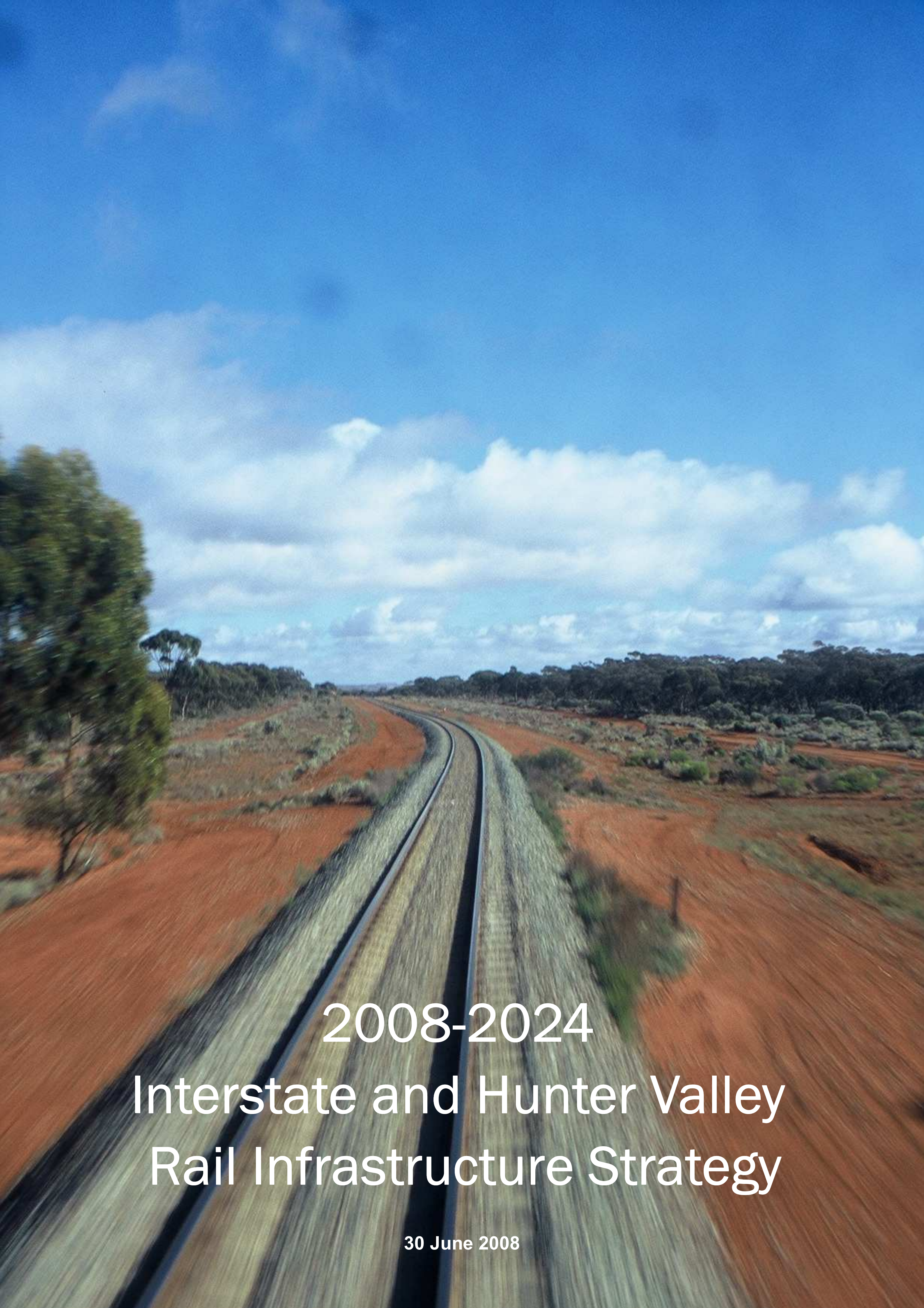


2008-2024
Interstate and Hunter Valley Rail Infrastructure Strategy

30 June 2008

1

Introduction

Purpose of this Strategy

The primary purpose of this Strategy is to assist Infrastructure Australia with its audit of nationally significant infrastructure by setting out ARTC's expectations of potential growth on the interstate and Hunter Valley rail networks over the 2008 – 2024 period, and identifying the infrastructure that may need to be developed to avoid bottlenecks to volume growth, and remove bottlenecks to efficiency.

This first section of the Strategy provides a high level overview of the industry, ARTC and current investments.

The Structure of the Australian Railway Industry

At the time of Federation, the State's rail systems had been developed as a series of stand-alone networks, radiating from the major ports to serve the hinterland and bringing rural produce and passengers to the major cities along the coast. Three separate track gauges were adopted by the States, effectively making their networks incompatible. The railways in each state were massive, vertically integrated enterprises managing all aspects of the rail system, and in many cases manufacturing many of the major capital items and undertaking most new construction.

This structure remained largely unchanged until the 1960's when there was an increase in momentum for a common gauge for the national rail network. Over the next two decades Melbourne, Perth and then Adelaide were linked to Sydney and Brisbane on the "uniform gauge" network. This network was completed in the mid 1990s with the standardisation of the Melbourne - Adelaide line.

Management of the network also increasingly recognised the ongoing shift in logistics, from a hinterland to port system, to a largely intercapital system. The Australian Government take-over of the South Australian railways and improved co-operation between the State rail networks through the 1980s gave way to the creation of a single interstate rail freight operator, National Rail, in the 1990s.

Through the 1990's, two significant forces drove the evolution of the industry structure. On the one hand was a view that the future of rail freight lay in competition between rail freight operators and that the separation of the rail infrastructure from operations ("vertical separation") was fundamental to effective competition. At the same time there was a strong belief that the introduction of private sector ownership into the industry would drive productivity and customer service. While this view was not incompatible with the argument for vertical separation, some States took the view that their rail freight businesses would be best privatised as vertically integrated concerns.

By the early 2000's, all of the Government rail freight operators had been privatised with the exception of the Queensland Government owned QR. In conjunction with this process, rail freight had also been fully separated from passenger services, again with the exception of QR.

Through the mid-2000's period, three of the rail freight businesses that had been privatised as vertically integrated concerns became vertically separated, with the track reverting to Government control in two of these cases.

As this evolution continues there is a reasonably clear pattern to the ownership and operation of the Australian rail network developing as follows:

- The interstate standard gauge network has been vertically separated and most of the network consolidated under ARTC control, as discussed in the following section. Figure 1 shows all Australian rail lines by the entity financially responsible for them.
- As a result of mergers over the last decade, the above-rail freight business is dominated by two operators, Pacific National and QR. In the intermodal market SCT also has a significant presence. There are also around six smaller, niche operators across a range of markets. All rail freight operators, with the exception of QR, are privately owned.
- All urban passenger railways remain run by State Governments as vertically integrated businesses, with the exception of Melbourne where management has been privatised on a franchise basis. With the imminent separation of the Brisbane urban passenger business from the rest of QR, all urban passenger networks will be fully separated from freight operations.
- The iron-ore railways in the Pilbara region remain vertically integrated and privately owned.

Two major structural issues remain unresolved.

First, a significant portion of the Australian rail network was designed and built to service the movement of agricultural produce to the ports, and the flow of passengers and other goods between capital cities and rural populations. Much of this trackage remains in use, even though the significance of these markets has declined enormously and in most cases rail has no realistic prospect of being able to sustain its business commercially.

No clear pattern has emerged for the management of these non-commercial "regional" lines. In NSW, ARTC man-

Figure 1 - Australian rail network by entity financially responsible.

ages the Country Regional Network on behalf of the NSW Government. Queensland's regional network remains part of the vertically integrated QR. Victoria's regional network recently reverted to Government control, with management by the V/line country / regional passenger business. South Australia's small number of regional lines are leased and managed by the private sector Genesee and Wyoming business. Western Australia's lines are leased and managed by Babcock and Brown Infrastructure, on a vertically separated basis. Tasmania's rail infrastructure recently reverted to Government ownership but remains managed by the incumbent operator, Pacific National, on the Government's behalf.

ARTC suggests a separate review of regional lines to assess the market and logistics changes which have impacted regional rail services, and to develop an appropriate strategy for regional rail infrastructure which can add value to Australia's regional transport needs.

Second, there have been repeated attempts to introduce third-party operations on the Pilbara rail lines to help reduce the capital costs of the establishment of new mining areas. At this stage none of the legal or commercial attempts to achieve third party access have been successful. ARTC considers the Pilbara rail infrastructure to be nationally significant and therefore of relevance to Infrastructure Australia. However, ARTC does not seek to comment on any aspects of this business.

ARTC Background

ARTC was established by the Australian Government in 1998 to coordinate the national rail network. It grew out of the National Competition policy reforms initiated in the early 1990's which as already noted led to a view that the interstate rail network would be best managed separately to the above rail operations.

This led to the signing in 1997 of an intergovernmental agreement by the Australian Government and the mainland States to improve the performance of the rail network across state borders.

The Intergovernmental Agreement provided for the creation of the Australian Rail Track Corporation Ltd (a public company who's shares are held by the Commonwealth of Australia) to take ownership of the interstate track of Australian National[1] and those states that wished to transfer control of their interstate networks. The agreement also envisaged ARTC more generally undertaking a role of supporting the development of an integrated national standard gauge network.

ARTC started out in 1998 with ownership of the track in South Australia including the Trans Australian Railway to Kalgoorlie, and soon thereafter took a lease of the Victorian interstate standard gauge network.

Early discussions with NSW, Queensland and Western Australia focussed on the development of agreements that would allow ARTC to sell access to their parts of the network. This was achieved in Western Australia. However, after a number of years it became apparent that a satisfactory arrangement was unachievable in NSW and an alternative approach was needed as the NSW track forms an

1. Australian National was created by the Australian Government in 1978 and combined the railways of South Australia and Tasmania with the already Commonwealth owned "Trans-Australian Railway" between Port Augusta and Kalgoorlie.

important core for many of the key interstate corridors.

One of the critical issues was the need to ensure an integrated approach to investment and operating protocols on the network. This became particularly problematic where divisions in ownership across a corridor meant that one owner could freeload on the investments of another and / or implement inconsistent operating protocols and agreements that made consistency and continuity of access not possible.

Recognising the inherent problems with the reselling approach to access, ARTC vigorously pursued a lease of the interstate and Hunter Valley networks in NSW. ARTC was ultimately successful in reaching agreement with NSW and took up the interstate and Hunter Valley network in NSW on 5 September 2004.

Having secured the NSW track, ARTC now manages and operates the vast majority of the interstate standard gauge network and is close to its goal of being a single organisation with the means to manage the interstate rail infrastructure and its operating protocols as an integrated whole.

ARTC continues to pursue the consolidation of the Queensland and Kalgoorlie – Perth sections of the interstate network. This strategy looks at the interstate business as a whole and accordingly includes analysis of the infrastructure requirements of those parts of the network not yet controlled by ARTC. The NSW/Queensland Border – Acacia Ridge section is currently owned and managed by QR. Kalgoorlie – Perth is leased from the State of WA by Babcock and Brown Infrastructure.

ARTC's Approach to its Business

ARTC has a market growth focussed approach to its business. That is, it is pursuing investment growth, based on market fundamentals, to secure the role of rail to value add to the Australian land transport task. ARTC believes that success in growing the business will then flow through to the increased revenues that will underpin the long-term sustainability of the business.

This has proved a successful strategy on the East-West corridor where rates of growth have greatly exceeded expectations, leading to very strong and sustainable revenue growth.

To achieve a volume growth led business model means that ARTC's strategies for investment in the network must be driven by market need, not by what might be engineeringly elegant. This means that its focus is very much on identifying what the market will respond to and tailoring the infrastructure investment to suit.

Applying these market focussed principles results in different strategies for different market corridors as illustrated in Figure 2.

On the East-West corridor ARTC has already achieved significant growth. With rail's share of the land transport market on the corridor siting at around 80%.

The focus for the east-west corridor is now on sustaining asset performance to maintain volume growth in alignment with economic growth. This means working to a maintenance regime that delivers appropriate levels of track performance, ride quality and speed restrictions, for the lowest life-cycle cost. It also means small targeted investments to ensure that rail capacity keeps up with underlying growth in the size of the market, including potential new minerals business.

For the North-South corridor, Melbourne – Sydney – Brisbane, ARTC is aiming to achieve a step change in performance. This corridor has been languishing for decades with significant falls in market share since the 1960's. The North-South covers three major markets: Melbourne – Brisbane, Melbourne – Sydney and Sydney - Brisbane.

The three keys to achieving this step change in performance are:

- A dramatic increase in reliability. The reliability of Melbourne – Brisbane services has been as low as 40% in recent years, which is clearly unacceptable to the market.
- Transit times that better meet logistics market needs. The market currently expects, and receives from road transport, a late afternoon pick-up for early next morning delivery, or in the case of Melbourne – Brisbane, early second morning delivery. If rail is to compete it needs to offer a service level that at least approaches this standard of freight availability.
- Reduced rail costs. At the moment rail's service levels are so poor that there is tremendous scope to grow market share purely by attending to service performance. However, once rail has achieved a solid service performance the focus will shift increasingly to the comparative door-to-door cost compared to road.

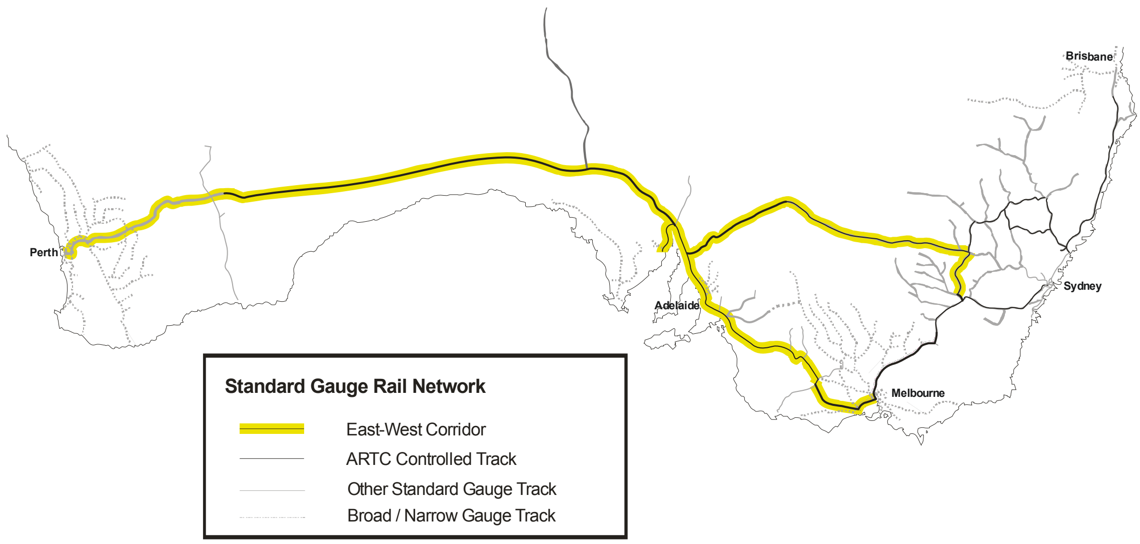


Figure 2 - ARTC market strategies.

Longer term the focus of investment on the North-South corridor needs to be maintaining an improved level of reliability and availability while continuing to drive down the door-to-door cost of the rail option.

The other key ARTC corridor is the Hunter Valley coal network. The challenge here is producer forecasts of rapidly growing demand. ARTC's strategy is to provide capacity ahead of export demand. ARTC's goal is to ensure that rail track capacity does not become a limit to the growth in export coal volumes. At the same time, ARTC will also work with customers to facilitate productivity improvements.

Scope of Current ARTC Investments

ARTC both invests its own funds, and is a recipient of Australian Government funding.

In its proposal to the NSW Government for the lease of the NSW interstate and Hunter Valley network ARTC proposed an investment program of $872 million, fully funded by ARTC on a commercial basis. This investment was primarily directed at redressing the significant maintenance deficit and improving the quality and competitiveness of the North-South corridor.

In the 2003/04, 2004/05 and 2005/06 financial years the Australian Government decided to supplement this investment by gifting a total of $820[2] million to ARTC. ARTC then fully reviewed its North-South investment strategy to optimise the scope of work given the larger pool of funds available. The resulting investment is described in the document North-South Corridor Strategic Investment Outline.

ARTC also has a rolling investment program in the Hunter Valley, delivering capacity to meet export coal demand.

ARTC's investment program for the North-South corridor now stands at $2.1 billion and is aimed at achieving the outcomes in Table 1.

	Melbourne—Sydney	Sydney—Brisbane	Melbourne—Brisbane
Transit Time	**Hours**	**Hours**	**hours**
2005	13.5	19.4	32.9
2010 (1500m)	10.5	15.1	25.6
2010(1800m)	11.6	15.1	26.7
Reliablility	**%**	**%**	**%**
2005	55	55	45
2010	75	75	75
Availability	**%**	**%**	**%**
2005	50	35	60
2010	75	60	85

Table 1 - North-South investment strategy outcomes.

The scope of work involved in ARTC's current 5-year investment program is as follows:

Melbourne – Sydney (Figure 3)

- **Concrete sleepering** of the entire ARTC track between Melbourne and Sydney. This will allow increased train speeds, reduce the incidence of temporary speed restrictions and delays due to track work, and eliminate speed restrictions imposed on high temperature days.
- **Southern Sydney Freight Line**. This will provide a freight track independent of the Sydney commuter lines between Chullora and Macarthur in Sydney's south. This will remove the current 'curfew' on freight trains operating in the metropolitan area during the morning and afternoon commuter peak periods. The line will connect with the Metropolitan Freight Network to Port Botany and separate this network from the urban passenger system.
- **Passing lanes and loop extensions Junee** – Melbourne. Four passing lanes and one loop extension are being constructed between Junee and Albury, and three passing lanes and one loop extension are being constructed between Seymour and Tottenham. Passing lanes are sections of double track nominally 6.8 km long that allow trains to pass each other without stopping. Loop extensions are being built to 1800 metres. This project will significantly increase capacity and reduce transit time.
- **Seymour – Wodonga double track**. The existing broad gauge track that parallels the standard gauge track between Seymour and Wodonga is to be converted to standard gauge, giving approximately 200 km of double track. This will virtually eliminate crossing delay on this section of the network. Around 150 track km out of the 400 track km on this section will remain timber sleepered at this stage.
- **Wodonga Bypass**. This project, being funded by Auslink and the Victorian Government, will provide a single track bypass of the Wodonga town centre, shortening the route, eliminating a heavily speed restricted curve and removing a number of level crossings.
- **Tottenham triangle**. The Tottenham triangle will provide a direct connection between the North-South and East-West corridors, eliminating the need for trains to reverse at Tottenham. This will reduce costs for through traffic and open-up options to use terminals other than the main Dynon terminal in Melbourne.
- **Tottenham – Dynon Upgrade**. This Auslink funded project will significantly enhance capacity through this complex and congested dual gauge section that is the throat to Melbourne's port area and the main rail freight terminal. The project will provide for a high-quality bi-directional double track the full distance from Dynon to Tottenham Junction.
- **Dynon – Footscray Road Upgrade**. This project, being funded jointly by ARTC, Auslink and the Victorian Government, will provide a second track through to the entrance to the port area, allow a direct connection between the North Dynon terminal and the port, and improve the configuration at the junction between the port area, the Dynon terminals and the through track to Southern Cross Station.
- Replacement of **Murrumbidgee River Bridge**, Wagga Wagga. This completed project replaced a life expired bridge with severe speed and axle load limits.
- **Automatic signaling**. This completed program has eliminated the last remaning sections of the network that used a 19th century signalling system that required signallers to manually admit trains to a section of track. The project has significantly raised capacity and reduced costs.
- **Overtaking loop on double track at Harden**. This completed loop, which was installed in conjunction with the signalling upgrade, allows fast trains to overtake slower trains, increasing capacity and reliability.

2. The $872 million investment included major works required to renew and sustain the asset. The discussion of the North-South Strategy in this paper deals only with enhancement projects.

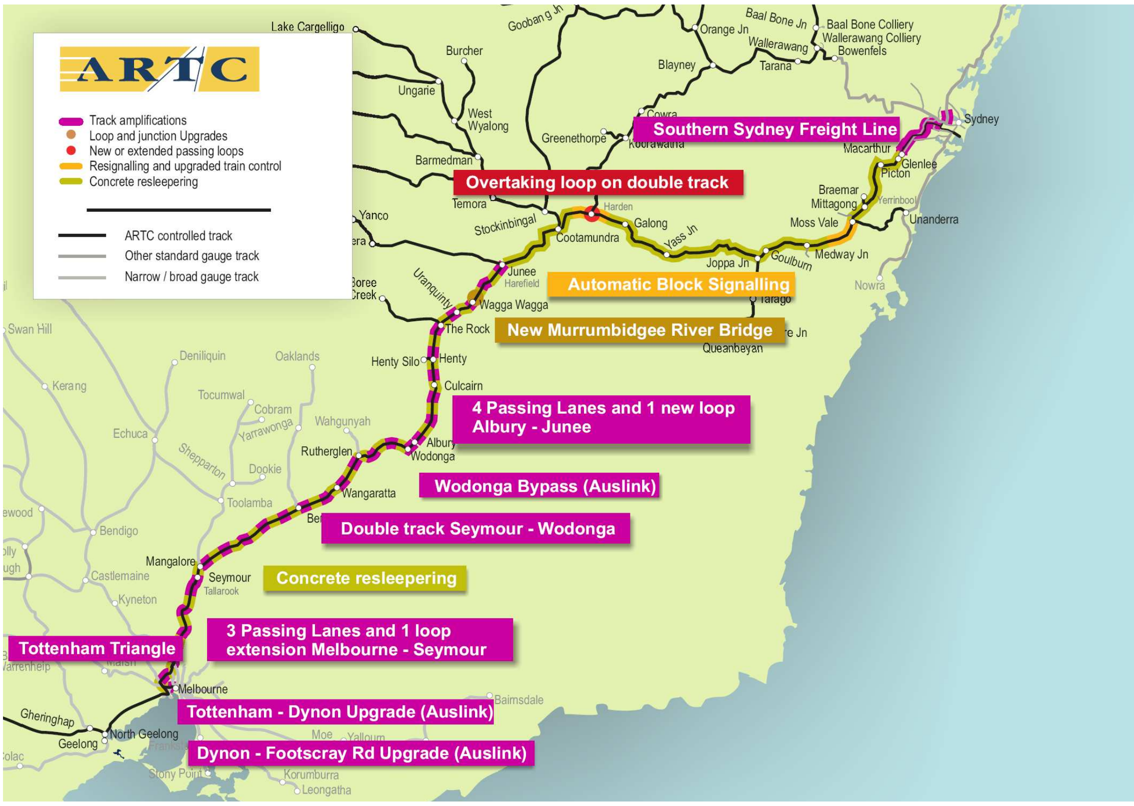


Figure 3 - Current scope of investment Melbourne - Brisbane.

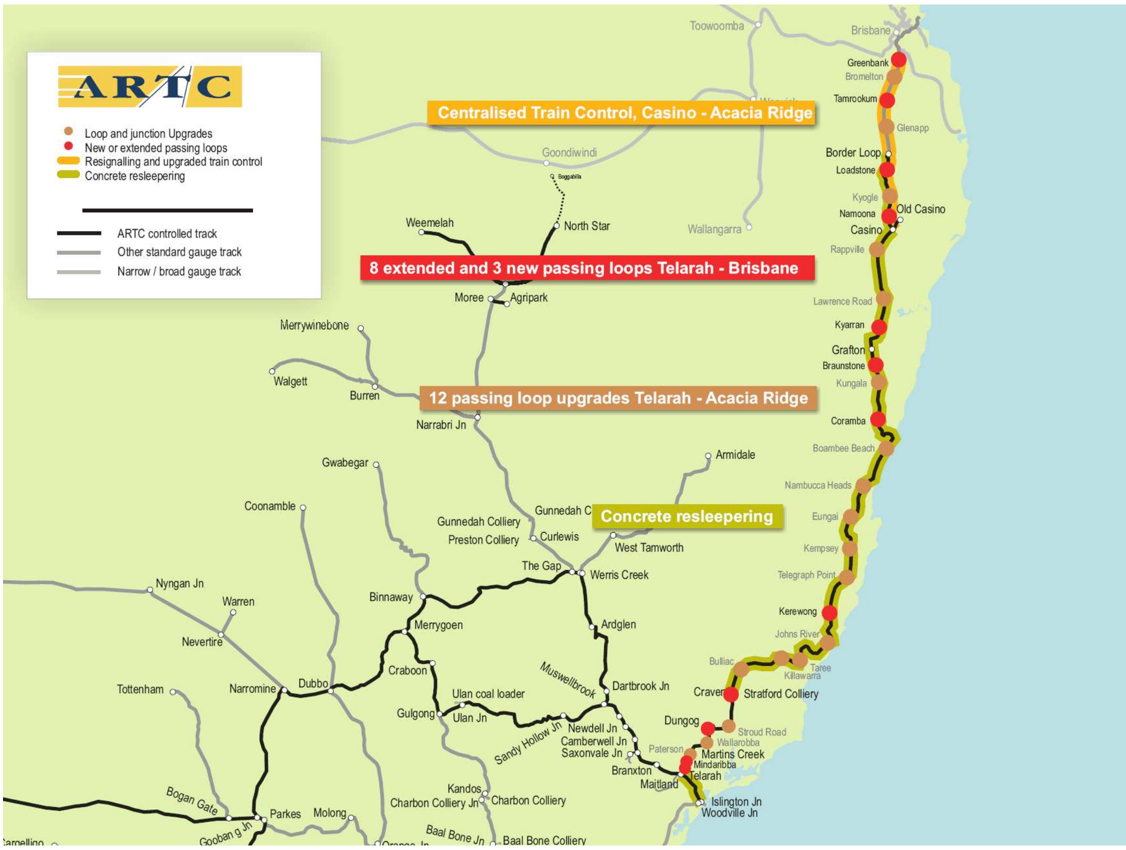


Figure 4 - Current scope of investment Sydney - Brisbane.

Sydney – Brisbane (Figure 4)

- **Concrete sleepering** between Sydney and the Queensland border.
- An approximate 50% increase in the number of long **passing loops** on the North Coast. This creates significant additional capacity, reduces transit time and increases reliability.
- Installation of **CTC signalling between Casino and Acacia Ridge**. This completed project has eliminated a 19th century signalling system (the electric staff system) that required every train to stop at the end of a section to exchange a metal token that gives it permission to be on a section of track. This has saved around forty-five minutes of transit time and reduced costs from repeated train stopping.
- **Loop upgrades** between Newcastle and Acacia Ridge. The upgrade program will eliminate a number of track configuration issues that cause unnecessary delays when trains enter and leave existing long passing loops.

Train Control Consolidation (Figure 5)

This recently completed project was an integrated series of physical projects and work process changes designed to significantly improve train control delivery.

The train control consolidation project:

- Eliminated manned signal boxes.
- Consolidated NSW train control to just two locations, Broadmeadow and Junee.
- Improved safety by having direct communication between network control and trains, and between infrastructure workers and network control.
- Eliminated double-handling of rail segment management by giving a network controller direct control of all parts of a rail segment.
- Reformed work practices in the signalling and train control area.
- Improved the efficiency and effectiveness of train management, and communications between train control and train crew.
- Increased reliability through the replacement of outdated equipment and technology.
- Reduced the ongoing cost of service provision.

Key physical projects included the replacement of manual block working with automatic block working on two sections of the Main South, closure of signal boxes controlling yards at 10 locations, and the upgrade of the two key train control centres to Network Management Centres.

East-West Upgrades (Figures 6 and 7)

ARTC is also continuing to invest in the east-west corridor to maintain its competitiveness. Significant recent and ongoing projects are:

- **6500 mm height clearance Parkes** – Crystal Brook. Increasing the height clearance for trains to 6500 mm between Parkes and Crystal Brook will allow a larger range of double-stacked container combinations to be carried. This will allow operators to carry "cubic" freight more efficiently.

Figure 5 - Train control consolidation projects.

Figure 6 - Current investments Adelaide—Kalgoorlie.

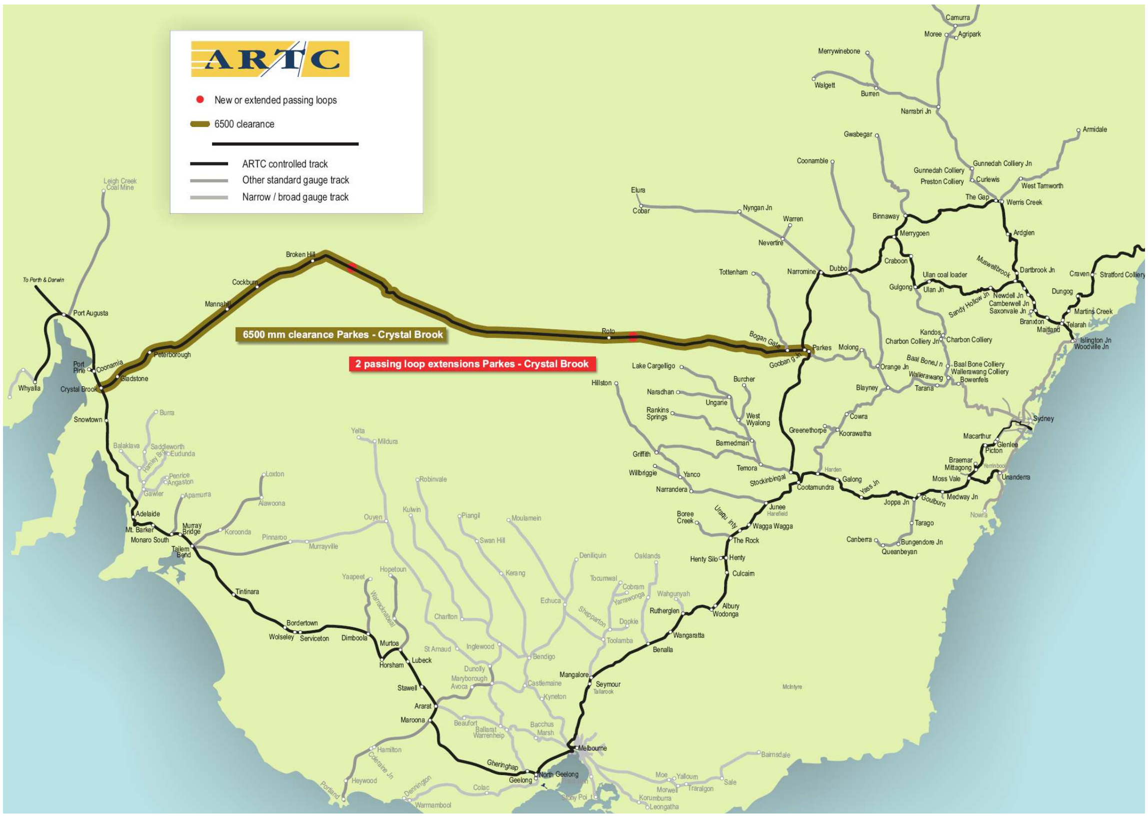


Figure 7 - Current investments Cootamundra—Crystal Brook.

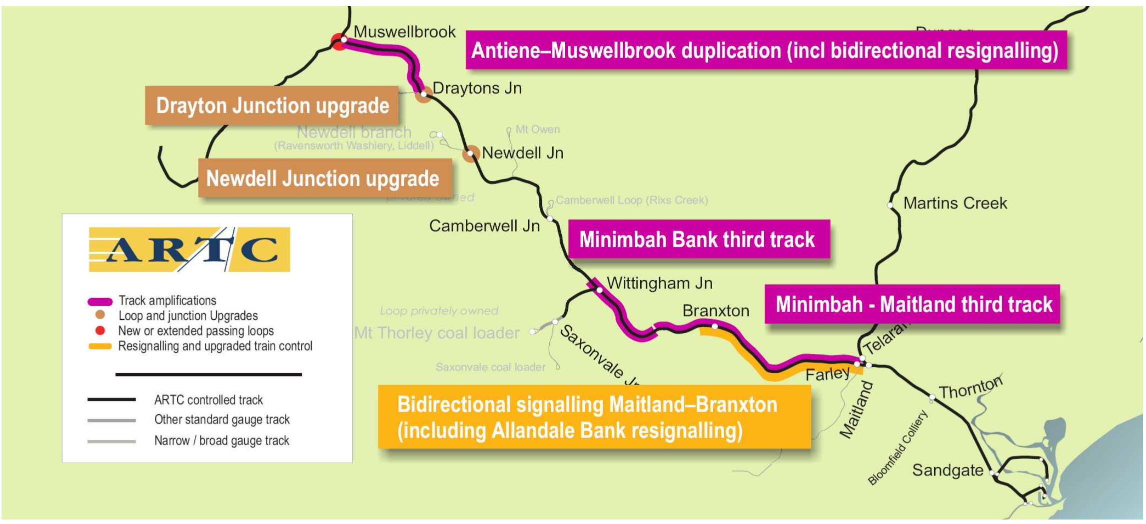


Figure 8 - Current 5-year investment strategy: Hunter Valley.

- **Passing loop extensions** for 1800 metre trains at Kinalung and Matakana have increased capacity and reduced transit times between Parkes and Crystal Brook. These extensions complement new loops also recently completed at Haig, Mungala, Winninowie, Mingary and Port Germain on the Adelaide – Perth corridor.

- ARTC's innovative **ICAPS** technology is has been rolled-out across the Port Augusta - Kalgoorlie corridor. ICAPS allows train drivers to remotely change turnouts at passing loops. This removes the need to bring the train to a stop to operate a push-button to change the points, thereby reducing transit time and fuel consumption.

Hunter Valley (Figures 8 and 9)

- **Sandgate Grade Separation** has eliminated the at-grade crossing conflict between coal trains accessing Kooragang Island, and passenger and interstate freight trains.

- **Bidirectional signalling between Maitland and Branxton** will allow trains to travel in either direction on either track to reduce the impact of track maintenance and incidents (such as locomotive failures).

- **Minimbah Bank Third Road**. This project will provide a third track at a reduced gradient of 1 in 100 along the length of the Minimbah Bank starting from the north of Whittingham Junction. This will provide a significant boost to capacity on this bottleneck section and allow trains to join the mainline from the Mt Thorley branch with minimum interference.

- **Newdell Junction and Drayton Junction upgrades** will increase the speed through the junctions for branchline trains from 25 km/h to 60 km/h.

- The **Antiene – Muswellbrook duplication** will extend the existing double track as far as Muswellbrook.

- **Ulan line Centralised Train Control** has replaced the 19th century electric staff system on this line.

- Construction of **five new passing loops on the Ulan** line will reduce running time between loop locations, increasing capacity.

- Additional and extended **passing loops between Muswellbrook and Werris Creek** will reduce running times between loops and allow a significant increase in train length.

- Two sets of projects are planned for the Werris **Creek – Narrabri line** which is currently part of the NSW Country Regional Network managed by ARTC on behalf of the NSW Government. The projects are:
    1. **CTC** to replace the electric staff system.

- 2. **Extension of up to 8 loops** to provide additional capacity.

Auslink

The Australian Government has made a further $550 million available for projects associated with rail freight across Australia under AusLink 1. Key Auslink 1 projects associated with the interstate and Hunter Valley network include:

- $20.3 million for development of the ARTC Advanced Train Management System (ATMS) to provide a new train control and safeworking system for the interstate and Hunter Valley network.

- $4.7 million for the Ernst and Young study into the North-South Rail Corridor.

- A $69.6 million contribution to the National Train Communications System.

- $110 million for works to improve freight access through northern Sydney and on the Port Botany line.

- $110 million for a new rail link from the Dynon intermodal precinct to the Port of Melbourne and the upgrade and elevation of Footscray Road.

- $80 million for the Port River Expressway and associated rail track modifications, including a new direct connection to the Adelaide port area and eliminating a section of shared freight / passenger track.

- $14 million to help construct a North Quay Rail Loop extension at the Port of Fremantle, and a new access road to the terminal.

- An $8 million contribution to the $12 million cost of extending eight rail loops to 1800 metres on the interstate line between Kewdale and Kalgoorlie.

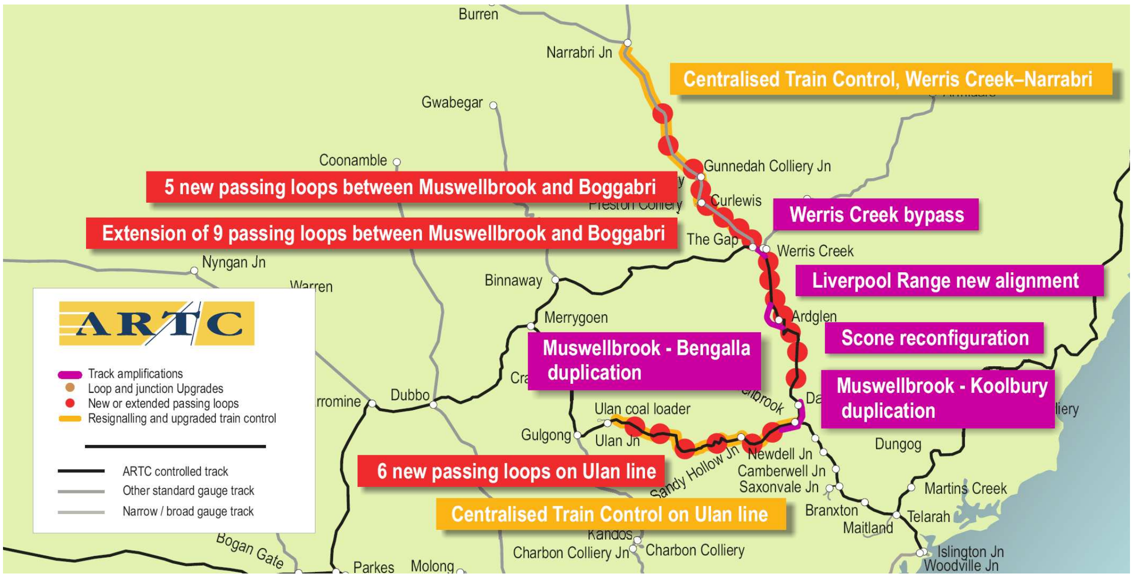


Figure 9 - Current 5-year investment strategy: Ulan and Gunnedah Basin lines.

- A $20.1 million contribution to the $33.1 million cost of replacing the final 76km of timber-sleepered track with concrete sleepers between Koolyanobbing and Kalgoorlie, leading to maximum train speeds up to 40 kph faster than at present.

- $11.5 million towards the cost of eliminating the Daddow Road level crossing at Kewdale to improve safety and traffic efficiency at the Kewdale and Forrestfield industrial areas.

ARTC has provided an indication to the Australian Government of those projects ARTC would support for Auslink 2 funding. In making its Auslink 2 submission, ARTC has adopted an approach that increases in capacity should generally be funded by the income ARTC generates in track access charges from the new traffic. Enhancement projects which increase efficiency and rail competitiveness, are generally seen as being appropriate projects to be supported by Auslink funding.

All projects in the Hunter Valley are considered to be commercially viable and hence not appropriate for Auslink funding.

ARTC would prefer to move to an environment where all investment could be commercially supported. However, this will not be achievable in the near term given that heavy vehicle road pricing and funding is not on a similar commercial basis.

This issue is discussed in more detail in Section 3 of this Strategy.

2

How this Strategy has been Developed

The underlying process for development of this investment Strategy is set out in Figure 10.

The development process essentially consists of assembling investment options that will improve rail market share and volume, analysing the implications of those potential investments in terms of the transport market, and then streaming desirable projects on the basis of either their economic or financial viability to achieve the optimum value adding to market improvement or development.

This Strategy document seeks to provide a high-level explanation of the key elements in this process. It is set-out as follows:

Section 3 discusses the investment environment. It articulates ARTC's investment objectives and some of the issues surrounding policy objectives for rail investment, as well as discussing the numerous issues that influence ARTC's ability to invest.

Section 4 provides an analysis of the intermodal market and sets out the basis for ARTC's forecasts of intercapital general freight demand and Hunter Valley coal volumes.

Section 5 discusses some of the technical issues associated with the characteristics of the railway and how changes to those characteristics through investment contribute to eliminating bottlenecks to efficiency, or capacity enhancement.

The following three sections (6 - 8) discuss the three ARTC corridors in more detail. Each of these sections provides an overview of the corridor and the traffics that use it, outlines the basis of the 15-year growth forecasts, discusses the current infrastructure, enhancement and capacity issues, and then sets out ARTC's expectation of the performance characteristics of the corridor to 2024 with the investment options proposed in this Strategy document.

For the purposes of these sections, enhancements are defined as those projects or strategies that eliminate a bottleneck to operational efficiency. Such enhancements will also have an impact on capacity, either because capacity enhancement is a by-product of the initiative, or be-

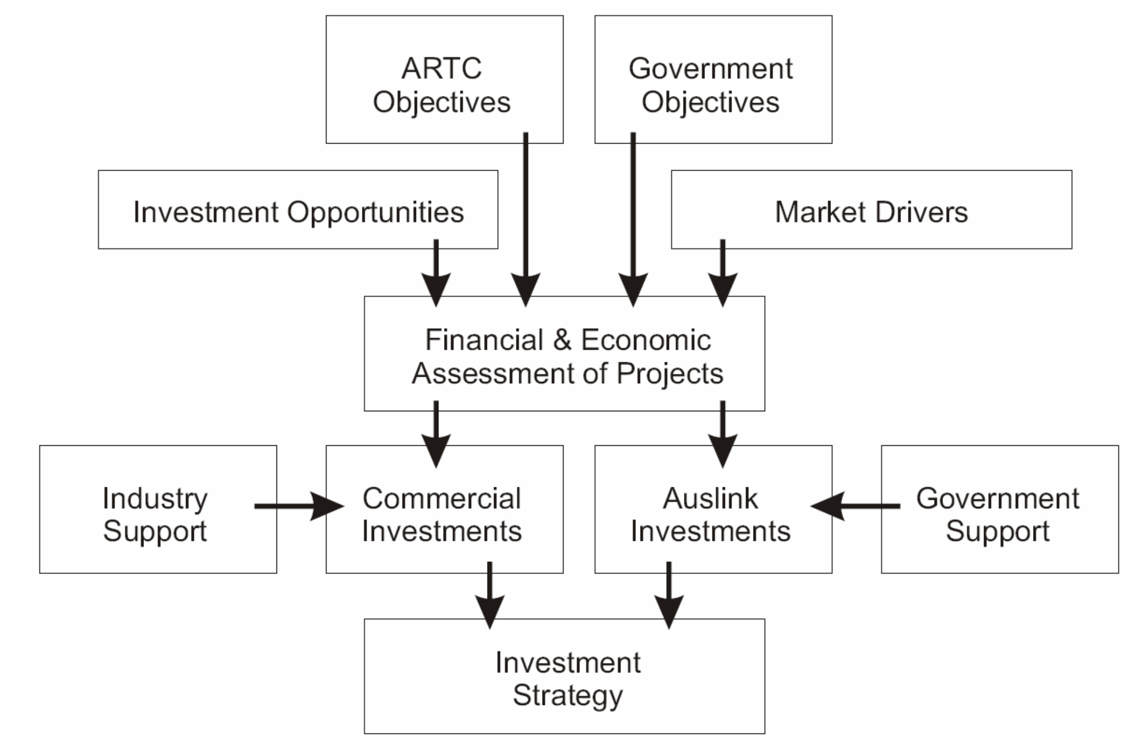


Figure 10 - Strategy Development Process.

cause the increased efficiency will generate additional demand.

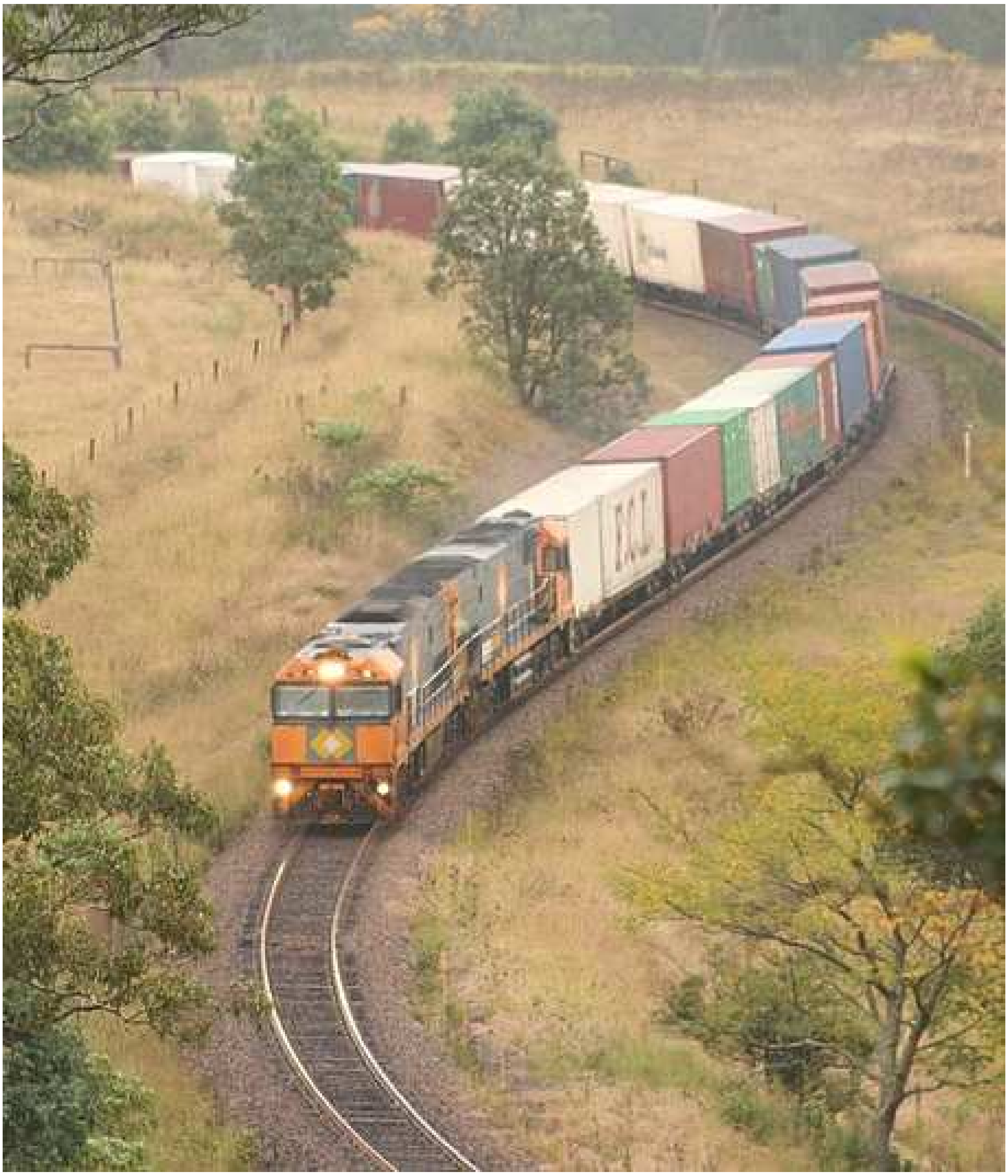
Capacity is analysed in two ways. First, capacity is assessed in terms of line sector utilisation. Where utilisation reaches 100%, investment in capacity projects becomes essential. Second, capacity is assessed in terms of its impact on transit time. In some cases capacity may not be essential in an absolute sense, but is required if operational performance is to be maintained. This assessment also has regard to the effect of enhancements on transit time.

For the purposes of determining the financial or economic justification for projects, and for forecasting capacity requirements, the analysis assumes a “high” growth scenario. This scenario assumes, among other things, an oil price of US$150 per barrel, a carbon price of $100 per tonne and a low price elasticity of demand for freight transport. This approach ensures that planning for enhancement projects proceeds to the timeframe necessary for capacity to remain ahead of demand. In the event that actual growth is less than the “high” scenario, project delivery can be slowed down.

Section 9 provides a summary of the key findings of the Strategy, including a summary of the critical projects that are envisaged as required over the 15-year period of this Strategy.

This Strategy rests on a considerable body of analysis, which would be too extensive to fully report within this document. This document therefore cross-references supporting Strategies as appropriate.

It should also be noted that ARTC is continuously reviewing and updating its Infrastructure Strategies and as such this document represents a snap-shot in time based on the best available information and analysis.



3

Investment Environment

Introduction

This section aims to provide relevant context for the discussion of specific investment initiatives.

A number of factors combine to make rail infrastructure investment complex and challenging, and particularly so at this point in time. These factors include:

- Issues with the institutional structure of the transport industry and the role of Government within the industry, and consequent difficulties for ARTC in planning for long-term investment.
- The historical long-term decline in rail's competitiveness.
- Evidence of a reversal in rail's competitiveness in the intercapital general freight sector.
- Uncertainty over future pricing of carbon emissions, and future oil prices, and how these will affect both total general freight volumes, and rail's market share.
- Uncertainty over the future direction of road-user charging, and the direction of other significant road cost inputs, and the effect that this may have on rail competitiveness.
- The direction of economic regulation of ARTC and the consequences of regulatory structures for ARTC's ability to invest.
- The continuous, linear nature of a rail network and the difficulty of compartmentalising it for the purposes of structuring financing packages for capital projects.
- Circumstances where the difficulty of appropriately managing risk may result in desirable projects not be able to proceed in the absence of Government involvement.

This section discusses each of these issues in more detail. The section also provides:

- A short description of ARTC's access charging structure.
- Some general commentary on risk.
- Some observations on the benefits of integrated land-use / transport planning.
- A discussion of the potential benefits of integrated upgrading of the road and rail lines on the NSW North Coast.

More detail on all of these issues is covered in two ARTC discussion papers, "Intermodal Market Analysis" and "Investment Environment Analysis".

Governments' Transport Objectives and the Institutional Structure of the Transport Industry

ARTC considers the institutional arrangements surrounding the transport sector to be flawed and believes that the efficiency of the sector as a whole would benefit from reform.

While the problems flow from many sources, the most important underlying issue is the absence of any meaningful linkage between road user charges and road investment. This has valid origins in the historical absence of an effective way to collect a charge for road use, other than the blunt instrument of tolls on major roads. As a result, responsibility for collecting revenue from road users and allocating that revenue to investment projects has been managed through the political process.

Given this environment, Governments have endeavoured to bring a degree of robustness to road investment decision making by insisting on an economic appraisal process. The recent extension of Australian Government funding to rail through the Auslink program has been widely applauded. This has now opened-up the possibilities for rail to gain funding for economically justified projects, with that justification underpinned by an economic appraisal process to ensure comparability with road.

However, this introduces difficult methodological issues. An investment that increases productivity creates the greatest economic benefit when users are not charged for it. In the road context, users are almost never charged for an enhancement[3]. In fact, road improvements usually result in less road user revenue, since most road revenue is collected as a fuel excise and a key benefit of most road enhancements is a reduction in fuel consumption. Road authorities are thereby encouraged through the economic analysis process to promote projects that reduce the amount of revenue generated from road users.

In ARTC's case, it will be in a position to fund some projects commercially by increasing access charges to recover the benefits of an enhancement investment. However, to the extent that ARTC funds projects commercially in this way, it reduces their economic benefit.

3 - The obvious exception is when the enhancement is constructed as a tolled road.

The investment issue that this creates for ARTC is that there is no simple divide between commercial investments and Auslink investments. An economic perspective with grant funding of capital works will always justify a project proceeding sooner than it will as a purely commercial project[4]. However, the quantum of Auslink funding is limited. If Auslink candidate projects are to be ranked on the basis of their benefit / cost ratios then it is in ARTC's interest to seek 100% Auslink funding for projects, even though this is likely to reduce the total scope of capital works investment.

What this illustrates is the difficulty of combining commercial and non-commercial institutional structures. Where the road infrastructure sector is essentially non-commercial, ARTC combines elements of both a commercial and a non-commercial environment, depending on the nature of the freight task. This creates a challenge in determining how it should promote investments for potential Auslink funding.

Resolution of this issue is a matter for Government. ARTC believes the best solution would be to move the roads sector onto a commercial footing. This would allow all pricing and investment decisions for both road and rail to be taken by commercial organisations using their market knowledge and judgement to optimise outcomes. It would allow resources to be directed to their highest and best use based on consumer preferences.

Such a market solution would be significantly enhanced by adoption of mechanisms to internalise externalities. A carbon trading scheme is a critical first step given the global importance of greenhouse gases, but pricing of air and noise pollution, and mechanisms to better reflect the cost to society of road accidents, would also lead to substantially better social outcomes.

While current Government review processes are considering the future direction for the road sector, ARTC has developed this Strategy on the basis of a continuation of the status quo. Specifically, it has assumed that that:

- Government would wish ARTC to commercially fund projects where there was no material competition from road. This would cover projects for the benefit of coal and most minerals.
- Government would in principle be willing to fund projects that enhanced or maintained rail's competitiveness against road provided they demonstrated a net economic benefit. It has also been assumed that there would be no requirement for ARTC to part fund the projects commercially, as this erodes their economic benefit.
- Government would not support Auslink funding where the dominant competition was from sea, which has externality effects similar to rail.
- Capacity projects would be funded by ARTC where the marginal revenue from the increased volume covered the cost of the projects (principally east-west), but Auslink funding would be available where to maintain competitiveness against road ARTC's rates are so close to marginal cost that revenue from increased volumes cannot meet the cost of increasing capacity.

Rail Market Share Trends

Rail in the intermodal market has had three decades of continuous decline and now has a relatively small share of the Australian non-bulk freight market, as shown in Figure 11[5].

Rail volumes have increased rapidly in those general freight markets where rail has a strong competitive advantage – long-haul intercapital general freight and import / export container traffic. This has been more than offset though by the continuing erosion of market share in the shorter haul markets, particularly north-south.

In bulk markets rail remains the mode of choice and with the strong growth in minerals exports rail continues to rapidly increase its volumes as shown in Figure 12.

When the bulk and non-bulk markets are combined, rail's share of the market stabilised some decades ago, and its share is only marginally smaller than that of road, as illustrated in Figure 13.

4 - This assumes that negative externalities are ignored, which is the traditional approach for transport economic appraisals.

5 - Source: Freight Measurement and Modelling in Australia, BTRE, 2006

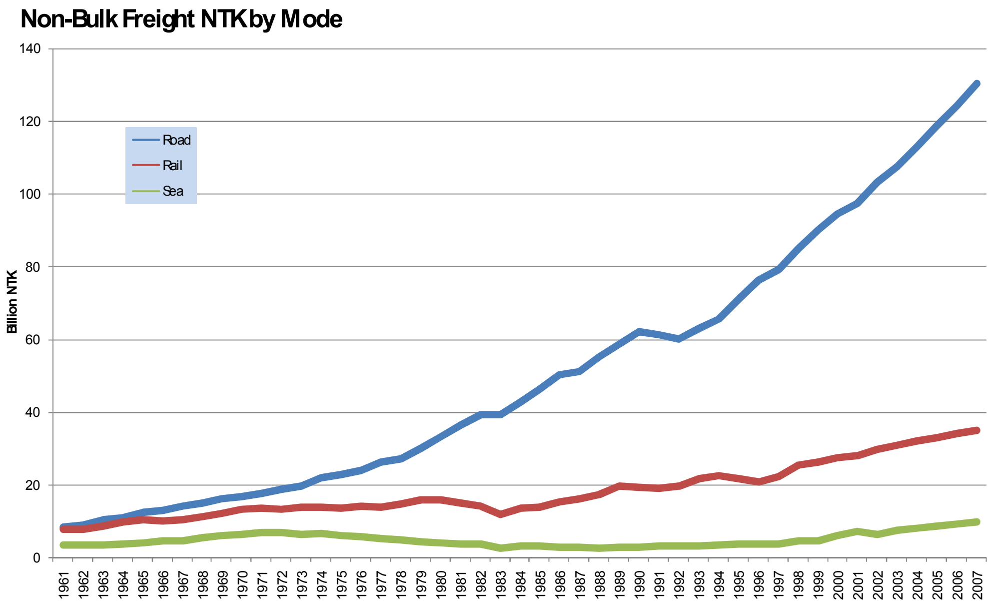


Figure 11

Notwithstanding rail's continuing strong position overall, there is a community perception that rail generally struggles as a mode.

Rail's declining share in that portion of the market where road and rail are in genuine competition is a major factor in this perception. A second factor is that rail has been subsidised to remain in a small number of markets, principally grain on low-volume rural branch lines, where logistics improvements and economic logic suggests that road is the more appropriate option. Although the volumes involved are small, they attract disproportionate amounts of community focus.

The road transport industry also likes to emphasise its share of the market as measured by tonnes rather than tonne kilometres. Measurement on this basis makes road's share sound overwhelmingly dominant, even though it is a poor measure of the task.

It should be noted that all of the volume and market share estimates in this strategy come with a caveat that there are considerable difficulties in establishing base data on the freight market.

The BTRE provides regular reports that seek to estimate the size of the freight transport market and sub-markets. However, while rail and sea transport are reasonably well defined, the scale and scope of road transport makes recording origin / destination data all but impossi-

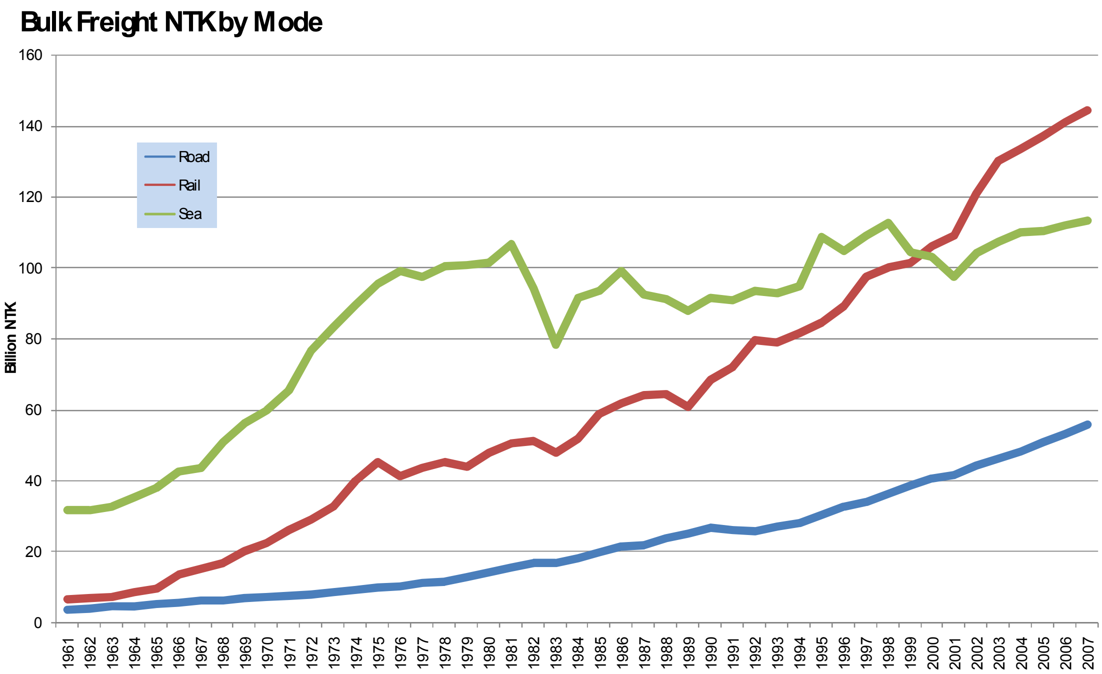


Figure 12

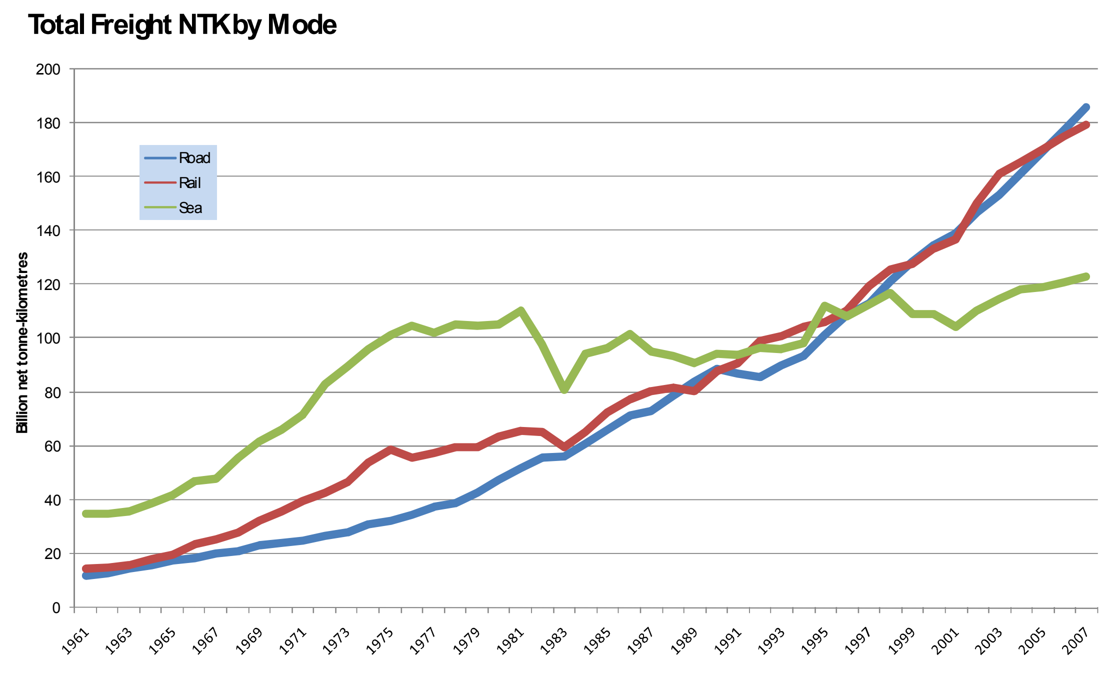


Figure 13

ble. While there is good data on road use by road section, where the freight using that road came from, and where it is going to, is almost impossible to record. The Bureau of Statistics has all but abandoned attempts to do so.

Accordingly, any estimate of the size of a freight sub-market will have a large margin of error associated with it.

Defining sub-markets is also problematic. For instance, when looking at intercapital general freight, it is necessary to define both what is a capital and what is general freight. In the case of Sydney, should Wollongong and Newcastle be included as part of a greater Sydney region, or not? Does general freight include slab steel, coiled rolls or wire, or are these more correctly included in bulk freight? Are shipping containers arriving in Melbourne for transfer by rail to Adelaide an intercapital movement, or just part of a larger import movement?

Rail Competitiveness Trends

Over the last five years there has been a significant shift in rail's competitiveness in the interstate general freight market. As shown in Figure 14, rail's price competitiveness against road has improved substantially since 2002/03, though it has declined against sea on the three routes where sea competes.

This price shift in favour of rail is believed to have been primarily driven by:

- Fuel price increases.
- Truck driver shortages, particularly for long-haul.
- Chain of responsibility legislation.
- Increasing costs of congestion

ARTC modelling suggests that price shifts of this magnitude will have a profound effect on rail's market share if they persevere. For instance, rail's market share in the three north-south markets is expected to more than triple, albeit from a low base.

At this stage there is no clear evidence of significant growth in rail volumes. Past research suggests that it takes around 7 years for the full effect of competitiveness shifts to be fully reflected in volumes and the nature of the recent cost changes may have been considered by the market to be temporary, adding to the normal lag effect.

However, ARTC is expecting that the recent changes in price competitiveness will have a compounding effect on the service level improvements arising from the North-South investment. Provided rail operators invest in capacity there is considerable potential for rapid growth in volume.

Figure 15 shows estimated current rail market share, and projected rail market share once the market fully adjusts to the recent shifts in relative road / rail prices.

Carbon Pricing

The Australian Government is committed to a 60% reduction in greenhouse gas emissions by 2050 (on 2000 levels) and the introduction of an Emissions Trading Scheme (ETS) by 2010. The Garnaut Climate Change Review commissioned by Australia's State and Territory Governments on 30 April 2007 is examining the impacts of climate change on the Australian economy, and will recommend medium to long-term policies and policy frameworks.

The transport sector should be a part of the ETS from the outset. Rail is widely acknowledged as a low-carbon form of freight transport and it would seem logical that increasing use of rail would be encouraged as part of a country's overall plan to reduce carbon emissions from the transport sector.

As the ETS is still under development, it is difficult to predict the nature of the mechanisms and how they will impact on rail. It is also difficult to forecast the consequences of carbon trading, which will have economic effects beyond those normally experienced and understood.

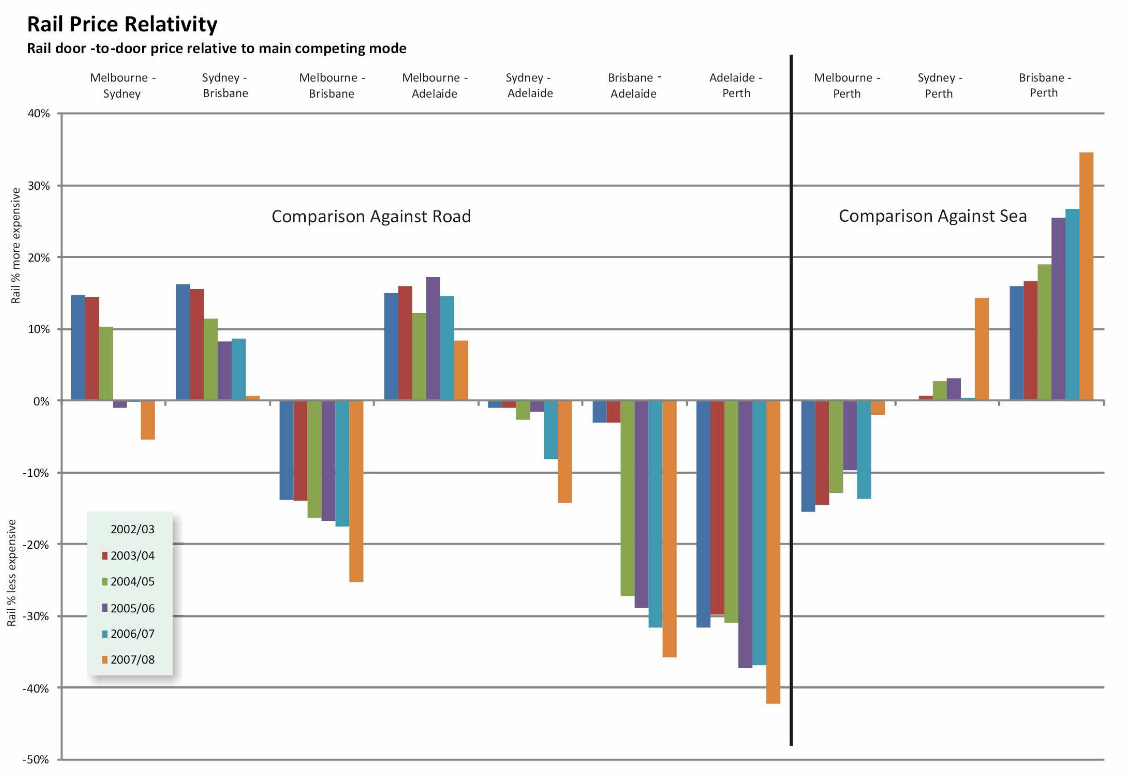


Figure 14

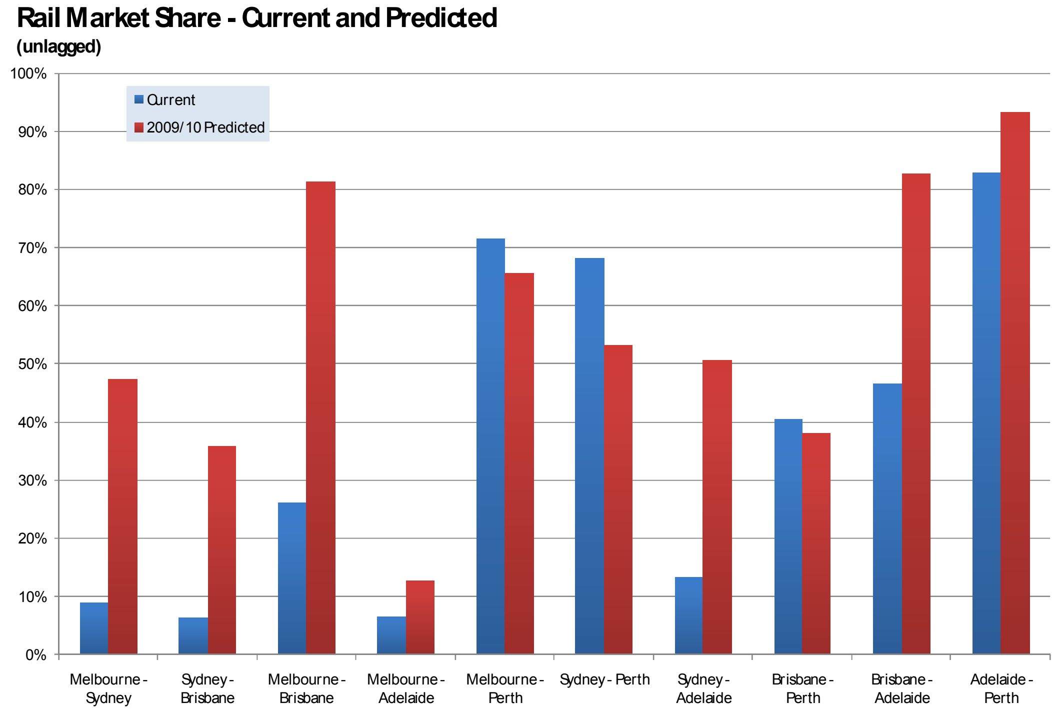


Figure 15

Nonetheless, ARTC has, as part of its modelling of the intercapital general freight market, attempted to model the potential impacts of the introduction of carbon pricing, both in terms of the impact on rail mode share, and on the demand for freight transport as a whole. In this it has been assumed that all modes, including sea freight on Single Voyage Permits, is captured by the ETS. Further detail is provided in Section 4.

Fuel Prices

Fuel prices have increased rapidly in the past 12 – 24 months. Evidence suggests that this is being driven by growth in demand, particularly from China and India, at a time of slowing world oil output.

There can be reasonable certainty that the growth in demand will not abate for some time. In terms of supply, the believers in “peak oil” would argue that supply is in terminal decline. In this environment the increase in oil prices would be expected to continue and even accelerate. At the opposite end of the spectrum are those that argue that there is sufficient oil to meet demand, at the right price. Under this view oil prices would stay high, or even increase, but at a more gradual rate than has been experienced in recent years.

At this point it seems unlikely that oil prices will return to anywhere near their levels of 2 – 3 years ago, though some correction to the most recent price peaks could be expected. It is likely that there will continue to be at least a slow increase in real terms over the medium term. However, it is unclear what base price this might be from.

Fuel efficiency is one of rail’s major competitive advantages against road and in this oil price environment the expectation is that rail will continue to improve its price competitiveness against road.

ARTC has attempted to take future potential oil prices into account in its modelling of the interstate market. More detail is provided in Section 4.

Road User Pricing

There has been considerable debate about heavy vehicle road access pricing regimes and, in particular, whether rail has been disadvantaged by the approach to road user charging, compared to that used for rail. A number of concerns with the existing approach have been expressed by rail industry participants in past reviews and inquiries.

It has not been rail’s contention that changes should be implemented with an explicit objective of bringing about a modal shift. Changes are needed in order for rail and road to compete on a level playing field, and to deliver optimal transport outcomes (irrespective of mode) to meet supply chain demands and drive efficient infrastructure investment.

The rail industry has supported Government initiatives, as the first building block to road pricing reform, to seek to improve the existing road pricing model, remove the cross-subsidisation occurring between vehicle types, and create a framework for a stronger and more urgent commitment to mass distance charging.

The resulting National Transport Commission 2007 Heavy Vehicle Pricing Determination recommendations broadly accepted by the Australian Transport Council in February 2007 go some way to addressing rail’s concerns with the current approach.

ARTC strongly supports the greater commitment to a time frame for using technological advancements to deliver direct heavy vehicle road user charging based on mass and distance.

There are a number of current changes and future reforms that will impact the level and structure of heavy vehicle road user pricing (and, indeed, overall road pricing) in the medium to long term that are expected to deliver an improved competitive environment in transport, and improve the competitiveness of rail in many national and regional supply chains.

However, many of these reforms are unlikely to have a significant impact in the short term. Despite the current uncertainties surrounding the eventual implementation of the above reforms, investors in rail infrastructure (which is long term by its very nature), whether it be above or below rail, will need to contemplate the improved outcome for rail, and transport more broadly, anticipated in the longer term.

Other Costs

As noted under the section on rail competitiveness trends, road is also facing cost pressures from the shortage of drivers and the effects of Chain of Responsibility legislation.

The looming shortage of drivers was identified some time ago. When first raised it related to the gradual aging of the long-distance driver workforce. In this context it was also noted that younger generations were more highly skilled and had different lifestyle expectations. These factors made the attraction and retention of drivers increasingly difficult.

More recently, the move by Australia to approximately full employment has greatly exacerbated the problem. In an environment of good job opportunities, long-distance truck driving represents an unattractive career option. This is putting increasing pressure on wage rates.

A related consideration is the introduction of Chain of Responsibility legislation. This legislation makes all participants in the supply chain jointly liable for certain breaches of the law, particularly in regard to driver hours and speed.

In some ways this legislation should make long-distance driving a more attractive proposition as it reduces the pressure on drivers to take risks. At the same time though, it is pushing up costs and making it relatively less attractive to be a sub-contractor compared to a direct employee.

The introduction of Chain of Responsibility is also being matched by a gradual increase in enforcement.

Rail Access Regulation

Part IIIA of the Trade Practices Act (TPA) establishes a national regime to facilitate third party access to the services of certain facilities of national significance such as electricity grids, natural gas pipelines or rail networks. All railway networks fall within the scope of Part IIIA.

ARTC considers that the application of regulation tends to be more heavy handed where the access provider has market power (price regulation) and/or is vertically integrated (prohibition on anti-competitive activity, separation, reporting, ring fencing), and less heavy handed otherwise. Different rail networks in Australia have different characteristics in this regard.

ARTC currently has an access undertaking covering the interstate network in South Australia, Victoria and New South Wales before the ACCC. The ACCC's draft determination indicates that the undertaking is likely to be accepted with only minor changes.

Given the light handed nature of access regulation on the interstate network, there is unlikely to be any significant direct impact on investment in rail infrastructure. Indirectly, and to the extent that competition has been promoted on the network, access regulation could be argued to have promoted, or at least not deterred, efficient investment in interstate rail. Other indirect impacts of regulation on the interstate network might relate to delays in regulatory decision making, and regulatory error resulting in underestimating appropriate investment returns.

The greater impact on investment in the interstate rail network is likely to arise where above-rail profitability is low, and complementary above-rail investments lag below-rail investment, or do not eventuate at all.

ARTC is also developing a separate access undertaking to cover the Hunter Valley coal network in NSW for submission to the ACCC. ARTC recognises that the commercial and operational characteristics of the Hunter Valley coal network are different to those of the interstate rail network.

The effects of existing constraints on the Hunter Valley coal supply chain has prompted the NSW Government to commission a review of the existing business and operating model in the Hunter Valley, primarily to develop a long term model that ensures the existing problem dissipates, and there is an improved framework for timely and efficient investment in supply capacity to meet demand going forward. ARTC's access undertaking will seek to align to the new business and operating model in the Hunter Valley.

Uncertainty associated with the outcome of this review is expected to be short lived. It is hoped any new model will deliver a more efficient and more certain framework for investment in rail infrastructure (as well as mine and port infrastructure), that recognises the commercial risks and realities of all supply chain participants.

ARTC Pricing

Pricing for access to the ARTC network is largely on a standardised two part tariff basis, with the exception of coal, which is priced on a per tonne basis.

The two part tariff is a train kilometre (tkm) charge and a gross tonne kilometre (gtk) charge. The tkm charge varies depending on the type of train, with variation generally based on maximum speed and axle load. The tkm charge is generally levied on timetabled paths rather than actual trains, though a category of train is provided to allow for ad hoc operations. The gtk charge is payable on actual gtk operated, and is common to all trains. Both the tkm and gtk charge vary between network sectors. ARTC endeavours to keep the number of such charging regions to a minimum and there are currently 15 charging regions.

Coal is priced on a straight rate per net tonne. The per tonne rate is set on a mine specific basis. ARTC aims to maintain a level of equity between mines having regard to their distance from the port, but does not apply a fixed formula for determining prices. This is currently under review in the context of the Hunter Valley access undertaking.

Price levels on the interstate network are constrained by the need for rail to remain competitive with road and sea. The current quantum of prices is essentially the residual left over from the cost of above rail operations. This price level was originally set at the time the transition was made to vertical separation and there has been little movement in those prices in real terms since that time. ARTC has, however, recently increased east-west access prices by the order of 10% in real terms and given a short-term 10% rebate on north-south prices.

This maintenance of access charges in real terms has to some extent acted to lock-in rail market shares. However, access charges, particularly on the north-south corridor, barely cover costs. This means that there is little scope to increase market share by reducing access charges. At the same time, ARTC has aimed to hold prices down consistent with the growth led approach to the business.

The quantum of access charges in the Hunter Valley is tightly constrained by the regulatory ceiling.

Risk and Investment

As a rail infrastructure provider, ARTC does not have any direct control over the delivery of above-rail services. While ARTC's approach is to invest for growth, it does not have a mechanism for ensuring complementary investment by above-rail operators in rollingstock and terminals.

Above-rail operators will, in turn, be subject to a range of influences in making their investment decisions. Not all of the influences will relate directly to the rail market. Specifically, the above-rail interstate intermodal business is now dominated by three operators. Two of these operators are privately owned and one (the largest intermodal operator) has experienced a long period of uncertainty arising from ownership issues, and now has a highly geared balance sheet. The second largest remains Government owned, and is subject to all of the investment complexities associated with Government ownership.

While there is mounting evidence that rail has the potential to experience a large and rapid growth in its volumes, this opportunity remains uncertain. Given the above-rail industry structure and the issues noted above, there is a strong possibility that operators will take a conservative approach to investment. In particular, the two largest operators are investing very heavily in coal assets, and in an environment of constrained capital it is possible that the desirable level of investment in intermodal assets may not be forthcoming.

Both above and below rail assets require a long term investment framework. Above rail investments in locomotives and rollingstock can be thirty year investments and a significant portion of the current locomotives fleet operating on the interstate network meet this age profile. Whilst new investment in above rail assets will be required to support growth in the freight task and will deliver improved environmental performance the current market conditions introduces a great deal of uncertainty around potential investment decisions.

Taxation based initiatives such as the allowance of accelerated depreciation on rail assets could encourage both the expansion of capacity and the introduction of new lower emission equipment.

Investment Financing Options

ARTC's current investment planning calls for expenditure of over $2.7 billion over the next five years. To finance this investment will require ARTC to access $1.2 billion of debt. In some scenarios, the desirable level of investment could be considerably greater.

This prospect raises the question as to whether there might be innovative forms of financing available.

While ARTC is open to considering all potential financing structures, its primary concern is to ensure that risk and reward are appropriately matched.

Looking forward, ARTC anticipates that the majority of its investments will be in assets that become fully integrated with its existing network. Accordingly, the new assets would have no stand-alone ability to generate their own revenue streams, and it would not be possible to make access pricing, and other terms and conditions of access to the new assets, independent of the associated ARTC network.

This suggests that, to introduce third parties into the financing of new assets, ARTC would need to provide some form of revenue guarantee. Consequently, ARTC will bear all, or the majority, of the risk. In this environment it is difficult to see how alternative financing structures could offer ARTC an acceptable risk and reward framework.

The exception to this is significant proposed sections of new alignment. These are relatively rare. The new alignment through the Liverpool Ranges is the best example. The proposed Inland Route and proposed Adelaide Hills bypass are other potential cases.

These projects may be suitable for packaging into stand-alone vehicles for financing purposes. In the case of the new Liverpool Ranges alignment, this is assisted by the fact that a small number of coal producers will be the primary beneficiaries and volume risk can be transferred from ARTC to those coal companies. In the case of a project such as the Adelaide Hills bypass it may be somewhat more difficult as the viability of that project will depend on future decisions by ARTC about access pricing and capacity enhancement on either side of the bypass, and the treatment of the existing track.

However, outside of these isolated cases it is difficult to see opportunities for structuring of investments using mechanisms such as Public-Private Partnerships.

Integrated Land-Use / Transport Planning

The benefits of integrated land-use / transport planning have long been recognised and Governments have pursued such concepts for centuries. In simple terms, the efficiency of transport and of cities will be optimised if freight-generating activities are located to make efficient use of the transport network.

While market forces will to some extent deliver such outcomes, the integral role of Government in urban planning means that they are not always free to do so. For instance, many Governments have adopted urban consolidation strategies that include a focus on the development of high-density residential accommodation around stations. As freight and passenger tracks are often shared, or share a corridor, this inevitably crowds-out industrial uses around rail lines.

Governments also seek to influence the location of industry to achieve job creation targets within particular areas, either for social reasons or to minimise commuting distances.

The consequences of some of these Strategies has been that freight generating industry has not been encouraged to locate in such a way as to efficiently incorporate rail into the logistics chain.

In Sydney for example, industry long ago moved to the west and south-west of the primary intermodal terminal at Chullora. Road access to Chullora, particularly from the south-west, is not efficient and for most traffics the use of rail involves travelling significant distances in the opposite direction to their ultimate destination. While the migration of industry to these areas has long been a part of the Government's plans, there has been no corresponding strategy to provide access to rail, either through development of intermodal terminals on the existing line to the south-west, or by construction of a new feeder line.

The consequence is that Sydney now has almost no scope for the development of efficiently located terminals. ARTC has been encouraging the development of a new terminal on army land at Moorebank. This is perhaps the only available site in Sydney that enjoys good road and rail access and has sufficient land area to accommodate an efficiently configured terminal.

However, ARTC believes that in an environment of multiple rail operators, and an increasingly sophisticated logistics industry, that is likely to want to co-locate warehousing with terminals, a single terminal with barriers to its further expansion falls short of the needs of the industry.

Melbourne provides another example of how land-use planning can be misaligned with the option of rail transport. Melbourne has ample land with good rail access in the Laverton and Somerton areas, and Victoria has aimed to focus industrial development in these two areas. However, its third planned industrial centre, Dandenong, is remote from the interstate rail network. While Dandenong has access to the broad gauge network, it is not realistic to expect that this will provide an efficient option for getting freight onto the national network. While there are plans to get standard gauge rail access to Dandenong in conjunction with the development of Hastings as a second Melbourne port, these are at best a medium to long-term plan.

In ARTC's view, Government's and industry should be pursuing a model where freight generating activity is consolidated in locations with good rail access for freight, and at the same time, activities that do not generate significant freight are discouraged from such areas. In some cases, this is likely to also require investment in new rail lines to access suitable sites. This is particularly true of Sydney, and may need to be considered in Brisbane.

Project Risk and Government Underwriting

ARTC has generally argued that Governments should, as far as possible, move toward an environment where the transport sector is placed on a market basis, with Government intervention only to address market failure.

One area in which ARTC believes that there is a risk of market failure is where infrastructure investment is required to facilitate new mining activities, but the nature of the work is such that it is difficult to structure commercial arrangements that appropriately manage risk.

An example of this scenario is where a new section of track is required to provide rail access for a number of new mines, where collectively the task would provide a commercial basis for ARTC to invest, but any one of the mines on its own is not sufficient to mitigate ARTC's risks. Such an investment could only proceed if an adequate number of miners were able to move their projects forward concurrently, or if a third party was willing to underwrite the risk.

Even where there was sufficient traffic to provide the basis for the project to go ahead, ARTC is likely to seek volume guarantees for the period necessary for it to recover its investment. Given that rail infrastructure is a very long-life asset, the expectation is that ARTC will generally recover its capital over an extended period. For instance, projects in the Hunter Valley are currently depreciated over a 32 year period. However, it would be unrealistic for ARTC to expect to get underwriting for such a term. Furthermore, where junior miners are involved, it would be reasonable for ARTC to seek parent or bank guarantees, and these would not be available for such a term.

The alternatives then are:

- For ARTC to apply a very high rate of return, and hence access charge, to the investment. It could be argued that this is not an economically desirable outcome, and in some cases it could render projects unviable.
- For ARTC to seek an up-front capital contribution. This risks undermining the viability of the project, given that such funding would be expected to earn a rate of return for the mining company that reflected mining investment rather than infrastructure investment. It also again becomes highly problematic where there are multiple potential users.

The circumstances that suffer from these sorts of barriers to investment are relatively rare and are most likely to arise in association with port developments. However, ARTC believes that this may be a case where it is legitimate for Government to intervene due to market failure, most likely by way of providing underwriting for investments.

Integrated Road / Rail Corridors

In developing its current North-South upgrading scope of work, ARTC has aimed to reduce transit time in the most cost effective way and to this end has adopted a number of innovative solutions to extract the best possible performance from the alignments that were laid out in the late 18th and early 19th century.

For rail to move to the next step in competitiveness, or even in fact to maintain competitiveness against a constantly improving road network, there is no alternative but to start to consider deviations of the current poorly aligned sections of the network. The NSW North Coast has a particularly bad alignment having been constructed as a series of branch lines rather than with the intention of it becoming the important main line it is today.

For a significant part of the North Coast an opportunity exists to achieve improvements in the rail alignment in a cost effective manner by the integration of rail deviations with the ongoing process of upgrading the Pacific Highway. The opportunity to bring road and rail together in a single corridor also allows environmental impacts to be minimised. This opportunity exists most strongly on the section between Taree and Grafton.

Where attempts have been made in the past to integrate new road and rail alignments there have been difficulties caused by different engineering standards required for the different modes. However, in the case of the North Coast the terrain lends itself reasonably well to an integrated approach.

The other key constraint to integrated deviations is the source and timing of funding. To be able to properly plan and deliver an integrated solution it is necessary for there to be a high degree of confidence that the funding for both the road and rail components of a new alignment will be available in the same timeframe. The integrated road and rail funding approach embodied in Auslink creates for the first time an environment where the necessary confidence could be provided.

ARTC has therefore proposed that the Commonwealth consider adopting a policy position that Pacific Highway upgrading projects between Taree and Grafton should be developed as integrated road and rail projects where there is a material benefit to rail, with Auslink funding structured to provide confidence that both the road and rail components can be delivered as a single project.

While this principle could be applied more generally to Auslink funded projects, the only promising area for such joint upgrading at this time appears to be on the NSW Mid North Coast.

ARTC has undertaken a high level analysis of the degree of alignment between Pacific Highway upgrade projects and potential rail deviations. This suggests that there are five projects that could be conveniently persued as joint projects. These offer a transit time saving in the order of 22 minutes and a rail distance reduction in the order of 10 km. However, while ARTC proposes a number of deviation projects in this Strategy, no specific proposals have been made for joint road / rail projects in the absence of a clear policy position on this issue.

4

Demand Scenarios

Introduction

As a general approach to infrastructure planning, ARTC takes a positive view of potential volume growth – this allows projects to be identified and progressed in a timely manner to ensure sufficient capacity in the event that the optimistic scenario prevails. In the event that growth is not so fast, projects can be slowed down accordingly.

Rail volumes are forecast using a model of cross-elasticity of demand with road and sea freight, and elasticity of demand for total freight transport. The cross-elasticity model has three primary inputs: price, availability (being the ability of a mode to meet the markets' preferred cut-off and delivery times), and; reliability.

Until recently, ARTC's optimistic scenarios were based on historical rates of demand growth plus 1% – 2%, and a broad continuation of historical rail market share, other than for the North-South Corridor where a significant market share increase was forecast following the completion of the North-South Corridor upgrade works.

However, for the reasons described in Chapter 3, it is possible that transport is facing a significant shift in its underlying cost fundamentals that would result in a more significant growth environment.

The key elements of this new environment are:

- Continued rising fuel costs in real terms.
- Continued rising labour costs in real terms, in particular for long-distance truck drivers.
- Introduction of a carbon trading scheme.
- Introduction of mass-distance charging for road access.
- Increased urban congestion.
- Continued rising demand for NSW coal.
- Continued rising demand for other Australian minerals.

For the purposes of this Infrastructure Strategy ARTC has therefore considered it prudent to model a range of scenarios that represent a departure from historical trends. This section summarises the modelling methodology and assumptions. More detail is provided in the paper "2008 – 2024 Intermodal Market Analysis".

Scenario Assumptions

The basic approach to developing the base case[6] volumes has been to postulate cost levels for key input costs as at 2017/18. This allows rail market share to be predicted for that year and a compound rate of growth to reach that market share to be determined. Costs are then

6 - The base case provides the starting point for the assessment of the economic and financial viability of potential investments. These investments, where justified, further enhance market competitiveness. The base case assumes that there will be sufficient rail capacity to accommodate the projected growth.

held constant in real terms from 2017/18 to 2023/24. It is important to note that the effect of the road / rail relative price changes has been applied progressively with a lag of 5 years.

The assumptions for the three scenarios are shown in Table 2.

(All prices $2007/08)	Low	Medium	High
Oil Price (US$ / barrel)	$80.00	$100.00	$150.00
A$ / US$ Exchange Rate	$0.85	$0.75	$0.65
Carbon Price (A$ / tonne CO2)	$25.00	$50.00	$100.00
Labour Costs	No real change	25% real increase	50% real increase
Road-User Charges	No real change	50% real increase	100% real increase

Table 2 - Scenario assumptions as at 2017/18

In all scenarios rail reliability and availability are assumed to improve significantly for the Melbourne – Sydney, Sydney – Brisbane and Melbourne – Brisbane corridors in 2009/10 with the completion of the North-South upgrade works.

It is important to note that while the oil price in the low and medium scenarios is below current price levels, ARTC believes that the freight market has not yet responded to the recent dramatic increases in fuel costs. Accordingly, even the low scenario will involve significant growth in rail volumes.

Given the magnitude of the freight cost increases that have already occurred, and the potential size of future changes, there is a very good prospect that the total freight market demand will be suppressed. To take account of this ARTC has also modelled a range of potential freight price elasticity impacts. The high, medium and low scenarios have used elasticities of -0.25, -0.5 and -1 respectively, with the volume impact calculated from the weighted average change in freight costs for a given market.

Market Share and Volume Outcomes

Figure 16 shows estimated rail market share in 2004/05 (which has been taken as the base year as it is the last year before the market was affected by significant cost increases), 2009/10, and under the high, medium and low scenarios in 2017/18. It should be noted that there is no allowance for lag in these estimates and the 2009/10 market share in particular is not likely to reach this level until some years afterwards.

The notable feature of this data is the significant increase in market share captured by rail on the short and medium haul routes.

Even under the low scenario, rail is achieving market shares of 30% - 40% on Melbourne – Sydney, Sydney – Brisbane and Sydney – Adelaide, and over 80% on Melbourne – Brisbane.

Under the high scenario, which is potentially the most plausible scenario in light of recent experience, rail is achieving around 60% market share on Melbourne – Sydney, Sydney – Brisbane and Sydney – Adelaide, and well over 80% on Melbourne – Brisbane.

On the east-west corridor, rail would be expected to capture some market share from road, but surrender some to sea, leaving it approximately neutral.

It is important to note that, while the scenarios involve assumptions about a number of cost inputs, the A$ fuel price is the dominant determinant of the market share outcomes.

Figure 17 shows an index of forecast volume in 2017/18 for the three scenarios, where the base year (2004/05) volume is 100.

Figure 18 shows total interstate general freight GTK on the ARTC network under the three growth scenarios.

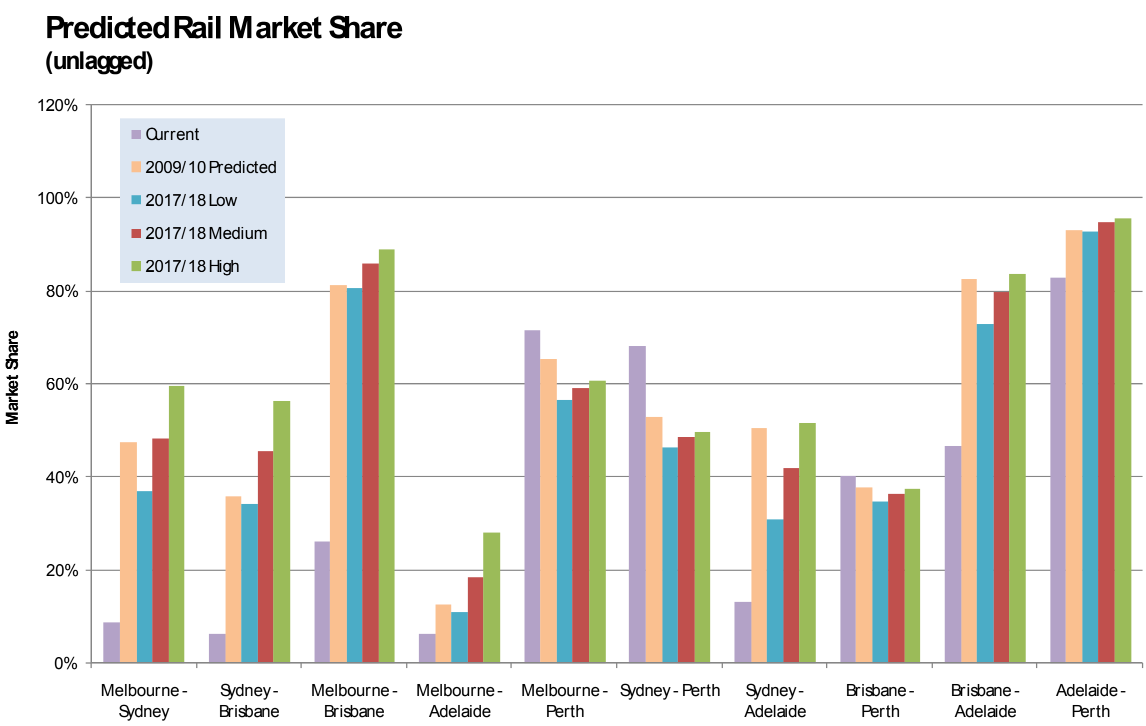


Figure 16

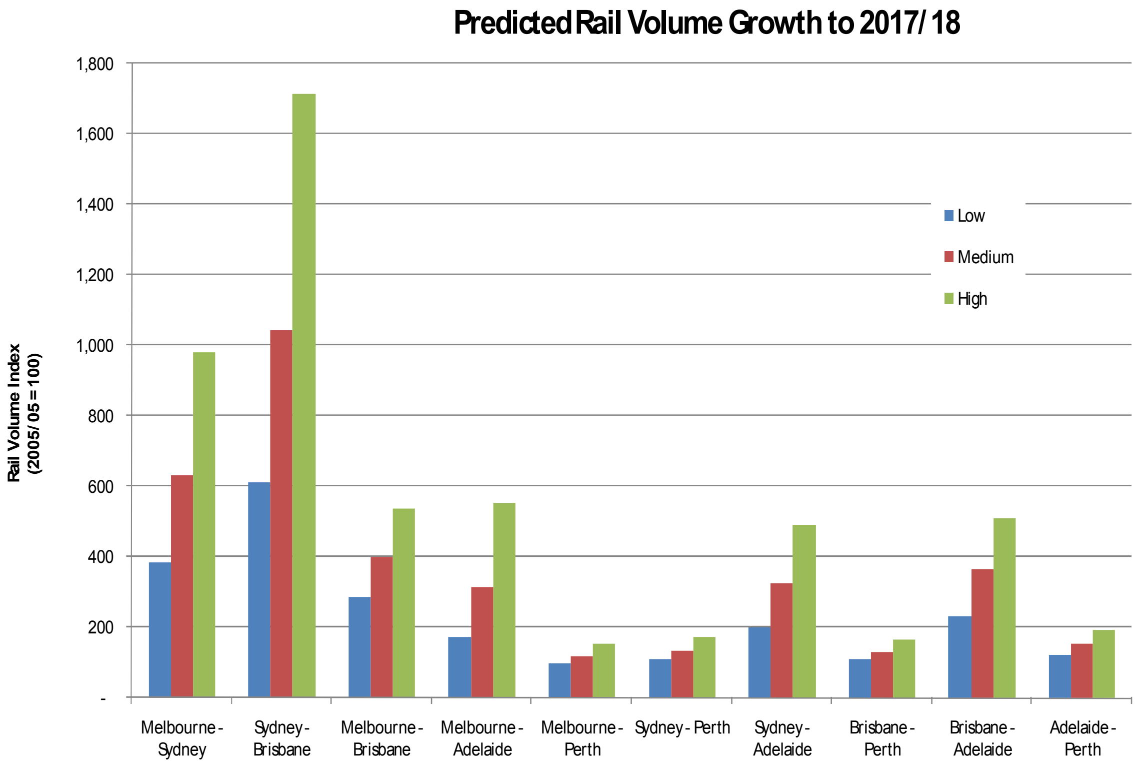


Figure 17

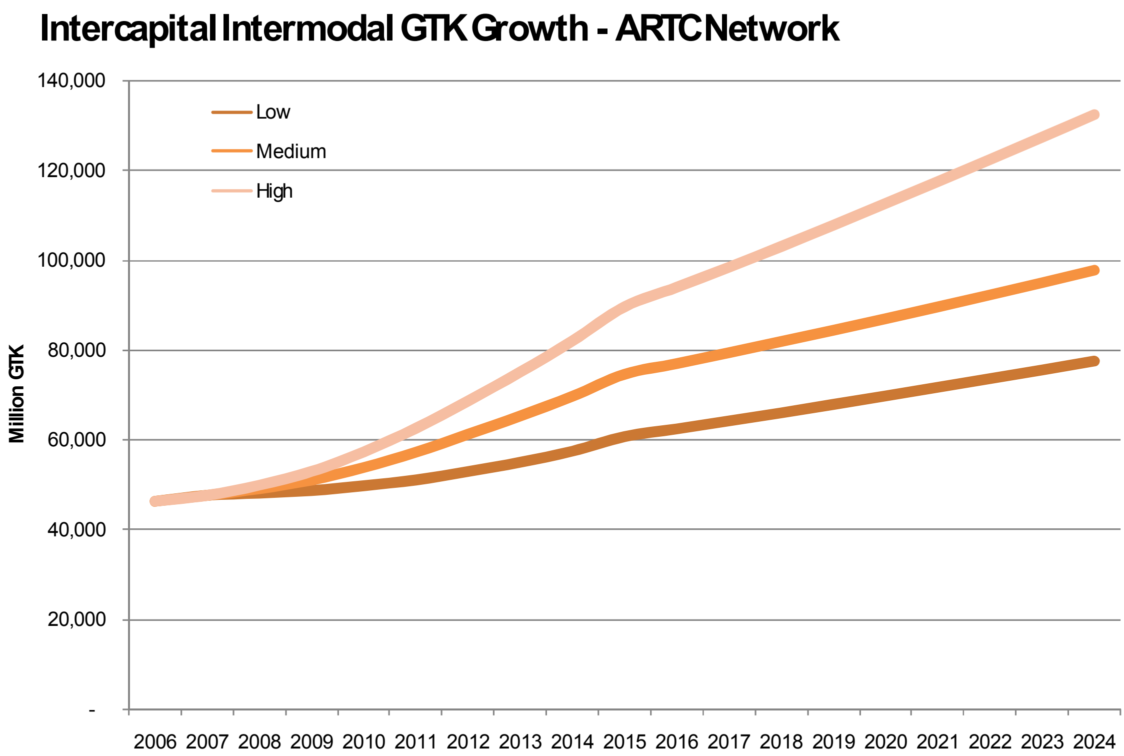


Figure 18

Hunter Valley Coal Volumes

With prices for both steaming and coking coal continuing to surge, Hunter Valley coal producers are continuing to raise their aspirational volume forecasts. There is a very high level of producer confidence in the forecasts and a growing willingness to underwrite infrastructure investment.

Producers are only just beginning to forecast with a 10 year horizon, so 15 year forecasts are largely speculative at this time. However, in terms of order of magnitude forecasts ARTC believes that there is potential volume growth as set out in Table 3.

	2009	2014	2019	2024
Total Export	133 mt	220 mt	244 mt	278 mt
of which:				
Upper Hunter	93 mt	128 mt	115 mt	117 mt
Ulan Line	29 mt	64 mt	75 mt	102 mt
Gunnedah Basin	11 mt	28 mt	54 mt	59 mt

Table 3 - Producer Coal Volume Forecasts.

Growth Implications

It is difficult to overstate the implications of the changing business environment for potential rail volumes.

Total rail volume growth in the low scenario described above significantly exceeds even the most optimistic of ARTC's previous projections.

The high growth scenario in this paper represents growth of almost 3 times ARTC's previous most optimistic forecast on the North-South corridor.

At the same time, east-west volumes are slightly below previous high-end forecasts as the impact on the size of the freight market due to cost increases more than offsets the modest gains in rail market share.

The year-15 Hunter Valley forecast is 58% above the highest tonnage previously considered. Even more significantly, the volume from the Gunnedah basin is three times higher than the previous highest forecast, while volume from mines on the Ulan line is almost double.

This infrastructure strategy therefore proposes investment in the interstate and Hunter Valley rail network that is orders of magnitude greater than anything previously contemplated.

Yet investment on this scale may be unavoidable if rail is going to play its role in minimising the economic impact of rising oil prices, reducing greenhouse gas emissions and carrying Australia's exports. In the absence of the investment, rail capacity will act as a constraint on volume growth, service levels will fall short of market needs, and freight transport costs will be higher than they otherwise need be.

5

Infrastructure Characteristics

Introduction

The purpose of this section is to provide an overview of each of the key characteristics of rail infrastructure and how they relate to the provision of an efficient and effective railway.

Speed / Axle Load & Cant Deficiency

Maximum permissible train speed on a section of track is defined in terms of an axle load. Any given track structure can only reasonably accommodate a certain level of impact. As train speed increases the level of impact also increases due to train dynamics. These dynamics can be reduced by increasing the smoothness of the track. Hence, determining speed and axle load involves a series of judgements about what is an acceptable level of impact for a given track structure, and what standard of 'smoothness' the track is going to be maintained to.

The maximum permissible train speed applies to tangent track only. On curves, train speed is limited by vertical force. To minimise this force, track in curves is generally canted (superelevated). The train speed at which all of the centrifugal force is directed downwards into the track is known as the balance speed. The extent to which trains are permitted to pass through a curve at a speed greater than the balance speed is known as the permitted cant deficiency. Cant deficiency is defined in terms of the difference between the applied superelevation and the superelevation that would be required for balance at a given speed.

Both maximum permitted speed, and cant deficiency, are dictated by track structure. Generally speaking, the stronger the track structure the higher the achievable permitted speed / axle load and cant deficiency. Track structure can be strengthened by installing heavier rail or sleepers, spacing sleepers more closely, or increasing ballast depth. Formation is also an important consideration, but it is not generally possible to change large lengths of formation.

Current maximum permitted speed / axle load combinations are shown in Figure 19.

Increasing permitted speed / axle load can generate significant efficiencies, particularly for bulk freight, but is generally only desirable on an origin-destination basis. Any change to speed / axle load is therefore a long-term process with the track structure being improved as its individual components are renewed. Alternatively, increases can be applied with the existing track structure at the expense of significantly reducing the life of the asset, leading to earlier requirements for renewal.

Increases in axle load (while holding speed constant) can obviously increase tonnage carried per wagon. Increasing maximum speed (while holding axle load constant) reduces transit time.

Increasing cant deficiency results in an increase in average speed without changing maximum speed. Each individual curve can make a contribution to reducing the average, and hence upgrades to individual curves may be justified as short-term projects to achieve transit time objectives.

Train Length

On single track railways, maximum permissible train length is dictated by crossing loop length.

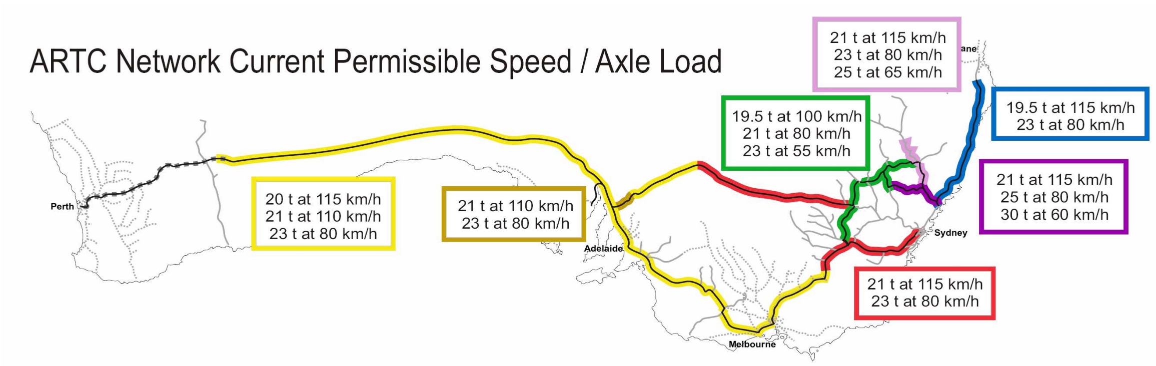
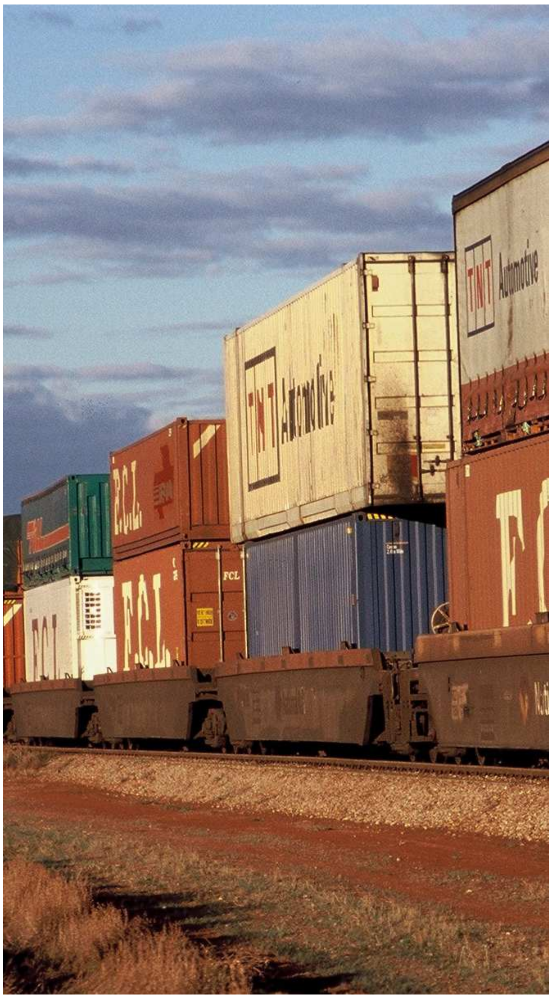


Figure 19

It is desirable for all crossing loops on a corridor to be the same length, and equal distance (with time) apart, to give maximum flexibility. However, as train lengths have increased over time, many corridors have ended up with a with non-homogeneous loop lengths. This logically follows, since doubling train length reduces the number of crosses by 75%. Typical train length has increased from around 400 m in steam days, to 1500 m - 1800 m today, significantly reducing the required number of loops even with growth in volume. As a result, only a portion of loops have been extended, but to maintain operational efficiency the remaining short loops have generally been retained.

It should be noted that the trade-off of longer trains (with only some loops extended) is that, on average, a train will need to stand longer at each cross. This interplay of the number of crosses against the delay when a cross occurs is important in determining transit times.

In practice, the longest trains on a corridor gain a degree of priority as they represent the most difficult trains to cross. As a matter of principle therefore, ARTC will not allow train lengths to be increased unless there is sufficient capacity at the new, longer, length for all operators that wish to operate at that length.



On double track railways, there is no absolute limiting factor for train length. However, there are a couple of issues that require consideration.

As train length increases, trains with conventional braking[7] take an increasing distance to come to a stand. Conventional signalling systems have signals placed based on expected braking distance. If longer trains are introduced, these distances are no longer safe and speed restrictions need to be applied or signals moved.

Longer trains also occupy a bigger space in the timetable as they take longer to pass any fixed point. On commuter railways with high train frequency and high reliability requirements this can create unacceptable operational constraints.

Increasing maximum train length has both efficiency and capacity benefits and can be a viable strategy for accommodating growth. Increasing train length has similar cost saving outcomes to introducing double-stacking of containers.

Container Height Clearance

Railways define the permitted dimensions of rolling stock by a rolling stock outline. To this outline is added various parameters to allow for the dynamic movement of the rolling stock, potential movement in the precise location of the track, and safety margins. This then defines the envelope that must be kept clear around the track. This is referred to as the structure outline.

Traditional outlines were based around a design that worked well for passenger carriages and allowed efficient arch construction of bridges and tunnels. The outline typically tapered at the top and allowed for a curved roof. Containers, which are necessarily rectangular, do not fit efficiently against this style of outline, with the corners representing the inevitable constraint.

As containers have become the dominant form of general freight transport, the outline for containers has become the key consideration for height clearances. Accordingly, ARTC defines height clearance in terms of what can be achieved for containers.

Current maximum permitted container heights are shown in Figure 20.

7. Electrically controlled pneumatic braking eliminates the braking delay associated with traditional air only systems and obviates this issue.

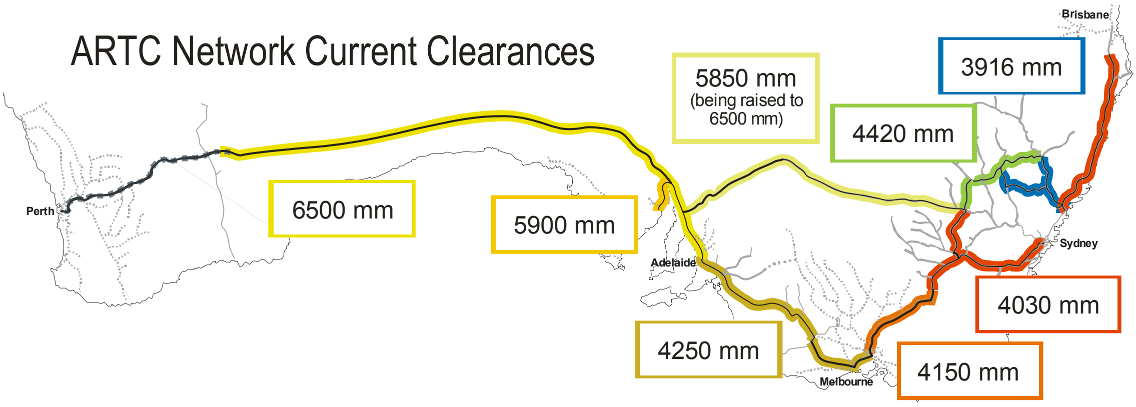


Figure 20

Increasing height clearances is generally a costly process as the key structures that limit height, road overbridges and tunnels, are usually expensive to replace or modify. Such structures are particularly prevalent on the east coast. The overhead wiring in the Sydney metropolitan area is also a constraint with no conceivable prospect of being avoided.

Increasing height clearances has two market drivers. First, domestic containerised freight has tended to be moved in increasingly tall containers. Marginal increases in height clearance can allow these taller containers to be moved on a broader range of wagons. Second, increasing single-stack clearances by around 2 metres allows containers to be double-stacked. This offers both efficiency and capacity benefits. As noted above, double-stacking and increasing train length offer comparable increases in efficiency for an equivalent increase in containers per train.

In the Hunter Valley there is a height clearance issue of a slightly different nature to that driven by containers. If the rolling stock outline were increased in the Hunter Valley, it would allow the same amount of coal to be carried in shorter wagons, or more coal to be carried in the same length wagon. Both options would result in an increase in capacity without needing to increase maximum train length. The latter would need to be pursued if there was to be an increase in permitted axle loads, as structural issues create inefficiencies in increasing the volume of coal carried in wagons constrained by the existing rolling stock outline. Moving to a more generous rolling stock outline may also allow off-the-shelf locomotives and wagons to be purchased from North America, reducing capital costs.

Signalling and Communications Systems

The Australian Rail Industry faces the challenge of being able to meet the increase in the freight task as set-out in Section A. In addition to this, future transport strategy foreshadows an ever increasing number of shuttle train services operating between capital city freight hubs and their ports.

Historically, the rail industry would meet these challenges by adding new infrastructure. However, the cost of providing new, additional infrastructure is very expensive when compared to an option of using new train control technology designed to achieve greater through-put on current infrastructure.

These new train control systems require less trackside infrastructure than conventional signalling systems; greatly improve the efficiency of train dispatching; allow for more flexible train operations, including bi-directional working without additional infrastructure; support the operation of trains separated by the safe braking distance between trains – thereby opening up capacity that was previously unavailable due to the historical method of train working, and offer authority enforcement to stop a train in the event that it is at risk of exceeding its authority.

The proposed form of train working (using new train technology, as described), provides an opportunity to introduce a different access pricing regime. This would result in a mix of trains being able to operate within a fleet without being discriminated on price. The proposed strategy to link capital city freight hubs with their ports in the future by way of shuttle (train) services, would benefit as a result of a different approach to access pricing – made possible by a change in the form of train working (as a result of a transition to the next generation of train control technology).

ATMS can accommodate a significant increase in the through-put of train services on current infrastructure. However, if selected crossing loops were converted to passing lanes of sufficient length to enable fleeted trains travelling in opposite directions to cross one another at speed, then the capacity of the network would be further improved.

Routes and Alignment

The interstate and Hunter Valley network was largely laid out in the late 19th and early 20th century. Since then the significant changes to that network have been:

- Major deviation work between Sydney and Cootamundra in the 1920's (which generally worsened the alignment from a modern day perspective).
- The gradual transfer of Sydney – Brisbane services from the 'Main North' route via the NSW Northern Tablelands, to the coastal route following its opening in 1932.
- Gauge standardisation from Sydney to Perth in the early 1970's, which involved new alignments between Broken Hill and the SA Border, between Peterborough and Port Augusta and between Kalgoorlie and Perth.
- A new standard gauge line between Adelaide and Crystal Brook in the early 1980's.
- Gauge standardisation between Melbourne and Adelaide in the mid-1990's, which involved a transfer of interstate freight from the corridor via Ballarat, to the Cressy Plains route.
- The gradual supplanting of the Sydney – Parkes corridor via Lithgow by the route via Cootamundra.

Routes and alignments have a significant effect on train operations. Distance is a very important driver of train costs, while curvature is a key determinant of differences between maximum and average speed. The maximum gradient on a corridor determines the maximum trailing load for the locomotives and hence the efficiency of their utilisation. New alignments or routes may also be desirable as the most effective means to achieve an increase in height clearance.

Changing routes or alignment is a large cost item. Areas that are desirable for deviations are also usually geographically challenging. Creating a new route will, in most cases involve hundreds of kilometres of new line.

The primary benefits of a new alignment are generally in distance, transit time and maximum ruling gradient, or a combination of the three.

Capacity

Capacity is best measured as percentage utilisation of practical capacity.

The calculation of theoretical capacity uses a simple principle that daily capacity on a given section of track is determined as the number of minutes in the day divided by the section running time of the longest section, plus an allowance for safeworking / signal clearance. This is adjusted to practical capacity using a factor. ARTC generally uses an adjustment rate of 65% for single track based on practical experience. On double track, practical capacity is close to theoretical capacity.

Capacity is obviously an enabler of growth. However, it also has important implications for transit time. The construction of loops, passing lanes and double track reduces transit time by eliminating some or all crossing delay. In some cases this can be the most cost-effective means for reducing transit time.

Within this Strategy capacity has a unique importance. Where the other characteristics of the network are fixed in the absence of investment, capacity utilisation changes as the rail freight task changes. Hence, investment is driven by underlying growth in the task rather than by the objective of achieving efficiency gains.

6

North-South Corridor

Introduction

The North-South corridor is defined in two ways:

- From an ARTC infrastructure perspective it covers the network bounded by Tottenham (Melbourne) and the NSW-Queensland border. It includes the future Southern Sydney Freight Line and Sydney Metropolitan Freight Network, but excludes the electrified RailCorp network between North Strathfield Junction and Broadmeadow. Between Scholey Street Junction and Maitland the North-South Corridor includes the main lines but not the adjacent coal lines, which are addressed as part of the Hunter Valley region. The physical network is shown in Figure 21.

- From a market perspective it covers the following interstate intermodal freight origin – destination pairs:
    - Melbourne – Sydney
    - Sydney – Brisbane
    - Melbourne – Brisbane
    - Brisbane – Adelaide

ARTC took control of the majority of the North-South infrastructure on commencement of the NSW lease. The Tottenham - Albury line section was part of the pre-NSW lease ARTC network.

The north coast and the line south of Junee are dominated by the interstate intermodal traffics described above, while the double track between Macarthur and Junee carries a wide range of traffics, none of which dominate. Key non-intermodal traffics are:

- Steel products, particularly from Whyalla to Newcastle, Wollongong to Brisbane and Sydney (ex Wollongong) to Melbourne.
- Grain along the full length of the Melbourne – Sydney corridor, including export grain from the Cootamundra / Junee / The Rock areas to both Moss Vale (for Port Kembla) and Melbourne, and domestic grain to Sydney.
- Coal between Tahmoor and Moss Vale (for Port Kembla) and between Craven and Maitland (Stratford Colliery).
- Limestone from Marulan for the cement works at Berrima and Maldon, and for Port Kembla. Clinker is also moved between Berrima and Maldon.
- Copper concentrate between Cootamunda (ex Goonumbla) and Moss Vale (for Port Kembla).

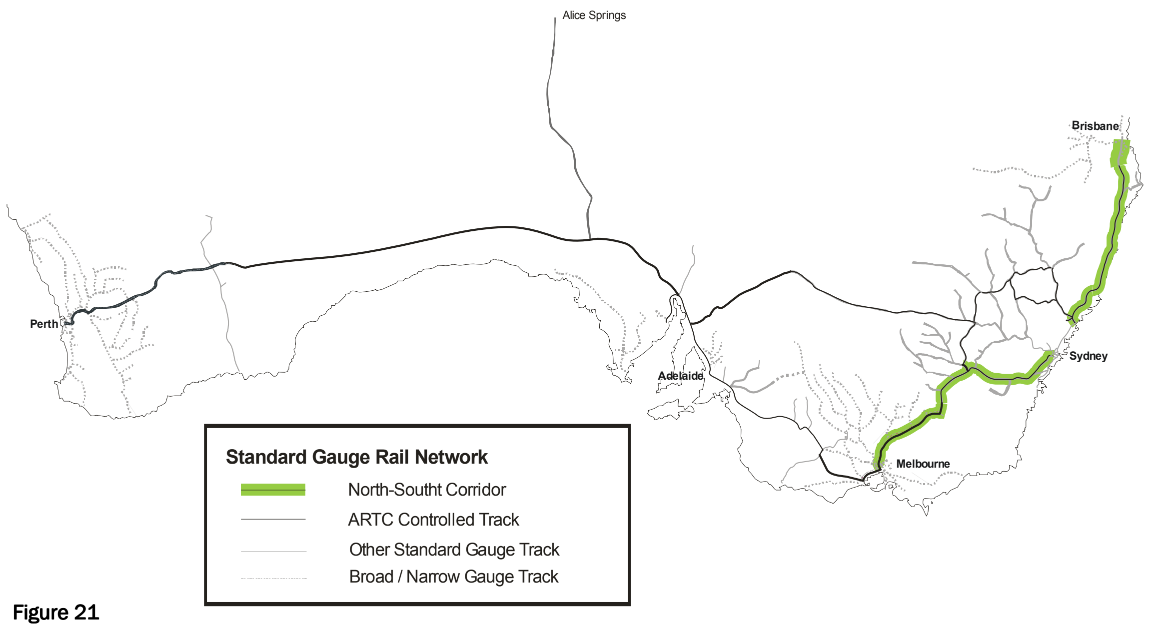
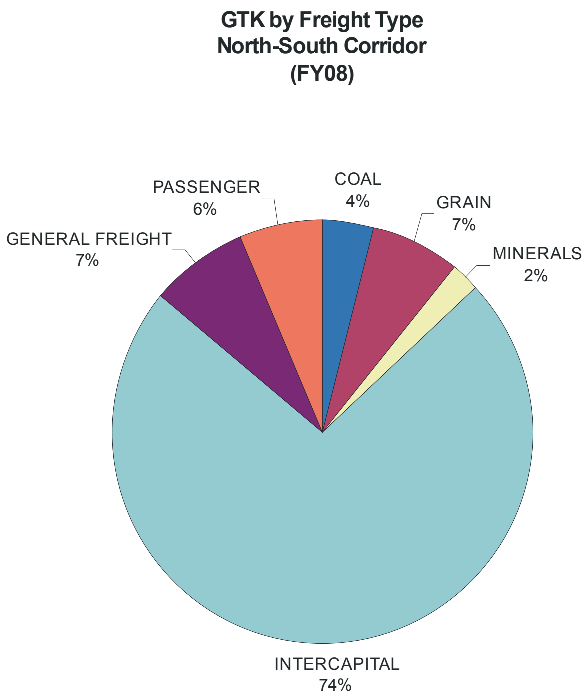


Figure 21

- Export containers between Junee and Melbourne, including traffic added at Wodonga.
- Containerised waste between Sydney and Goulburn (for Crisps Creek).
- Passenger services, being:
  - XPT services between Sydney and Brisbane, Casino, Grafton and Melbourne.
  - Explorer services between Sydney, and Canberra and Griffith.
  - Regional commuter services from Newcastle to Dungog and Campbelltown to Moss Vale / Goulburn.

Figures 22 and 23 show the split of GTK and revenue, respectively, for the North-South Corridor by traffic category.



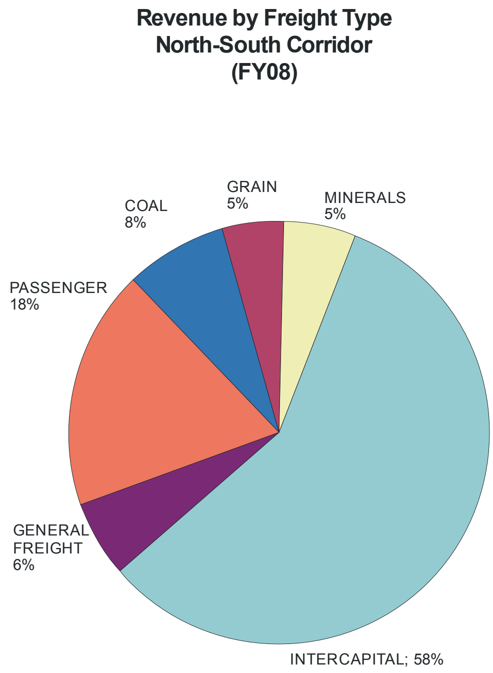


Figure 22 & 23

Intermodal Performance Requirements

Intermodal traffics have threshold performance requirements to meet market demand for freight cut-off and availability. This translates to a transit time objective for each origin-destination pair. On the north-south corridor the important markets, the transit time objectives ARTC has set in this strategy, and current actual transit times, are shown in Table 4.

Traffic	Target Transit Time	Current Average Transit Time
Melbourne - Sydney Intermodal	10.4	14.7
Sydney – Brisbane Intermodal	15.1	19.8
Melbourne - Brisbane Intermodal	28	34.5
Brisbane – Adelaide Intermodal	40	47.8

Table 4

2008 Infrastructure Characteristics

Table 5 sets out the performance of the North-South corridor against the key characteristics of the infrastructure as at early 2008.

Market Forecast

Growth projections for interstate intermodal freight have been set out in Section 3.

Assumed growth rates for other traffics are as follows:

- Steel traffic is assumed to grow at an underlying rate of 3.5% per year.
- Minerals and general freight traffic is generally assumed to grow at 2%.
- Export grain is assumed to grow at 1% or 2% with an underlying assumption that yield growth is greatest on the most marginal land. Domestic grain is assumed to grow at 3% reflecting economic growth.
- Passenger services are assumed to not grow.

There are two known significant potential new traffics for the North-South corridor. These are:

- Aggregates from the Marulan area to Sydney. The depletion of existing hard rock resources traditionally sourced from Prospect in Sydney has resulted in the three major aggregates suppliers looking to develop new resources. The two key replacement sources are the Bombo area on the NSW South Coast (which would not use the ARTC network), and the Marulan area, adjacent to the current limestone

North-South Corridor 2008	Sections	Speed / Axle Load	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Melbourne - Sydney	Dynon - Albury	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,500 m	4.15 m	CTC	307.1 km	1 in 50 Northbound 1 in 50 Southbound
	Albury – Junee	21 t at 115 km/h 23 t at 80k km/h	75 mm	1,500 m	4.03 m	CTC	162.2 km	1 in 40 Northbound 1 in 40 Southbound
	Junee – Macarthur	21 t at 115 km/h 23 t at 80k km/h	75 mm	1,800 m	4.03 m	Automatic Track Block	429.7 km	1 in 50 Northbound 1 in 40 Southbound
	Macarthur – Chullora (RailCorp)	21 t at 80 km/h 23 t at 80k km/h	75 mm	1,800 m	4.03 m	Automatic Track Block	37.0 km	1 in 100 Northbound 1 in 100 Southbound
Sydney - Brisbane	Chullora – Broadmeadow (RailCorp)	21 t at 80 km/h 23 t at 80k km/h	75 mm	1,500 m	4.03 m	Automatic Track Block	158.8 km	1 in 40 Northbound 1 in 40 Southbound
	Broadmeadow – Telarah	21 t at 115 km/h 23 t at 80 km/h	75 mm	1,500 m	4.03 m	Automatic Track Block	31.6 km	1 in 70 Northbound 1 in 90 Southbound
	Telarah – Qld Border	19.5 t at 115 km/h 23 t at 80 km/h	75 mm	1,500 m	4.03 m	CTC	680.6 km	1 in 66 Northbound 1 in 66 Southbound
	Qld-Border – Acacia Ridge (QR)	19.5 t at 115 km/h 23 t at 80 km/h	75 mm	1,500 m	4.03 m	CTC	98.3 km	1 in 66 Northbound 1 in 66 Southbound

Table 5 - Key performance characteristics of the North-South Corridor, 2008.

mining operations. It is anticipated that volumes from the Marulan area will grow very quickly from around 2010, levelling-out at about 10 mtpa.

- Melbourne – Albury Passenger Services. The prospective transfer of the Seymour – Albury broad gauge line to ARTC will see the existing 3 Melbourne – Albury return passenger services per day transfer from the broad to the standard gauge. This is assumed to occur for the 2009/10 financial year.

The modelling has assumed that there are no changes to train configuration over the 15 year period. While the current north-south investment will allow train lengths to increase between Melbourne and Sydney, a conservative position has been adopted that this will not necessarily occur. To the extent that average train lengths do increase it will reduce the number of trains on this section and hence performance will be better.

Train Numbers

Forecast volume growth under the high, medium and low scenarios has been translated into a train number forecasts to allow capacity utilisation and transit time to be modelled. This forecast, for two line sections that are representative of different parts of the corridor, is shown in Figure 24.

Enhancements

ARTC already has a significant investment program underway that will deliver a number of significant benefits, in particular:

- An increase in cant deficiency across most of the corridor, which will allow a speed increase of at least 5 km/h on most curves.
- Increasing speed / axle load to 21 t at 115 km/h on the Melbourne – Albury and Maitland – Border Loop sections.
- Eliminating the constraints on access to Sydney from the south through construction of the Southern Sydney Freight Line.
- Significantly reducing delay through the construction of additional crossing loops on the North Coast and passing loops, lanes and double track Junee – Melbourne.

The further major enhancements that ARTC believes are important for the north-south corridor over the next 15 years are as follows:

- **Capacity enhancement through Northern Sydney**. The corridor between Sydney and Newcastle, and in particular the southern end of it, is recognised as the major constraint on operations on the north-south corridor. Freeing-up capacity in this area is key to rail increasing its levels of reliability. ARTC has proposed an initial objective of four freight paths per hour for 22 hours per day and and a scope of work with an estimated cost of $830 million to achieve this. This project was an election commitment of the Federal Labor Government, and ARTC has assumed in this Strategy that the project will proceed, with completion in 2014. The modelling assumes that these works boost Melbourne – Brisbane and Sydney – Brisbane reliability by 10 percentage points. A second stage to lift capacity to four paths per hour for 24 hours per day is desirable. This work would also have significant benefits for passenger services. ARTC believes that funding in the order of $1 billion would appropriately reflect the benefit to freight services of this second stage, and that a 2020 timeframe for completion is appropriate.
- **Development of a new multi-user intermodal terminal at Moorebank.** This will remove the constraints to both competition and growth caused by the current limited terminal capacity, and provide a more efficient and better located option. It would also facilitate the introduction of double-stacking out of Sydney.
- ARTC is concerned about intermodal **terminal capacity in Brisbane** and has not seen reliable plans for improvement. This Strategy makes no proposals for a scheme to address this concern. However, ARTC recommends that the Queensland and Austra-

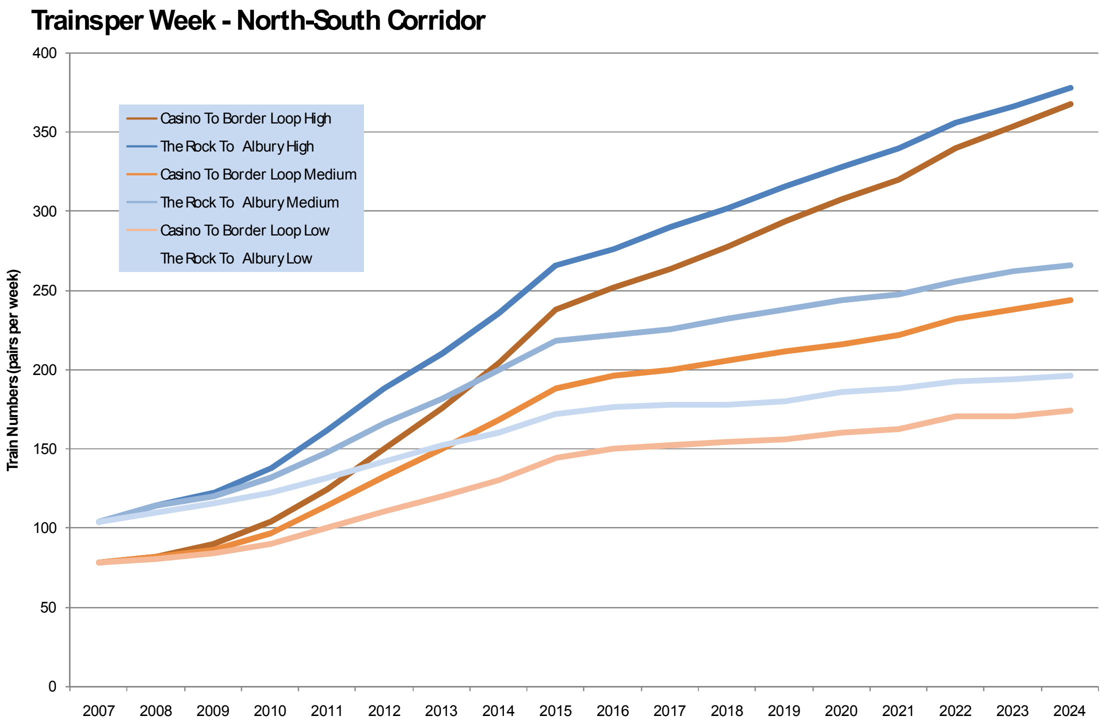


Figure 24

lian Government give further consideration to options, and what Government intervention may be appropriate to ensure that this potential bottleneck does not become a critical issue.

- **NTCS**. In common with the rest of the network, the Network-wide Train Communications System will be rolled-out across the north-south corridor over the next 12 months.

- **ATMS**. The north-south corridor would need to be upgraded to ATMS from 2011. However, this relies on Government assistance. As discussed below, ARTC anticipates extensive capacity works will be required on this corridor and the early introduction of ATMS will allow significant savings on these works by minimising the signalling scope. ARTC also believes that the introduction of ATMS into the Sydney and Melbourne metropolitan areas will strongly support the development of cross-metropolitan container traffic.

- **Double stacking Melbourne – Sydney**. Clearing the Melbourne – Sydney line for double stacking would offer a cost saving of 1.5% to 2.5% in the largest general freight market, while providing significant additional capacity. Economic analysis suggests that this project is justified in a 2015/16 timeframe under the high growth scenario.

- **Deviations on both the North Coast, and Main South line between Goulburn and Junee**. Deviations offer significant benefits in terms of reduced transit time and reduced distance. As already noted, many capacity projects are required in order to maintain transit times at target levels in an environment of growing volumes. In some cases deviations can offer a lower cost solution to maintaining transit time while offering material costs savings for both above and below rail as a result of shorter route distance and a shorter, better quality track. This Strategy provides for a total of 8 deviations to be completed in 2014.

There is a long-standing proposal for a new "**Inland Route**" between Melbourne and Brisbane following a corridor that remains to the west of the Great Dividing Range for as much of the distance as possible. This proposal is currently subject to a $15 million study requested by the Australian Government. ARTC has not identified a compelling requirement to pursue an Inland Route in the 15-year timeframe of this Strategy. While ARTC sees this as a potential longer-term goal, at this time there are no market benefits that would appear to justify the significant cost. Sufficient capacity has also been able to be provided through targeted enhancement of the coastal route at a cost significantly below the expected cost of an inland solution. Accordingly, this Strategy does not make any provision for an Inland Route. However, ARTC will review the position once the current Inland Route study is complete.

With the enhancement projects currently underway, together with those proposed above, the North-South Corridor would have the characteristics set out in Table 6 in 2024. It is assumed that within this timeframe ARTC will have been successful in securing control of the track from the NSW / Qld Border to Acacia Ridge and will have rolled-out comparable upgrading to that which it is delivering on its current network. Characteristics that are an improvement over the current level of performance are highlighted in bold.

Proposed Investment

Enhancement projects have already been described above.

Given the dramatic growth in volumes forecast in the high growth scenario, capacity will become constrained on both the North Coast and the south by 2013 to 2014. This is despite the significant capacity increases delivered by the current investment program.

Just as critically, to maintain target Superfreighter transit times will require investment in loops and passing lanes starting by 2012.

ARTC is proposing a number of interrelated projects at Port Botany and Enfield to enhance the capacity for cross-metropolitan container movements. These works will optimise the performance of either end of this line to ensure maximum use is made of the current single track portion of the line.

ARTC's proposed scope of investment is set out in Table 7.

Outcomes

Performance with the proposed investment is summarised in Table 8.

8. 6.80 metre height clearance would only be provided as far as Moorebank terminal. Moorebank – Chullora and the metropolitan freight network would remain at 4.03 m

9. Note that all costs are "order of magnitude" estimates only and are in $2008.

North-South Corridor 2024	Sections	Speed / Axle Load	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Melbourne - Sydney	Dynon - Albury	**21 t at 115 km/h** **23 t at 80k km/h**	**110 mm**	**1,800 m**	**6.80 m**	**ATMS**	307.1 km	1 in 50 Northbound 1 in 50 Southbound
	Albury – Junee	21 t at 115 km/h 23 t at 80k km/h	**110 mm**	**1,800 m**	**6.80 m**	**ATMS**	162.2 km	1 in 40 Northbound 1 in 40 Southbound
	Junee – Macarthur	21 t at 115 km/h 23 t at 80k km/h	**110 mm**	1,800 m	**6.80 m**	**ATMS**	**408.0 km**	1 in 50 Northbound 1 in 40 Southbound
	Macarthur – Chullora (ARTC)	21 t at 115 km/h 23 t at 80k km/h	**110 mm**	1,800 m	**6.80 m**	**ATMS**	37.0 km	1 in 100 Northbound 1 in 100 Southbound
Sydney - Brisbane	Chullora – Broadmeadow (RailCorp)	21 t at 80 km/h 23 t at 80k km/h	**110 mm**	1,500 m	4.03 m	Automatic Track Block	158.8 km	1 in 40 Northbound 1 in 40 Southbound
	Broadmeadow – Telarah	21 t at 115 km/h 23 t at 80 km/h	**110 mm**	1,500 m	4.03 m	**ATMS**	31.6	1 in 70 Northbound 1 in 90 Southbound
	Telarah – Qld Border	**21 t at 115 km/h** **23 t at 80k km/h**	**110 mm**	1,500 m	4.03 m	**ATMS**	**665.0**	1 in 66 Northbound 1 in 66 Southbound
	Qld-Border – Acacia Ridge (ARTC)	**21 t at 115 km/h** **23 t at 80k km/h**	**110 mm**	1,500 m	4.03 m	**ATMS**	**92.3**	1 in 66 Northbound 1 in 66 Southbound

Table 6 - Key performance characteristics of the North-South Corridor, 2024.

Year	Section	Scope	Cost ($m)
2011	Brisbane - Sydney	22 loop extensions and 4 new loops	$260
2011	Sydney	Port Botany Upgrade	$49
2013	Brisbane - Sydney	Northern Sydney Freight Works Stage 1	$830
2013	Cootamundra - Melbourne	Duplication Seymour - Tottenham	$300
2014	Brisbane - Sydney	3 deviations	$441
2014	Sydney - Cootamundra	4 deviations	$351
2014	Cootamundra - Melbourne	1 deviation	$70
2015	Brisbane - Sydney	17 Passing Lanes of 14 km each	$481
2015	Cootamundra - Melbourne	Duplication Wodonga - Junee	$300
2015	Sydney - Cootamundra	Double-stack clearances	$214
2016	Cootamundra - Melbourne	Double-stack clearances	$107
2018	Brisbane - Sydney	16 Passing Lanes of 14 km each	$480
2019	Sydney - Cootamundra	SSFL Enhancement	$50
2020	Brisbane - Sydney	Northern Sydney Freight Works Stage 2	$1,000
		Total	**$4,933**

Table 7[9] - Proposed scope of work on the North-South Corridor.

	Melbourne - Sydney#	Sydney - Brisbane*	Melbourne - Brisbane	Brisbane - Adelaide
Capacity (Superfreighter pairs per week)				
2009	10	8	16	2
2014	36	33	45	3
2019	59	67	64	4
2024	74	92	77	5
Transit Time (Hours)				
Target	10.4	15.1	28.0	40.0
2009	11.2	14.7	25.9	37.3
2014	10.1	14.2	24.8	36.1
2019	10.1	14.1	24.7	36.0
2024	10.2	15.0	25.7	37.3
Reliability (% freight available on-time)				
2009	55%	55%	45%	45%
2014	85%	75%	75%	75%
2019	85%	85%	85%	85%
2024	85%	85%	85%	85%

Transit time to Chullora in 2009 & to Moorebank thereafter.

* Transit time to Chullora in all years.

Table 8 - Performance outcomes for the North-South Corridor.

7

East-West Corridor

Introduction

The East-West corridor is defined in two ways:

- From an infrastructure perspective it covers the network bounded by Cootamundra, Dynon (Melbourne) and Kalgoorlie, as shown in Figure 25.
- From a market perspective it encompasses the traffic that flows across the infrastructure, including the following interstate intermodal freight origin – destination pairs, some of which extend beyond the boundaries of the infrastructure:
  - Melbourne – Perth
  - Sydney – Perth
  - Brisbane – Perth
  - Adelaide – Perth
  - Melbourne – Adelaide
  - Sydney – Adelaide

The east-west corridor is dominated by the interstate intermodal freight traffics noted above. Other traffics that operate over it are:

- Steel products, particularly from Whyalla to Melbourne and Newcastle.
- Grain:
  - Between Cootamundra and Euabalong West,
  - Along the full length of the Melbourne – Adelaide line.
  - North from Adelaide to Crystal Brook.
- Lead concentrate between Broken Hill and Port Pirie.
- Mineral sands between the Bemax siding at Kanandah (Broken Hill) and Port Pirie.
- Copper concentrate (in relatively small amounts) from Cobar to Port Pirie.
- Export containers between Adelaide and Melbourne and from Port Pirie and Bowmans (north of Adelaide) to Adelaide.
- Passenger services, being:

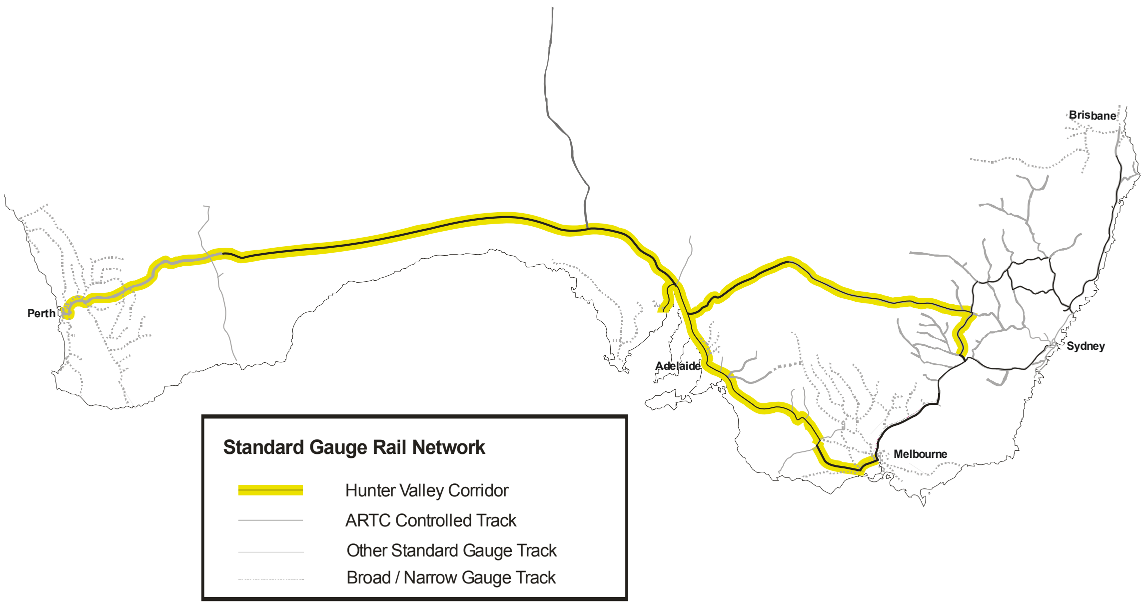


Figure 19

- The Indian Pacific between Sydney and Perth via Adelaide.
- The Ghan between Adelaide and Darwin (which operates on the east-west corridor as far as Tarcoola)
- The Overland between Melbourne and Adelaide.
- The CountryLink Outback Explorer between Sydney and Broken Hill (which operates on the east-west corridor between Parkes and Broken Hill).

Figures 26 and 27 show the split of GTK and revenue respectively by traffic category for the East-West Corridor.

Performance Requirements

Intermodal traffics frequently have threshold performance requirements to meet market demand for freight cut-off and availability. This translates to a transit time objective for each origin-destination. On the east-west corridor the important markets, the transit time objectives ARTC has set in this strategy, and current actual transit times, are shown in Table 9.

Traffic	Target Transit Time	Current Average Transit Time
Melbourne – Perth Intermodal	58	57.3
Melbourne – Perth Express Intermodal	50	47.0
Sydney – Perth Intermodal	74	68.1
Sydney – Perth Express Intermodal	50	53.5
Melbourne – Adelaide Intermodal	12	13.3
Adelaide – Perth Intermodal	42.5	40.6
Sydney – Adelaide Intermodal	28	29.3

Table 9 - Current and ARTC Target Transit Times.

2008 Infrastructure Characteristics

Table 10 sets out the performance of the East-West corridor against the key characteristics of the infrastructure in 2008.

Market Forecast

Forecast intermodal volume growth has been set out in section 4. In addition to the assumptions set out in that section, assumptions about existing and new traffics have been modelled as set out in Table 11.

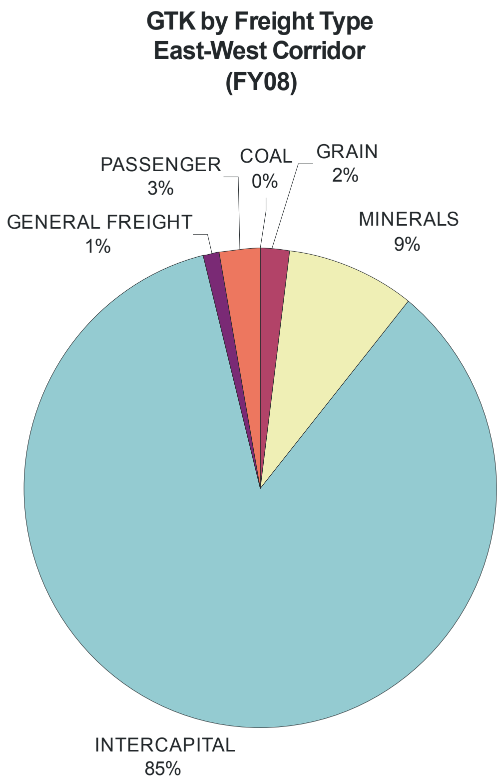
Train Numbers

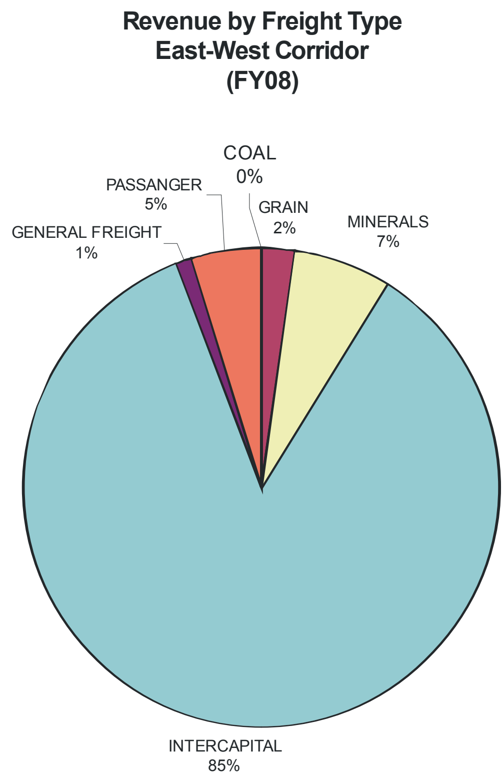
Forecast volume growth under the high, medium and low scenarios has been translated into a train number forecasts to allow capacity utilisation and transit time to be modelled. This forecast for four line sections that are representative of different parts of the corridor is shown in Figure 28.

Enhancements

The major enhancements that ARTC wishes to pursue on the east-west corridor over the next 15 years are as follows:

- **1800 metre train length Melbourne – Adelaide.** Moving from the current corridor limit of 1500 metres to 1800 metres would both add capacity, and bring operational efficiencies. There is a requirement for a number of loops of less than 1500 metres to be extended on this line and a significant number of existing “1500 metre” loops are physically 1800 metres and can be made to accommodate 1800 metres with relatively straightforward signalling changes. These circumstances suggest that 1800 metres is a logical and cost-effective





Figures 26 & 27

East-West Corridor 2008	Sections	Speed / Axle Load & Cant Deficiency	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Melbourne - Adelaide	Dynon – Gerringhap	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,500 m	4.10 m	CTC	95.9 km	1 in 100 Eastbound 1 in 80 Westbound
	Gerringhap – Maroona	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,500 m	4.10 m	Data Train Orders	62.7 km	1 in 90 Eastbound 1 in 90 Westbound
	Maroona – Islington	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,500 m	4.10 m	CTC	597.1 km	1 in 40 Eastbound 1 in 40 Westbound
Adelaide - Perth	Islington – Port Augusta	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,800 m	6.50 m	CTC	307.2 km	1 in 100 Eastbound 1 in 100 Westbound
	Port Augusta - Kalgoorlie	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,800 m	6.80 m	Train Orders	1,684.5 km	1 in 90 Eastbound 1 in 80 Westbound
	Kalgoorlie – Perth (Westnet Rail)	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,800 m	6.80 m	Train Orders	653.0 km	1 in 90 Eastbound 1 in 90 Westbound
Cootamundra - Crystal Brook	Cootamundra - Parkes	19.5 at 100 km/h 21 at 80 km/h 23 at 55 km/h	75 mm	1,800 m	4.05 m	Electric Train Staff	200.5 km	1 in 75 Eastbound 1 in 75 Westbound
	Parkes - Broken Hill	21 at 115 km/h 23 at 80 km/h	75 mm	1,800 m	5.90 m	Train Orders	677.0 km	1 in 100 Eastbound 1 in 100 Westbound
	Broken Hill – Peterborough	20 t at 115 km/h 21 t at 110 km/h 23 t at 80 km/h	75 mm	1,800 m	5.90 m	Train Orders	283.5 km	1 in 100 Eastbound 1 in 120 Westbound
	Peterborough – Crystal Brook	21 t at 110 km/h 23 t at 80 km/h	75 mm	1,800 m	6.50 m	Train Orders	86.5 km	1 in 80 Eastbound 1 in 120 Westbound

Table 10 - Key performance characteristics of the East-West Corridor, 2008.

strategy. It is proposed that the necessary works to allow the train length increase be completed in 2013.

- **Double stacking Sydney – Parkes**. Clearing the Sydney – Parkes line for double stacking would allow both Sydney – Perth and Sydney – Adelaide traffic to go to a double stacked configuration. This would bring both significant efficiencies, and capacity benefits. It would also complement the introduction of double-stacking between Melbourne and Sydney. This Strategy has assumed the project is completed in 2015, based on the indicative timeframe suggested by a preliminary economic analysis.
- **Track upgrading western Victoria and Cootamundra – Parkes**. Upgrading of these line sections would allow increases in maximum speed, and in cant deficiency. These would both increase operational efficiency and reduce transit time.
- **Horsham Bypass**. A deviation around Horsham would save approximately 15 km and reduce transit time by 10 minutes. A significant proportion of the cost could be offset against the cost of track upgrading of the existing, significantly longer, route.
- **NTCS**. In common with the rest of the network, the Network-wide Train Communications System will be rolled-out across the east-west corridor over the next 12 months.
- **ATMS**. It would be desirable to upgrade the east-west corridor to ATMS from 2011.

This Strategy does not make provision for double-stacking between Melbourne and Adelaide in its 15-year timeframe. While ARTC sees this as a desirable longer-term goal, at this time economic analysis suggests that under current scenarios it is not required in the next 15 years.

The Strategy also does not make provision for an Adelaide Hills bypass, which is one option for achieving double-stacking and also offers some other operational benefits. Such a bypass requires further research and may be justified for reasons not directly associated with rail performance. In the event that Government decided to pursue a bypass, it may bring forward the time at which implementation of double-stacking is economically justified.

With the enhancement projects proposed above, the East-West Corridor would have the characteristics set out in Table 12 in 2019. Improvements from 2008 are shown in bold

Proposed Investment

Modelling indicates that capacity constraints will become significant on the Melbourne – Adelaide corridor, between Port Augusta and Tarcoola, and between Kalgoorlie and Perth.

To maintain target Superfreighter transit times will also require investment in further loops.

ARTC's proposed scope of investment over the period to 2024 is set out in Table 13.

Outcomes

Performance with the proposed investment is summarised in Table 14.

	Low	Medium	High
Steel and Melbourne – Adelaide Shipping Containers	3.5% p.a.	3.5% p.a.	3.5% p.a.
Minerals & General Freight	2% p.a.	2% p.a.	2% p.a.
Export Grain	1% - 2% p.a.	1% - 2% p.a.	1% - 2% p.a.
Domestic Grain	3% p.a.	3% p.a.	3% p.a.
Passenger	Nil	Nil	Nil
Western Plains	3 mtpa in 2012 (Peculiar Knob only)	11 mtpa in 2012 (Peculiar Knob + Hawkes Nest)	11 mtpa in 2012 (Peculiar Knob + Hawkes Nest)
Goldstream	1.4 mtpa in 2012	1.4 mtpa in 2012	1.4 mtpa in 2012
BHPB	2.5 mtpa in 2012 (option 1)	3.1 mtpa in 2012 (option 2)	21.5 mtpa in 2012 (option 3)
Mindarie	0.3 mtpa in 2012	0.3 mtpa in 2012	0.3 mtpa in 2012
Penola	0.75 mtpa in 2012	0.75 mtpa in 2012	0.75 mtpa in 2012

Table 11 - Scenario assumptions for East-West non-intermodal Traffics.

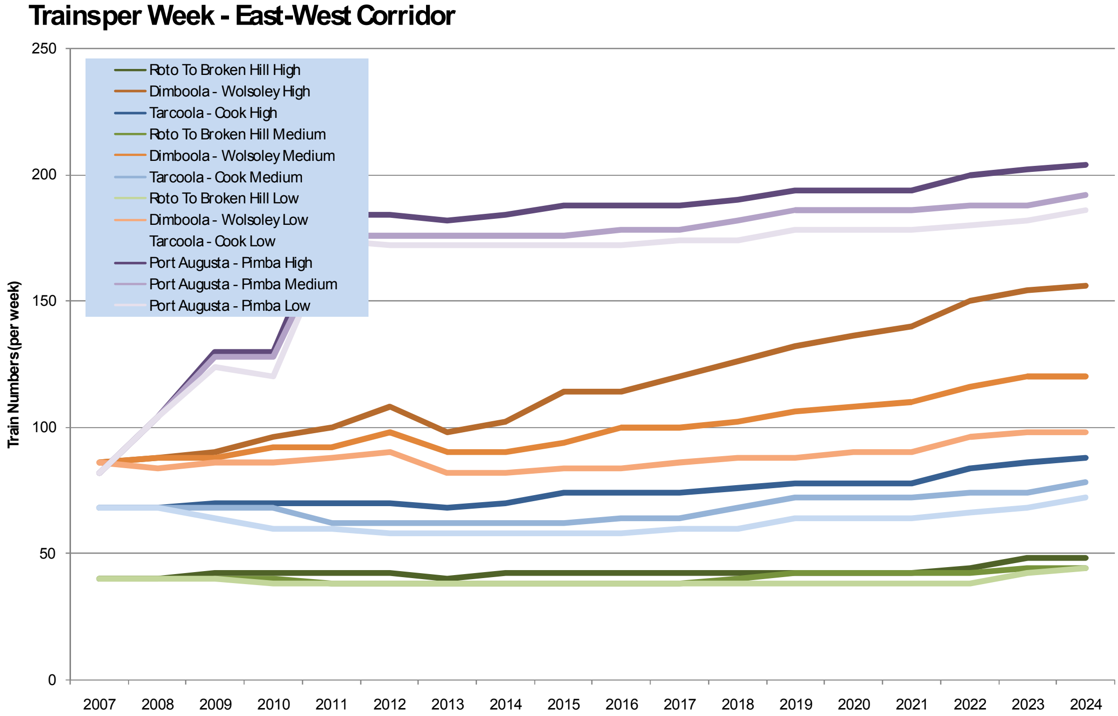


Figure 28

East-West Corridor 2008	Sections	Speed / Axle Load & Cant Deficiency	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Melbourne - Adelaide	Dynon – Gerringhap	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	**1,800 m**	4.10 m	**ATMS**	95.9 km	1 in 100 Eastbound 1 in 80 Westbound
	Gerringhap – Maroona	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	**1,800 m**	4.10 m	**ATMS**	62.7 km	1 in 90 Eastbound 1 in 90 Westbound
	Maroona – Islington	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	**1,800 m**	4.10 m	**ATMS**	**582.1 km**	1 in 40 Eastbound 1 in 40 Westbound
Adelaide - Perth	Islington – Port Augusta	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	307.2 km	1 in 100 Eastbound 1 in 100 Westbound
	Port Augusta - Kalgoorlie	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	1,684.5 km	1 in 90 Eastbound 1 in 80 Westbound
	Kalgoorlie – Perth (ARTC)	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	653.0 km	1 in 90 Eastbound 1 in 90 Westbound
Cootamundra - Crystal Brook	Cootamundra - Parkes	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	200.5 km	1 in 75 Eastbound 1 in 75 Westbound
	Parkes - Broken Hill	21 t at 115 km/h 23 t at 80 km/h	75 mm	1,800 m	**6.80 m**	**ATMS**	677.0 km	1 in 100 Eastbound 1 in 100 Westbound
	Broken Hill – Peterborough	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	283.5 km	1 in 100 Eastbound 1 in 120 Westbound
	Peterborough – Crystal Brook	**21 t at 115 km/h** **23 t at 80 km/h**	**110 mm**	1,800 m	**6.80 m**	**ATMS**	86.5 km	1 in 80 Eastbound 1 in 120 Westbound

Table 12

Year	Section		Scope	Cost ($m)
2010	Melbourne - Adelaide		7 loop extensions	$9
2010	Melbourne - Adelaide		Geelong port connection	$60
2010	Adelaide - Crystal Brook		1 loop extension	$5
2010	Crystal Brook - Kalgoorlie		4 new loops	$24
2010	Cootamundra - Crystal Brook		Upgrading, including TOW and 2 loops	$85
2011	Melbourne - Adelaide		5 new loops	$12
2011	Melbourne - Adelaide		Track upgrading	$110
2011	Crystal Brook - Kalgoorlie		2 new loops	$12
2011	Kalgoorlie - Perth		4 new loops	$24
2011	Cootamundra - Crystal Brook		5 loop extensions	$24
2012	Melbourne - Adelaide		11 loop extensions	$29
2012	Crystal Brook - Kalgoorlie		11 new loops	$66
2013	Melbourne - Adelaide		15 loop extensions	$16
2013	Melbourne - Adelaide		Grade separation of Goodwood Jct	$85
2013	Adelaide - Crystal Brook		Grade separation of Torrens Jct	$35
2016	Crystal Brook - Kalgoorlie		5 new loops	$30
2017	Crystal Brook - Kalgoorlie		4 new loops	$24
2019	Melbourne - Adelaide		2 new loops	$12
2022	Melbourne - Adelaide		3 new loops	$12
			Total	**$674**

Figure 13 [10] - Proposed scope of work on the East-West Corridor.

	Melbourne - Perth	Melbourne - Perth Express	Sydney - Perth#	Sydney - Perth Express	Melbourne - Adelaide	Adelaide - Perth	Sydney - Adelaide
Capacity (Superfreighter pairs per week)							
2009	11	2	6	5	3	5	4
2014	11	3	6	5	7	5	8
2019	14	3	7	6	12	6	15
2024	16	3	8	7	17	7	19
Transit Time (Hours)							
Target	58.0	50.0	74.0	50.0	12.0	42.5	28.0
2009	55.7	47.7	54.3	52.3	11.6	41.1	22.6
2014	55.3	47.3	53.8	51.8	11.5	40.8	21.4
2019	55.7	47.7	54.4	52.4	11.5	41.2	21.4
2024	56.5	48.5	55.3	53.3	11.8	41.7	21.8
Reliability (% freight available on-time)							
2009	75%	80%	80%	80%	55%	80%	55%
2014	75%	80%	80%	80%	55%	80%	85%
2019	75%	80%	80%	80%	55%	80%	85%
2024	75%	80%	80%	80%	55%	80%	85%

Train Numbers include Parkes - Perth

Table 14 - Performance outcomes for the East-West Corridor.

10 Note that all costs are “order of magnitude” estimates only and are in $2008.

8

Hunter Valley Corridor

Introduction

The Hunter Valley corridor is defined by the infrastructure required by the Hunter Valley coal industry. This covers the network as shown in Figure 29.

Coal is the dominant traffic across all of this network, though general freight, grain and passenger services represent a significant proportion of the traffic north of Muswellbrook on the line to the Gunnedah Basin. Coal to Craven on the North Coast line is treated as a North-South Corridor traffic.

All but a very small proportion of the export coal shipped through Newcastle is transported by rail for shipping from either Carrington (Port Waratah) or Kooragang Island.

Most of this coal comes from a series of mines and coal loaders strung out along the Hunter Valley, conveyed to the ports on the railway that runs between Muswellbrook and Newcastle. Coal also feeds onto this line from Ulan and Gunnedah, west and northwest of Muswellbrook respectively, and, much closer to the port, from Stratford, Pelton and the southern suburbs of Newcastle.

Domestic coal is also transported over the same network. This sector is comparatively small, but demand is anticipated to grow substantially over the next five years, especially on the Ulan and Upper Hunter lines. Macquarie Generation has recently commissioned a new balloon loop at Drayton that will receive substantial volumes of coal originating from mines on the Ulan line.

Export coal also arrives at the port from the Newstan and Teralba mines to the south of Newcastle. This traffic operates on the RailCorp network as far as Broadmeadow. Accordingly this strategy does not specifically address these volumes.

The Hunter Valley coal network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line from Maitland to Antiene and a shared single track with passing loops, and some short sections of double track, from that point north and west.

The heaviest coal volumes are at the lower end of the Hunter Valley, but the expected growth in coal mining along the Ulan line and in the Gunnedah basin is likely to produce significant changes in coal demand and traffic patterns over the next few years, necessitating a strong focus on the single track sections of the network north of Muswellbrook.

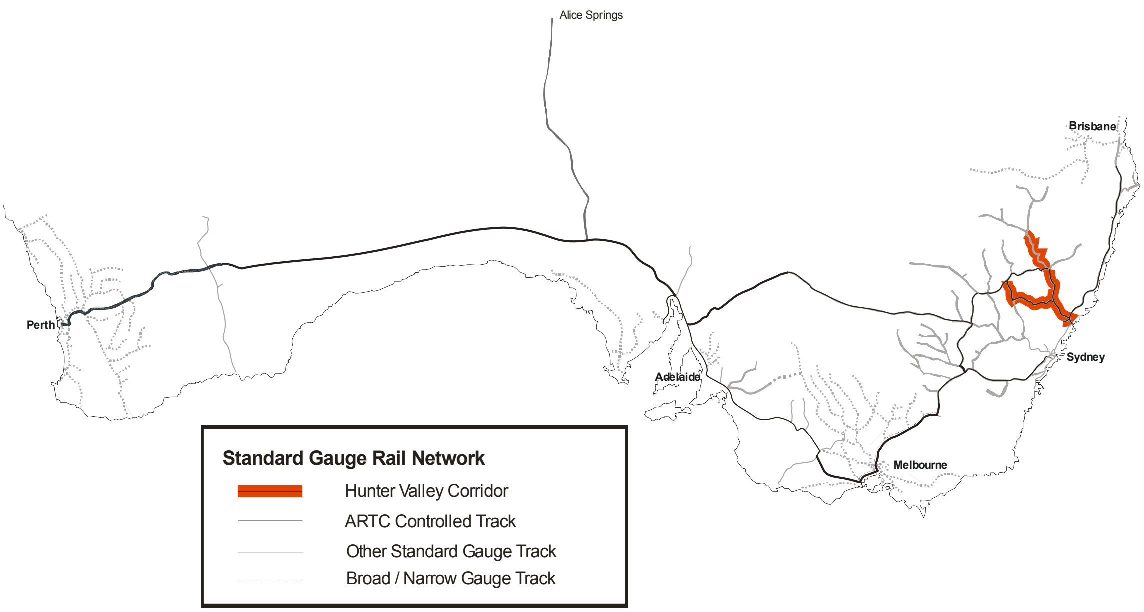


Figure 29

2008 Infrastructure Characteristics

Table 15 sets out the performance of the Hunter Valley corridor against the key characteristics of the infrastructure as at 2008.

Market Forecast

This Strategy assumes that the forecast coal demand of 107 mtpa for 2007 will increase to around 133 mtpa in 2009, 220 mtpa in 2014, 244 mtpa in 2019 and 278 mtpa in 2022.

These forecasts are based on ARTC consultations with the coal mining industry. In the short-term these forecasts significantly exceed the port capacity that will be available.

Declared capacity for 2008 is 96.4 mtpa, which will result in coal volumes being constrained by 18%. For 2009, ARTC is expecting declared capacity to run at 100 mtpa until the NCIG third loader, or the PWCS capacity upgrade, create more capacity. At 100 mtpa capacity, 2009 volumes would be constrained by 25% below what producers have advised they would like to produce.

ARTC has assumed that PWCS capacity becomes available in the second quarter of 2009. NCIG is expected to ramp-up progressively from the first quarter 2010 to the fourth quarter. With the completion of NCIG, nameplate port capacity will be 143 mtpa. However, demand forecasts will continue to outstrip this capacity. Both PWCS and NCIG have options for the further development of their terminals. There is an extensive master planning exercise underway at present, led by the Hunter Valley Coal Chain Logistics Team, to determine the optimum path forward for achieving coal chain capacity in-line with producer's aspirations. It is anticipated that this will lead to recommendations for further enhancements to the coal chain infrastructure that will ultimately provide a path forward to meet forecast volumes.

11 Technically the Gap, which represents the northern extent of ARTC's current lease.

In the meantime, ARTC planning has proceeded on the basis that beyond 2011 the other parts of the coal logistics chain will deliver sufficient capacity to accommodate the producer forecasts. Accordingly, ARTC's planning is based on providing sufficient rail infrastructure capacity to meet proposed aspirations.

Enhancements

ARTC is pursuing six enhancements to the Hunter Valley network.

First there is a short-term goal to introduce trains of up to 1350 metres on the line to the Gunnedah basin. Trains on this corridor are currently limited to 740 metres. Moving to the longer train configuration will bring significant efficiencies for these producers as well as providing capacity benefits for both the rail network and the port.

The second aim is to offer 30 tonne axle loads to the Gunnedah basin. At present axle loads are limited to 25 tonnes, where the rest of the Hunter Valley area operates at a standard 30 tonnes. Whether to adopt 30 tonne axle loads is a matter for the industry, which will ultimately meet the cost. ARTC's role is to provide all of the information it requires, mainly future pricing, to allow it to make an informed decision.

A new alignment over the Liverpool Range will deliver the third enhancement, the elimination of the current ruling 1 in 40 gradient and thereby the need to use "bank" engines. The 1 in 40 gradient also represents a barrier to trains longer than around 1350 metres and the new alignment will create the opportunity to consider going to longer trains on this line, probably the current Hunter Valley standard of 1650 metres, which would represent the fourth enhancement.

The fifth initiative is a long term aim to adopt North American rollingstock outlines. As discussed in Section 5, this will allow increased efficiencies in loading, and the acquisition of off-the-shelf rolling stock. While all new structures are being built to a suitable outline, it is not anticipated that the this outline will be introduced within the 15 year timeframe of this Strategy.

	ARTC Sections	Speed / Axle Load	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Newcastle - Muswellbrook	Port Waratah - Maitland	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	CTC	28.0 km	1 in 90 Southbound 1 in 70 Northbound
	Maitland - Muswellbrook	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	CTC	95.4 km	1 in 80 Southbound 1 in 60 Northbound
Muswellbrook - Ulan	Muswellbrook - Ulan	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	CTC	146.6 km	1 in 80 Southbound 1 in 50 Northbound
Muswellbrook - NarHunter Valley Corridor 2008 rabri	Muswellbrook - Dartbrook	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	CTC	7.5 km	1 in 90 Southbound 1 in 70 Northbound
	Dartbrook – Werris Creek [11]	21 t at 115 km/h 25 t at 80 km/h	75 mm	740 m	3.916 m	CTC	119.6 km	1 in 40 Southbound 1 in 40 Northbound
	Werris Creek – Narrabri (RIC)	21 t at 115 km/h 25 t at 80 km/h	75 mm	740 m	4.220 m	Electric Staff	149.5 km	1 in 75 Southbound 1 in 50 Northbound

Table 15 - Key performance characteristics of the Hunter Valley Corridor, 2008.

ATMS is the sixth enhancement and is assumed to be rolled out from 2011. The large sunk cost in the existing CTC signalling system, and its relative newness, raise some questions as to whether ATMS is a suitable investment within the 15 year timeframe of this Strategy. However, the significant above-rail benefits and strong demand for additional capacity suggest that it is prudent to plan for its rollout. As with all ARTC investments, this position will be kept under continuing review.

With the enhancement projects proposed above, the Hunter Valley Corridor would have the characteristics set out in Table 16 in 2024 , with improvements since 2008 shown in bold.

Proposed Investment

ARTC is well positioned to ensure that track capacity remains ahead of demand despite the large forecast increases in volume.

ARTC's proposed scope of investment is set out in Table 17. The scope essentially provides for:

- Progressive development of a third track the full distance from Maitland to the foot of Nundah bank (near Newdell).
- Loop extensions and, subsequently, double tracking of the corridor between Muswellbrook and Gunnedah, with additional loops between Gunnedah and the connection point for the Narrabri mine.
- Additional loops on the Ulan line, with double track extending from Muswellbrook to the junction for the Anvil Hill mine.

The total scope amounts to an order of magnitude cost in $2008 of $1,790 million.

Performance with Investment

ARTC's proposed scope of work is designed to ensure that capacity remains ahead of demand. ARTC does not set target transit times for coal services. However, given the nature of the volume growth, and ARTC proposed scope of works, it would be anticipated that journey times would:

- Remain reasonably constant between the ports and Muswellbrook.
- Improve significantly between Muswellbrook and Gunnedah, and Muswellbrook and Anvil Hill.

Hunter Valley Corridor 2008	ARTC Sections	Speed / Axle Load	Cant Deficiency	Max Train Length	Container Height Clearance	Signalling System	Distance	Ruling Gradient
Newcastle - Muswellbrook	Port Waratah - Maitland	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	**ATMS**	28.0 km	1 in 90 Southbound 1 in 70 Northbound
	Maitland - Muswellbrook	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	**ATMS**	95.4 km	1 in 80 Southbound 1 in 60 Northbound
Muswellbrook - Ulan	Muswellbrook - Ulan	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	**ATMS**	146.6 km	1 in 80 Southbound 1 in 50 Northbound
Muswellbrook - Narrabri	Muswellbrook - Dartbrook	21 t at 115 km/h 25 t at 80k km/h 30 t at 60 km/h	75 mm	1,650 m	3.916 m	**ATMS**	7.5 km	1 in 90 Southbound 1 in 70 Northbound
	Dartbrook – Werris Creek	**21 t at 115 km/h** **25 t at 80k km/h** **30 t at 60 km/h**	75 mm	**1,650 m**	3.916 m	**ATMS**	119.6 km	**1 in 80 Southbound** 1 in 40 Northbound
	Werris Creek – Narrabri (RIC)	**21 t at 115 km/h** **25 t at 80k km/h** **30 t at 60 km/h**	75 mm	**1,650 m**	4.220 m	**ATMS**	149.5 km	1 in 75 Southbound 1 in 50 Northbound

Table 16 - Key performance characteristics of the Hunter Valley Corridor, 2024.

Year	Section	Scope	Cost ($m)
2008	Newcastle- Muswellbrook	Antiene to Grasstree duplication	$30
2008	Muswellbrook - Ulan	Muswellbrook - Ulan CTC	$9
2008	Muswellbrook - Ulan	Mangoola (304 km) loop	$9
2008	Muswellbrook - Ulan	Rylestone Rd (381 km) loop	$9
2008	Muswellbrook - Ulan	Wollar (410 km) loop	$11
2008	Muswellbrook - Narrabri	Willow Tree loop extension	$6
2008	Muswellbrook - Narrabri	Gunnedah loop (RIC)	$11
2008	Muswellbrook - Narrabri	Ardglen loop extension	$10
2008	Muswellbrook - Narrabri	Werris Creek to Gunnedah CTC (RIC)	$10
2008	Muswellbrook - Narrabri	Breeza loop extension (RIC)	$4
2008	Muswellbrook - Narrabri	Curlewis loop extension (RIC)	$4
2009	Newcastle- Muswellbrook	Bidirectional signalling Maitland to Branxton	$23
2009	Newcastle- Muswellbrook	Newdell Junction	$7
2009	Newcastle- Muswellbrook	Minimbah Bank 3rd road - 8 min headway	$61
2009	Newcastle- Muswellbrook	St Heliers - Muswellbrook duplication	$27
2009	Muswellbrook - Ulan	Aerosol Valley (370 km) loop	$9
2009	Muswellbrook - Ulan	Worondi (348 km) loop	$9
2009	Muswellbrook - Narrabri	Braefield passing loop	$9
2009	Muswellbrook - Narrabri	Gunnedah - Narrabri CTC (RIC)	$10
2009	Muswellbrook - Narrabri	Emerald Hill loop extension (RIC)	$4
2009	Muswellbrook - Narrabri	Boggabri loop extension (RIC)	$4
2010	Newcastle- Muswellbrook	Drayton Junction upgrade	$270
2010	Muswellbrook - Narrabri	Quipolly passing loop	$9
2010	Muswellbrook - Narrabri	Parkville loop extension	$7
2010	Muswellbrook - Narrabri	Murrurundi loop extension	$7
2010	Muswellbrook - Narrabri	Scone reconfiguration	$2
2010	Muswellbrook - Narrabri	Werris Creek Bypass	$17
2010	Muswellbrook - Narrabri	Watermark passing loop (RIC)	$9
2010	Muswellbrook - Narrabri	Muswellbrook - Koolbury duplication	$35
2011	Newcastle- Muswellbrook	Minimbah - Maitland 3rd road	$6
2011	Muswellbrook - Ulan	Radio Hut (319 km) loop	$9
2011	Muswellbrook - Ulan	Muswellbrook - Bengalla duplication	$30
2011	Muswellbrook - Narrabri	New Liverpool Range alignment	$290
2011	Muswellbrook - Narrabri	Wingen passing loop	$9
2011	Muswellbrook - Narrabri	Burilda loop extension (RIC)	$9
2011	Muswellbrook - Narrabri	South Gunnedah passing loop (RIC)	$9
2012	Newcastle- Muswellbrook	Nundah Bank 3rd road for 8 min headway	$100
2012	Muswellbrook - Ulan	Wilpingjong (422 km) loop	$9
2012	Muswellbrook - Narrabri	Baan Baa passing loop (RIC)	$9
2014	Muswellbrook - Ulan	404 km loop	$9
2014	Muswellbrook - Ulan	Bengalla - Anvil Hill Duplication	$30
2014	Muswellbrook - Narrabri	Scone - Parkville Duplication	$20
2014	Muswellbrook - Narrabri	505 km loop (RIC)	$9
2015	Newcastle- Muswellbrook	Muswellbrook Junction grade seperation	$50
2016	Muswellbrook - Narrabri	Koolbury - Togar duplication	$60
2016	Muswellbrook - Narrabri	Parkville - Wingen Duplication	$30
2016	Muswellbrook - Narrabri	Togar - Scone duplication	$30
2017	Muswellbrook - Narrabri	Quirindi - Werris Creek duplication	$60
2017	Muswellbrook - Narrabri	Willow Tree - Braefield Duplication	$30
2017	Muswellbrook - Narrabri	Wingen - Murulla duplication	$30
2017	Muswellbrook - Narrabri	Blandford - Murrurundi duplication	$30
2018	Muswellbrook - Narrabri	Braefield - Quirindi duplication	$30
2018	Muswellbrook - Narrabri	Werris Creek - Gunnedah duplication (RIC)	$120
2019	Muswellbrook - Narrabri	523 km loop (RIC)	$9
2020	Newcastle- Muswellbrook	Camberwell - Whittingham 3rd Road	$100
2023	Muswellbrook - Ulan	324 km loop	$9
2023	Muswellbrook - Ulan	337 km loop	$9
2023	Muswellbrook - Ulan	353 km loop	$9
2023	Muswellbrook - Ulan	378 km loop	$9
		Total	**$1,791**

Table 17 [13]

13 Note that all costs are “order of magnitude” estimates only and are in $2008.

9

Key Strategy Findings

This Strategy has been prepared in an investment environment where significant growth in rail volume is considered both likely and desirable. ARTC believes that Government policy should encourage, and at the least not hinder, this occurring. This Strategy aims to set out an integrated and optimised steam of projects to ensure adequate capacity for the forecast growth, while securing efficiency gains at the earliest opportunity.

In summary ARTC believes that:

- Significant growth in rail volume is likely as:
  - Recent shifts in road / rail cost relativities are expected to result in a large increase in rail's general freight market share.
  - A comprehensive, well structured carbon pricing scheme will further enhance rail competitiveness. Other anticipated future input cost changes will also enhance rail's position.
  - Coal, iron ore and other minerals are expected to grow strongly, with most of the new volume likely to be on rail.
- Significant growth in rail volume is desirable because:
  - The expected increase in rail market share is a result of the market responding to price signals, which is desirable at both a macro and micro economic level.
  - Rail is safer and more environmentally friendly than road, and in particular is more fuel efficient.
  - The growth in minerals exports is underpinning Australia's economic growth.
- Good policy will support rail growth since:
  - Mechanisms to internalise externalities, such as carbon pricing, will deliver better social outcomes, and are likely to favour rail transport.
  - Commercialisation of the road sector, with Government intervention only to address market failure, will promote efficient resource allocation and is likely to favour rail transport.
  - Commercially realistic, light-handed economic regulation, vertical separation and a national approach to safety and planning regulation, will promote timely investment and efficient and responsive rail operations.
  - Integrated land-use / transport planning that recognises and reinforces the role of rail will assist rail competitiveness and improve social outcomes.
- Policy should not hinder rail growth, and in particular:
  - A carbon pricing scheme should include transport, with an upstream point of obligation.
  - Government should not interfere in the market response to rising fuel costs by artificially lowering the price, other than to assist with structural adjustment.
  - In the event that pricing and investment in the road sector does not move to a commercial basis, Government should provide adequate funding to rail to achieve the same outcomes.

ARTC has developed an integrated and optimised stream of projects with a 15-year horizon as follows:

- Detailed intermodal volume projections have been produced based on scenarios around fuel prices, carbon prices and other key cost inputs. Coal and minerals projections have been developed based on producer forecasts.
- Efficiency enhancement projects have been identified, and recommended implementation dates developed, based on economic and financial analysis.
- Projects have been identified to ensure capacity remains ahead of demand while maintaining service levels, while having regard to both the capacity benefits of enhancement projects, and the additional demand generated by them.

Key enhancements to increase efficiency include:

- Rollout of the ATMS communications based safeworking system.
- Extensive additional track and other enhancements on the RailCorp network between Strathfield and Broadmeadow.

- An increase in maximum length Melbourne – Adelaide to 1800 metres.
- Track upgrading in western Victoria and Cootamundra – Parkes.
- Development of the Moorebank Common-User Intermodal Terminal.
- Melbourne – Sydney double-stacking.
- A new alignment on the Liverpool Ranges in the vicinity of Ardglen.

Key projects to ensure adequate capacity include:

- Full double-track Melbourne – Sydney.
- Passing lanes Maitland – Brisbane.
- New and extended loops Melbourne – Adelaide.
- Additional loops Adelaide – Tarcoola.
- A third track between Maitland and the foot of Nundah bank (near Newdell).
- Double-track from Musellbrook to Gunnedah and Muswellbrook to Anvil Hill, plus additional loops beyond Gunnedah and Anvil Hill to Turrawan and Ulan respectively.

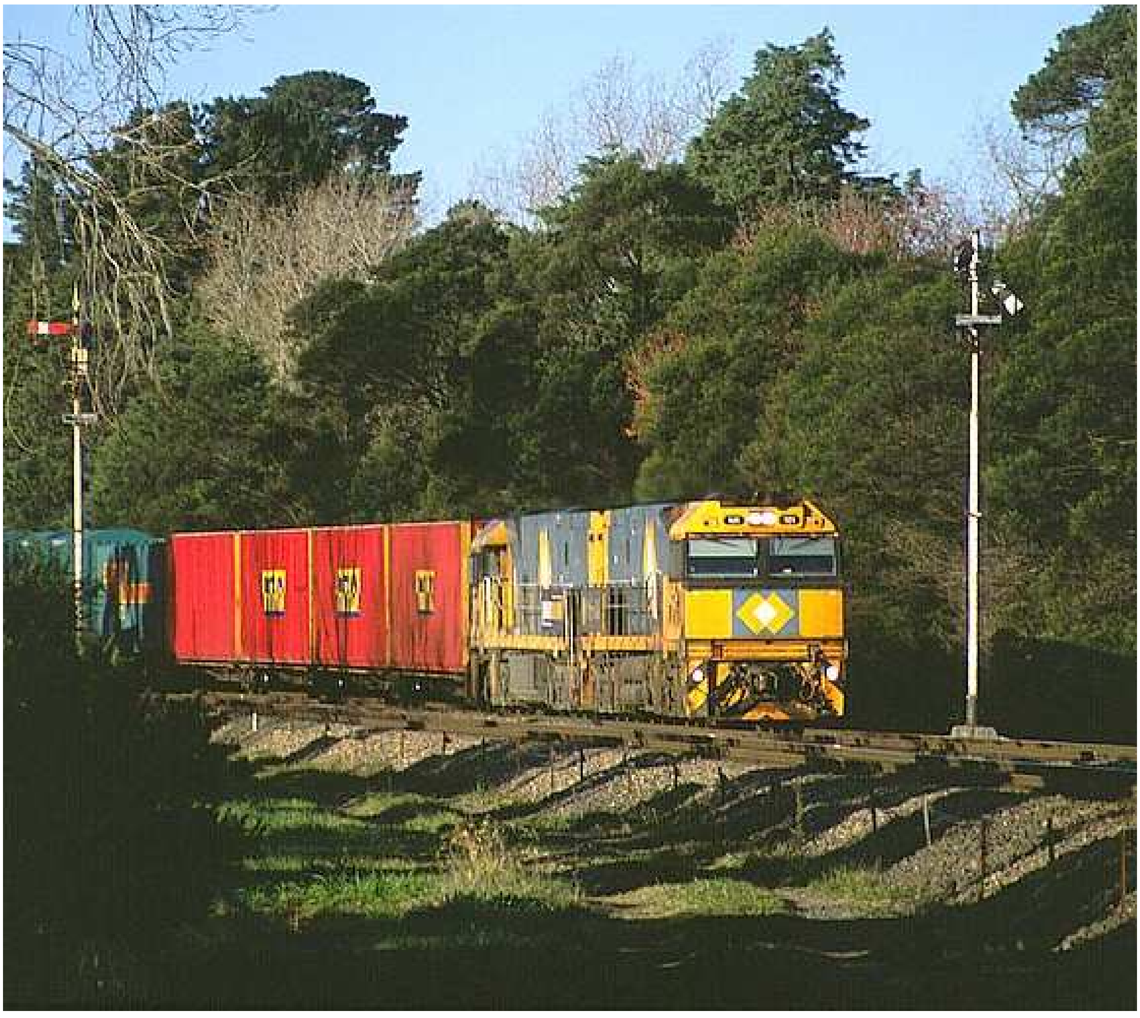
The scope of proposed investments, including projects still underway under ARTC's North-South upgrading, is shown in Table 18 and Figure 30 . The estimated cost of the full scope of works is $6.96 billion over the next 15 years as shown in Table 19.

North South	$	4,933
East West	$	674
Hunter Valley	$	1791
Network-wide	$	563
Total	**$**	**7,961**

Table 19 - Order of magnitude cost of proposed projects.

Finally, a number of issues and opportunities remain to be further analysed and considered. These include:

- Whether an Inland Route between Melbourne and Brisbane is a viable or desirable project.
- Whether an Adelaide Hills bypass is a viable or desirable project.
- A process to address the risk that terminal capacity in Brisbane will become a constraint.
- Whether a new rail corridor should be provided in conjunction with upgrading of the Pacific Highway on the NSW mid-North-Coast, on sections where such an approach provides a cost-effective way of achieving rail efficiency increases.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Brisbane - Sydney	Track upgrading, loop upgrading, 8 extended & 3 new loops, CTC			22 loop extensions and 4 new loops		Northern Sydney Freight Works Stage 1	3 deviations	17 passing lanes of 14 km each			16 passing lanes of 14 km each		Northern Sydney Freight Works Stage 2				
Sydney - Cootamundra	Track upgrading	SSFL	Moorebank terminal	Port Botany upgrade			4 deviations	6.8 m clearance				SSFL enhancement					
Cootamundra - Melbourne	6 passing lanes, 2 loop extensions, track upgrading, Tottenham - Dynon upgrade	Seymour - Wodonga duplication, 1 passing lane, Tottenham triangle	Wodonga bypass				1 deviation	Wodonga - Junee duplication	6.8 m clearance								
Melbourne - Adelaide			7 loop extensions	5 new loops, Western Vic Upgrade, Geelong port connection	11 loop extensions, Horsham deviation	15 loop extensions, Grade sep Goodwood Jct						2 new loops			2 new loops		
Adelaide - Crystal Brook			1 loop extension			Grade sep Torrens Jct											
Crystal Brook - Kalgoorlie			4 new loops	2 new loops, 6.8 m clearance	11 new loops				5 new loops	4 new loops							
Kalgoorlie - Perth				4 new loops													
Cootamundra - Crystal Brook	6.5 m clearance		Cootamundra - Parkes upgrading including TOW and 2 loops	5 loop extensions													
Newcastle - Muswellbrook	Antiene - Muswellbrook duplication stage 2	Maitland - Branxton bi-di, Antiene - Muswellbrook duplication stage 3	Minimbah Bank 3rd road	Minimbah - Maitland 3rd Road	Nundah Bank 3rd Road				Muswellbrook Jct Grade Separation				Camberwell - Whittingham 3rd road				
Muswellbrook - Ulan	3 new loops	2 new loops		Muswellbrook - Bengalla Duplication, 1 new loop	1 new loop		Bengalla - Anvil Hill Duplication, 1 new loop										4 new loops
Muswellbrook - Narrabri	5 loop extensions, Werris Creek - Gunnedah CTC	3 loop extensions, Gunnedah - Narrabri CTC	2 loop extensions, 2 new loops, Werris Creek Bypass, Muswellbrook - Koolbury Duplication	New Liverpool Range alignment, 3 new loops	1 new loop		Scone - Parkville duplication, 1 new loop		Parkville - Wingen, Togar - Scone and Koolbury - Togar Duplications	Quirindi - Werris Creek, Willow Tree - Braefield, Wingen - Murulla and Blandford - Murrurundi Duplications	Braefield - Quirindi and Werris Creek - Gunnedah Duplications	1 new loop					
Network Wide		NTCS						ATMS									

Table 18

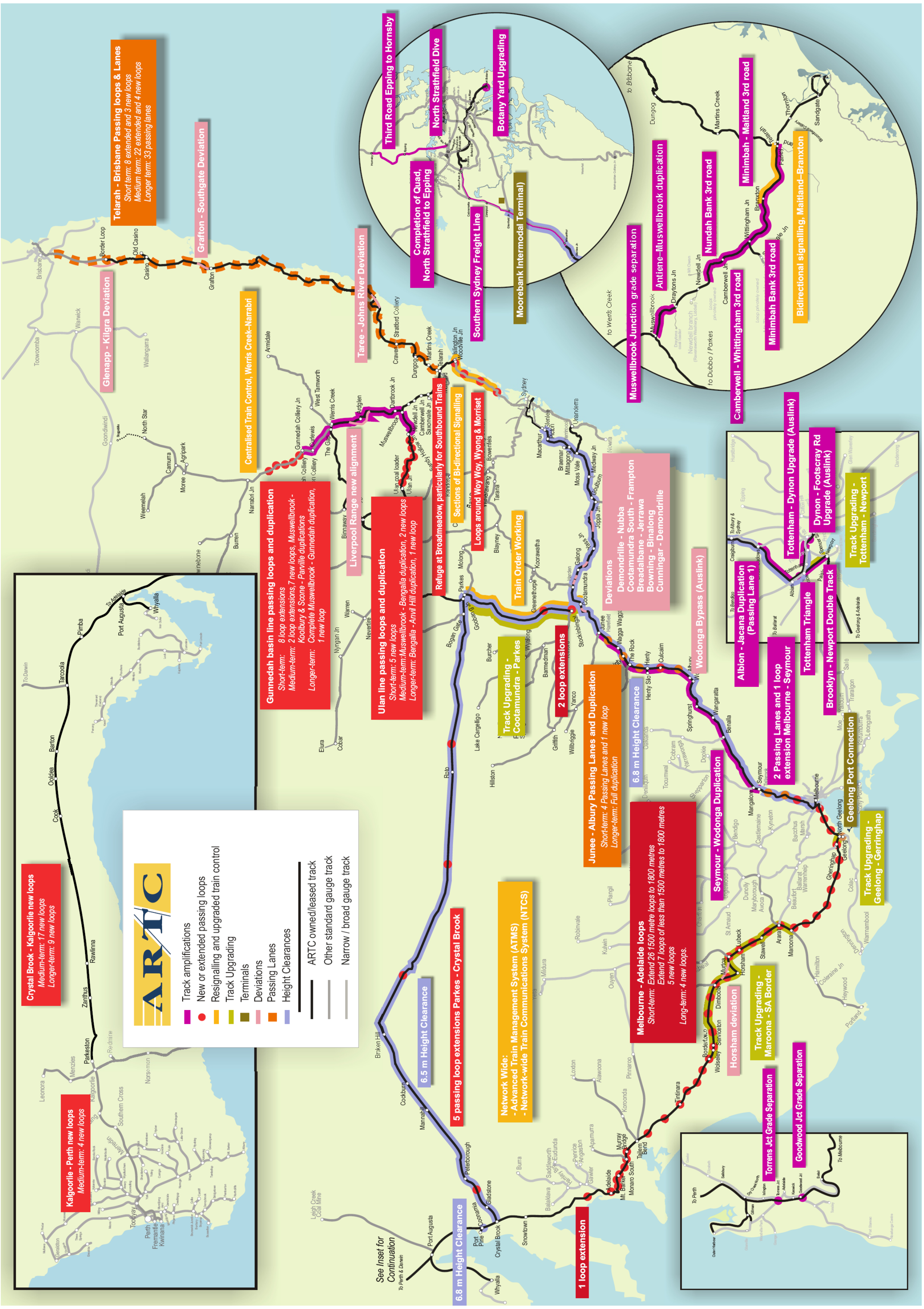

ARTC
Track amplifications
New or extended passing loops
Resignalling and upgraded train control
Track Upgrading
Terminals
Deviations
Passing Lanes
Height Clearances
ARTC owned/leased track
Other standard gauge track
Narrow / broad gauge track
Telarah - Brisbane Passing loops & Lanes
Short-term: 8 extended and 3 new loops
Medium-term: 22 extended and 4 new loops
Longer-term: 33 passing lanes
Grafton - Southgate Deviation
Glenapp - Kilgra Deviation
Centralised Train Control, Werris Creek-Narrabri
Taree - Johns River Deviation
Gunnedah basin line passing loops and duplication
Short-term: 8 loop extensions
Medium-term: 2 loop extensions, 7 new loops, Muswellbrook - Koolbury & Scone - Parville duplications
Longer-term: Complete Muswellbrook - Gunnedah duplication, 1 new loop
Liverpool Range new alignment
Ulan line passing loops and duplication
Short-term: 5 new loops
Medium-term: Muswellbrook - Bengalla duplication, 2 new loops
Longer-term: Bengalla - Anvil Hill duplication, 1 new loop
Refuge at Broadmeadow, particularly for Southbound Trains
Sections of Bi-directional Signalling
Loops around Woy Woy, Wyong & Morriset
Train Order Working
Deviations
Demondrille - Nubba
Cootamundra South - Frampton
Breadalbane - Jerrawa
Bowning - Binalong
Cunningar - Demondrille
Wodonga Bypass (Auslink)
Track Upgrading - Cootamundra - Parkes
2 loop extensions
Junee - Albury Passing Lanes and Duplication
Short-term: 4 Passing Lanes and 1 new loop
Longer-term: Full duplication
6.8 m Height Clearance
Seymour - Wodonga Duplication
Melbourne - Adelaide loops
Short-term: Extend 26 1500 metre loops to 1800 metres
Extend 7 loops of less than 1500 metres to 1800 metres
5 new loops
Long-term: 4 new loops.
Network Wide:
- Advanced Train Management System (ATMS)
- Network-wide Train Communications System (NTCS)
5 passing loop extensions Parkes - Crystal Brook
6.5 m Height Clearance
Crystal Brook - Kalgoorlie new loops
Medium-term: 17 new loops
Longer-term: 9 new loops
Kalgoorlie - Perth new loops
Medium-term: 4 new loops
6.8 m Height Clearance
1 loop extension
Horsham deviation
Track Upgrading - Maroona - SA Border
Torrens Jct Grade Separation
Goodwood Jct Grade Separation
2 Passing Lanes and 1 loop extension Melbourne - Seymour
Geelong Port Connection
Track Upgrading - Geelong - Gheringhap
Albion - Jacana Duplication (Passing Lane 1)
Tottenham Triangle
Brooklyn - Newport Double Track
Tottenham - Dynon Upgrade (Auslink)
Dynon - Footscray Rd Upgrade (Auslink)
Track Upgrading - Tottenham - Newport
Third Road Epping to Hornsby
North Strathfield Dive
Botany Yard Upgrading
Completion of Quad, North Strathfield to Epping
Southern Sydney Freight Line
Moorebank Intermodal Terminal)
Muswellbrook Junction grade separation
Antiene–Muswellbrook duplication
Nundah Bank 3rd road
Minimbah - Maitland 3rd road
Camberwell - Whittingham 3rd road
Minimbah Bank 3rd road
Bidirectional signalling, Maitland–Branxton
See Inset for Continuation

Figure 30