments in capacity on the Sydney freight network (passing loops, track duplication and turnbacks) to be avoided, and $76 million to be deferred.	Infrastructure cost savings.

* Reliability is defined as the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised. Availability is defined as the percentage of services available with departure and arrive times that are convenient for customers, which relates to cut-off and transit times. Most freight customers want departures during the day or early evening.

** In addition to the labour cost savings associated with faster transit times (captured in the operating cost savings benefit), there is also a value placed on time sensitive freight arriving at the destination earlier.

*** An additional north–south rail connection for freight means that freight can avoid being delayed by transferring to an alternative rail line following flooding or a major incident.

Source: PwC analysis based on ACIL Allen inputs, 2015.

There are also a number of broader economic impacts that may flow from the Inland Rail Programme that are considered separately from a cost benefit analysis framework. These include:

- Lower prices for consumers as a result of lower intercapital freight transport costs (predominantly manufactured goods), which reduces the cost of living for households.
- Economic growth (i.e. Australian GDP, and GSP, as increased profits and incomes are multiplied throughout the economy as a result of:
    - Increased freight productivity: reduces distribution costs and increases profits for industries where intercapital freight is an input or output.
    - Improved mine to port accessibility: reduces transport costs and increases profits for existing mines and agricultural producers, and results in additional exports that would not otherwise have been viable.
    - Local sourcing of resources: increases demand for Australian labour and materials for construction and ongoing operations for Inland Rail.
- Creation of economic activity and jobs associated with construction and ongoing operation of Inland Rail in Queensland, New South Wales and Victoria.
- Support for regional community development as a result of locally sourced resources for construction and operation of Inland Rail.
- Enhanced competition between rail and road freight by providing a credible alternative, which will drive further innovation and efficiency.
- Development of freight precincts around Inland Rail terminals as a result of benefits from co-location and clustering of industries (e.g. as a result of reduced road transport costs to warehousing, economies of scale and knowledge sharing opportunities). Regional business development is a catalyst for new intermodal transport hubs being developed in regional areas.

Any benefits associated with terminals have not been captured in the economic appraisal as intermodal terminals are outside of the scope of the Inland Rail Programme. For this reason wider economic benefits (WEBs) have not been captured in the economic appraisal as they may be linked to intermodal terminals:

WEBs from Inland Rail, as currently defined by Infrastructure Australia, are likely to be relatively minor. If terminal precincts and/or improved passenger services on the Sydney metropolitan rail network are incorporated into the scope, Inland Rail may offer a range of WEBs. These may include the following:

- Agglomeration economies due to industrial uses clustering in a precinct surrounding the new terminal.
- Labour market deepening if the industrial uses bring employment close to workers, thereby reducing commuting costs.
- Increased output in imperfectly competitive markets caused by the clustering of industrial uses reducing business time.

9.5. Approach to cost benefit analysis

A conventional economic CBA methodology has been applied to provide an assessment of the costs and benefits of Inland Rail that can be valued in monetary terms taken from the perspective of the community as a whole. It also includes an assessment of externalities, such as environmental impacts and accident cost savings. The CBA helps to establish the overall economic merit of a potential future investment in Inland Rail.

The nature of the Inland Rail Programme is such that the economic impacts are broad and long term, and not easily measured. The Programme is also a critical enabler for complementary investments in land use and supply chains that leverage the enhanced logistics capabilities of Inland Rail. These benefits are also not easily identified or measured as they will in practice evolve and change over time with changes in a complex domestic economy.

To establish a rigorous economic assessment of measurable benefits, the CBA has focused on direct user benefits in core markets, such as the intercapital/intermodal market, and relevant externality impacts that arise from a mode shift to rail. However in recognition of the broad and long term nature of the Programme, a four per cent discount rate has been adopted in preference to a more conventional seven per cent discount rate, although both have been included for comparative purposes. A lower discount rate of four per cent is consistent with international practice for large scale long lived infrastructure projects, as it allows benefits accrued later in the assets life to be captured. A 50 year appraisal period has also been applied, consistent with ATC guidance.

The costs consist of the capital and labour resources used to build and maintain Inland Rail. The CBA defines and measures the key benefits of Inland Rail as changes in producer surplus as a result of additional capacity and more efficient rail transport for freight in the Melbourne to Brisbane corridor, improvement in passenger rail journey performance due to a reduction in shared passenger/freight running in Sydney and Brisbane, and reduced externalities from less trucks on the road (e.g. reduced crash, congestion and environmental costs, and improved residential amenity). Key measures developed in this assessment include NPV of costs and benefits, and benefit cost ratios (BCRs).

The economic analysis compares a scenario where there is Inland Rail to a 'without Inland Rail' Base Case. This is undertaken to establish the net economic benefits to the community that could be expected from the railway. The Base Case scenario assumes that rail and road freight would continue using existing infrastructure, that is, existing roads and the coastal railway. The scenarios analysed are outlined further in Chapter 7 (Demand).

The CBA methodology has been prepared considering the following national and state guidance:

- Infrastructure Australia 2014 Reform and Investment Framework.[134]
- ATC 2006 National Guidelines for Transport System Management in Australia.[135]
- Queensland Government Project Assessment Framework Supplementary Guidance Material on Cost Benefit Analysis.[136]
- New South Wales Treasury 2007 Guidelines for Economic Appraisal.[137]
- TfNSW 2013 Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives.[138]
- Victorian Department of Treasury and Finance 2013 Economic Evaluation for Business Cases Technical Guidelines.[139]

As there are no specific guidelines in Australia (or internationally that PwC has identified) that relate to freight rail projects, it is largely the principles of these guidelines that have been applied combined with PwC's experience undertaking cost benefit analysis for the freight sector.

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134 Infrastructure Australia, Reform and Investment Framework, August 2014.

135 ATC, 'National Guidelines for Transport System Management in Australia', Volumes 3 and 4, 2006.

136 Queensland Government, 'Project Assessment Framework – Cost Benefit Analysis, 2015.

137 NSW Treasury, 'NSW Government Guidelines for Economic Appraisal', available at: http://www.treasury.nsw.gov.au/__data/assets/pdf_file/0016/7414/tpp07-5.pdf, 2007.

138 TfNSW, 'Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives, 2013.

139 VIC Department of Treasury and Finance, "Economic Evaluation for Business Cases Technical guidelines', August, available at: http://www.dtf.vic.gov.au/Publications/Investment-planning-and-evaluation-publications/Lifecycle-guidance/Technical-guides-Stage-2-Prove, 2013.

9.6. Cost benefit analysis assumptions

Key assumptions underpinning the CBA include:

- **Appraisal period:** The appraisal period commences in 2014–15 and extends 50 years from the first full year of operation in 2024–25 consistent with the recommendation for rail investments in the ATC 2006 Guidelines for Transport System Management in Australia.[140]
- **Pricing year:** All costs and benefits are measured in real 2014–15 prices, with inputs expressed in earlier pricing years inflated using Australian Bureau of Statistics data on the Australia Consumer and Producer Price Indices.
- **Discount rate:** Future net benefits and costs are discounted to the base year using four and seven per cent discount rates (with sensitivity testing of 10 per cent) consistent with a number of national and state guidelines, but also reflecting the long term nature of the Inland Rail Programme together with a review of the 20 year historical Australian Government bond rates that support application of a four per cent discount rate (Figure 9.2).
- **Residual value:** Reflecting an assumed 100 year economic life for rail assets, the future stream of impacts beyond the 50 year appraisal period has been captured in net terms as a lump sum discounted to the final year of the appraisal.[141] This lump sum is subsequently discounted in line with other costs and benefits to represent the present value. This is identified as one of two approaches to estimating the residual value in the Infrastructure Australia 2014 Reform and Investment framework and the ATC 2006 National Guidelines for Transport System Management.

The CBA draws upon the following inputs:

- Base case and Inland Rail scenario definitions presented in Chapter 7 (Demand).
- Railway and train performance specifications and service offering defined by ARTC and presented in Chapter 5 (Service offering, scope and opportunities).
- Capital and operating cost assumptions developed by PB and Aquenta and presented in Chapter 8 (Cost).
- ARTC development of reference trains and train operating costs presented in Chapter 8 (Cost).
- ACIL Allen demand forecasts as discussed in Chapter 7 (Demand).

[140] ATC, 'National Guidelines for Transport System Management in Australia', Volume 3, p 54., 2006.

[141] ATC, 'National Guidelines for Transport System Management in Australia', Volume 4, p 44, 2005.

Figure 9.2 Economic discount rates

A discount rate is used to translate future cash flows in economic analysis—both costs and benefits—to a common time unit, thereby accounting for:

- Opportunity cost: A benefit or return could be earned from investing funds or applying resources in their next best alternative use or in another project, implying the discount rate must reflect earnings in alternative uses.
- Rate of time preference: People prefer to receive benefits sooner and make payments later due to a number of factors including consumer impatience and expectations of increased real incomes in the future. Therefore, a dollar of benefit in the future is worth less than a dollar of benefit in the present.

In order to establish a rigorous economic assessment of measurable benefits, the economic analysis has focused on direct user benefits in core markets, such as the intercapital/intermodal market, and relevant externality impacts that arise from a mode shift to rail. However, in recognition of the broad and long term nature of the Programme, a four per cent discount rate has been adopted. A seven per cent discount rate has also been included for comparative purposes.

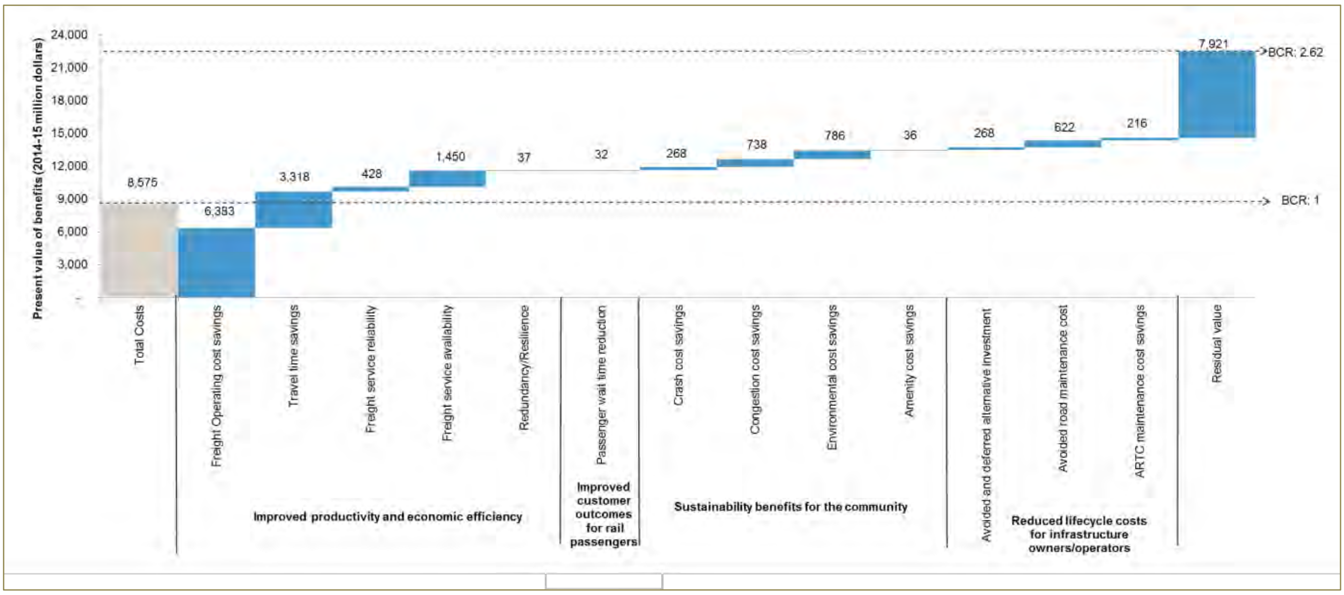
A lower discount rate of four per cent is consistent with international practice for large scale long lived infrastructure projects. A 50 year appraisal period has also been applied, consistent with ATC guidance. Government contributions to the capital costs of the project are being sought, meaning the real Australian Government bond rate is appropriate to reflect the opportunity cost of capital. A review of 20 years of historical Commonwealth bond rates support the application of a four per cent discount rate.

Source: PwC analysis based on, Infrastructure Australia, 'Reform and Investment Framework Templates for Use By Proponents (to be read in conjunction with Infrastructure Australia's Better Infrastructure Decision-Making guidelines: Templates for Stage 7 Solution evaluation (Transport infrastructure), p 7, 2014; NSW Treasury, 'NSW Government Guidelines for Economic Appraisal', p 55, 2007; Victorian Department of Treasury and Finance, 'Economic Evaluation for Business cases-Technical Guidelines', p 25 2013; Queensland Government, 'Project Assessment Framework: Cost Benefit Analysis', 2015; TfNSW, 'North West Rail Link Project Definition Report', p 80, 2011; Independent cost-benefit analysis of broadband and review of regulation Volume II-The cost and benefits of high-speed broadband, p89, 2014; AECOM, 'High Speed Rail Study Phase 2 Report', p xiii, 2014; ATC 'National Guidelines for Transport System Management in Australia', volume 4, p44, 2006.

9.7. Key findings from cost benefit analysis

A comparison of the present value of direct Inland Rail costs and benefits at a four per cent discount rate is presented in Figure 9.3 for the core scenario requiring additional loops on the Western Line and Brisbane metropolitan network (Clapham and Murarrie) to enable coal train lengths to increase from 650 metres to 1010 metres.

Figure 9.3 Comparison of Inland Rail costs and benefits (incremental to the base case, discounted – four per cent, 2014-15 dollars)



Note: Results are presented on an incremental basis to the base case and requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on inputs from ARTC and ACIL Allen, 2015.

The CBA results at four and seven per cent discount rates are presented in Table 9.2 by benefit type, alongside estimates of the economy wide impacts of Inland Rail as these direct costs and benefits flow on and multiply throughout the Australian economy. The same CBA results are presented by beneficiary in Table 9.3.

Key findings of the economic analysis for the Inland Rail scenario including complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres are as follows:

- Inland Rail is estimated to be economically viable at a four per cent discount rate, with a BCR of 2.62, meaning that the present value benefits to society from Inland Rail are expected to be more than double the present value of costs over the life of Inland Rail. At a seven per cent discount rate, which gives less weight to future benefits, the present value benefits to society are estimated to almost offset the present value costs.
- By economic benefit:
  - The most significant benefit of Inland Rail is freight operating cost savings, which represents 28 per cent of total benefits. This is due to longer and more efficient container and coal trains which reduce the cost of transporting freight along the corridor. The greatest benefit accrues to road freight diversion given significantly lower operating costs for rail relative to road.
  - Freight transit times account for 15 per cent of total benefits. Inland Rail provides a shorter and more direct rail route for intercapital freight travelling between Melbourne and Brisbane relative to the existing coastal railway which bypasses Sydney. Other significant benefits include reduced congestion (five per cent) and environmental costs (five per cent) as a result of removing heavy vehicles off the road network.
  - Reflecting the long-term nature of Inland Rail benefits and 100 year life of rail assets, the future stream of benefits beyond the 50 year appraisal period has been captured and represents 35 per cent of total benefits.

- By beneficiary/stakeholder:
  - The main beneficiaries of Inland Rail are intercapital freight users (accounting for 68 per cent of total benefits) as a result of freight operating cost savings, time savings, improved reliability, improved availability and redundancy/resilience to incidents.
  - Regional freight is also a significant beneficiary, accounting for 16 per cent of total benefits as a result of freight operating cost savings for coal and agricultural freight and net revenue from exports that would not have otherwise occurred.
  - Approximately 13 per cent of benefits accrue to the broader community as a result of reduced congestion, improved environmental sustainability and improved residential amenity from removing trucks off the road.

An alternative scenario has also been presented excluding investment in additional loops on the Western Line and Brisbane metropolitan network to enable coal train lengths to increase from 650 metres to 1010 metres. The assumed cap of 87 coal train paths becomes binding at lower volumes because less can be carried per train, resulting in Inland Rail coal volumes decreasing from 19.5 million tonnes to 9 million tonnes. In addition, smaller train lengths reduce economies of scale resulting in operating cost savings decreasing from $6.4 billion to $5.4 billion. However, the reduction in volumes is also reflected in a lower incremental maintenance and operating cost and smaller environmental disbenefits.

Table 9.2 Cost benefit analysis results for Inland Rail by benefit type (incremental to the base case, discounted, $2014–15 millions)

MELBOURNE TO BRISBANE INLAND RAIL PROGRAMME COSTS AND BENEFITS	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)
COSTS				
Capital costs	7650	6590	7607	6554
Operating costs	133	66	133	66
Maintenance costs	793	380	775	371
Total costs	**8575**	**7036**	**8515**	**6991**
BENEFITS				
1) Freight user benefits				
Freight operating cost savings	6383	2785	5359	2271
Freight value of time savings	3318	1417	3310	1413
Improved reliability	428	186	428	186
Improved availability	1450	579	1450	579
Redundancy/resilience to incidents	37	12	37	12

MELBOURNE TO BRISBANE INLAND RAIL PROGRAMME COSTS AND BENEFITS	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)
2) Improved customer outcomes for rail passengers				
Reduced rail passenger wait time	32	14	32	14
3) Improved safety and sustainability for the community				
Reduced rail and road accidents	268	112	267	111
Reduced road congestion**	738	318	738	318
Reduced environmental costs	786	332	899	387
Improved residential amenity	36	14	58	25
4) Reduced lifecycle costs for infrastructure owners/operators				
Avoided infrastructure investments	268	176	268	176
Reduced road maintenance costs***	622	267	622	267
ARTC maintenance cost savings	216	107	216	107
5) Residual value of assets (future stream of net benefits)	7921	833	8121	844
Total benefits	**22 503**	**7152**	**21 806**	**6711**
RESULTS				
Net present value of costs and benefits	**13 928**	**116**	**13 291**	**(280)**
Benefit cost ratio	**2.62**	**1.02**	**2.56**	**0.96**

Note: Results are presented on an incremental basis to the base case and represent the Inland Rail scenario both including and excluding investment in additional loops on the Western Line and Brisbane metropolitan network to enable coal train lengths to increase from 650 metres to 1010 metres. * Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres. **The costs of road congestion have been estimated based on the marginal cost approach presented in the TfNSW, 'Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives', 2013 which uses changes in BITRE forecasts of the social cost of congestion and changes in forecast total metropolitan vehicle kilometres travelled to estimate the change in costs for each additional kilometer travelled. The Infrastructure Australia 'Australian Infrastructure Audit', 2015 presents estimates of the future costs of congestion based on strategic traffic modelling forecasts to estimate the costs of road delay as a result of congestion across six capital cities. However, insufficient information is presented in the Australian Infrastructure Audit Report to enable unit rates to be developed and applied to project-specific Inland Rail demand. ***Avoided road maintenance costs have been estimated based on unit costs of road maintenance by vehicle type from the Transport for NSW, 'Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives', 2013. The National Transport Commission publishes estimates of heavy vehicle road costs (e.g. road maintenance, common road costs such as street lighting, rest bays and lighting and heavy vehicle share of road investment) to inform the level of heavy vehicle charges. However, there is insufficient publicly available information to enable unit rates to be developed and applied to project-specific Inland Rail demand. The offsetting loss in revenue to the National Transport Commission has not been included as economic cost benefit analysis excluded financial transfers with no incremental impact on resources.

Source: PwC analysis based on inputs from ARTC and ACIL Allen, 2015.

Table 9.3 Cost benefit analysis results for Inland Rail by beneficiary (incremental to the base case, discounted, 2014–15 dollars)

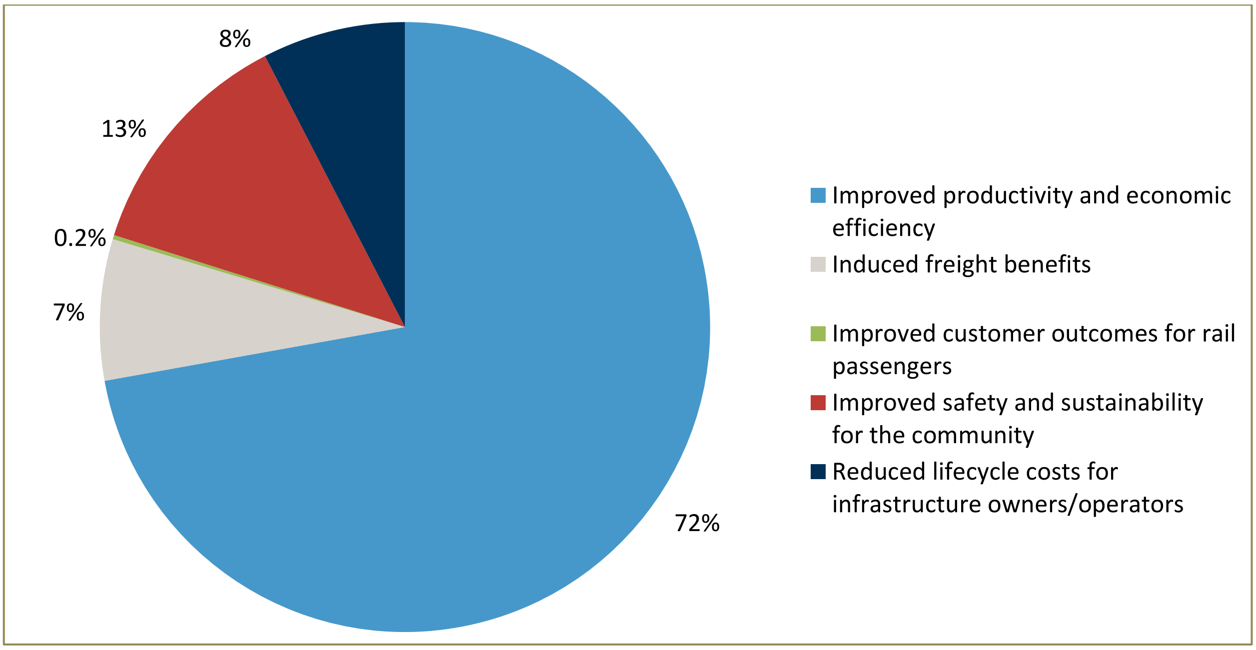
BENEFICIARY (PV $ MILLIONS)	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)	PV AT 4% DISCOUNT RATE ($M)	PV AT 7% DISCOUNT RATE ($M)
COSTS				
Capital costs	7650	6590	7607	6553.8
Operating costs	133	66	133	65.6
Maintenance costs	793	380	775	371.4
Total costs	**8575**	**7036**	**8515**	**6991**
BENEFITS				
1) Intercapital/intermodal freight	**15 361**	**4666**	**15 862**	**4716**
Melbourne to Brisbane	12 222	3697	12 621	3737
Brisbane to Adelaide	1278	389	1320	393
Brisbane to Perth	1860	579	1921	585
2) Regional freight	**3524**	**1271**	**1995**	**693**
Coal	1592	585	0	0
Agricultural products	1850	658	1910	665
Others (including steel, minerals, general freight, and other extra-corridor)	82	28	84	28
3) Community	**2821**	**879**	**3126**	**962**
4) Passengers	**50**	**16**	**52**	**16**
5) Rail network owners (ARTC & QR)	**747**	**321**	**772**	**324**
Total benefits	**22 503**	**7152**	**21 806**	**6711**
Net present value of costs and benefits	**13 928**	**116**	**13 291**	**(280)**
Benefit cost ratio	**2.62**	**1.02**	**2.56**	**0.96**

Note: Results are presented on an incremental basis to the base case and represent the Inland Rail scenario both including and excluding investment in additional loops on the Western Line and Brisbane metropolitan network to enable coal train lengths to increase from 650 metres to 1010 metres. * Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres. **The benefits to coal users under the 'No Western Line Upgrade' are estimated to net to zero in rounded terms, reflecting offsetting operating costs (from slightly longer distances), and time savings. Changes in benefits to non-coal freight in the 'No Western Line Upgrade' reflect apportioning of the residual value – without the Western Line upgrade, non-coal freight drives a larger share of benefits over the appraisal period and is assumed to do so in the long-run.

Source: PwC analysis based on inputs from ARTC and ACIL Allen, 2015.

A summary of the distribution of Inland Rail benefits as a portion of total benefits is provided in Figure 9.4 (discounted at four per cent) and Figure 9.5 (discounted at seven per cent).

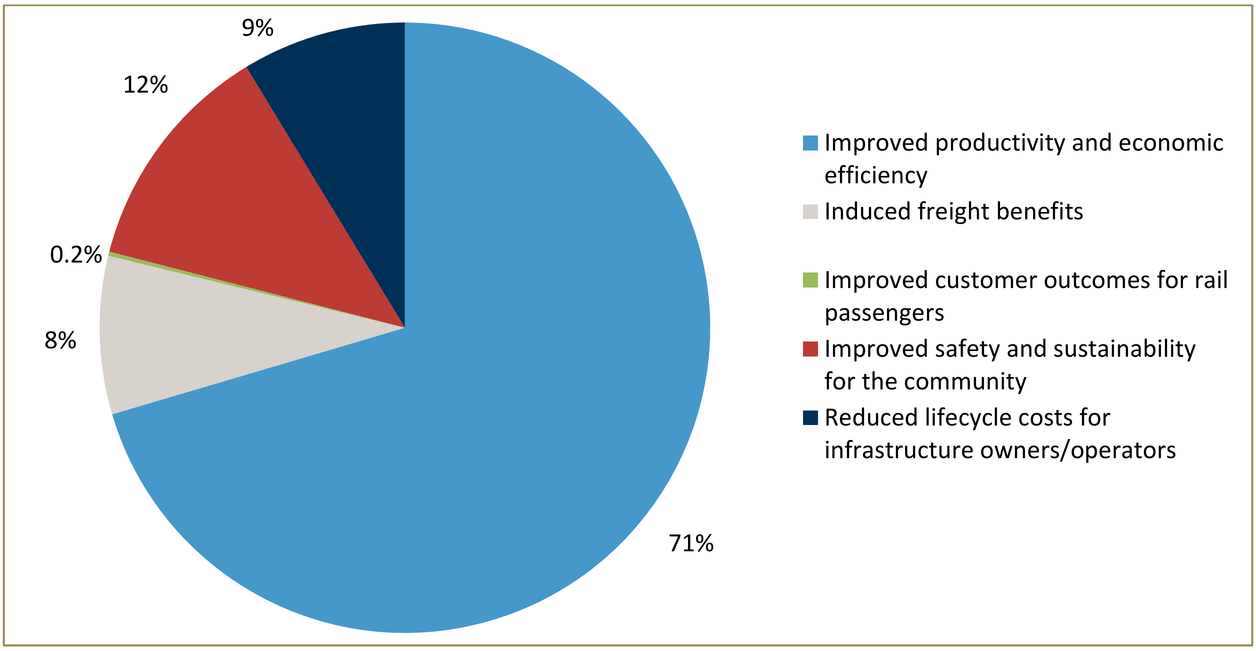
Figure 9.4 Distribution of Inland Rail benefits (discounted at four per cent), excluding the residual value



Note: Freight user benefits will be enjoyed by freight companies as well as the consumers of products transported along the corridor. *Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 9.5 Distribution of Inland Rail benefits (discounted at seven per cent), excluding the residual value



Note: Freight user benefits will be enjoyed by freight companies as well as the consumers of products transported along the corridor. *Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

9.8. Cost benefit analysis sensitivities

Acknowledging the inherent uncertainty in forecasting demand, costs and benefits for a 100 year asset like a freight railway line, the results of the economic analysis should not be treated as point estimates, but the full range of sensitivity testing of key assumptions should be considered by decision makers. There will also be a number of unquantifiable benefits of Inland Rail that should be taken into account, noting that economic analysis is one of many inputs in to the decision making process.

Sensitivity testing has been undertaken on key demand, cost and economic assumptions against the core Inland Rail results assuming a four per cent discount rate and requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

The economic sensitivity tests Includes three main components:

- The demand sensitivity tests illustrate a potential range of economic appraisal results if the estimated level of demand differs from the core scenario. This tests the robustness of the results under alternative outlooks for the freight market (for example, due to changes in the global coal price or GDP growth), or mode shift assumptions (for example, due to factors that determine the relative price of road and rail freight or the behavioural responses that might occur to those prices). Demand sensitivity scenarios were discussed in Chapter 7 (Demand).
- Subsequently, the sensitivity of the results is also tested to changes in the technical assumptions used to calculate the present value of economic costs and benefits for the demand in the core scenario. This considers alternative appraisal periods, approaches to calculating residual value, discount rates, and increases/decreases in costs and benefits.

- Combination of concurrent demand and key assumption sensitivities in packages of upside and downside scenarios were also considered.

Key findings of the sensitivity testing include:

- Doubling the responsiveness of freight operators to price reductions ('price elasticity') with Inland Rail is forecast to have the most significant positive impact on demand (a 41 per cent increase in Melbourne to Brisbane volumes in 2049–50) and increase the BCR to 3.52. Halving the assumed price elasticity reduces Melbourne to Brisbane volumes by 27 per cent, and reduces the BCR to 1.94.
- Doubling the Inland Rail access charge would maximise the financial revenue, but is forecast to have the most significant negative impact on demand with a 71 per cent decrease in Melbourne to Brisbane volumes in 2049–50 and would decrease the BCR to 1.87
- Permitting B-triple access on the full length of the Hume, Newell or Pacific Highway corridors between Melbourne and Brisbane is forecast to have a negative impact on demand (a 35 per cent decrease in Melbourne to Brisbane volumes in 2049–50) and decrease the BCR to 2.25.
- A package of concurrent upside scenarios including high price elasticity (2a), road pricing (4a) and high coal prices (5a), would increase intercapital demand on Inland Rail by 48 per cent (and total demand by 13 per cent) relative to the core scenario. Combined with a 10 per cent reduction in capital costs, this would increase the BCR to 4.06.
- A package of concurrent downside scenarios including low price elasticity (2b), B-triple access (4b) and low coal price scenario (5d) would decrease intercapital demand on Inland Rail by 42 per cent (and total demand by 50 per cent) relative to the core scenario. Combined with a 30 per cent increase in capital costs (9c), this would lower the BCR to 1.37.
- Inland rail remained economically viable (a BCR above 1) for all sensitivity tests of key cost benefit analysis assumptions, except under a discount rate of 10 per cent, which decreases the to 0.55 due to the longer term nature of Inland Rail benefits.

A summary of the sensitivity analysis results in ascending order of the BCR is provided in Table 9.4.

Table 9.4 Cost benefit analysis sensitivity analysis results (incremental to the base case, four per cent discount rate, 2014–15 dollars)

SCENARIOS		BCR
1.	**Core scenario:** Requires capital investment in additional loops on the Western Line or additional loops and Brisbane metropolitan rail network (at Murrarie and Clapham Yard) to enable coal train lengths to increase from 650 metres to 1010 metres.	**2.62**
2.	**Demand price elasticity**†	
2a.	**High price elasticity:** Assumes a negative four per cent price elasticity which is double the core appraisal elasticity and benchmarked against the upper bound of the price elasticity range reported by 2008–09 survey respondents.	**3.52**
2b.	**Low price elasticity:** Assumes a negative one per cent price elasticity which is half of the core appraisal elasticity and benchmarked against the lower bound of the price elasticity range reported by 2008–09 survey respondents.	**1.94**
3.	**Alternative rail access prices**‡	
3a.	**Increased Inland Rail access price:** Rail access price assumed to increase by 20 per cent per tonne between Illabo to Kagaru.	**2.54**

SCENARIOS	BCR
3b. Decreased Inland Rail access price: Rail access price assumed to decrease by 20 per cent per tonne between Illabo to Kagaru.	2.70
3c. Revenue maximising rail access price for intercapital freight: Revenue maximising rail access price is the access price at which Inland Rail obtains the maximum revenue, which was estimated to be 202 per cent of the core access price.	1.87
3d. High Inland Rail coal access price ($14 per thousand gross tonne kilometres): Inland Rail access charge assumed to be $14 per gross tonne kilometre consistent with the QCA's October 2014 draft determination for the Western System - decreasing coal volumes to 11.5 million tonnes.[142]	2.63
3e. High Inland Rail coal access price ($19 per thousand gross tonne kilometres): Inland Rail access charge assumed to be $19 per gross tonne kilometre, consistent with QR's May 2015 submission to the QCA - decreasing coal volumes to 11.5 million tonnes.[143]	2.65
4. Alternative road pricing and access arrangements	
4a. Road pricing based on depreciated optimised replacement cost (DORC) values: Tests impact on Inland Rail if road applies a DORC pricing approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).[144]	2.73
4b. B-triple access: As the core appraisal assumes B-triple access will not be possible between Melbourne and Brisbane, considers the impact of B-triples on the Hume, Pacific or Newell Highway corridors on Inland Rail demand along with no change in the road pricing approach.[145]	2.25
4c. Road pricing based on DORC values and B-triples access: Considers the impact of B-triples on the Hume, Newell or Pacific Highway corridors on Inland Rail demand along with applying a DORC value approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).	2.30
5. Change in coal price[§]	
5a. High coal price: Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and no change in Inland Rail coal access charge ($5 per thousand gross tonne kilometres).	2.73
5b. High coal price ($US95 per tonne) and high Inland Rail coal access charge ($14 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $14 per gross tonne kilometres Inland consistent with the Queensland Competition Authority's October 2014 draft determination for the Western System – resulting in coal volumes remaining at 19.5 million tonnes.	2.73

142 QCA, 'Queensland Rail's 2013 Draft Access Undertaking', October, 2013.

143 Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May 2015.

144 Increasing Melbourne to Brisbane road user costs by 169 per cent (an estimate of the depreciated optimised user costs of B-doubles and higher productivity vehicles) leads to higher prices for road freight and improved volumes in the base case and with Inland Rail. Under these assumptions, in 2049–50 Inland Rail's total volumes will increase by two per cent and the volume of non-bulk goods between Melbourne and Brisbane will increase by eight per cent.

145 B-triples can transport almost 50 per cent more mass than B-doubles, and super B-doubles would allow a prime mover to pull four twenty-foot equivalent units (TEUs) provided that axle limits are not exceeded. These two vehicle configurations significantly improve road freight cost efficiency for mass or volume constrained freight. It is assumed that approximately half of all movements are on these trucks, with a 38 per cent operating cost saving compared to articulated trucks (but that they must travel via the Hume, Newell or Pacific Highway corridors imposing an additional two per cent distance).

SCENARIOS	BCR
5c. High coal price ($US95 per tonne) and high Inland Rail coal access charge ($19 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $19 per gross tonne kilometres Inland , consistent with QR's May 2015 submission to the QCA – resulting in coal volumes remaining at 19.5 million tonnes.[146]	**2.73**
5d. Low coal price: This scenario assumes a lower coal price of US$55 per tonne and no change in Inland Rail coal access charge ($9 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 4 million tonnes.	**2.50**
5e. Low coal price, low Inland Rail coal access charge:[ll] This scenario assumes a lower coal price of US$55 per tonne and a 20 per cent reduction in Inland Rail coal access charge ($7 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 6 million tonnes.	**2.53**
6. Change in GDP growth[**]	
6a. High GDP growth: This scenario assumes that 2013–14 will see 2.8 per cent growth in real GDP followed by 2.7 per cent growth in 2014–15 and 3.3 per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with trend at 3.2 per cent pa.	**2.92**
6b. Low GDP growth: This scenario assumes that 2013–14 will see 2.7 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and 2.8 per cent in 2015–16. After this period ACIL Allen has assumed that long-run real growth is in line with the projections of the Treasury's Intergenerational Report less 0.6 percentage points.	**2.32**
6c. Capped demand growth: This scenario conservatively assumes no growth in demand post 2054-55 which is the final year for which GDP forecasts are available from the 2015 Intergenerational Report.	**2.08**
7. Change in long term oil price.	
7a. High oil price: This scenario assumes an oil price of $US 200 per barrel ($2015) by 2030.	**2.72**
7b. Low oil price: This scenario assumes an oil price of $US 50 per barrel ($2015) by 2030.	**2.48**
8. Upside and downside scenarios	
8a. Package of upside scenarios: This scenario assumes high price elasticity (2a), road pricing based on depreciated optimised replacement cost (DORC) values (4a), a high coal price ($US95 per tonne) (5a) and a 10 per cent reduction in capital costs.	**4.06**
8b. Package of downside scenarios: This scenario assumes low price elasticity (2b), B-triple access on the Hume, Pacific or Newell Highway corridors (4b), a low coal price ($US55 per tonne) (5d) and a 30 per cent increase in capital costs (9c).	**1.37**
9. Key cost benefit analysis assumptions.	
9a. Delay in Inland Rail construction: Assumes Inland Rail construction is delayed by 1 year, with single stack operations commencing in 2023-24 and double stacking from 2025-26.	**2.25**
9b. P90 capital costs: This scenario includes probabilistic risk with a higher level of confidence.	**2.46**
9c. High capital costs: This scenario assumes a 30 per cent increase in capital costs.	**2.06**

[146] Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May, 2015.

SCENARIOS	BCR
9d. Low capital costs: This scenario assumes a 30 per cent decrease in capital costs.	**3.59**
9e. Increased ongoing costs: This scenario assumes a 30 per cent increase in ongoing operating and maintenance costs.	**2.53**
9f. Decreased ongoing costs: This scenario assumes a 30 per cent decrease in ongoing operating and maintenance costs.	**2.72**
9g. Increase benefits: This scenario assumes a 30 per cent increase in total benefits.	**3.43**
9h. Decreased benefits: This scenario assumes a 30 per cent decrease in total benefits.	**1.82**
9i. Alternative residual value: This scenario calculates the residual value based on the straight line depreciation of capital costs based on remaining asset life at the end of the 50 year period rather than the future stream of benefits, assuming economic lives ranging from 50 years for approach earthworks to 100 years for track, viaducts, culverts and tunnels – resulting in an estimated residual value of $4.5 billion ($2014-15, excluding escalation, undiscounted) with a present value of $441 million ($2014-15, excluding escalation, discounted).	**1.70**
9j. Shorter evaluation period: This scenario calculates the residual value based on the straight line depreciation of capital costs based on remaining asset life at the end of the 50 year period rather than the future stream of benefits taking in to account the 100 year life of rail assets.	**2.31**
9k. Seven per cent discount rate: Future costs and benefits are discounted using a seven per cent discount rate.	**1.02**
9l. 10 per cent discount rate: Future costs and benefits are discounted using a 10 per cent discount rate.	**0.55**

* Relates to Melbourne to Brisbane, Adelaide to Brisbane and Perth to Brisbane intercapital freight.

† The core demand assumes a price elasticity of two per cent.

‡ The core demand assumes an access price of approximately $17 per tonne for Melbourne to Brisbane intercapital freight in real 2024–25 prices. Intercapital rail access price makes up 15.8 per cent of total door-to-door price in the core demand. Coal access charges are assumed to be $5 per thousand gross tonne kilometres on Inland Rail between Oakie and Acacia Ridge and $14 per thousand gross tonne kilometres on the Western Line and Brisbane metropolitan network. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

§ The core demand assumes a US$75 per tonne Newcastle benchmark coal price. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

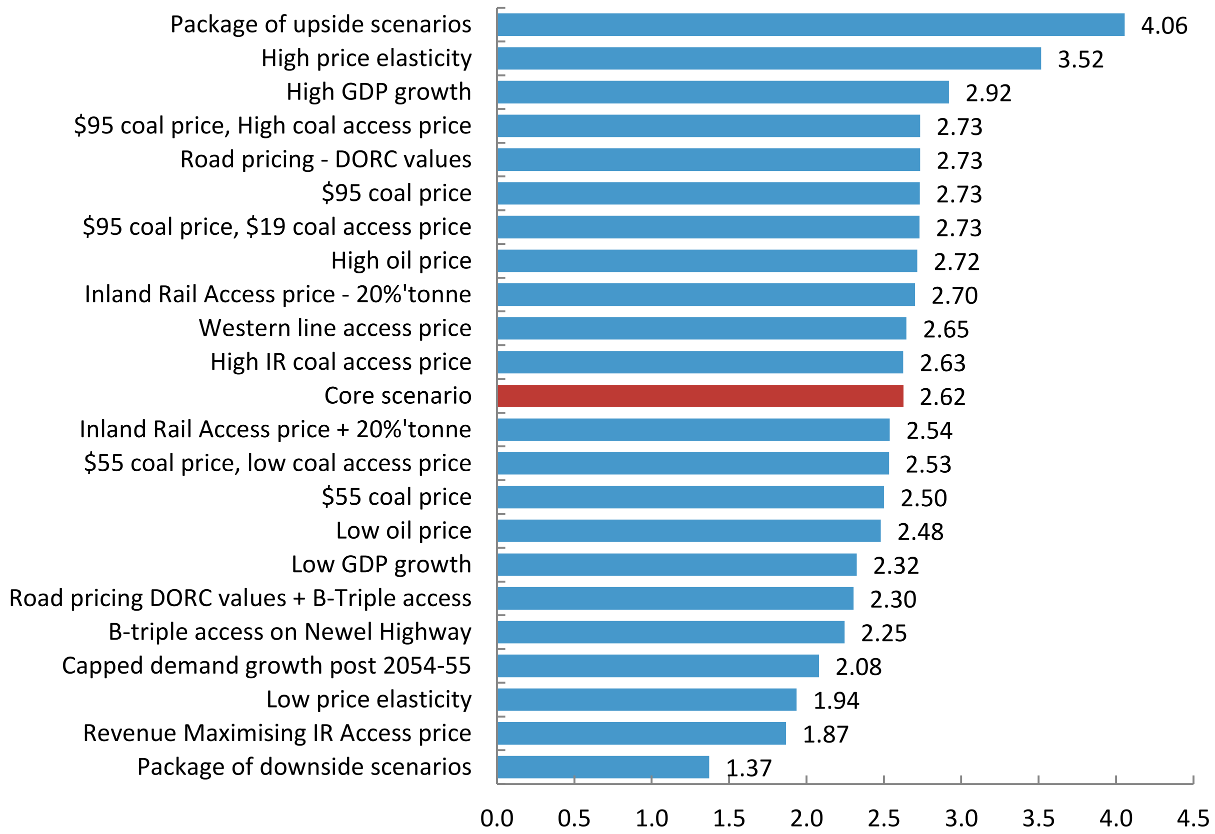
II Sensitivity 5d and 5e producer similar outcomes in rounded terms due to the competing effects of higher producer surplus and greater externality disbenefits.

** The core demand assumes that 2013–14 will see 2.75 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and three per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with the projections of the Treasury's Intergenerational Report (Source: Department of Treasury and Finance, 2010).
The core demand assume a long term oil price of $US 130 per barrel ($2015).

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Figure 9.6 charts the results of the demand sensitivity tests, providing a potential range of economic appraisal results if the outlook for demand differs from the core demand scenario. It also includes the package of upside and downside scenarios which consider alternative assumptions related to both demand and capex spends. This scenario includes complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Figure 9.6 Summary of cost benefit analysis demand sensitivity analysis results (incremental to the base case, four per cent discount rate, 2015 dollars)

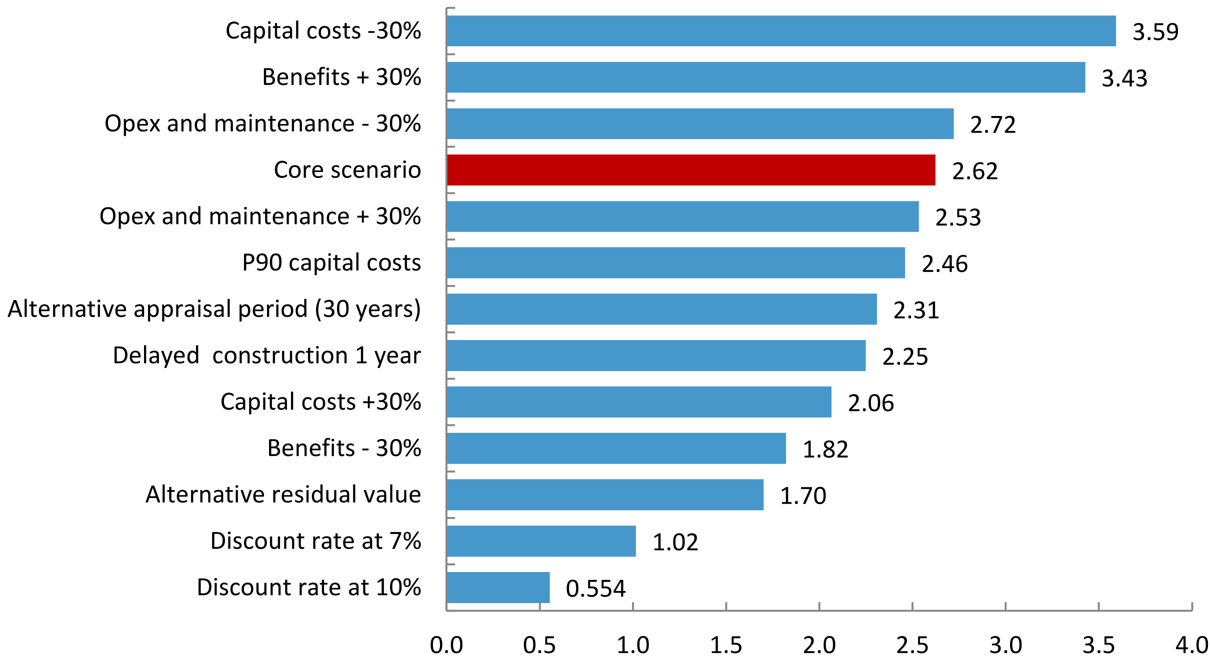


Note: *Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 9.7. presents the results of the sensitivity tests on the technical economic appraisal assumptions, which alter the present value of costs and benefits for the level of demand in the core scenario. These results assume complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres are provided in

Figure 9.7 Summary of cost benefit analysis key assumption sensitivity analysis results (incremental to the base case, four per cent discount rate, 2015 dollars)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

As highlighted in the analysis above, a key sensitivity test is whether the results remain robust to a combination of concurrent downside scenarios. The independent and combined impacts of various scenarios that would lower demand on Inland Rail relative to the core scenario, combined with the impact of greater than expected construction costs is shown in Table 9.5.

Table 9.5 Incremental BCR impacts in the package of downside scenarios (core BCR = 2.62)

Scenario		BCR at 4% discount rate		BCR at 7% discount rate	
		Independent impact	Combined impact	Independent impact	Combined impact on
1	5d: The coal price collapses	2.50	-	0.96	
2	2b: Lower prices have a less than expected effect on non-bulk demand	1.94	1.83	0.82	0.77
3	4b: Trucking is more competitive than expected	2.25	1.75	0.96	0.76
4	9c: Construction costs are greater than expected	2.06	1.37	0.79	0.59

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

The independent and combined impacts of various scenarios that would improve the level of demand on Inland Rail relative to the core scenario, combined with the impact of lower than expected construction costs is shown in Table 9.6.

Table 9.6 Incremental BCR impacts in the package of upside scenarios (core BCR = 2.62)

	Scenario	BCR at 4% discount rate		BCR at 7% discount rate	
		Independent impact	Combined impact	Independent impact	Combined impact on
1	5a: The coal price is higher than expected	2.73	-	1.07	
2	2a: Lower prices have a greater than expected effect on non-bulk demand	3.52	3.62	1.32	1.37
3	4a: Trucking is less competitive than expected	2.73	3.69	1.03	1.35
4	9d: Construction costs are less than expected	2.88	4.06	1.12	1.49

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

9.9. Economic impact assessment approach

CGE modelling of the national, state and regional impacts has been undertaken based on the Monash Multi Regional Forecasting Model (MMRF) dynamic modelling of construction and operations phase impacts drawing on capital, operating and maintenance cost estimates and estimates of productivity improvement experienced by the freight and transport industries.

CGE modelling is a widely used economic impact analysis tool for simulating the economy-wide effects of projects or policies, which represent 'shocks' to the economy. CGE models replicate how the economy will adjust to 'shocks' from significant projects and policies.

CGE is a useful complementary analysis to direct benefits analysis because it explores the possible wider economy implications by considering how the direct impacts of Inland Rail will provide flow-on impacts to sectors and regions. The results are presented as an estimate of the year-to-year impacts of Inland Rail over the 50 year operating timeframe to 2073–74, such as changes in industry demand and subsequent supply chain demand impacts. The economy-wide analysis considers how the Programme interacts with the regional, state and national economies. The model uses the costs and benefits determined in the cost benefit analysis as inputs and examines how they interact with the wider economy. For example, the model will consider how the capital costs of building Inland Rail will interact with the economy by stimulating demand for construction services as the network is built. When improvements in freight efficiency occur, industries that use rail freight to transport their products interstate or to foreign export markets can take advantage of their lower costs to expand production.

The following costs and benefits from the CBA were used to 'shock' the MMRF:

- Construction period: Capital expenditure during construction simulates expenditure in each region in which Inland Rail operates.

- Operating period:
  - Ongoing operating and maintenance expenditure stimulate expenditure in each region in which Inland Rail operates.
  - Freight user and cost savings generate economic efficiencies that directly and indirectly benefit freight operators, consumers and industry, with positive impacts accruing to the location of the beneficiaries as a result of:
    - Improved productivity and efficiency of freight (operating cost savings, value of freight time savings, improved reliability and availability and redundancy and resilience to incidents) – included as net productivity improvement in the rail freight industry.
    - Congestion cost savings – included as net productivity improvement in the road freight industry.
    - Community benefits affecting non-freight users (reduced congestion and crash costs) – split between the two MMRF industries making up private use of road transport; that is, the road passenger and the private transport industry (assuming that a given level of effective passenger rail services is able to be supplied at a lower cost).
    - Passenger benefits from reduced wait time – included via primary factor productivity shocks to the passenger rail industry (assuming that a given level of effective passenger rail services is able to be supplied at a lower cost).

9.10. Key economic impact assessment assumptions

- Financing of Inland Rail: To fund the development of Inland Rail, the economy is assumed to expand net foreign investment. This means that it is assumed there is foreign ownership of the expansion in Australia's capital stock. This assumption means that the capital expenditure to develop Inland Rail creates a net economic stimulus to the economy as it is assumed to not crowd out other projects. Servicing the higher foreign ownership of Australia's capital requires subsequent higher annual outflows that do not accrue to Australians, noting that:
  - Relaxing this assumption to allow domestic investment to fund Inland Rail would require either: a) allowing the reduction of consumption in Australia to save more and fund the capital stock expansion; or b) allowing Inland Rail to crowd out other projects.
  - This assumption does not suppose that Inland Rail itself is funded by overseas borrowing, just that for a given level of domestic saving, additions to total investment at the Australian economy level must come from additional net foreign investment.
  - In order to accommodate additional net foreign investment, the current account balance must move towards deficit during the construction phase of Inland Rail. This requires a fall in exports during the construction phase.
- Capital and labour market assumptions: The economic model incorporates constraints on resources:
  - The capital stock for an industry is assumed to be fixed in that industry once installed. Investment is driven by rates of return.
  - Capital stocks in industries accumulate according to investment and depreciation.

  - In the long term, capital stocks adjust rates of return to their base case values.

- Labour market: The labour market is assumed to be driven by underlying population growth and institutional factors, meaning while the labour market can temporarily expand or contract around full employment, in the long run it must transition to a demographically driven full employment position. In effect this means that at a national level, employment returns to the level in the base case and that any gains to labour in a simulation accrue in the form of increased wages.[147]
- Commodity exports for Western Australia: In the MMRF database, a major user of the rail freight industry in Western Australia is the iron ore industry. The rail lines that service the iron industry are mainly from mines to nearby ports. It is assumed that Inland Rail does not affect these rail links and that Western Australian exports of iron ore and other commodities are unaffected by Inland Rail. It is expected that the main effects of Inland Rail on Western Australia come through intercapital containerised freight.
- Construction period: The economic impacts during the construction period are driven by the accumulation of capital into the rail freight sector. During this period capital accumulates in the sector as the rail network is developed, but this capital does not directly generate returns until Inland Rail begins to operate.
- Operating period: Following the CBA, the operation period is 2024–25 to 2074–75. As Inland Rail begins to operate, the cost savings, user efficiencies and other associated benefits begin to accumulate, allowing individuals and industries to benefit from a more efficient and cheaper use of rail freight.

9.11. Key economic impact assessment results

CGE modelling of the national, state and regional impacts has been undertaken to estimate broader economy wide impacts of Inland Rail's construction and operation requiring investment in additional loops on the Western Line and Brisbane metropolitan network to enable coal train lengths to increase from 650 metres to 1010 metres. The Inland Rail Programme is expected to have a net positive impact of $16 billion on GSP over its 10 year construction period and 50 year operation. The Programme is also expected to deliver an additional 16 000 jobs at the peak of construction, and an average of 700 additional jobs per annum over the entire period.

The distribution of economy wide benefits across the States varies, with the Programme having a strong positive impact on the GSP of Victoria, New South Wales and Queensland. During construction, Queensland and New South Wales receive the largest shares of the stimulus due to most of the Inland Rail corridor being developed within these states, however Victoria will also benefit as it contains a significant share of the construction workforce.
Once operational, Queensland and Victoria benefit most as they are the origin or destination for all intercapital freight or coal freight, while New South Wales also benefits as it is the most significant origin for agricultural freight, and is the point where Brisbane/Perth and Brisbane to Adelaide intercapital freight joins/leaves Inland Rail.

A summary of the Australia wide economic impacts from Inland Rail including complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres is provided in Table 9.7.

[147] The CGE modelling provides forecasts to 2049-50 which has necessitated extrapolation of CGE results to the 2073-74 economic appraisal period. Reflecting an assumed return to long run employment following Inland Rail stimulus from construction and operations, the economic analysis conservatively assumes a linear return to zero incremental employment from 2049-50 to 2073-74.

Table 9.7 Summary of Australia wide economic impacts from Inland Rail

MEASURE		TOTAL CHANGE 2014-15 TO 2073-74	CONSTRUCTION 2014-15 TO 2024-25	OPERATION 2024-25 TO 2073-74
GSP (2014-15 dollars, $b, discounted using 4 per cent real discount rate)		16.4	1.0	15.4
Annual employment ('000 FTEs)	Average*	0.7	0.8	0.6
	Peak	15.9	15.9	3.5

Note: *The CGE modelling provides forecasts to 2049-50 which has necessitated extrapolation of CGE results to the 2073-74 economic appraisal period. Reflecting an assumed return to long run employment following Inland Rail stimulus from construction and operations, the economic analysis conservatively assumes a linear return to zero incremental employment from 2049-50 to 2073-74. **Assumes complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Sensitivity tests of estimates of GDP with Inland Rail discounted using four per cent, seven per cent and 10 per cent discount rates are shown in Table 9.8. Higher discount rates increase the discounting of ongoing productivity impacts during the operating phase.

Table 9.8 Sensitivity analysis of GDP to changes in discount rate (2014-15 dollars, $ billion, discounted)

	PV AT 4% DISCOUNT RATE ($ BILLIONS)	PV AT 7% DISCOUNT RATE ($ BILLIONS)	PV AT 10% DISCOUNT RATE ($ BILLIONS)
GDP	16.4	7.0	3.7

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Impact of construction

During construction of Inland Rail, direct capital expenditure is estimated to stimulate economic activity and raise Australia's GDP by around $1.0 billion and temporarily support around 800 FTE jobs over the period (peaking at 15 900 FTE jobs in 2019–20).

This stimulatory impact on the economy occurs as the construction works, such as groundwork, tunnelling and laying tracks, stimulates the construction sector in each region of Inland Rail. The expansion in the construction sector supports additional flow on demand in the economy through the construction industry supply chain and additional spending on consumer orientated products by the construction workforce.

This net economic impact is less than the $7.3 billion in capital expenditure ($2014–15, discounted at four per cent). While construction of Inland Rail draws in a net inflow of foreign investment into Australia and expands Australia's capital stock, until Inland Rail begins operating, this capital does not generate returns or additional user and efficiency benefits. In addition the increase in foreign investment required to finance the addition to investment requires a decline in net exports to allow for an increase in capital inflow.

Impact of operation

During the operation life of Inland Rail to 2073–74, Inland Rail is estimated to stimulate further economic activity and raise Australia's GDP by a further $15.4 billion. These longer term benefits occur as the direct benefits of Inland Rail begin to accrue and drive cost savings and user efficiencies, and these directly and indirectly benefit freight operators, consumers and industry.

Impact by industry

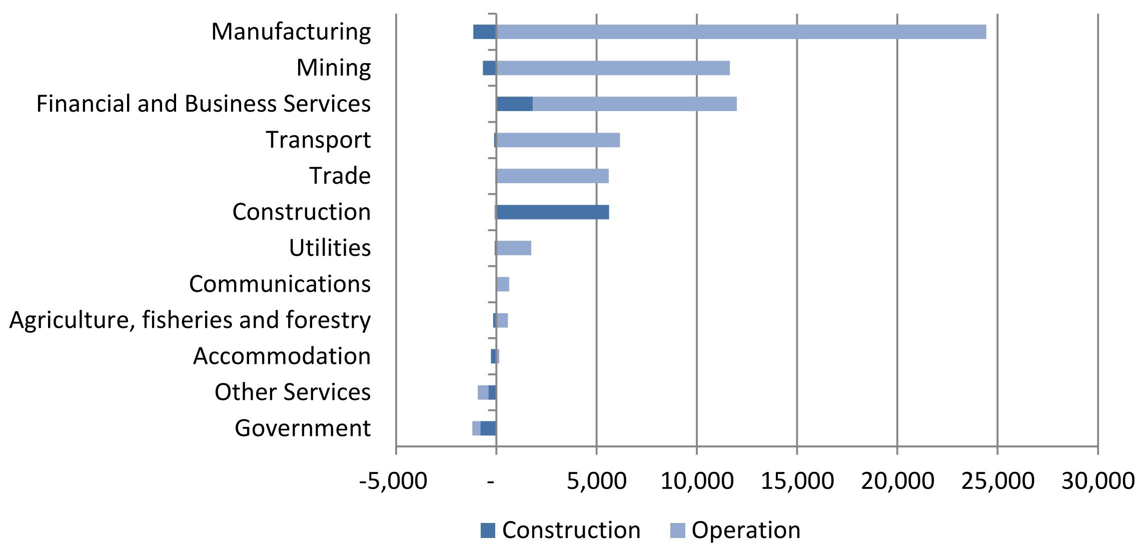
The economic impacts during construction and operation by industry is shown in Figure 9.8. During the construction period, there is an anticipated increase of value-added to GDP in the construction industry, flowing through the construction industry supply chain to induce additional demand in the financial and business services industries. Industries that are trade exposed, such as mining and manufacturing, experience negative impacts over this period, as exports contract to accommodate the inflow of foreign capital required to finance construction.

As Inland Rail becomes operational, the benefits transition towards the manufacturing and mining industries through reduced freight input costs.

The strong growth in the manufacturing and trade industries is expected as demand is forecast to be driven by containerised intercapital freight travelling on Inland Rail between Melbourne and Brisbane. Results for the mining sector are mainly driven by the performance of the coal industry in Queensland.

Some of the industries are negatively affected as the expansion of the construction, manufacturing and mining sectors drives demand for inputs and puts upward pressure on input costs. Industries that do not benefit through the direct or supply chain stimulus, such as the government sector, must compete for inputs (including labour), contracting and releasing resources into the other industries.

Figure 9.8 Economic impacts by industry during Inland Rail construction and operation (industry value-added to GDP, 2014-15 dollars, $ million, discounted using four per cent discount rate)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Impact by state

The impacts by state throughout the duration of the Programme are presented in Figure 9.9. During construction, the direct stimulus of capital expenditure to build Inland Rail will stimulate activity in Queensland, New South Wales and Victoria. Queensland and New South Wales receive the majority of the stimulus due to the large share of the Inland Rail corridor developed within each state. Approximately two per cent of the capital expenditure is on Victorian track segments. Although a significant share of the construction workforce is located in Victoria.

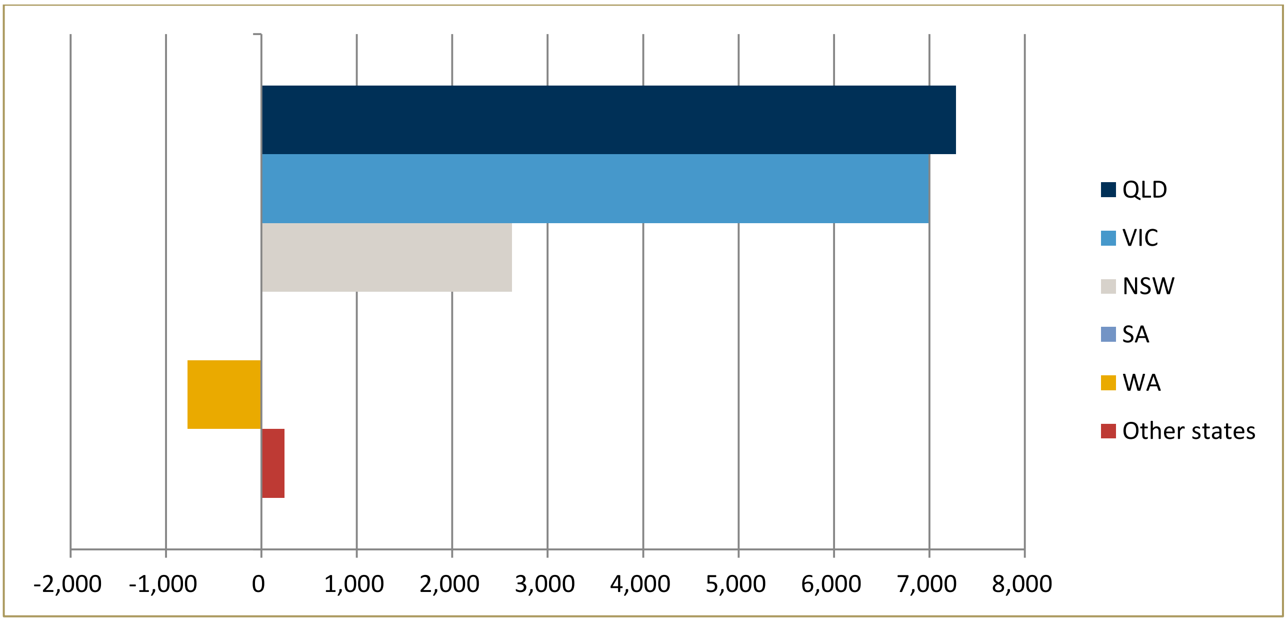
During the operating phase, Queensland and Victoria are the origin or destination for all intercapital freight or coal freight, while New South Wales is the most significant origin for agricultural freight, and is the point where Brisbane to Perth and Brisbane to Adelaide intercapital freight joins/leaves Inland Rail.

Benefits to Western Australia from intercapital freight productivity improvement are more than offset by two factors:

1. The constraint on Western Australia exports imposed by the assumption to reflect the fact that commodity exports from Western Australia use ports and rail lines unconnected to Inland Rail.
2. The improved industry and export performance of the Eastern States raises the cost of production and consumption in Western Australia. As a heavily trade exposed state, Western Australia is disadvantaged when the competitiveness of the eastern States is enhanced.

South Australia is not as trade exposed as Western Australia so the competitiveness effect on its exports is much less than Western Australia, resulting in a relatively small increase in GSP as a result of Inland Rail.

Figure 9.9 Economic impacts by state during Inland Rail construction and operations (GSP, 2014-15 dollars, $ million, discounted using four per cent discount rate)



Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

A sensitivity analysis of GSP across the affected states at four per cent, seven per cent and 10 per cent discount rates is shown in Table 9.9. Higher discount rates reduce projected benefits for Victoria more than for Queensland and New South Wales. This is because a relatively high proportion of construction occurs in Queensland and New South Wales, with a higher proportion of Victorian GSP generated during the operations phase. As the discount rate increases, there is more discounting of longer term economic impacts during the operations phase.

Table 9.9 Sensitivity analysis of GSP to changes in discount rate (2014-15 dollars, $ million, discounted)

	PV AT 4% DISCOUNT RATE ($ MILLIONS)	PV AT 7% DISCOUNT RATE ($ MILLIONS)	PV AT 10% DISCOUNT RATE ($ MILLIONS)
QLD	7274	3470	2010
VIC	6987	2821	1368
NSW	2626	1315	801
SA	5	(85)	(94)
WA	(776)	(538)	(395)
Other states	242	54	9

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

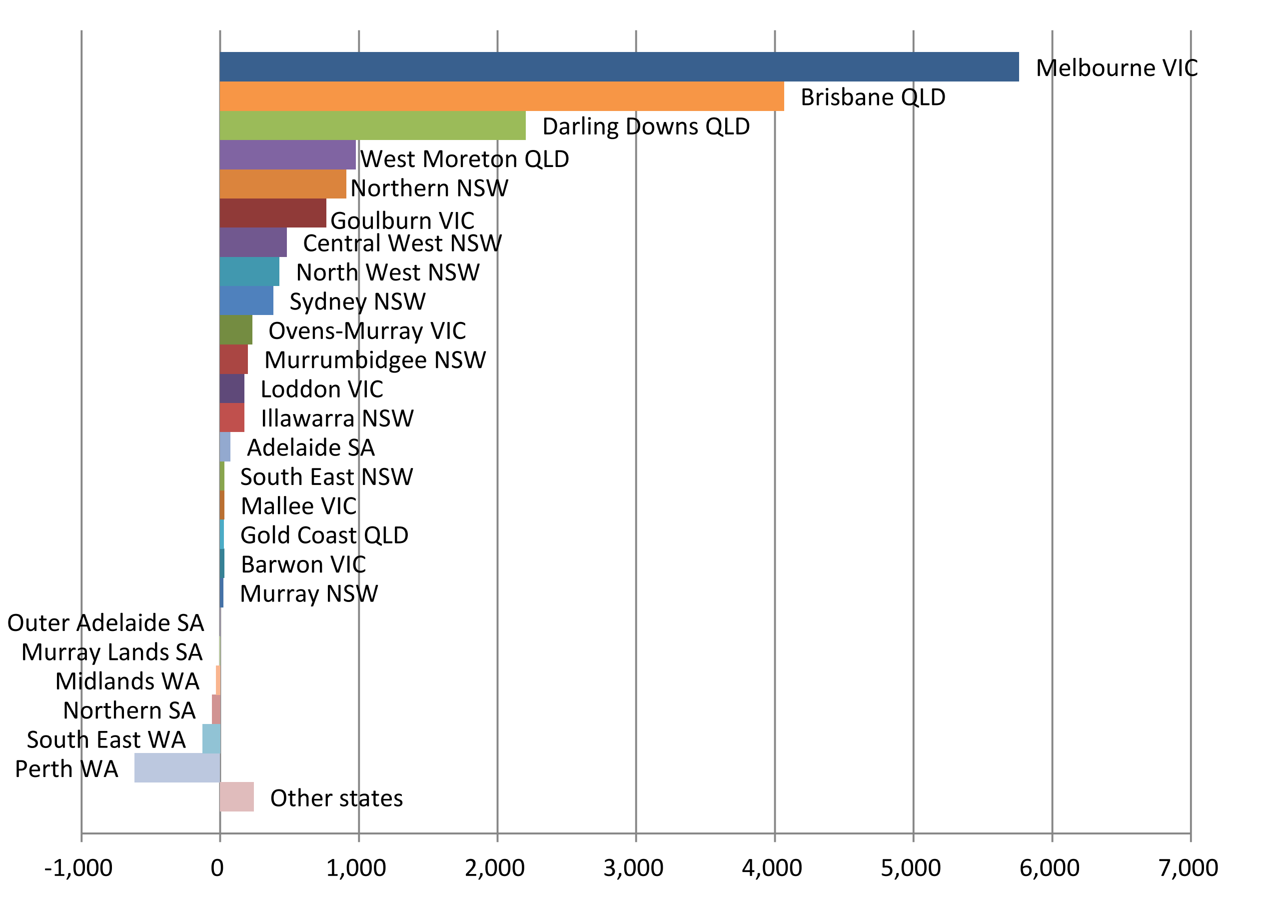
Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Impact by economic region

Following from the impacts by state, Figure 9.10 presents the impacts by region over 60 years of Inland Rail construction and operations (2014–15 to 2073–74). Impacts by region reflect state level results, noting that:

- Melbourne and Brisbane Statistical Divisions are estimated to have the greatest economic impact given their relative importance to the state economy (i.e. other regions in the state source a number of inputs from the capital cities) and the manufacturing and financial services sectors that benefit most during Inland Rail operations are located in the capital cities.
- Other regions are also estimated to benefit during construction (i.e. those located along the Inland Rail alignment), as well as from improved productivity and freight efficiency for the coal industry (e.g. West Moreton) and agricultural industry (e.g. Darling Downs and Northern New South Wales) .
- Sydney is estimated to have a relatively small economic impact from Inland Rail as a supplier to other regions in New South Wales.
- Perth makes the largest contribution to the Western Australia economy, and therefore negative economic impacts for Perth are reflective of statewide estimates for Western Australia.

Figure 9.10 Economic impacts by region over during Inland Rail construction and operation (Gross Regional Product, 2014-15 dollars, $ million, discounted using four per cent discount rate)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

The sensitivity analysis of Gross Regional Product (GRP) at four per cent, seven per cent and 10 per cent discount rates is shown in Table 9.10. These results reflect the state level estimates, whereby GRP estimates for those regions that accrue most of their GRP during Inland Rail's operating phase, rather than from expenditure during construction, are reduced more as a result of higher discount rates.

Table 9.10 Sensitivity analysis of GRP estimates to changes in discount rate (2014-15 dollars, $ million, discounted)

	PV AT 4% ($ MILLIONS)	PV AT 7% ($ MILLIONS)	PV AT 10% ($ MILLIONS)
Melbourne VIC	5760	2231	1013
Goulburn VIC	766	382	240
Ovens-Murray VIC	230	116	73
Loddon VIC	172	67	30

	PV AT 4% ($ MILLIONS)	PV AT 7% ($ MILLIONS)	PV AT 10% ($ MILLIONS)
Mallee VIC	30	12	6
Barwon VIC	29	14	7
Northern NSW	908	486	314
Central West NSW	480	216	114
NorthWest NSW	427	254	181
Sydney NSW	384	162	88
Murrumbidgee NSW	199	97	56
Illawarra NSW	176	74	35
South East NSW	30	15	8
Murray NSW	22	11	6
Brisbane QLD	4065	1651	782
Darling Downs QLD	2203	1141	700
West Moreton QLD	979	662	516
Gold Coast QLD	27	16	12
Adelaide SA	75	(16)	(34)
Outer Adelaide SA	(3)	(3)	(3)
Murray Lands SA	(8)	(8)	(7)
Northern SA	(58)	(58)	(51)
Midlands WA	(31)	(25)	(21)
SouthEast WA	(128)	(106)	(88)
Perth WA	(617)	(407)	(286)
Other states	242	54	9

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

9.12. Summary

PwC undertook an economic analysis for Inland Rail, which involved application of a CBA framework which quantifies the direct costs and benefits attributable to Inland Rail. CGE modelling was undertaken to estimate the impacts of Inland Rail as these direct costs and benefits flow on and multiply throughout the regional, state and national economies.

Key findings of the economic analysis are:

- Recognising the broad and long term nature of the Programme, and its catalytic impact across national supply chains, a 4 per cent discount rate was adopted, which is consistent with international practice for large scale long lived infrastructure projects.
- The cost benefit analysis (which estimates and analyses direct benefits) suggests that Inland Rail is viable at a four per cent discount rate and marginal at a seven per cent discount rate.
- Inland Rail will generate significant economic activity, including jobs and an increase in GDP.
- Realising the full benefits of Inland Rail will require complementary decisions that support the rationale for investing in Inland Rail; for example not concurrently investing in a step change in road capacity or providing B-triple access between Melbourne and Brisbane.
- A network approach to rail access charges on the corridor is also important to maximise rail mode share and economic benefits. Rail access charges aimed at maximising revenue could significantly reduce potential modal shift and economic benefits achievable from Inland Rail.
- Investments complementary to Inland Rail are also important to unlock Inland Rail benefits, including double stack terminal capacity in Melbourne and Brisbane, and some investment to enable longer coal trains from the Surat and Clarence-Moreton Basins.

Chapter 10
Financial analysis

10. FINANCIAL ANALYSIS

10.1. Purpose of this chapter

Financial analysis has been undertaken to determine whether the revenues are sufficient to cover the capital and ongoing operating costs for Inland Rail, considering a Public Sector Comparator (PSC) approach but without consideration of financing costs, taxation considerations or the potential involvement of any private sector party (including associated contracting structures).

The outcomes of the financial appraisal:

- Provide indicative present value outcomes from a Programme perspective.
- Generate cashflow projections to support the assessment of budgetary considerations.

10.2. Approach

The approach undertaken has been to assess the financial feasibility of Inland Rail assuming it is delivered solely by the Australian Government. In this way the financial appraisal assesses Inland Rail as a PSC as defined in the National Public Private Partnerships (PPP) Guidelines which assumes the Programme is procured, constructed, owned and operated by the Australian Government.

The purpose of this analysis is to determine whether the revenues are sufficient to cover the capital and ongoing costs for Inland Rail. The financial appraisal has been prepared on a standalone basis assuming there is no existing infrastructure that can be leveraged (apart from existing track scheduled for upgrade) to deliver or operate Inland Rail.

To analyse Inland Rail on a standalone basis, a geographic approach has been applied to define the 'Inland Rail' business. Once operational, Inland Rail will operate within a network including the coastal route, branch lines, passenger networks and other rail lines in each of the jurisdictions. Inland Rail has been defined on a geographical basis, therefore does not provide insights as to broader impacts on ARTC, Sydney Trains, NSW Trains and QR who could potentially experience reduced revenues as a result.

10.3. Financial appraisal assumptions

The following has been assumed in relation to ownership and delivery of Inland Rail on a standalone basis:

- South of the New South Wales/Queensland border, Inland Rail traverses track that is mostly leased long term by ARTC. North of the border, part of the railway would traverse track, or a rail corridor, owned by the Queensland Government and leased long term by ARTC.[148] For the purpose of this analysis, revenues have been captured on a geographic basis between Illabo and Kagaru assuming one operator undertaking maintenance and collecting revenues.
- Access revenue and below rail maintenance costs for part of the route that uses corridor owned by QR between the New South Wales/Queensland border and Kagaru has been assumed to accrue to Inland Rail.
  It has been assumed this corridor would be leased from QR based on an annual peppercorn rent as Inland Rail would upgrade and convert significant sections of the corridor to dual gauge, with a long tunnel beneath Toowoomba.

148 ARTC, Queensland standard gauge rail line – leased to ARTC, available at: http://www.artc.com.au/Article/Detail.aspx?p=6&np=4&id=260, 2010.

- Access charges (explained further in Section 7.5) have been assumed to be set to encourage rail volumes (and thus the economic benefit of Inland Rail) rather than to maximise financial revenue, which inherently assumes an integrated network to pricing and track operations with the parallel coastal route.
- Capital costs identified between Tottenham to Illabo and Kagaru to Acacia Ridge that have been identified as required to enable the Inland Rail performance specifications and service offering, and the benefits of which are largely for Inland Rail users, are assumed to accrue to the Inland Rail business.
- The operating and maintenance costs have been prepared by Lycopodium assuming Inland Rail is operated on a standalone basis (i.e. there are no cost savings and efficiencies by making use of existing ARTC staff and facilities).
- The study focuses on a project-specific analysis of Inland Rail. While it is acknowledged there are relationships between the coastal and other existing railways and Inland Rail, the financial appraisal has assessed the feasibility of Inland Rail as a standalone project, assuming it is a separate entity and does not make assumptions relating to the financial implications to the wider network.

Other key assumptions underpinning the financial analysis include:

- NPV Base date: 1 July 2014.
- Costs: Costs are real as of 1 January 2014 (i.e. the first escalation is applied starting 1 January 2015).
- Operating term: Financial results are presented based on 50 years of full operations commencing in Financial Year 2025.
- GST: GST excluded.
- Basis of cash flows: Nominal.
- Timing: Real cashflows have been provided in a monthly profile for the 10 year programme.
- Periodicity: Quarterly through construction and semi-annual after full operations commencement.
- Escalation (Construction): 2.50 per cent per annum for construction costs for the first five years (applied annually) and 2.75 per cent for all subsequent years based on evidence provided to Infrastructure Australia as discussed in Chapter 8 (Costs).
- Escalation (Operations and Maintenance): Estimated based on a report for DRID for Inland Rail prepared by Turner & Townsend.
- Escalation (Revenue): Long term CPI rate of 2.7%.

The financial appraisal also draws upon the following inputs:

- Inland Rail and train performance specifications and service offering defined by ARTC and presented in Chapter 5 (Service offering, scope and opportunities).
- Capital and operating cost assumptions developed by ARTC with assistance from their technical advisors PB, Aquenta and Lycopodium, presented in Chapter 8 (Cost).
- Revenue estimates developed by ARTC based on the demand analysis undertaken by ACIL Allen as discussed in Chapter 7 (Demand).

The background and reasoning that led to the discount rate applied is provided in Figure 10.1.

Figure 10.1 Discount rate assessment

The financial appraisal for Inland Rail represents a PSC as defined in the National PPP Guidelines. The PSC is an estimate of the hypothetical, whole-of-life cost of a public sector project if delivered by government. The PSC is costed on the basis of the state (or in the case of Inland Rail, the Australian Government) retaining all systematic risk (i.e. it is assumed that minimal or no systematic risk is transferred under the reference project procurement assumptions).

Given that Inland Rail is a net cost project and the absence of any private sector party means the Australian Government must bear all the systematic risk of the project, the appropriate discount rate for the financial appraisal will be the risk free rate as proxied by the yield on long term Australian Government Bonds. A pre-tax, nominal discount rate of 5.60 per cent has been applied based on a 20 year average of the 10 year Australian Government Bond Rate.

* Note the appropriate discount rate may change depending on which government entity is the ultimate delivery agent for Inland Rail and whether the private sector is involved.

Source: PwC, 2015.

10.4. Revenue assumptions

Access charge assumptions are currently considered to be conservative, representing a scenario that favours rail volume and rail mode shift (and thus economic benefits) through minimising freight costs for customers. If any increases were assumed in the rail access charges, then demand levels are expected to reduce in response, therefore there is a delicate balance and consideration of benefits to financial outcomes is required. Access charges on Inland Rail are assumed to be 100 per cent passed through by ARTC to train operators and by train operators to freight customers. Access charges assumptions are summarised in Chapter 7 (Demand).

10.5. Financial appraisal results

The analysis suggests that Inland Rail will not generate sufficient access revenue relative to total costs. As shown in Table 10.1, the NPV and NPC for Inland Rail cash flows (before financing) are negative with and without the Western Line investment.

However, considering only ongoing operating revenues and maintenance costs, Inland Rail is NPV positive. The results (assuming a 50 year operating term and complementary upgrades to the Western Line) presented in Table 10.1, are depicted graphically in Figure 10.2.

Table 10.1 Financial appraisal results for Inland Rail (Programme NPV (NPC), $ million, discounted, pre-tax nominal cash flows excluding financing costs, PSC, 2014–15 dollars)

INLAND RAIL PROGRAMME COSTS AND REVNUES	NPV / NPC ($ MILLIONS) INCLUDING WESTERN LINE UPGRADE*	NPV / NPC ($ MILLIONS) NO WESTERN LINE UPGRADE
Costs		
Capital costs^	(7847)	(7847)
Operating costs	(294)	(283)
Maintenance costs	(1574)	(1511)
Total recurrent/ongoing costs	**(1869)**	**(1794)**
Total costs	**(9716)**	**(9640)**
Revenues		
Steel	29	29
Grain	127	127
Intercapital/intermodal	2819	2819
General Freight	59	59
Passenger	4	4
Coal	968	467
Minerals	13	13
Total revenues	**4019**	**3518**
Programme: net operating cash flows only (excluding capital costs)	**2150**	**1725**
Programme: total cash flows	**(5696)**	**(6122)**

Note: Assumes ACIL Allen demand estimates, revenue estimates provided by ARTC based on that demand, US$75 Newcastle benchmark coal price, 5.60 per cent discount rate.

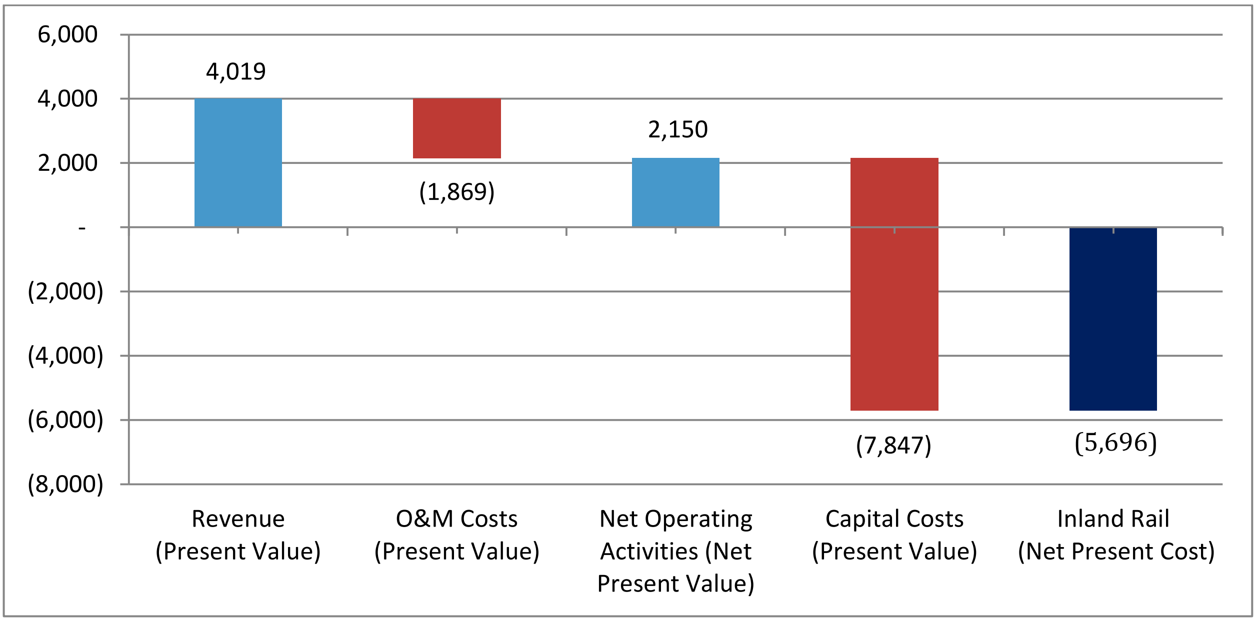
* Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

^Summary of the adjustments to the basis of estimate for the purpose of the financial analysis:

- Excluded $25.69 million of capital costs representing those that have been incurred ($24.76 million) and those which are expected to be incurred ($0.93 million) prior to 1 July 2015. These costs represent costs incurred to November 2014 and the expected management cost to July 2015.
- The 'concept design costs' for certain track sections previously expected to be incurred in 2014-2015 ($6.99 million) have been shifted to the first half of 2015-2016.

Source: PwC, 2015.

Figure 10.2 Inland Rail financial assessment: summary of Inland Rail costs and revenue ($ million – nominal)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

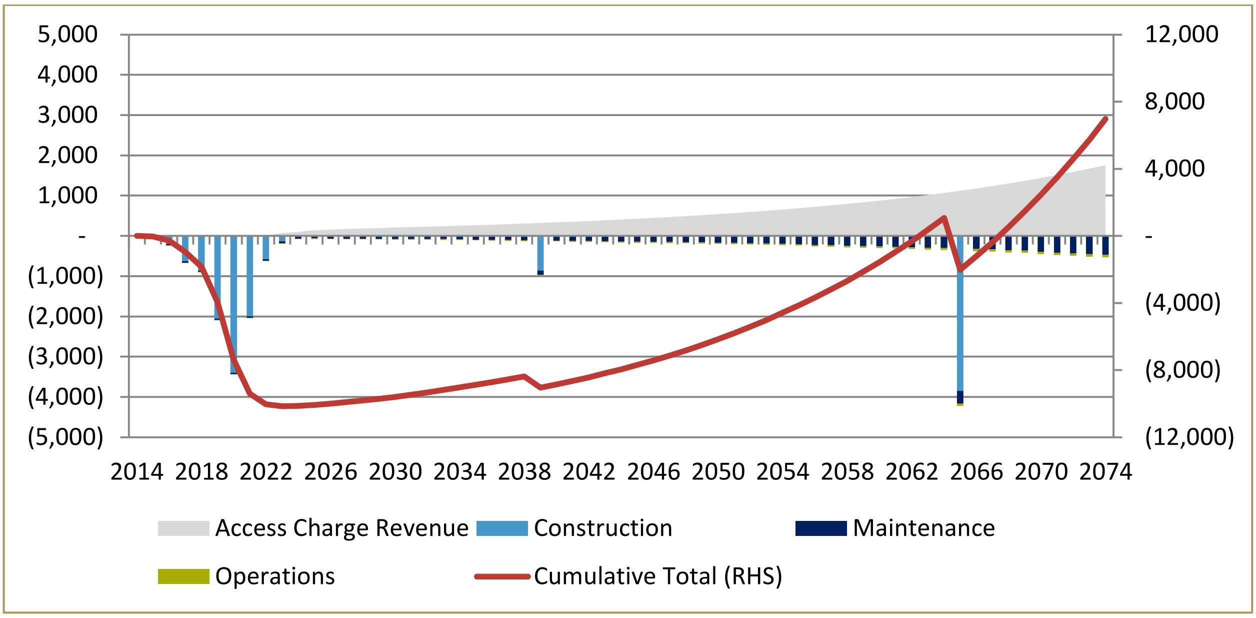
A summary of Inland Rail cashflows over the 50 year operating term are presented in Figure 10.3 and Figure 10.4.

The following additional capital costs are included in the financial analysis:

- Costs scheduled to occur 15 years into operation of Inland Rail to accommodate the extension of passing loops and all major periodic maintenance and other required costs.
- Costs scheduled to occur 40 years into operation of Inland Rail relating to additional loops required to meet future capacity.

The results suggest that below rail revenue is not sufficient to recover the significant capital outlay required for construction of Inland Rail. The results also indicate Inland Rail has positive operational cash flows, i.e. if capital costs are excluded, an operational Inland Rail is cashflow positive. Inland Rail only generates enough cash flow to offset the large capital outlay in nominal terms after approximately 35 years from construction.

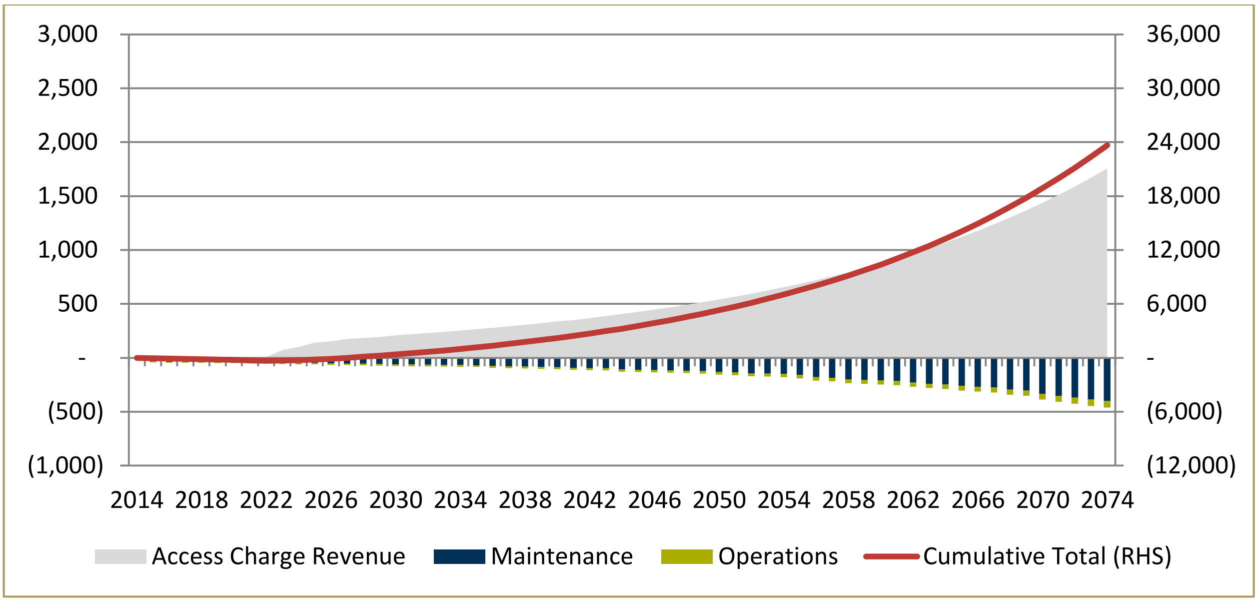
Figure 10.3 Inland Rail financial assessment: summary of Inland Rail costs and revenue (including capital costs, $ million – nominal)



Note: The large construction spend estimated to be incurred in 2064 represents the cost of additional loops to accommodate the future volumes based on ARTC modelling. * Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 10.4 Inland Rail financial assessment: summary of Inland Rail ongoing costs and revenue (excluding capital costs, $ million – nominal)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

10.6. Sensitivity analysis

Sensitivity testing has been undertaken on key revenue, cost and economic assumptions against the core Inland Rail results based on the results of the 50 year assessment period including complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

The financial sensitivity tests Includes three main components:

- The revenue sensitivity tests illustrate a potential range of financial results if the estimated level of revenue differs from the core scenario. This tests the robustness of the results under alternative outlooks for the freight market (for example, due to changes in the global coal price or GDP growth), or mode shift assumptions (for example, due to factors that determine the relative price of road and rail freight or the behavioural responses that might occur to those prices). Revenue sensitivity scenarios are based on the demand sensitivity scenarios, which were discussed in Chapter 7 (Demand).
- Subsequently, the sensitivity of the results is also tested to changes in the technical assumptions used to calculate the present value of financial costs and revenue. This considers alternative appraisal periods, approaches to discount rates, and increases/decreases in costs.
- Combination of concurrent revenue and key assumption sensitivities in packages of upside and downside scenarios were also considered.

Table 10.2 sets out the alternative revenue scenarios that have been analysed and their respective impact on the Inland Rail financial results.

Table 10.2 Financial sensitivity analysis results for revenue sensitivities ($ million, discounted)

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
1. Core Scenarios				
1a. Core scenario: Requires capital investment in additional loops on the Western Line or additional loops and Brisbane metropolitan rail network (at Murrarie and Clapham Yard) to enable coal train lengths to increase from 650 metres to 1010 metres.	**(5696)**	**-**	**2150**	**-**
1b. Core scenario: Assumes there is no capital investment in additional loops on the Western Line or additional loops and Brisbane metropolitan rail network.	**(6122)**	**(426)**	**1725**	**(426)**

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
2. Demand price elasticity†				
2a. High price elasticity: Assumes a negative four per cent price elasticity which is double the core appraisal elasticity and benchmarked against the upper bound of the price elasticity range reported by 2008–09 survey respondents.	(4923)	773	2924	773
2b. Low price elasticity: Assumes a negative one per cent price elasticity which is half of the core appraisal elasticity and benchmarked against the lower bound of the price elasticity range reported by 2008–09 survey respondents.	(6232)	(536)	1615	(536)
3. Alternative rail access prices‡				
3a. Increased Inland Rail access price: Rail access price assumed to increase by 20 per cent per tonne between Illabo to Kagaru.	(4978)	719	2869	719
3b. Decreased Inland Rail access price: Rail access price assumed to decrease by 20 per cent per tonne between Illabo to Kagaru.	(6416)	(720)	1431	(720)
3c. Revenue maximising rail access price for intercapital freight: Revenue maximising rail access price is the access price at which Inland Rail obtains maximum revenue, which was estimated to be 202 per cent of the core access price.	(1412)	4285	6435	4285
3d. High Inland Rail coal access price ($14 per thousand gross tonne kilometres): Inland Rail access charge assumed to be $14 per gross tonne kilometre consistent with the QCA's October 2014 draft determination for the Western System - decreasing coal volumes to 11.5 million tonnes.[149]	(5606)	90	2241	90
3e. High Inland Rail coal access price ($19 per thousand gross tonne kilometres): Inland	(5247)	449	2600	449

[149] QCA, 'Queensland Rail's 2013 Draft Access Undertaking', October 2013.

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
Rail access charge assumed to be $19 per gross tonne kilometre, consistent with QR's May 2015 submission to the QCA - decreasing coal volumes to 11.5 million tonnes.[150]				
4. Alternative road pricing and access arrangements				
4a. Road pricing based on depreciated optimised replacement cost (DORC) values: Tests the impact on Inland Rail if road applies a DORC pricing approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).[151]	(5542)	154	2305	154
4b. B-triple access: As the core appraisal assumes B-triple access will not be possible between Melbourne and Brisbane, it considers the impact of B-triples on the Hume, Pacific or Newell Highway corridors on Inland Rail demand along with no change in the road pricing approach.[152]	(6384)	(688)	1463	(688)
4c. Road pricing based on DORC values and B-triples access: Considers the impact of B-triples on the Hume, Newell or Pacific Highway corridors on Inland Rail demand along with applying a DORC value approach that captures the road cost base (based on analysis in the 2010 Inland Rail Alignment Study).	(6185)	(488)	1662	(488)

[150] Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May 2015.

[151] Increasing Melbourne to Brisbane road user costs by 169 per cent (an estimate of the depreciated optimised user costs of B-doubles and higher productivity vehicles) leads to higher prices for road freight and improved volumes in the base case and with Inland Rail. Under these assumptions, in 2049–50 Inland Rail's total volumes will increase by two per cent and the volume of non-bulk goods between Melbourne and Brisbane will increase by eight per cent.

[152] B-triples can transport almost 50 per cent more mass than B-doubles, and super B-doubles would allow a prime mover to pull four twenty-foot equivalent units (TEUs) provided that axle limits are not exceeded. These two vehicle configurations significantly improve road freight cost efficiency for mass or volume constrained freight. It is assumed that approximately half of all movements are on these trucks, with a 38 per cent operating cost saving compared to articulated trucks (but that they must travel via the Hume, Newell or Pacific Highway corridors imposing an additional two per cent distance).

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
5. Change in coal price§				
5a. High coal price: Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and no change in the Inland Rail coal access charge ($5 per thousand gross tonne kilometres).	(5696)	-	2150	-
5b. High coal price ($US95 per tonne) and high Inland Rail coal access charge ($14 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $14 per gross tonne kilometres consistent with the QCA's October 2014 draft determination for the Western System – resulting in coal volumes remaining at 19.5 million tonnes.	(5147)	549	2700	549
5c. High coal price ($US95 per tonne) and high Inland Rail coal access charge ($19 per thousand gross tonne kilometre): Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne) and an Inland Rail coal access charge of $19 per gross tonne kilometres Inland, consistent with QR's May 2015 submission to the QCA – resulting in coal volumes remaining at 19.5 million tonnes.[153]	(4603)	1093	3243	1093

[153] Queensland Rail, 'Explanatory Submission – Queensland Rail's Draft Access Undertaking 1, Volume 1', May 2015.

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
5d. **Low coal price:** This scenario assumes a lower coal price of US$55 per tonne and no change in the Inland Rail coal access charge ($9 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 4 million tonnes.	(6332)	(635)	1515	(635)
5e. **Low coal price, low Inland Rail coal access charge:** This scenario assumes a lower coal price of US$55 per tonne and a 20 per cent reduction in the Inland Rail coal access charge ($7 per thousand gross tonne kilometres) – resulting in coal volumes decreasing to 6 million tonnes.	(6311)	(614)	1536	(614)
6. **Change in GDP growth**[ll]				
6a. **High GDP growth:** This scenario assumes that 2013–14 will see 2.8 per cent growth in real GDP followed by 2.7 per cent growth in 2014–15 and 3.3 per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with trend at 3.2 per cent pa.	(5542)	154	2304	154
6b. **Low GDP growth:** This scenario assumes that 2013–14 will see 2.7 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and 2.8 per cent in 2015–16. After this period ACIL Allen has assumed that long-run real growth is in line with the projections of the Treasury's Intergenerational Report less (0.6 percentage points).	(5881)	(185)	1965	(185)
6c. **Capped demand growth:** This scenario conservatively assumes no growth in demand post 2054-55 which is the final year for which GDP forecasts are available from the 2015 Intergenerational Report.	(6447)	(750)	1400	(750)
7. **Change in long term oil price**				
7a. **High oil price:** This scenario assumes an oil price of $US200 per barrel ($2015) by 2030.	(5566)	131	2281	131

REVENUE SCENARIO	INLAND RAIL PROGRAMME ($ MILLIONS)		INLAND RAIL OPERATING CASH FLOW ($ MILLIONS)	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
7b. Low oil price: This scenario assumes an oil price of $US50 per barrel ($2015) by 2030.	(5869)	(173)	1978	(173)
8. Upside and downside scenarios				
8a. Package of upside scenarios: This scenario assumes high price elasticity (2a), road pricing based on depreciated optimised replacement cost (DORC) values (4a), a high coal price ($US95 per tonne) (5a) and a 10 per cent reduction in capital costs.	(3990)	1706	3118	968
8b. Package of downside scenarios: This scenario assumes low price elasticity (2b), B-triple access on the Hume, Pacific or Newell Highway corridors (4b), a low coal price ($US55 per tonne) (5d) and a 30 per cent increase in capital costs (9c).	(9502)	(3806)	560	(1590)

* Relates to Melbourne to Brisbane, Adelaide to Brisbane and Perth to Brisbane intercapital freight.

† The core demand assumes a price elasticity of two per cent.

‡ The core demand assumes an access price of approximately $17 per tonne for Melbourne to Brisbane intercapital freight in real 2024–25 prices. Intercapital rail access price makes up 15.8 per cent of total door-to-door price in the core demand. Coal access charges are assumed to be $5 per thousand gross tonne kilometres on Inland Rail between Oakie and Acacia Ridge and $14 per thousand gross tonne kilometres on the Western Line and Brisbane metropolitan network. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

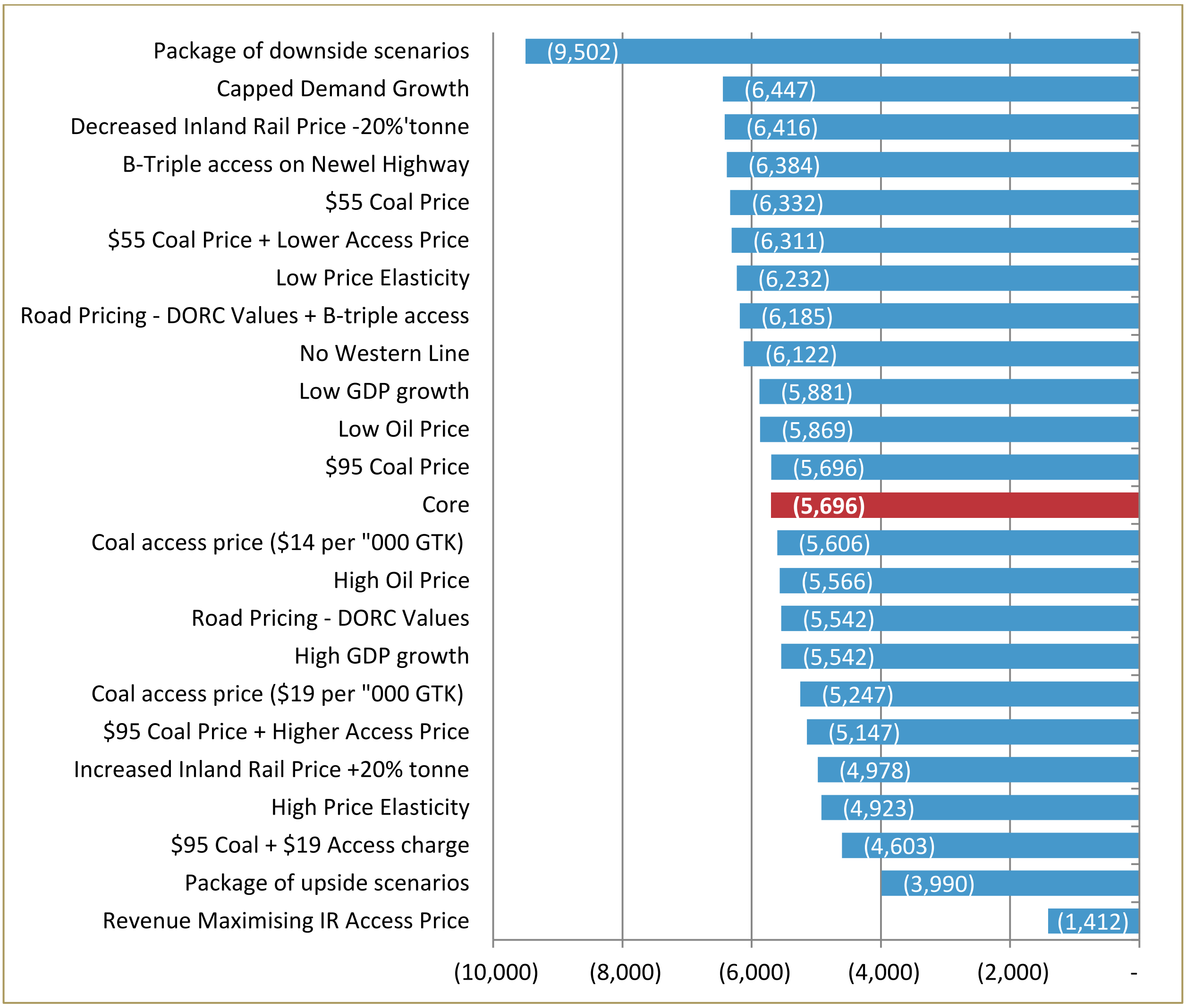
§ The core demand assumes a US$75 per tonne Newcastle benchmark coal price. These volumes require complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

ǁ The core demand assumes that 2013–14 will see 2.75 per cent growth in real GDP followed by 2.5 per cent growth in 2014–15 and three per cent in 2015–16. After this period, it has been assumed that long-run real growth is in line with the projections of the Treasury's Intergenerational Report (Source: Department of Treasury and Finance, 2010). The core demand assume a long term oil price of $US 130 per barrel ($2015).

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

The results of the revenue scenarios analysed above are shown graphically in Figure 10.5 and Figure 10.6.

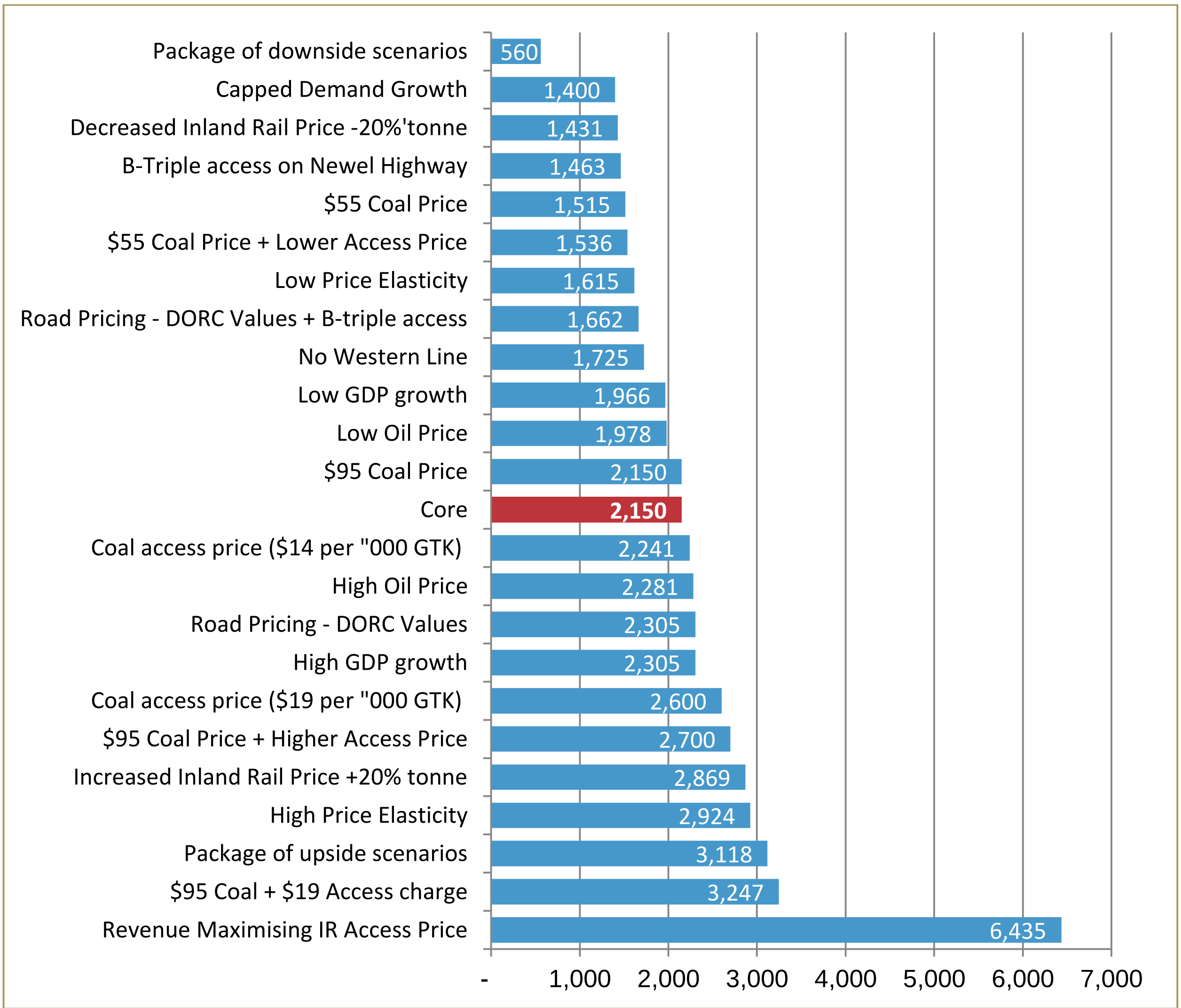
Figure 10.5 Financial sensitivity analysis results for revenue sensitivities ($ millions, discounted)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 10.6 Financial sensitivity analysis results for revenue sensitivities (operating cash flow) ($ millions, discounted)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

The key findings of the revenue sensitivity analysis include:

- The overall NPC of Inland Rail and the NPV of the operations of Inland Rail improves significantly by assuming a revenue maximising rail access price for intercapital freight.
- The overall NPC of Inland Rail and the NPV of the operations of Inland Rail is moderately sensitive to changes in the access prices and to decreases in coal price.
- The overall NPC of Inland Rail and the NPV of the operations of Inland Rail is not sensitive to changes in GDP Growth, price elasticities or changes in assumptions regarding road pricing and the use of B-triples.
- Increases in volumes do not necessarily translate into increases in revenue and overall changes in the NPC of Inland Rail.

- Increases (decreases) in revenue can, in some instances be offset by increases (decreases) in maintenance costs (due to changes in volumes). This means the overall change in NPC may not be as pronounced as expected and in some instances the results may appear counterintuitive to the reader (ie. Where the decrease in revenue is more than offset by a decrease in maintenance costs the overall NPC may improve).

Further sensitivity analysis on other key assumptions used in the financial analysis is shown in Table 10.3.

Table 10.3 Sensitivity analysis NPV (NPC) (pre-tax) nominal cash flows ($ million, 2014 dollars, discounted)

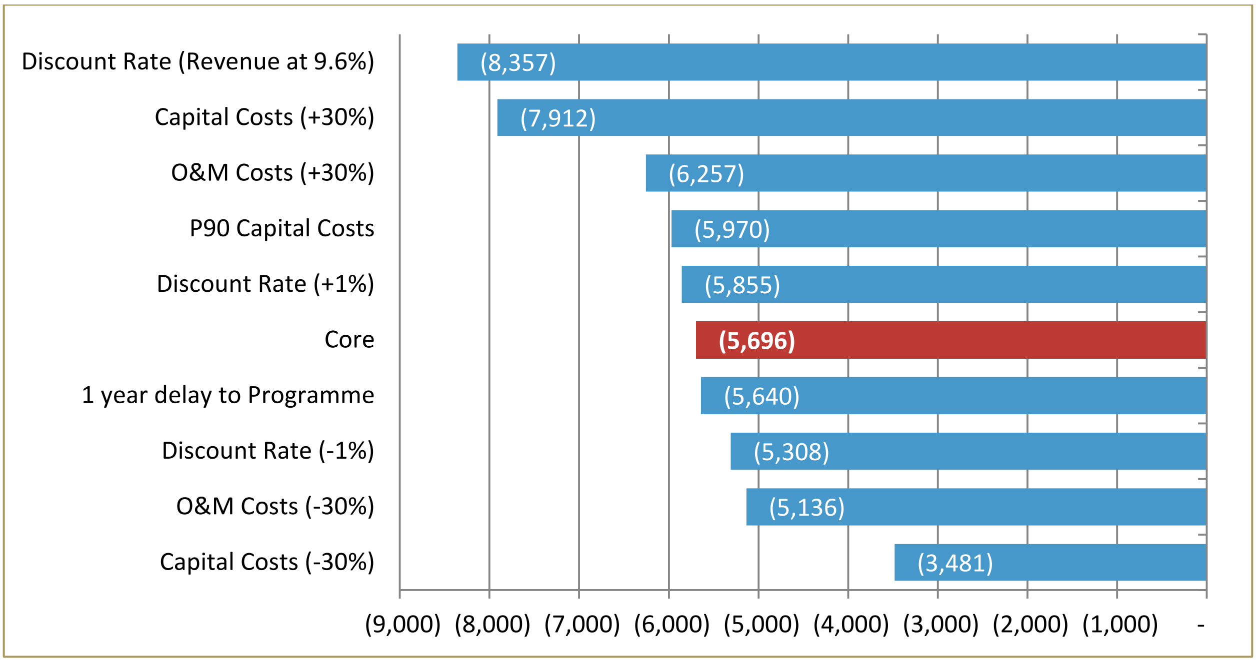
	INLAND RAIL PROGRAMME		INLAND RAIL OPERATING CASH FLOW	
SENSITIVITY	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
Differing Discount Rates: Revenues are discounted at a higher rate (9.6%) reflecting the systematic risk of these cashflows.	(8,357)	(2,660)	(510)	(2,660)
Higher discount rate: Future costs and revenues are discounted using a 6.60% discount rate.	(5,855)	(159)	1,498	(653)
Lower discount rate: Future costs and revenues are discounted using a 4.60% discount rate.	(5,308)	389	3,127	977
High capital costs: This scenario assumes a 30 per cent increase in capital costs.	(7,912)	(2,215)	2,150	-
Low capital costs: This scenario assumes a 30 per cent decrease in capital costs.	(3,481)	2,215	2,150	-
Increased ongoing costs: This scenario assumes a 30 per cent increase in ongoing operating and maintenance costs.	(6,257)	(561)	1,590	(561)
Decreased ongoing costs: This scenario assumes a 30 per cent decrease in ongoing operating and maintenance costs.	(5,136)	561	2,711	561
P90 Capital Costs: This scenario applies a risk range contingency of 36% representing the P90 risk range estimate.	(5,970)	(274)	2,150	-
1 Year Delay: This scenario assumes a 1 year delay in the construction programme whilst maintaining the assessment period to 2074.	(5,640)	57	1,892	(258)

Note: * A negative (positive) percentage change implies an increase (decrease) in NPC. ** Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

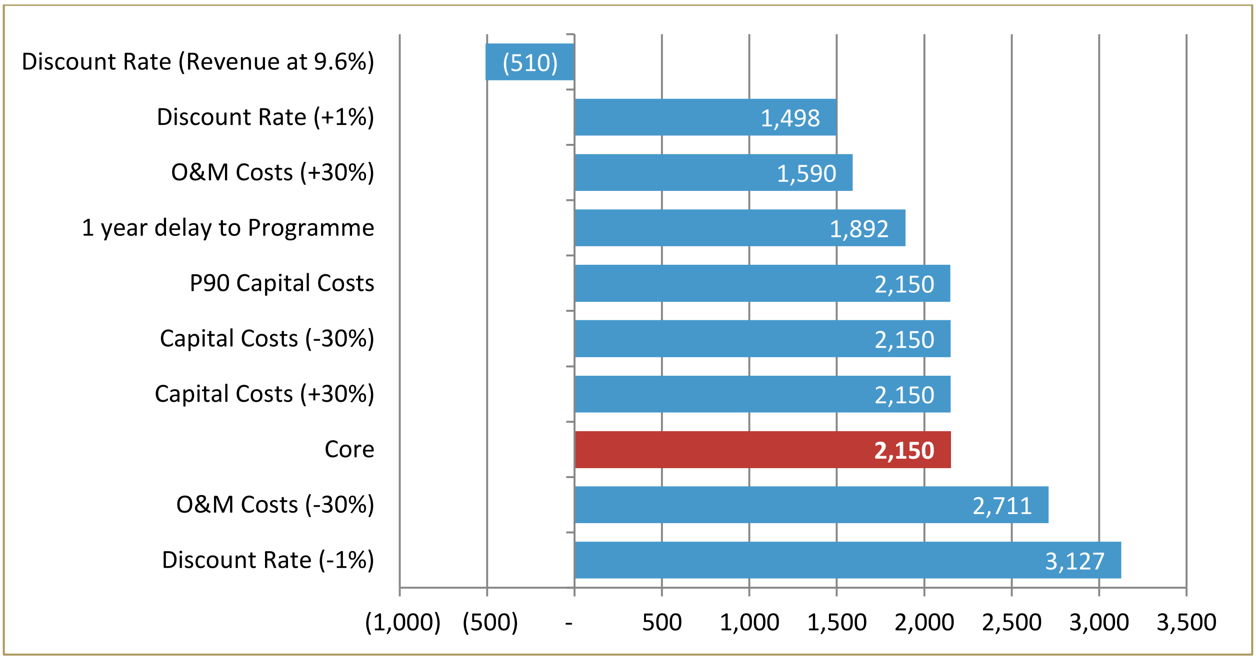
The results presented in Table 10.3 are depicted graphically in Figure 10.7 and Figure 10.8 respectively.

Figure 10.7 Financial sensitivity analysis results for key financial assumptions ($millions NPC)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.
Source: PwC, 2015.

Figure 10.8 Financial sensitivity analysis results for key financial assumptions (operating cash flow) ($ millions NPV)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.
Source: PwC, 2015.

The key findings of the key assumption sensitivity analysis include:

- The overall NPC of Inland Rail is most sensitive to changes in capital costs and relatively insensitive to changes in discount rates and operating and maintenance costs.
- The NPV of the operations of Inland Rail is most sensitive to changes in discount rates and only somewhat sensitive to changes in operation and maintenance costs.

As highlighted in the analysis above, a key sensitivity test is whether the results remain robust to a combination of concurrent downside scenarios. Table 10.4 steps out the independent and combined impacts of various scenarios that would lower revenue on Inland Rail relative to the core scenario, combined with the impact of greater than expected construction costs.

Table 10.4 Incremental financial impacts in the package of downside scenarios ($ million, 2014 dollars, discounted)

Scenario		INLAND RAIL PROGRAMME NPC (Change from Core)		INLAND RAIL OPERATING CASH FLOW NPV (Change from Core)	
		Independent impact	Combined impact	Independent impact	Combined impact on
1	5d: The coal price collapses	(635)	(635)	(635)	(635)
2	2b: Lower prices have a less than expected effect on non-bulk demand	(536)	(1282)	(536)	(1282)
3	4b: Trucking is more competitive than expected	(688)	(1590)	(688)	(1590)
4	8c: Construction costs are greater than expected	(2215)	(3806)	-	(1590)

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Note: The combined impact of different revenue scenarios are not additive.

Table 10.5 steps out the independent and combined impacts of various scenarios that would improve the level of revenue on Inland Rail relative to the core scenario, combined with the impact of lower than expected construction costs.

Table 10.5 Incremental financial impacts in the package of upside scenarios ($ million, 2014 dollars, discounted)

Scenario		INLAND RAIL PROGRAMME NPC (Change from Core)		INLAND RAIL OPERATING CASH FLOW NPV (Change from Core)	
		Independent impact	Combined impact*	Independent impact	Combined impact on*
1	5a: The coal price is higher than expected	-	-	-	-
2	2a: Lower prices have a greater than expected effect on non-bulk demand	773	773	773	773
3	4a: Trucking is less competitive than expected	154	968	154	968
4	8c: Construction costs are less than expected	738	1706	-	968

Source: PwC analysis based on ARTC and ACIL Allen inputs, 2015.

Note: The combined impact of different revenue scenarios are not additive.

10.7. Summary

In summary, the financial feasibility of Inland Rail was developed assuming it is delivered solely by the Australian Government including procurement, construction, ownership, and operations. The financial appraisal did not include financing costs, taxation considerations or the potential involvement of any private sector party (including associated contracting structures).

On a net present basis Inland Rail's ongoing benefits do not outweigh the large capital investment required upfront over a 50 year operating term. However, once operational, Inland Rail runs profitably (i.e. revenue more than covers ongoing operations and maintenance costs), the NPV of which is approximately $2.2 billion over 50 years.

Overall, Inland Rail is not NPV positive over the assessment life and thus requires government investment to deliver the infrastructure that would support the service offering. This is due to the large capital expenditure required over the 10 year construction schedule covering approximately 1700 kilometres between Melbourne and Brisbane.

Chapter 11

Environmental, planning and legislative strategy

11. ENVIRONMENTAL, PLANNING AND LEGISLATIVE STRATEGY

11.1. Purpose of this chapter

The purpose of this chapter is to provide a strategy for the ongoing assessment and management of key environmental and cultural heritage impacts, and to provide a recommended planning and environmental approval and corridor protection strategy.

11.2. Approach

A range of preliminary assessments have been completed and strategies developed to inform the delivery of Inland Rail Programme. These include:

- Environmental

  A strategy for the assessment and management of key environmental impacts has been developed based on a Preliminary environmental risk assessment (PERA), and review of applicable legislation, guidelines and national and international best practice.

- Approvals

  A strategy outlining the current planning and environmental approval legislation as it relates to Inland Rail, including a recommended planning and environmental approval and corridor protection strategy.

- Cultural heritage

  A topic paper provides the necessary background for understanding heritage issues associated with Inland Rail. It covers Indigenous and non-Indigenous heritage for the proposed alignment and sets out the core processes for the identification, mitigation of impacts and management of heritage.

This chapter provides an overview of the key sections within these strategies and assessments.

11.3. The need for an environmental, planning and legislative strategy

Planning and environmental approvals are required for both development and operation of Inland Rail which will consist of both greenfield alignments, where new corridors are required to be defined and protected, and existing rail corridors where upgrade/enhancement works are required.

Inland Rail will have a range of physical, social, ecological and economic impacts, both positive and negative. Key impacts need to be investigated and identified with regard to construction and operation of Inland Rail and proposed measures need to be put in place to mitigate negative impacts and enhance benefits.

Inland Rail does not exist as a separate legal entity and the Programme does not currently have any statutory approval or status. Consequently, there are no corridors which are specifically protected in the name of Inland Rail (although existing rail corridors and some future corridors in Queensland have some protection); nor are there any specific planning or environmental approvals currently in place. It is important to establish Inland Rail's statutory status and protection as soon as practically possible.

11.4. Environmental impact and regulatory assessment and management strategies

The key findings of the PERA and the cumulative impact assessment informed the identification of the key environmental factors for the environment strategy, planning strategy and environmental approval pathway for the rail alignment sections. This section provides an overview of the key environmental factors to be considered for Inland Rail and a summary of key applicable regulations, guidance and best practice policy for the assessment and management of key environmental factors across federal and state jurisdictions. These have been used to inform the development of an environmental management strategy for each factor (e.g. flora and fauna).

11.4.1. Key environmental impacts

Key environmental factors considered include:

1. noise and vibration
2. flora and fauna
3. air quality and greenhouse gas emissions
4. social
5. water
6. landscape and visual amenity
7. land use and property
8. soil and contaminated land
9. traffic, transport and access.

These are associated with applicable parties in Table 11.1 and their full descriptions, impacts and management strategies are discussed further within this section.

Table 11.1 Parties impacted by environmental factors

IMPACTED PARTIES	ENVIRONMENTAL FACTORS								
	1	2	3	4	5	6	7	8	9
Residential properties and landowners	✓		✓		✓	✓	✓		✓
Communities	✓		✓	✓	✓	✓	✓		✓
Hospitals	✓								
Schools	✓								
Churches	✓								
Community centres/facilities	✓								
Tourist attractions	✓								
Recreational facilities	✓								
Commercial properties/businesses	✓		✓	✓	✓	✓			

IMPACTED PARTIES	ENVIRONMENTAL FACTORS								
Endangered ecological communities		✓							
Wildlife corridors		✓	✓						
Threatened species–critically endangered and vulnerable		✓							
Aquatic flora and fauna		✓			✓				
Receiving waters					✓			✓	
Site workers								✓	
Rail and road users									✓

Source: PwC, adapted from PB inputs, 2015.

Noise and vibration

ENVIRONMENTAL IMPACT

- Construction noise and vibration impacts to nearby residences and sensitive receivers (e.g. schools, hospitals and churches) associated with new track within greenfield areas or increased rail traffic on existing track.
- Operational rail noise and vibration impacts to nearby residences and sensitive receivers (e.g. schools, hospitals and churches) associated with new track within greenfield areas or increased rail traffic on existing track.

BEST PRACTICE OPPORTUNITIES

- Continue to trial ARTC’s Rail Noise Abatement Program (RNAP) across New South Wales and monitor its success with a view to expanding the program across the Inland Rail alignment in high risk or priority areas/projects.
- Operational best practice opportunities to minimise noise at the source (i.e. rollingstock), through implementation of licence requirements and ongoing engagement with rail operators across Inland Rail.
- Opportunity to design and construct greenfield rail away from noise sensitive receivers and communities.

MANAGEMENT STRATEGY

- Implement applicable state policy and noise guideline planning levels for each state jurisdiction.
- Manage noise impacts through appropriate rail alignment design, (including opportunities to bypass key urban/town centres) and location of signals, passing loops and passing lanes in consultation with design engineers.
- Manage noise complaints through liaison with rail operators to address operator-specific noise complaints.
- Investigate and consider opportunities for noise control at source to manage operational noise through engagement with federal and state governments and rail operators, possibly over time, to mitigate future (2035 and beyond) noise impacts.

- Undertake further detailed assessment of the increase in rail traffic movements and impacts on noise assessment criteria to ensure that potential impacts can be identified, managed and costed at an early stage.
- Continue to engage and work with rail operators through licence requirements to minimise noise levels at source (i.e. rolling stock across Inland Rail). The New South Wales Government is currently reviewing the possibility of requiring rail operators to hold New South Wales Environment Protection Licences and have direct responsibility for controlling noise from rollingstock.

Flora and fauna

ENVIRONMENTAL IMPACT

- Clearing of vegetation for new track or track upgrades, construction compounds, ancillary facilities and access tracks.
- Permanent removal of native vegetation and associated habitat fragmentation and reduction.
- Impacts to threatened species, populations, ecological communities, ecosystems and fauna habitats.
- Potential impacts to aquatic flora and fauna from creek crossings and associated river embankment works, vegetation clearing, weed spreading and fauna disturbance.

BEST PRACTICE OPPORTUNITIES

- Impact avoidance: Be able to demonstrate that the flora and fauna survey data has informed specific avoidance in ecologically significant locations.
- Biodiversity offsets: Provide a comprehensive program-wide biodiversity offset package that addresses the Commonwealth and state offset requirements.
- Habitat connectivity: Ensure that national, state and regional habitat corridors are considered in the project design.

MANAGEMENT STRATEGY

- Apply state specific legislative requirements and compliance requirements. Where applicable, implement Commonwealth EPBC survey guidelines, impact assessment guidelines and offset guidelines.
- Liaise with relevant agencies to discuss the use of bilateral mechanisms to streamline Commonwealth and State approval processes for flora and fauna assessment and management.
- Implement the relevant State systems/legislative requirements for flora and fauna survey, assessment and offsetting for the missing link (greenfield) projects and other projects where required by legislation across Inland Rail alignment.
- Manage any potential cumulative impacts across projects by ensuring active projects take into account already agreed offset requirements for any previous/completed projects which are considered relevant to current projects (with regards to the project’s ecological communities).
- Through desktop assessment of the Inland Rail alignment, identify areas of potential biodiversity significance where vegetation clearing is expected and undertake ground-truthing exercise to identify any ecological constraints that may require route optimisation.

Air quality and greenhouse gas emissions

ENVIRONMENTAL IMPACT

- Generation of dust from earthworks and movement of construction vehicles.
- Dispersion of particulate emissions during rail operations (diesel and coal dust emissions).
- Greenhouse gases generated during construction and operation.
- Greenhouse gas savings through reduction in road freight.

BEST PRACTICE OPPORTUNITIES

- Implement driver assistance systems and speed management.
- Incorporate Electronically Controlled Pneumatic (ECP) brakes.
- Retrofit emission control–diesel particulate filters (DPF), selective catalytic reduction (SCR), and exhaust gas recirculation (ECR).
- Improve train and freight car aerodynamics.
- Implement idle management systems.
- Management of coal dust through maintaining moisture content in coal or veneering coal prior to transportation.
- Ambient Air Quality (AAQ) standards stipulate that dust management measures should ensure all relevant air quality criteria are met at the closest receptor locations.
- Utilisation of Liquefied Natural Gas (LNG) or Compressed Natural Gas (CNG) in place of diesel (if deemed suitable/practicable).

MANAGEMENT STRATEGY

- Adopt the Ambient Air Quality National Environmental Protectional Measure (AAQ NEPM) across each State for the assessment and management of ambient air quality impacts.
- Work with industry, State and Federal government agencies to move towards implementing the above best practice measures that are considered practicable and feasible to implement.
- Manage air quality impacts through appropriate rail alignment design and location of signals, passing loops and passing lanes in consultation with design engineers.
- Manage construction emissions on a project basis and in accordance with licence requirements.

Social

ENVIRONMENTAL IMPACT

- Positive economic benefits for local communities associated with increased expenditure from construction personnel purchasing local goods, services and accommodation.
- Socio-economic issues associated with the permanent severance of rural properties.
- Disruption from construction.
- Potential for itinerant workforce.

BEST PRACTICE OPPORTUNITIES

- Consideration of developing and implementing the following:
  - A community development and benefits program including school and university engagement, enhancement or replacement of impacted community facilities and infrastructure.
  - Industry and business engagement and capacity building to ensure local and regional involvement during the construction phase.
  - Workforce training, education and apprenticeships during the construction phase.
  - Housing and workforce management strategy.
  - Community and emergency services planning and engagement.
  - Social Impact Management Plan (SIMP) per region, managed through the engagement process and monitoring of outcomes with stakeholder groups.

MANAGEMENT STRATEGY

- Develop and implement standard social impact assessment methodology for specific Inland Rail sections that meets the requirements of state legislation/guidelines.
- Develop and implement stakeholder engagement plans to guide consultation and engagement with landholders, especially with regard to land acquisition, the wider community, service providers, government agencies and other key stakeholders.

Water

ENVIRONMENTAL IMPACT

- Erosion and sedimentation from construction activities and associated impacts on water quality.
- Water quality impacts as a result of spills or leaks from construction vehicles or machinery, or from chemical stores onsite.
- Where the alignment crosses floodplains, significant watercourses, or high quality groundwater aquifers (via tunneling), changes to the existing hydrological regime and increased risk of flooding.
- Where structures are to be built across the water courses, changes to flow velocity and associated scouring around bridge piers and sedimentation within waterways around structures.

MANAGEMENT STRATEGY

- On a project basis apply the New South Wales Water Sharing Plans, Aquifer Interference Policy and requirements for Queensland Great Artesian Basin (GAB) and sub-artesian water management areas.
- Develop and implement a suite of measures on a project basis to manage soil and water quality during construction, i.e. preparation of detailed erosion and sediment control plans that have been developed and approved by a Certified Professional in Erosion and Sediment Control (CPESC). Update measures as appropriate as new technologies of practices are available.
- Assess potential impacts to surface water bodies or influence through surface/groundwater interaction in greenfield sections and incorporate appropriate mitigation measures agreed by the relevant state water management authorities.

Landscape and visual amenity

ENVIRONMENTAL IMPACT

- Reduced visual amenity from construction plant and machinery, stockpiles and general construction activities.
- Reduced visual amenity as a result of the introduction of rail infrastructure into rural and or natural views i.e. high level viaducts traversing country side.

MANAGEMENT STRATEGY

- Develop and implement a consistent methodology that meets applicable state guidelines and is adaptable to site specific conditions, landscape characteristics and sensitive receivers to assess and manage landscape and visual amenity impacts. Look to minimise such impacts via design alignment reviews and refinements.
- On a project basis, prepare landscape/urban design strategies which include measures to consult with community members to identify sensitive receivers, appropriate viewpoints and individual properties with a view to developing appropriate sensitive design measures, visual barriers, appropriate landscaping species or natural screening where possible and appropriate.

Land-use and property

ENVIRONMENTAL IMPACT

- Restrictions or changes to property access and temporary use of land for access, site compounds or staging activities.
- Impediments of existing agricultural practices across alignments i.e. stock management and irrigation equipment.

MANAGEMENT STRATEGY

- Implement applicable legislative procedures for each state to address planning and land use approval processes.
- Look to minimise impact via design alignment reviews and refinements.

Soil and contaminated land

ENVIRONMENTAL IMPACT

- Disturbance to soil resulting in soil erosion.
- Contaminated materials in rail corridor including asbestos and contaminated soil.

MANAGEMENT STRATEGY

- Implement the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1) across all state jurisdictions to apply a consistent approach to the assessment of site contamination.
- Development of project specific waste strategies to ensure the adoption of appropriate waste management measures for the three major waste streams; timber sleepers, ballast and contaminated material, including asbestos and spoil.
- Measures should be implemented on a project by project basis investigating the appropriateness of re-use, onsite or offsite disposal and contamination testing requirements.

Traffic, transport and access

ENVIRONMENTAL IMPACT

- Disruption to freight and passenger rail services during tie-in works to the existing rail network.
- Changes to property access and road network as a result of removal or consolidation of level crossings.
- Traffic impacts such as delays or diversions as a result of construction of road bridges or level crossings, or from construction vehicles on the local road network.

MANAGEMENT STRATEGY

- Implement applicable traffic and transport legislation and guidelines to each state jurisdiction to assess and manage the impacts on the local road networks.
- Refer to the recommendations and conclusions documented in the Level Crossings Issue Paper to address conflicts and impacts to traffic, other road users and communities for the missing links (greenfield projects).
- Plan and undertake early consultation with landholders to address access and community impacts.

11.4.2. Sustainability

The main requirements and guidance for the assessment of the sustainability aspects of projects relate to:

- The use of a sustainability assessment/rating tool, such as the Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability Rating Tool.
- The completion of climate change risk assessments and adaptation strategies to inform the project.
- Ensuring that projects are consistent with the main principles of ecologically sustainable development, as part of the environmental impact assessment stage of the project.

BEST PRACTICE OPPORTUNITY

- Best practice in Australia at this stage is to target an ‘excellent’ or ‘leading’ rating through the ISCA Infrastructure Sustainability Rating Tool for the design, approvals, construction and operation of Inland Rail. Early endorsement of the desired ISCA rating level will allow planning and design to consider and incorporate a suite of measures and activities to achieve the desired rating and provide sustainable outcomes for Inland Rail.
- Consider implementing the principles and concepts outlined in the Sustainable Procurement Guide (2013) for environmental purchasing.
- Consider implementing the Green Star (Green Building Council of Australia) or NABERS for evaluating and incorporating sustainability principles in existing and new buildings.
- The TfNSW Transport Projects Division has a number of best practice sustainability policies and targets which are indicative of best practice sustainability assessment and management for transport projects in New South Wales.

MANAGEMENT STRATEGY

- In consultation with ARTC and DIRD review justification for adoption of ISCA rating tool across Inland Rail projects and engage with internal stakeholders to agree the desired ISCA rating.

- In consideration of above, review potential implementation of the ISCA Infrastructure Sustainability Rating Tool for particular Inland Rail projects, including agreeing the desired rating; noting that some state approval authorities may have this as a mandatory requirement.
- Assess the Programme against the principles of ESD during planning approval processes.
- Consider additional sustainability best practices including Green Star rating for buildings and applying the principles of Sustainable Procurement Guide (2013).

11.4.3. Cumulative environmental impacts

A program of the scale, geographical extent and duration of Inland Rail includes a number of different types of cumulative impacts including:

- Programme-wide impacts of specific indicators across the geographical extent of the Programme, including:
  - Cumulative impact on biodiversity, including combined loss of vegetation and habitat across adjacent route sections.
  - Combined impact on Indigenous and non-Indigenous heritage items and places across adjacent route sections.
  - Potential impact on air quality in Queensland sections as a result of potential increases in coal dust emissions from additional coal freight.
- Impacts that can accumulate over the duration of the construction and operational phases, including:
  - Increases over time (accumulation) in noise and air quality impacts as train numbers increase.
  - Social impacts of long, or multiple, construction phases for adjacent or nearby projects, including use of haul roads and disruption to passenger rail and existing freight operations.
- Cumulative impacts of the Programme in combination with known, or future, major infrastructure developments.

11.5. Planning considerations

11.5.1. Land use and zoning

Key land uses and land use zoning along Inland Rail alignment are provided in a map series, provided within the Environmental Strategy.

11.5.2. Corridor protection

The protection of the Inland Rail corridor is a crucial step to deliver Inland Rail as it can preserve land acquisition and tenure opportunities and provide some planning and land use protection from other development around the rail corridor. Inland Rail does not yet have formal or legal status, and so no corridors are specifically protected.

In New South Wales the most important mechanism for securing Inland Rail's status and preserving the corridor will be to list those projects classified as State Significant Infrastructure (SSI) in the Infrastructure State Environmental Planning Policy (SEPP) as soon as possible, with an additional objective of having them nominated in the State and Regional Development SEPP (SRD SEPP) as Critical SSI.

Corridor protection in Queensland can be provided through mechanisms such as:

- Declaration of 'future railway land' under the *Transport Infrastructure Act (TI) 1994.*
- The *Transport Planning Coordination (TPC) Act 1994* and *Acquisition of Land Act 1967*, which provides for compulsory acquisition of land for a transport purpose (not just passenger transport).

- Community Infrastructure Designation (CID).
- State Development Areas (SDA).

There has already been a substantial amount of corridor protection work on the SFRC, which is to be adopted for the Calvert/Rosewood to Kagaru section (via the TI Act). The Gowrie to Grandchester section of the alignment is also gazetted (via the TPC Act) and Inland Rail uses this alignment. However in other cases, Inland Rail needs to be gazetted (at the state level) to secure corridor status. In Victoria, Inland Rail is generally within the existing rail corridor and there is unlikely to be a need for corridor protection.

11.6. Planning and environmental approvals

Planning and environmental approvals are pre-requisites to the commencement of construction for major projects. Consequently planning and environmental approvals are:

- Often critically important in setting and meeting project time lines.
- Significant elements of project and corporate risk management strategies.

There is no uniform national law or process for securing planning and environment approvals, or for securing corridor protection. Each state has its own environment and planning laws, and there are Australian approval requirements which overlay state laws. The planning and environment approvals and corridor protection strategy for Inland Rail must therefore be developed in close consultation with the Australian and state governments.

11.6.1. Planning approvals strategy

Relevant State and Commonwealth planning requirements have been reviewed to determine the relevant planning approval pathway for each rail section and approaches to rail corridor protection with relevance to regional and local plans. A summary of the planning approval process is provided in Table 11.2. Flow charts outlining the potential environmental planning approvals pathways that are available for each state are provided in Figure 11.1, Figure 11.2 and Figure 11.3.

It is anticipated that greenfield alignments will require corridor protection under relevant state planning instruments. Greenfield works are likely to trigger the Australian Government *EPBC Act 1999* and therefore a full environmental impact assessment, which will require property acquisition to ensure the corridor is secured.

Where there are existing rail lines, existing use rights will apply and the completion of the relevant legislative level of environmental assessment will also be required. Works outside of the corridor will also require detailed planning and Environmental impact assessments (EIA).

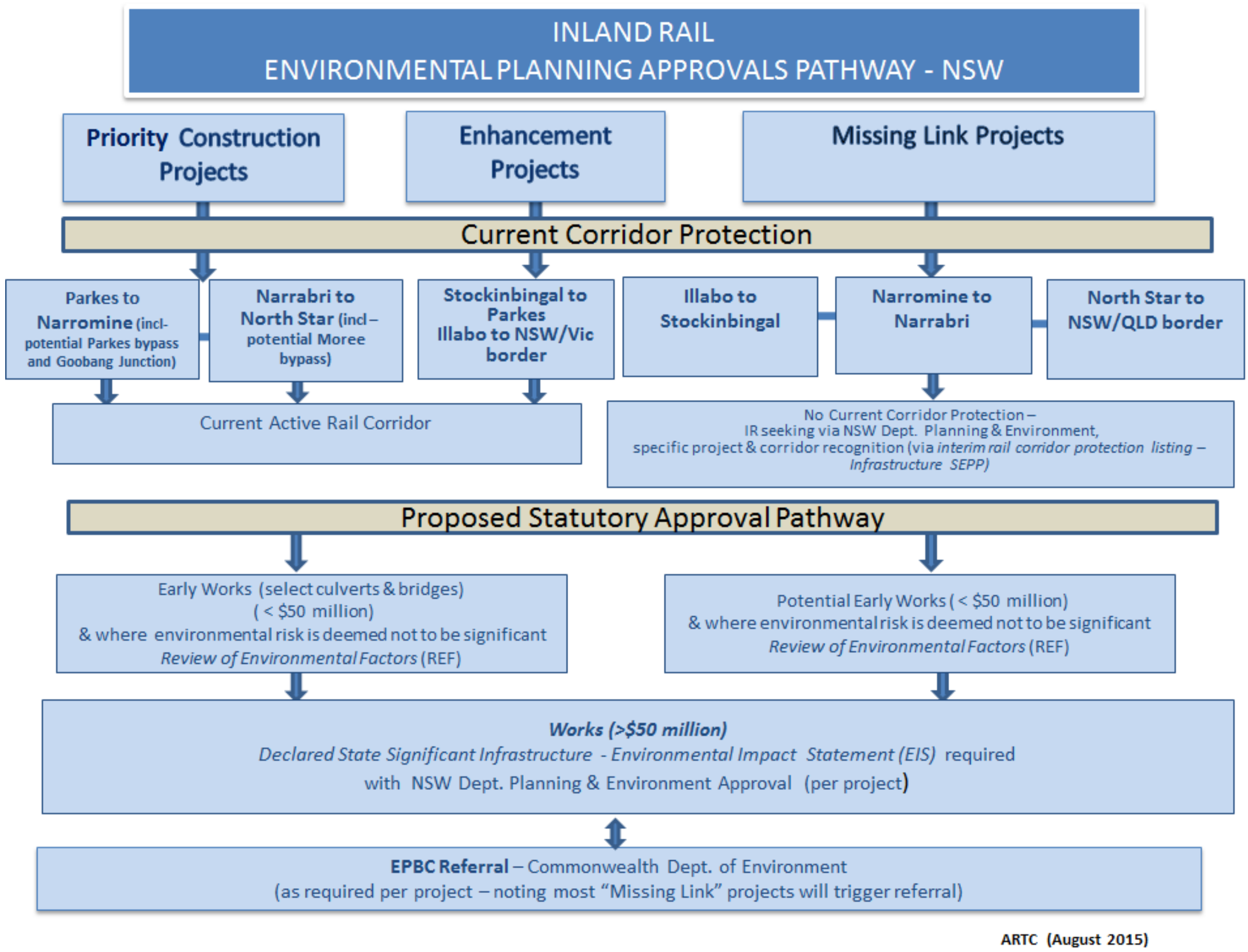
Table 11.2 Summary of planning approval processes

PROJECT	PROPOSED WORKS	CORRIDOR STATUS	COMMONWEALTH (EPBC)	STATE PLANNING REQUIREMENTS
Victoria				
Melbourne to New South Wales border	Enhancement works – bridge lifting and possible loops	Existing use rights	Unlikely	Individual planning permits or ministerial planning scheme amendment
New South Wales				
Victoria border to Illabo Stockinbingal to Parkes	Enhancement works – bridge lifting and possible loops	Existing use rights	Unlikely	EIS as part of SSI process or apply ARTC's REFs for works (or part of works e.g. enabling works) that are under $50 m and meet other legislative requirements.
Narromine to Narrabri Illabo to Stockinbingal	Greenfield construction	No protection	Likely	EIS as part of SSI process.
Parkes to Narromine Narrabri to North Star	Track upgrades, loops, flood protection, bridges, culverts and level crossings	Existing use rights	Not anticipated	EIS as part of SSI process or REF's for works (or part of works e.g. enabling works) that are under $50 m and meet other legislative requirements.
North Star to Queensland border	Greenfield construction	Part greenfield, part abandoned corridor	Likely	EIS part of SSI process.

<table>
<tr><th>PROJECT</th><th>PROPOSED WORKS</th><th>CORRIDOR STATUS</th><th>COMMONWEALTH (EPBC)</th><th>STATE PLANNING REQUIREMENTS</th></tr>
<tr><td colspan="5">Queensland</td></tr>
<tr><td>New South Wales Border to Oakey</td><td>Mostly greenfield construction</td><td>No protection</td><td>Likely trigger</td><td rowspan="5">Options include:
• Progress existing Community Infrastructure Designation/Transport Infrastructure Act in parallel with EPBC requirements under bilateral agreement (where required).
• Declaration of a Co-ordinated Project under SDPWO Act with related environmental assessment linking to EPBC bilateral agreement.</td></tr>
<tr><td>Oakey to Gowrie</td><td>Capital works – narrow gauge to dual gauge</td><td>Existing use rights</td><td>Not anticipated</td></tr>
<tr><td>Gowrie to Grandchester</td><td>Greenfield construction</td><td>Gazetted as “future public transport corridor” under TPC Act. Some properties acquired</td><td>Yes – known triggers</td></tr>
<tr><td>Calvert/Rosewood to Kagaru (SFRC)</td><td>Greenfield construction</td><td>Gazetted as ‘future railway land’ under TI Act. Some properties acquired</td><td>Yes – known triggers</td></tr>
<tr><td>Kagaru to Acacia Ridge</td><td>Enhancement works – bridge lifting and possible loops</td><td>Existing use rights</td><td>Unlikely</td></tr>
</table>

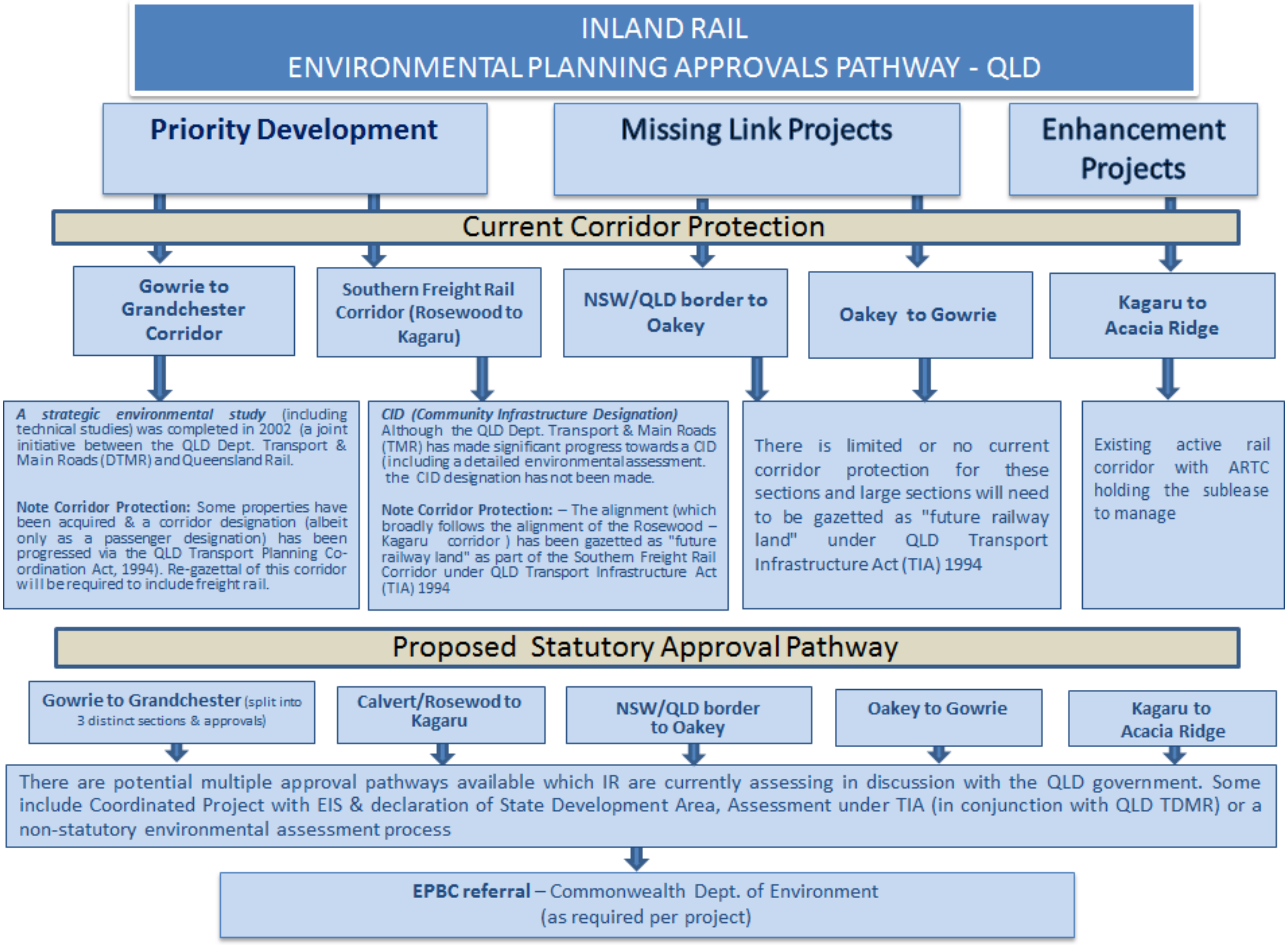
Source: ARTC, 2015.

Figure 11.1 New South Wales environmental planning approvals pathway



Source: ARTC, 2015.

Figure 11.2 Queensland environmental planning approvals pathway

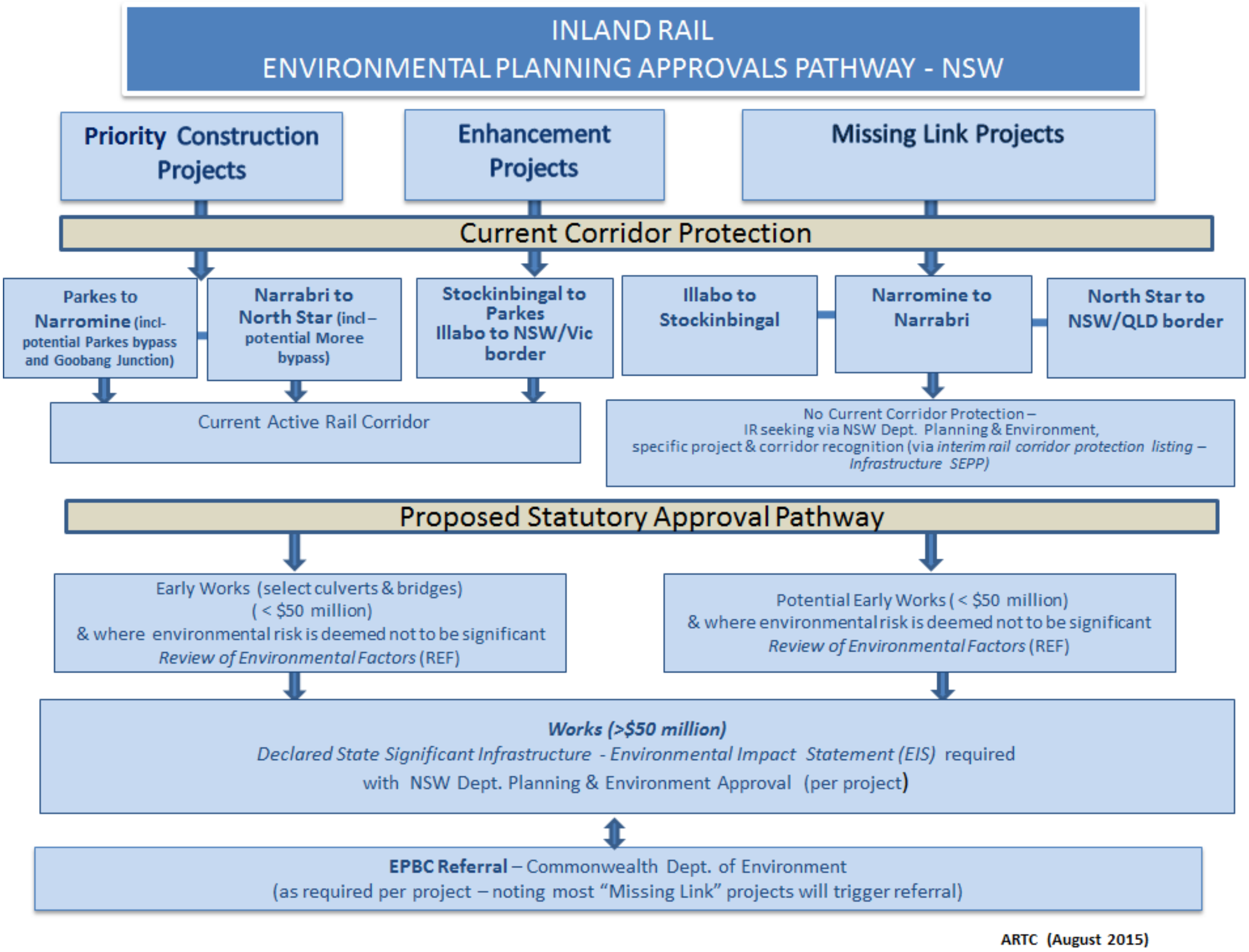


ARTC (August 2015)

Note: The Transport Infrastructure Act may also be a potential mechanism for planning approvals.

Source: ARTC, 2015.

Figure 11.3 Victoria environmental planning approvals pathway



Source: ARTC, 2015.

11.7. Cultural heritage investigation and management

A Cultural Heritage Topic Paper was completed in November 2014 which focused on four key areas:

- Identification of best practice.
- Desktop assessment.
- Development of a heritage management strategy.
- Provision of indicative costs and timing.

The identification of best practice guidelines was undertaken following a thorough examination of relevant international, federal and state heritage legislation, as well as regulations, policy and guidance.

The heritage management strategy sets out the core processes for the identification, mitigation of impacts and management of heritage. Based on the contents of the heritage strategy, indicative costs and timing have been provided as estimates.

11.7.1. Legislative context and guidelines

The national legislation provides a framework for the protection and management of items considered to be of national or international significance. The intention of state based legislation is to identify, protect and manage items identified as significant at the state level. A summary of heritage guidelines which operate alongside the legislative framework has also been provided to assist in the identification of heritage best practice.

11.7.2. Best practice

The identification of best practice guidelines was undertaken following a thorough examination of relevant international, federal and state heritage legislation, as well as regulations, policy and guidance. Based on this assessment the Burra Charter and the Ask First guideline are the most applicable guidelines for Inland Rail.

The Burra Charter is recognised by the International Council for Monuments and Sites (ICOMOS) and provides a framework specific to the Australian heritage context. The Ask First guideline was created under the auspices of the Australian Heritage Commission and is recognised as a national best practice standard for Indigenous heritage.

11.7.3. Heritage registers search results

A detailed list of all non-Indigenous and Indigenous sites related to the alignment is contained within the Cultural Heritage Topic Paper.

11.7.4. Heritage management strategy

The key steps involved in the Indigenous and non-Indigenous heritage management strategy include heritage identification, stakeholder engagement, heritage significance assessment, field survey, impact assessment, implementation of mitigation and management measures, and documentation of measures implemented which may include salvage (collection, removal, excavation of heritage) and/or archival recording.

There are a range of non-Indigenous and Indigenous heritage management processes available for the overall strategy for heritage investigation, mitigation and management. These include:

- **Heritage significance assessment:** In situations where an identified heritage place does not have a related citation or description of significance.
- **Heritage impact assessment:** To understand the nature and scale of heritage impacts.
- **Conservation management strategies and plans:** Mechanisms to help secure the appropriate long-term conservation of a heritage place.

11.7.5. Heritage approvals

The form of approval required for changes to a heritage place differ between local heritage places identified in statutory planning documents and those included in a state heritage register.

Specialist heritage approvals are not required for proposed works to a local heritage place but rather if the proposed works are classed as a development, a development approval (Queensland and New South Wales) or planning permit (Victoria) will be required from the relevant local council or state department, depending on the approval pathway chosen. With regard to places included on the state heritage register, the types of consents vary by state.

Queensland

The General Exemption Certificate is given without application and is a self-assessable process which provides upfront permission for ongoing maintenance and necessary work to keep a Queensland Heritage Place well maintained and in good condition. An Exemption Certificate requires an application to the Department of Environment and Heritage Protection (DEHP) for minor works that will not involve significant change. Development approval is required for significant changes to a state heritage place and DEHP act as a concurrence agency.

New South Wales

A Section 60 Permit is required to carry out works, including excavation, to an item listed on the State Heritage Register (SHR), or subject to an interim heritage order with approval granted by the New South Wales Heritage Council. A Section 140 Archaeological Permit and Section 144 Variation Permit are required for the disturbance or excavation of sites not listed on the SHR but thought to have archaeological potential.

Victoria

An application to Heritage Victoria for a Heritage Permit is required for works that will alter an object or place included on the Victorian Heritage Register. Permit Exemptions can be obtained in certain circumstances including those approved by the Heritage Council on the recommendation of the Executive Director and as part of a set of standard exemptions which covers minor maintenance and repair works.

11.7.6. Native title

The Inland Rail alignment crosses areas where registered Native Title Claims (determined or non-determined) exist. The registered native title claimants under the *Native Title Act 1993* have access to certain procedural rights while any application is being considered for activities that affect their native title rights and interests before a determination is made by the Federal Court.

The procedural rights include either the right to be consulted, or the opportunity to comment, or the same rights as an ordinary freehold title holder. Inland Rail may therefore be required to consider the impact of activities on native title rights and interests, and consult with the registered Indigenous claimants.

The Heritage Management Strategy outlined in section 11.7.4 will fully examine legal requirements concerning any registered Native Title Claims concerning Inland Rail.

In addition to the above consultative requirements, in land tenure terms, Native Title can only be claimed over un-alienated land—for example, public land ‘Crown land or Crown road reserves’ that has not been used for a public purpose. Therefore, in terms of Inland Rail, the issue of dealing with native title from a land tenure perspective relates only to a select group of land owners.

11.8. Current/planned activities

11.8.1. Planning approvals–general

- Establishing a list of projects (for each state) and their scope (i.e. further development of the Scope Book within the Basis of Estimate), in terms of their physical extent and capital value.
- Assess each stage of the Programme to confirm the likely planning approval pathway. Where further information is required, develop a gap analysis of the limitations identified to date. This could include:
  - The need for better information on project definition.
  - Preliminary scoping of environmental impacts (building on work undertaken to date).

  - Determination of capital value of works.
  - Schedule for development of each section within the wider Programme.
  - Evaluation of whether there will be in-corridor or greenfield works.
  - The perceived Programme advantages and disadvantages of potential identified state approval pathways.
- Undertake additional targeted investigations and environmental planning approval pathway assessments (strategies) in order to confirm the planning approval pathway.
- Develop an approvals timeline for each of the planning approval pathways involved and review against the overall Inland Rail delivery to ensure timeframes are achievable and appropriate.

11.8.2. Commonwealth planning approvals

- Undertake preliminary (desk-based) assessments and ground-truthing to determine which projects may have an impact on Commonwealth Matters of National Environmental Significance and therefore may require a referral under the EPBC Act.
- Establish an understanding of timeframes for each planning approval pathway.
- Consultation with the Commonwealth Department of Environment to seek preliminary advice on the likely planning approval approaches.
- For high-risk sections or those planned for early delivery, consider preparing project-specific referrals.
- For bilateral agreements:
  - Monitor the progress of establishing bilateral arrangements in the three states.
  - Investigate whether any works are proposed on Commonwealth land (where a significant impact on Commonwealth land would be a trigger) where the bilateral process would not apply.
- Liaison with the Commonwealth Department of Environment to explore the value and relevance of the strategic assessment method.

11.8.3. New South Wales planning approvals

- Ongoing consultation with New South Wales Department of Environment and Planning should continue to investigate the potential of listing Inland Rail in the Infrastructure SEPP and SRD SEPP, and seeking a 'critical infrastructure' designation (CID).
- Consultation with New South Wales Department of Environment and Planning to explore the department's intentions with regard to strategic environmental assessment. For example, whether it is likely to be included in future planning reforms within the ultimate Inland Rail timeframe.

11.8.4. Queensland planning approvals

- Continue consultation with relevant Queensland agencies to confirm likely pathways for identified development projects.

11.8.5. Corridor preservation

- For recommendation under New South Wales planning approvals–seek specific listing of Inland Rail in the Infrastructure SEPP and SRD SEPP, and CID designation through consultation with New South Wales Department of Planning.

- Undertake a review of work done to date on the SFRC CID to determine the scope of residual environmental assessment work required to secure approval to construct the Calvert/Rosewood to Kagaru corridor section.
- Continue consultation with Queensland government stakeholders to seek gazettal of the relevant Queensland Inland Rail corridors.
- Undertake a desktop review of local plans to identify complementary and incompatible land uses adjacent to the alignment, with a brief summary report outlining any ‘hotspots’ (acute land use conflicts) or opportunities (corridor already zoned).

11.8.6. Regional planning

- Undertake a review of regional growth plans to identify the extent to which the Inland Rail Programme could be incorporated (and to what benefit), identify the plan review cycles, and future opportunities to engage with the relevant authorities to promote inclusion of the Programme.

11.8.7. Major developments

- Undertake periodic review of Infrastructure Australia’s Priority Projects Register, the Queensland Department of Infrastructure, Local Government and Planning’s Key Infrastructure Project Register, New South Wales Department of Planning’s Major Project Register and relevant local council planning and development systems to monitor new proposed developments and update the Major Development Register as appropriate.

11.8.8. Stakeholder engagement

- Undertake targeted consultation and engagement with relevant stakeholders and regulatory authorities identified in Chapter 6 (Communication and stakeholder engagement), to outline the proposed environmental assessment process and timeframes.
- Review and update the Stakeholder Engagement Plan as appropriate.

11.8.9. Environmental strategy

- In line with further Inland Rail alignment refinements and preferred route selection, undertake further detailed assessment of the increase in rail traffic movements and impacts on noise assessment criteria to ensure that potential impacts can be identified, managed and costed at an early stage.
- For the management and mitigation of identified rollingstock noise and air quality issues continue to work with industry, state and federal government agencies to move towards implementing best practice measures that are considered practicable and feasible to implement.
- As part of the development of a Heritage Management Strategy, initiate a Stakeholder Engagement Plan for consulting with Indigenous and non-Indigenous heritage stakeholders and native title claimants. This strategy and plan will cover native title consultation requirements and processes, identify potential impacts and propose impact assessment methodologies and management approaches.
- Through desktop assessment of the Inland Rail route, identify areas of high Aboriginal archaeological potential and possible biodiversity significance and undertake ground-truthing exercise to identify any Aboriginal archaeological or ecological constraints that may require route optimisation.
- In consultation with ARTC and DIRD, review justification for adoption of ISCA rating tool across Inland Rail projects/stages and engage with internal stakeholders to agree desired ISCA rating.

11.8.10. Cultural heritage and native title investigation and management

- Indigenous heritage identification (survey) in high risk areas should be prioritised, along with the consideration of avoidance options for non-Indigenous heritage items in the new track alignment.
- Develop a strategy for heritage stakeholder engagement, including Indigenous stakeholders.
- Recording and identification of heritage areas should be integrated into the procurement of heritage services.
- Complete strategies for Interpretation, Public Engagement in Heritage and Intangible Heritage as early as possible to meet emerging trends in heritage best practice.
- Complete a native title search.

11.9. Summary

Development of the long Inland Rail corridor is highly complex with extensive environmental and heritage approval and legislative requirements across three state governments and the Australian Government.

Inland Rail does not exist as a separate legal entity and does not currently have any statutory approval or status. Consequently, there are no corridors which are specifically protected in the name of Inland Rail (although existing rail corridors and some future corridors in Queensland have some protection); nor are there any specific planning or environmental approvals currently in place. It is important to establish Inland Rail's statutory status and protection as soon as practically possible.

There has been a substantial amount of work on the SFRC, which is to be adopted for the Calvert/Rosewood to Kagaru section. The Gowrie to Grandchester section of the alignment is also gazetted and Inland Rail is to use this alignment. However, in other cases Inland Rail needs to be gazetted (at the state level) to secure corridor status. In Victoria, Inland Rail is generally within the existing rail corridor and there is unlikely to be a need for corridor protection.

Protecting the rail corridor through available state mechanisms should be progressed as soon as possible to preserve land acquisition and tenure opportunities, and provide planning and land use protection from other major developments.

Each state has its own environment and planning laws and there are Australian approval requirements which overlay state laws. The planning and environment approvals and corridor protection strategy for Inland Rail must therefore be developed in close consultation with the Australian and state governments.

Chapter 12
Property acquisition

12. PROPERTY ACQUISITION

12.1. Purpose of this chapter

The purpose of this chapter is to provide an overview of the property acquisition required for Inland Rail and an assessment of the options for corridor ownership and acquisition under the relevant State and Commonwealth legislation. The chapter presents a recommendation regarding the preferred approach.

12.2. Approach

The Inland Rail Property Acquisition Strategy includes the core assumptions and definitions underpinning the analysis; an overview of the various property interests impacted by the proposed alignment; the range of property transactions that will need to take place throughout the alignment; the proposed delivery options and land tenure models available; and a recommended acquisition program. This chapter provides an overview of the key sections within the Property Acquisition Strategy.

12.3. Overview of the acquisition task

There are an estimated 1900 to 2000 property transactions to be undertaken over a 10 year programme on an approximate 51/49 per cent Queensland/New South Wales split (as shown in Table 12.1).

Properties will need to be acquired throughout the proposed corridor to allow:

- The legal creation of the corridor through the creation of plans and land titles.
- Access to land for investigation purposes (environmental investigations, survey and monitoring, geotechnical samples and bore holes).
- Access to land for construction purposes including site establishment (by way of contract of sale or short term licence agreements).
- Relocation and location of existing and new utility and services through the creation of easements and rights of way.
- Ongoing permanent access to the rail corridor through private land by creating right of access.

Table 12.1 Number of property acquisitions and transactions

		TOTAL	QLD	NSW
Acquisitions	no.	1000 - 1100	51%	49%
Transactions	no.	1900 - 2000	63%	37%

Source: ARTC, 2015.

Apart from the Illabo to Stockinbingal section, all others are considered high risk in terms of potential delay to construction due to land use and land ownership. Advancing and condensing the acquisition program into an initial three to five year timeframe would mitigate delays and create efficiencies in construction costs.

In Queensland, parts of Inland Rail follow the alignment of rail corridors reserved by DTMR. DTMR has already acquired 35 whole properties (52 titles) for Calvert/Rosewood to Kagaru, known also as the SFRC, with 102 titles still to acquire. A further 12 whole properties (14 titles) have been acquired for the Gowrie to Grandchester rail corridor, with a further 157 titles identified for acquisition in this section.

12.4. Proposed approach to property acquisition

The Property Acquisition Strategy recommends a tenure model and a range of property acquisition strategies for each state. An outline of these recommendations is provided within this section.

The delivery of land and other property related matters is proposed to be managed through a blend of existing ARTC expertise, external specialty service providers, and use of resources from DTMR in Queensland.

It is recommended that Inland Rail adopt an operator (e.g. ARTC) leased/state owned land tenure model on the condition that a memorandum of understanding (MoU) is executed between the operator and the New South Wales and Queensland Governments. The MoU should include agreements on land tenure arrangements, the efficiency of acquisition processes, the exemption of Commonwealth and state taxes, and cooperation during the construction of Inland Rail.

Adoption of this model for a new rail corridor in these states appears to be the least complex model, as it provides continuity and consistency from a legal and commercial perspective. Under this model, the operator can utilise various state legislation which includes the New South Wales *Transport Administrative Act 1988,* the *Public Works Act 1912* and the *Queensland Transport Infrastructure Act 1994* to assist not only in the acquisition of land, but also the development, ongoing operation and management of the land as rail corridor. The Inland Rail operator does not need to own the rail corridor, however requires a form of legal tenure preferably via a lease.

In New South Wales, it is proposed that the operator will seek to acquire land in freehold through private treaty in the first instance, noting that partial interests in land (easements) will also be required. Where private treaty negotiations are not feasible or unsuccessful, acquisition by TfNSW through New South Wales compulsory acquisition processes would be required. It is proposed that in both cases the land would ultimately be incorporated into the operator New South Wales lease.

In Queensland, land is proposed to be acquired by DTMR at the request of the operator for both corridor and tunnel (stratum) and then leased to the operator.

In greenfield rail corridor sites, the acquisition program for Inland Rail will be the precursor to the construction program and commence when design has established an optimal rail corridor width. Compensation will be offered to affected landowners and assessed under relevant acquisition legislation. Negotiations will seek a private treaty outcome, however the compulsory acquisition process will be implemented in conjunction with relevant state jurisdictions, such as DTMR.

Lease or licence agreements will also be required for both construction and environmental purposes and in both states instigated and controlled by the operator. Land tenure on existing lease terms in New South Wales and Queensland will also need further consideration to ensure they align with the Inland Rail Programme.

No consideration of a private sector or third party ownership model for all or part of the Inland Rail Programme has yet been made. This may be further assessed after review of this strategy and advice on potential funding/financing arrangements by the Commonwealth Government.

12.5. Access to land

Access to private land is required on both a temporary and permanent basis. The nature of the occupation determines the nature of the legal documentation required to protect ARTC's interests to facilitate delivery of Inland Rail.

The array of documentation required to access private land is outlined in Table 12.2.

Table 12.2 Private land access documentation requirements

REASON	DOCUMENTATION	NATURE OF OCCUPATION
Site investigations	Access agreement	Temporary
Construction purposes	Licence / lease agreements	Temporary
Construction/operation	Contract of sale	Permanent
Relocation of utilities/access to the corridor	Easement	Permanent

Source: ARTC, 2015.

12.6. Acquisition types

Partial acquisition

This is the partial acquisition of land from its parent parcel for the purpose of creating a rail corridor and is often referred to as 'strip acquisition' of land. The majority of land acquired for this project is expected to be strip acquisition.

Strip acquisition is more complex than whole property acquisition. It requires the assessment and negotiation of compensation caused when land is left as residual in the owner's name. The residual property is considered damaged and thus referred to as 'injurious affection'. The further complication arises as a technical subdivision of land occurs, and time delays are created through the process of registration of the plan and the creation of titles at the state-based land titles office. Part of a property can be acquired by either private treaty or compulsorily means.

The types of partial property interests are outlined in Table 12.3.

Table 12.3 Types of partial property interests

TYPE	PURPOSE
Rights of way	To gain access to the corridor in specified locations.
Easement for access	To gain access for rail maintenance purposes; to provide access to third parties.
Easements for services	Location and relocation of existing services away from the new corridor.
Easements for support	Provide structures with legal protection.
Easement for electricity	Provide electricity supply to the corridor (points and other infrastructure).
Easements for water supply	Provision of water supply for construction, including tunnels.

Source: ARTC, 2015.

Whole acquisitions

This is the acquisition of a whole property. This will occur where:

- The location of the rail corridor has an intolerable impact on the residual of the land and acquisition of the whole property is justifiable (on an economic, political or environmental basis).
- The landowner is suffering hardship as a result of the acquisition process.
- The project design identifies the whole property is required for the rail corridor with no usable surplus land for the landowner.
- There is a business case to support whole of acquisition first and sale of residual later.

The acquisition of a whole property can be effected by either private treaty or compulsory means.

Stratum acquisition

In the Gowrie to Kagaru section of the Inland Rail Programme, there is a need to construct five rail tunnels. The usual practice to achieve title to protect subsurface infrastructure assets (for rail and road tunnels), is to acquire the land as a stratum and this is the recommended approach for Inland Rail.

Stratum is land defined in terms of vertical height as well as having horizontal dimensions. This land, like all land, is defined by way of a registered survey plan. The less palatable alternative is to acquire the land in freehold, which effectively means the purchase of a section of mountain.

12.7. Other property transactions required

Acquisition of land for creation of a new rail corridor is more complex than acquiring land to expand an existing rail network as, over time, existing interconnecting property rights such as easements for access are established.

Based on ARTC's experience in the Hunter Valley, the total number of property transactions required for a major rail development is generally twice the number of property acquisitions. These other related transactions, including easements, various landowner and construction deeds, offsets, licensing and severance considerations are outlined in detail within the Property Acquisition Strategy.

Sale of residual land

There are approximately 120 (titles) properties identified as potential surplus land at an estimated recoupment value of approximately $10.5 million.
This is an estimated gross amount and excludes property maintenance costs, stamp duty, GST, legal and selling agent's costs. The net proceeds are estimated to be 95 per cent of $10.5 million ($9.4 million).

The specific sale approach including tax and accounting implications (which may arise based on the acquisition strategy adopted) will be dealt with on a case-by-case basis.

12.8. Legislative and approval framework

A summary of the property legislation anticipated to be used for this project throughout the relevant jurisdictions is provided in Table 12.4.

Table 12.4 Legislative framework for property acquisition

JURISDICTION	COMPULSORY ACQUISITION LEGISLATION	OTHER RELEVANT LEGISLATION
New South Wales	*Land Acquisition (Just Terms Compensation) Act 1991*	*Transport Administration Act 1988* *The Real Property Act 1900* *The Conveyancing Act 1919* *The Roads Act 1993* *Electricity Supply Act 1995* *Environment Planning and Assessment Act 1979*
Queensland	*Acquisition of Land Act 1967*	*Transport Infrastructure Act 1994* *Land Act 1994* *Property Law Act 1974* *Electricity Act 1994*
Victoria	*Land Acquisition and Compensation Act 1986*	*Transport Integration Act 2010*
Commonwealth of Australia	*Lands Acquisition Act 1989*	*The Corporations Act 2001* *The Native Title Act 1993* *The Environment Protection and Biodiversity Conservation Act 1999*

Source: ARTC, 2015.

If the operator leased/state owned land tenure model is adopted, the acquisition of land and assessment of compensation could be in accordance with:

- New South Wales - Land Acquisition (Just Terms Compensation) Act 1991.
- Queensland - Acquisition of Land Act 1967.

Approval will also need to be sought to commence compulsory acquisition through a submission to the federal or state governments. This will allow the formal compulsory acquisition process to proceed.

12.9. Compulsory acquisition

Land will be acquired by private treaty where possible and practical, however if negotiations are not successful, inevitably compulsory acquisition of land will occur. The process of compulsory acquisition will be predetermined by the land tenure model adopted, as land acquired under an operator leased/state owned land model will default to state ownership. Similarly, land owned under operator leased/Commonwealth owned land model will default in ownership to the Commonwealth.

The compulsory acquisition of land will need to occur under the following circumstances:

- Project Environmental Approval has been gained.
- The claim for compensation by the landowner is considered spurious and not supported by professional advice. The objective to reach a fair and reasonable quantum of compensation (in a reasonable amount of time) has failed after using techniques such as negotiation, mediation or arbitration.

- The landowner cannot be found.
- The land is held in public ownership (i.e. a road reserve, public reserve, Crown Land) and compulsory acquisition is considered the most efficient means to obtain clear title.
- The land is a deceased estate with no living beneficiaries to the will found.

The advantages and disadvantages of the various compulsory acquisition processes in New South Wales, Queensland and the Commonwealth have been outlined in Table 12.5.

Table 12.5 Advantages and disadvantages of compulsory acquisition processes

LEGISLATION	ADVANTAGES	DISADVANTAGES
New South Wales *Land Acquisition (Just Terms Compensation) Act 1991*	• Defined though relatively long process on a minimum of 15 months to gain access to land. • ARTC have experience in this process.	• Requires the support of TfNSW to instigate the process. • The Act encourages private treaty process which takes precedent over the compulsory process. • Contains time frame resetting provisions.
Queensland *Acquisition of Lands Act 1967*	• Defined timescale for access to land. • A streamlined process where access to land can occur within 12 months (subject to conditions). • Payment of compensation is negotiated post access to land. • There is no direct appeal to compensation. Queensland legislation also includes a variety of legislative pathways to define and gazette rail corridors prior to acquisition and construction.	• Requires empowering legislation. • Relies on the support of DTMR (and their resources and processes) to instigate the process.

LEGISLATION	ADVANTAGES	DISADVANTAGES
Commonwealth *Lands Acquisition Act 1989*	• Access to land independent of compensation claim and resolution process. • The one legislation (and process) can be used throughout the Programme.	• Prior to the Preliminary Acquisition Declaration becoming 'absolute', an owner or any other potential claimant may appeal to the Administrative Appeals Tribunal as to the validity of the proposed acquisition. • The compensation claim and resolution process is complex and out of ARTC control. • Both the Federal Court and Administrative Appeals Tribunal can be involved leading to excessive legal and resourcing costs. • Relatively longer period for access to the land.

Source: ARTC, 2015.

12.10. Acquisition timeframes and program

Indicative timeframes to gain access to land for construction purposes (based on the New South Wales acquisition legislation) is provided in Table 12.6.

Table 12.6 Indicative timeframes for property acquisition (New South Wales acquisition legislation)

TIMELINE (MONTHS)	TASK	TIMEFRAME
	Agreement to Enter Land	-4 months prior.
2	**Identification of Land Take**	-2 months.
	Due Diligence	-2 months prior to landowner approach. Noise and other studies complete.
	Compensation Assessments	-2 months.
4	**Letter of Offer of compensation**	0.
	Negotiation of Compensation	+2 months.
	Instigation of Compulsory Acquisition Process	+4 months.
10	**Preliminary Acquisition Notice (PAN or equivalent)**	+6 months.
	Access via Private Treaty	Any time after agreement reached (plus 1 - 2 months for contract exchange.
20	**Access via Compulsory Acquisition**	+ 9 – 10 months after PAN issued, or + 15 – 16 months after first letter of compensation issued.

Source: ARTC, 2015.

The notable and relevant difference between the state and Commonwealth legislation includes:

- New South Wales legislation has a mandatory 'reasonable negotiation timeframe' that has to be conducted prior to the compulsory process is instigated. This means if compulsory acquisition is required, a minimum 15 to 16 month timeframe is required to access land for construction.
- Queensland does not have this provision and thus if a compulsory process is instituted, access to land is shortened to a potential minimum of five months.
- Apart from the Illabo to Stockinbingal section, all others are considered high risk in terms of potential delay to construction due to land use and land ownership. Advancing and condensing the acquisition program into an initial three to five year timeframe period would mitigate delays and create efficiencies in construction costs.

Acquisition program and time frames summary

An overview of the indicative acquisition program is provided in Table 12.7.

Table 12.7 Indicative acquisition program

ROUTE SECTION	CORRIDOR TYPE	PURPOSE	INDICATIVE PROPERTY DELIVERY DATE	REQUIRED PRECEDENTS PRIOR TO COMMENCEMENT
Illabo to Stockinbingal (NSW)	New (Missing Link)	Acquisition of New Corridor	Year 5	• 15% reference design completed. • Land Tenure Resolved – approval from TfNSW to include land in NSW Lease. • Funding confirmed.
Parkes to Narromine (NSW)	Existing	Widening of Existing Corridor	N/A	• Identification of three passing loop sites based on operational modelling.
Narromine to Narrabri (NSW)	New (Missing Link)	Acquisition of New Corridor	Year 3 - 4	• 15% reference design completed. • Land Tenure Resolved. • Funding confirmed.
Narrabri to North Star (NSW)	Existing and New	Camurra Bypass new corridor (potential Curve Easing)	Year 3	• 15% reference design completed. • Land Tenure Resolved – approval from TfNSW to include in NSW Lease. • Funding confirmed.
North Star to Yelarbon (NSW)	Existing and New	Acquisition of New Corridor	Year 3 - 4	• Centreline finalised. • Land tenure model is resolved. • IGA with QLD DTMR to assist in acquisition program (QLD land only) resolved. • 15% reference design completed. • Funding confirmed.
Yelarbon to Oakey (QLD)	New	Acquisition of New Corridor	Year 3	• Centreline finalised. • Land tenure model is resolved. • IGA with QLD DTMR to assist in acquisition program resolved. • 15% reference design completed. • Funding confirmed.

ROUTE SECTION	CORRIDOR TYPE	PURPOSE	INDICATIVE PROPERTY DELIVERY DATE	REQUIRED PRECEDENTS PRIOR TO COMMENCEMENT
Oakey to Gowrie (QLD)	New	Acquisition of New Corridor	Year 3	• Centreline finalised. • Land tenure model is resolved. • IGA with QLD DTMR to assist in acquisition program resolved. • 15% reference design completed. • Funding confirmed.
Grandchester/ Gowrie to Calvert/ Rosewood (QLD)	New	Acquisition of New Corridor	Year 3 - 4	• Centreline finalised. • Land tenure model is resolved. • IGA with QLD DTMR to assist in acquisition program resolved. • 15% reference design completed. • Funding confirmed.
Calvert/ Rosewood to Kagaru (QLD)	New (Development)	Acquisition of New Corridor	Year 3	• Centreline finalised. • Land tenure model is resolved. • IGA with QLD DTMR to assist in acquisition program resolved. • 15% reference design completed. • Funding confirmed.
Kagaru to Acacia Ridge (QLD)	Existing	Widening of existing corridor	Year 3	• Identification of (2) passing loop sites based on operational modelling. • IGA with QLD DTMR to assist in acquisition program resolved. • Reference design. • Land tenure resolved – approval to include land in QLD lease. • Funding confirmed.

Source: ARTC, 2015

12.11. Acquisition costs

The total property costs for the Inland Rail Programme are provided in Chapter 8 (Costs).

12.12. Planned property related activities

- Commence negotiations with TfNSW to obtain tenure by incorporation into the existing ARTC lease to operationally use parts of the Country Rail Network (CRN), classified as both operational and non-operational rail corridors, at Gwabegar, Narromine, Curban, Narrabri by ARTC for Inland Rail and incorporate new land into the lease after freehold purchase by ARTC.
- Agreement with both the New South Wales and Queensland governments be entered into to:
    - Provide priority to any request for compulsory acquisition by ARTC for Inland Rail.
    - Provide priority to the registration of any plans lodged at the relevant Land Titles Office.
    - Seek an exemption of stamp duty for any land transactions.
    - Provide priority for any ARTC request to a state controlled entity for location or relocation of services as a result of Inland Rail.
- Agreement with the Queensland Government be entered into to:
    - Seek continuing and prompt finalisation of their acquisition program for the SFRC, Gowrie and Grandchester rail corridors and to assist in the acquisition of the balance of the new Inland Rail corridors in Queensland.
    - Allow incorporation of existing corridors into an extended lease.
    - Request DTMR to utilise land already acquired to assist in investigation and construction purposes.
- Agreement with Queensland and New South Wales on ultimate land tenure subject to the financial and ownership model adopted.
- Provide investor, client, customer, end user, stakeholder and community confidence the Programme is proceeding and is not just a study.

12.13. Summary

Inland Rail is a large infrastructure Programme whereby the acquisition of property and other property related transactions is a critical success factor. The key issues and next steps for Inland Rail are summarised below.

- Overall there are an estimated 1900 to 2000 property transactions to be undertaken over a 10 year programme on an approximate 51/49 per cent Queensland/New South Wales split.
- 1000 to 1100 parcels of land (titles) are anticipated to be affected by an acquisition process with approximately 400 to 450 private and public land owners affected. An estimated 66 of those titles have been acquired by the Queensland Government for rail corridors between Calvert/Rosewood to Kagaru and Gowrie to Grandchester.
- Apart from the Illabo to Stockinbingal section, all others are considered high risk in terms of potential delay to construction due to land use and land ownership. Advancing and condensing the acquisition program into an initial three to five year timeframe would mitigate delays and create construction efficiencies.
- Land tenure arrangements have yet to be finalised, noting that a state owned/operator leased arrangement is favoured as it is consistent with existing arrangements and provides benefits via companion legislation.

- It is recommended that an MoU be implemented between the Commonwealth and state governments that includes land tenure arrangements, the efficiency of acquisition processes and the exemption of Commonwealth and state taxes.

Chapter 13
Risks

13. RISKS

13.1. Purpose of this chapter

This chapter provides an overview of the process undertaken for the identification and assessment of risks for Inland Rail.

A Risk Management Plan has been developed to document the strategies, processes, systems and personnel that will be implemented to deliver risk management services for Inland Rail.

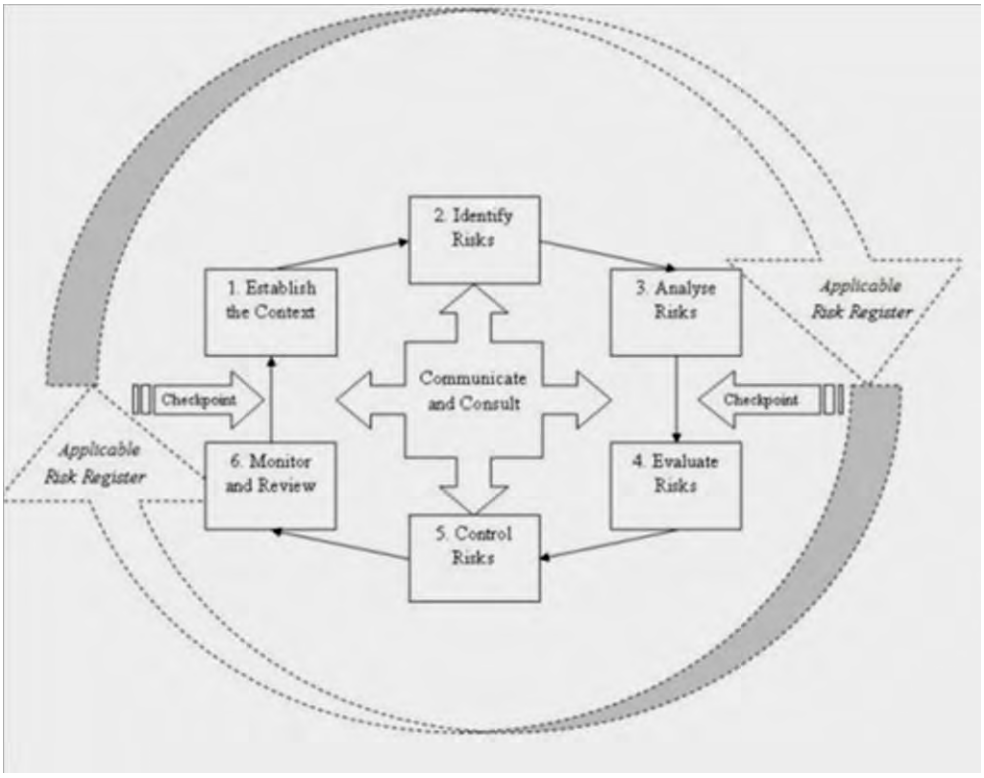
Risks have also been quantified as part of development of the costs with the results and quantitative process outlined in Chapter 8 (Costs). The risk assessment also informs the investment decision and identifies treatments to further manage risks to reduce the quantitative impacts to realise value for money.

13.2. Approach

The Inland Rail Risk Management Framework is based on the ARTC Corporate Risk Management Framework. The framework will assist in managing risks effectively through the application of the risk management process described in the risk management plan.

A broad overview of ARTC's risk management process is shown in Figure 13.1. The policy meets relevant industry and government standards for identifying, assessing, managing and treating risk.

Figure 13.1 Broad overview of ARTC's risk management process



Source: ARTC, 2015.

13.3. Risk assessment

Approximately 150 risk items have been identified and risks have been categorised between Strategic risks and Programme risks. A risk manager has provided risk management services to support the preparation of a revised Risk Management Plan and register, and further inform the development of Inland Rail.

The risk assessment undertaken to date considered two distinct parts, including:

- Strategic risks: Considered to be those that may affect progress of the development of Inland Rail. Strategic risks were assessed separately from project risks, enabling the identification, monitoring, action and tracking of risks to develop the business case in line with the schedule. Strategic risks are the responsibility of the Australian Government and other risks will have a number of owners, with no single owner taking responsibility for the mitigation, management and control of all risks.
- Programme risks: Identified by considering the outcomes sought, the tasks that must be completed to achieve those outcomes, and the interface with other infrastructure, parties and projects. Programme risks were considered as:
  - Inherent (planned) risk: Describes the potential for a project's scheduled activities to increase or decrease from the base cost estimates. These risks were assessed by considering the likely ranges in quantity, timing and unit rates or prices for the construction and operation activities.
  - Contingent (unplanned) risk: Risks (or opportunities) that exist through unforeseen circumstances or events. These risks relate to potential changes in a project intended development, procurement, implementation, financing and operations. These risks were assessed by analysing the likely downside and upside ranges for unforeseen risks for a project (that is, the consequence of such risks), as well as the probability of occurrence of these risks and opportunities.

This chapter summarises the current Strategic and Programme risks assessed as high or above.

Strategic risks

The key strategic risks for the Programme and identified mitigations are outlined in Table 13.1.

Table 13.1 Key strategic risks and identified mitigations

	KEY STRATEGIC RISKS	MITIGATIONS
1	10 year funding consistent with the cost estimate and schedule is not available. Risk the total out turn costs for Inland Rail exceed government expectations and ability to fund the Programme.	• Business case justification. • Operations modelling to identify timing of benefits realisation. • Refinements of commercial principles relating to value for money and risk allocation. • Staging of works to adjust cash flow.

	KEY STRATEGIC RISKS	MITIGATIONS
2	Stakeholder expectations influenced by previous Inland Rail studies, forums, and communications which do not adequately explain or address the difference from the basis of design utilised within the 2010 study, such that a mismatch with the Inland Rail objectives occurs.	• Governance structure and briefing of stakeholders. • QLD Government and agency meetings to refine Gowrie to Grandchester alignment and Queensland requirements for future proofing (including passenger services). • NSW Government and agency meetings to refine alignment around Moree and Parkes (potential bypasses).
3	Lack of integration of development of terminals, rolling stock, policy framework in conjunction with Inland Rail lead to all or parts of Inland Rail being a stranded asset.	• Stakeholder Reference Group. • Programme Management Plan. • Service Offering. • Draft Terminal Strategy. • Operational modelling. • Road shows and industry consultation. • ARTC national advocacy.
4	Market take up of Inland Rail changes considerably during delivery and/or operation leading to lower demand for train paths.	• Demand modelling and sensitivity analysis in business case. • Change management process with Programme Management Office (PMO) to track and address the implications of key indicators for policy, pricing and market.
5	Lack of certainty of governance arrangements and lack of informed and timely decision making by stakeholders (Australian Government, Victoria, New South Wales, and Queensland State Governments, ARTC, and any other funding/delivery partners) requirements/priorities.	• Inter-government agreements to be entered into between Australian and state governments. • Agreement between Australian Government and ARTC. • Inland Rail scope defined in business case and supporting documents endorsed as the Programme and varied only by agreement between the parties.
6	Staging of projects for Inland Rail becomes primarily driven by stakeholder priorities, rather than being Programme benefit driven, leading to greater exposure to delivery delays when stakeholder priorities change.	• Staging to be approved by DIRD and the IR-IG with stakeholder agreement obtained.

Source: ARTC, 2015.

Programme risks

An assessment of the key Programme risks is provided in Table 13.2.

Table 13.2 Key Programme risks and identified mitigations

PROGRAMME RISKS		MITIGATIONS
1	Concept phase design and cost estimate uncertain until the Programme has environmental approval, reference design and tender price.	• Develop reference design including refined tunnel design. • Undertake environmental impact assessment and prepare EIS. • Review outcome of selected tender alignment of second range crossing at Toowoomba for potential interface issues with Inland Rail alignment. • Finalise alignment. • Undertake fieldwork including, flora and fauna, services, topographic, property and geotechnical surveys. • Community, stakeholder and industry engagement. • Obtain statutory and regulatory approvals. • Implement property acquisition strategy after preliminary design. • Complete robust operational analysis and value engineering. • Finalise delivery strategy and agree risk allocation. • Refine schedule and budget. • Adjust risk contingency within schedule and estimate as information quality/certainty improves.
2	ATMS not available for use for Inland Rail in accordance with Programme schedule requirements.	• Early engagement with ARTC's ATMS development team. • Commence work on potential NSW and QLD rules changes/accreditation associated with ATMS. • Identify existing viable alternative to ATMS (where no application development is required). • Develop a safeworking strategy identifying key interact points with the ATMS development and the Inland Rail Programme.
3	Opposition from stakeholders including individual landowners, community lobby groups, councils and/or businesses results in delays and additional costs.	• Early, proactive engagement to ensure community and stakeholder preferences are well understood and reflected in the reference design. • Communications and engagement strategy to recognise need for different approaches to mainstream media and social media. • Stakeholders given clear feedback explaining how their feedback has been considered. • Proactive messaging around the Programme emphasises the overall benefits. • Opportunities to improve stakeholder and community outcomes are proactively identified and implemented on accordance with agreed scope, schedule and budget requirements. • Use of relevant forums and communication tools e.g. web, twitter and roadshows.

	PROGRAMME RISKS	MITIGATIONS
4	Regional weather not fully taken into account in the development of detailed project/Programme schedules and budgets.	• Within the 10 year schedule a high level factor has been applied for weather disruption to the construction activities. • Inland Rail Programme is based on a five day week (Toowoomba tunnel construction to be a 24/7 operation). • Carry out detailed work to assess weather impact on individual geographical sections of the route using Bureau of Meteorology and other statistical data, compare with allowances within current schedule.
5	Delays due to unknown environmental/heritage constraints and/or items found during construction.	• Detailed site investigations. • Comprehensive environmental impact assessment and approvals process with agreed, practical mitigation measures in place before construction. • Undertake ongoing monitoring during design development and construction.
6	Delay in securing and preserving the corridor resulting in increased cost, Programme delay and/or need for realignment.	• Achieve statutory approval. • Agree and lock-in alignment – field investigations, design development, property acquisition (Gazettal) and environmental approvals process for each state.
7	Requirements for future proofing are under-estimated (e.g. implications of passenger services, unidentified 3rd party works, facilitating works to minimise service disruptions during future system upgrade/augmentation).	• Clearly define agreed requirements for third party works and passenger service interfaces. • Complete site specific constructability reviews. • Complete robust operational modelling. • Undertake reference design with track configuration to enable duplication in the long term.

Source: ARTC, 2015.

The risk assessment is important in enabling selection of an appropriate delivery or contracting model that helps mitigate the key risks. Further work will be undertaken on risks at the individual project level based on the revised delivery strategy.

Risk value

The total out turn cost estimates incorporate an inherent risk allowance developed specifically for Inland Rail.

The process included:

1. Review of qualitative risk registers previously prepared by Advisian and modification of template to enable quantitative contingent risk valuations to be centrally held within the risk register.
2. Review of the quantitative risk model previously prepared by Advisian including updating the base estimate data to align with the updated estimate prepared in March 2015.

3. Quantitative risk workshops on 11 and 12 March 2015 including stakeholders to identify key parameters for the quantification of risk in updated risk registers (inherent and contingent).
4. Carried out risk modelling to quantify the risk associated with Inland Rail.

The results of the probabilistic analysis (Monte Carlo simulation) undertaken by Aquenta are provided in Table 13.3. Chapter 8 (Costs) shows that the risk allowances are within acceptable bounds for this stage of the Programme lifecycle.

Table 13.3 Risk contingency results

DESCRIPTION	RISK CONTINGENCY
Base estimate (excluding risk and escalation)	100%
P50 Total Programme cost (excluding escalation)	126.1%
P90 Total Programme cost (excluding escalation)	135.9%

Source: ARTC, 2015.

13.4. Summary

Key Strategic and Programme risks have been identified and appropriate mitigations have been incorporated into the management and schedule for Inland Rail.

Within the cost estimate, a risk allowance has been made that reflects the current understanding of risks (against the current stage in the Programme lifecycle).

Scope and approvals need to be effectively managed to ensure delivery in line with the scope of the Programme. Aquenta recommends:

1. Further investigation and design is carried out to provide greater reliability in the design solution and, where possible, develop estimates based on reference designs for the project in lieu of typical scopes of work.
2. The costs of key items including tunnels and viaducts are refined to allow their associated cost risk uncertainty ranges to be reduced therefore providing the greatest opportunity to reduce budget contingency.
3. Continued planning for Inland Rail to align the Programme delivery strategy and master schedule.
4. All activities needed to secure the rail corridor are carried out resolve risks associated with major changes to alignment.

Chapter 14

Packaging, procurement and delivery

14. PACKAGING, PROCUREMENT AND DELIVERY

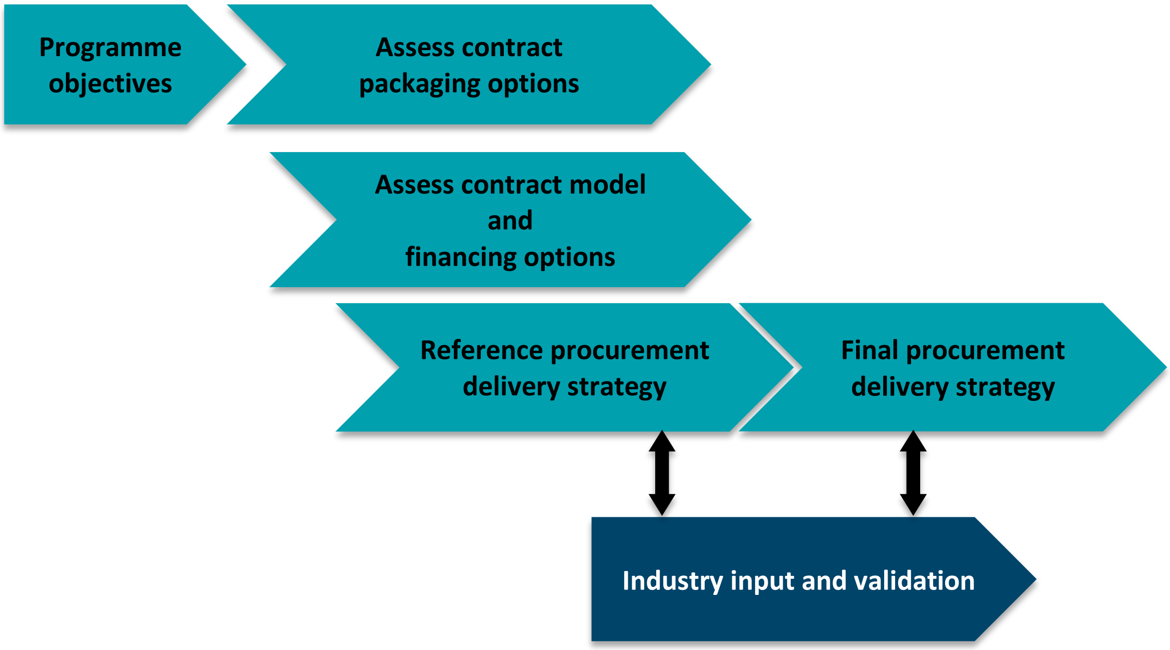
14.1. Purpose of this chapter

The purpose of this chapter is to provide an overview of the works packages for key sections of Inland Rail, including consideration of delivery options. The chapter also examines staging and governance approaches that will ensure deliverability and value for money.

14.2. Approach

This chapter provides an overview of the consideration in developing a reference procurement delivery strategy (RPDS) prepared by Everything Infrastructure Group (EIG), with input from ARTC, PB and PwC. The approach applied to develop the RPDS is illustrated in Figure 14.1.

Figure 14.1 RPDS development process



Source: EIG, 2015.

EIG has developed an array of associated delivery principles and assumptions within the context of the stated Programme objectives (refer to Chapter 2, Vision and strategic context) which define the assessment framework for assessing the contract packaging options, contract model and delivery options. An overview of these principles and assumptions is provided in section 14.3 and section 14.4.

14.3. Key delivery principles

Through staging an interactive and iterative process, the RPDS aligns with these key principles:

- Maximise flexibility in staging of Programme delivery, including being able to accommodate and take advantage of any changes in Programme funding.
- Ensure certainty of scope and future proofing requirements before commencing construction works.
- Undertake enabling works to facilitate start-up of major contracts.
- Procure long lead items early to avoid delaying the Programme.

- Build confidence in the market and supply chain to demonstrate commitment to the Programme.
- Level of demand for key resources to meet market capacity and capability and so ensure availability and competitiveness when engaging contractors.
- Achieve legacy outcomes from temporary works required during construction.
- Minimise disruption to existing freight network.
- Incur major costs as close as possible to when benefits from those assets are realised, whilst still considering key delivery risks.
- Ensure no stranded assets and that incremental benefits are optimised.
- Ensure network efficiencies are realised.
- Minimise whole of life cost.
- Provide cost certainty once contracts are awarded.

14.4. Packaging options

The packaging options identified for Inland Rail include:

- A single contract package for all the major infrastructure works.
- Separation of projects into geographical work packages such that one contractor (or consortium) does all the work within each geographical segment.
- Separation of projects to match distinct market capability (identified as discipline packages in this report), with one contracting entity doing all the work within a package for the entire length of the project.
- Combinations of geographic and market separation.

The inclusion of maintenance obligations within the packages will also be considered along with network access management.

Further details on the packaging options are summarised in Table 14.1.

Table 14.1 Inland Rail work packaging options by geographic section of track

PACKAGE	COMMENTARY
Single	A single contract to deliver all the major infrastructure works
Geographic	Delivery could be separated solely on a geographical basis with each geographic package having a single contracting entity that would then be responsible for delivery of that section and Work Health and Safety (including rail safety) within the defined area. Splitting geographically would require engaging a contractor with the skills to design and construct all elements (greenfield / brownfield) and potentially rail systems. This will create interface risks from end to end systems integration and increase complexity for the contractor as they would require the full range of skills. It also potentially drives sub optimal solutions for key materials (for example, rail, ballast and sleepers).

PACKAGE	COMMENTARY
Discipline	Based on experience and industry engagement the disciplines could include enabling works, tunnelling, surface civil works, earthworks and drainage, bridges and viaducts, track construction, rail systems, tunnel systems, introduction into service, maintenance and operations. Involves higher interface risks (during construction and post completion), introduces complexity in managing work health and safety during delivery, and has the potential to drive sub optimal solutions for some geographic areas as it may not properly account for local factors and capabilities.
Combined	A combination of geographic and discipline packages.

Source: EIG, 2015.

14.5. Contracting models

An analysis of the full spectrum of contracting models was undertaken to determine the most appropriate model for each package type. The range of possible models, along with their relative level of risk transfer to the private sector is shown in Figure 14.2.

Figure 14.2 Contracting models

Source: EIG, 2015.

In addition to the models above, a number of variants and hybrids (such as design, build and maintain (DBM) and early contractor involvement (ECI) were also considered.

The key features of the Programme considered to have an impact on a preferred contracting model are outlined in Table 14.2.

Table 14.2 Key features and impacts on preferred contracting model

FEATURE	POTENTIAL IMPACT
Certainty of scope	• The scope of the Programme is being progressively determined, such that it will be clearly defined and will be able to be effectively and efficiently priced by the private sector at the time the various packages are taken to market.
Timing	• There is no specific timing imperative for award of major contracts that drives the need for accelerated delivery models, therefore adequate planning can occur to reduce risk.
Risks and uncertainties	• There should be no key risks or uncertainties retained by the Australian Government or ARTC that the private sector does not normally accept and that would lead to the application of models where the majority of delivery risk is retained by government. The one exception to this may be areas where upgrade work is within a live and regularly used rail operating environment and where track access may be restricted (not an unusual circumstance in other ARTC contracts). • The nature of the key elements of design and construction work are well understood by relevant market sectors, with reasonable degrees of competition, i.e. design and construction of new rail alignment, rail upgrade, tunnelling, tunnel systems, rail systems, supply of materials etc and hence should be regarded as low risk. • Extensive investigative work is planned that should enable effective and efficient transfer to the private sector of risks such as geotechnical, environmental and contamination.
Approvals and corridor acquisition	• Work is progressing on alignment definition so as to allow planning approvals and corridor acquisition to be developed to a point that will allow an appropriate balance of risk allocation and cost between ARTC and the contracting entities.
Specialist skills	• Specialist maintenance skills/experience may be required in relation to tunnel systems (depending upon ventilation, fire, life and safety solutions). • Specialist maintenance skills/experience is required in relation to ATMS (similar to ARTC's remaining network). • There is a significant long term operational network management, control and maintenance cost component associated with the Programme.

Source: EIG, 2015.

The key features of the Programme to be considered during an assessment of the contracting models for each work package type are provided in Table 14.3.

Table 14.3 Identification of contracting models

CONTRACT MODEL	DESCRIPTION	GENERAL APPLICATION
Engineering Procurement Construction Management (EPCM)	A contract management organisation manages the design, procurement and construction on behalf of the Principal.	Generally used where early commencement is essential and the designs of the various aspects of the total project will develop as work progresses.
Alliance	Government collaborates with one or more non-owner parties (e.g. a designer and constructor) to share the risks and responsibilities in delivering the construction phase. All project delivery risks are shared by the alliance participants.[154]	Generally preferred where: • the scope of work or interfaces are not clearly defined • processes and/or site access arrangements are uncertain • an accelerated commencement of work is required • risks are not readily quantifiable and/or transferrable to the private sector.
Managing Contractor (MC)	Involves the engagement of a single contractor to manage the design and construction on behalf of the client (owner).	Typically used where the client does not have its own capability or capacity to perform the role and certain aspects of final scope and requirements are evolving or uncertain. Cost, time and performance risk for individual contracts awarded under the MC model are generally passed down to the various sub contractors and suppliers engaged to complete work.
Delivery Partner (DP)	Involves an organisation that partners with a client for the delivery of a project or program of works.	It ideally lends itself to a situation where the client needs to build a substantial team with a diverse range of skills to assist it with the implementation of a project in circumstances where the client does not have sufficient internal appropriately skilled resources.
Design then Construct (Construct Only)	Separate contract for the construction of works to a design by the client and/or its design consultants.	The model is used when the client elects to specify the project details and detail the design rather than to describe the infrastructure in terms of its performance.
Design and Construct (D&C)	The contractor takes responsibility for both design and construction to achieve specified performance requirements.	The D&C model is best suited to works which can be readily verified as compliant, defects are reasonably detectable and preventative, and rectification maintenance is minimal.

[154] Infrastructure Australia, National PPP Guidelines, Volume 1, Procurement options analysis, December 2008.

CONTRACT MODEL	DESCRIPTION	GENERAL APPLICATION
Design, Construct, Operate and Maintain (DCOM) **Design, Build and Maintain (DBM)**	Model contemplates design and construction and then, for a specified term, the operation and maintenance of infrastructure.	Utilised where there is opportunity for whole of life value for money optimisation of infrastructure and/or where there is merit for single point accountability for performance. A variant of this model is a Design, Build and Maintain (DBM) only model. This is generally applied when operations are across a wider network or by a range of operators.
Private Public Partnership (PPP)	Private sector partnering with government in: • Financing and funding all or part of the cost of the delivery of a project. • Operating and / or maintaining the project over an agreed concession period (generally in excess of 15 years); and being paid upon service delivery, preferable by the users.	Generally applied where there is a clear focus on service delivery and outcomes that, when combined with the delivery discipline that comes of private sector financing, is determined as providing value for money for government. It requires additional benefits, including a risk transfer to the private sector that more than offsets the premium that applies to private sector funding when compared to government borrowing rates.

Source: EIG, 2015.

14.6. Programme management office

An infrastructure programme and RPDS of this size will require a dedicated Inland Rail PMO to manage the broad range of contracts required to implement the Programme. The proposed governance structure for the delivery phase of the Inland Rail Programme including the PMO is provided in Chapter 17 (Programme management).

14.7. Proposed market sounding

A key step in development of a preferred delivery strategy for the Programme is the testing of the RPDS with key market sectors to confirm and receive feedback on the validity and appropriateness of the assumptions used and conclusions drawn.

Such exercises can be an invaluable source of up to date information but must also be tempered with consideration of the commercial perspectives of market participants in the process. As a consequence, commentary and feedback received from the participants should be considered in the context of broader market conditions.

Market context

The civil construction market is currently experiencing a downtown since resource and mining based activity pushed the sector to peaks in major projects in the 2012–13 financial year. In Queensland alone, the market has moved from a peak of $18 billion in funded major projects to a forecast $6.3 billion in 2015–16.[155] This is mirrored nationally by the Performance of Construction Index, prepared monthly by the Australian Industry Group and Housing Industry

[155] Queensland Major Contractors Association, Major Projects Report, February 2015.

Association. The measurement for February 2015 showed a contraction in the performance index, the fourth consecutive month of contraction against the index. To compound this, the new orders sub-index in the engineering construction sector fell 5.4 points to 38.5 points, the 14th consecutive month of contraction in the sector.[156]

These softening market conditions in the engineering construction sector are expected to drive some value advantages for funded projects that can capitalise on the thin national pipeline in the sector and combine competitive tension and lack of competing large scale alternatives to potentially achieve favourable pricing and risk transfer arrangements with engineering construction contractors.

Key market sounding questions

The proposed market sounding process will provide valuable feedback on the market's ability, capacity and appetite with regards to the works packages defined within the RPDS. Information obtained through the market sounding process will allow the project team to refine the packaging and proposed procurement approaches to achieve an optimal balance between the competitive tension for each works package, the required management and oversight effort required to maximise value for money from the structure.

Key overarching questions that will be used to inform the detailed questions for market sounding participants include:

- What is the consensus view of the identified market sounding participants regarding deliverability of the range of potential works packaging options—including ARTC's defined reference works packaging—and how the proposed packaging could be further optimised?
- What is the market appetite and capacity for specific scope inclusions in relation to particular works packages, for example inclusion of financing or maintenance obligations for more technically complex and scope components?
- What are the other potential major competing private and public sector civil engineering opportunities that may impact on resourcing, pricing and the overall deliverability of the Programme within the planned time period?
- What are the major Programme risks that would be anticipated by the market at this early stage?

Works packaging options to be considered and tested during the market sounding process include:

- Whether the single package option is achievable or (as expected) not achievable.
- The potential for a single rail track work and rail/tunnel systems package that goes end to end and is combined with long term operations and maintenance.
- The potential for separate bridge(s) and viaducts package(s) combining major civil works to suit a specialist contracting market. This potentially allows economies of scale and competition, but introduces more interface risk.
- The potential for a separate rail track works package(s) that builds on alignment provided by others and that suits specialist rail contractors.
- Further splitting some of the larger packages, including tunnelling – particularly Gowrie to Kagaru.
- The potential for separate enabling works contracts for power supply, water and road access to major construction sites.
- Including supply for major materials within major packages to reduce interface risk.
- Combining some of the adjoining missing link and upgrade packages.

[156] AI Group, Performance of Construction Index Update, www.aigroup.com.au, 2015.

14.8. Potential accelerated delivery schedule

Inland Rail has developed a RPDS to identify ways to stage project development and construction to accelerate Programme delivery from a 10 year to 8 year schedule based on engineering and technical elements which may deliver greater value for money for the Programme through:

- Reduced construction out turn cost and reduced Programme overhead and management costs resulting from a shorter delivery schedule, including the associated reduced escalation impact.
- Bringing forward the full benefits of the Programme.

The RPDS evaluates a revised schedule that considers the logical sequence of works for the major tunnelling section within the Gowrie to Kagaru section of the Programme. Based on recent experience with the Sydney Metro Northwest (formerly the North West Rail Link), this is considered to represent the longest logical sequence of activities and therefore, in the absence of external factors, the likely critical path to Programme completion.

An assessment of the durations for the key sequenced work elements required in delivering the tunnelling section has revealed there may be an opportunity to bring forward the overall development schedule from 10 years to 8 years, and potentially achieve early delivery of this section, and as a consequence, the overall Programme.

If a revised completion schedule were to be implemented, the new alignment (including the tunnel section and the missing links) would be potentially completed within an eight year timeframe. While this needs to be further investigated, it presents an opportunity to improve the overall outcomes of the Programme. Consequently, the RPDS is designed to retain flexibility to accelerate the delivery schedule to less than that currently contemplated. However, this will impact on funding requirements and the operator's resourcing and capability to manage the Programme.

A potential eight year timeframe is not unrealistic when considered in comparison with other major projects. For example, the Sydney Metro Northwest with a budgeted value of $8.3 billion (out turn costs) is on schedule to be delivered in a period of approximately seven years from approval of the delivery strategy and commitment to fund.

14.9. Next steps

1. Update the RPDS to develop the Final Procurement Delivery Strategy (FPDS) based on outputs from the review exercise.
2. Consult with key market sectors (market sounding) to test the validity of the FPDS. This industry engagement process will generally involve the operator's senior personnel working with key consultants experienced in this process to:
    - Prepare background information and questionnaire.
    - Identify and invite key market sector representatives to participate in the process.
    - Conduct individual workshops with selected invitees to obtain initial feedback.
3. Review and consolidate the market feedback and prepare a market sounding outcome report.
4. Update the FPDS based on market feedback and following further consideration of the issues with ARTC and key stakeholders.
5. Further develop and confirm the FPDS through a review and approval process.

14.10. Summary

An analysis of the packaging options, contracting models and potential staging of works has identified:

- A number of geographic and discipline based work package options and contracting models are potentially available to deliver Inland Rail.
- A revised completion schedule could potentially bring forward the delivery of the critical path – the tunnelling section within the Gowrie to Kagaru section of the Programme. If the revised completion schedule were to be implemented, the new alignment (including the tunnel section and the missing links) has the potential to be completed within an eight year timeframe.
- Market sounding is required to inform and validate the selection of procurement options and proposed revised completion schedule.
- Next steps will include reviewing and updating a RPDS in line with market and stakeholder feedback which will lead to the development of an FPDS.

Chapter 15
Affordability

15. AFFORDABILITY

15.1. Purpose of this chapter

Inland Rail provides a significant opportunity to change the fundamentals of the freight logistics supply chain in Australia and deliver economic and social benefits long into the future.

The purpose of this chapter is to outline opportunities to improve affordability for government with regard to Inland Rail cashflows, funding requirements, and budgetary impacts of investing in Inland Rail. The Programme Business Case has developed costs in line with the identified scope and in doing so, a number of assumptions have been made with regard to risk, escalation, and market conditions potentially impacting on the proposed 10 year programme.

This chapter considers:

- The cost impacts for a 10 year programme at its most likely (P50), and potentially worst case (P90).
- The anticipated revenues over the assessment life, commencing in 2025.
- An analysis of scenarios and opportunities to improve cost certainty and affordability throughout the delivery phase of Inland Rail.
- Likely funding requirements (amount and timing) for governments.

This chapter is informed by all the other elements of the Programme Business Case and presents the budgetary impacts to provide context regarding the affordability of the Programme. Primarily, this chapter builds on Chapter 10 (Financial analysis), which outlined the financial impacts by analysing Inland Rail costs and revenues, presenting these in present value terms.

This chapter provides a platform for further discussions with key stakeholders (i.e. local, state and federal governments, and market participants) regarding funding mechanisms that may enable Inland Rail to be delivered more affordably with contributions from parties anticipated to realise the benefits of Inland Rail.

15.2. Approach

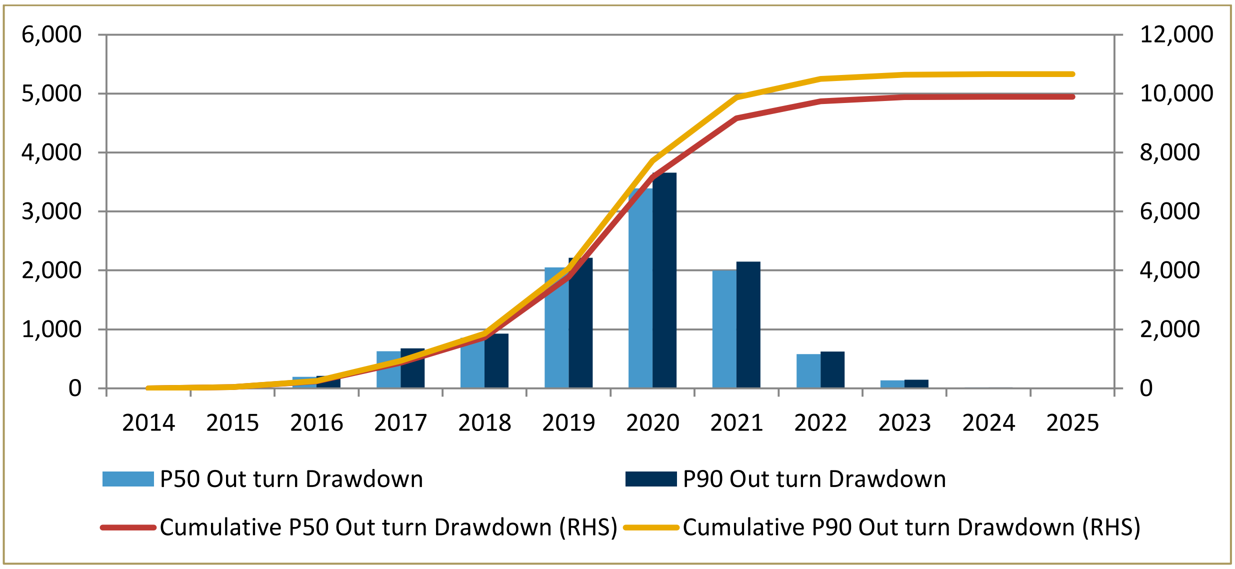
The approach adopted to consider affordability included:

- Identifying the most likely cashflow for Inland Rail as currently proposed and modelled in the Programme Business Case.
- Identifying and comparing the capital cost requirements in line with the 10 year programme with the operational requirements in terms of costs and revenues for the Inland Rail operator.
- Determining the need for government investment.
- Considering opportunities for stakeholder funding contributions.
- Identifying delivery scenarios that could potentially improve the affordability of Inland Rail.

15.3. Delivery cashflow

The P50 and P90 project cost estimates and escalation anticipated for Inland Rail are outlined in Figure 15.1.
A significant impact on the cashflow occurs in year 2019–20 as a result of a number of projects being progressed and delivered during that period. Cashflow is based on P50 and P90 cost estimates including escalation rates based on advice from Turner & Townsend to DIRD. This is discussed further in section 15.5.2.

Figure 15.1 P50 and P90 project cost estimates including escalation



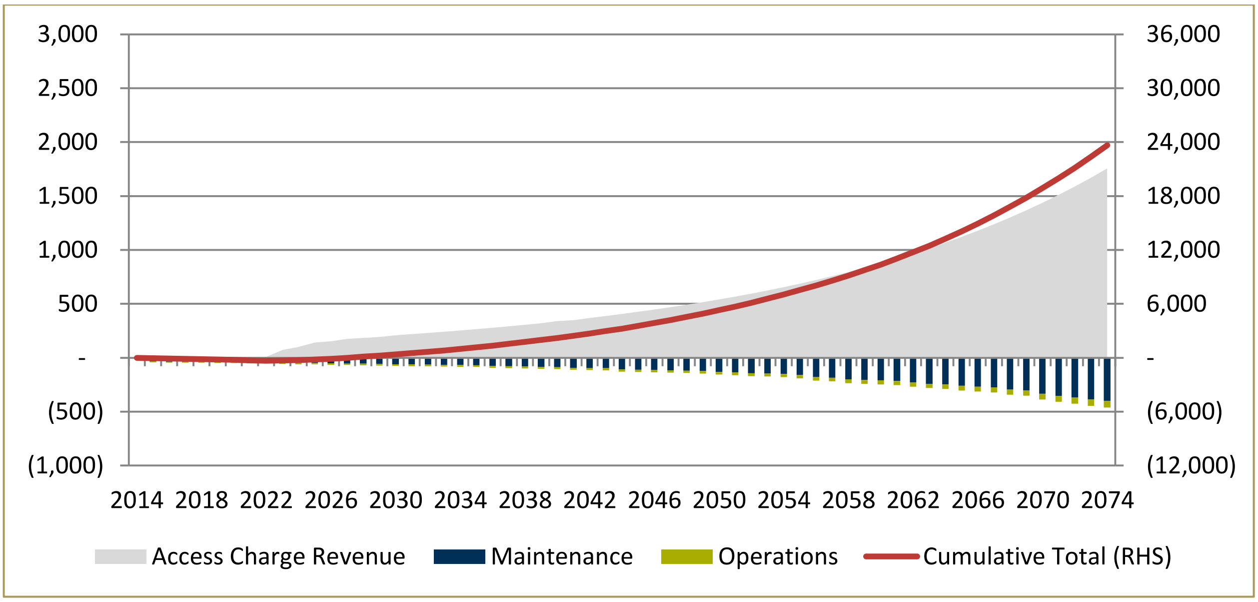
Source: PwC, 2015.

15.4. Cost versus revenue

To understand the operational funding requirements, an assessment of the anticipated cashflows for operating and maintenance costs has been compared against the anticipated revenues for an operating period of 50 years.

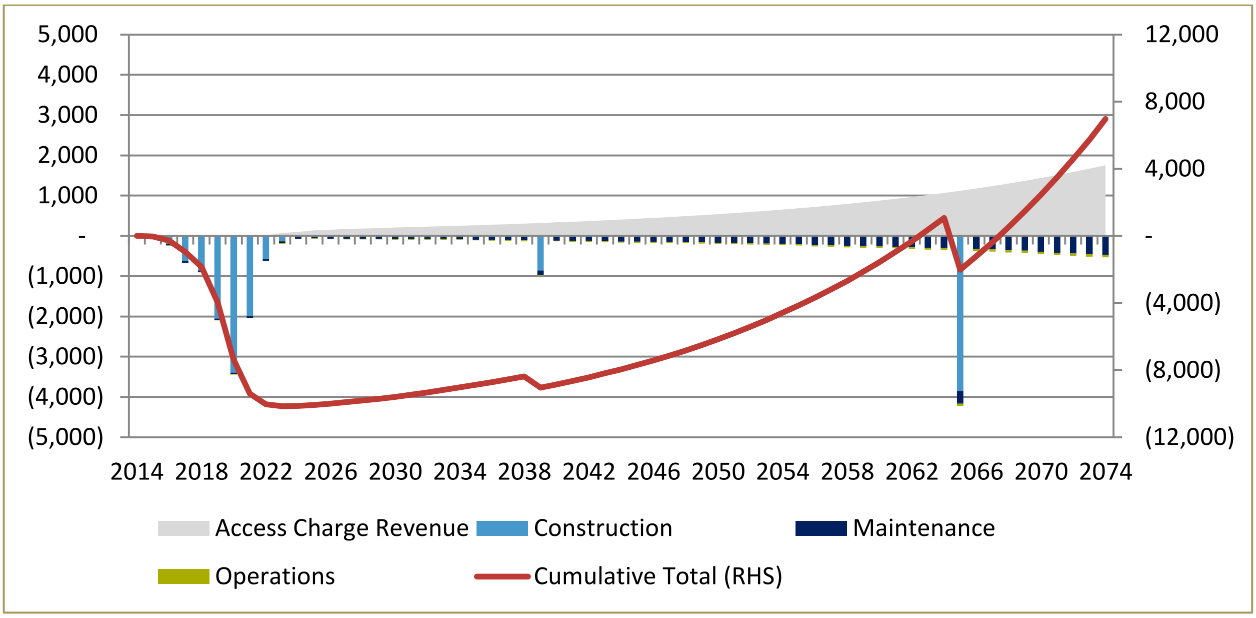
This comparison is provided graphically in Figure 15.2 (includes operating costs and revenue) and Figure 15.3 includes the capital costs of Inland Rail.

Figure 15.2 Inland Rail financial assessment: summary of Inland Rail ongoing operating costs and revenue ($ million – nominal)



Source: PwC, 2015.

Figure 15.3 Inland Rail financial assessment: summary of Inland Rail costs (including capital) and revenue ($ million – nominal)



Source: PwC, 2015.

15.5. Opportunities

To assist affordability a range of opportunities have been identified, including:

- Further consideration on staging of the 10 year programme.
- De-risking of the Inland Rail Programme.
- Value engineering.
- Market engagement.
- Funding and financing.

This section summarises these opportunities to assist and inform government decision making with regard to the Programme. Further work is required to ascertain the impacts on key stakeholders including market participants, local and state governments and the community.

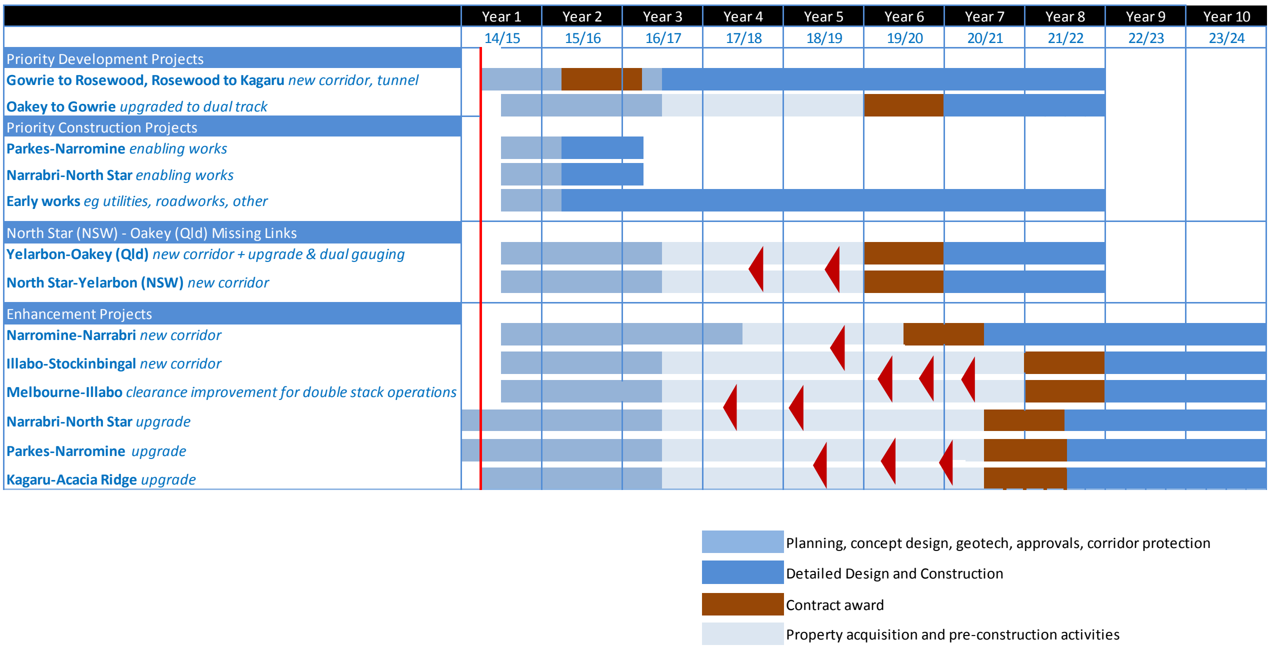
15.5.1. Staging

The Australian Government requested development of a 10 year programme to deliver Inland Rail and as part of the development process, the key scope items have been considered for complexity, delivery timing, and funding requirement, which has informed the delivery schedule. However, as part of their work, EIG identified a potential eight year delivery schedule which was outlined in Chapter 14 (Packaging, procurement and delivery). This alternate schedule is provided in Figure 15.4.

The Inland Rail RPDS update proposes that this accelerated delivery schedule may deliver greater value for money and improve affordability for the Programme through:

- Reduced construction out-turn cost and reduced Programme overhead and management costs resulting from a shorter delivery schedule, including the associated reduced escalation impact.
- Bringing forward the full benefits of the Programme including additional revenues.

Figure 15.4 Revised completion schedule



Note: the triangles on this schedule reflect the potential to bring particular activities forward (i.e. to start and complete them earlier), should funding be available.

Source: EIG, 2015.

15.5.2. De-risking the Programme

As outlined, within the cost estimate there is a significant amount of contingency at both the P50 (approximately $1.8 billion in 2014 dollars) and at the P90 (approximately $2.5 billion in 2014 dollars) confidence levels. As the Programme engineering, design, property and stakeholder requirements are better understood the allocation of risk and associated allowances for contingency could potentially be reduced—improving overall affordability.

The risk ranges as a percentage of the base estimate are within acceptable bounds for this stage of the Programme lifecycle as outlined in Table 15.1. However, these bounds may not be reflective of the scale of Inland Rail and there is potential opportunity to better reflect risk as an overall quantum for Inland Rail. This may further improve affordability.

Table 15.1 Risk contingency results

DESCRIPTION	RISK CONTINGENCY
Base Estimate (excluding risk and escalation)	100%
P50 Total Programme Cost (excluding escalation)	126.1%
P90 Total Programme Cost (excluding escalation)	135.9%

Source: ARTC, 2015.

Chapter 13 (Risks), identifies the following activities that could improve the reliability of the base estimate and therefore reduce the risk allowance:

- Carrying out further investigation and design to provide greater reliability in the design solution, and where possible developing estimates based on reference designs for the project in lieu of typical scopes of work.
- Refining the costs of key items including tunnels and viaducts to allow their associated cost risk uncertainty ranges to be reduced, therefore providing the greatest opportunity to reduce budget contingency.
- Continuing planning for Inland Rail Programme such that the cost estimate can be aligned to the Programme delivery strategy and master schedule.
- Carrying out all activities needed to secure the rail corridor such that risks associated with major changes to alignment can be resolved.

The benefits associated with de-risking the Programme are two-fold:

- It better informs the funding requirements and affordability of the Programme.
- It enables the market to better price works packages to be delivered within the 10 year programme which improves value for money.

15.5.3. Value engineering

Value engineering is the process of identifying value areas which assist to refine the scope and prioritise items important to key stakeholders in meeting the key service requirements. Value engineering informs the base estimate and anticipated revenues, and assists in de-risking the Programme.

Value engineering is anticipated to occur throughout delivery of Inland Rail to ascertain scope and interfaces, reduce potential redundant works and identify opportunities to deliver greater value in delivering separate project/packages. The quantitative impact of value engineering will be incorporated into subsequent revisions and updates to the base estimate for the Programme.

An additional part of any value engineering process may also include further clarification of ARTC's role in delivery and operations of Inland Rail. As outlined Chapter 10 (Financial analysis), a Public Sector Comparator (PSC) was developed to assess Inland Rail as a stand-alone business owned and operated by government. Further consideration of leveraging ARTC existing assets, operations and accreditations may also improve affordability of the Programme.

15.5.4. Market engagement

To drive quality outcomes and value for money, pursuing an effective and efficient procurement process for each Inland Rail work package is necessary. In the procurement context, efficiency or the productivity of resources used to conduct an activity to achieve the maximum value includes the selection of a procurement process that is consistent with government policy and is the most appropriate to the procurement objective under the prevailing circumstances. Efficiency in procurement is enhanced by conducting transparent, fair and appropriately competitive processes. Effectiveness of outputs in terms of price, quality and quantity, and the degree to which outputs contribute to specified outcomes, can be achieved by correctly identifying the need, accurately drafting functional specifications, rigorously assessing responses and negotiating the final contract, and then diligently managing the contract.

Procurement strategies specific to each project and work package will need to be developed to enable comprehensive development, engagement, monitoring and assessment at all stages of the procurement process. Key to realising better value for money will be appropriate understanding, pricing and allocation of risks within the contracting mechanism for each package.

The combination of an appropriate contracting mechanism that allocates risks and a procurement process that improves understanding of the risks, presents the opportunity to improve value for money through effective procurement. Procurement processes are available to improve the dialogue and therefore understanding of projects that lead to effective risk allocation and greater value for money. Some examples of these to be considered and incorporated into the relevant procurement strategies include:

- Early contractor involvement: Primarily used where there is a combination of design and construction activities incorporated into the contract.
- Early tendered involvement: Primarily used where the contractor or service provider is being engaged and there is a well-defined scope or service requirement.

These processes will be integral in enabling interfaces and associated risks to be understood and defined throughout the life of the Programme. It is envisaged that all appropriate procurement processes will be competitive and may use pre-qualification or panel schemes to ensure appropriate tenders are involved to improve efficiency of the procurement processes. This may further improve affordability through risk allocation and competition that provides greater cost and delivery certainty.

15.5.5. Funding and financing

DIRD are concurrently undertaking an assessment of funding and financing options for Inland Rail separate to the Programme Business Case. The contents of this chapter have been presented to inform this separate assessment.

The Australian Government's Infrastructure Finance and Funding Reform (April 2012) paper outlines that a major constraint on the delivery of infrastructure is the funding capacity of Australian governments and identified that there is opportunity for the private sector to provide financing capital for infrastructure projects. The report identified a number of key funding reform recommendations including:

- Governments should implement targeted measures such as user charges to enhance price signals to better balance supply and demand, and to increase the funding available for infrastructure investment.
- For appropriate projects, the Australian Government should consider the greater use of alternative funding models, including co-funding availability payments alongside state and territory governments.
- Governments should utilise appropriate models to drive revenue from the broader benefits delivered by major infrastructure projects, such as value capture for transport infrastructure.
- Governments should take a more flexible approach to the allocation of risk, including demand risk, for high net public benefit projects that have the capacity to generate revenue streams from users.

The Programme Business Case is based on users paying access charges to fund Inland Rail's operational and maintenance requirements. Inland Rail will also be a catalyst for additional private sector and market based investments in terminals and rollingstock in addition to traditional infrastructure financing entities. There are opportunities to improve affordability through an appropriate funding and financing structure for Inland Rail.

15.6. Need for government funding

At approximately $10 billion, Inland Rail is a significant investment in Australia's future freight logistics chain and based on the scale and scope, the market is unlikely to be able to commit the total financial resources required to deliver stand-alone projects. Therefore, it is the role of government to facilitate a step change to foster and enable the market to invest where appropriate to complement Inland Rail and realise greater benefits for the economy and the community.

The National Infrastructure Plan (2013) outlines that there is a strong link between good infrastructure decisions and the long-term performance and fairness of Australia's economy and society. The lack of available infrastructure funding is the major constraint to bridging the gap between the infrastructure we have and the infrastructure we need. It also outlines that if investment is made in the infrastructure we need, we can enjoy lower transport costs, lower congestion costs and create more competitive industries.

The National Commission of Audit outlines the Commonwealth responsibilities and role in nationally significant infrastructure.[157] It outlines that while the states are best placed to make decisions and deliver infrastructure projects most needed by local communities, there is a role for the Commonwealth to play in the coordination of nationally significant infrastructure. Under the *Infrastructure Australia Act 2008,* nationally significant infrastructure includes energy, transport, communications and water infrastructure in which further investment will materially improve national productivity. Direct Commonwealth investment in infrastructure could be made directly, or through financing infrastructure alongside state governments. Australian Government intervention may be necessary to ensure that infrastructure which provides broader economic or social benefits, but may not be commercial, is delivered.

Funding costs

Business Council of Australia President Tony Shepherd has stated that the Australian Government could borrow money to help finance critical infrastructure to get key projects off the ground and indicates that 'good debt' is borrowing for a needed piece of economic infrastructure that will add to the productivity and growth of the country. He also indicated there is a case for the Commonwealth and states to look at leveraging private sector investment.[158]

Inland Rail presents the Australian Government with the opportunity to invest in economic infrastructure that would enable private sector to invest in complementary investments such as terminals and rollingstock.

15.7. Summary

- Inland Rail requires significant capital investment, most likely almost $10 billion over the 10 year delivery schedule.
- Once operational, Inland Rail would be self-sustaining from a cashflow perspective through anticipated access charges and potentially provide a return.
- There are opportunities to further investigate leveraging existing assets and operations of ARTC to maximise value and affordability of Inland Rail.
- The Australian Government is best placed to support the funding and financing required for Inland Rail and there is opportunity to engage with key stakeholders to explore opportunities for funding contributions or complementary investments.

There are a range of items to be further considered with regard to funding, including:

- Commonwealth: Impact of investment on budgets over the 10 year Inland Rail Programme, as well as identification of a preferred funding and financing option.
- States: Opportunity for states to contribute to support Inland Rail or in alternative/additional infrastructure.
- Local: Opportunity to invest in complementary infrastructure such as sidings and terminals.
- Private sector: Noting that market engagement has not occurred, there is opportunity to seek input from market participants and users of Inland Rail in contributing to the capital cost through either upfront contributions, levy, or access charges once operational. Market engagement will form a key part of the strategy if government approves Inland Rail.
- ARTC: Ability to invest and or leverage existing investments in infrastructure and operations over time for its shareholders (currently the Australian Government).

[157] National Commission of Audit, http://www.ncoa.gov.au/report/phase-two/part-a/2-3-broader-role.html, 2015.

[158] The Sydney Morning Herald, http://www.smh.com.au/business/borrow-to-fund-infrastructure-20130730-2qxcr.html, 2013.

Chapter 16

Benefits realisation

16. BENEFITS REALISATION

16.1. Purpose of this chapter

Benefits realisation is the process of identification, definition, tracking and optimisation of results to ensure potential Inland Rail Programme benefits are realised.

An effective benefits management strategy is an important contributor to the Programme Business Case and government decision making. This chapter identifies and explains the specific benefits which are directly attributable to Inland Rail and provides a draft management strategy.

16.2. Approach

Benefits outlined in this chapter describe the change as an outcome and how it will be measured, whereas the economic benefits considered in the economic analysis (Chapter 9) seek to value and quantify the impacts as part of the CBA. The benefits discussed in this chapter may therefore not reconcile directly with the economic CBA.

Responsibility for the achievement of a number of Inland Rail's benefits may lie with interrelated parties, for example, transit time is the responsibility of train operators.

The Inland Rail benefits have been assessed in accordance with well accepted frameworks and guidelines.
Key principles applied to this assessment include:

- Benefits are dynamic: Benefits identified at the commencement of the investment's life cycle will almost certainly change over the life of the investment. They need to be regularly reviewed and updated, in response to changes in scope, objectives and delivery.
- The 'business' needs to own the benefits: Benefits must be owned by appropriate business sponsors/owner and managers.
- Benefits are not automatic: In addition to effective management, delivery of desired benefits requires active monitoring of progress.
- Benefits need to be first understood as outcomes: With an understanding of the holistic change required to realise outcomes, benefits can be planned, realised and reported.
- Intermediate outcomes are needed to realise business benefits: Achievement of and reporting on intermediary outcomes (those associated with the change along the way) are just as important as the benefits associated with final strategic outcomes.
- Benefits are both financial and non-financial: Benefits realised and measured can be both subjective and objective.

Given that the benefits are dynamic, as the Inland Rail Programme moves through its lifecycle, the realisation of outcomes will change as the Programme is delivered.

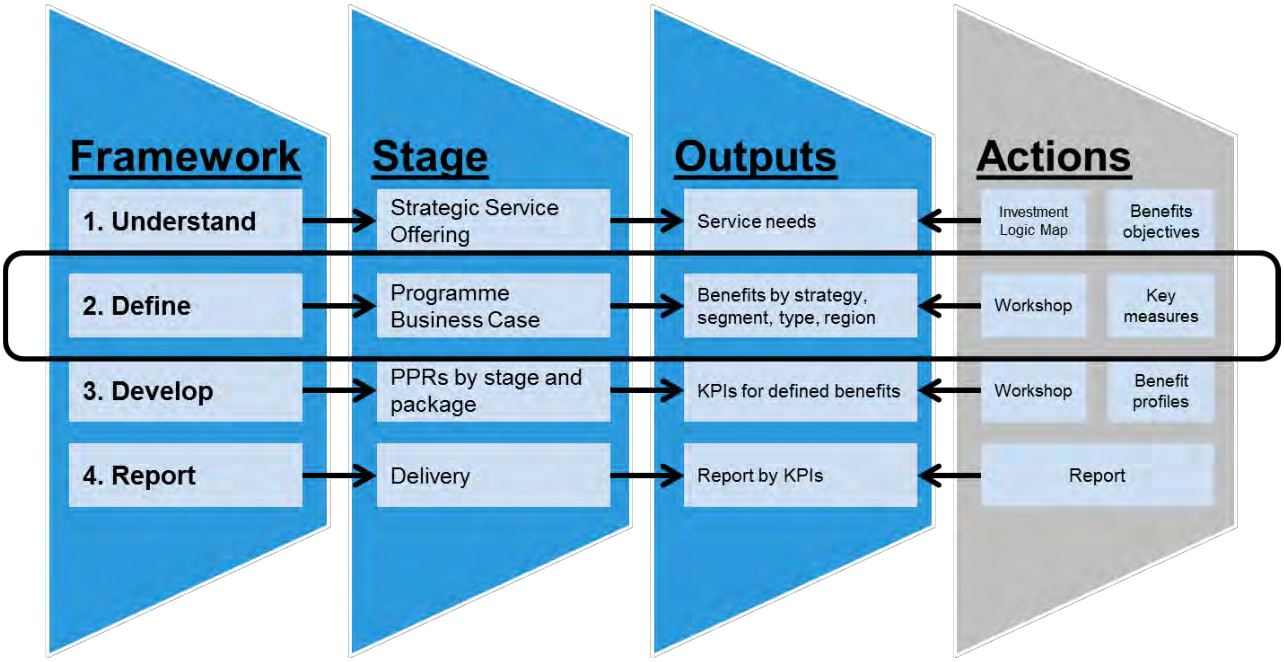
The process of understanding the outcomes of an investment and adding detail over time to develop and clearly define benefits for reporting purposes is summarised in Figure 16.1, the Benefits management framework developed for the Programme.

Key phases of the benefits management framework include:

- Understand: Before planning or measuring benefits, it is necessary to understand which outcomes are the target of an identified investment.

- Define: Updates and defines the findings from the Understand phase. An ILM exercise was undertaken to identify the problems and benefits associated with Inland Rail, as well as development of an overarching strategy to enable projects/stages to contribute to realisation of the Programme benefits.
- Develop: Updates and further defines the benefits and project/stage plans for realising the benefits by developing a structure to measure and report the success in achieving the outcomes.
- Report: Performance reporting of the actual versus planned benefits in accordance with the strategy and plans.

Figure 16.1 Benefits management framework



Source: PwC, 2015.

At this stage the Programme Business Case outlines a draft Programme benefits management strategy. This provides a framework for benefits to be realised and measured at the Programme level.

As Inland Rail progresses the Programme benefits management strategy will evolve to provide a clear process for benefits management and reporting at the Programme and the project/stage/package level.

16.3. Benefit context

Chapter 3 (Problem identification and analysis) outlined the strategic problems Inland Rail will respond to. These problems include:

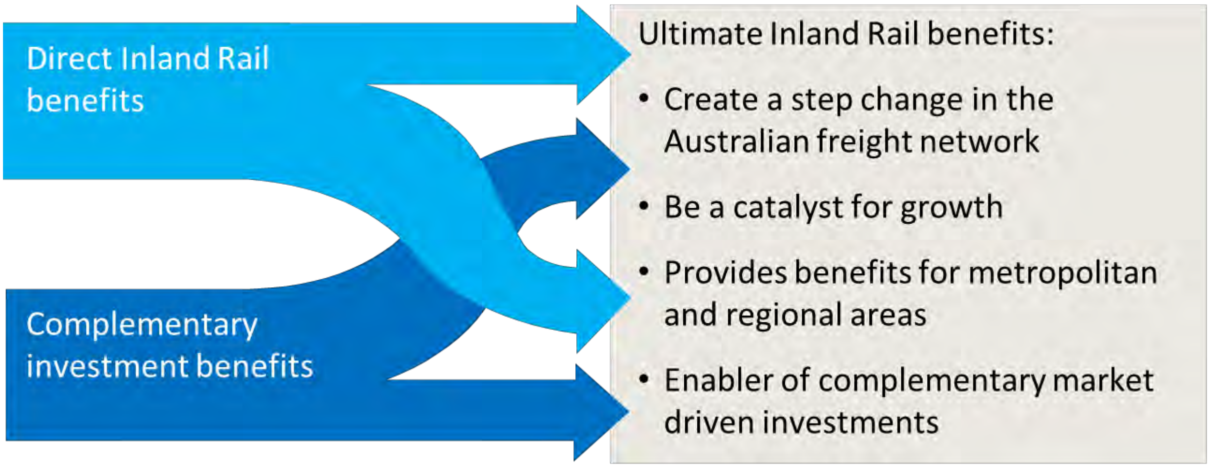
- Existing infrastructure between Melbourne and Brisbane has insufficient capacity to meet future freight demand.
- Current north–south freight infrastructure is constrained and this will increasingly impact negatively on freight productivity.
- The continued reliance on road for freight transport will result in increasing safety, environmental and community impacts with associated costs.
- Existing north–south freight infrastructure is impacting accessibility to supply chain networks for regional producers and industries and inhibiting the productivity and economic growth potential of regional communities.

- Lack of resilience on existing north–south freight infrastructure exposes supply chains to disruptions and sub-optimal reliability.

16.4. Strategic benefits

Inland Rail presents a unique opportunity to realise broader benefits for the economy and the community as it enables market driven complementary investments. There are a range of direct benefits of Inland Rail outlined in section 16.5 and broader benefits that are enabled by Inland Rail as outlined in Figure 16.2.

Figure 16.2 Direct and complementary benefits



Source: PwC, 2015.

The overarching vision of Inland Rail is to:

- **Create a step change in the Australian Freight Network:** Inland Rail offers significant performance advantages over the existing coastal route, including faster and more reliable transit times, shorter alignments, more optimal grades, the potential for double stacking and longer and heavier axle load trains. It will improve the reliability and resilience of the freight network and improve access to export ports and urban freight destinations. These operational efficiencies will increase the role rail plays in the broader freight network and will allow rail to compete in the market as a viable alternative to road, increasing the overall network capacity and freight mode options available to the market.
- **Be a catalyst for growth:** Inland Rail will future proof Australia's rail freight task against population growth and the projected increase in freight demand, allowing for increased productivity in major capital cities. It will improve the safety of the network with a better mix and separation of modes in urban and regional environments, providing options for movement of goods that do not require larger vehicles than is currently used throughout the passenger vehicle network. This separation will result in improved network efficiency through shorter journeys, lower fuel and maintenance costs, leading to supply chain efficiencies and reduced costs which will ultimately benefit consumers.
- **Provide benefits for metropolitan and regional areas:** The diversion of Melbourne to Brisbane and regional rail freight from the Sydney and Brisbane metropolitan rail networks and the transfer of road freight (which currently transits through the Newell Highway or regional towns in Victoria, New South Wales and Queensland) onto Inland Rail will reduce the competition for scarce capacity on the rail and road networks of these major cities. It is predicted that the construction of Inland Rail will remove a significant number of trucks from roads on the east coast, resulting in improved environmental sustainability through reduced road congestion, fewer emissions and less noise. The 10 year delivery programme will support economic activity in the regions and create regional jobs

in Queensland, New South Wales and Victoria during construction and longer term economic opportunities for the regional areas through access to the new infrastructure and associated services.

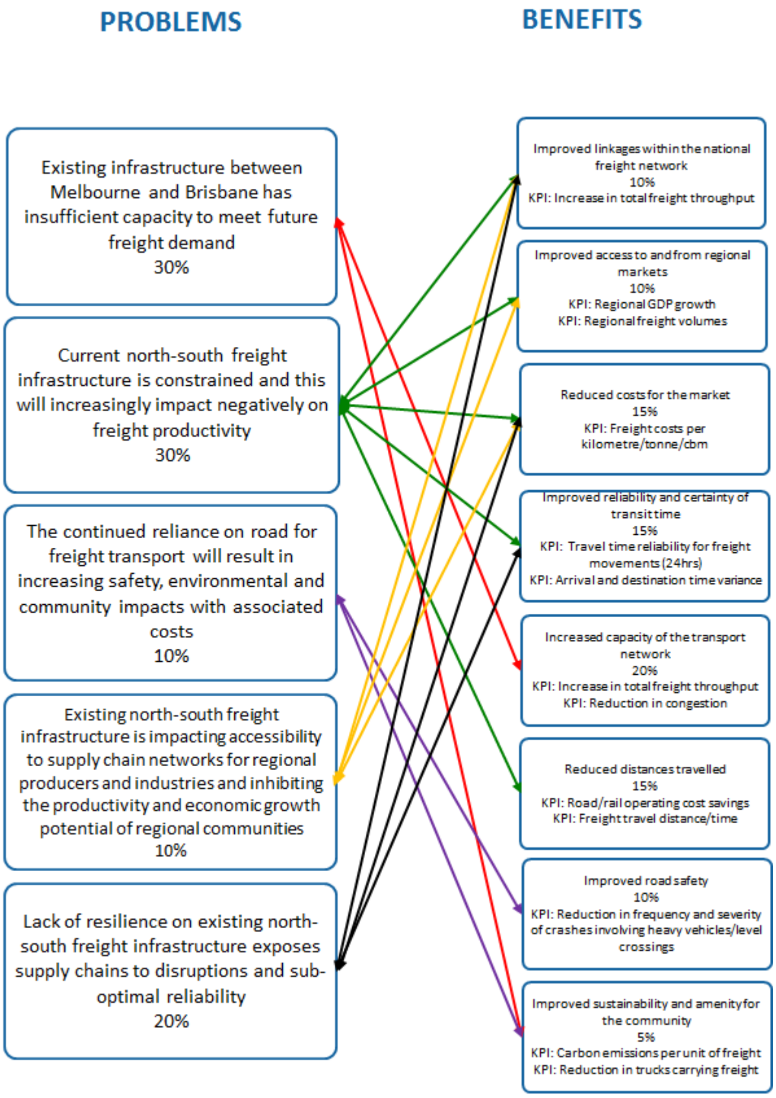
- **Be an enabler of complementary market driven investments:** The ultimate benefits of Inland Rail require interdependent and complementary investment in a number of other projects, policies and initiatives and these will be coordinated throughout the Programme, including:
  - Regional terminals and loading facilities for regional/agricultural/coal freight.
  - Rollingstock investment in longer, heavier trains along with supporting train operations to take advantage of the improved rail offering (e.g. determination of arrival, departure and transit times) by train operators.
  - Double stack terminal capacity in Melbourne and Brisbane and ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
  - Investment in connecting coal and agricultural rail lines and rail sidings from the Surat and Clarence–Moreton Basins in south west Queensland to the Port of Brisbane (the Western Line and in metropolitan Brisbane).

16.5. Inland Rail benefits defined

This section provides further detail on each of the benefits identified in section 16.4, their interactions with key markets as well as impacts on regional areas and capital cities. Corresponding measures are outlined in Table 16.1.

An ILM workshop was undertaken that reviewed, updated and confirmed the key problem statements, confirmed the Programme level benefits and indicative Key Performance Indicators (KPIs) applicable to the Programme. A summary of the problems and benefits extracted from the ILM are outlined in Figure 16.3. The benefits identified build upon those presented in the PPR (May 2014) and the Strategic Review and Service Offering (Nov 2014), and reflect the current status and information available for Inland Rail. The percentages in Figure 16.3 represent the relative level of importance of the problems and benefits when compared against each other.

Figure 16.3 Investment Logic Map



Source: ARTC, ILM (extract), 2015.

IMPROVED LINKAGES WITHIN THE NATIONAL FREIGHT NETWORK

Inland Rail will provide the backbone for the freight network that will enable the right freight to be moved by the right mode across Victoria, New South Wales and Queensland.

Improved network linkages enable:

- More direct routes for intercapital freight to key destinations.
- Ability to utilise longer/heavier coal trains with greater train path certainty for mine to port access.
- Better silo access and branch line integration for agriculture.
- Capital cities to utilise additional capacity to prioritise passenger services with separation of freight train paths.
- Regional opportunities for economic growth and increased population growth along the new route.

IMPROVED ACCESS TO AND FROM REGIONAL MARKETS

Inland Rail will improve access to and from regional markets including:

- Improved linkages to regional areas for intercapital freight.
- Improved mine to port accessibility between coal mines in the Surat and Clarence-Moreton Basins and the Port of Brisbane which reduces operating costs and also results in additional coal exports that would not have otherwise occurred.
- Agricultural areas and regions have improved access to key local and international markets, provide improved drought resilience and ability to move greater volumes of grain via rail (the preferred mode).

REDUCED COSTS FOR THE MARKET

- Reduced intercapital freight transport costs for the market are likely to result in lower prices for consumers (predominantly manufactured goods). This also presents an opportunity for flow-through of cost savings to reduce the cost of living for households.
- Inland Rail is likely to reduce lifecycle costs for infrastructure owners/operators on the coastal route and road network (i.e. Newell and Pacific Highways) as a result of lower freight volumes on these assets. This reduces maintenance costs and enables investments in capacity to be avoided or deferred.
- Reduced transport costs may improve competitiveness of key markets and economic activity, particularly in the agricultural and coal sectors.
- Reduced operating costs may improve the viability of some mines resulting in induced coal freight volumes that would not otherwise have occurred. There will be additional profits to mines, which Australian owners will retain, and additional taxes (company, royalties and payroll tax) for profits accruing to overseas owners.
- Coal freight in the Surat and Clarence–Moreton Basins should benefit from reduced above rail operating costs as a result of higher axle loads east of Oakey (20 tonne axle loads compared to the current 15.75), longer trains (1010 metres compared to the current 650 metres) a more direct alignment in tunnel across the Toowoomba Range that avoids the current crossing where operating speeds are constrained by high gradients and tight curves on a winding track.
- Intercapital and agricultural freight currently travelling by road should benefit from reduced operating costs as a result of economies of scale in rail relative to road transport.

IMPROVED RELIABILITY AND CERTAINTY OF TRANSIT TIME

- Improved reliability and certainty of transit time results in productivity and economic efficiency as a result of operating cost savings, shorter transit times, improved availability and avoided incidents on the coastal route.
- Benefits associated with higher axle loads, longer trains, lower gradients, longer curves, resulting in shorter transit times and avoided incidents and flooding.
- Freight customers have indicated they may be willing to pay for improved reliability and availability with Inland Rail.
- These benefits would induce additional freight volumes that would not have occurred in the absence of Inland Rail.

INCREASED CAPACITY OF THE TRANSPORT NETWORK

- Increased capacity enables the opportunity to return unused freight paths to passengers in Sydney and Brisbane during off peak periods (noting that passengers are already given absolute priority in peak periods).
- Improved customer outcomes for rail passengers between Sydney and Brisbane with unused freight paths on the coastal route able to be returned to passenger services. The benefit of increased frequency of passenger services reduces average wait time and provides greater reliability and certainty for passengers.
- Road traffic through Sydney will be relieved by allowing greater capacity for public transport, avoiding the need for capacity augmentation on existing routes.

Increased freight capacity enables:

- Greater volumes of intercapital freight to be moved via rail with a reduced reliance on road.
- Coal trains to utilise longer/heavier trains with better port access.
- Agricultural freight, including grain to utilise rail in accessing key local and international markets.

REDUCED DISTANCES TRAVELLED

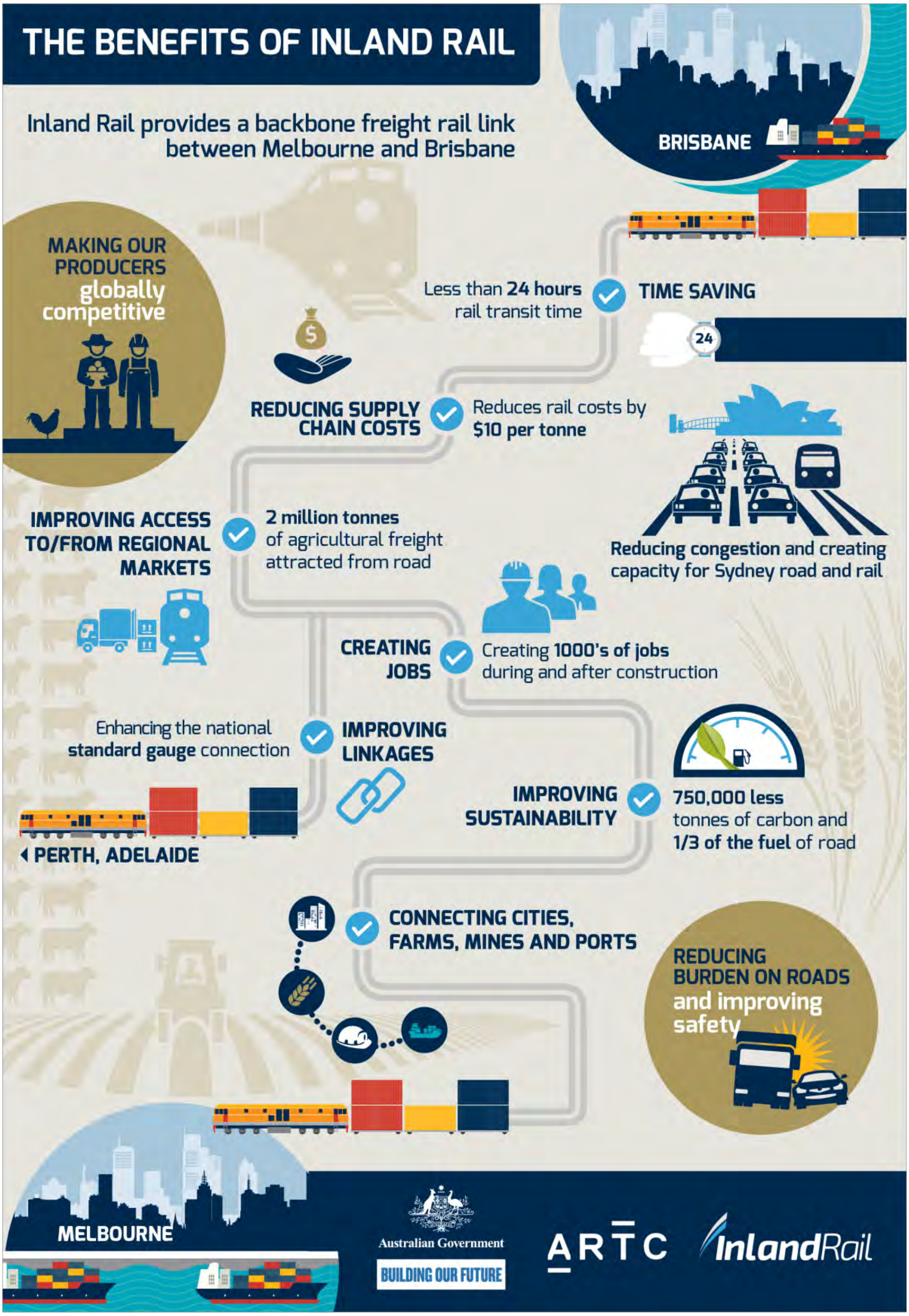
- Inland Rail reduces the distance travelled by freight which supports and enables other benefits such as reducing costs, improving safety and sustainability. This should also provide benefits with regard to shrinkage or damage to freight through reduced distances travelled.

IMPROVED ROAD SAFETY

- Inland Rail will support improved safety for the community as a result of removing heavy vehicles from the road network, reducing the distance travelled for rail freight and separating freight and passenger rail. This includes the implementation of a suitable policy for treatment of level crossings along the corridor.

IMPROVED SUSTAINABILITY AND AMENITY FOR THE COMMUNITY

- Sustainability benefits for the community result from removing heavy vehicles from the road network and reducing the distance travelled for rail freight. This results in improved road congestion, fewer emissions and less noise.
- Improved sustainability and amenity impacts also include the potential to provide rail lines away from housing or bypass towns, improving accessibility and amenity in regional areas.


THE BENEFITS OF INLAND RAIL
Inland Rail provides a backbone freight rail link between Melbourne and Brisbane
BRISBANE
MAKING OUR PRODUCERS globally competitive
Less than 24 hours rail transit time
TIME SAVING
24
REDUCING SUPPLY CHAIN COSTS
Reduces rail costs by $10 per tonne
IMPROVING ACCESS TO/FROM REGIONAL MARKETS
2 million tonnes of agricultural freight attracted from road
Reducing congestion and creating capacity for Sydney road and rail
CREATING JOBS
Creating 1000's of jobs during and after construction
Enhancing the national standard gauge connection
IMPROVING LINKAGES
IMPROVING SUSTAINABILITY
750,000 less tonnes of carbon and 1/3 of the fuel of road
PERTH, ADELAIDE
CONNECTING CITIES, FARMS, MINES AND PORTS
REDUCING BURDEN ON ROADS and improving safety
MELBOURNE
Australian Government
BUILDING OUR FUTURE
ARTC
InlandRail

16.6. Benefits realisation

To enable realisation of the benefits it is important to understand the measures and baseline data that will demonstrate success. Measurement will occur before, during and post delivery of the 10 year Inland Rail Programme. The key measures for the benefits attributable to Inland Rail are outlined in Table 16.1.

Table 16.1 Summary of measures and proposed KPIs

BENEFIT		BASELINE MEASURE	PROPOSED KPIS
1	Improved linkages within the national freight network	National Freight network map 2015, pre business case consideration.	KPI: Increase in total rail freight throughput on the corridor.
2	Improved access to and from regional markets	National Freight network map 2015, pre business case consideration.	KPI: Regional freight volumes.
3	Reduced costs for the market	Average cost per kilometre 2014 as assumed in business case.	KPI: Freight costs per km/tonne.
4	Improved reliability and certainty of transit time	Current reliability data 2014 base year for all modes.	KPI: Rail line haul transit time (24hrs) KPI: Arrival and destination time variance.
5	Increased capacity of the transport network	Volume/capacity ratio of network 2014 for rail and road.	KPI: Increase in total rail freight throughput on the corridor.
6	Reduced distances travelled	National Freight network maps 2015, pre business case consideration.	KPI: Rail operating cost savings. KPI: Rail freight travel distance.
7	Improved road safety	2014 road crash statistics.	KPI: Reduction in frequency and severity of crashes involving heavy vehicles/level crossings.
8	Improved sustainability and amenity for the community	2014 freight vehicle emissions rail and road.	KPI: Carbon emissions per unit of freight (km/tonne) based on mode share (rail and road).

Source: PwC, 2015.

The ultimate benefits of Inland Rail are likely to be realised beyond the lifecycle of the Programme. Ultimate benefits can be realised by:

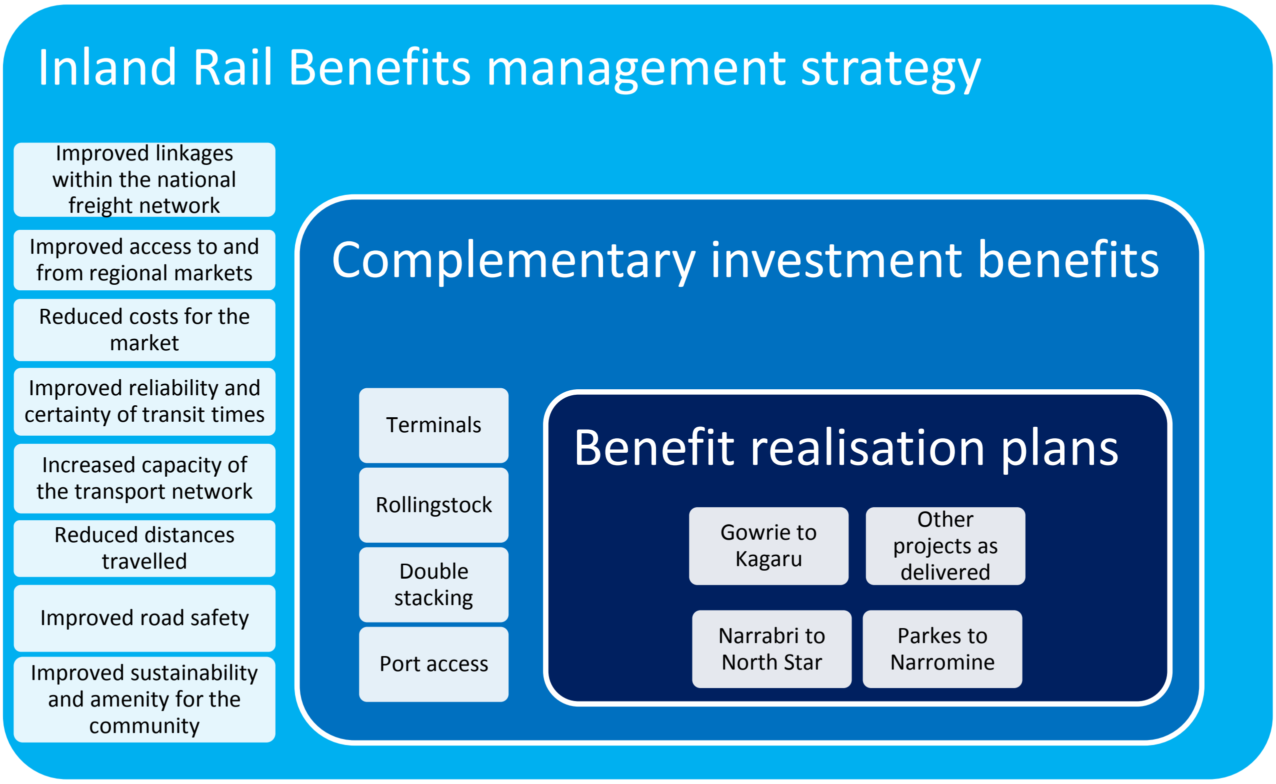
- Actively pursuing and facilitating investment in terminals in line with the 10 year delivery programme.
- Working with customers and operators to enable longer and heavier trains providing a more efficient service for customers.

- Working with coal stakeholders in South East Queensland, the Queensland Government and Port of Brisbane to improve connections for coal and agricultural lines.

16.7. Reporting and project contribution

The benefits management framework developed for the Inland Rail Programme outlines a clear distinction between Programme benefits and benefits for each project/stage/package as outlined in Figure 16.4. To effectively realise the benefits, the Programme benefits management strategy outlines the key benefits and metrics to be used to demonstrate realisation of the anticipated benefits at the Programme level. Each project/stage/package will have specific KPIs that contribute to the Programme benefits. These assessments may be separate and attributable to their type or geographic region.

Figure 16.4 Benefits management strategy per project/section



Source: PwC, 2015.

A benefits realisation plan will be developed for each project/stage/package. These plans will prioritise and detail how and when the expected benefits will be delivered by respective project/stage/package. The benefits realisation plan is an important document as it specifies the size, timeframe, metrics, ownership and responsibility for each proposed benefit.

Benefit profiles will be created for each highly ranked benefit and will outline how they will be measured and reported and is likely to include the profiles in Table 16.2.

Table 16.2 Benefit profiles

BENEFIT PROFILE	DESCRIPTION
Observable	• What precisely is the benefit to be realised?
Outcomes	• What are the verifiable differences that will be noticeable between pre and post implementation?
Attribution	• Where will this benefit arise? • Can this Programme claim its realisation? • Is the accountability and responsibility for delivering the benefits clear and agreed?
Measurement	• How and when will the achievement of the benefit be measured?
Report	• Who will be reported to, how frequently and what are the accountabilities?

Source: PwC, 2015.

Benefits will be measured at the Programme and project/stage/package level throughout and post delivery of the Programme. It is essential that there are resources allocated to complete this task after completion of the Programme. Once benefits have been confirmed and agreed, it is necessary to realise and report on these outcomes. Benefit ownership will form part of the governance arrangements for Inland Rail.

Benefit reporting will flow through all levels of governance through allocation of responsibility, accountability and control. Information will flow through Programme reports at the work stream level through to the project control group and steering committee.

The following will be undertaken to enable benefit tracking:

- Develop measurement tools and trial these using information that is easily attainable.
- Collect primary evidence (monitor the time and resources spent on conducting measurements and data collection).
- Develop reporting dashboards or templates which can be used to analyse data and provide better presentations in communicating results.
- Regularly assess the accuracy of the results, inform stakeholders if results are inconsistent with expectations and determine whether key assumptions need to be changed.
- Update benefit profile registers.

16.8. Summary

The Inland Rail Programme benefits management strategy outlined in this chapter has been developed in accordance with well accepted frameworks and guidelines. The strategy shows a clear distinction between Programme benefits and benefits for each project/stage/package. The strategy outlines the metrics to be used to demonstrate realisation of the anticipated benefits at the Programme level, while each project/stage/package will have specific KPIs that contribute to the Programme benefits.

Benefit reporting will flow through all levels of governance from the work stream level through to the project control group and steering committee.

Inland Rail is expected to provide the following direct benefits:

1. Improved linkages within the national freight network.
2. Improved access to and from regional markets.
3. Reduced costs for the market.
4. Improved reliability and certainty of transit time.
5. Increased capacity of the transport network.
6. Reduced distances travelled.
7. Improved road safety.
8. Improved sustainability and amenity for the community.

Investment in Inland Rail also provides the opportunity for the market to respond and invest in complementary infrastructure, including:

- Rollingstock, through longer, heavier trains.
- Double stack terminal capacity in Melbourne and Brisbane and ability to accommodate 1800 metre trains initially and up to 3600 metre trains in the future.
- Regional terminals and loading facilities for regional/agricultural/coal freight.
- Connecting coal and agricultural rail lines and rail sidings from the Surat and Clarence-Moreton Basins in south west Queensland to the Port of Brisbane (the Western Line and in metropolitan Brisbane).

The ultimate benefits of Inland Rail will result from a combination of both direct and complementary investments that:

- Create a step change in the Australian freight network.
- Becomes a catalyst for regional and economic growth.
- Enable and attract complementary market-driven investments.

Chapter 17

Programme management

17. PROGRAMME MANAGEMENT

17.1. Purpose of this chapter

The purpose of this chapter is to outline the management and governance structures that have been developed to enable effective delivery of Inland Rail. These structures respond to the requirements of the RPDS outlined in Chapter 14 (Packaging procurement and delivery).

17.2. Approach

Development of the Programme management framework for Inland Rail involved the consideration of a broad range of processes, governance and resourcing requirements. This includes but is not limited to:

- Review of the current PMP and controls.
- Determining the requirements to implement packaging, procurement and delivery recommendations.
- Identifying key delivery phase tasks/categories.
- Identifying development phase governance requirements.
- Identifying PMO resource and leadership requirements to respond to the packaging, procurement and tasks.
- Identifying controls required to manage the Programme.
- Identifying the next steps for the identified projects/stages including required government approvals.

17.3. Programme governance

The Australian Government established the IR-IG in 2014 with the ARTC asked to develop a 10 year programme for Inland Rail. ARTC mobilised an Inland Rail PMO in 2014 with a blended team of existing ARTC staff, new ARTC personnel and contractors, complemented by technical advisors and service providers.

Current governance

The current governance structure includes the committees and groups outlined in Table 17.1.

Table 17.1 Committees and groups

COMMITTEE/GROUP	OVERVIEW
IR-IG	The Deputy Prime Minister, as Programme sponsor, established the IR-IG to provide oversight to the Programme.
Inland Rail Steering Committee (IR-SC)	The IR-SC was established to provide strategic input to the Programme and to identify impacts on other projects or operations. This committee will also make key decisions relating to operation of the completed corridor, such as the train configuration requirements, to guide preparation of the design, risks, costs and demand estimates. Operational decisions required by the Programme team will be raised through the preparation of issue papers submitted to the IR-SC. PPRs and milestone packages will be reviewed by this group during 'gold and final reviews'. The IR-SC also interfaces with the Budget Investment Committee when drawing down funding allocated to ARTC.

COMMITTEE/GROUP	OVERVIEW
Inland Rail Project Control Group (IR-PCG)	The IR-PCG comprises the management team from the Programme and will review and coordinate progress of the project, monitoring risks, providing assurance and reviewing any scope changes. The group will make operational decisions relating to delivery of the Programme, within their delegation. Decisions above the IR-PCG's delegated authority will be raised to the IR-SC or the IR-IG. The IR-PCG will undertake 'red reviews' for submissions to the IR-SC, IR-IG and Australian Government.
Inland Rail Peer Review Group (IR-PRG)	The IR-PRG is being established as a small group of industry experts with considerable experience, who will provide input to senior members of the Programme team. This group will provide alternate perspectives on the Programme.

Source: ARTC, 2015.

17.4. Programme management

An infrastructure programme of this size will require a significant expansion of the current Inland Rail PMO to manage the broad range of contracts and activities required to implement the Programme. These include:

- Development of funding submissions and further evaluation activities as required by the relevant approval agencies.
- Corridor protection, property acquisition and early and enabling works.
- Reference design for the Programme with potential other specific design contracts, potentially by section.
- Contracts for upgrade works, new alignment works, specialist tunnelling, and rail systems and activities.
- Enabling works contracts for power supply, water and road access to major construction sites.
- Major supply contracts (sleepers, rail, hook and pull, and turnouts).
- Operate and maintain arrangement for the entire link.

A broad range of management and specialist capability is required to deliver the Programme, including:

- **Programme management:** Effective management is critical to ensure Inland Rail is able to meet its time and financial requirements. Key elements such as risks, collation of cost data, issues and document management must be well managed throughout the subsequent planning, procurement and delivery phases. Also important to the success of the Programme is the effective management of administrative and project management systems to support the broader team including management of consultants and Programme team budgets, recording asset costs, reporting arrangements, secretariat and governance support arrangements.
- **Probity advisors/governance:** Appointment of probity advisors at an appropriate stage is important to ensure a robust process is adhered to and a value for money outcome is achieved by Inland Rail.
- **Communication and stakeholder management:** Effective communication and stakeholder management throughout the planning, procurement and delivery phases will be important to keep key stakeholders and the public informed about the status of the Programme, and manage stakeholder issues as they arise (e.g. property resumptions).

- **Technical support:** Technical expertise is required to further define the Programme and packages to enable the necessary documentation to be developed in readiness for procurement. Other elements such as property requirements and early works will need to be further developed before these activities can be undertaken.
- **Environmental/planning/approvals/legal:** Inland Rail will require a number of planning and other approvals before construction can commence. Legal advice will be required throughout the procurement and delivery phases to ensure the interests of government (and ARTC/the operator) are maintained, including advice relating to property acquisition, planning and approvals, procurement and tender and development, and agreement of contracts.
- **Property:** Effective management and undertaking of the property acquisition activities (i.e. valuation, mediation and negotiation) is critical to ensure the required properties are delivered within the established timeframes to allow construction to commence.
- **Procurement:** Upon confirmation of the RPDS, it is envisaged there will be a number of procurement packages ready to proceed. Necessary procurement support will include the development of procurement plans and schedules, development of negotiation strategies, development of procurement documentation, management of procurement processes and management of potential interactive bid processes.
- **Commercial:** Commercial support will include the development of commercial principles and contracting mechanisms, undertaking commercial due diligence on project proponents, commercial evaluation of bids and supporting the management of funding arrangements for Inland Rail.

Programme management plan

A PMP sets the strategy for development, procurement and delivery of Inland Rail. Separate project management plans will be developed for each Inland Rail section/project during development and construction.

The PMP is a live document, with further details and information to be added at key milestones as Inland Rail is delivered. A summary of the key contents of the PMP that forms the basis for effective management of Inland Rail is outlined in Table 17.2.

Table 17.2 Contents of Programme management plan

NO.	SECTION	OVERVIEW
1.	Executive summary	A summary of the PMP.
2.	Background and objectives	Provides context to the background of Inland Rail, previous assessments, desired outcomes, service offering and objectives.
3.	Scope	Provides an overview of Inland Rail scope inclusions, exclusions, assumptions and constraints. Also outlines the key deliverables of activities including PPRs and project management plans.
4.	Governance	Summarises the governance arrangements for the Programme and respective projects, interface arrangements with ARTC, funding and governance reporting requirements.

NO.	SECTION	OVERVIEW
5.	Design management	Outlines the key policy areas and standards that underpin the design. Also outlines the design development process, including value engineering for the Programme. The key features are the Basis of Design, Concept of Operations and Concept of Maintenance.
6.	Interface management	Outlines the interface management policy and processes to manage key interfaces across three levels of government, three state governments, landholder agreements, rail and road authorities and other stakeholders.
7.	Project delivery strategy	Within Inland Rail there are discrete projects. This section outlines the project delivery approach and policies, and how relevant project works packages, funding and contracting interrelate with Inland Rail objectives, commercial principles and management framework.
8.	Cost management	This section outlines the cost management policy of Inland Rail including items such as overall cashflow, PPR status, requirements and conditions. It also outlines cost controls, estimation principles and variation approval mechanisms, as well as ongoing reporting frameworks.
9.	Schedule management	Inland Rail creates both opportunities and potential conflicts. This section outlines the schedule reporting structure and controls within the Programme.
10.	Risk and issues management	Risk and issues management policies, processing, escalation and reporting requirements will be outlined in this section. Programme, project and strategic risk registers will also be actively managed and updated to reflect changes over the life of the Programme.
11.	Change and configuration management	To effectively manage Inland Rail over the 10 years it is inevitable that changes will occur. To manage these changes Inland Rail will establish change management processes and policies and an integrated approach that considers potential impacts of change across the Programme.
12.	Safety management	The safety management policy and relevant ARTC systems will be outlined in this section. There will also be a number of policies outlined including work safety, rail safety, accreditation, tunnel safety, safety in design, legislation and hazardous material handling.
13.	Quality management	Quality expectations, policies and standards including quality review, audit, assurance and reporting processes will be outlined in this section. It will also outline requirements for internal and external parties.
14.	Environmental management	This section outlines the processes for environmental assessments, approvals and management including relevant licences or permits, management plans and reporting requirements.

NO.	SECTION	OVERVIEW
15.	Human resource management	Human resource policies and team philosophy will be outlined as well as the key roles and responsibilities of the team, reporting requirements and Programme leadership. This section will provide an overview of consultants, contractors and delivery partners as well as induction requirements.
16.	Stakeholder and communications management	Stakeholder and communications policies and objectives will be outlined along with strategies and plans for the key stakeholder groups. Key stakeholders include community, customers, industry, media, governments and regulators. Key roles, responsibilities and protocols will be outlined along with reporting requirements and escalation and immediate response authorities.
17.	Procurement and commercial management	Procurement policy and objectives will be articulated to ensure the Programme delivers value for money. Key market segments will be identified and industry briefings will be targeted in line with the approved reference procurement and delivery strategy. Commercial management will include contract management, performance management, reporting and dispute resolution procedures.
18.	Operational readiness	This section will outline operational readiness procedures for each stage/project to adhere to, including commissioning requirements and post project evaluation for each stage and the overall program.
19.	Regulator notifications	This section summarises the regulatory requirements and management procedures to meet these requirements.
20.	Benefits management	This section outlines the benefits, metrics at the Programme level and KPIs that projects can report to. It also outlines benefit ownership linked to the governance structure of the Programme.

Source: ARTC, 2015.

17.5. Next steps

This section of the chapter outlines the next steps identified at the Programme level and provides further detail on the Gowrie to Kagaru (new dual gauge track) and construction projects of Parkes to Narromine and Narribri to North Star (predominantly upgraded track).

Approval and funding process

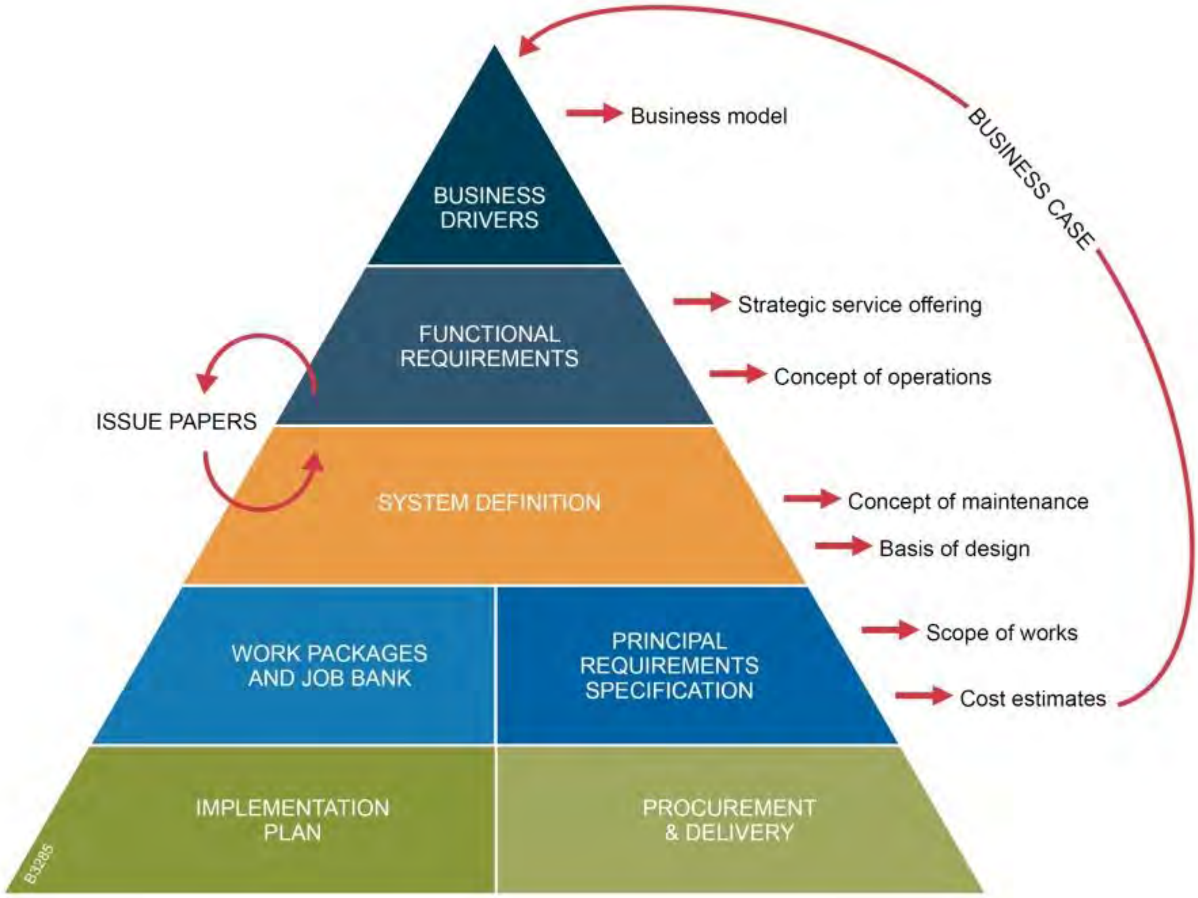
The approval and funding process for the delivery of Inland Rail will occur in a staged process to align with project stages and affordability. The Programme Business Case will be provided to the Australian Government and IR-IG for consideration and endorsement.

Should the Australian Government decide to release further funding for development or construction, it is envisaged that this would occur through Individual Project Proposal Reports (PPRs) for each stage of the Inland Rail Programme. The individual PPRs for development or construction funding will provide investment level information on costs, risks and delivery strategy, effectively being a proxy for individual business cases for each discrete phase of work.

Programme next steps

Inland Rail is being administered in line with the Australian Government's Notes of Administration for the development and delivery of projects along with ARTC's Project Management Procedure. The current design, operations and maintenance documents will be Inland Rail's living reference to the requirements that guide future design phases. The key Programme documents are outlined in Figure 17.1.

Figure 17.1 Process and document hierarchy



Source: ARTC, 2015.

A summary of the key deliverables being progressed is outlined in Table 17.3.

Table 17.3 Key deliverables

DELIVERABLE ITEM	STATUS/KEY OUTCOMES	NEXT STEPS
Basis of design report	This phase of development has provided: • Basic engineering operational requirements. • Key technical assumptions for the base case. • A process for ongoing review of the base case design parameters.	• Maintain as live document in future development phases. • Value engineering considerations. • Ongoing stakeholder feedback. • Risk and opportunity considerations.
Concept of operations report	This phase of development has provided: • General operating specification assumptions for the base case. • A freight demand profile for the base case. • Identification of infrastructure requirements for base case. • Network key performance indicators. • Identification of future-proofing assumptions.	• Operational modelling to inform infrastructure requirements, environmental impacts (especially at sensitive receivers) and property requirements. • Ongoing stakeholder and market consultation. • Detailed train modelling of the alignment in Queensland. • Detailed train modelling to accommodate the Brisbane extension study and revised coal demand. • The refinement of the infrastructure requirements via the next iteration of operational analysis across the inland network for revised demand scenarios.
Concept of maintenance report	This phase of development has provided: • A base case maintenance strategy consistent with international best practice. • A maintenance strategy which supports no capital work for 15 years. • Provisioning centre location assumptions. • Maintenance resourcing requirements. • A maintenance activity schedule.	• Update the maintenance strategy report in line with the outcomes of future development phases.

DELIVERABLE ITEM	STATUS/KEY OUTCOMES	NEXT STEPS
Environmental assessment	This phase of development has provided: • An overarching environment strategy document. • Provision of a clear environmental planning approval framework and process. • A baseline for how the key environmental indicators might be addressed.	• Finalise the planning approval strategies for identified Inland Rail projects/stages. • Finalise the strategies for the assessment of the key environmental indicators to be used in these approval strategies. • Commence the planning approval process (including securing rail corridor for greenfield sites) for the identified projects/stages.
Development projects	This phase of development has provided: • Preliminary assessment confirming the preferred corridor. • A preliminary tunnel and geotechnical assessments. • A preliminary environmental risk assessment. • Refinement of understanding of statutory approval requirements for planning and environmental consents. • An analysis of the required rail alignment against land acquired by DTMR. • A stakeholder and communications plan. • A delivery schedule.	• Optimisation of the preferred alignment, including multidisciplinary studies. • Development of a PMO with ARTC and Queensland Government members, technical and other advisers. • Procurement of technical and specialist advisers and project management resources. • Ongoing consultation with the Queensland and Australian Governments.
Construction projects	This phase of development has provided: • Identification of potential areas of flora, fauna and heritage constraints. • Site verification of large culverts and bridges and upgrade options. • A preliminary hydrological study identifying flood risk areas.	• Complete engineering designs and obtain environmental approvals for early construction works. • Refine the delivery strategy for construction. • Undertake additional field work. • Identify public utilities and review

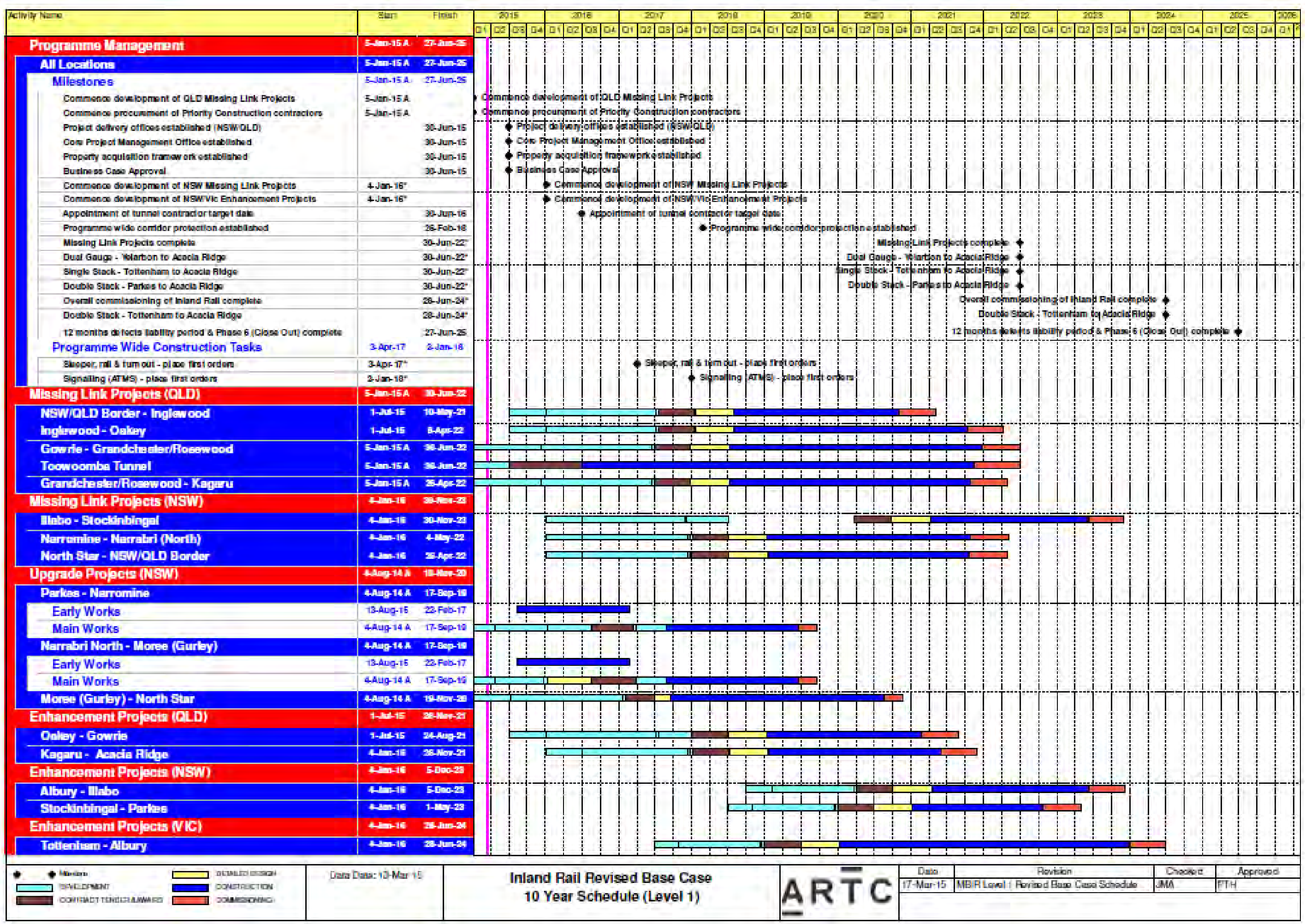
DELIVERABLE ITEM	STATUS/KEY OUTCOMES	NEXT STEPS
	• A regional geological investigation. • Options to upgrade/recondition the existing track structure. • A revision of the horizontal and vertical track alignments to identify suitable locations for passing loops, and potential opportunities for curve easing to remove speed constraints.	potential utility diversions or protection requirements. • Undertake stakeholder and community consultation. • Consult with the local Aboriginal land councils to identify areas of heritage significance. • Commence work on the EIS for the main upgrade works.
Aerial survey/ photography	This phase of development has provided: • Commencement to establish a Geographic Information System (GIS) as part of an integrated approach to project information management on Inland Rail. • Key datasets considered pivotal to the progression of preliminary designs and environmental and planning approvals.	• Update the GIS information for the project throughout the life of the Inland Rail Programme. • Capture survey data for the corridor in the coming months.

Source: ARTC, 2015.

Upgrade project next steps

The Programme for the delivery of Inland Rail is outlined in Figure 17.2. The 10 year programme is based on the key requirements, service offering and critical path items (i.e. tunnels).

Figure 17.2 Delivery programme



Source: ARTC, 2015.

17.6. Summary

- At this stage it is assumed the IR-SC will assume responsibility from the IR-IG for oversight of Inland Rail through the delivery phase.
- The approval and funding process for the delivery of Inland Rail will occur in a staged process to align with projects/stages and affordability. The Programme Business Case will be provided to the Australian Government and IR-IG for consideration and endorsement.
- Should the Australian Government decide to release further funding for development or construction, it is envisaged that this would occur through Individual Project Proposal Reports (PPRs) for each stage of the Inland Rail Programme. The individual PPRs for development or construction funding will provide investment level information on costs, risks and delivery strategy, effectively being a proxy for individual business cases for each discrete phase of work.
- An infrastructure Programme of this size and complexity will require a significant expansion of the current Inland Rail PMO to manage the broad range of activities required to progress and implement the Programme. A broad range of management and specialist capabilities will be required in the PMO to support the successful delivery of Inland Rail.
- A PMP sets the strategy for development, procurement and delivery of Inland Rail. Separate project management plans will be developed for each Inland Rail section/project during development and construction.
- The Programme identifies the Gowrie to Kagaru project/section as being on the critical path to Programme completion. Further work is required to resolve uncertainties and provide confidence in the final route alignment.

Chapter 18

Port of Brisbane Extension

18. PORT OF BRISBANE EXTENSION

18.1. Purpose of this chapter

At the request of the Australian Government, ARTC has undertaken planning and strategic assessment of possible options for a 24/7 dedicated freight rail link from Acacia Ridge to the Port of Brisbane (the Port of Brisbane Extension). The Port of Brisbane Extension would link Inland Rail to the Port of Brisbane via a dedicated rail freight corridor, avoiding the need for coal and agricultural trains to share the Brisbane metropolitan network with passenger services.

A dedicated route also has the potential to attract import/export Port of Brisbane shuttle trips by rail (currently all Port of Brisbane shuttle traffic is carried by road) by improving some of the most constrained sections between Oakey and the metropolitan network in Brisbane. Inland Rail provides a step change in coal and agricultural train capacity and performance and drives consideration of the Port of Brisbane Extension. Without Inland Rail, justification of the Port of Brisbane Extension would principally be based on Port of Brisbane shuttle freight.

This chapter presents the current and future problems justifying consideration of options for the Brisbane metropolitan network, outlines the process used to justify selection of a preferred option and presents the outcomes of strategic economic and financial appraisals of a combined Inland Rail and Port of Brisbane Extension.

18.2. Background

Work on the Port of Brisbane Extension began in 2010 when the Port of Brisbane Pty Ltd initiated a pre-feasibility study into a dedicated freight rail corridor from Miles, in Western Queensland, to the Port. A Port of Brisbane Extension will assist in meeting South East Queensland's growing freight task and enable realisation of the Port of Brisbane's capacity expansion. Additionally, a Port of Brisbane Extension offers the potential to:

- Reduce congestion on South East Queensland's road network by incentivising moving goods by rail instead of road.
- Support the growth of import and export markets by enabling the Port of Brisbane's expansion.
- Develop an efficient route to market for increased agricultural produce.
- Unlock the potential for increased coal exports.
- Remove rail freight from the existing passenger rail line, resulting in faster, more frequent and reliable freight trips.
- Resolve conflicts between inner-city residential communities and freight operators (primarily via a reduction in trucks).

ARTC entered into a deed of co-operation with Port of Brisbane Pty Ltd to share information, particularly research and analysis underpinning their corridor investigations, for the Inland Rail Port of Brisbane Extension Study. The Port of Brisbane Extension Study was conducted by ARTC, with the Port of Brisbane Pty Ltd between mid-2014 and April 2015.

18.3. Approach to Port of Brisbane Extension planning and strategic assessment

Arup was commissioned to analyse four potential corridors for a dedicated freight route for the Port of Brisbane Extension. A desktop pre-feasibility study, which excluded detailed designs, field work and community engagement was used for preliminary route section analysis, with high-level engineering and environmental assessments used to guide the potential alignments for each option. A multi-criteria analysis of options was facilitated by Arup with participation by ARTC and the Port of Brisbane.

The approach to estimating agricultural and coal demand is described in Chapter 7 (Demand). Port of Brisbane container shuttle assumptions and scenarios developed by PwC were modelled by Deloitte Access Economics (Deloitte) based on bottom up forecasts of relative rail and road supply chain costs travelling between the Port of Brisbane and around 600 origins and destinations.

The Port of Brisbane Extension strategic economic analysis applies a CBA framework to quantify a range of direct economic benefits generated by Inland Rail and the Port of Brisbane Extension combined and to compare the value of these benefits to their costs. The CBA methodology has been prepared considering a range of national and state guidelines, including the Infrastructure Australia 2014 Reform and Investment Framework and the ATC 2006 National Guidelines for Transport System Management in Australia.

The Port of Brisbane Extension strategic financial appraisal assesses the financial feasibility of Inland Rail with the Port of Brisbane Extension assuming it is delivered solely by the Government. In this way the financial appraisal assesses the Inland Rail and Port of Brisbane Extension as a PSC as defined in the National PPP Guidelines. The purpose of this analysis is to determine whether the revenues are sufficient to cover the capital and ongoing costs for the Inland Rail and Port of Brisbane Extension.

18.4. Problem assessment

In 2013-14, almost 38.7 million tonnes of trade was handled through the Port of Brisbane (36.3 million tonnes excluding dredged sand for Brisbane Airport), accounting for almost 93 per cent of Queensland's containers and motor vehicles, 50 per cent of the state's agricultural exports, 83 per cent of Queensland's meat and tallow exports, and 99 per cent of the state's Petroleum exports.

Container trade through the Port of Brisbane is growing, driven largely by Queensland's population growth. The Port of Brisbane currently handles more than one million containers each year. By 2039–40, this figure is expected to reach four million containers. While this outlook is positive for the economy, without investment in appropriate infrastructure, growing trade volumes will increase pressure on surrounding landside infrastructure, the broader rail and road network, and as a result, the community.

Queensland and Australian Government infrastructure investments over the past decade have seen substantial improvements to the road network, including connections to the Port of Brisbane. Investments in freight rail infrastructure however, have been minimal. Currently, freight rail does not have 24/7 access to the port.

The Port of Brisbane is currently characterised by an over-reliance on the transport of freight by road. The existing metropolitan freight network to the Port of Brisbane is shown in Figure 18.1. Containerised agricultural and coal freight enters the metropolitan rail network at Calvert/Rosewood and travels to the Port of Brisbane via the Ipswich and Cleveland Lines which are shared with passenger services. Rail modal share is low and dropping. In 2000–01, rail mode share for agriculture was more than 14 per cent; now, it is approximately five per cent. Only four per cent of port-bound container freight is currently transported by rail. The global standard is closer to 30 per cent. Domestically, both Melbourne and Sydney have around 20 per cent rail modal share, while Sydney is targeting 30 per cent within 10 years. This means that the vast majority of port-bound container freight is currently transported by road through metropolitan Brisbane, increasing congestion, accidents and emissions.

Figure 18.1 Existing metropolitan freight network to the Port of Brisbane

Source: ARTC, 2015

Without dedicated freight rail access to the state's major international gateway, Queensland's future growth, productivity and competitiveness have the potential to be constrained.

If rail mode share continues at current levels, or further erodes, freight-induced congestion in South East Queensland will worsen, impacting on liveability and economic prosperity. Congestion already costs Brisbane City more than \$1.2 billion annually. Without appropriate infrastructure investments, this could rise to \$3 billion by 2019–20.[159]

With the introduction of Inland Rail the constraints on coal freight productivity will move to the Brisbane metropolitan network which is currently designed for 650 metre trains due to restrictions on the Toowoomba Range. Modest capital

[159] Brisbane City Council, Brisbane Long term Infrastructure Plan 2012–2031, p 17, 2012.

cost improvements to passing loops at Murarrie and Clapham Yard will allow train lengths of 1010 metres. Inland Rail also presents an alternative core scenario excluding investment in loop extensions on the Western Line and Brisbane metropolitan network (at Murarrie and Clapham Yard), but due to the constraints Inland Rail would still be limited to coal train lengths of 650 metres.

Performance specification

Like Inland Rail, the Port of Brisbane Extension will be a single track, double stacked, dual gauge line. However, its design has been future-proofed to allow for upgrading to double track, should this eventually be required. The performance specification for the Port of Brisbane Extension is outlined in Table 18.1.

Table 18.1 Comparison of the key technical characteristics underpinning Inland Rail versus Port of Brisbane Extension performance specification

	PORT OF BRISBANE EXTENSION	INLAND RAIL
Train length	1800 m*	1800 m, with future proofing for 3600 m train length 15 years after operation
Axle Load / Max Speed	30 tonnes @ 80km/h**	21 tonnes @ 115 km/h (intermodal), 25 tonnes @ 80 km/h (bulk/coal), with future proofing for 30 tonnes @ 80 km/h where new structures (greenfield & brownfield) or formation on new track is constructed
Double stacking	7.1 m clearances for double stack operation in well wagons	7.1 m clearances for double stack operation in well wagons
Interoperability	Dual gauge***	Full interoperability over the interstate mainline standard gauge network

Source: ARTC, 2015

*While the Port of Brisbane does not currently have the capacity to accommodate 3600 metre trains envisaged for Inland Rail, it is assumed that trains of this length would be broken up at an appropriate terminal.

**The Port of Brisbane Extension reduces Inland Rail's design speeds from 115 km/h to 80 km/h as the proposed corridors pass through a complex urban environment, requiring sensitivity to noise and amenity issues.

***The Port of Brisbane Extension proposes dual-gauge access, rather than a standard-gauge rail extension only, to cater for narrow-gauge rollingstock, Queensland's predominant rollingstock.

Corridor analysis

Four potential corridors were considered by the study, including upgrading the existing corridor. Engineering and environmental risk assessments were used to supplement previous studies and pre-feasibility materials.

All options were designed to be operationally compatible with Inland Rail but to meet higher anticipated long-term demand (due to port-bound intrastate freight currently using other networks that will feed into Inland Rail).

Options were assessed using Infrastructure Australia's multi-criteria analysis approach. Two, separate multi-criteria analyses, supported by two phases of technical investigations, were undertaken to identify a preferred option. The first multi-criteria analysis narrowed the four options to two potentially viable routes. Following additional, detailed investigations across a number of technical areas, a second multi-criteria analysis identified a preferred corridor for analysis in the Programme Business Case.

Strategic options assessment

The initial analysis undertaken in October 2014, identified two corridor options as suitable for further development. These options were then assessed through a second phase of study, held in March 2015.

- **Eastern Freight Rail Corridor:** This option proposes a dedicated freight line from the interstate standard gauge line south of Acacia Ridge intermodal terminal to the Port of Brisbane, including in two tunnels (of 4.8 kilometres and 4.4 kilometres) or below natural ground level, plus some ground-level and elevated structures. This option broadly follows the Gateway Motorway and passes in tunnel beneath urbanised areas.
- **Long Tunnel:** This option proposes a dedicated freight line from the intermodal terminal at Acacia Ridge to the Port of Brisbane. Adopting a more direct, north-easterly route to the port, this option is mostly in a 17 kilometre tunnel.

Both options were initially examined as double track 'ultimate' solutions and compared with two other corridor options that were discarded as a result of the initial multi-criteria analysis.

- **Upgraded Existing Corridor:** Upgrading the existing corridor was rejected as an ultimate, double track alignment as it passes through dense, inner-city residential communities, making it technically difficult to construct and socially unacceptable. Large numbers of properties would be resumed and numerous major arterial road structures would be completely rebuilt, causing huge logistical challenges. The cost would be high, yet the end product would not meet best practice, with too many substandard curves and gradients.
- **Electrified Tunnel:** Constructing a 26 kilometre electrified tunnel from Larapinta to the Port of Brisbane was also investigated and rejected. The proponent of this tunnel put it forward as a single-track proposal. The cost of future-proofing this option, allowing scope for double track, is prohibitive. The requirement to swap between diesel and electric locomotives also limits its carrying capacity, while increasing its operational complexity. The location of the southern portal within the environmentally significant Larapinta Glider Forest was also of concern.

The Eastern Freight Rail Corridor is more cost effective than the Long Tunnel and presents opportunities for greater operational flexibility and future staging. The multi-criteria analysis showed that cost was not the only factor favouring this option. It also has less social and quality of life impacts, and ecological impacts were found to be manageable.

The Long Tunnel remains a feasible alternative but it carries increased cost and more significant risks than the Eastern Freight Rail Corridor. No diesel-operated freight tunnel of this length has been constructed beneath an urbanised area before. It is also evident that adopting a route in tunnel does not eliminate community and environmental impacts. While potential noise, vibration and air quality impacts require more thorough investigation to predict accurately, the study indicated that they could prove substantial.

The Eastern Freight Rail Corridor, as the most cost effective option, has been selected for the purposes of analysis within the Programme Business Case. Notwithstanding the results of the initial multi-criteria analysis, further planning is required before a preferred option (and associated corridor) can be selected.

These four rail freight corridor options are shown in Figure 18.2.

Figure 18.2 Rail freight corridor options to the Port of Brisbane

Source: ARTC, 2015

18.5. Port of Brisbane Extension strategic demand analysis

Scenarios analysed

The demand projections and the economic and financial appraisals for the Port of Brisbane Extension presented in this report have analysed two scenarios:

Base case scenario

As with the Inland Rail demand analysis and economic analysis, the Port of Brisbane Extension strategic demand analysis compares a scenario where there is the Port of Brisbane Extension to a 'without Port of Brisbane Extension' base case. In the base case, it is assumed that there is no Port of Brisbane Extension or Inland Rail and freight is transported to the Port of Brisbane by road (the Port of Brisbane Motorway, Gateway Motorway North, Pacific Motorway and Centenary Motorway) and existing rail lines (the Ipswich and Cleveland Lines), and that a continuation of existing 'incremental' spend patterns occurs. It is a 'do minimum' base case and assumes currently committed and funded investments and no change to current policies (e.g. road user charging, a price or tax on carbon and no B-triple access to the Port of Brisbane).

Estimated agricultural and coal freight under the base case is as per the Inland Rail base case. However, the base case also includes additional freight travelling to the Port of Brisbane from North Queensland (largely containerised agriculture).

Inland Rail and Port of Brisbane Extension scenario

With Inland Rail in operation, and no upgrades on the Western Line and Brisbane Metropolitan rail network, the potential volume of coal freight would still be constrained by axle load and train length on these sections of rail. As a result, high transportation costs were estimated to subdue coal exports to an estimated 8.8 million tonnes.

Accordingly, the Inland Rail and Port of Brisbane Extension scenario requires a staged investment approach such that by 2022–23, Inland Rail is also supported by modest improvements to the Western Line and Metropolitan network which enable coal trains to increase in length from 650 metres to 1010 metres. By accommodating longer trains, these upgrades enable an estimated 19.5 million tonnes of coal per annum to become viable for export and provide sufficient capacity until demand justifies further investment. An alternative Inland Rail core scenario has also been presented excluding complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres, which would limit coal train lengths to 650 metres and reduce coal volumes to nine million tonnes. However, the Port of Brisbane Extension analysis has been undertaken including the Western Line upgrade.

Even with these upgrades, a dedicated route would still be required to alleviate future capacity constraints in the face of growing demand. Accordingly, and notwithstanding the uncertainties involved in estimating this demand – including changes in land use, government policy and investment in passenger rail – the Port of Brisbane Extension (single track) is assumed to become operational when capacity (130 weekly paths) on the Brisbane Metropolitan Network could be exceeded by the level of forecast demand with the Port of Brisbane Extension.

Completion of the Port of Brisbane Extension bypasses additional constraints in the metropolitan rail network, enabling coal train lengths to increase from 1010 metres to 1500 metres and Port of Brisbane shuttle trains to increase from 900 metres to 1800 metres by rail. Relative to the existing metropolitan rail network, the Port of Brisbane Extension also reduces travel time by 30 minutes and the travel distance by one kilometre.

Approach to strategic demand analysis

Combining the Port of Brisbane Extension with the Inland Rail scenario provides operating cost savings for all rail freight users and external benefits to the community by increasing train lengths for coal and Port of Brisbane shuttle freight (which reduces required paths), and providing time and distance savings relative to the existing metropolitan network. This could potentially attract Port of Brisbane shuttle freight to rail, but is not estimated to result in additional coal mines commencing production (i.e. because mine to port supply chain costs are reduced below the world coal price), while induced agricultural freight has not been assumed.

Demand for the Port of Brisbane Extension does not include intercapital container freight travelling on Inland Rail which are transported from the intermodal terminal at Acacia Ridge to end markets in Brisbane by road (i.e. this freight does not travel to the port) or Inland Rail agricultural freight with end markets before the Port of Brisbane.

The key inputs to rail demand on the Port of Brisbane Extension are described below.

Agricultural freight: Agricultural freight to the Port of Brisbane is currently 616 000 twenty-foot equivalent units (TEUs) based on 2012–13 tonnes for containerised agriculture originating from the North Coast and Goondiwindi.
This existing rail freight was forecast to grow at 1.1 per cent per annum consistent with ACIL Allen agricultural freight forecasts for Inland Rail, which take into account population growth, trends in grain yield and the impacts of climate change.[160] The Port of Brisbane Extension demand analysis also assumes the commencement of Inland Rail operations would boost agricultural traffic from 2022–23, due to attracting volumes from road largely originating out of Moree and Goondiwindi.

Coal freight: Coal demand is forecast to reach 19.5 million tonnes per annum consistent with Inland Rail including complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres, with all of these volumes originating in the Surat and Clarence-Moreton Basins and travelling to the Port of Brisbane by rail. Although there are operating cost savings from reduced travel times and distances, these are not estimated to result in additional mine production.

Port of Brisbane container shuttles: Port of Brisbane container shuttle assumptions and scenarios developed by PwC were modelled by Deloitte based on bottom up forecasts of relative rail and road supply chain costs travelling between the Port of Brisbane and around 600 origins and destinations.

Underpinning the Deloitte model estimates are PwC assumptions around the total market for containerised trade, the origins and destinations producing or receiving the goods, and fixed and variable supply chain costs. The geographical distribution of freight was underpinned by the Queensland Transport and Logistics Council and Port of Brisbane 2013 Import/Export Supply Chain Study (the IMEX study).[161]

Total container demand at the Port of Brisbane is currently (2013–14) 1.1 million TEUs.[162] This baseline figure was grown in-line with the most recent (2014) BITRE forecasts for the Port of Brisbane to 2032–33, with 2014–15 forecasts adjusted to reflect year-to-date trade statistics at the Port of Brisbane.[163] Long-term growth is assumed to be related to long run GDP forecasts in the Australian Government's 2015 intergenerational report, adjusted for relative population growth between Queensland and Australia.

Key assumptions underpinning the core Port of Brisbane Extension scenario are $50 per lift at the Brisbane Multimodal Terminal and other intermodal terminals; intermodal terminals located at Ebenezer and Toowoomba (to be opened in conjunction with Inland Rail in 2022–23), Bromelton (2029–30) and Acacia Ridge (existing capacity to 2027–28), origins–destinations as per the IMEX study; $3.15 per kilometre trucking costs; 1800 metre Port of Brisbane shuttle trains, congestion growth of 1.1 per cent per year; and real wages growth of 0.6 per cent.

A scenario (the Policy and Price change scenario) has also been considered that assumes changes to land use policy and other incentives to support a relocation of logistical operations from suburbs near the Port of Brisbane to areas around Ebenezer, and lift costs reduced to $30.[164] These changes would potentially attract additional mode shift owing to longer average freighting distances and lower handling costs.

160 ACIL Allen Consulting, 2015.

161 Queensland Trade and Logistics Council, Port of Brisbane Import/Export Logistics Chain Study, 2013.

162 Port of Brisbane, Trade Statistics, available at: http://www.portbris.com.au/trade-logistics/trade-statistics.

163 BITRE, Containerised and non-containerised trade through Australianports to 2032,33, available at: https://www.bitre.gov.au/publications/2014/files/report_138.pdf, 2014.

164 In other jurisdictions, policy change and incentives are often required to encourage mode shift to rail, for example the Mode Shift Incentive Scheme in Victoria.

Acknowledging that forecasting containerised shuttle demand is highly complex task that relies on many uncertain and interrelated inputs in terms prices, production, land use and other infrastructure, a number of additional demand scenarios were formulated with variations in these key inputs.

The Port of Brisbane shuttle demand results are displayed in Table 18.2 in the core Port of Brisbane Extension scenario along with several other scenarios in which the key assumptions were altered. These scenarios included a high demand scenario (which includes more favourable assumptions for rail such as trade forecasts, lower lift costs and lower growth in operating costs), a low demand scenario (including the opposite) and others in which the supply chain costs for rail are reduced through policy or other means.

The core Port of Brisbane Extension and policy and price changes scenarios were used for the purpose of economic appraisal, and the demand scenarios resulting in the highest and lowest rail demand respectively included in sensitivity testing.

Table 18.2 Demand scenarios for Port of Brisbane shuttle demand in 2044–45

NAME	KEY ASSUMPTIONS	TOTAL CONTAINER FREIGHT		PORT OF BRISBANE SHUTTLE		WEEKLY TRAIN TRIPS
		TEU	RAIL SHARE	TEU	RAIL SHARE	
Port of Brisbane Extension	Core assumptions	4 876 780	6.4%	44 180	1.00%	5
Port of Brisbane Extension + policy and price changes	Lower lift costs and policy to grow logistics activity around Ebenezer	4 876 780	9.1%	175 558	3.8%	18
Port of Brisbane Extension and high port shuttle demand	High demand assumptions	5 429 644	13.40%	428 278	8.30%	44
Port of Brisbane Extension and low port shuttle demand	Low demand assumptions	2 829 312	5.80%	10 224	0.40%	1
Port of Brisbane Extension and less fixed rail costs	No transport charges Brisbane Multimodal Terminal - stevedore	4 876 780	15.8%	505 303	11.0%	52
	No transport charges Brisbane Multimodal Terminal - stevedore No lift costs	4 876 780	21.6%	785 252	17.0%	81

NAME	KEY ASSUMPTIONS	TOTAL CONTAINER FREIGHT		PORT OF BRISBANE SHUTTLE		WEEKLY TRAIN TRIPS
		TEU	RAIL SHARE	TEU	RAIL SHARE	
Port of Brisbane Extension + government incentive	Subsidy to achieve 30% rail mode share	4 876 780	30.0%	1 195 833	25.9%	124

Note: 2044–45 is the last year for which Port of Brisbane shuttle demand was modelled by Deloitte. The model assumes the Port of Brisbane Extension and 1800 metre shuttle capacity becomes available at Ebenezer (assumed to open in conjunction with Inland Rail), Toowoomba and Acacia Ridge in 2022 and at Bromelton in 2030 for the purpose of demand modelling. Demand results are as estimated by Deloitte. For the CBA, these results were adjusted to incorporate updated GDP projections and to avoid double counting of containerised agricultural freight estimated to use Inland Rail. Total container freight includes a modelling assumption that the existing rail share for containerised trade (including agricultural goods) is maintained over the modelling period - the Port of Brisbane shuttle rail share is calculated excluding this base component.

Source: ACIL Allen, 2015.

Project case demand

Given the estimated level of demand described above, a key assumption for the purpose of economic appraisal is when the Port of Brisbane Extension is assumed to become operational and when this shift to rail, and its associated benefits could be realised.

With Inland Rail in operation (single stack only), the existing freight route to the Port of Brisbane and the Western Line still constrains coal production by imposing axle load and train length constraints that lead to higher transportation costs and make a number of mines unviable for production.

There is, however, scope to expand freight operations on the existing corridor through staged upgrades to the existing network. Engineering modelling provided by ARTC suggests that additional path capacity could be created through even modest upgrades, which could potentially satisfy demand for several decades before a Port of Brisbane Extension is required. As such, the project scenario also includes upgrades to the Western Line and Metropolitan network, including passing loops at Murarrie and Clapham Yard, at an estimated cost of $54 million (strategic $2014-15 excluding escalation).

Determining the exact time for which these upgrades provide sufficient capacity is difficult. There are many variables in forecasting demand; and changes to the existing rail network such as more frequent commuter services or a new government policy to grow rail mode share – both possible scenarios – could bring forward the date by which a new route is needed. A decision by the Queensland Government to establish a new terminal precinct, for example, at Ebenezer, would improve the viability of port shuttles.

Based on the level of coal and agricultural freight demand and the level of Port of Brisbane shuttle demand that could be achieved in the presence of the Port of Brisbane Extension, it is assumed that upgrades to the Western Line and Brisbane metropolitan rail network satisfy demand until 2040–41, at which point demand exceeds assumed capacity of 130 weekly paths, and until 2029–30 under the Policy and Price change scenario.

Once constructed the Port of Brisbane Extension allows for 1800 metre Port of Brisbane shuttle trains and 1500 metre coal trains. The reduction in operating costs for Port of Brisbane shuttle is modelled to induce a shift from road to rail that is assumed to occur over a four year ramp up period, while the reduction in cost for coal freight users does not make further exports viable, but provides economic benefits to existing users and the community.

Total forecast demand under this staging approach is outlined below in Table 18.3.

Table 18.3 Forecast Port of Brisbane containerised, agricultural and coal freight with the Port of Brisbane Extension

	2019–20	2029–30	2039–40	2049–50	2059–60	2069–70
Containerised shuttle (Port of Brisbane Extension)						
Port of Brisbane shuttle containers (‘000 teu)	-	-	-	34.1	44.8	58.4
Port of Brisbane shuttle trains (round trips per week)	-	-	-	4	5	6
Containerised shuttle (Port of Brisbane Extension and Policy/Price change)						
Port of Brisbane shuttle containers (‘000 teu)	-	26.8	97.6	151.5	198.6	259.3
Port of Brisbane shuttle trains (round trips per week)	-	3	10	16	21	27
Agricultural and other products						
Agricultural freight (million tonnes)	1.4	3.4	3.8	4.2	4.7	5.3
Agricultural trains (round trips per week)	16	37	39	43	48	53
Coal						
Coal exports (million tonnes)	8	19	19	19	19	19
Coal trains (round trips per week)	80	87	87	64	64	64

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres. Estimates of Port of Brisbane shuttle train numbers assume 1800 metre trains (net payload 186 TEU) from the opening of the Port of Brisbane Extension. Estimates of coal train numbers assume current 650 metre trains increase to 1010 metres in 2022–23 following completion of the Oakey to Calvert/Rosewood section of Inland Rail, and to 1500 metres (net payload 5758 tonnes) following completion of the Port of Brisbane Extension. Estimates of agricultural train numbers assume that increased volumes are accommodated by increasing train length up to a 900 metre specification for containerised agriculture (net payload 2052 tonnes) and 800 metres for bulk (net payload 2010 tonnes). Adjustments were made to the original Port of Brisbane shuttle demand estimates originating from Toowoomba to prevent double counting of containerised agricultural volumes estimated to use Inland Rail.
Source: PwC analysis based on ACIL Allen and Deloitte inputs, 2015.

18.6. Port of Brisbane Extension strategic benefits

The Port of Brisbane Extension increases the efficiency of rail trips to the Port of Brisbane by a) providing a one kilometre and 30 minute time saving relative to the existing network, and b) providing capacity for longer trains with a higher payload. This provides additional benefits above the core inland rail case from:

- Operating cost savings for regional freight (agriculture and coal) that would travel by rail to the Port of Brisbane without the Port of Brisbane Extension, and from import and export freight that shift from road to rail.
- Reduced environmental and crash costs from a reduced number, and shorter freight trips.
- Improved amenity, and reduced road maintenance and congestion costs from encouraging a shift from road to rail.

18.7. Strategic costs

Opportunities to stage the construction of the Port of Brisbane Extension were identified and strategic costs to construct a single track only, while preserving the corridor required for the ultimate alignment were estimated to be $2.51 billion (P50, $2014-15, excluding escalation for the Eastern Freight Rail Corridor).[165] A typical construction profile was applied by PwC to convert total costs estimated by Arup for the Port of Brisbane Extension to annual cash flows.

Allowances for upgrades to the Western Line/Brisbane metropolitan rail network to enable coal trains to increase from 650 metres to 1010 metres prior to the opening of the Port of Brisbane Extension are assumed in the Inland Rail financial appraisal. Therefore these works are assumed to be driven by the Inland Rail Programme and not included in the costs or benefits for the Port of Brisbane Extension.

Below rail operating and maintenance costs are estimated based on unit rates estimated for the Toowoomba Range section of Inland Rail.

18.8. Strategic economic analysis

Methodology and key assumptions

The CBA framework for the Port of Brisbane Extension is consistent with the Inland Rail Economic Appraisal in Chapter 9. Key assumptions underpinning the analysis include:

- **Construction period:** Commences 6 years prior to required operation (2040–41) in the Port of Brisbane Extension (core) scenario and (2029–30) in the policy and price change scenario.
- **Appraisal period:** The appraisal period commences the financial year after the Port of Brisbane Extension becoming operational and extends 100 years from the first year of operation.
- **Discount rate:** Future net benefits and costs are discounted to the base year using four and seven per cent real discount rates consistent with the Australian Government’s Project Proposal Report Guidance.
- **Residual value:** Reflecting an assumed 100 year economic life for rail assets, the future stream of impacts beyond the 50 year appraisal period has been captured in net terms as a lump sum discounted to the final year of the appraisal as recommended in the ATC Guidelines.[166]

165 ARTC, based on advice from Arup, PB and Project Support Pty Ltd., 2015.

166 ATC, National Guidelines for Transport System Management in Australia, Volume 4, p 44, 2005.

Key updates / changes to the appraisal methodology relative to the Inland Rail scenario include:

- Increase in coal train length from 650 metres to 1010 metres from the opening of Inland Rail (including the Western Line Upgrade) and to 1500 metres in the year the Port of Brisbane Extension becomes available (2040–41 for the core scenario and 2029–30 for the Policy and Price change scenario).
- Reduction in rail travel time by approximately 30 minutes which reduces rail operating costs for agricultural and coal freight travelling to the Port of Brisbane.
- Inclusion of Port of Brisbane shuttle benefits.

The CBA draws upon the following inputs for the Port of Brisbane Extension component:

- Capital cost assumptions developed by Arup, PB and Project Support.
- Operating costs for rail and road, measured by Deloitte for Port of Brisbane shuttle and using PwC modelling of train operating costs for coal and agricultural trains based on PB cost estimates and ARTC train modelling.
- Port of Brisbane shuttle container demand forecasts developed by Deloitte using assumptions and scenarios developed by PwC.
- Maintenance cost assumptions developed by PB for Inland Rail, based on the Toowoomba Range Tunnel unit rates estimated by Lycopodium (adjusted for relative distance).

Results

The Port of Brisbane Extension results in increased capital costs of $2.51 billion (P50, $2014-15, undiscounted), but produces additional benefits relative to Inland Rail from:

- Operating cost savings to coal and agricultural freight using Inland Rail as a result of a 30 minute reduction in travel times (which also increases the induced freight producer surplus) and longer trains.
- Benefits from reduced trucks as a result of diverting freight to Port of Brisbane shuttle, including reduced congestion (i.e. travel times and vehicle operating costs), accidents and environmental costs (e.g. greenhouse gas emissions, air pollution and water pollution); and increased amenity in residential areas (e.g. visual amenity and noise pollution).

However, since these benefits would not begin to be realised until 2040-41 (or 2029-30 in the Policy and Price change scenario), they are discounted to only a small share of their undiscounted value. As a result, the additional discounted costs with the Port of Brisbane Extension are estimated to be greater than the additional discounted benefits such that the Port of Brisbane Extension and Inland Rail combined reduces the BCR from 2.62 with Inland Rail alone, to 2.40 with the Port Extension. The Policy and Price Change scenario increases total benefits relative to the Port Extension scenario, however this is offset by bringing forward the timing of the capital expenditure, reducing the BCR to 2.32. The alternative core Inland Rail scenario excluding the Western Line Upgrade would limit coal train lengths to 650 metres and further reduce the BCRs to 2.32 and 2.26 respectively (assuming the same timing for the Port of Brisbane Extension).

The cost benefit analysis results for the Port of Brisbane Extension and Policy/Price change scenario, by benefit type are presented in Table 18.4 while Table 18.5 presents the results by beneficiary.

Table 18.4 Cost benefit analysis results for Port of Brisbane Extension by benefit type (incremental to the base case, discounted, 2014-15 dollars)

INLAND RAIL PROGRAMME COSTS AND BENEFITS	INLAND RAIL AND PORT EXTENSION				INLAND RAIL AND PORT EXTENSION AND POLICY AND PRICE CHANGE			
	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE		INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
PV at specified discount rate	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**
COSTS								
Capital costs	8681	7131	8638	7095	9237	7729	9194	7693
Operating costs	138	66	138	66	133	70	142	66
Maintenance costs	819	389	801	380	838	400	820	391
Total costs	**9638**	**7588**	**9577**	**7543**	**10 217**	**8199**	**10 156**	**8154**
1) Freight user benefits								
Freight operating cost savings	6519	2828	5402	2283	6726	2918	5538	2332
Freight value of time savings	3369	1432	3361	1428	3398	1449	3390	1445
Improved reliability	428	186	428	186	428	186	428	186
Improved availability	1450	579	1450	579	1450	579	1450	579
Redundancy/resilience to incidents	37	12	37	12	37	12	37	12
2) Passenger benefits								
Reduced rail passenger wait time	32	14	32	14	32	14	32	14
3) Community benefits								
Reduced rail and road accidents	277	115	268	111	286	120	272	112
Congestion cost savings	767	326	767	326	855	358	855	358
Reduced environmental costs	807	337	921	393	867	359	982	416
Improved residential amenity	40	15	62	26	51	19	73	30
4) Infrastructure cost savings								
Avoided infrastructure investments	268	176	268	176	268	176	268	176
Reduced road maintenance costs	626	268	626	268	638	272	638	272
ARTC maintenance cost savings	216	107	216	107	216	107	216	107
5) Residual value of assets	8272	860	8420	867	8669	900	8847	909
Total benefits	**23 088**	**7255**	**22 234**	**6774**	**23 821**	**7462**	**22 905**	**6940**

INLAND RAIL PROGRAMME COSTS AND BENEFITS	INLAND RAIL AND PORT EXTENSION				INLAND RAIL AND PORT EXTENSION AND POLICY AND PRICE CHANGE			
	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE		INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
Net present value of costs and benefits	**13 451**	**(333)**	**12 657**	**(769)**	**13 604**	**(737)**	**12 749**	**(1215)**
Benefit cost ratio	**2.40**	**0.96**	**2.32**	**0.90**	**2.33**	**0.91**	**2.26**	**0.85**

Note: *Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015

Table 18.5 Cost Benefit analysis results for Port of Brisbane Extension by beneficiary (incremental to the base case, discounted, 2014–15 dollars)

INLAND RAIL PROGRAMME COSTS AND BENEFITS	INLAND RAIL AND PORT EXTENSION				INLAND RAIL AND PORT EXTENSION AND POLICY AND PRICE CHANGE			
	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE		INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
PV at specified discount rate	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**	**4% ($m)**	**7% ($m)**
COSTS								
Capital costs	8681	7131	8638	7095	9237	7729	9194	7693
Operating costs	133	66	138	66	133	70	142	66
Maintenance costs	819	389	801	380	838	400	820	391
Total costs	**9638**	**7588**	**9577**	**7543**	**10 217**	**8199**	**10 156**	**8154**
BENEFITS								
1) Intercapital/ intermodal freight	15 527	4678	16 036	4729	15 650	4690	16 201	4746
Melbourne to Brisbane	12 355	3707	12 759	3747	12 452	3717	12 891	3761
Brisbane to Adelaide	1292	390	1335	395	1302	391	1348	396
Brisbane to Perth	1880	581	1942	587	1895	582	1962	589
2) Regional freight	3708	1311	2017	695	3848	1360	2038	697
Coal	1756	623	0	0	1880	671	0	0
Agricultural products	1870	659	1931	666	1885	661	1951	669
Others (including steel, minerals, general freight, and other extra-corridor)	83	28	85	28	83	28	86	29
3) Community	2950	901	3251	982	3235	975	3550	1055
4) Passengers	51	16	52	16	51	16	53	16

INLAND RAIL PROGRAMME COSTS AND BENEFITS	INLAND RAIL AND PORT EXTENSION				INLAND RAIL AND PORT EXTENSION AND POLICY AND PRICE CHANGE			
	INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE		INCLUDING WESTERN LINE UPGRADE*		NO WESTERN LINE UPGRADE	
5) Rail network owners (ARTC and QR)	755	321	780	325	761	322	788	326
6) Port of Brisbane Extension Benefits	97	28	97	28	275	99	275	99
7) Total benefits	23 088	7255	22 234	6774	23 821	7462	22 905	6940
Net present value of costs and benefits	**13 451**	**(333)**	**12 657**	**(769)**	**13 604**	**(737)**	**12 749**	**(1215)**
Benefit cost ratio	**2.40**	**0.96**	**2.32**	**0.90**	**2.33**	**0.91**	**2.26**	**0.85**

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

18.9. Financial assessment

Methodology and key assumptions

In order to analyse the financial implications of the Port of Brisbane Extension, an Inland Rail scenario has been considered that includes the additional financial impact of the Port of Brisbane Extension including additional revenue, capital costs and operating and maintenance costs associated with the construction and operation of the Port of Brisbane Extension.

Additional financial assumptions required for analysis of the Port of Brisbane Extension are set out below:

- Access revenue estimated on the same basis as Inland Rail.
- The construction start date is based on the capacity of the existing infrastructure under different revenue scenarios. The core Port of Brisbane Extension scenario assumes that construction will commence in July 2035 and run for six years, completing in June 2041.
- Below rail operating costs and maintenance costs have been estimated by prorating the operating and maintenance costs incurred on the Toowoomba Range (given it is deemed as being comparable from an operating and maintenance perspective) based on the kilometre length of the Port of Brisbane Extension.
- Operating term of 50 years of full operations starting at commencement of Inland Rail in 2024–25 with the Port of Brisbane Extension coming online in 2040–41.
- Inland Rail and Port of Brisbane Extension defined as a single business.

Notwithstanding the above, all other financial assumptions are the same as those applied to the financial analysis of Inland Rail as presented in Chapter 10.

Strategic results

The NPV and NPC of the different cash flow components (revenue, costs) for Inland Rail with the Port of Brisbane Extension is shown in Table 18.6.

Table 18.6 Inland Rail and Port of Brisbane Extension assessment – Programme NPV (NPC) ($ million)

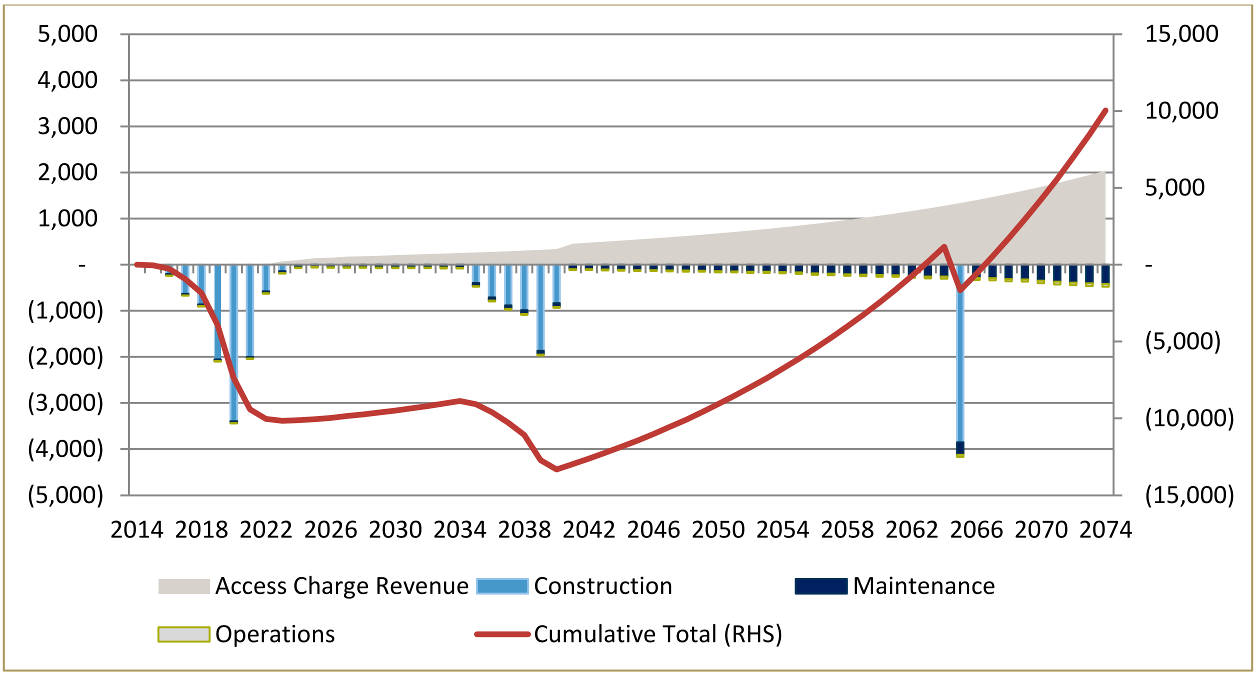
PROGRAMME COSTS AND BENEFITS	NPV / (NPC) ($MILLIONS)
Costs	
Capital costs	(9181)
Operating costs	(300)
Maintenance costs	(1607)
Total recurrent/ongoing costs	**(1907)**
Total costs	**(11 088)**
Inland Rail Revenues	
Steel	29
Grain	127
Inter capital	2819
General Freight	59
Passenger	4
Coal	968
Minerals	13
Total Inland Rail Revenues	**4019**
Port of Brisbane Extension Revenue	**574**
Total Revenues	**4593**
Programme: operating cash flows only (excluding capital costs)	**2686**
Programme: total project cash flows	**(6495)**

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres. Assumes ARTC demand, US$75 Newcastle benchmark coal price, and 5.60 per cent discount rate. Figures in this table may not total due to rounding.

Source: PwC, 2015.

The results mirror those observed for Inland Rail, as the below rail revenue is not sufficient to recover the significant capital outlay required for construction of the Inland Rail and Port of Brisbane Extension. As was the case with just Inland Rail, Inland Rail with the Port of Brisbane Extension has significant positive operational cashflows, however Inland Rail with the Port of Brisbane Extension only generates enough cash flow to offset the large capital outlay in nominal terms after approximately 50 years from commencement of construction. A summary of Inland Rail with Port of Brisbane Extension nominal cashflows over the 50 year (2025–2074) operating term is presented in Figure 18.3 and Figure 18.4.

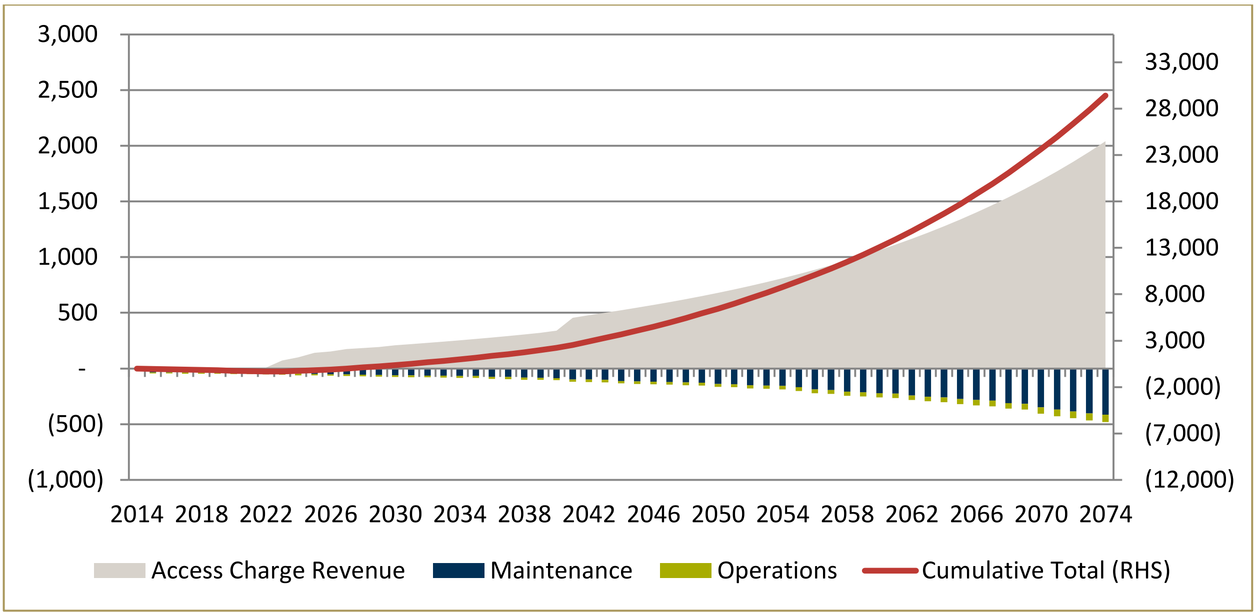
Figure 18.3 Inland Rail financial assessment: summary of Inland Rail and Port of Brisbane Extension costs and revenue ($ million – nominal)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 18.4 Inland Rail financial assessment: summary of Inland Rail and Port of Brisbane Extension ongoing costs and revenue ($ million – nominal)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

A financial comparison to Inland Rail presented in Chapter 10 (Financial analysis) to Inland Rail with the Port of Brisbane Extension presented directly above is provided in Table 18.7. To ensure a like for like comparison, the results have been compared assuming a 50 year operating period for both Inland Rail with and without Port of Brisbane Extension.

Table 18.7 Comparison of cost and revenue - Inland Rail only and Inland Rail with Port of Brisbane Extension – Programme NPV (NPC) ($ million)

PROGRAMME COSTS AND BENEFITS	INLAND RAIL NPV / (NPC) ($ MILLIONS)	INLAND RAIL + PORT OF BRISBANE EXTENSION NPV / (NPC) ($ MILLIONS)	CHANGE ($ MILLIONS)
Construction Costs	(7847)	(9181)	(1334)
Operating and Maintenance Costs	(1869)	(1907)	(38)
Revenue	4019	4593	574
Total	(5696)	(6495)	(799)

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

The results suggest that while the addition of the Port of Brisbane Extension achieves an uplift in below rail revenue (an NPV increase of $575 million) it is not enough to outweigh the larger cost to deliver and operate the Port of Brisbane Extension (an NPC increase of $1370 million) meaning overall the Port of Brisbane Extension is $795 million more expensive in net present terms compared to just Inland Rail.

18.10. Port of Brisbane Extension sensitivity analysis

To further evaluate the economic and financial viability of the Port of Brisbane Extension, sensitivity tests have been conducted on the operation commencement, coal prices and other key assumptions driving the economic appraisal and financial analysis.

The results for the economic sensitivity analysis are presented in Table 18.8 and Figure 18.5, showing economic sensitivity analysis results in ascending order based on the estimated BCR. In summary:

- The Inland Rail and Port of Brisbane Extension BCR would exceed the BCR for Inland Rail alone if capital costs were reduced by 30 per cent or benefits were increased by 30 per cent (a proxy for total demand increasing by 30 per cent).
- A high coal price ($US95) would result in additional coal exports (36 per cent), although the additional benefits are offset by an assumed increase in the access charge, reflecting an increased margin between coal prices and mine to port supply chain costs, and the exclusion of producer surplus accruing to overseas mines.

- A high demand scenario (high port shuttle demand, a US$95 coal price and increased agricultural production) is estimated to result in a larger BCR than Inland Rail alone, meaning the benefits from additional freight volumes using the Inland Rail and Port Extension are sufficient to offset the additional Port of Brisbane Extension costs.
- A low demand scenario (low port shuttle demand, a US$55 coal price and lower agricultural production) would push out the assumed timing for Port Extension operations to at least 2073–74 and reduce the BCR to 2.2.

Table 18.8 Strategic economic appraisal results for Port of Brisbane Extension sensitivity analysis (incremental to base case, $ million, 2014–15 dollars, discounted)

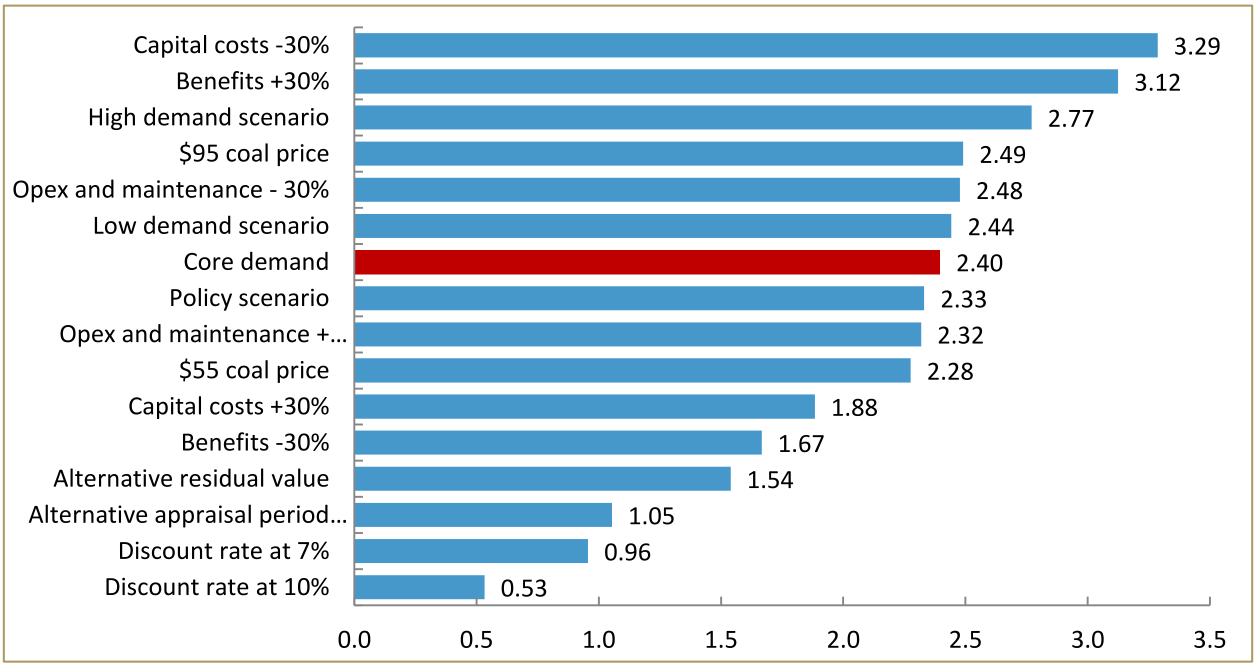
SCENARIOS	BCR AT 4% DISCOUNT RATE
1. **Port of Brisbane Extension:** Assumes Port of Brisbane Extension starts operations in 2040-41.	**2.40**
2. **Policy and price change scenario:** Assumes changes to land use policy and other incentives to support a relocation of logistical operations from suburbs near the Port of Brisbane to areas around Ebenezer, and lift costs reduced to $30. Port of Brisbane Extension starts operations in 2029-30.	**2.33**
3. **High coal price:** Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne until the opening of the Port Extension). Assumes Port of Brisbane Extension starts operations in 2040-41 at which point coal volumes increase from 19.5 Mt to 26 Mt.	**2.49**
4. **Low coal price:** This scenario assumes a lower coal price of US$55 per tonne. Assumes Port of Brisbane Extension starts operations in 2040-41.	**2.28**
5. **High Demand:** Assumes Port of Brisbane Extension starts operations in 2029–30 (reflecting slower ramp up of port shuttle than the policy and price change scenario and the requirement for the Port Extension), high port shuttle demand, a US $95 coal price and 1.3% p.a. growth in agricultural freight.	**2.77**
6. **Low Demand:** Assumes Port of Brisbane Extension starts operations in 2073–74, lower Port of Brisbane shuttle demand, a US $55 coal price and 1.1% p.a. decline in agricultural freight.	**2.44**
7. **High capital costs:** This scenario assumes a 30% increase in capital costs. Assumes Port of Brisbane Extension starts operations in 2040–41.	**1.88**
8. **Low capital costs:** This scenario assumes a 30% decrease in capital costs. Assumes Port of Brisbane Extension starts operations in 2040–41.	**3.29**
9. **Increased ongoing costs:** This scenario assumes a 30 per cent increase in ongoing operating and maintenance costs. Assumes Port of Brisbane Extension starts operations in 2040–41.	**2.32**
10. **Decreased ongoing costs:** This scenario assumes a 30 per cent decrease in ongoing operating and maintenance costs. Assumes Port of Brisbane Extension starts operations in 2040–41.	**2.48**

SCENARIOS	BCR AT 4% DISCOUNT RATE
11. **Increased benefits:** This scenario assumes a 30 per cent increase in total benefits. Assumes Port of Brisbane Extension starts operations in 2040–41.	**3.12**
12. **Decreased benefits:** This scenario assumes a 30 per cent increase in total benefits. Assumes Port of Brisbane Extension starts operations in 2040–41.	**1.67**
13. **Alternative residual value:** This scenario calculates the residual value based on the straight line depreciation of capital costs based on remaining asset life at the end of the 50 year period rather than the future stream of benefits. Assumes Port of Brisbane Extension starts operations in 2040–41.	**1.54**
14. **Shorter evaluation period:** This scenario calculates the residual value based on the straight line depreciation of capital costs based on remaining asset life at the end of the 50 year period rather than the future stream of benefits taking in to account the 100 year life of rail assets. Assumes Port of Brisbane Extension starts operations in 2040–41.	**1.05**
15. **Seven per cent discount rate:** Future costs and benefits are discounted using a 7% discount rate. Assumes Port of Brisbane Extension starts operations in 2040–41.	**0.96**
16. **10 per cent discount rate:** Future costs and benefits are discounted using a 10% discount rate. Assumes Port of Brisbane Extension starts operations in 2040–41.	**0.53**

Note: Results are presented on an incremental basis to the base case and represent the Inland Rail and Port of Brisbane Extension scenario. Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Figure 18.5 Summary of economic appraisal results for Port of Brisbane Extension sensitivity analysis (incremental to base case, $ million, 2013–14 dollars, discounted)



Note: Results are presented on an incremental basis to the base case and represent the Inland Rail and Port of Brisbane Extension scenario. Assumes complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015.

Sensitivity testing has been undertaken on key revenue, cost and financial assumptions against the core Inland Rail with Port Extension results based on a 50 year assessment period.

The financial analysis results for the Port of Brisbane Extension sensitivity analysis is presented in Table 18.9.

Table 18.9 Financial analysis results for the Port of Brisbane Extension sensitivity analysis Programme NPV (NPC) ($ million)

SENSITIVITY	INLAND RAIL PROGRAMME + PORT OF BRISBANE EXTENSION		INLAND RAIL + PORT OF BRISBANE EXTENSION OPERATING CASH FLOW	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
Base Case	**(6495)**	-	**2686**	-
Higher discount rate – Future costs and revenues are discounted using a 6.6 per cent discount rate.	(6559)	(64)	1864	(823)
Lower discount rate – Future costs and revenues are discounted using a 4.6 per cent discount rate.	(6183)	312	3921	1234
High capital costs: This scenario assumes a 30 per cent increase in capital costs.	(9110)	(2615)	2686	-
Low capital costs: This scenario assumes a 30 per cent decrease in capital costs.	(3880)	2616	2686	-
Increased ongoing costs: This scenario assumes a 30 per cent increase in ongoing operating and maintenance costs.	(7067)	(572)	2114	(572)
Decreased ongoing costs: This scenario assumes a 30 per cent decrease in ongoing operating and maintenance costs.	(5923)	572	3258	572
Alternate Appraisal Period: Assumes a 30 year appraisal period starting in 2024-25 to coincide with the full operations of Inland Rail.	(7456)	(961)	483	(1203)
Policy and price change scenario: Assumes changes to land use policy and other incentives to support a relocation of logistical operations from suburbs near the Port of Brisbane to areas around Ebenezer, and lift costs reduced to $30. Port of Brisbane Extension starts operations in 2029-30.	(6623)	(127)	2973	287

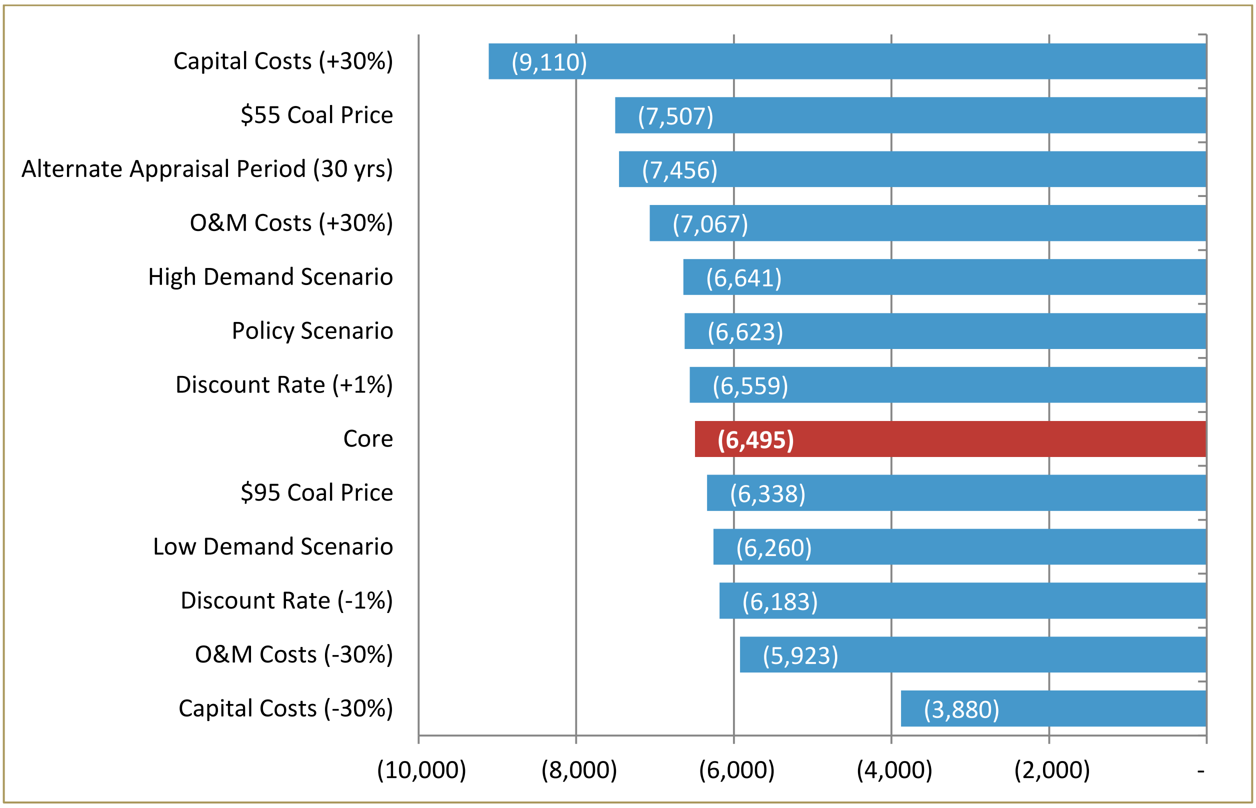
SENSITIVITY	INLAND RAIL PROGRAMME + PORT OF BRISBANE EXTENSION		INLAND RAIL + PORT OF BRISBANE EXTENSION OPERATING CASH FLOW	
	NPV(NPC)	CHANGE FROM BASE CASE	NPV(NPC)	CHANGE FROM BASE CASE
High coal price: Assumes a higher coal price of US$95 per tonne (noting that capacity constraints relating to paths through metro Brisbane restrict the realisation of additional coal exports relative to the core assumption of US$75 per tonne until the opening of the Port Extension). Assumes Port of Brisbane Extension starts operations in 2040-41 at which point coal volumes increase from 19.5 Mt to 26 Mt.	(6,338)	157	2,843	157
Low coal price: This scenario assumes a lower coal price of US$55 per tonne. Assumes Port of Brisbane Extension starts operations in 2040-41.	(7,507)	(1,012)	1,674	(1,012)
High Demand: Assumes Port of Brisbane Extension starts operations in 2029–30 (reflecting slower ramp up of port shuttle than the policy and price change scenario and the requirement for the Port Extension), high port shuttle demand, a US $95 coal price and 1.3% p.a. growth in agricultural freight.	(6,641)	(146)	2,725	38
Low Demand: Assumes Port of Brisbane Extension starts operations in 2073–74, lower Port of Brisbane shuttle demand, a US $55 coal price and 1.1% p.a. decline in agricultural freight.	(6,260)	235	2,169	(518)

Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015

The financial analysis results for the Port of Brisbane Extension sensitivity analysis, based on the Programme NPV (NPC) is presented in Figure 18.6.

Figure 18.6 Financial analysis results for Port of Brisbane Extension sensitivity analysis



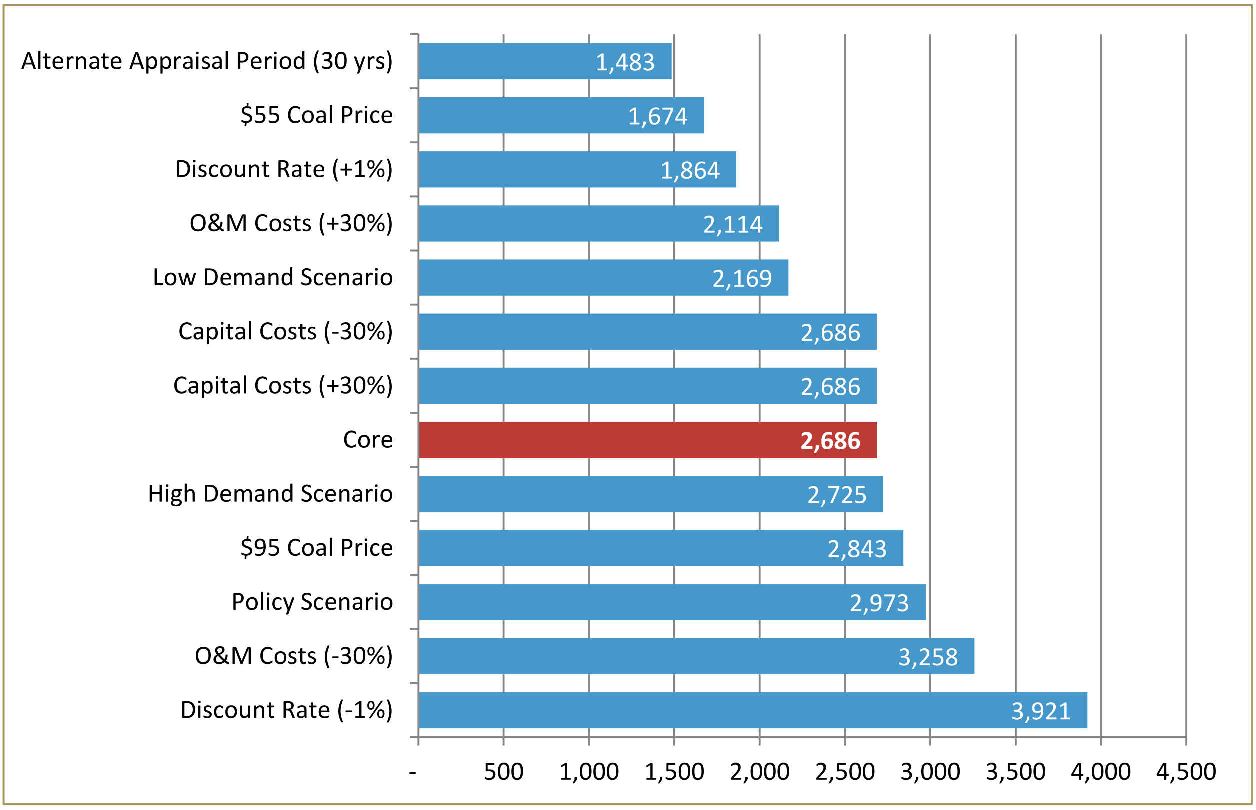
Note: Requires complementary investment in the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.

Source: PwC, 2015

The financial analysis results for the Port of Brisbane Extension sensitivity analysis, based on the operating cashflow is presented in Figure 18.7.

Under the high demand scenario the Port of Brisbane Extension is required to be constructed earlier to meet demand needs of the network. The resulting increase in NPC more than offsets the increased revenue, causing the overall NPC to increase conversely under the low demand scenario.

Figure 18.7 Financial analysis results for Port of Brisbane Extension sensitivity analysis (operating cash flow)



Note: Requires complementary investment on the QR network (Western Line and Brisbane metropolitan network) to enable coal train lengths to increase from 650 metres to 1010 metres.
Source: PwC, 2015

The key findings of the key assumption sensitivity analysis include:

- The overall NPC of the Inland Rail Programme is most sensitive to changes in capital costs and coal price and relatively insensitive to changes in Port Shuttle demand and operating and maintenance costs.
- The NPV of the operations of Inland Rail is most sensitive to changes in discount rates and coal price and only moderately sensitive to changes in Port Shuttle demand and operations and maintenance costs.

18.11. Summary

Supplementary analysis of a dedicated freight line extension from the existing interstate line in Brisbane to the Port of Brisbane identified two potential options, with the lowest cost option estimated to cost around $2.5 billion (P50, $2014-15, excluding escalation). Further planning is required before a preferred option (and associated corridor) can be selected. The analysis indicated that a staged investment of approximately $54 million (strategic, $2014-15, excluding escalation) commencing in 2023 could enable the existing route to meet demand until 2040-41 (or until 2029-30 if more aggressive land use and complementary investment policies are applied to attract greater volumes to rail), decreasing the BCR from 2.3 with Inland Rail alone, to 2.1 with Inland Rail and the Port of Brisbane Extension operating from 2040-41. Action to preserve the preferred corridor could however be prudent as, even with staged upgrades to the existing route, a new, dedicated freight line would eventually be required (i.e. the initial investment to increase capacity could postpone but not remove the need for the new route). Progression of the Port of Brisbane Extension will require further community consultation and completion of an EIS.

Appendix A

Technical specifications

APPENDIX A TECHNICAL SPECIFICATIONS

This appendix provides additional technical information relevant to the scope of Inland Rail identified in Chapter 5 (Service offering, scope and opportunities). The technical specifications required to successfully deliver Inland Rail include:

- infrastructure
- survey and track
- capping layer and earthworks
- drainage and flooding
- rail systems
- telecommunications
- electrical
- level crossings
- utilities
- structural and civil
- tunnels
- safety.

The technical specifications have been informed by a range of technical reports and assessments, including:

- **Draft Basis of Design Report:** A living design criteria document that evolves as the Programme matures and will be reviewed at six monthly intervals.
- **Draft Tunnel Concept Design Summary**: The preliminary assessment of tunnel requirements including type, construction method and ventilation requirements.
- **Level Crossing Strategy:** The concept assessment phase that outlines the principles used to determine level crossing scope and treatment options.
- **Safety Assurance and Accreditation Strategy**. The strategy to meet Inland Rail's Rail Safety accreditation requirements across the three states (New South Wales, Victoria and Queensland).

A.1 Approach

The approach adopted for the development of the technical requirements for Inland Rail included:

- A review of current standards.
- A review of best practice approaches for key elements.
- Consideration of ARTC Codes of Practice.
- Identification of technical requirements across the key elements.
- Development of technical assumptions to inform the cost estimates.

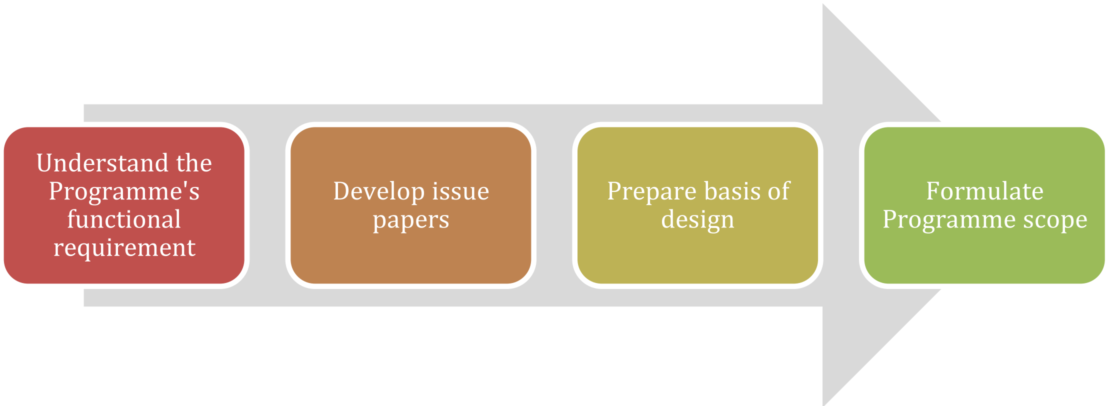
Context

The Draft Basis of Design Report outlines various engineering design parameters and methodology approaches and is a primary point of reference for the design of Inland Rail. It is a living reference which:

- Specifies the basic technical requirements for the corridor.
- Specifies the technical assumptions.
- Establishes a process for challenging and testing these assumptions.
- Confirms the key issues and processes to be addressed during the design development.

The iterative process adopted to inform the technical requirements that support the scope of Inland Rail is shown in Figure A.1.

Figure A.1 Process to inform technical requirements



Source: PB, 2015.

Standards

An anticipated hierarchy of design standards, in order of priority applicable to Inland Rail, was developed. It included:

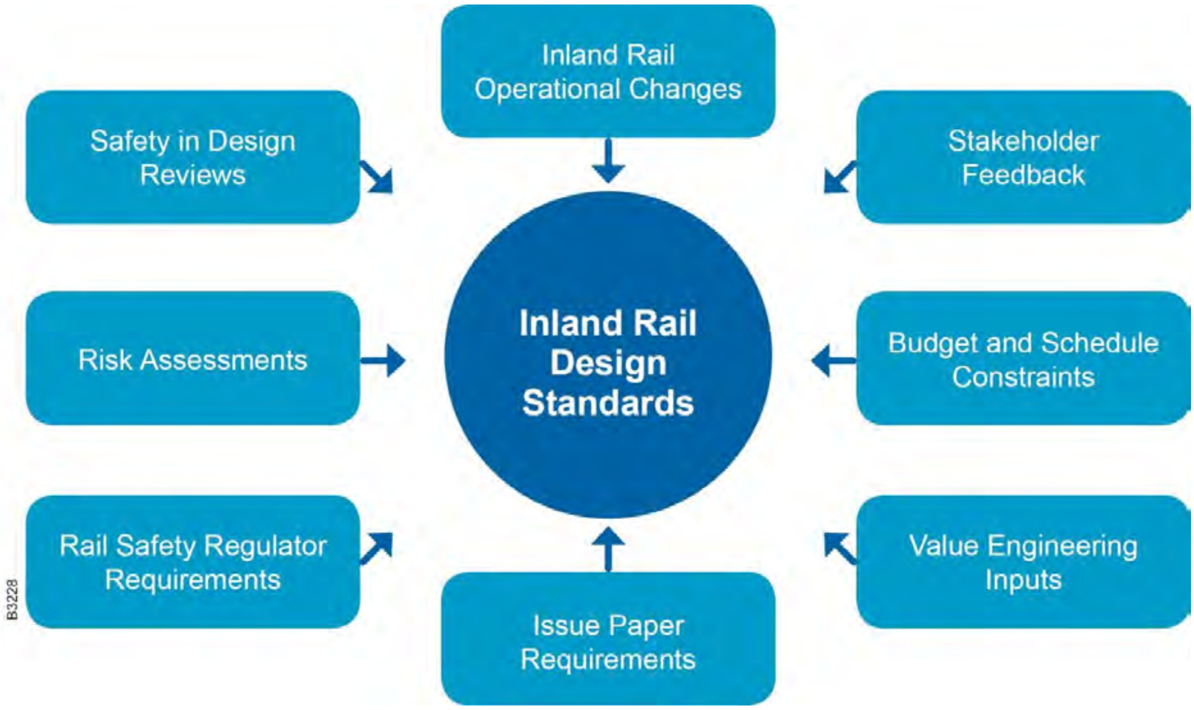
- Inland Rail specific requirements (the ARTC Code of Practice, CoP) will be the minimum standard to be complied with. Variations may be required to meet the service offering specifications.
- ARTC CoP for Track and Civil Standards, and the current ARTC Signalling Standards.
- Standards approved by ARTC for the utilisation of the ATMS.
- New or existing standards amended to incorporate the above Inland Rail requirements.
- ARTC standards relevant to heavy haul, interstate, freight and coal.
- Other ARTC standards.
- ARTC procedures, work instructions, form guidelines and type approval procedures.
- Rail Industry Safety and Standards Board (RISSB) standards.
- Australian Standards.
- State standards (VRIOGS standards, QR standards where applicable).
- International best practice such as the Heavy Haul guidelines.

Standards review

In the first instance, the ARTC standards for both freight and heavy haul were reviewed by the project team. As a follow up measure, applicable state standards were also reviewed.

The potential inputs for ongoing updates and management of the design standards for Inland Rail are shown in Figure A.2. It is recognised that once the initial base assumptions and design criteria are set, and risks and opportunities considered, there will be a need for ongoing updates and alterations to the standards to suit a number of factors. One key element will be a review of the infrastructure standards to match the recent and predicted technological advances in rollingstock.

Figure A.2 Standards review



Source: PB, 2015.

A.2 Infrastructure

A preliminary assessment of asset criticality to the continuity of Inland Rail has been completed. For the purpose of this paper, critical infrastructure is defined as infrastructure that could cause significant impact to the network severely limiting or preventing the ability to operate trains, causing significant loss of revenue to track owners or operators and/or customers. Critical infrastructure is not easily rectified by a temporary fix or routine reactive measures. This approach is based on a similar exercise conducted on the ARTC Hunter Network.

The asset types that have been determined as critical and not critical are identified in Table A.1 and Table A.2 respectively.

Critical infrastructure, based on the analysis from the ARTC Hunter Network Business Continuity Plan, indicates that the maximum outage time allowable should be assessed based on the cost impact caused by the loss of operations.

Table A.1 Critical infrastructure

ASSET	CRITICALITY REASON
Underbridges	Reconstruction of the track formation over a bridge is required to resume train operations. This could be a significant timeframe dependant on the type of structure and size of spans.
Large culverts	Reconstruction of the track formation over a large culvert is required to resume train operations. This could be a significant timeframe depending on the age of the structure and size of spans.
Major signal interlocking	Large Relay Based Interlockings (RBI) would take weeks/months to reconstruct if completely lost. Procurement of relays is a risk within short timeframes. Length of time to test and commission is also a potential risk. Complex Computer Based Interlockings (CBI) may also take a month or more to reconstruct.
Tunnels	Failure of tunnels is likely to totally block train movements. Tunnels may require reconstruction to continue operations, which may take significant timeframes to construct.
Viaducts	Failure of viaducts is likely to totally stop train operations. Viaducts may require reconstruction to continue business, which may incur significant timeframes.
Land/geotechnical slips	Significant land slips which undermine the track formation may require engineering or rectification works before track can be reopened. This may involve significant timeframes to rebuild.
Non-standard turnouts and crossings	If component/s are at a critical point in the network e.g. Acacia Ridge to Oakley section or Illabo to Melbourne and spare parts are not available, the impact to operations may be equivalent to the lead time of the required components, which may significantly restrict operations.
Network control	Failure of network control has the capacity to affect the entire network, preventing or severely restricting the ability to operate trains. The effect is likely not limited to a section of track, but could prevent, or restrict operations to large areas or the entire network.

Source: PB, 2015.

Table A.2 Non-critical infrastructure

RISK ELEMENT	CRITICALITY REASON
Overbridges	Ability to re-open track is limited by investigation, clean up and track rectification works. The track could be reopened without the structure being rebuilt.
Small culverts	Generally readily available, temporary workarounds may be implemented with alternative sizes and proprietary products may be available. Relatively quick construction time to get the track open and running.
Footbridges	Ability to re-open track is limited by investigation, clean up and track rectification works. Track could be reopened without structure being rebuilt.

RISK ELEMENT	CRITICALITY REASON
Level crossing signalling	Level crossings can be hand signalled to allow trains to run. Rectification is required for track/signalling if damaged and may not result in a closure of the track for an extended period.
General track damage	Standard turnouts and crossings: Generic risk applicable to entire network, although spares are available. Cuttings: Assumed that track could be reopened after removal and stabilisation of foreign material and associated track rectification.
Signal gantries	Alternative safe working methods available e.g. flagmen to continue trains running.
General trackside signalling	Alternative safe working methods available e.g. flagmen to continue trains running.
Track drainage	Risk applicable to entire network. Corrective maintenance required if damaged and may not result in a closure of the track for extended period.

Source: PB, 2015.

Design life targets

As Inland Rail is a long term piece of infrastructure, consideration was given to appropriate design life of key elements. They include:

- **Primary rail assets–100 years:** Examples include civil and structural elements, foundations, retaining structures, culverts, tunnel portals, tunnel elements and other structural load bearing elements.
- **Rail systems–50 years:** Examples include track formation and capping and concrete sleepers/bearers.
- **Rail systems–30 years:** Examples include permanent way track, ballast, turnouts, crossing diamonds, arrestor systems, noise and vibration isolation components, electrical supply systems, transformer and main distribution boards.
- **Rail systems (rotable systems)–15 years:** Examples include:
  - Rail telecommunications systems—fibre and copper back bones, signalling and train control systems and wayside equipment.
  - Rail fixings and fastening systems, turnouts and crossing diamonds (e.g. crossing piece).

A.3 Survey and track

This section contains a brief summary of the key topics and outcomes that have emerged from discussions with key ARTC technical leads and PB subject matter experts. The overall approach required to the proposed design, standards and specification which must be met to deliver the proposed Inland Rail design.

The design will be developed in accordance with ARTC standards including:

- Australian Height Datum for all height information.

- Survey specifications from ARTC will apply to Inland Rail with Survey Control Marks being placed and shown on design drawings.
- As built drawings will show remaining and new Survey Control Marks and Track Control Marks, as a minimum these are spaced at 20 metres on curves and 100 metres on straights, as specified in the ARTC standards.

A specific chainage has been adopted using the 9.7 kilometre mark on the Melbourne side of the Maribyrnong River.

Track structure

The design of new track and track to be upgraded will be in accordance with the ARTC CoP (unless a value engineering proposal is approved by the ARTC Engineering Waiver process) and the key requirements are outlined in Table A.3.

Table A.3 Track structure

ITEM	DESCRIPTION
Rail	• 53 kg rail is to be used as a minimum on all brownfield project sites. • 60 kg rail as a minimum on greenfield sites.
Welding	• Continuously Welded Rail (Flashbutt). • Adjustment welds to be aluminothermic.
Sleepers	• Heavy duty concrete sleepers designed for 30 tal at 115 km/h to suit 1435 mm standard gauge sections combined with 1067 mm or 1600 mm in areas of dual gauge.
Fastenings	• Fastenings shall be resilient elastic type.
Ballast depth	• 300 mm (minimum) to 500 mm (maximum) ballast measured beneath the low rail. • For ballast bridges the ballast depth shall be 300 mm (minimum) to 600 mm (maximum) below sleepers.
Ballast shoulder	• 300 mm minimum width (400 mm on curves < 600 m radius).

Source: PB, 2015.

Track geometry

The key principles to be considered in development of appropriate track geometry are outlined in Table A.4.

Table A.4 Track geometry

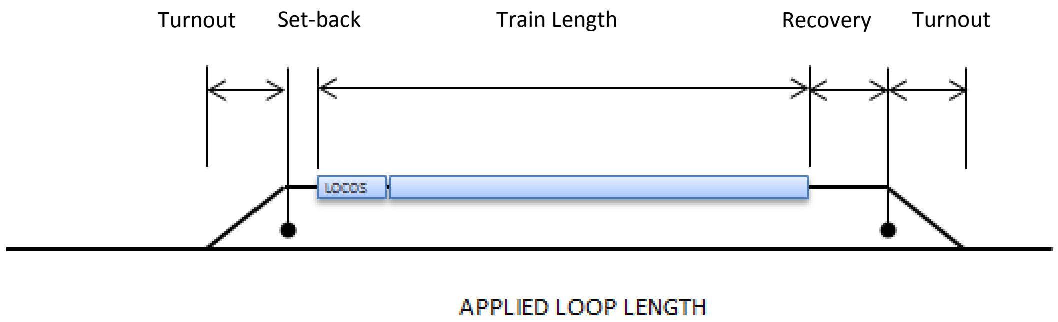
ITEM	TYPICAL	RECOMMENDED LIMIT
Horizontal curve	• 1500 m or flatter (target). • 1200 m normal minimum. • 800 m in mountainous terrain.	• 800 m or flatter to allow for 115 km/h at maximum superelevation. • 400 m tightest radius in mountainous terrain for 80 km/h at maximum superelevation. It is recommended that 500 m minimum radius is the limiting factor to alleviate instances of wheel squeal. • If operational modelling indicates that trains cannot achieve these speeds (115 km/h and 80 km/h respectively), tighter radii may be considered for approval.
Track centres	• 6.5 m.	• Minimum 4.5 m widened for curvature in accordance with ETI-07-02 for loops and 5.2m for sidings.
Layout	• Assume 100 year long term duplication.	• Set out track for duplication. • Utilities and services outside area of track.
Grade	• 1:100 or flatter.	• 1:80 (compensated) for general alignment. • 1:50 (compensated) in mountainous terrain. • 1:200 preferred at arrival or departure points at loops.
Vertical curve (equivalent radius)	• General alignment 5000 m. • Mountainous alignment 1800 m.	• General alignment 2800 m. • Mountainous alignment 1300 m.
Curve Compensation	• Where grades are steeper than 1:110, grades will be compensated for curvature using n=1.65R. Both the physical and compensated grades must be shown.	• Where grades are steeper than 1:110, grades will be compensated for curvature using n=1.65R. Both the physical and compensated grades must be shown.

Source: PB, 2015.

Loops

A typical arrangement for a loop to accommodate an 1800 metre train is typically 2165 metre from points to points. A typical loop arrangement is shown in Figure A.3.

Figure A.3 Typical loop arrangement



Source: PB, 2015.

The following requirements are to be met in the design of passing loops:

- Loops to accommodate 1800 metre long train.
- 15 metre set back from trackside indicators/signage.
- 105 metre recovery loco set, assuming four recovery locos (With ATMS there will be differences for three loops south of Parkes).
- 80 kilometre per hour turnouts (minimum 1:18.5) consideration should be given to canted rails through the turnout and swing nose crossings where required.
- Loop sites to indicate future extension for 3600 metre trains which will require a 3965 metre loop length.
- Loop sites to include at grade pads at each turnout for maintenance and construction.

The following items should be considered when designing passing loops:

- Passing lanes should be considered based upon operational requirements.
- Maintenance sidings attached to any proposed loops should consider mainline protection in the form of catch points.
- Longer term duplication.

Turnouts

All turnouts shall be located on straight, grade track where possible and shall be as per Table A.5.

Table A.5 Turnout type

LOCATION	TURNOUT TYPE
Inland Rail loop connections	1 in 18.5 1200R tangential type suitable for 80 km/h entry speed on concrete bearers.
Other sidings or mainline connections	1 in 10.5 R250 tangential type suitable for 40 km/h entry speed on concrete bearers.

Source: PB, 2015.

Turnouts are to be in accordance with ARTC CoP Section 3, Points and Crossings. Mixed Gauge turnout reference drawings are referred to; and to be in accordance with ARTC Supplementary Appendix to ARTC Track and Civil CoP– Mixed Gauge Track – ETF-00-01.

A.4 Capping layer and earthworks

Details of the capping layer and earthworks are to be determined based on site specific geotechnical investigations and are subject to further design. This section summarises the key elements and considerations given to the capping layer and earthworks including geotechnical, embankment and formations.

Geotechnical

The assessment of geological conditions has been based on geological maps at 1:250,000 scale or 1:100,000 scale, where available. Geological map lithology was available and translated into geological units in GIS.

The design of new earthworks shall be as per ARTC Track and Civil Code of Practice Section 8 Earthworks and related technical specifications (ETC-08-01) and standards (ETM-08-01) in addition to relevant Australian Standards. ARTC Heavy Haul Infrastructure Guidelines should be considered, where appropriate.

Formation capping layer

A capping layer is proposed on all new and upgraded formation works (including embankments and cuttings). The specification of the capping layer will be designed on a case-by-case basis to meet the functional requirements of the layer.

Embankment

Embankments shall be made up of two zones of embankment material, Structural Fill and General Fill. The Structural Fill will directly underlie the capping and the thickness of this layer will depend on the subgrade/general fill California Bearing Ratio. General Fill will typically comprise of re-use of site won material.

Formation geometry

Excavation for cuttings and embankment profiles need to adhere to the minimum slopes stipulated in ETM-08-01 Section 3.3 and 3.8 respectively. Section 3.8 indicates the standard batter slope of 1V:1.75H. Cuttings and embankment profiles shall satisfy the following slope stability criteria:

- Minimum Factor of safety (FoS) of 1.2 under temporary loading (during construction, flooding and earthquake loading).

- Minimum FoS of 1.5 post construction under permanent loading.

A.5 Drainage and flooding

Drainage considerations are divided into cross drainage and track drainage. Sizing of both the cross and track drainage systems at both existing and greenfield sites require survey of existing drainage infrastructures and topographical information at upstream and downstream of crossings.

Based on Section 10 of the ARTC Track and Civil CoP – Flooding (RTS3433) and Part 5B: Drainage of the Austroads Guide to Road Design 2013 – Open Channel, Culverts and Floodways, the following design standards are proposed:

- Cross drainage:
  - Greenfield sections to be constructed to provide Q100 immunity in accordance with the ARTC service offering.
  - Brownfield upgrades shall be subject to further investigation and assessment. All brownfield sections to be no worse than existing.
  - Additional immunity shall be provided at high risk areas for example tunnel portals, major bridge crossings and crossings that could result in major adverse flooding impact on surrounding land users or townships.
  - Flow conveyance shall not be substantially reduced to minimise excessive flood impact on local land owners.
- Track drainage:
  - Greenfield sections to be Q100.
  - Brownfield upgrades shall be subject to further investigation and assessment. All brownfield sections to be no worse than existing.
  - Water quality impact protection:
    - Water quality basins shall be provided if the track drainage discharge point is within 200 metres upstream of a water sensitive receptor.
    - Swale/grass channels shall be provided if the track drainage discharge point is 200 metre to 500 metre upstream of a water sensitive receptor.
    - No water quality mitigation measures will be provided if the discharge point is more than 500 metre upstream of any water sensitive receptor.

A.6 Rail systems

The intermodal Reference Trains used for Inland Rail are outlined in Table A.6.

Table A.6 Intermodal Reference Train

VARIABLE	VALUE
Max train speed	115 km/h.
Average speed northbound intermodal	72.4 km/h for a 24 hour transit time.
Axle load	21 tal.
Track gauge	Standard (1435 mm).

VARIABLE	VALUE
Maximum height (static outline)	6.5 m from top of rail.
Traincrew configuration	Two driver operations (driver only operations to be investigated).
Traincrew depots	Single depot in Melbourne.
Traincrew operations	Four driver relay working with use of crew van.
Locomotive provisioning	At terminus locations (Melbourne and Brisbane).
Locomotive refuelling	In-Line refuelling wagon.
Rollingstock maintenance	Melbourne or Brisbane.
Rollingstock rapid response	Melbourne, Parkes, Brisbane.
Rollingstock operating days	310 based on 85% utilisation.
Locomotive km per annum	306 000 km based on 2 round trips per week.
Healthy	90% reliable on time running.
Wagon km per annum	306 000 km based on 2 round trips per week.
Train length	1800 m.
Max gross train weight	5926 tonne.
Planned gross train weight	4542 tonne northbound, 2400 tonne southbound.
HP/T ratio	2.7 hp/t (3 engines).
En-route train requirements	• Train crossings. • Crew changes – to be done during train crossings. • Refuelling – automated with no requirement to stop.

Source: PB, 2015.

Coal Reference Train assumptions are outlined in Table A.7.

Table A.7 Coal Reference Train

VARIABLE	VALUE
Axle load	15.75 tal.
Track gauge	Narrow (1067 mm).
Train length	1010 m.
Max gross train weight	5463 tonne.
Train configuration	4 x 2600 class locomotives with 88 wagons.

Source: PB, 2015

Infrastructure condition monitoring

The following systems within Table A.8 shall be provided on the network at locations determined during detailed design.

Table A.8 Condition monitoring systems

SYSTEM	FEATURE	DESCRIPTION
Active Level Crossings	Locations	The use of constant time warning predictors is preferred.
	Functionality	Autonomous operation.
Stream Flow Detection	Locations	Locations to be determined by a detailed analysis of all streams, other than at bridge sites, rating each location by a weighted combination of a number of key parameters such as: • Barrel Length • Stream Flow • Velocity • Freeboard • Subgrade conditions.
Hot Wheel and Hot Bearing Detection	Location	One location each at approximately 40 km from the terminal points and regular intervals along the main line. Locations to avoid being: curves, areas where trains are or have been braking, areas where sudden speed changes (run-in and run-out) are likely to occur.

SYSTEM	FEATURE	DESCRIPTION
	Functionality	Capable of autonomous operation.
	Accuracy	± 3 degrees Celsius.
	Reliability	Data transfer to office within three minutes of end of train passing detector.
	Availability	99.99% of high-level alarms to be announced to train controller & to train driver. Data for 95% of vehicles-crossings to be identified and recorded.
Wheel Impact Load Detection	Locations	One location, south of Parkes.
	Accuracy	Record dynamic wheel loads to within 10%.
	Availability	Data for 95% of vehicles-crossings to be identified and recorded.
Dragging Equipment Detection	Locations	Locations subject to further design.
Out of gauge load detectors	Locations	On departure from terminals and prior to reaching areas of critical infrastructure (i.e. tunnels).
High wind detection	Locations	Locations to be determined by a detailed analysis of all areas subject to potentially high winds.
Inline weighbridges	Locations	On departure from terminals.
Stress Free Temperature measurement	Location	Install sensors in the rail web at all potential 'rail bunching' sites as part of a system to prevent track buckles in hot weather.

Source: PB, 2015.

Signalling and train control

The existing signalling infrastructure will require surveying to determine its suitability for re-use and the accuracy of as-built records. This survey is to include determination of equipment types/condition, position of trackside equipment and cable routes as well as a review of design/construction standards. Where existing signalling infrastructure is proposed to be re-used, and it does not comply with the proposed Inland Rail standards, an assessment will be undertaken to determine the cost/benefit of upgrading the existing infrastructure.

ATMS requires an accurate database reflecting the track centreline co-ordinates. It is suggested that this be carried out at the same time as the conventional corridor survey.

Safeworking system

The safeworking system will be provided by ATMS between Illabo and Acacia Ridge. The existing Centralised Train Control (CTC) system will be retained between Melbourne and Illabo. ATMS will require each point switch to be monitored and controlled by a trackside unit connected via radio communications to the control centre. This trackside unit will comprise of power supplies and interface to the point switch and over point track circuit, and houses the Trackside Interface Unit (TIU). The TIU is an interlocking object controller that provides fail safe control of the point.

Contingency management

ATMS will be bounded by rules and procedures specific to the system which includes contingency rules in the event of a failure of the system. Failure of the system can include locomotive equipment failure, communications failure or total failure and the level of the failure will determine the type of procedures introduced.

The extent of impact on the network in a failure scenario will depend on the contingency developed in the event of ATMS failure. Provided that the system reverts to a Train Order type system whilst train delays occur, impacts can be minimised with effective management by the Network Control Centre.

Turnouts

All new turnouts will be power operated by electric point machines and will be remotely controlled from the relevant train control centre via the TIU. Existing turnouts that are not currently provided with remote controlled electric point machines will be upgraded. All turnouts will be assessed during the survey to determine what level of control should be applied. For most turnouts, mechanical cranking handles would be provided to operate a failed points machine.

Signals

There are no signals required within ATMS unless the ATMS safeworking territory interfaces with a signalled section, e.g. CTC. In this case, an exit signal will be provided and will be driven from the adjacent safeworking interlocking system. Stop/block boards will be used instead of signals.

Train detection

Train detection is provided by each ATMS equipped locomotive that provides the ATMS Authority Management System (AMS) with location of the head locomotive and that the train consist is intact. Train detection is provided over point switches to lock and prevent the switch from moving when a train is passing over the switch and also confirms the location of the train at the AMS. The choice of track circuit should be Jeumont Schneider High Voltage Impulse. Provision of train detection inside sidings will be considered on a case-by-case basis. ATMS includes inertial sensors enabling it to operate in tunnels without global positioning system technology but due to safe working considerations, it is proposed that axle counters are located at both ends of a tunnel, restricting the occupation within a tunnel to a single train.

Interlocking

ATMS does not require conventional computer or processor based interlockings. Control of point switches at passing loops is managed by the centralised AMS. An interlocking may be provided at yards if that yard is to operate autonomously. Vital fibre-optic communication links may be required between TIUs if radio coverage is not available. These links may also be required for trackside asset monitoring systems or equipment.

Power supplies

Each TIU will be solar powered, unless there is a convenient connection to local reticulated supplies. They will each have Universal Power Supply that will have sufficient capacity to maintain point switch operation even when there are periods of insufficient sun.

Interim signalling solution

It is assumed that by the time design and construction of Inland Rail commences, ARTC's ATMS will be proven and operational, and will be the logical control system for the railway. If ATMS is still under development or acceptance trials at the time of construction, a train order working system with in-cab operation of trackside point machines would be a suitable interim safe working system. If this solution eventuated the trackside location cases should be designed and built to accept a TIU.

Train control centre

The ATMS will be housed at a single control centre with a backup unit located at an alternative centre. Depending on the length of track placed under Inland Rail control, i.e. into Queensland, there is most probably no need to construct a new control centre building. There are possibly three new control boards required, therefore the existing ARTC train control centres could accommodate them.

A.7 Telecommunications

Inland Rail will provide the corridor based telecommunications infrastructure to support the correct utilisation of the National Train Communications System (NTCS). This includes the provision of suitable communications towers, associated telecommunications equipment and ancillary services.

The NTCS platform provides voice and data communication between Train Control, field staff and field infrastructure, interoperability of train operations between Train Control Centres and provides for the communications environment needed to support the data-intensive train management systems of ATMS.

Inland Rail will be fully integrated with ARTC's ATMS system.

A.8 Electrical

Inland Rail will be subject to a complete survey to determine what power equipment is available, proximity to community based reticulated supplies and any issues that might affect the use of solar power, e.g. severely shaded areas. Any equipment found to not have the required working life of 25 years should be replaced with new equipment.

The details of new power requirements are in the early stages of development. The need to take electrical power into account will be required for the following:

1. Passing loops – signalling and communication.
2. Existing network sidings – signalling and communications.
3. Tunnel – ventilation, communications systems and water supply.

If equipment is located at a suitable distance from reticulated supplies, then it should also be considered as a back-up proposal. Any tunnel ventilation loads being required for both safety and operational purposes also require a primary and back-up power supply.

Power for passing loops

Each passing loop consists of a number of point machines, a signalling trackside unit and a communication network. To facilitate the reliability and quality of power for all these systems, an Uninterruptable Power System (UPS) with batteries charged through solar panels will be required. It is assumed that solar panels will be used at all sites, unless the level of sunlight hours requires unrealistically sized solar powered units.

Each remote asset management interface will be provided either locally or accommodated from a passing loop power source. The drain on these asset management devices is very low and may be timed or switched on as a train approaches. Track circuit occupancy could be used to energise the device.

Power for existing network sidings

Each siding consists of a number of signals, points machines, communications networks, supervisory control and data acquisition systems, hut auxiliaries and back up equipment, and will be different in size and capacity. To facilitate the reliability and quality of power for all these systems, each site will have a UPS and batteries between the power source and the loads.

If sidings are remote the power would be solar powered and use manually operated points if the number of points is significant. The survey will highlight these issues.

Where sidings are located at major depots, the primary power supply is expected to be from the local power authority fed from the reticulated supply. Presently, it is intended to have all sidings at major depots.

A.9 Level crossings

For level crossings, there is general acceptance by the Australian rail industry and regulators of the approach endorsed by the RISSB, whereby the risk is calculated using a nationally recognised assessment tool, the Australian Level Crossing Assessment Model (ALCAM), combined with a cost-benefit analysis approach to determine the level of protection.

It should be noted that, over and above what the National and QR Safety Regulators may require, both the New South Wales and Queensland Governments have general policies aiming to limit the number of new at-grade crossings. These policies do not strictly preclude new at-grade crossings, but a compelling justification would need to be provided. The use of ALCAM, coupled with cost-benefit analysis, is proposed to provide this justification.
This proposed approach will be discussed with rail safety regulators. Cost-benefit analysis is likely to show a poor return on the expenditure needed to grade-separate local roads and other roads with few vehicle movements, compared with the application of that expenditure to removing or upgrading other level crossings of busier roads, elsewhere on the rail network.

For this phase (Concept Assessment) the following principles have been used to develop the scope for treatment of road crossings on the Inland Rail alignment:

- All freeway, highway and arterial road crossings are to be grade separated in both greenfield and significantly upgraded brownfield line sections.
- A desktop risk-based approach (based on expected ALCAM outcomes) was adopted to develop treatments at all other rail and road crossings.
- Level crossing arrangements on the existing alignments between Somerton to Parkes and Kagaru to Acacia Ridge remain unchanged.
- Maintaining connectivity of Travelling Stock Routes has been addressed as an item separate to road crossings in the Inland Rail scope.

- While some level crossing closures have been considered appropriate in the Concept Assessment phase, future phases will look at opportunities to amalgamate land holdings and rationalise level crossing arrangements to reduce the impact of severance.

Options considered for crossing treatments is outlined in Table A.9.

Table A.9 Level crossing treatments

CROSSING TYPE	TREATMENT
Grade Separation – major road	• Freeway, highway, arterial and other roads with 4 or more lanes.
Grade separation – minor road	• Local Roads and other 2 lane roads if grade separation identified by Phase 1 Concept Assessment risk assessment.
Active crossing	• Crossing with bells, flashing lights and boom barriers, as identified by Phase 1 Concept risk assessment. • Level crossing surfacing assumed to be rubber panels. • For the purposes of the cost estimate, all active crossings are assumed to be boom gate crossings.
Passive crossing (urban and rural)	• Stop signs with approach warning signs, as identified by Phase 1 Concept risk assessment. • Level crossing surface assumed to be bitumised concrete panels.
Re-build existing active crossing	• Crossing re-build in brownfield route sections where track and formation are reconstructed.
Re-build existing passive crossing	• Crossing re-build in brownfield route sections where track and formation are reconstructed.

Source: ARTC, 2015.

The Concept Assessment identified a potential 731 level crossings across both missing link (48 per cent) and enhancement (52 per cent) projects. The current capital cost estimate has allowed 337 level crossing treatments with final requirements determined based on additional design, engineering and stakeholder engagement.

A.10 Utilities

Co-location of services in the rail corridor is an important factor in the design of new routes and will require:

- Installation of additional underground conduits to allow for future service installations.
- At-grade installations and above ground installations e.g. posts, for current and future scenarios.

Each state has a number of utility companies that provide services and their assets are not only limited to those states but can cross state boundaries. Utilities such as water and sewer services are owned and operated by local utility providers and local councils, while electrical and telecommunications providers have national coverage.

There are a number of services that may be affected by the project:

- Pipelines (water, stormwater, sewage, gas or otherwise).
- Cables (electrical, fibre-optic, telecommunications or otherwise).
- Water channels.

- Electrical installations (street lighting, traffic signals, Intelligent Transport Systems and telecommunications plant).

The majority of these utilities are recorded on Dial Before You Dig (DBYD), a national referral agency, but some utilities may not be. The service information collated by DBYD, as-constructed plans and detailed field survey will be identified by its type, nature, configuration, asset owners and its general condition. These services will be plotted in Computer Aided Design and GIS and will be overlaid on the rail alignment throughout the corridor.

Once concept plans and proposed mitigation strategies are developed, the process of engagement with authorities will commence. This process will need to be managed efficiently due to diverse geographic positions of authorities.

Considerations on issues detailed below will be required as Inland Rail progresses:

- Protection of the rail corridor.
- Allowance for possible future services.
- Relocation or protection work to be carried out by the authorities including specialised works and any civil works that the authority may wish to carry out.
- Relocation or protection work to be included in the Construction Contract Documents.
- Management of the environment.
- Identification of opportunities for 'early works' in advance.
- Timing of both the specialised and civil works, with regard to the overall construction staging, including necessary lead time for the purchase and supply of equipment.

All decisions made with authorities in regards to the treatment of the affected services will be closely coordinated with other civil and track works such that an integrated solution can be developed. Where possible, the rail alignment will be adjusted to avoid relocation of major utilities such as bulk water mains, gas mains, oil pipes and high voltage transmission lines.

Protection

In circumstances where existing services can be protected during construction without compromising the integrity and service life of these services, a protection methodology will be developed in consultation with service authorities. The protection works will be developed in conjunction with the proposed construction staging and traffic management.

Relocation

Where existing services are located within proposed railway corridor and relocation is inevitable, even after refinement of alignment, these services will be relocated outside the corridor in coordination with service authorities. Inland Rail will develop a concept relocation alignment and configuration in conjunction with other permanent works to discuss further with utility authorities. Upon agreement with authorities in relation to the preferred relocation option, the authorities will be engaged to develop preliminary design and relocation costing.

A majority of utilities such as electrical, telecommunication and gas will need to be designed by utility owners preferred consultants. The relocation design of other services such as water and sewer will be undertaken by the project in close coordination with ARTC and individual utility authorities.

Example service relocation design standards and guidelines include:

- SEQ Water Supply and Sewerage Design and Construction Code.
- Sewerage Code of Australia.

- Water Supply Code of Australia.
- Energex Underground Distribution Construction Manual.
- Energex Overhead Design Manual.
- Relevant Australian Standards.
- Local council design standards and guidelines.
- Service authorities design guides.

A.11 Structural and civil

This section summarises the key structural and civil requirements for new and existing structures.

New structures

The design of new structures will be as per ARTC Track and Civil CoP Section 9 and Australian Standard AS5100 and will comprise:

- Design life to be 100 years.
- Maximum fire load 200/250.
- Minimum 300LA rail traffic load with applicable dynamic load allowance.
- Underbridges and culverts to be of concrete and/or steel construction to suit local environment.
- For culverts, minimum cover over pipe culverts to be 1.0 metre exclusive of ballast.
- Overbridges to be single span across tracks including access roads, with minimum 7.1 metre vertical clearance above rail.
- Comply with the ARTC CoP Section 9 Structures, except where a value engineering proposal is approved by an ARTC Engineering Waiver.

The structures that will be considered within the design will include:

- Underbridges (including viaducts) assumed to allow no provision for maintenance access roads across the structure.
- Overbridges (including footbridges).
- Large culverts.
- Large retaining walls (greater than two metres in height).

As part of the proposed alignment review some of the scoping rationale applied to the structures within greenfield locations will be reviewed and updated. This review will primarily focus on how the extent of bridges across flood plains is determined in addition to quantifying when an embankment becomes a bridge structure. With regards to the later point, it has currently been agreed in principal that the relationship of embankment versus bridge should be quantified with respect to the extent of the corridor width so as to limit land acquisition and imported material requirements. On this basis, a provisional rationale has been developed that indicates that in any location where the embankment width toe-to-toe, plus 10 metre wide clear zones on either sides exceed 60 metres, then a bridge/viaduct should be adopted. However, this rationale will be subject to further review and investigation.

Existing structures

The Bridge Management System database outputs for all existing structures along the proposed alignment will be reviewed against the requirements of Inland Rail. There will be a particular focus on the load carrying capacity and clearances of each structure, with potential upgrade works identified as required.

ARTC have a schedule of heritage listed structures located within the rail corridor. This schedule has been reviewed with particular focus on those structures that directly impact upon the track (i.e. underbridges, culverts and footbridges). A total of nine heritage listed underbridges and five overbridges have been identified as part of this review, with the structures located on the N73-Werris Creek to Mungindi and S00-Main South sections of track. In these areas a review will be undertaken to determine whether the alignment will need to be modified to ensure that these heritage assets are maintained.

A.12 Tunnels

This section summarises the outcomes of the Draft Tunnel Concept Design Summary Report and collates concept design development recommendations, developed by PB and Arup, for the tunnels required for the route section between Gowrie and Kagaru for the purposes of informing the cost estimate for Inland Rail.

It is important to note that all the requirements defined herein are based on experiential knowledge of the Arup and PB team and assumptions made in the absence of detailed data and investigations. The advice is intended for early stage estimating purposes and requires further analysis and design development to validate and confirm assumptions and requirements.

Number of tunnels

There are five proposed tunnels in the section from Gowrie to Kagaru through the Toowoomba Range, Little Liverpool Range and the Flinders Range. A brief description of each tunnel, its location and length is shown in Table A.10.

Table A.10 Tunnel details

REF #	TUNNEL NAME	LENGTH (M)	PEAK DEPTH (M)	TUNNEL TYPE
1	Toowoomba Range	6380	230	Long
2	Helidon (Six Mile Creek)	170	40	Short
3	Little Liverpool Range	1100	110	Medium
4	Woolooman (SFRC1)	1050	80	Medium
5	SFRC2	200	40	Short

Source: PB, 2015.

Toowoomba Range Tunnel (6380 metres long)

The current rail geometry includes a 1:60 sustained grade (22 kilometre) ascending east to west with the long tunnel for 6380 metres at the western end of this climbing grade, presenting significant rail operating challenges for westbound trains.

In the sequence of volcanics and sedimentary rocks that will be tunnelled through, it is necessary to understand the behaviour of some lithologies on exposure. The Main Range volcanics include multiple layers of materials such as basalt lavas and pyroclastic tuffs. The basalts can be highly vesicular with vesicles either empty or filled with secondary minerals known as amygdules, which are expansive.

The Eastern Portal can be expected to be on slopes of about 10 to 15 degrees with contours near perpendicular to the tunnel axis. Based on the log of the Geological Survey Queensland (GSQ) borehole a vertical portal face will be excavated into mudstone, siltstone and sandstone of the Heifer Creek Formation. Near vertical and sub-horizontal joints are expected to control the permeability of the rock mass of generally very poor to fair quality. The mudstone and siltstone can be expected to desiccate and fret on exposure, and slake when wetted. Bedding is expected to dip towards the southwest at less than about 15 degrees.

The Western Portal can be expected to be on side long ground sloping up to about five degrees with contours diagonal to the tunnel axis. Based on the log of the GSQ borehole the portal conditions will comprise about one or two metres of residual soil overlying extremely and highly weathered basalt to about 11 metre depth. Joints in the underlying high strength moderately weathered basalt or better will be near vertical, sub-horizontal and mainly tight. Permeability will most likely be controlled by joints but highly permeable weathered tuff beds cannot be ruled out. Consequently the rock mass quality can vary from very poor to excellent.

Helidon (Six Mile Creek) Tunnel (170 metres long)

The current rail geometry includes 1:60 sustained gradient through the tunnel climbing from east to west. The tunnel is located part way down the 22 kilometre decent from Gowrie to Helidon. There is a potential opportunity to replace this tunnel with large cutting but it is proposed to include the tunnel option in the current scope for the purpose of the business case cost estimate.

Given the short length of tunnel and the expected moderate strength of the formations, excavation by excavator with picks and rubber tyred trucks for spoil removal would be feasible. Alternatively, roadheaders would be suitable but would require significant power reticulation. Spoil should be able to be run to embankment fills. Shotcrete is proposed as concrete lining over permanent rockbolts.

Based on the favourable topography (i.e. mountainous/steeply sloping), remote location and comparative absence of existing infrastructure/development in the immediate vicinity of the proposed portal locations, it is considered that an earthworks solution (i.e. approach cutting) rather than a dive structure would be an appropriate solution for the portal approaches.

The western portal shows an approximate 19 metre maximum on the centreline cut rising over approximately 200 metres through Gatton Sandstone. The cutting is mostly oblique to contours (45 degrees), the upside northern cut will be approximately 35 metres and considerably higher than the downside southern cut of approximately 10 metres.

The eastern portal shows an approximate 18 metre maximum cut rising over approximately 300 metres through Koukandowie Formation. The cutting is initially parallel to contours across a slope of approximately 1:7.5.

Little Liverpool Range Tunnel (1100 metres long)

The tunnel is located at the top of two 1:100 rising grades for westbound and eastbound trains with a longer climb for the westbound trains. The tunnel is located on the eastern side of the summit (falling grade for the eastbound trains).

The tunnel could be excavated by either drill and blast methods or roadheader with the latter having the advantage of giving smoother excavation profile with minimal overbreak. However, significant temporary power supply is required for roadheader operation. Excavator with cutting wheel or picks may be feasible although production rates are slower. Spoil removal would be by off road dump trucks and may be suitable for reuse as embankment fill material.

The eastern portal is located on ground sloping at about 10 to 15 degrees with contours near perpendicular to the alignment. The western portal is located in side long ground sloping about 15 degrees towards the west. This portal is on the east side of a watercourse near parallel to the alignment and draining towards the north-–west.
Approach cuttings will be required at each portal.

Woolooman Tunnel (SFRC1) (1050 metres long)

The tunnel is located at the top of two 1:100 rising grades for westbound and eastbound trains with longer climb for the westbound trains. The tunnel is located on the western side of the summit (rising grade for the eastbound trains).

The tunnel could be excavated by either drill and blast methods or roadheader with the latter having the advantage of giving smoother excavation profile with minimal overbreak. However, significant temporary power supply is required for roadheader operation. Excavator with cutting wheel or picks may be feasible although production rates are slower. Spoil removal would be by off road dump trucks and spoil may be suitable for reuse as embankment fill material.

Based on the favourable topography (i.e. mountainous/steeply sloping), remote location and comparative absence of existing infrastructure/development in the immediate vicinity of the proposed portal locations, it is considered that an earthworks solution (i.e. approach cutting) rather than a dive structure would be an appropriate solution for the portal approaches.

The western portal shows a maximum centreline cut of about 15 metres. Contours are perpendicular to the tunnel portal with an approach slope of approximately 1:20 to 1:10. The eastern portal shows a maximum cut of about 15 metres over. Contours are perpendicular to the tunnel portal with an approach slope of approximately 1:5.

Woolooman Tunnel (SFRC2) (200 metres long)

The tunnel is located in close proximity to the above tunnel and on the falling grade of 1:100 maximum for eastbound trains.

Given the short length of tunnel and the expected moderate strength of the formations, excavation by excavator with picks and rubber tyred trucks for spoil removal would be feasible. Alternatively, roadheaders would be suitable but would require significant power reticulation. Spoil should be able to be run to embankment fills. Shotcrete is proposed as concrete lining over permanent rockbolts.

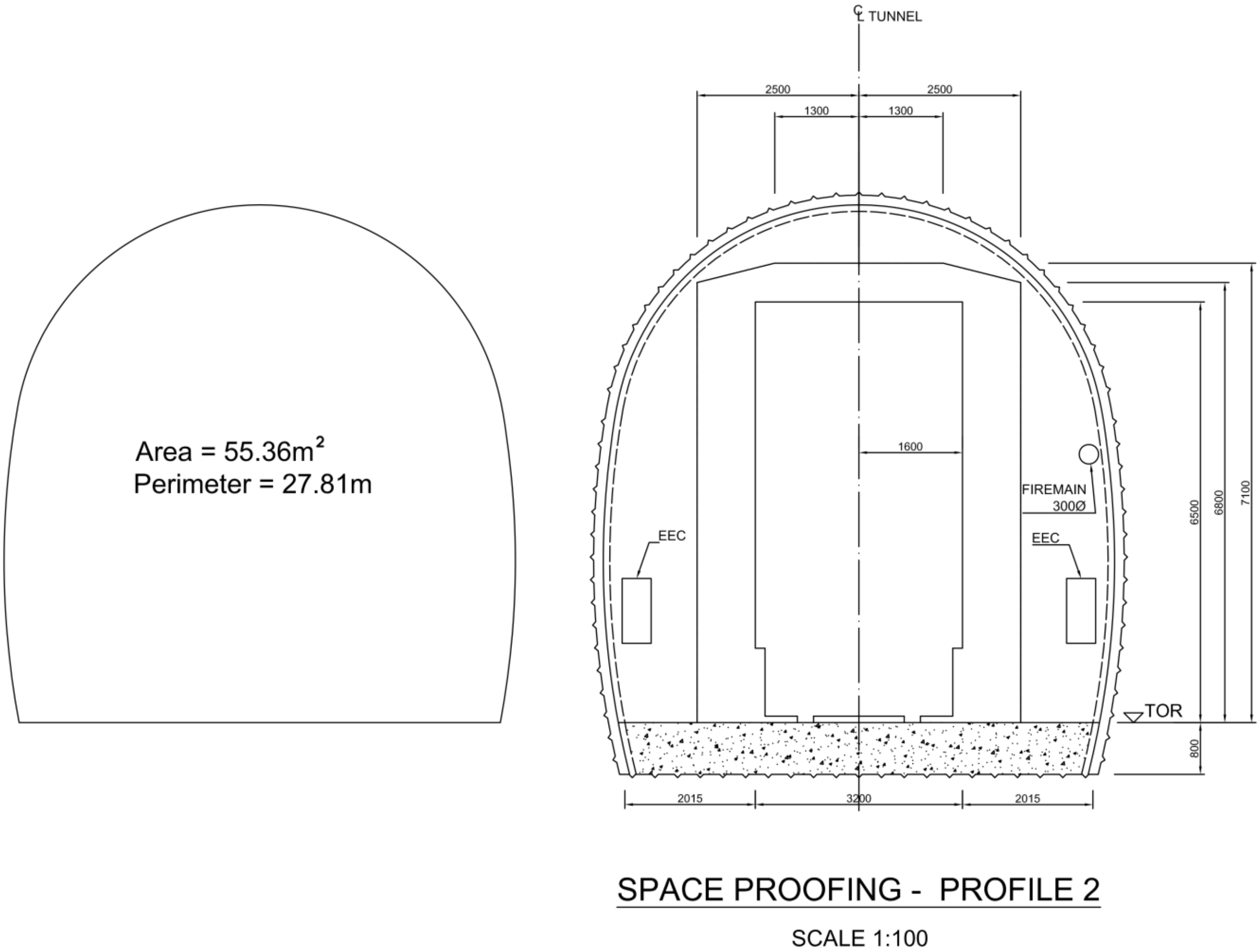
Based on the favourable topography (i.e. mountainous/steeply sloping), remote location and comparative absence of existing infrastructure/development in the immediate vicinity of the proposed portal locations, it is considered that an earthworks solution (i.e. approach cutting) rather than a dive structure would be an appropriate solution for the portal approaches.

Tunnel requirements

200 metre Short Tunnel

Tunnel technical and structural requirements along with the ventilation and fire, life, safety requirements were developed by Arup. Fire life and safety requirements include provision of a trackside walkway, while no emergency egress is required. With regard to ventilation requirements, there are no special mechanical and electrical fit out requirements or minimum cross sectional area (CSA) required. A 200 metre tunnel concept is outlined in Figure A.4.

Figure A.4 Profile two for short tunnels (as supplied by Arup)

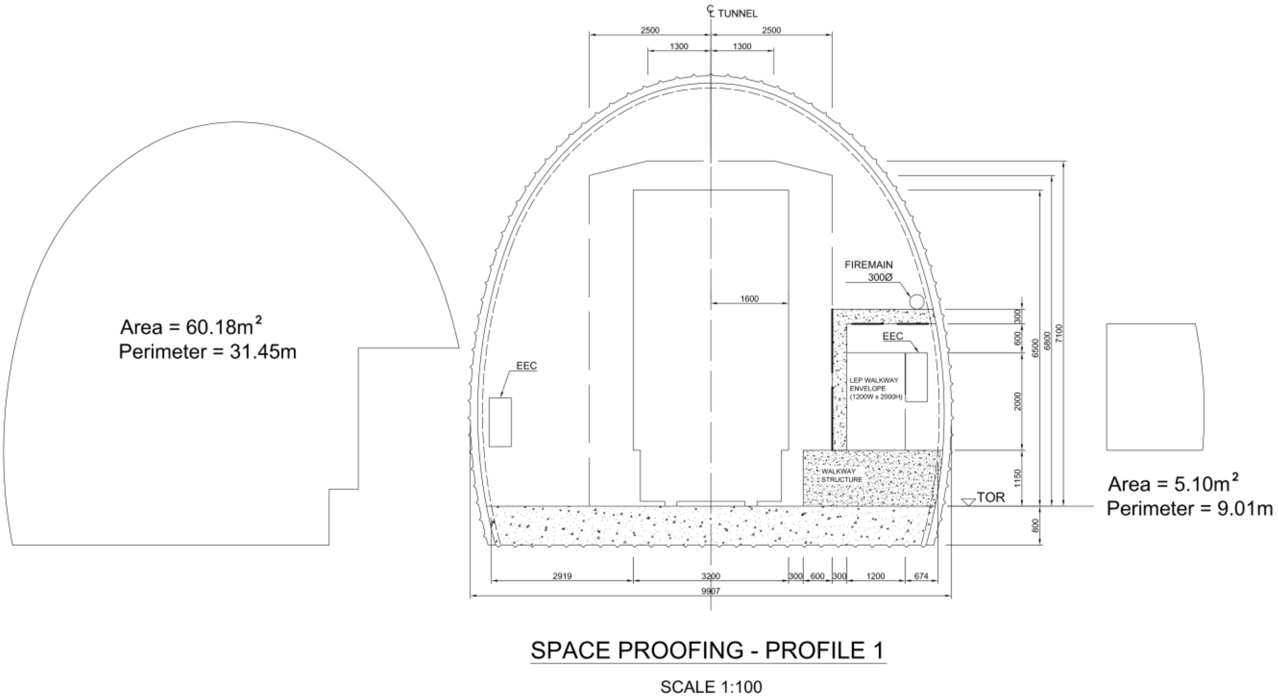


Source: PB, 2015.

1000 metre Medium Tunnel

Tunnel technical and structural requirements along with the ventilation and fire life safety requirements were developed by Arup. Fire life and safety requirements include longitudinal egress passages to be provided as per cross-sectional drawing. Tunnels have been designed so that a train passes through the tunnels without fan operation. A 1000 metre tunnel concept is outlined in Figure A.5.

Figure A.5 Profile one for medium tunnels (as supplied by Arup)



Source: PB, 2015.

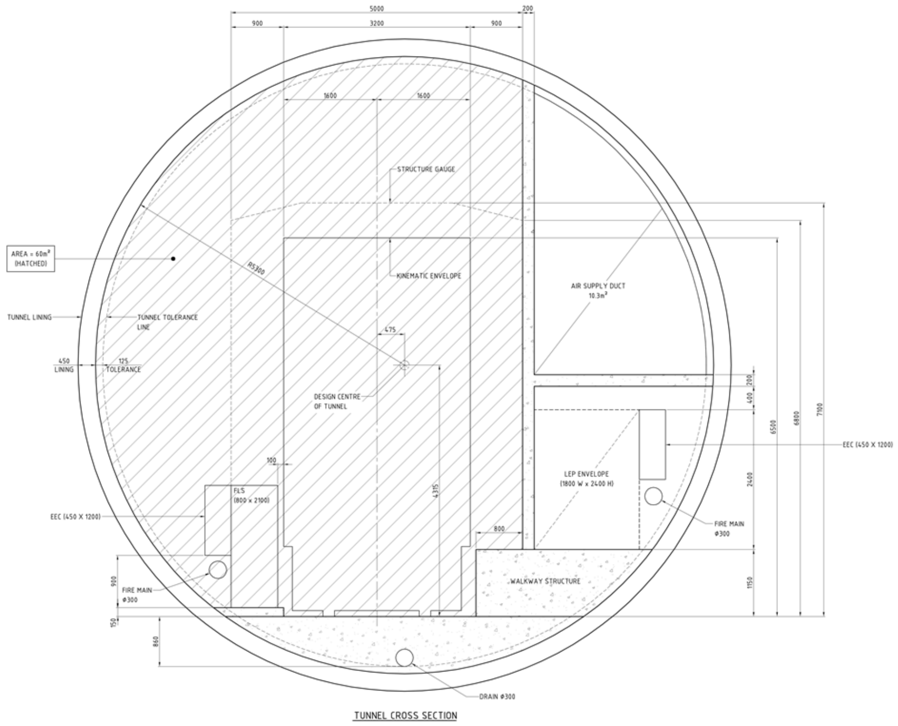
6000 metre Long Tunnel

Two options were identified for the Toowoomba long tunnel, with differing CSA and corresponding ventilation requirements in order to achieve the rail operating requirements.

The concept for Option A is outlined in Figure A.6 which proposes a 60 metre^2 CSA. This option is used as the base case for cost estimating for the Programme Business Case.

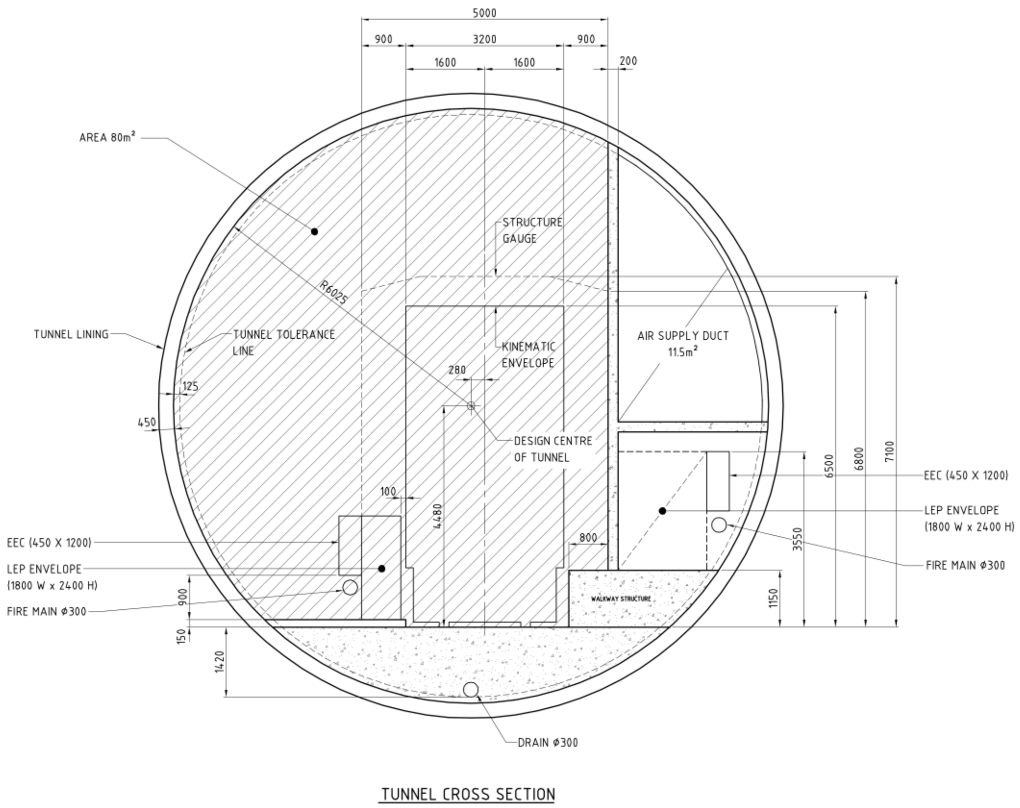
A concept for Option B with an 80 metre^2 CSA is outlined in Figure A.7, which has been considered for the purpose of quantifying the potential risk impact should Option A not adequately meet ventilation and train performance requirements.

Figure A.6 Long tunnel cross section with 60 metres squared area (Option A)



Source: PB, 2015.

Figure A.7 Long tunnel cross section with 80 metres squared area (Option B)



Source: PB, 2015.

The commodity mix of coal and other goods like grain and hazardous materials increases the fire risk in tunnels. Fire in a tunnel can compromise the safety of train crew and adversely affect the tunnel structure. The primary strategy to combat fire would be to not stop the train in the tunnel, but to proceed under normal running speed to a point outside the tunnel where fire services can more easily access the fire and extinguish it.

The key fire life safety concerns are:

- Egress and access for train crews, operations and maintenance staff and incident response personnel.
- Sufficient ventilation for operations and incident smoke control.
- Fire brigade incident response, safety and access.

To address the egress/access issues, a Longitudinal Egress Passage (LEP) is provided as follows:

- LAP 1800 mm wide by 2400 mm high with four hour fire access doors at 120 metre spacing.
- 800 mm wide walkway beside LEP in train space and 800 mm wide by 2100 mm clear space on opposite track side at top of rail level for emergency access to wheel and bogey incidents.
- LEP to be formed with 4 hour fire rated walls and roof using core filled block walls or equivalent with 200 mm concrete slab above clear space and longitudinal vent duct above of approximately five square metres section of same fire rating.
- Fire mains – assume 2 x 300 mm inside diameter mains, one inside the LEP with hydrants at 120 metre opposite the fire doors and the other in a protected location in the train space with hydrants every 60 metres.

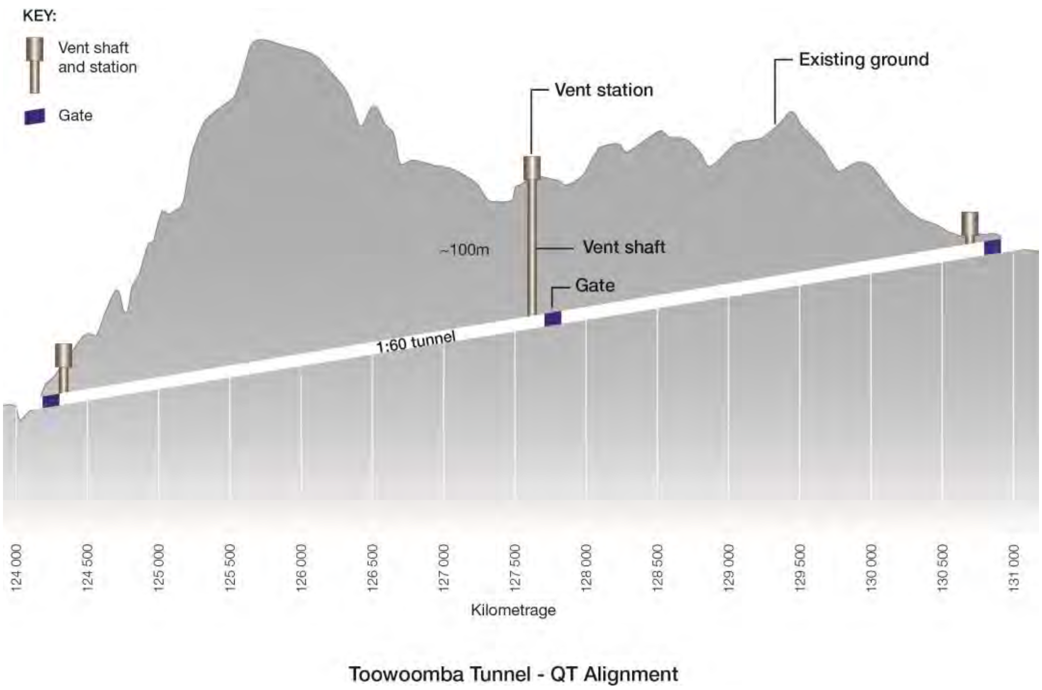
If the train became disabled in the tunnel or stops, the ventilation system will be used to control air quality or to control smoke to allow the safe escape of the train crew and expedite fire service intervention if required.

The ventilation system provided must deal with the agreed design fire for the types of freight envisaged including those with a high Fire Heat Release Rates to control the smoke in such a manner as to assist the safe escape of the train crew. Fire life safety considerations can be appropriately dealt with using a combination of fire life safety measures and operational responses. Australian Standard AS 4825 (Tunnel fire life safety) would be applicable for a freight rail tunnel.

Ventilation concepts are developed from basic consideration of oxygen consumption, exhaust production and temperature of the exhaust. Radiated heat from the locomotives also gives rise to warming of the tunnel structure. The rates of generation of the exhaust are determined by the locomotive power, train speed and train load as affecting the work done in pulling the wagons. If the exhaust fumes are not vented the trains may stall in the tunnel. Another consideration is to safely deal with smoke during a fire incident. Studies to date are very preliminary and may change as the design develops.

As advised by Arup, the Toowoomba tunnel vent station is assumed at the mid-point ventilation shaft and equipment as identified in Figure A.8.

Figure A.8 Ventilation



Source: PB, 2015.

Power for tunnels

The Basis of Design Report (Draft) outlines that assumptions have been made around the electrical requirement of tunnels. It is expected there will be a number of tunnels on the route which will be naturally ventilated. However, dependent on length and track grade, a number of tunnels will require mechanical ventilation. The ventilation of these tunnels is required for removal of heat and maintaining the air quality within the tunnel.

The mechanical ventilation electrical loads are substantial, in the order of four–five Mega-volt amperes. The electrical load is driven by fan size, which is determined by tunnel length and track gradient.

The tunnel ventilation system, due to its safety and operational importance, needs both primary and secondary power supplies with the capacity to operate ventilation system from either primary or secondary system.

To provide power supply reliability, the two connection points to the local power authority must be independent. This means a connection to different Power Authority feeders or at the least to a different power authority switchboard bus.

From the separate connection points to the ventilation fans a robust and reliable power supply needs to be maintained. All-important elements that constitute the High Voltage (HV) distribution network that provides the power to the ventilation system will need to be duplicated. The duplication includes the HV transmission line, substation, transformers and main switchboard.

Two substations will be constructed, one at each tunnel entrance. These substations will contain:

- power transformers
- main switchboards
- mechanical switchboard

- train 3G communications
- signalling
- control building and building services.

The duplicated substations and HV distribution network will provide an electrical power supply that is robust and reliable ensuring the operational and safety requirements are achieved.

A.13 Safety

This section summarises the key safety and ATMS accreditation requirements.

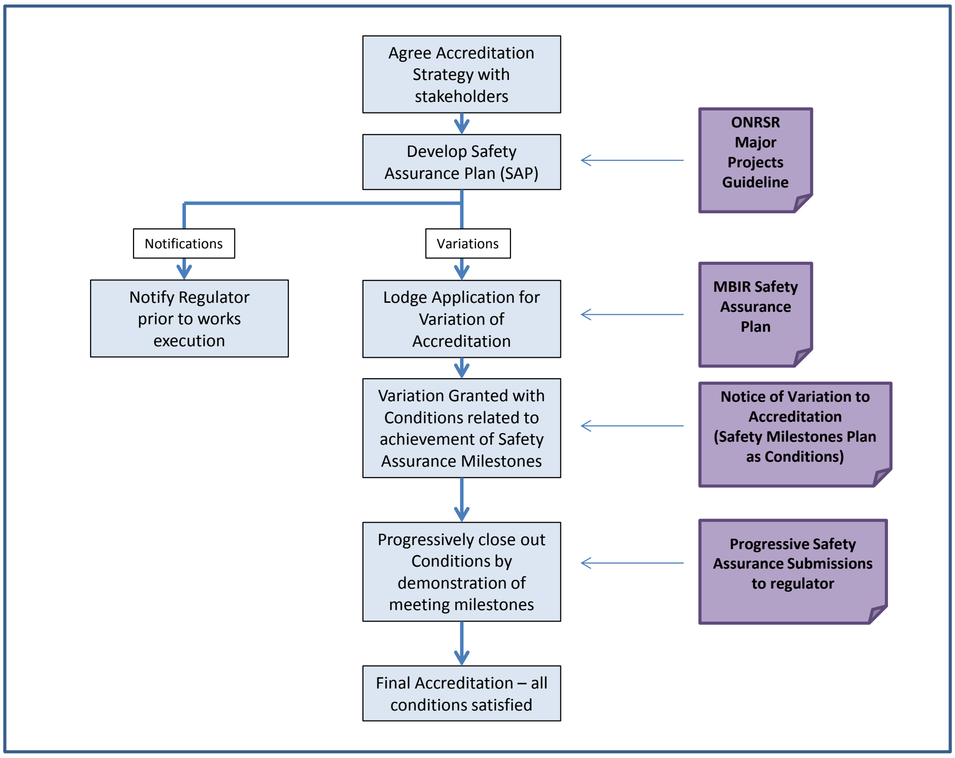
Safety assurance and accreditation strategy

Inland Rail has Rail Safety accreditation implications in three states (New South Wales, Victoria and Queensland). In order to participate in the construction or operation of Inland Rail, organisations must have the relevant accreditation, or work under the control of a suitably accredited party.

Accreditations are generally subject to a range of constraints and conditions. They are granted based on a description of physical assets and the operating regime, plus the implementation of an agreed Safety Management System (SMS). When significant changes to the infrastructure or operating/maintenance regime are proposed, a Variation to Accreditation may be required, supported by safety assurance documentation, or for less significant changes, a Notification to the regulator may be required.

The Rail Safety Accreditation Strategy is restricted to Rail Safety Accreditation and does not address Workplace Health and Safety (WHS) risks, which are dealt with via a separate mechanism, in particular ARTC's SMS and a specific WHS Management Plan to be developed for Inland Rail. The safety accreditation process is outlined in Figure A.9.

Figure A.9 Safety accreditation process



Source: PB, 2015.

The safety of railways in Australia is subject to two primary types of legislation:

- WHS acts, which apply to all industries and all workplaces.
- Rail safety legislation, which is specifically designed to mitigate safety risks associated with the ultimate operation of railways.

While rail safety is predominantly focused on the safety of the operating railway, it should be emphasised that the creation of a safe railway starts with safety assessment at the earliest planning phase i.e. in the feasibility and concept development phases, and this continues throughout the project delivery lifecycle into the operation and decommissioning phases.

Rail Safety legislation is administered by:

- The Office of the National Rail Safety Regulator (ONRSR) in New South Wales and Victoria.
- DTMR in Queensland.

The Queensland requirements are similar to the ONRSR requirements, but with some minor legislative and administrative differences.

Common to both regimes is a requirement for those involved in railway construction, operation and maintenance to be accredited as a Rail Transport Operator (RTO). RTO accreditation is in turn either one or both of:

- **Railway Infrastructure Manager (RIM):** Required for construction and maintenance of rail infrastructure.
- **Rolling Stock Operator (RSO):** Required for the movement of rollingstock.

Organisations must possess the appropriate Rail Safety accreditation before undertaking railway construction or operation. Also of significance to Rail Safety accreditation is that Inland Rail incorporates the potential deployment of a major new safeworking system, ATMS, currently under development by ARTC and Lockheed Martin.

Of particular note in relation to Inland Rail construction/upgrade:

- In Victoria, ARTC is accredited as a RIM for construction, commissioning, maintenance, modification and installation of railway tracks, signalling/communications and associated infrastructure, specific to the Inland Rail corridor.
- In New South Wales, ARTC is accredited as a RIM for construction, commissioning, maintenance, modification and installation of railway tracks, signalling/communications and associated infrastructure. The wording of the Notice of Accreditation does not clearly specify any geographic boundaries for New South Wales (unlike for other states), but by clarification with ONRSR it is understood that the accreditation is restricted to the locations where ARTC currently operates existing railways.
- In Queensland, RIM accreditation covers construction, commissioning, maintenance, modification and installation for the existing rail infrastructure as defined by geographic boundaries within the accreditation notice.
- In New South Wales, Victoria and Queensland, ARTC is also accredited as an RSO for the movement of rollingstock for the purposes of infrastructure maintenance and construction. In New South Wales and Victoria this covers the use of freight wagons, recording vehicles, road-rail vehicles and track maintenance vehicles. In Queensland the rollingstock type is ‘as authorised by ARTC’s SMS’.

- In New South Wales and Victoria, there is a specific restriction on accreditation relating to the use of ATMS i.e. ARTC does not have accreditation for ATMS. This restriction will need to be removed or modified prior to ATMS being used.
- In New South Wales there are four short sections of track between Narromine and Narrabri that are currently managed by John Holland (RIM) as part of the CRN. These are to be handed over to ARTC (or other party) as part of Inland Rail.

ATMS accreditation strategy

Inland Rail is currently scoped with ATMS as its primary safeworking system from Illabo to Acacia Ridge and safety accreditation surrounding the use of ATMS is a critical dependency for the Inland Rail accreditation strategy.

ATMS is a developing product and is currently going through the process of gaining regulatory safety approval. Its development is being managed by a separate project team within ARTC.

Under the current rollout plan, ATMS is scheduled to gain ONRSR approval for use in South Australia in January 2016. ATMS will be deployed in South Australia as an Electronic Authority System as defined in the National CoP. Once this is achieved, further work will be required in order to gain accreditation for its use in New South Wales/Queensland (noting that ATMS is not proposed for use on Inland Rail in Victoria). This work will not involve changes to the ATMS product or its associated Safety Cases, but work to introduce the safeworking rules necessary to support ATMS into the New South Wales/Queensland jurisdictions which do not operate under the National CoP.

Safety assurance

Implementation of the proposed accreditation strategy is to be supported by a safety assurance program consistent with the requirements of ONRSR’s recently issued Major Projects Guideline. The various accreditation submissions will be supported by a series of progressive safety assurance documents, providing demonstration that safety risks are reduced at key project milestones for each work package.

A detailed Safety Assurance Plan is to be developed for Inland Rail. This accreditation strategy is not intended to provide detail in this respect, but it is useful to describe the high level principles and the overall approach to safety assurance since this is a critical success factor in gaining accreditation

Non-ARTC delivery

In the event that an alternative party is given (full or partial) responsibility for delivering or operating the railway, the accreditation strategy will need to be reconsidered. In the main, the general principles presented in this document would apply, but specific details would need to be defined based on the accreditation status of the particular parties involved.

A.14 Next steps

The range of technical assessments undertaken to date have informed development of the Inland Rail scope and technical specifications. The reports referred to in this appendix form the basis to move forward through the design development stage.

A.15 Summary

Inland Rail is a long term piece of infrastructure with technical specifications aligned to the appropriate design life of its key elements. These include:

- **Primary rail assets–100 years:** Examples include civil and structural elements, foundations, retaining structures, culverts, tunnel portals, tunnel elements and other structural load bearing elements.
- **Rail systems–50 years:** Examples include track formation and capping and concrete sleepers/bearers.
- **Rail systems–30 years:** Examples include permanent way track, ballast, turnouts, crossing diamonds, arrestor systems, noise and vibration isolation components, electrical supply systems, transformer and main distribution boards.
- **Rail systems (rotable systems)–15 years:** Examples include rail telecommunications systems and rail fixings and fastening systems, turnouts and crossing diamonds.

New and upgraded track will be designed in accordance with the ARTC CoP. New structures will be designed as per ARTC Track and Civil CoP Section 9 and Australian Standard AS5100.

Infrastructure to be delivered includes:

- Five proposed tunnels in the sections between Gowrie to Kagaru through the Toowoomba Range, Little Liverpool Range and the Flinders Range. The current rail geometry for the 6380 metre Toowoomba range tunnel includes a 1:60 sustained grade (part of a 22 kilometre ascent) ascending east to west, presenting significant operating challenges for westbound trains.
- The provision of suitable communications towers, associated telecommunications equipment and ancillary services to support NTCS.
- The use of ATMS as the primary safeworking system from Illabo to Acacia Ridge.

Key features of the intermodal reference train is provided in Table A.11.

Table A.11 Key intermodal reference train details

VARIABLE	VALUE
Max train speed	115 km/h.
Average speed northbound intermodal	72.4 km/h for a 24 hr transit time.
Axle load	21 tal.
Track gauge	Standard (1435 mm).
Train length	1800 m.
Max gross train weight	5926 tonne due to horsepower and hp/t ratio.
Planned gross train weight	4542 tonne northbound, 2400 tonne southbound.

Source: PB, 2015.

Appendix B

Operational analysis

APPENDIX B OPERATIONAL ANALYSIS

B.1 Purpose of this appendix

Operational analysis and modelling has been undertaken to inform the Programme Business Case and to confirm that the service offering is deliverable. ARTC's operational expertise has informed the infrastructure requirements and cost estimates.

B.2 Approach

Concept of Operations and Concept of Maintenance reports have been prepared to investigate and analyse the operational and maintenance requirements of Inland Rail. These include:

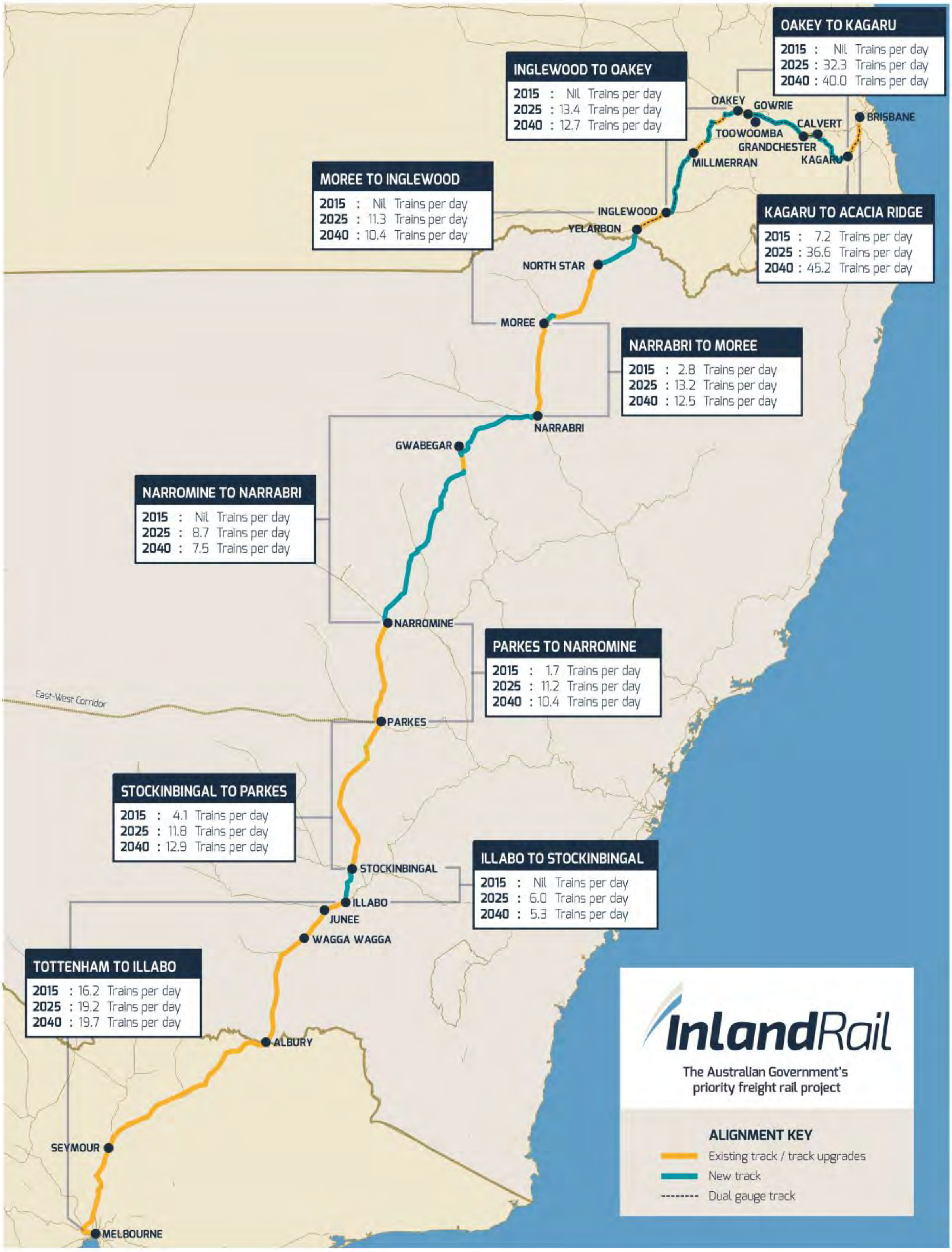
- **Concept of Operations:** This report provides a baseline for understanding and defining the conceptual operations of the Inland Rail Programme and presents the current operating specification for the existing Inland Rail.
- **Concept of Maintenance:** This report considers the various risks, issues and possible mitigations, and proposes a recommended position to define the optimum maintenance strategy to meet infrastructure availability and reliability targets.

For the purpose of this analysis, it is assumed that ARTC operates and maintains the Inland Rail network as part of the Interstate Network managed by ARTC. Whilst commissioning of Inland Rail is not anticipated until 2022 to 2024, ARTC existing practices and regulatory framework are assumed to prevail.

B.3 Defining the operational requirements

The demand for the Inland Rail Programme, defined within Chapter 7 (Demand), has informed the above and below rail operational requirements for Inland Rail. Expected daily movements throughout the corridor for years 2015, 2025 and 2040 are shown in Figure B.1.

Figure B.1 Expected train movements per day – 2015, 2025 and 2040



Source: ARTC, 2015

B.4 Key performance indicators

KPIs for rail operations on Inland Rail are anticipated to be aligned with relevant ARTC policies and Part 8 of the ARTC Australian Competition and Consumer Commission (ACCC) Interstate Access Undertaking dated July 2008 (the Undertaking). Operational KPIs aligning with the demand profile have been created and have informed the operational specification requirements for Inland Rail, including:

- Improved reliability (98 per cent).
- Transit time (24 hour linehaul).
- Lower prices.
- Freight available when the market wants (within agreed available times).

The Undertaking covers the terms and conditions of access for parties seeking to run trains on the mainline standard gauge rail track owned or leased by ARTC. The document does not set specific availability and reliability targets. ARTC's specific obligation under the Undertaking is:

'*ARTC undertakes during the Term to maintain the Network (but only insofar as the Network is relevant to the Operator's Scheduled Train Paths) in a condition which is fit for use by the Operator to provide rail transport services having regard to the terms of the Access Agreements*'.

The Undertaking further obliges ARTC to report performance indicators (as set out in Appendix G of the Undertaking). KPIs for infrastructure availability, utilisation and reliability will need to be developed in line with this document. KPIs will also be developed for the categories of safety, customers, environment and risk management.

Safety

Safe operation of all rail activities on Inland Rail is anticipated to be in line with the ARTC Safety Policy dated October 2013 which sets out to ensure that no one is harmed when working on the ARTC network. New missing links will also require safety accreditation.

Customers

Existing and potential customers of the ARTC network, including Inland Rail, are required (under this current access regime) to be fair and provide equitable access in line with the Undertaking.

Inland Rail has a number of potential products being transported which can be categorised as intermodal and bulk. Each customer will have a different target measure including:

- Intermodal services – 98 per cent reliability of freight delivery as per the agreed freight availability times.
- Coal services – 90 per cent of daily train planned throughput.

The keys to obtaining these targets will be overall network reliability and healthy trains.

Environmental

Environmental compliance of Inland Rail's enhancements is anticipated to be generally in line with the ARTC Environmental Policy dated March 2011, which provides a framework for continual improvement of an Environmental Management System and sets out the commitments of ARTC for managing potential environmental risks. Inland Rail missing links will be provided in accordance with planning and environmental conditions included in relevant statutory and regulatory approvals.

Risk management

It is anticipated that ARTC will maintain a risk register for all operations which will be measured against the existing ARTC Risk Management Policy and Risk Procedure RM 01 dated 16 July 2013.

B.5 General operating specifications

To achieve these KPIs, Inland Rail will need to perform in accordance with the specifications outlined within Table B.1.

Table B.1 General operating specifications

ATTRIBUTE	SPECIFICATION
Service Offering timeframe	• Initial 15 years + an additional 15 years. • Design year 2040.
Days of operation per year	• 360.
Transit time (northbound intermodal) Melbourne to Brisbane	• <24hrs. • Minimum 4 paths (1800 m long train).
Transit time (southbound intermodal) Brisbane to Melbourne	• <24hrs. • Minimum 4 paths (1800 m long train).
Customer target Intermodal Reference Trains	• 98% reliability of freight delivery as per the agreed freight availability times.
Customer target Coal Reference Trains	• 90% of daily train plan throughput as per agreed freight availability times.
Customer target	• 90% of health services arriving within 15 minutes of schedule. • Grain, general freight, livestock, cotton.
Environment monitoring	• Wind detectors in high potential areas. • Stream flow detectors in high potential areas. • Noise monitoring to occur in high potential areas. • Dust monitoring to occur in high potential areas.

Source: PB, 2015.

B.6 Above rail

ARTC will ensure that existing and potential customers of Inland Rail are provided with fair and equitable access in line with the Undertaking. The assumed above rail operating specifications are provided in Table B.2.

Table B.2 Above rail operating specifications

ATTRIBUTE	SPECIFICATION
Minimum train speed performance on grades for operational modelling	• 20 km/h
Maximum train length	• 1800 m (initially)
Train priority for planning	• Passenger services where existing passenger obligations apply • Northbound Intermodal services • Southbound Intermodal services • Coal services (timetabled operation) • Other timetable services • Ad hoc train services
Non timetabled services	• Heritage trains • Steam trains • Special event trains • Infrastructure work trains • Will be managed on an ad hoc requirement basis and no additional allowance in the cost estimate
Melbourne terminal	• A new interstate intermodal freight terminal with double stacking capability.
Brisbane terminal	• Acacia Ridge Freight Intermodal Terminal.
Intermodal Reference Train	• 21 tal. • 1800 m train length. • 4456 tonne gross trailing weight. • 2.7 hp/tonne.
Queensland Coal Reference Train	• 15.75 tal. • 1010 m train length. • 5859 tonne gross trailing weight. • 1.7 hp/tonne.
En-route exclusions	• No mainline loading to occur including passing loops for planned operations.
Above rail on track equipment	• Hot wheel and hot bearing detectors. • Wheel impact load detectors. • Dragging equipment detectors. • Out of gauge load detectors. • In-line weighbridges.
Rollingstock clearance envelope	• ARTC Rollingplate ‘F’ for clearances as per ARTC standards.

ATTRIBUTE	SPECIFICATION
Rollingstock refuge sidings	• No specific rollingstock refuges provided. • In the event of a rollingstock failure, loops or maintenance sidings will be utilised.
Disaster recovery	• ARTC disaster management protocols to remain as per current standard. Possible options are but not limited to: - New local diversion. - Divert over current class 1 and class 2 lines. - Divert to current North Coast line. - Unload at alternate location and road bridge.
Braking curve	• GW40 for intermodal reference train.
Toowoomba Range tunnel train restrictions	• No Class 1–explosives. • No passenger services or livestock services.
Peaking / seasonal capacity	• ARTC's modelling has allowed for capacity to deliver the capability to supply peaking and seasonal capacity.
Dangerous goods	• To be assessed via a risked based approach: - Class 1 – explosives. - Class 2 – gases. - Class 3 – flammable liquids. - Class 4 – flammable solids. • Class 5 – oxidising substances. • Class 6 – toxic substances. • Class 7 – radioactive material. • Class 8 – Corrosives. • Class 9 – Miscellaneous dangerous goods.
Passenger services	• All current NSW and VIC passenger services will be catered for within the overall network (including coastal route). • Additional passenger services could be negotiated as per access protocols, where appropriate to paths or infrastructure allows. • No provision has been made for new QLD passenger services.
Livestock Services	• No provision has been made for QLD livestock services.

Source: ARTC, 2015.

B.7 Below rail

Capacity management

Capacity of the network is anticipated to be managed in line with current network principles which are broken into two segments, development of the train plan as detailed in capacity planning and then delivery of the train plan by ARTC's Network Control. Network controllers, under the guidance of the relevant train transit manager, will prioritise train operations in line with the network principles and customer requirements.

Capacity planning

Corridor capacity will be managed in line with the current Customer Commitment Chart, which is published on the ARTC website and displays a graphical representation of committed capacity (train paths).[167] The Customer Commitment Chart represents all committed capacity on the existing network as well as capacity that is committed but not contracted to rail operators.

Existing systems and processes are anticipated to be utilised to develop the train plan for Inland Rail in line with the current access undertaking. When agreed between all stakeholders, committed capacity will be published on the ARTC website.

Design capacity (future proofing)

Inland Rail is being designed to meet operational demand for 15 years after completion (i.e. 2040) without the need for further major capital investment in this period. It is assumed that in year 15 all loops will be extended to 3600 metres to accommodate demand going forward. In practical terms, however, should demand exceed current projections, works identified for future proofing may need to be brought forward.

Train prioritisation

Train prioritisation is anticipated to be aligned with the ARTC Network Principles matrix which outlines the priority of each train type and the key objective of ensuring trains that enter the network on time (healthy), exit the network on time, and trains that enter the network late (unhealthy) do not lose any more time with every endeavour made to recover the trains to their correct path.

Any train that is healthy will remain healthy and not be affected by an unhealthy service. A target of 98% reliability is to be provided to enable safe operation of trains on the network, particularly effective tunnel operations.

Environmental condition monitoring

There are number of environmental conditions that pose a significant risk to the reliability of the network.
The first is the risk of flooding and then subsequent cancellation of train paths as a result of the flooding.
In order to reduce this risk, water flow detectors will be located in high risk areas.

The second is the risk of high wind causing a derailment by lifting the train off the tracks. In order to reduce this risk, wind detectors will be located in high risk areas.

Finally a weather forecasting approach is proposed to be in place to predict weather conditions ranging from flooding, wind, fire, and snow.

PUBLIC LEVEL CROSSING

At locations where the railway—be it existing or proposed—crosses a public road forming a level crossing, the protection requirements will be determined in line with ARTC standards and AS1742.7, Manual for Uniform Traffic Control Devices Part 7. Utilisation of these standards will allow the establishment of critical sighting distances at each level crossing, and combined with the road traffic patterns, determine the level of protection at the level crossing.

All assessments will also be subjected to the risk and mitigation process using ‘So Far as Reasonably Practicable’ principles.

Safety Interface Agreements are required to be developed for all level crossings along the route.

[167] ARTC, http://www.artc.com.au/Content.aspx?p=187, 2015.

PRIVATE LEVEL CROSSING

Construction and or introduction of altered train operations in the railway may affect access to private properties, such as farm access tracks, and there will be requirement to liaise with affected property owners in the process for crossing the railway at these locations.

Key considerations include farm machinery, livestock and private vehicles and how access will be controlled with the ARTC Network Controller, and how the railway right of way will be protected during periods that access is not required (e.g. locked gates).

Maintenance strategies

As Inland Rail is designed for the primary purpose of intermodal freight and coal trains, the maintenance strategies must be able to support the operational requirements of these customers.

Intermodal freight is a 24/7/360 day operation, servicing the domestic and export consumer market. In order to support this market the planned maintenance strategy is to have planned track possessions based around the train schedule.

The strategy of having long maintenance windows which cause significant train delays or cancellations will not support the reliability of service expected by the customer.

B.8 Network control

Control centres

The control of the network needs to be clearly defined to allow for a safe working system. As the existing interstate network is already controlled by ARTC, it is assumed that Inland Rail will be used as an extension of the existing ARTC network.

Network control interfaces

Network control centre interfaces will be located at various locations along the corridor and are anticipated to be managed according to the ARTC network principles and procedures for each location.

Network rules and procedures

ARTC is progressively moving to a common rule book structure across its entire network using the Rail Industry Safety and Standard Board (RISSB) suite of rules with sections drawn down to suit the network. Similar to this, ATMS is also being developed to meet the requirements of the RISSB suite of rules. The current rules will remain in place with the relevant rules updated to reflect the new sections of track.

Access to network

Access to the network will be in line with the Undertaking which will be extended to include access to the Inland Rail corridor. Under Clause 2.7(b) of the Undertaking, ARTC is committed to make available, on the ARTC website, information which will assist Access Seekers with development of an Access Application, and will assist during the negotiation of an Access Agreement.

Access charges, based on a ‘flag fall fee’ plus ‘gross tonne per kilometre’ charge are assumed to apply and will be based on the axle load and required priority (train speed) of each train. In line with the Undertaking, the access fees will be published by ARTC.

In-track train monitoring equipment

The implementation of in-track train monitoring equipment is the responsibility of either the rail operator or network provider depending on the monitoring task required. For the network operator the main requirement is to detect dragging equipment and hot axle boxes. The reason for this is when this type of failure occurs it has potential to cause significant track damage. As a minimum, the Inland Rail network will include the in track monitoring equipment for detecting dragging equipment and hot axle boxes. For ongoing monitoring, it is recommended that the equipment be located every 450 kilometres which is effectively placing them at three locations along the corridor.

It is also recommended that ARTC and or rail operators also consider the implementation of:

- in-line weighbridge
- out of gauge detectors
- wheel measurement detectors.

The obligation on the rail operator is to ensure that only a compliant train fit for operation enters the ARTC or QR network. Based on this obligation the expectation is ARTC will have one additional location.

The suggested location is just south of Parkes. The reason for south is the general freight flow will be loaded in the northbound direction and if any issues are identified these can be attended to at Parkes.

B.9 Below rail operating specifications

The below rail operating specifications are provided in Table B.3.

Table B.3 Below rail operating specifications

ATTRIBUTE	SPECIFICATION
Periodic planned track infrastructure maintenance operations	• Track access for maintenance will be required as part of the concept of maintenance. The periodic planned track maintenance windows will be under six hours whilst operations remain.
Unplanned emergency track maintenance	• Track possessions will occur when the need arises to address any critical track infrastructure failures. This will be managed on the day of operation.
Total track distance	• Approximately 1700 km – Tottenham to Acacia Ridge.
Track gauge	• Tottenham to Tullamarine - Dual standard and broad gauge. - 1435 mm and 1600 mm (1600 mm at specific locations only). • Tullamarine to Yelarbon - Standard gauge. - 1435 mm. • Yelarbon to Acacia Ridge - Dual standard and narrow gauge. - 1435 mm and 1067 mm.
General alignment track standards	• Design speed – 115 km/h. • Grade - 1:100 target, 1:80 maximum (compensated). • Grade – 1:200 maximum at arrival or departure at loops. • Curve radius – 1500 m target, 800 m minimum (mountainous terrain). • Cant/cant deficiency – set for Intermodal Reference Train.

ATTRIBUTE	SPECIFICATION
Medium speed alignment track standards (mountainous terrain)	• Design speed – 80 km/h minimum. • Grade – 1:100 target, 1:50 maximum (compensated). • Grade – 1:200 maximum at arrival or departure at loops. • Curve radius – 800 m target, 400 m minimum. • Cant/cant deficiency – set for Coal Reference Train.
Variation to maximum train speed and general alignment track standards	• 160 km/h XPT Melbourne to Illabo and Kagaru to Acacia Ridge. • 145 km/h Xplorer Narrabri to Moree.
Defined mountainous terrain locations	• Laidley to Grandchester. • Calvert/Rosewood to Woolooman (North). • Toowoomba Tunnel (East) to Helidon Spa. • Toowoomba Tunnel (West) to Toowoomba Tunnel (East). • Woolooman (North) to Woolooman (East).
Turnouts	• Track speed on the straight and 80 km/h maximum on entry/exit onto a diverging track.
Minimum structure gauge for double stacking requirements	• As per ARTC Plate F for double stacking (7.1 m above rail).
Train operations safe-working system	• ATMS – Illabo to Acacia Ridge.
Safe-working system contingency	• In the event that ATMS fails, the safe working system will be a form based system. This will result in degraded operations causing delays and potential loss of capacity.
Track configuration	• Duplicated track to be able to operate in a bi-directional configuration. • Single track with passing loops to operate in a bi-directional configuration.
Track infrastructure maintenance provisioning centres	• Track maintenance provisioning centres are included as part of the concept of maintenance. • To provide a central location for track maintenance work groups and for the holding of track infrastructure inventory such as ballast, sleepers, and rail. • Maintenance provisioning centres located every 200 km. • Ballast, rail, sleepers will be transported to provisioning centres. • Minimum siding length required to load infrastructure work trains is 500 m including the capability for a run-around road.
General maintenance sidings	• Track maintenance provisioning centres are included as part of the concept of maintenance. • General maintenance sidings are included to allow the holding of track infrastructure maintenance machines. • 50 km maximum distance between general maintenance sidings. • To be located as a spur of a current or future passing loop. • Track speed on the straight (80 km/h exit through the loop) and entry 20 km/h minimum on entry/exit onto the crossing / passing loop. • Minimum siding length required to hold infrastructure track machines is approximately 200 m.

ATTRIBUTE	SPECIFICATION
Below rail on track equipment	• Active level crossing protection. • Points condition monitoring. • Specific ATMS will be included as part of the ATMS installation.
Saleable track capacity threshold	• Maximum of 50% of the theoretical capacity on a single line section of track.
Network control	• ARTC will be the train controller from Tottenham to Acacia Ridge.
Restricted speed locations (excluding temporary speed restrictions based on track and environmental condition)	• In practice trains may not achieve 115 km/h for operational reasons including train performance, management of braking on steep grades and occupancy of the line by other trains. For example: - At 80 km/h turnouts entry/exit for crossing loops. - Following slower moving services causing trains to not operate at track speed. - Ascending/descending significant grades e.g. Toowoomba range at curves that have been restricted to less than 115 km/h.
Temporary speed restrictions	• The maintenance metric is the percentage of kilometres under speed restrictions. • The operations metric is minutes lost due to temporary speed restrictions. • The target is less than 5% in order to deliver a reliable network.
Holding loop locations	• The likely locations of congestion/delay are: - On approach to the Acacia Ridge terminal. - On approach to the intermodal terminal in Melbourne. - On approach to Parkes travelling northbound. - On approach to Parkes traveling southbound. - On approach to the Sydney to Melbourne mainline at Illabo travelling southbound. - On approach to the western mainline at Oakey travelling northbound. • The terminal locations will be part of the terminals scope to accept trains on arrival. The other locations are for future consideration and not currently part of scope or part of the cost estimate.
Passing loops	• As required to meet the 2040 design year, plus saleable target capacity threshold and the transit time target. • No crossing loops within tunnels.
Recovery capacity capability	• The saleable target capacity threshold makes a 32% allowance to ensure sufficient capacity for reliable operations including at peak demand.
Maximum train speeds	• 160 km/h XPT, Melbourne to Illabo and Kagaru to Acacia Ridge. • 145 km/h Xplorer, Narrabri to Moree. • 115 km/h @ 21 tal, Tottenham to Kagaru. • 90 km/h @ 23 tal, Tottenham to Kagaru. • 80 km/h @ 25 tal, Tottenham to Kagaru.

Source: ARTC, 2015.

B.10 Future proofing

Inland Rail will be designed to meet operational demand for 15 years after completion (i.e. 2040) without the need for further capital investment. It is assumed that in year 15 all loops will be extended to 3600 metres to accommodate future demand.

An overview of the specifications required to future proof Inland Rail so that it can meet operational requirements past the initial 15 years of operation is provided in Table B.4.

Table B.4 Future proofing

ATTRIBUTE	SPECIFICATION
3600 m train	Loop lengths • Plan loops in locations to allow for future extension to accommodate a 3600 m train. Terminals • Provision to be made for two tracks to accommodate 3600 m train at the entry to the Melbourne and Brisbane terminals. Tunnels • Design to allow for provision of future second tunnel for all tunnels on Inland Rail if required. • Tunnel design to consider requirement for adequate ventilation to accommodate 3600 m trains and distributed power.
30 tal	• Missing Links to be constructed to 30 tal. • 30 tal future proofing may also need to be considered on a freight task basis.

Source: ARTC, 2015.

B.11 Asset management

Regulatory requirements

ONRSR has a requirement to promote the ongoing safety of rail infrastructure and rollingstock assets. The intent of the Rail Safety National Law (RSNL) is to harmonise pre-existing asset management requirements operating in each Australian state and territory. Pending enactment of RSNL in Queensland, *Queensland Transport (Rail Safety) Act 2010* continues to apply. RSNL and specific state legislation require infrastructure managers and train operators to operate under a SMS.

These are intended to ensure the ongoing safety and longevity of rail infrastructure and rollingstock, and by extension, to protect all users of Australian rail systems. The legislation specifies certain duties and obligations for officers, operators, and other relevant parties concerning the ongoing management and safety of rail infrastructure and rollingstock assets.

A strategic approach to maintenance has been developed and considers the variety of issues that will affect the maintenance and the frequency with which it is carried out. Some of the factors that inform the approach are:

- Regulatory requirements (as a minimum, these standards must always be met).
- Geographical and environmental conditions (for example, is the asset indoors or outdoors, and is it exposed to severe weather conditions?).
- Asset utilisation.
- Asset criticality.
- Business needs (reliability and availability).
- Risk of failure.

All these considerations affect the asset maintenance strategy adopted and will impact on the balance desired between the cost of maintaining the asset and the performance required from the asset.

Asset management regulatory requirements

The RSNL makes it clear that rail safety is the shared responsibility of everyone who has a role at any point of an asset's lifecycle. Each party has a duty to work with others to ensure that everything reasonably practicable is done to ensure the safety of assets throughout their lifecycle. However, the degree to which a person is accountable for rail safety is dependent on the nature of the risk their activities might pose to rail safety.

Asset management as part of the Safety Management System

Consideration of the performance, safety and integrity of infrastructure is essential if the safety of railway operations is to be maintained. Accordingly, ARTC has a documented SMS to cover their railway operations, including tasks or activities that are contracted out, in a form approved by the regulator.

As part of this process, the roles, responsibilities, and accountabilities of personnel (including contractors) charged with maintaining safety and performing each of the activities prescribed by the plan should be clearly documented. This includes nominating the competent person who has primary responsibility and accountability for asset management.

B.12 Monitoring asset performance

ARTC SMS has processes in place to manage the risk associated with safety critical assets, monitoring asset performance against these risks and its own expectations. Through these systems and processes ARTC can demonstrate that it:

- Understands the performance of safety critical assets by identifying what needs to be monitored, measured, and reported.
- Establishes and records the method and frequency of monitoring, measurement, analysis and evaluation of the performance of safety critical assets.
- Monitors trending performance against the predicted strategic life of an asset.
- Reports on performance issues based on the level of safety risk and escalates high-risk performance issues so that that they are adequately addressed.
- Communicates any results and via the communications strategies already in place for the SMS.

- Improves the conformance of safety critical assets with nominated standards by:
  - reviewing operational and maintenance controls, and assessing the risk of assets not meeting the predetermined standards.
  - identifying the root cause(s) of safety performance issues.
- Improves the SMS continuously by identifying potential risks and taking corrective action.
- Documents where opportunities have been taken to reduce or eliminate risk and how this was achieved.

Condition assessment and monitoring

Asset management is heavily reliant on relevant and valid asset condition assessments and failure data. Since asset maintenance is a 'live' framework, the ongoing collection (and subsequent analysis) of infrastructure condition data is important in enabling continuous improvement.

Missing links (greenfield)

One of the fundamental requirements defined in the Inland Rail Strategic Service Offering is for no major capital spend on infrastructure for a 15 year period following commencement of operations. In practice, this does not mean the infrastructure is maintenance-free. Routine maintenance (RCRM) and some types of major periodic maintenance (e.g. temping, rail grinding and ballast shoulder cleaning) is still required to minimise degradation of the assets, which in turn would lead to a loss of reliability and availability.

Performance and reliability data will be used from similar ARTC corridors to determine likely failure modes and hence establish maintenance principles and procedures.

A Strategic Asset Maintenance Policy will be developed for Inland Rail. Asset maintenance polices do not completely remove the risk of unforseen faults and failures in the assets, therefore a maintenance strategy will be required to manage the assets to achieve desired levels of performance or reliability risk. The provision for reactive/corrective work must still be made in the form of on-call maintenance personnel to attend faults and consequently Maintenance Provisioning Centres (maintenance depots) will be provided at approximately 200 kilometre intervals.

MAINTENANCE ACCESS

Through the greenfield route sections, a continuous maintenance access track suitable for maintenance vehicles will be provided. The maintenance access track will be discontinuous at underbridges, viaducts and tunnels with turning circles/hammerheads provided at the ends of maintenance tracks. Widening bridges to accommodate a three and a half metre access track significantly increases bridgeworks and is not considered to offer value for money. Vehicular access into the corridor should be provided as close as practicable on either abutment of underbridges.
A maintenance walkway should be provided at underbridges on one side only.

Where practicable, the access track should be a minimum of three and a half metres wide with frequent passing points. The corridor acquisition strategy defines a 40 metre wide corridor through the greenfield route sections. With the exception of deep cuttings where additional retention may be required to provide a three and a half metre wide maintenance access track, no additional land take is required for the maintenance access track.

Corridor access points should be provided at points where the rail corridor has a close interface with the adjacent public road network. Level crossings present the most appropriate corridor access points, however where this is not practicable, vehicular access points should be provided at nominal five kilometre intervals.

Enhancements (brownfield)

The maintenance strategy on the brownfields sections (i.e. enhancement projects/construction) is closely related to the extent of upgrade works undertaken either by Inland Rail or by interfacing capital works projects. Where the infrastructure is upgraded to meet the Inland Rail service offering and corresponding technical specifications (see Chapter 5), then a maintenance strategy for brownfield sections, similar to that for the greenfield route sections will be adopted.

If the existing infrastructure is retained with limited upfront capital works on the corridor, it is likely that the infrastructure will require a higher level of maintenance than that for the greenfield route sections.
The maintenance framework is equally applicable to brownfield route sections as for greenfield, with the policies and procedures reflecting increased maintenance requirements based on asset performance requirements.

Existing provisioning centres

The location and coverage of existing provisioning centres on the Inland Rail route are summarised in Table B.5.

Table B.5 Existing provisioning centres

LOCATION	COVERAGE
Seymour	Outer Melbourne to Albury.
Wagga Wagga	Albury to Junee.
Cootamundra	Junee to Illabo (and existing Main South line to Yass).
Parkes	Stockinbingal to Parkes (and East West line to Broken Hill).
Dubbo	Not on the Inland Rail alignment. Consider new provisioning centre at Narromine.
Narrabri	Existing facility is a sub-provisioning centre of Dubbo; upgrade to full provisioning centre.

Source: ARTC, 2015.

Between Gowrie and Kagaru, Inland Rail will share the existing corridor between Gatton and Grandchester utilising existing provisioning centres. There are no provisioning centres between Kagaru and Acacia Ridge.

B.13 Upgraded and new provisioning centres

The following service centre location and functional requirements are recommended.

Melbourne to Illabo/Stockinbingal to Parkes

There are existing provisioning centres at Seymour, Wagga Wagga, Cootamundra and Parkes. It is assumed that the existing provisioning centres are adequate for the current operational requirements (21 tonne axle load, 115 kilometres per hour).

Greenfield route sections

One of the key factors in determining the location and frequency of provisioning centres is the response time to attend a fault. A consideration for location of provisioning centres to faults which introduce operational restrictions or suspend services and result in ARTC being unable to meet its obligations and commitments under the service offering, Interstate Rail Access Undertaking and result in loss of revenue. The location and position of provisioning centres must balance the cost of constructing and operating the provisioning centre against the risk of loss of business continuity.

Where land acquisition permits, new provisioning centres should be provided on the alignment allowing direct access to track.

For greenfield missing link projects, where the provisioning centre is on the Inland Rail alignment, one siding at 250 metres long for storage of on-track plant will be provided (in addition to ballast train loading/storage siding).

B.14 Asset management plans and annual works program

The Asset Management Plan (AMP) is the means by which ARTC articulates the procurement, maintenance, renewal and disposal needs of its managed infrastructure over the long term.

Infrastructure condition is identified by maintenance teams and automated methods (e.g. track geometry recording car inspections and rail flaw detection inspections); however the AMP needs to consider the root cause/s of deterioration when putting forward the strategy.

Infrastructure condition that has reached an actionable stage in the short term (Priority E, 1 or 2) is recorded as a defect then scoped and actioned accordingly. Deterioration that is expected to require action in the medium term (within 6 to 12 months) is recorded in Ellipse as a priority 3 (planned maintenance) and an appropriate review date nominated, if applicable.

B.15 Summary

Key performance indicators and compliance

KPIs for all rail operations are anticipated to be aligned with relevant ARTC policies and Part 8 of the Undertaking. Operational KPIs aligning with the demand profile have been created and have informed the operational specification requirements for Inland Rail.

Safe operation of all rail activities on Inland Rail will be in line with the ARTC Safety Policy dated October 2013 which sets out to ensure that no one is harmed when working on the ARTC network. New missing links will also require safety accreditation.

Key operating specifications

Inland Rail will be designed to meet operational demand for 15 years after completion (i.e. 2040) without the need for further capital investment. Inland Rail will operate 360 days of the year with a transit time of under 24 hours (northbound and southbank intermodal).