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AUSTRALASIAN RAILWAY ASSOCIATION

STATISTICAL REPORT

Rail bitre

Trainline 8

Bureau of Infrastructure and Transport Research Economics
and
Australasian Railway Association

Trainline 8

Statistical Report

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Cover photograph: One Rail Australia all female crew, Belinda and Amy, operated the company's first coal train in Qld in April 2020. Photo courtesy of One Rail Australia.

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Foreword

Trainline 8 provides an overview of freight, urban and non-urban passenger rail. The report analyses traffic levels, the provision of infrastructure and rolling stock, and railway performance.

The *Trainline* series is a collaboration between BITRE and the Australasian Railway Association (ARA).

We acknowledge the assistance of those organisations which (voluntarily) provided data and other information about the Australian railway industry and provided answers to follow up questions.

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At a glance

Results

- In 2018–19, freight tonnages reported by infrastructure managers ('below-rail') tonnages declined on most sectors of the interstate network, both intermodal and other freight. This occurred on both the North—South and East—West corridors.
- Scheduled intermodal freight train transit times on the ARTC and Arc Infrastructure interstate corridors in 2020 were largely unchanged from 2019.
- There has been a decline in the number of scheduled Sydney to Brisbane and Brisbane to Sydney freight services. All Sydney to Perth freight services now travel via Lithgow.
- Between January to August 2020 most Brisbane to Melbourne intermodal services completed their trip faster than schedule, while most Melbourne to Brisbane services were slower than schedule.
- Total urban heavy rail patronage for 2018–19 was 754.4 million passenger journeys, while for light rail there was 236.8 million passenger journeys.
- Patronage grew on all urban heavy rail networks in 2018–19 (compared to the previous financial year). Adelaide had the greatest patronage growth, at 8.3 per cent. Perth had the smallest increase, at 1.6 per cent.
- Sydney still has Australia's busiest urban heavy rail passenger network, with approximately 379 million passenger journeys in 2018–19.
- In 2018-19, light rail patronage declined slightly in Melbourne and Sydney, remained steady in Adelaide, and grew strongly on the Gold Coast.
- In December 2019 and April 2020, Sydney's L2 and L3 light rail lines from Circular Quay to Randwick and Circular Quay to Kingsford commenced operations respectively.
- In July 2020, Adelaide Metro light rail services switiched to a private (franschise) operating model with heavy rail services to follow in early 2021.
- Total non-urban rail patronage for 2018–19 was approximately 65 million passenger journeys, a decline of 2.6 per cent from the previous financial year. New South Wales and Western Australia had declines, Queensland remained steady, while Victoria had an increase.
- Most cities exceeded their urban heavy and light rail punctuality targets, while non-urban punctuality results were poorer.
- In 2018-19, there were 100 notified fatalities on Australian railways that the Office of the National Rail Safety Regulator regulates.

Railway networks and assets

- Australia has an estimated 32 900 route-kilometres of operational heavy railways, approximately 10 per cent of which is electrified.
- Australia has 326 route-kilometres of operational light rail/tramways.
- Melbourne has Australia's largest heavy and light rail urban passenger networks at an estimated 401 route kilometres and 250 route-kilometres, respectively.
- The principal iron ore railways are in Western Australia's Pilbara region (2 642 route-kilometres). The principal coal networks are the central Queensland systems (1 979 route-kilometres) and the New South Wales Hunter Valley Coal network (approximately 785 route kilometres). Grain flows run from agricultural hinterlands to ports for export and to cities for domestic consumption. There are approximately 4 700 route-kilometres of operational railway that are largely or exclusively used for grain haulage.
- In September 2020, there were an estimated 2065 operational locomotives in Australia, which is slightly higher than 2019. Approximately 50 per cent of the fleet is aged 12 years or less.

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CHAPTER 1

Australia's railway industry

Trainline is a compendium of Australia's rail industry. It provides data and an analysis of the industry[1].

Australia's railways are evolving, with changes both outside and within the industry. This includes:

- **Urban patronage.** The introduction of frequent urban rail services with high average speeds, good bus, cycling, and parking links to high amenity stations has generated strong patronage growth in some Australian cities.
- **Resurgence of light rail.** In addition to Melbourne's extensive tram/light rail network, Sydney, Adelaide, and the Gold Coast's light rail networks are expanding, and new services have begun in Canberra and Newcastle.
- **Regional and inter-urban passenger service.** Regional passenger services, specifically in Victoria, have been upgraded both in rollingstock and infrastructure within the last decade.
- **Logistics.** Interlinked chains of international and domestic production and distribution have revolutionised the production and consumption of manufactured and processed goods. Logistics systems for bulk commodities have also been improved and broadened, such as with containerised grain and ores movement from rail heads to ports.
- **Commodity flows.** Australia is a major exporter of iron ore and coal, with virtually all of this being transported by rail from mine to port. These exports have grown exponentially, enabled partly by new, expanded and upgraded railways.
- **Technology.** Railway operations have embraced leading-edge technology, such as the world's heaviest wagon axle loads and development of remotely-controlled iron ore trains in Western Australia, the introduction of driverless metro trains in Sydney, improvements in vehicle design and performance, and shifts towards predictive and real time maintenance.

The following chapters give an overview and data on railway transport's tasks; characteristics of the railways and train operators' rolling stock; and aspects of railway performance, including safety, environment, and reliability.

1 As a statistical report, the industry analysis does not consider operational, technical or regulatory aspects. Discussion of these aspects can be found in BTRE (2006). Note also, information on 2018-19 railway infrastructure investment levels will be published in BITRE's 2020 issue of the *Australian Infrastructure Statistics Yearbook*.

CHAPTER 2
Rail traffic

This chapter examines the Australian railway industry's principal tasks. It discusses the major freight commodities moved and markets served. It also summarises passenger transport.

Overview

Railways excel at transporting large volumes of both freight and passengers. In Australia, this primarily involves moving bulk commodities (for export) and urban and intercity passenger transportation.

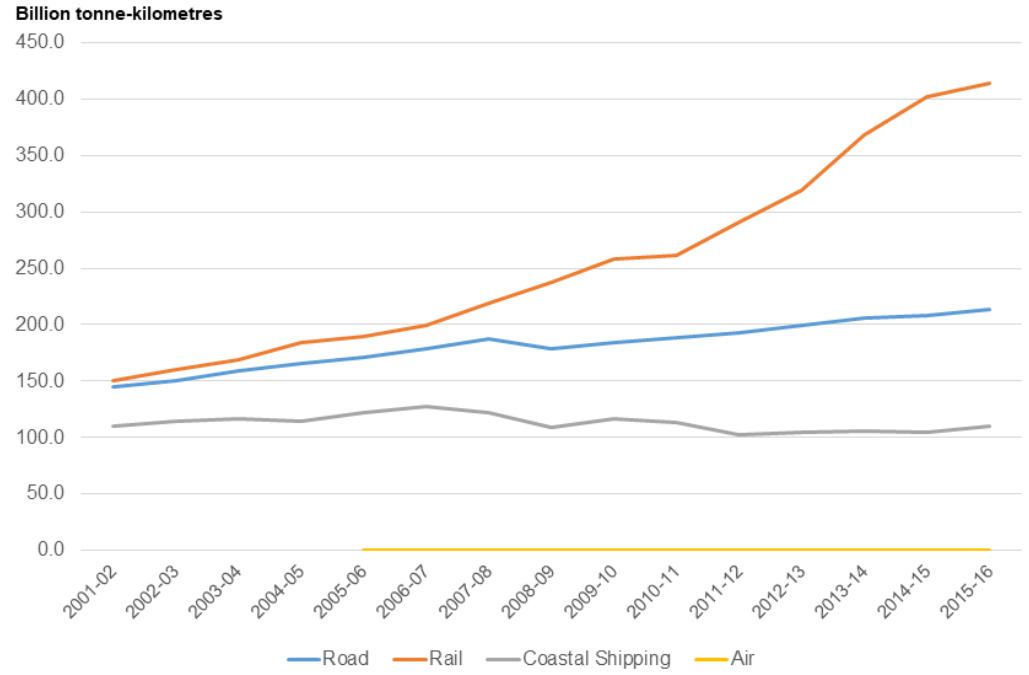
Weekday commuting to central city areas is the key passenger rail task. The previous surge in rail patronage in Perth, commencing in 2006, illustrates the growth in some commuter services (BITRE 2012, p. 55). Similarly, strategic investments in track and trains on some of regional Victoria's railway corridors have brought exceptionally strong patronage growth (BITRE 2014, p. 68).

Rail transport's role in the Australian economy has increased sharply in recent years; see Figure 1. Rail now accounts for more than one-half of Australian freight transport activity, up from approximately 36 per cent at the turn of the century. Rail freight transport's strong position is primarily founded on the transportation of iron ore, coal and other bulk products such as grain primarily to ports for export. BITRE estimates Pilbara iron ore transportation accounted for approximately 64 per cent of the national net tonne kilometres (NTK) in 2015-16, while combined coal transportation in Queensland and New South Wales comprised approximately 20 per cent of the national NTKs for the same period.

Rail is also often central to moving other bulk commodities, such as sugar and timber, especially to ports, as well as containerised export agricultural commodities. Rail and road transport compete strongly for short-haul and long-distance non-bulk freight, but as distances increase rail transport's competitiveness increases. Rail's mode share of non-bulk freight is highest between the eastern states and Perth (the East—West Corridor)[2].

2 BITRE 2009 (*Road and rail freight: competitors or complements?*) assesses the circumstances for rail and road competition, particularly in non-bulk freight. See, also, *Freightline 1* (BITRE 2014a, and other issues in the series) for contextual material on rail and road freight.

Figure 1 Estimated Australian freight volumes by transport mode



Source: Figure produced using data from BITRE (2017), (Table T2.1c, p.55).

The recovery of rail's freight market share rose sharply, particularly from the 2007-08 financial year. This rise was driven by growth in commodity exports, with three times the volume of iron ore production in 2012 relative to 2002 and black coal production rising by 45 per cent in the decade to 2012–13[3].

Growth in commodity exports has been achieved through the expansion of ports, terminals, processing, mines and railways. The railways enable Port Hedland to be the world's largest bulk export port. Newcastle is the world's largest coal export port.

3 This is still the latest available estimate.

National rail freight task, tonnes

Due to an ongoing data shortage *Trainline* is unable to report the national 'above rail' freight task. Table 1, below, shows reported tonnages until 2015–16.

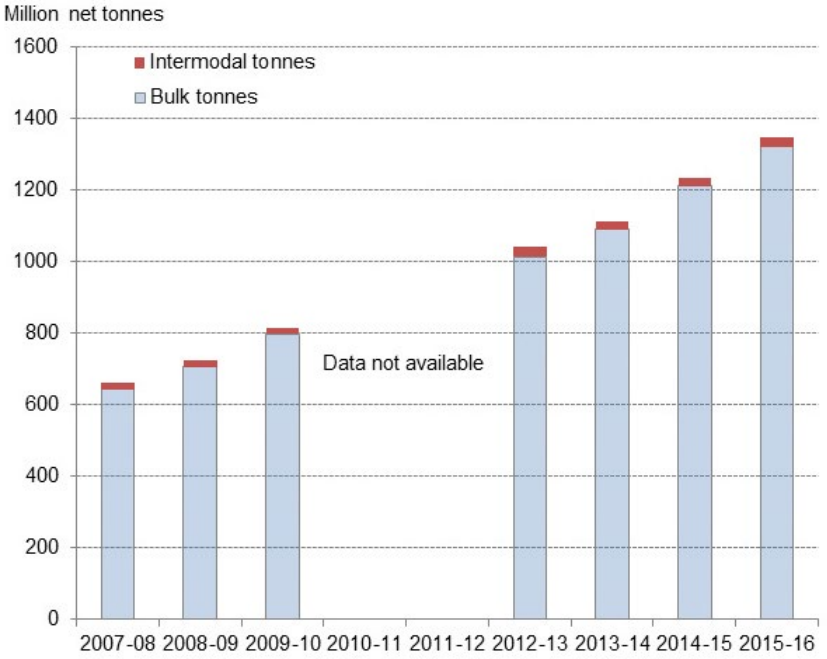
Table 1 National rail freight task, thousand net tonnes

Year	Bulk	Bulk NTKs	Intermodal	Intermodal NTKs	Total	Total NTKs
2007–08	642 826	n/a	19 519	n/a	662 345	n/a
2008–09	705 039	n/a	17 481	n/a	722 520	n/a
2009–10	798 763		16 521		815 284	
2010–11	-	n/a	-	n/a	-	n/a
2011–12	-	n/a	-	n/a	-	n/a
2012–13	1 012 997	n/a	27 559	n/a	1 040 556	n/a
2013–14	1 089 566		21 891	n/a	1 111 457	n/a
2014-15	1 210 949	349 014 582	24 272	n/a	1 235 221	n/a
2015-16	1 322 085	381 125 118	25 366	32 364 817	1 347 451 934	413 489 935

Notes: The table excludes traffic data for some of the smaller train operators, such as Sydney Rail Services.
Data for 2010–11, 2011–12, and 2016–17 are not available.

Sources: BITRE estimates; Previous *Trainline* editions that sourced operator provided data.

Figure 2 National rail freight task, 2007–08 to 2015–16



Notes: The chart excludes traffic data for some of the smaller train operators, such as Southern Shorthaul Railroad and Sydney Rail Services.

Data for 2010–11, 2011–12, and 2016–17 are not available.

Sources: BITRE estimates; (BITRE 2012a; 2014; 2015); 2015–16 data was provided by Pacific National, Aurizon, Fortescue Metals Group, BHP, Rio Tinto, Roy Hill Holdings, Genesee & Wyoming Australia (including r), SCT Logistics, TasRail, QUBE, Watco, and Fletcher International Exports.

Trainline uses specific definitions for bulk and non-bulk freight. In principle, 'bulk' freight involves large quantities of homogenous product that is conveyed in wagons. Non-bulk freight is generally any containerised or unitised freight either placed on container wagons, transported in an enclosed wagon (for example, SCT Logistics) or transported on a wagon with a secure fastening capability. However, 'non-bulk' freight is not always containerised. Conversely bulk commodities sometimes travel in containers. In this report, 'bulk' refers to anything not considered 'intermodal', where 'intermodal' is generally considered to be containerised freight or freight in a louvre wagon. Steel may also be deemed intermodal, particularly on Pacific National trains that carry both intermodal and steel products on intermodal designated trains.

National freight task, by operator

There is some publicly-available data that reports national rail freight activity. Aurizon provides quarterly train-operator traffic data[4] to the Australian Stock Exchange (ASX). That material forms the basis of the data shown in Table 2, with more details in Appendix C. Pacific National (formerly part of the Asciano group that was split into three separate businesses in August 2016), does not publish data publicly as it is not a publicly listed company, hence there is no Pacific National data after 2015–16.

Traffic volumes reflect rail's competitiveness with other transport modes (particularly for intermodal traffic) and prevailing economic conditions. Variations in individual commodity flows arise from international demand for commodities as well as train operators winning or losing major contracts.

Since 2017–18, Aurizon has reported its above rail results as coal and bulk only.

Data sources and (where published) a breakdown of information into quarters (where possible) and half-years are shown in Appendix C and Appendix D.

In addition to measuring freight transport by tonnes and NTKs, transport by twenty-foot equivalent (TEU) units of shipping containers provides another measure, where available. This measure shows freight activity by volume rather than weight. As Table 3 shows, *Trainline* has reported Pacific National and Aurizon's TEU results. As Pacific National no longer reports to the ASX and Aurizon has ceased intermodal operations, this and future editions of Trainline cannot report this metric.

Table 2 ASX train operator traffic trends (billion net tonne-kilometres)

Period	Pacific National				Aurizon					Combined
	Coal	Other bulk	Intermodal (including steel)	Total	Coal	Iron ore	Bulk	Non-bulk — plus residual bulk from 2011–12	Total	Total
2007–08	12.7	2.8	25.9	41.4	42.8	-	13.6	4.8	61.2	102.6
2008–09	13.9	3.6	22.5	40.0	43.5	-	14.3	4.2	62.0	102.0
2009–10	18.1	3.4	22.2	43.7	45.3	-	15.2	3.7	64.2	107.9
2010–11	18.3	4.0	21.8	44.2	40.9	-	-	18.9	59.8	104.0
2011–12	20.0	5.6	23.0	48.6	41.9	6.7	-	14.3	62.9	111.5
2012–13	24.0	6.0	22.7	52.7	43.6	10.3	-	13.2	67.1	119.8
2013–14	29.2	5.1	21.5	55.8	49.2	12.2	-	12.5	73.9	129.7
2014–15	30.9	5.1	23.8	59.8	49.1	10.4	-	12.9	72.4	132.2
2015–16	31.8	4.4	22.4	58.6	49.7	9.6	-	12.3	71.6	130.2
2016–17	n/a	n/a	n/a	n/a	47.6		15.4[a]	12.2	n/a	n/a
2017–18	n/a	n/a	n/a	n/a	50.4		13.4		63.8	n/a
2018–19	n/a	n/a	n/a	n/a	50.5		8.5		59	n/a

Sources: Aurizon (2020, p.16); Previous *Trainline* editions that sourced ASX data

Note: [a] Bulk for the 2016–17 and 2017–18 financial years includes iron ore. For the 2018–19 year bulk comprised agricultural products, and mining and industrial inputs.

4 Aurizon's traffic data here refer to its own train haulages. The company also provides third-party access to its tracks (particularly Pacific National trains), which the company reports through its Aurizon Network subsidiary.

Since 2017–18, Aurizon has reported its above rail results as coal and bulk only.

Data sources and (where published) a breakdown of information into quarters (where possible) and half-years are shown in Appendix C and Appendix D.

Aurizon's public reporting in 2020 does not publish bulk net tonne kilometres. It has, however, published mass tonnes throughput, which in 2019-20 was 48.1 million, compared to 44.6 in 2018-19. (Aurizon 2020a, p.16)

The Genesee and Wyoming parent company previously reported the results of its Australian operations to the New York Stock Exchange, which *Trainline* published in previous editions. Since the sale of its Australian operations (now branded One Rail Australia) in 2020, these results are no longer available.

Tasrail reports its freight task in its annual report. Table 3, below, shows and compares Tasrail's freight task for the 2017–18 and 2018–19 financial years.

Table 3 Tasrail freight task (net tonne kilometres)

Period	2017/18	2018/19	Change (per cent)
Coal	42 601 177	42 695 134	0.22%
Cement	25 976 894	25 459 817	-1.99%
Mineral concentrates	22 810 917	22 053 768	-3.32%
Logs	23 989 688	28 903 180	20.48%
Intermodal general	246 889 952	246 822 408	-0.03%
Intermodal paper	126 246 955	117 019 541	-7.31%
Total	**488 515 583**	**482 953 848**	**-1.14%**

Source: Tasrail 2019, p.25..

Box 1 Further freight rail operator traffic data resources

No single data source covers the entire Australian network. Data sources are train operator data, and track/infrastructure manager data.

TasRail provides information on tonnages of some commodities that it transports, such as logs and minerals. (Tasrail 2019)

The ARTC reports aggregated Hunter Valley network quarterly coal tonnage throughput (ARTC n.d.)

Aurizon has information packs for each of its coal networks (Aurizon 2020c).

Traffic data and projections can also be provided to the infrastructure managers' economic regulators, which may then publish that material[5].

While explicit rail traffic data is not generally available for Pilbara railways or for east coast coal ports, the export iron ore and coal from those ports is generally moved to the ports by rail. Discussion and data sources for each of those ports can be found in Australia's Bulk Ports (BITRE 2013).

BITRE's *Freightline* series also presents freight flows by commodity (BITRE 2014a and BITRE 2014b, BITRE 2016, BITRE 2018, BITRE2018a).

An informal source of east-west rail activity at Gheringhap in Victoria is on Graham Elliott's web site: http://ghaploop.railpage.org.au/ and in the BITRE report on that data source (BTRE 2007).

5 Aurizon's economic regulator is the Queensland Competition Authority (http://www.qca.org.au/Rail); ARTC's is the ACCC (https://www.accc.gov.au/regulated-infrastructure/rail); Arc Infrastructure is the Economic Regulation Authority [WA] (http://www.erawa.com.au/rail/rail-access).

Interstate network traffic

This section reports interstate freight traffic flows by line segment based on below-rail (infrastructure manager) provided data. It only includes tonnages on the interstate network that ARTC and Arc Infrastructure each manage. Table 4 and Table 5 show intermodal and total gross tonnes by line segment, with line segments ordered from north to south and east to west. Figure 3, Figure 5, Figure 6 and Figure 7 also show the data. ARTC's data excludes regional import/export intermodal trains that join the network at such locations as Harefield (Junee). The results now include the southern Sydney Chullora—Selfton Park and Sefton Park—Macarthur sectors. There are three factors to note when reviewing the tonnages:

- Where freight does not move along the entire length of a segment, it has been weighted by the proportion of the line segment travelled. Tonnages are calculated as gross. Empty wagons and locomotive weights are therefore included.
- Coal traffic is excluded. This is because that traffic is not in a form that is amenable to comparison with other commodities. In particular, while coal generally does not move on the interstate network, large coal volumes briefly traverse the network near Newcastle and in the New South Wales Southern Highlands. In those locations, coal tonnages are higher than all other commodities carried.
- ARTC and Arc Infrastructure provided tonnages are not comparable with the above rail tonnages reported because the above rail tonnages cover the whole of Australia, whereas the below rail data only measures traffic on the ARTC and Arc Infrastructure interstate networks. The two measures are therefore not 'like for like' in scope.

Table 4 Below-rail gross tonnes by line segment, North-south corridor

Line segment, by direction of freight	Million gross tonnes					
	Intermodal			Total		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Acacia Ridge to Casino	2.94	3.00	2.68	3.09	3.01	2.70
Casino to Acacia Ridge	4.48	4.63	4.13	4.63	4.65	4.15
Acacia Ridge – Casino	7.43	7.64	6.81	7.72	7.66	6.86
Casino to Maitland	2.96	3.02	2.70	3.64	3.29	2.99
Maitland to Casino	4.50	4.64	4.14	5.22	4.96	4.45
Casino–Maitland	7.46	7.66	6.83	8.86	8.25	7.44
Chullora to Sefton Park	n/a	n/a	5.93	n/a	n/a	16.80
Sefton Park to Chullora	n/a	n/a	6.92	n/a	n/a	20.70
Chullora–Sefton Park	n/a	n/a	12.85	n/a	n/a	37.50
Sefton Park to Macarthur	n/a	n/a	4.48	n/a	n/a	7.18
Macarthur to Sefton Park	n/a	n/a	4.48	n/a	n/a	11.30
Sefton Park–Macarthur	n/a	n/a	8.96	n/a	n/a	18.48
Macarthur to Tahmoor	4.73	4.75	4.49	9.44	9.33	9.53
Tahmoor to Macarthur	4.92	4.86	4.50	14.45	14.61	15.00
Macarthur–Tahmoor	9.66	9.61	8.99	23.88	23.94	24.53
Moss Vale to Tahmoor	4.73	4.73	4.49	10.48	10.37	10.52
Tahmoor to Moss Vale	4.92	4.85	4.50	17.61	17.71	17.78
Tahmoor – Moss Vale	9.65	9.58	8.99	28.09	28.08	28.30
Moss Vale to Marulan	4.89	4.89	4.67	12.13	11.11	11.20
Marulan to Moss vale	4.96	4.85	4.78	21.34	18.67	18.79
Moss Vale – Marulan	9.85	9.74	9.45	33.47	29.77	29.99
Marulan to Goulburn	4.89	4.89	4.67	9.72	8.70	8.69
Goulburn to Marulan	4.96	4.85	4.78	13.85	10.96	11.12
Marulan–Goulburn	9.85	9.74	9.45	23.58	19.66	19.81
Goulburn to Cootamundra	4.89	4.89	4.67	7.44	6.18	6.18
Cootamundra to Goulburn	4.96	4.86	4.78	11.35	8.14	8.04
Goulburn–Cootamundra	9.85	9.74	9.45	18.80	14.32	14.22
Cootamundra to Junee	3.64	3.70	3.37	6.87	5.22	5.59
Junee to Cootamundra	3.16	3.13	2.94	7.28	5.53	6.44
Cootamundra–Junee	6.80	6.83	6.31	14.15	10.75	12.03
Junee to Albury	3.64	3.70	3.37	7.32	6.59	6.45
Albury to Junee	3.16	3.14	2.94	7.23	6.52	7.33
Junee–Albury	6.80	6.84	6.31	14.55	13.11	13.78
Albury to Tottenham	3.64	3.70	3.39	7.22	6.35	5.54
Tottenham to Albury	3.13	3.07	2.88	5.17	4.50	4.46
Albury–Tottenham	6.77	6.77	6.26	12.39	10.85	9.99

Source: Data provided by ARTC.

Note: Totals are subject to rounding.

Table 5 Below-rail gross tonnes by line segment, East-West corridor

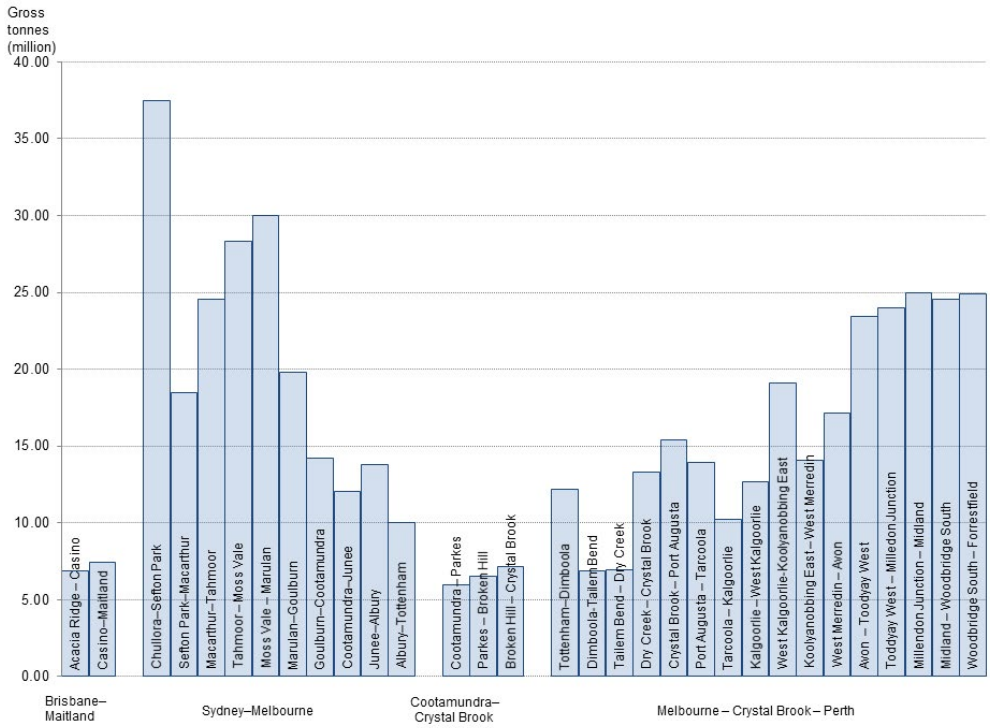
Line segment, by direction of freight	Million gross tonnes					
	Intermodal			Total		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Cootamundra to Parkes	1.26	1.21	1.32	2.91	2.18	2.45
Parkes to Cootamundra	1.81	1.74	1.87	5.93	3.55	3.55
Cootamundra–Parkes	3.07	2.95	3.19	8.85	5.72	6.00
Parkes to Broken Hill	2.27	2.22	2.43	2.79	2.78	2.98
Broken Hill to Parkes	2.46	2.37	2.48	3.68	3.36	3.57
Parkes – Broken Hill	4.73	4.59	4.91	6.47	6.14	6.55
Broken Hill to Crystal Brook	2.26	2.19	2.32	4.05	4.32	3.67
Crystal Brook to Broken Hill	2.45	2.38	2.46	3.07	3.18	3.47
Broken Hill – Crystal Brook	4.71	4.57	4.79	7.12	7.50	7.14
Tottenham to Dimboola	4.27	4.55	3.91	6.77	6.80	5.76
Dimboola to Tottenham	3.37	3.98	3.60	7.92	8.91	6.45
Tottenham–Dimboola	7.64	8.53	7.51	14.69	15.71	12.22
Dimboola to Tailem Bend	4.13	4.08	3.41	4.88	4.82	3.71
Tailem Bend to Dimboola	3.24	3.46	2.99	3.72	3.78	3.17
Dimboola – Tailem Bend	7.38	7.54	6.40	8.60	8.60	6.88
Tailem Bend to Dry Creek	4.17	4.13	3.45	4.93	4.91	3.77
Dry Creek to Tailem Bend	3.27	3.50	3.03	3.75	3.82	3.21
Tailem Bend – Dry Creek	7.44	7.64	6.48	8.68	8.73	6.98
Dry Creek to Crystal Brook	5.55	5.23	4.71	7.49	7.10	6.23
Crystal Brook to Dry Creek	4.55	4.62	4.19	10.00	9.42	7.07
Dry Creek – Crystal Brook	10.10	9.85	8.90	17.49	16.52	13.30
Crystal Brook to Port Augusta	7.29	7.19	6.53	8.96	8.43	7.78
Port Augusta to Crystal Brook	6.48	6.76	6.12	9.30	8.42	7.65
Crystal Brook – Port Augusta	13.77	13.95	12.65	18.25	16.85	15.43
Port Augusta to Tarcoola	7.71	7.52	6.63	8.15	7.52	7.08
Tarcoola to Port Augusta	6.65	6.82	6.21	8.26	7.39	6.84
Port Augusta – Tarcoola	14.36	14.34	12.85	16.41	14.91	13.92
Tarcoola to Kalgoorlie	5.85	5.81	5.10	5.99	5.75	5.46
Kalgoorlie to Tarcoola	4.48	4.52	4.28	5.04	5.01	4.77
Tarcoola – Kalgoorlie	10.33	10.32	9.37	11.02	10.75	10.24
Kalgoorlie to West Kalgoorlie	5.55	5.01	5.16	7.15	7.07	6.72
West Kalgoorlie to Kalgoorlie	4.45	4.15	4.29	6.06	6.23	5.94
Kalgoorlie – West Kalgoorlie	10.00	9.16	9.45	13.21	13.30	12.66
West Kalgoorlie to Koolyanobbing East	5.48	4.94	5.06	16.00	13.58	8.06
Koolyanobbing East to West Kalgoorlie	4.42	4.10	4.21	21.96	17.82	11.03
West Kalgoorlie – Koolyanobbing East	9.90	9.04	9.27	37.97	31.39	19.09
Koolyanobbing East to West Merredin	5.47	4.94	5.06	13.02	11.48	7.31
West Merredin to Koolyanobbing East	4.41	4.10	4.21	7.97	7.87	6.80
Koolyanobbing East – West Merredin	9.89	9.04	9.27	20.99	19.35	14.10
West Merredin to Avon	5.48	4.94	5.07	14.95	13.03	9.71
Avon to West Merredin	4.42	4.10	4.21	8.52	8.29	7.45

Line segment, by direction of freight	Million gross tonnes					
	Intermodal			Total		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
West Merredin – Avon	9.90	9.04	9.28	23.47	21.32	17.16
Avon to Toodyay West	5.48	4.94	5.06	19.71	15.90	14.63
Toodyay West to Avon	4.40	4.10	4.21	9.77	9.07	8.81
Avon – Toodyay West	9.88	9.04	9.27	29.49	24.97	23.44
Toodyay West to Millendon Junction	5.48	4.94	5.06	20.21	16.45	15.02
Millendon Junction to Toodyay West	4.41	4.10	4.21	9.93	9.24	8.94
Toodyay West – Millendon Junction	9.89	9.04	9.27	30.15	25.69	23.96
Millendon Junction to Midland	5.48	4.94	5.06	20.94	17.09	15.78
Midland to Millendon Junction	4.41	4.10	4.21	10.16	9.43	9.17
Millendon Junction – Midland	9.89	9.03	9.27	31.10	26.52	24.96
Midland to Woodbridge South	5.48	4.94	5.07	20.74	16.90	15.59
Woodbridge South to Midland	4.42	4.11	4.22	9.95	9.25	8.97
Midland – Woodbridge South	9.92	9.05	9.29	30.69	26.14	24.56
Woodbridge South to Forrestfield	5.51	4.95	5.08	20.90	17.06	15.77
Forrestfield to Woodbridge South	4.43	4.12	4.23	10.11	9.41	9.14
Woodbridge South – Forrestfield	9.94	9.07	9.31	31.01	26.47	24.90

Source: Data provided by ARTC and Arc Infrastructure.

Note: Totals are subject to rounding. Arc Infrastructure has revised its calculation methodology and now includes Kalgoorlie – West Kalgoorlie. This new methodology applies from 2016–17 data.

Figure 3 Total below rail gross tonnes on the interstate network, by line segment, 2018–19



Sources: Data provided by ARTC and Arc Infrastructure.

The following explains some variations in intermodal traffic, in addition to market factors:

- Changing intermodal train composition. ARTC-provided intermodal tonnages are calculated from train type designations (for example 'intermodal' or 'steel') that trains use, not on the actual products each train carries. Some Pacific National intermodal designated trains also carry steel products. This differs from the earlier practice where it carried steel products on steel designated trains only. To account for this change, ARTC-reported intermodal volumes are the sum of volumes from all intermodal designated trains and steel trains. Steel is moved along the East–West corridor between New South Wales (Newcastle and Port Kembla) and South Australia and Western Australia (Port Augusta, Whyalla and Perth). Steel trains also operate between Melbourne and Port Augusta and Perth. On the North-South corridor, there are also steel movements primarily between Port Kembla and the interstate capitals.
- Intermodal traffic on the North—South segment between Sydney (Macarthur) and Cootamundra (West) includes some diverging/converging traffic at Cootamundra West from the East—West Corridor (via Broken Hill)[6]

6 Until 2020 about half of Sydney to Perth trains travelled via Cootamundra West with the other half travelling via Lithgow. All Perth to Sydney trains travelled via Cootamundra West. Now, all Sydney to Perth trains travel via Lithgow and all Perth to Sydney trains continue to travel via Cootamundra West.

- Some intermodal rail traffic originates/terminates at terminals in Parkes/Goobang for the East—West Corridor (via Broken Hill). SCT Logistics, for example, generally operate one Goobang—Crystal Brook train per week in each direction.
- Higher intermodal traffic volumes west of Crystal Brook, where the Melbourne/Adelaide and Sydney/Parkes traffic to and from Perth and Darwin share the track.
- Intermodal flows fall west of Tarcoola; the junction with the Darwin line.
- Interstate capital city to capital city intermodal trains sometimes pick up and drop off freight at regional locations en route (for example the Logic terminal at Barnawartha in Victoria and Ettamogah in New South Wales).

Figure 4 Pacific National steel train

Note: The image above shows Pacific National Port Kembla to Brisbane steel train 3WB3 at Boambee Beach on 7 October 2020. Photo courtesy of Rodney Avery.

According to ARTC's data, below-rail intermodal tonnages decreased on all sectors of the North—South corridor, in both directions of travel. The Brisbane—Sydney sectors had the greatest decline, with an average decrease of almost 11 per cent in both directions of travel. Between Sydney and Melbourne, the decreases ranged from nine per cent (Cootamundra to Albury) to one per cent (Cootamundra to Moss Vale).

On the East—West Corridor, all sectors between Cootamundra West and Crystal Brook saw growth; up to 10 per cent (Parkes to Broken Hill). All other sectors to Kalgoorlie had declines; as much as 17 per cent (Tailem Bend to Dry Creek). West of Kalgoorlie, there was modest growth on all sectors, in both directions of travel, of approximately 2.7 per cent.

"Other" traffic on the interstate network

There is significant non-intermodal freight traffic, classified as "other" in Figure 5, Figure 6 and Figure 7[7].

Other significant non-intermodal freight flows are as follows:

- **Grain movements** generally join the network from a web of branch and secondary lines, connecting agricultural hinterlands to the ports. Movements on the interstate network are heaviest close to Perth and in New South Wales.
- **Aggregate, sand and limestone quarries** in the southern New South Wales Southern Highlands boost tonnages between Macarthur and Goulburn.
- **Grain** comprises the majority share of all 'other' tonnages between Kalgoorlie and Koolyanobbing.

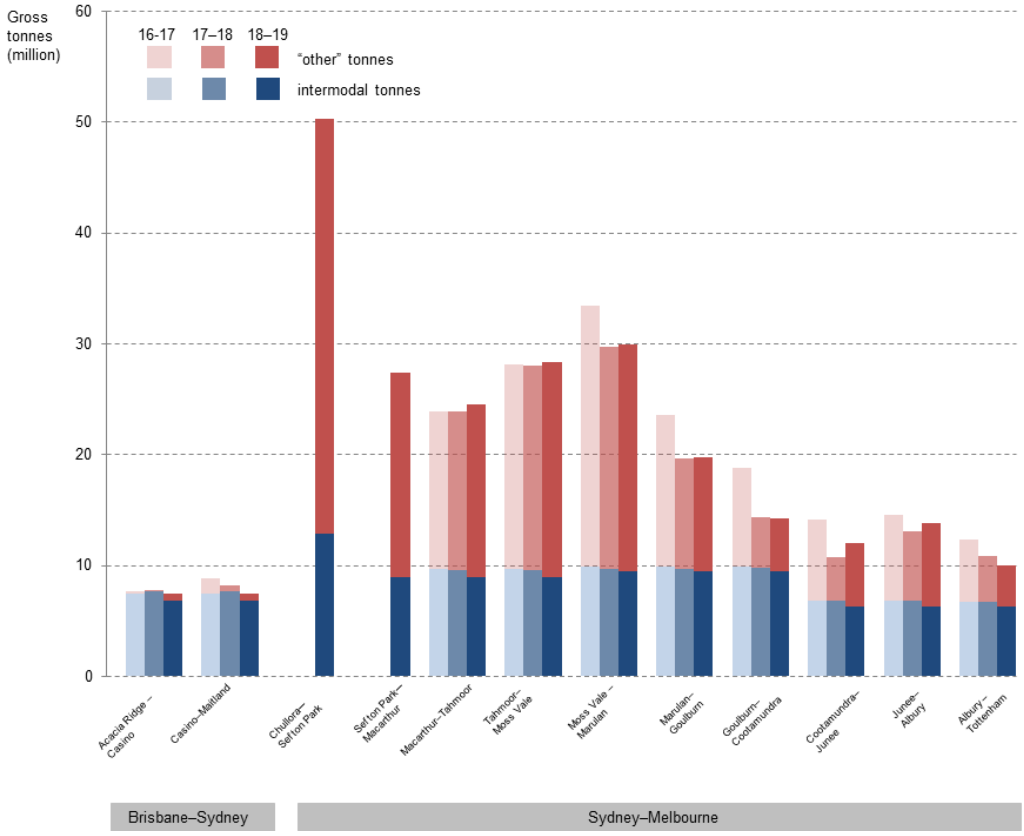
There have been major 'other' tonnage increases (greater than 100 per cent) between Acacia Ridge and Casino, and from Port Augusta to Tarcoola but these changes are not statistically significant due to the small baseline figures from 2017-18. Other significant changes to non-intermodal tonnages in 2018-19 were as follows:

- Cootamundra—Junee: up by approximately 46 per cent;
- Junee—Albury: up by approximately 30 per cent;
- Broken Hill to Crystal Brook: down by 37 per cent;
- Crystal Brook to Broken Hill: up by approximately 27 per cent;
- Melbourne (Tottenham)—Adelaide (Dry Creek): down by approximately 44 per cent; and
- Dry Creek—Crystal Brook: down by approximately 34 per cent.

There was a significant drop in non intermodal tonnages between Koolyanobbing East and Kalgoorlie (greater than 50 per cent). This was due to the suspension of Iron Ore operations out of Koolyanobbing. These tonnages went east to Kalgoorlie and then south to Esperance. At the beginning of 2020/21, however, tonnages had returned to earlier levels. All other sectors between Kalgoorlie and Perth had reduced non intermodal tonnages, of approximately 16 per cent. According to advice from Arc Infrastructure, this reduction is partly due to the suspension of iron ore mining operations at Mount Walton, whose product had previously travelled by rail to Kwinana.

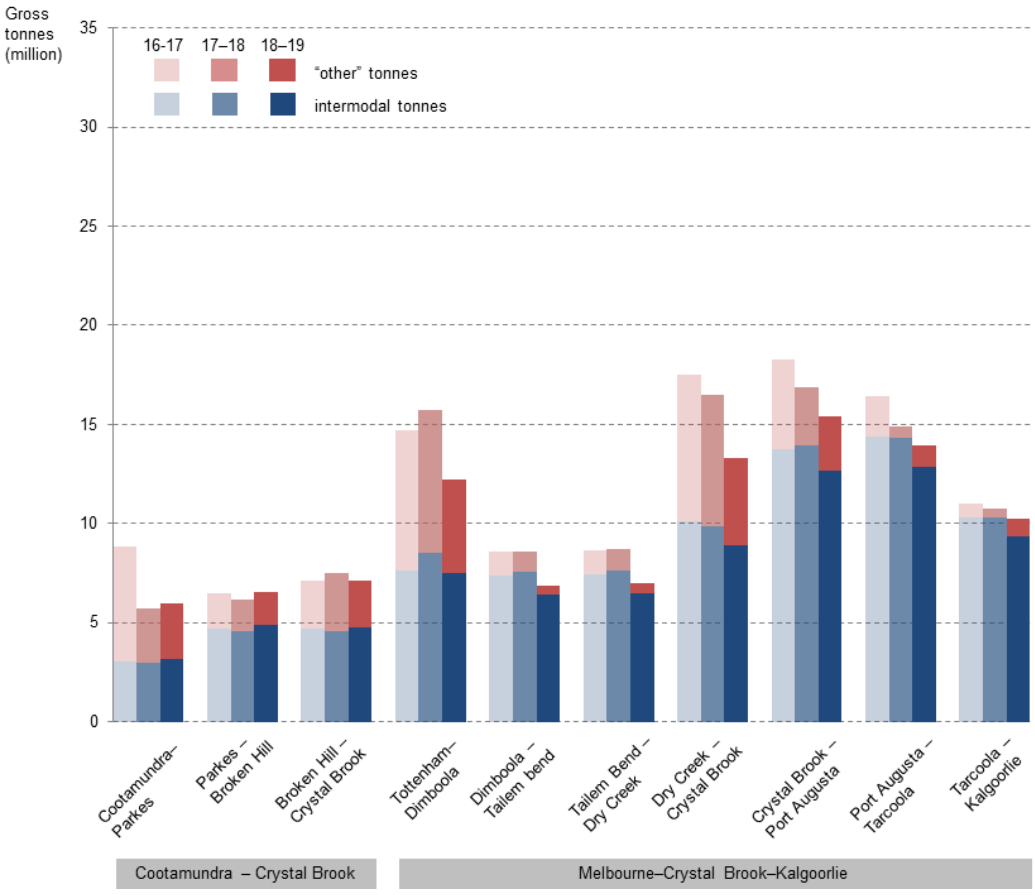
7 To obtain 'other tonnages, deduct the intermodal component from the total figure.

Figure 5 Gross tonnage on the North–South corridor, by line segment, 2016–17 to 2018–19



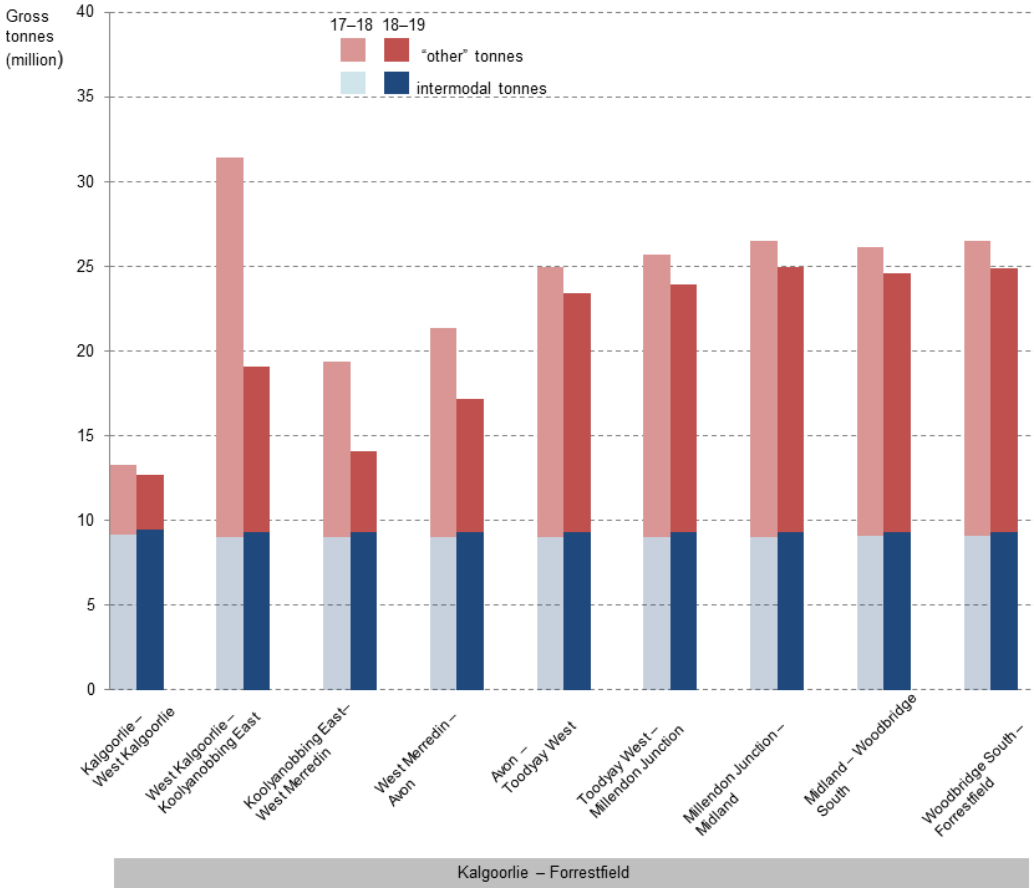
Source: Data provided by ARTC.

Figure 6 Gross tonnage on the East–West corridor, by line segment, 2016–17 to 2018–19



Source: Data provided by ARTC.

Figure 7 Gross tonnage on the East–West corridor, by line segment, 2017–18 to 2018–19



Source: Data provided by Arc Infrastructure.

National Freight and Supply Chain Strategy and Action Plan

In August 2019, the Australian Transport and Infrastructure Council released the National Freight and Supply Chain Strategy and accompanying National Action Plan. The Action Plan states how the Strategy will be implemented. According to the Strategy, "It sets a national vision for freight systems and supply chains to contribute to a strong and prosperous Australia through achieving the following goals:

- Improved efficiency and international competitiveness;
- Safe, secure, and sustainable operations;
- A fit for purpose regulatory environment;
- Innovative solutions to meet freight demand;
- A skilled and adaptable workforce;
- An informed understanding and acceptance of freight operations." (Transport and Infrastructure Council, 2019, p.6).

The Action Plan states that these goals will be achieved through action across the following four areas:

- Smarter and targeted infrastructure investment;
- Enabling improved supply chain efficiency;
- Better planning, coordination, and regulation; and
- Better freight location and performance data. (Transport and Infrastructure Council, 2019a, p.23)

The strategy has a 20 year outlook, and will be reviewed every five years (Transport and Infrastructure Council, 2019, p.27).

The Action Plan has the following 13 Actions:

- Ensure that domestic and international supply chains are serviced by resilient and efficient key freight corridors, precincts and assets;
- Provide regional and remote Australia with infrastructure capable of connecting regions and communities to major gateways, through land links, regional airports or coastal shipping;
- Identify and support digital infrastructure and communication services necessary for improved and innovative supply chains;
- Advance heavy vehicle road reform to facilitate efficient investment in infrastructure;
- Adopt and implement national and global standards, and support common platforms, to reduce transaction costs and support interoperability along supply chains;
- Promote training and re-skilling of industry and government workforces appropriate to current and future needs;
- Facilitate new and innovative technologies that improve freight outcomes and understand the deployment, skills and workforce requirements for operators and infrastructure;
- Build community acceptance of freight operations;
- Ensure freight demand is integrated in transport and land use planning across and between jurisdiction boundaries and freight modes;

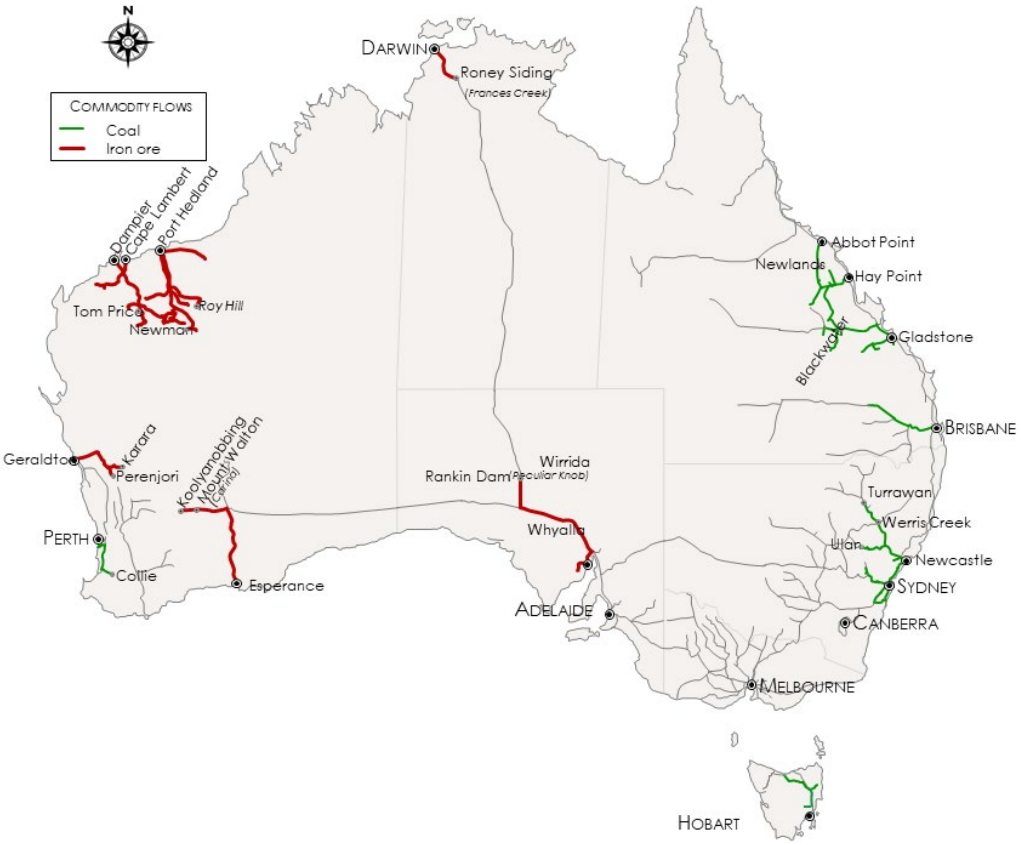
- Strengthen the consideration of freight in all other government planning and decision-making;
- Investigate policy, planning and operational solutions to improve freight access and movement along domestic and international supply chains;
- Improve regulation to be more outcomes focused and risk-based to support innovation and reduce regulatory burden whilst maintaining safety, security and sustainability; and
- Develop an evidence-based view of key freight flows and supply chains and their comparative performance to drive improved government and industry decision-making, investment and operations. (Transport and Infrastructure Council, 2019a).

Aspects of the Action Plan that directly pertain to rail include:

- Moorebank Intermodal Terminal in New South Wales;
- Kenwick Intermodal Terminal in Western Australia;
- Katherine Agribusiness and Logistics Hub in the Northern Territory;
- Port Botany rail line duplication;
- Melbourne port rail shuttle;
- Inland Rail, including corridor preservation, corridor surveying, and terminals planning;
- Murray Basin Project;
- Standardisation and interoperability across rail networks;
- Advanced Train Management System pilot;
- Townsville eastern access rail corridor and Port of Brisbane rail access corridor identification and protection; and
- Scheduling and operating procedures to improve rail freight access and flows through metropolitan areas.

Rail freight traffic, by commodity

Figure 8 Principal iron ore and coal flows



This section discusses rail freight traffic by commodity or market. Iron ore and coal are the rail industry's two largest bulk freight flows.

Iron ore traffic

Australia exports most of its iron ore,[8] almost all of which is moved to port by rail[9]. The largest flows are in the Pilbara region of Western Australia, which accounts for over 94 per cent of Australia's iron ore exports (BITRE, 2014b). The integrated railways of the Pilbara region, by infrastructure owner, are:

- **Rio Tinto:** The Robe River to Cape Lambert and the former Hamersley Iron's network to Port Dampier. Since 2012, trains on the Hamersley railway have been approximately 2.4 kilometres long and with a capacity of 26 000 tonnes (BITRE 2013, p. 31). Rio Tinto inaugurated

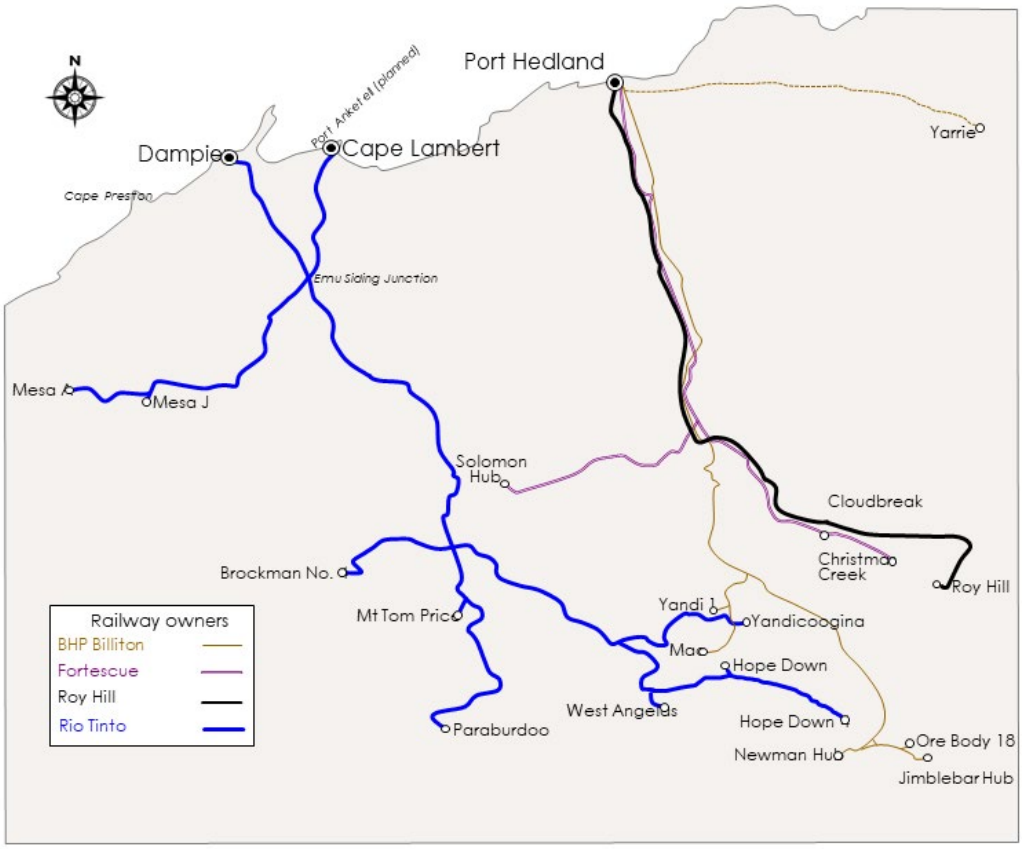
8 There are two domestic manufacturers of steel, Arrium and BlueScope Steel, with a blast furnace at Whyalla and Port Kembla, respectively. Arrium has sourced its iron ore mostly from the Middleback Ranges in South Australia. BlueScope Steel uses iron ore from Mount Newman (Western Australia) and Savage River (Tasmania). See BITRE 2014a.

9 Rail has an estimated 86 per cent share of the domestic iron ore freight task, with road having an estimated two per cent. Where iron ore is used in domestic manufacturing, coastal shipping is used to shift iron ore between ports (representing an estimated 12 per cent of the domestic iron ore freight task). See BITRE 2014b, p.21.

its first driverless train revenue service on 10 July 2018. The train carried 28 000 tonnes of iron ore over 280 kilometres from Tom Price to Cape Lambert (Rio Tinto, 2018).

- **BHP:** The Goldsworthy line (to Yarrie) and the Newman line run to Port Hedland. Each train on the Newman line can carry approximately 37 000 tonnes (BITRE 2013, p. 27). The Goldsworthy (to Yarrie) line ceased operations 2014 but remains mothballed.
- **Fortescue Metals Group:** The Fortescue Hamersley line from Solomon Hub and the Christmas Creek line run to Port Hedland. Trains on these lines can haul approximately 33 000 tonnes each (BITRE 2013, p. 27).
- **Roy Hill Holdings:** A 344 kilometre railway from Roy Hill to Port Hedland. These trains typically haul 232 ore cars, with a payload of more than 32 000 tonnes of ore.

Figure 9 Pilbara iron ore railways, by infrastructure owner

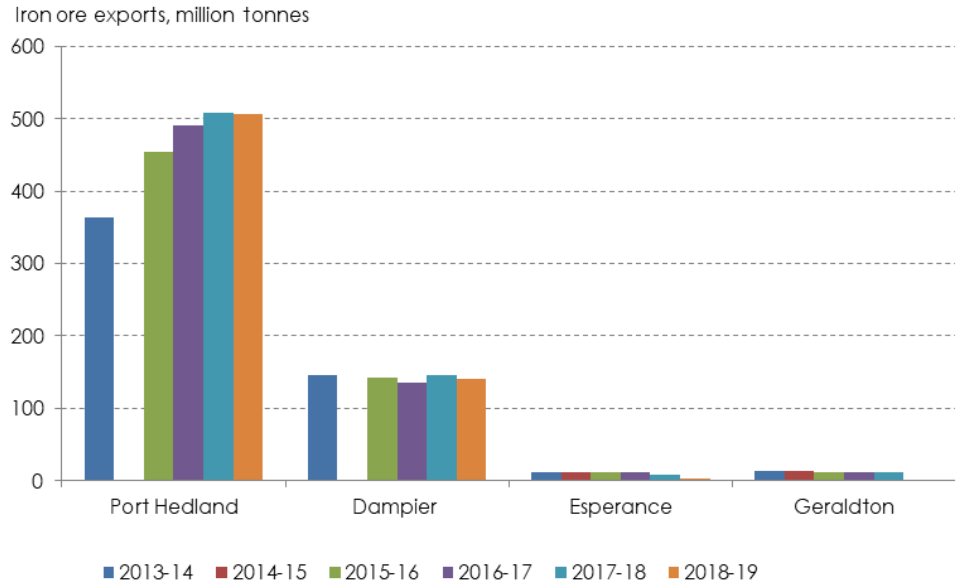


The scale of the task means rail is the most efficient means for transporting iron ore from mine to port. Tonnages exported, by principal port, denote tonnages hauled by the iron ore railways; see Table 6. Exports through Esperance dropped significantly, due the cessation of the Cleveland-Cliffs 11 million tonne a year operation at Koolyanobbing. This was partly offset by Mineral Resources Limited (MRL) taking over the operation, with state government incentives (Southern Ports, 2019, p.8).

Table 6 Iron ore exports, million tonnes, 2018–19

Port Hedland[10]	Dampier	Cape Lambert (Port Walcott)	Esperance	Geraldton	Fremantle (Perth)[11]	Total
506.6	141.2	n/a	3.15	.865	-	651.8

Figure 10 Iron ore exports by financial year



Notes: Cape Lambert iron ore facilities lie within the administrative area of Port Walcott. The data for Port Walcott is not available for the reporting periods.

Sources: Pilbara Ports Authority (2020), p.8; Southern Ports (2019, p.44); Mid West Ports (2020); BITRE (2014b).

Coal traffic

Similar to iron ore, rail is the best and dominant mode for hauling coal from mine to port, particularly given Australia's coalfields are mostly located inland. Most Australian (black) coal extraction is in Queensland and New South Wales. Queensland coal is predominantly metallurgical (used in steel making) while the New South Wales coal is predominantly thermal (typically used in electricity generation)[12].

Most of Australia's coal haulage by rail is in these two states. Aurizon manages the Central Queensland Coal Network, which is narrow gauge track with train axle loads of 26.5 tonnes. The network comprises five coal systems. ARTC manages the New South Wales (standard gauge) Hunter Valley system. The systems are:

- **Newlands (Queensland).** This system runs through the northern end of the Bowen Basin, to the port at Abbot Point. The line services mines at Collinsville, Sonoma, Newlands, Lake

10 The Pilbara Ports Authority source document reports total throughput, itemised by commodity type as a percentage of the total. The totals listed here for Port Hedland and Dampier are what BITRE has calculated according to the iron ore percentage of the total. .

11 There is no data for Fremantle as the port has ceased all iron ore exports..

12 BITRE (2013, p. 9) gives an overview of coal attributes.

Vermont and Clermont. Aurizon recently linked it to the Goonyella Rail Corridor (For more details see Aurizon 2020c).

- **Goonyella (Queensland).** Goonyella is an electrified system that services the Bowen Basin coal region. It primarily serves the terminals at Hay Point and Dalrymple Bay. (For more details, see Aurizon 2020c.)
- **Blackwater (Queensland).** This system services the Bowen Basin coal region. It delivers coal to the two export terminals at the Port of Gladstone. It also services domestic users such as the Stanwell and Gladstone power stations, Cement Australia and Comalco refinery. The system consists of mostly electrified duplicated lines that extend west from Rockhampton. (For more details see Aurizon 2020c.)
- **Goonyella to Abbot Point (Queensland).** This system links the Goonyella and Newlands systems, enabling coal to be delivered to either the ports of Hay Point or Abbot Point. (For more details see Aurizon 2020d.)
- **Moura (Queensland).** This system is approximately 242 route kilometres and services the Boundary Hill, Dawson, and Callide mines. It is single track with passing loops and is linked to the Gladstone power station, Comalco refinery, Queensland Alumina Limited, Cement Australia and the R G Tanna and Wiggins Island coal terminals at the Port of Gladstone. (For more details see Aurizon 2020c.)
- **Hunter Valley (New South Wales).** Coal is transported to three coal-loading terminals in Newcastle and to domestic users. Train axle loads are up to 30 tonnes for most of the network, with scope for increases, at speeds of up to 80 kilometres per hour (ARTC 2020, p.16). Maximum train lengths are approximately 1500 metres (ARTC 2020, p.15). According to ARTC, 2020 contracted export volumes were 196.5 million tonnes per annum, which will remain stable until 2024, at which time ARTC forecasts it to drop to 157.9 million tonnes per annum by 2028 (ARTC 2018, p 5). In 2020, an average of 68 trains needed to be operated each day, based on contracted volumes and train sizes. This translates to one train every 21 minutes. ARTC's capacity planning provides for a maximum of 97 trains per day (ARTC 2020, p.14).

Table 7 Annual coal traffic, Queensland and New South Wales, 2019–20

	Queensland					NSW
	Blackwater	Goonyella	Moura	Newlands	Southeast Qld	Hunter Valley
Net tonnes (m)	55.6	59.9	13.8	20.8	5.5	164.3

Notes: Queensland tonnages include all above rail operators.

Hunter Valley tonnages are also available through the web site of the Hunter Valley Coal Chain Coordinator (https://www.hvccc.com.au/DailyPlanning/Pages/SummaryPerformanceReports.aspx)

Sources: Aurizon (2020a, p.57); ARTC n.d. (multiple issues).

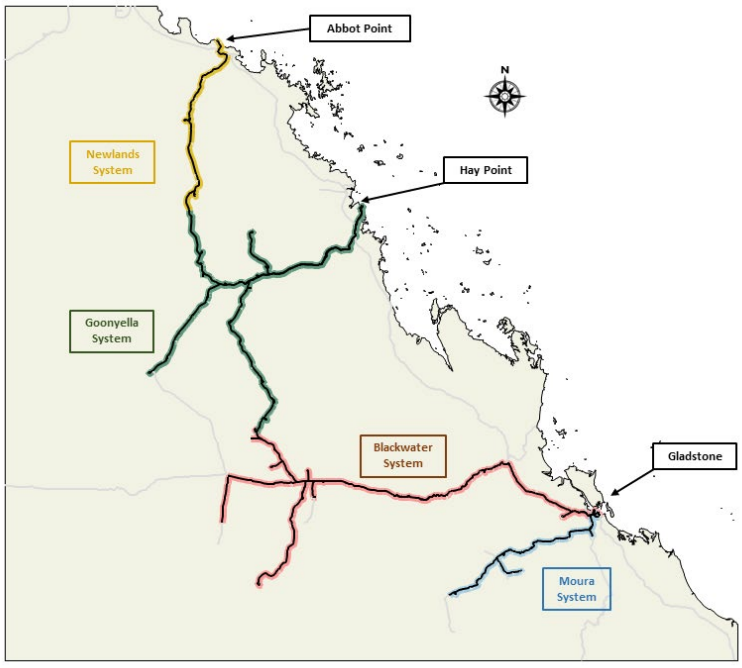
Figure 11 ARTC Hunter Valley Coal Network

Map courtesy of ARTC.

Figure 12 Aurizon coal train

Notes: The image above shows a loaded Aurizon coal train arriving at Hexham, near Newcastle, October 2020. Photo courtesy of Rodney Avery.

Figure 13 Central Queensland Coal Network



In addition to the main coal systems, other places of significant coal haulage by rail includes:

- The West Moreton coal fields in southern Queensland;
- The Southern mine region at Wongawilli Colliery, New South Wales;
- The Metropolitan Colliery, near Helensburgh, New South Wales;
- The Tahmoor colliery, near Picton, New South Wales;
- The Western coal region, near Lithgow, New South Wales; and
- Fingal, in Tasmania.

Aurizon and Pacific National dominate coal haulage, with involvement also by One Rail Australia, Southern Shorthaul Railroad[13] and Tasrail. Aurizon is the main coal train operator in Queensland, while Pacific National dominates in the Hunter Valley.

Table 8 Aurizon above rail coal haulage, Queensland and New South Wales

	2016–17	2017–18	2018-19	2019-20
Tonnes (million)	198.2	212.4	214.3	213.9
Net tonne kilometres (billion)	47.6	50.4	50.5	50

Source: Aurizon (2020, p.16)

Approximately 77 per cent of Aurizon's coal haulage task in 2019-20, by net tonne kilometres, was in the Central Queensland Coal Network.

Coal extracted in Tasmania is used domestically.

Table 9 Coal exports, by principal ports, (million tonnes), 2018-19

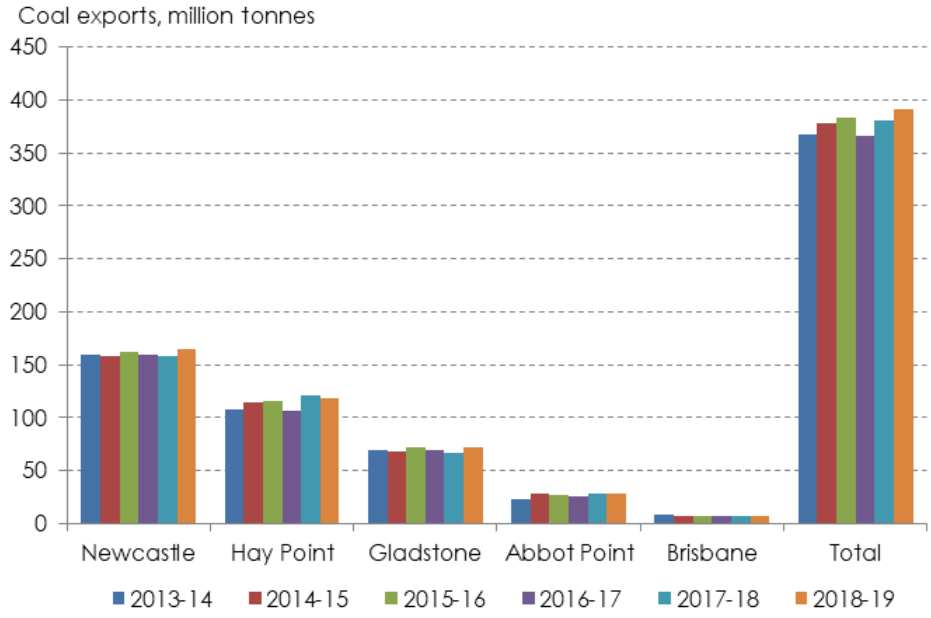
Newcastle[a]	Hay Point	Gladstone	Abbot Point	Port Kembla	Brisbane
165.2	118.3	72.4	28.9	n/a	6.5

Note [a]: The Port of Newcastle figure is for the 2019 calendar year. [a]

Sources: Port of Newcastle (2020), p.2; North Queensland Bulk Ports Corporation (2019), pp.16,18; Gladstone Ports Corporation (2020); advice from Port of Brisbane.

13 Southern Shorthaul Railroad operate coal trains in New South Wales on behalf of Centennial Coal.

Figure 14 Coal exports by port



Sources: Port of Newcastle (2020), p.2; North Queensland Bulk Ports Corporation (2019), pp.16,18; Gladstone Ports Corporation (2020); advice from Port of Brisbane. previous editions of *Trainline*.

Figure 15 Dalrymple Bay Coal Terminal - Hay Point

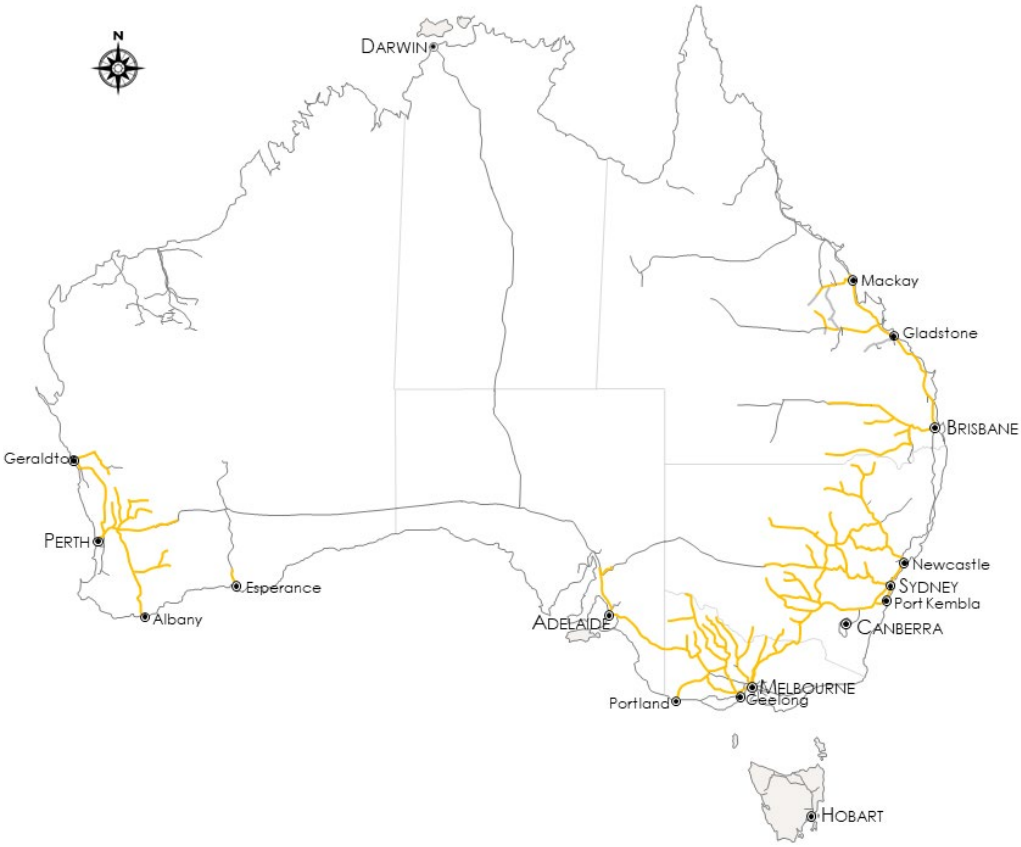
Notes: The image above shows coal unloading operations at the Dalrymple Bay Coal Terminal (Hay Point). Photo courtesy of Dalrymple Bay Coal Terminal.

Grain traffic

A major role for Australia's railways is hauling agricultural produce from rural areas to ports for export and, to a lesser extent, domestic consumption. Grain harvests are predominated by cereal grains (for example wheat and barley), but also pulses and oilseeds. Rail has traditionally dominated grain transport over long distances, while road transport becomes more competitive over shorter distances.

Figure 16 shows grain flows by rail. This traffic largely uses dedicated grain haulage branch lines, which connect with main lines. In September 2020, there was an estimated 4 700 route-kilometres of operational railway track that was largely or exclusively used for grain haulage.

Figure 16 Australian grain railway flows



Notes: The major grains hauled by rail in Australia for domestic and export consumption include; milling wheat, stockfeed wheat, durum, malt barley, feed barley, sorghum, canola, chickpeas.

The map shows grain flows along the railway lines that are designated as operating in September 2020. Some railways, notably in south-west Western Australia and in central New South Wales, are not shown as they are classified non-operational. The Toolamba—Echuca line in Victoria is currently also non-operational thus not shown.

AEGIC (2014, p. 33) illustrated the rail transport costs for wheat, by state and grain handling company, within the overall export logistics supply chain. For a 200 km rail haul, these represent around one-third of the post-farm gate prices[14] through to the export vessel. As a major supply chain cost, therefore, the mode choice plays a major role in the overall costs.

Grain traffic trends

In December 2019, US based company Watco expanded its Australian operations, from just Western Australia, to Queensland also (The Dispatch, December 2019, p.1). In Western Australia it hauls for CBH Group, while in Queensland it serves GrainCorp. Its Queensland operations include hauling grain to Mackay, Gladstone, and Fisherman Islands. Watco purchased eight locomotives from the United States and 128 wagons from China for its Queensland operations (The Dispatch, December 2019, p.1).

14 The farm gate price is the global price the grain grower receives, minus expenses.

According to the Australian Export Grains Innovation Centre (AEGIC), approximately half of the grain transported to port from upcountry storage travels by rail, with the remaining half travelling by road (AEGIC, 2018, p.50). AEGIC further claims that the shift from rail to road transport due to the closure of some lines in South Australia and Western Australia has been offset by new operational efficiencies in other parts of the rail network (AEGIC, 2018, p.50).

While rail transport has a traditional advantage for bulk grain transportation over long distances and is the preferred mode choice, this advantage is not absolute and has been partially eroded by other factors that have improved road transport's competitiveness or restricted rail transport's efficiency[15]. These include:

- Variable infrastructure quality across the networks, slower speeds, the need in places to change locomotives from mainline types to branch line types, chokepoints and short crossing loops at strategic locations [16];
- Variable rolling stock age and capacity, which can at times be less than what the infrastructure can accommodate;
- Degrees of grain handlers' investment in grain receival sites, including closure of smaller sites;
- Improved roads and road transport services, including more widespread use of bigger and heavier trucks;
- Increased containerisation of grain, although this is still usually transported by rail;
- Deregulation of grain export marketing, which has seen smaller shipments being moved on diverse pathways for a broader range of bulk handlers and export marketers;
- Increased on-farm grain storage that is more suited to truck transport;
- Rail industry restructuring, funding and ownership changes;
- Rail transport and infrastructure availability;
- Increased domestic grain consumption of wheat produced in New South Wales, for which road transport is better suited;
- Coordinating train loading times with port receival times; and
- Weather events, where smaller harvests in droughts reduce the export grain task and are focused on the domestic grain task that is mostly trucked.

While track infrastructure may reduce rail transport's efficiency, this should be seen in the context of how much grain travels on the lower grade lines. According to advice from John Holland Rail, for example, the amount of grain traffic on these lines is already low; thus, the significance of these restrictions should be seen in that context.

Bulk grain transport by rail in parts of New South Wales has become more efficient and competitive as a result of improvements to the NSW Government's Country Regional Network (CRN), which John Holland Rail manages. According to advice from John Holland Rail, the annual maintenance and capital plan expenditure is now approximately $125 million. Previous annual maintenance and capital works programs were as high as $180-200 million. Annual work plan priorities are jointly identified between Transport for NSW and John Holland Rail, with the annual sum allocated to works determined via the NSW Government annual budget.

Annual work plan improvements include replacement of life expired bridges, under-bridges and culverts, level crossing and signalling system upgrades, ballast re-surfacing and depth increase,

15 *Trainline* 3 discusses in detail these changes and challenges to grain transport by rail. (See BITRE, 2015)
16 For more information on track infrastructure constraints, from a grain grower's perspective, see (Grain Central 2017)

track re-conditioning, re-railing with heavier rail (new and used) and replacement of timber sleepers with steel sleepers, except in sections where jointed track remains, including; The Rock—Boree Creek, Griffith—Hillston, Ungarie—Naradhan, Ungarie—Lake Cargelligo, Bogan Gate—Tottenham, Burren Junction—Merrywinebone and Camurra—Weemelah. All other lines now feature full 'face' steel sleeper pattern and continuous welded rail.

The track maintenance strategy has permitted improvements to line capability (speed and/or higher axle loads). Heavier and more powerful locomotives can operate on sections of the CRN where they previously could not (for example to Walgett) and wagons can carry heavier payloads.

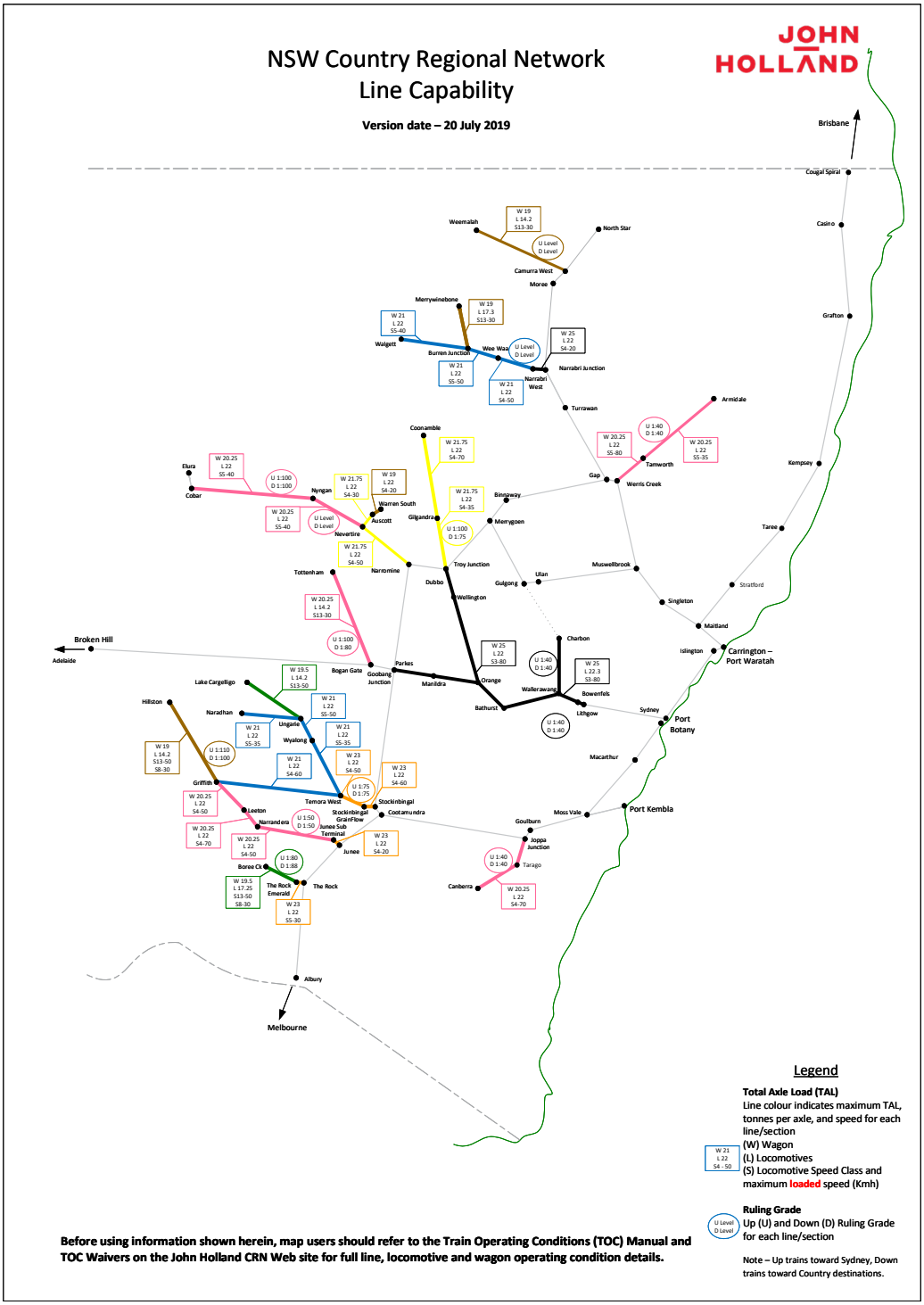
While 21 per cent of the CRN has a line capability of 76—78 tonnes gross (low traffic western lines), 61 per cent of the network now permits gross wagon tonnage of 84 tonnes or higher. This exceeds the maximum capability of more than ~75 per cent of the current bulk grain wagon fleet. This translates to reduced transport costs and improved competitiveness of rail transport in turn[17].

John Holland Rail has also received funding under the NSW Government's Fixing Country Rail programme for:

- Hillston yard reorganisation and siding extension.
- Grain siding extensions at Ardlethan, Barellan, Nevertire, Burren Junction.
- Junee to Griffith Line Upgrade project – project underway, in design and planning, and procurement stage.
- Hermidale Multi User Siding project – completed in November 2019.
- Temora West Multi User Siding project – project in construction.
- Coonamble South Multi User Siding project – completed October 2020
- Tarago Passing Loop Extention project – project completed in April 2020.
- Planning and design for reinstatement of the Junee north triangle connection to the Main South.
- Feasability studies into completion of the Maryvale – Gulgong line and reinstatement of the Rylston – Gulgon line for delivery of coal to Mount Piper.
- Construction in 2021 of new 1800 crossing loops at Pinecliffe (Molong) and Maryvale (Wellington) and crossing loop extensions at Polona (Blayney) and Bumberry (between Manildra and Parkes).

17 For further information on Transport for NSW's CRN works see https://www.transport.nsw.gov.au/projects/current-projects/country-regional-network-crn

Figure 17 New South Wales Country Rail Network Infrastructure Standards November 2020



Note: The map above shows the New South Wales CRN network capabilities by line. Map courtesy of John Holland.

Box 2 Further reading on railway grain handling

For grain crop reports and forecasts see:

- http://www.graincorp.com.au/
- https://www.cbh.com.au/
- https://www.awb.com.au/
- https://www.ldc.com/au/en/business-lines/grains-oilseeds/
- www.emeraldgrain.com

Non-bulk and short-haul rail freight traffic

Non-bulk and short-haul (a distance that is shorter than that which intermodal rail transport is usually considered viable) rail freight movements are mostly containerised, although SCT Logistics, for example, typically uses louvre wagons for their palletised traffic.

Short-haul traffic is often thought to be uncompetitive with road freight, due to the relative short distances over which the freight is moved. It can, however, be successful. To succeed, short-haul rail traffic needs:

- Minimised drayage costs between the hinterland and intermodal terminal;
- Low line haul and high road haul costs; and
- A convergence of parties who encourage short haul and viable hinterland terminals (BITRE 2016a, pp v-vi)[18].

Apart from rail container movements between domestic intermodal terminals, rail services also undertake maritime tasks (for import, export and Bass Strait traffic) that can be classified as follows:

- Landbridge movements, from one port to another. Container movements from around Hobart, to the Port of Burnie (for export or transfers to and from the mainland), is a primary example.
- Regional export movements, from inland terminals to the port. This traffic includes agricultural commodities, such as grain, hay, sugar, cotton, grains, livestock, wine and logs.
- Urban import and export movements. These are short-haul container movements, linking the port terminal with urban logistics centres (where boxes are de-stuffed, stored or distributed to local businesses around the terminals). These local rail services also shift empty containers. SCT Logistics' daily container shuttle train from its Penfield intermodal terminal to the Port of Adelaide for Treasury Wines Estate is an example.
- Export maritime activities are generally based around single commodities and/or a single company's logistics-based hub, such as agricultural produce from the Fletcher International terminal at Dubbo..

The following discussion focuses on port rail flows to or from capital cities and urban shuttles, while noting other non-capital city flows can operate.

18 BITRE 2016a (*Why short-haul intermodal rail services succeed*), provides an in depth discussion on the (potential) of short-haul rail transport in Australia.

Rail (and road) volumes of containers through the primary capital city ports are reported in BITRE's regular Waterline series. (BITRE 2019 gives the latest figures.)

Landbridge and regional movements

Port of Brisbane — Fisherman Islands

Figure 18 shows the rail container flows between Queensland intermodal terminals and the Port of Brisbane (Fisherman Islands).

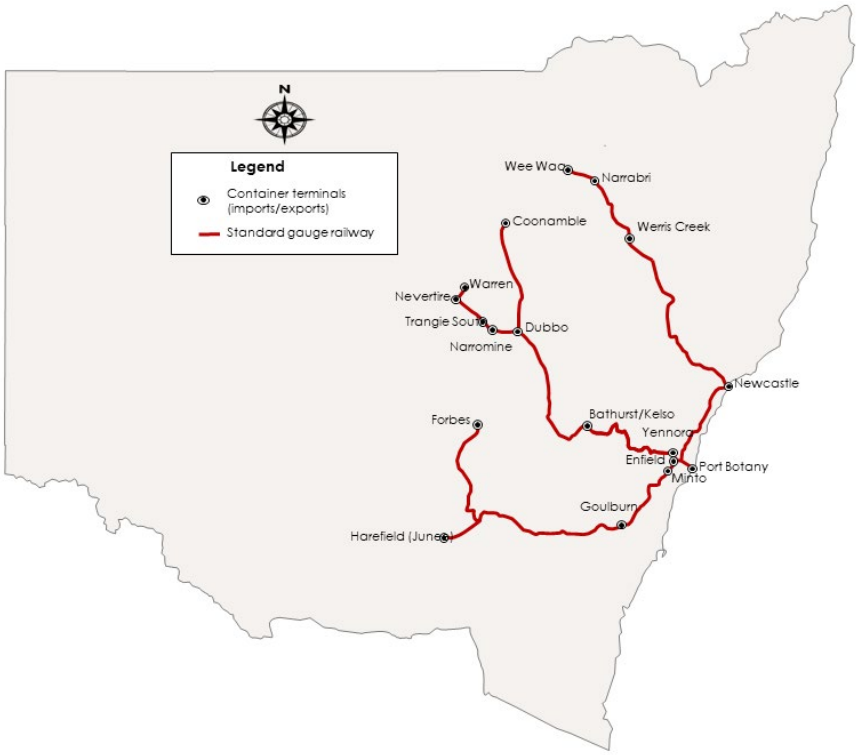
Figure 18 Rail container operations serving the Port of Brisbane (Fisherman Islands)

The only current containerised freight travelling to the Port of Brisbane by rail is refrigerated meat from Rockhampton.

The Port of Brisbane used to manage export traffic, including seasonal cotton, from Dalby and Goondiwindi, but these ceased in late 2009 and September 2014 respectively. This was due to tunnel height restrictions in the Toowoomba Range, which prevented the transportation of shipping containers higher than 8'6". This made rail transport from these centres unviable and the traffic has switched to road transport. The Queensland government recently completed a tunnel lowering project, which began in 2018, to facilitate the transportation of 9'6" containers.

Sydney Ports — Port Botany

Figure 19 Rail container operations serving Sydney Ports — Port Botany



Regional services are based on export container traffic, with train movements to the hinterland conveying empty boxes for filling. Rail moves a range of containerised commodities, primarily agricultural, to Port Botany. These commodities include:

- Specialised grain, conveyed from Forbes, Narrabri, Dubbo, Coonamble and Narromine;
- Meat and other agricultural produce from Dubbo;
- Containerised grain and cardboard (from Visy's plant at Tumut) from Harefield (near Junee)[19];
- Viterra pack cereals (wheat and barley), oilseeds and pulses from Narrabri;
- Cotton from Warren, Nevertire, Wee Waa, Narrabri, and Trangie South;
- Logs from Bathurst/Kelso and Newcastle (Sandgate);
- Logs from Goulburn to Port Botany and Port Kembla;
- Grain, oilseeds, pulses, and refrigerated meat from Dubbo;
- Containerised plantation logs, grain, meat and other agricultural products from Werris Creek; and
- Aluminium ingots and various agricultural produce from Newcastle.

19 QUBE Logistics, which operates this service, has been alternating between using the Port of Melbourne and Port Botany for this service.

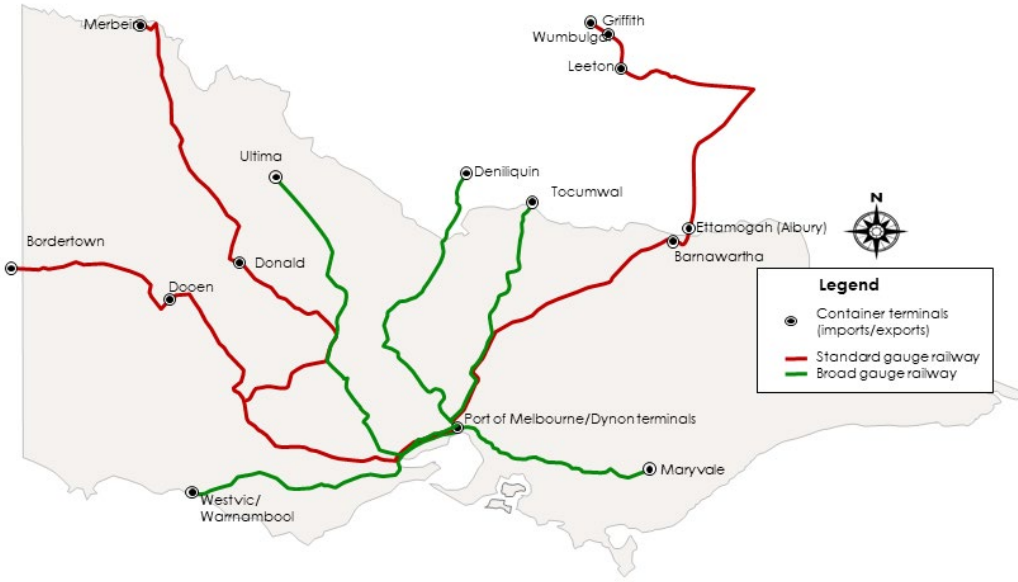
In June 2019, Crawfords Freightlines commenced hauling plantation logs from its newly built terminal at Werris Creek to Port Botany. Crawfords says it built the terminal as an open access facility, which may attract other rail traffic from other operators. (Namoi Independent, June 2019) The Crawfords facility also coordinates containerised rail services from Narrabri with its Werris Creek freight to maximise pathing availability through the ARTC and Sydney Trains networks into Port Botany.

The NSW Government is funding the recommissioning of six kilometres of line from West Tamworth to Westdale to facilitate the construction of an intermodal facility to be operated by QUBe that will compete with the Werris Creek facility. The approximate cost of this project is $35 million. (Transport for NSW, 2020)

NSW Port's estimate of rail's modal share for the Port of Botany in December 2018 was 16.7 per cent[20]. (NSW Ports 2019, p.3)

Figure 20 shows the major regional container export flows through the Port of Melbourne. It does not show rail container flows through the port that originate or are destined for Tasmania.

Figure 20 Rail container freight operations serving the Port of Melbourne



The non-urban movements can be categorised into western and eastern Victoria flows, and southern New South Wales flows. Products transported by rail are as follows.

Intrastate Victoria.

- Merbein (Mildura) – grain, wine, grapes, fruit;
- Donald - peas, grain;

20 This is a reduction from previous levels but NSW Ports puts the decline in the context of the 'rural decline'.

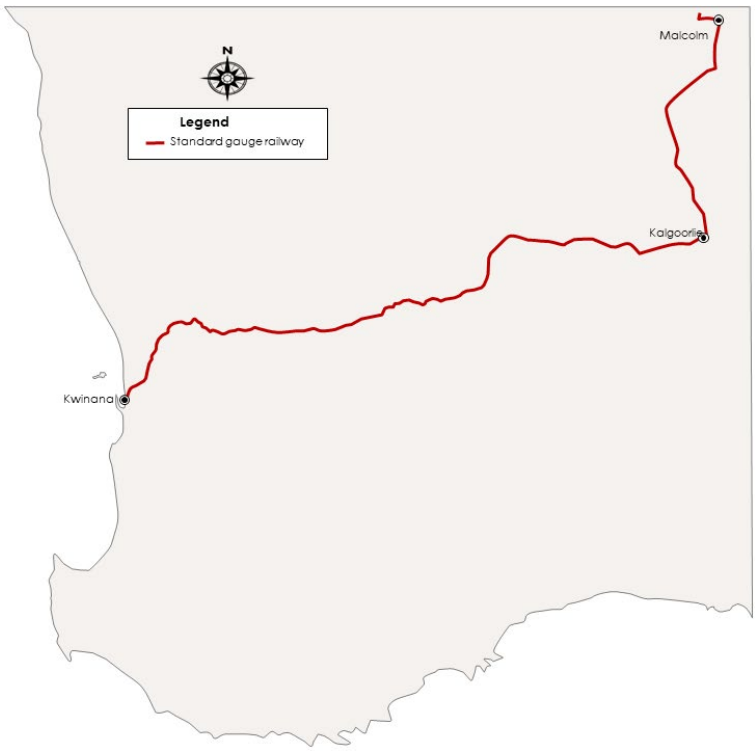
- Westvic Container Export Services, at Warrnambool - meat and dairy products metal ingots, machinery;
- Wimmera Container Line, at Dooen (near Horsham) - grain, hay, and pulses;
- Maryvale in the Latrobe Valley – containerised paper;
- Ultima – hay, grain, and wine; and
- SCT Logistics rail hub at Barnawartha – cotton for export to Asia.

Southern New South Wales and South Australia. Export flows to the Port of Melbourne, including:

- Deniliquin – containerised rice;
- Tocumwal - grain, hay, rice, potatoes, cottonseed, dairy;
- Griffith and the Wumbulgal terminal – containerised wine, rice, other cereals, cotton, and hay;
- Rice and pelleted feeds for animals, from Leeton;
- Containerised paper from the Ettamogah Rail Hub; and
- Containterised logs from Bordertown.

Kwinana

Figure 21 Rail container operations serving Kwinana



The primary regional container export flows are nickel from Malcolm (near Leonora) and nickel products from a nickel smelter south of Kalgoorlie.

Port Adelaide

There are regional maritime container traffic flows to Port Adelaide. While purpose-built containers are also used for haulage of mineral sands (such as from Kanandah, near Broken Hill, to Port Flat), these movements lie outside this analysis.

Figure 22 Rail container operations serving Port Adelaide

According to advice from Bowmans Rail, regional trains operate between the Bowmans Rail's intermodal terminal (operated by Balco Australia) and Outer Harbor. The terminal is used for the export of agricultural products such as hay, pulses, lead, mineral sands and project materials. The facility is also used as a consolidation point for a range of commodities, a task that would otherwise be done at the port. The terminal is served by rail services that convey containers to Outer Harbor. Some Bowmans container trains also serve the Nyrstar lead smelter at Port Pirie. Containerised lead is collected from the smelter for export through Outer Harbor.

One Rail Australia also transports Oz Minerals copper concentrates for export from Prominent Hill in northern South Australia to the Inner Harbor Port Adelaide berth #29 bulk precinct.

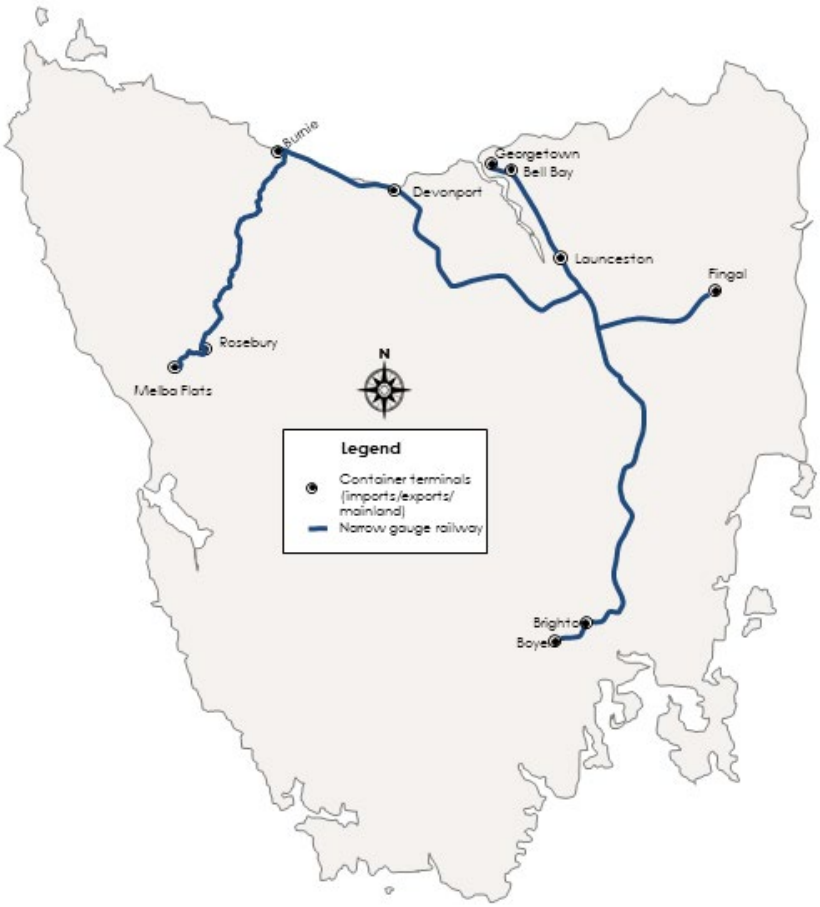
According to advice from Flinders Ports, in October 2018 Flinders Ports upgraded the intermodal rail infrastructure by decommissioning the northern rail spur and building a new spur 25 metres

north of the decommissioned track. This allows for 50 metres of operational working distance between tracks to pre stage and store rail containers.

Tasmania

Tasmania has a growing freight rail network which is operated and maintained by TasRail, the state's fully integrated railway. With modernised terminals located at Burnie, Brighton and George Town (Bell Bay), TasRail provides freight haulage and storage services throughout the state. Containerised freight services connect major industrial areas to Tasmania's premier shipping ports where freight is moved across Bass Strait. Bulk freight services provide efficient, integrated, end-to-end supply chain services and the haulage of bulk commodities to storage facilities for onward export. TasRail also operates Tasmania's only publicly-owned bulk handling, storage and ship loading facility for bulk minerals, which is located within the Port of Burnie. In 2019-20 TasRail commenced a project to replace the bulk minerals shiploader at the Burnie Port, that will be completed in 2021/22.

Figure 23 Rail container operations serving Tasmanian ports



Rail traffic terminals in Tasmania include:

- George Town: A multi modal-terminal with container storage area handling containerised general freight, metal ingots and bulk log freight. TasRail also has direct rail access to the woodchips mills within Bell Bay. According to advice received from TasRail, forestry freight grew by 48 per cent in 2019-20, partly due to "TasRail's efficient and direct integration into the woodchip mills at Bell Bay."
- Devonport: A freight terminal handling containerised general freight;
- Burnie: An upgraded multi-modal freight terminal, which handles containerised general freight, bulk metal concentrates, paper products, and metal ingots;
- Launceston: A freight terminal handling containerised general freight; and
- Brighton: A multi-modal freight terminal with container hardstand and storage area that handles containerised general freight, bulk log freight, and metal ingots.

TasRail also hauls zinc ingots, bulk minerals concentrates, bulk cement, coal, paper products, sugar, recycled metal, glass bottles, fish food, fertiliser, construction materials, consumer goods, groceries and aluminium ingots.

TasRail advised that in 2019-20 they reopened the log siding at Parattah (on the South Line) and constructed a siding extension at Bell Bay to allow direct access to a second woodchip mill..

Short-haul urban maritime container movements

Short-haul urban shuttle trains provide a rail link from seaports to surrounding intermodal (distribution) centres. These services are advantageous by virtue of the fact they reduce road congestion into and out of the ports and connecting arterial roads. There are several flows of short-haul urban maritime container movements. These are:

- Yennora – Port Botany (approximately 40 kilometres);
- Minto – Port Botany (approximately 55 kilometres);
- Enfield – Port Botany (approximately 18 kilometres);
- Direk/Penfield – Outer Harbor, Port Adelaide (approximately 25 kilometres);
- Forrestfield/Kewdale – Fremantle (Inner Harbour) (approximately 24 kilometres);
- Fremantle (North Quay) – Kwinana (approximately 28 kilometres).

The Yennora and Minto operations handle imports and exports. The terminals conduct logistics activities for imported goods, including storage, consolidation and deconsolidation, and onwards road distribution to nearby warehouses. Exports include empty container transfers to the port.

The short-haul movement between the SCT Logistics terminal at Direk (Penfield) and Outer Harbor in South Australia involves the export of wine.

The Western Australian Government subsidises the transportation by rail of (loaded) containers between intermodal facilities at Forrestfield and Kwinana and North Quay at Fremantle. Empty containers and non-metropolitan movements are not subsidised. Intermodal Link Services (a part of the Intermodal Group) and Watco operate train services between Fremantle and Forrestfield with 2-3 trains operated per day, 6-7 days per week. Aurizon operate two scheduled return trains per day between Kwinana and North Quay, carrying products off the Malcolm train and its Kalgoorlie-Perth freight trains.

According to advice from Fremantle Ports, in 2019-20, rail transport moved 20 per cent of container freight through the port, with a peak of 23.6% in March 2020.

In September 2020, Pacific National announced it will begin running shuttle trains between its Kewdale terminal in Perth and the North Quay Freight Terminal at Fremantle Port's Inner Harbour. Pacific National is offering up to five port shuttle services a week which is expected to commence in 2021. Each service will haul up to 100 containers from the port to Kewdale. Pacific National thinks the service could initially shift up to 26,000 shipping containers onto trains each year. (Australasian Transport News, September 2020).

Figure 24 Rail container operations at Fremantle

Note: The figure above shows train loading/unloading operations at North Quay Rail Terminal in Fremantle. (Photo courtesy of Fremantle Ports)

Following an agreement between Salta Properties and the Victorian government, construction of a new intermodal terminal in the outer south eastern Melbourne suburb of Dandenong South will start in 2021. The agreement involves the federal and Victorian governments investing a $28 million to connect rail to Salta's boundary site, while Salta will invest $50 in the facility itself. The facility will connect with the Port of Melbourne via the existing suburban rail network. Upon completion, the terminal will have 110,000 square metres for storing full and empty containers (The Urban Developer, 2020).

In September 2020, Patrick Terminals and the Port of Melbourne agreed to construct a new rail terminal, which is due to commence in early 2021 and expected to be finished by mid 2023. The facility will provide an additional connection between the port and suburban intermodal terminals and it will handle 200 000 TEUs annually. The terminal will have two dual gauge 23 tonne axle load sidings of 600 metres (Rail Express, September 2020). This is part of the Port of Melbourne's Port Rail Transformation Project.

The Port Rail Transformation Project is intended to provide a rail solution to meet the needs of a growing port, and aims to reduce truck movements across Victoria, particularly in Melbourne's inner western suburbs. According to advice from the Victorian Department of Transport, the key elements of the project are:

- integrated provision of port, rail, land and assets at the port - Port of Melbourne will provide rail land and rail assets on the similar basis it provides wharf and road land and assets;
- new on-dock rail terminal capacity - development of a new on-dock rail terminal at Swanson Dock East;
- new road and rail infrastructure - to improve operational efficiencies of rail inside the port gate; and
- improved rail terminal operation arrangements and transparency - new working arrangements between Port of Melbourne and Rail Terminal Operators that are currently part of the PRTP. From commencement, this will included ACFS (Appleton Rail Terminal) and Qube (Victoria Dock Rail Terminal), with Patrick to also participate in the near future (Swanson Dock East) once infrastructure has been constructed.

Box 3 Further resources on non-bulk freight activity

Most of Australia's major ports report throughput statistics by freight type, freight origin, and freight destination on their websites, through a search facility.

Most Australian ports publish throughput data either on their webpage or in their annual reports.

BITRE's Waterline series reports quarterly data on rail traffic volumes through the mainland state capital city ports (where traffic is measured in, twenty-foot container equivalent unit (TEU) containers).

Urban rail passenger traffic

Each of the mainland state capital cities operate urban passenger rail services. These services enable the mass movement of passengers to and from capital city centres. Urban passenger rail services provide an alternative to private cars, which minimises road congestion.

Table 10 Urban rail patronage (millions of journeys), 2018-19

	Brisbane[a]	Sydney[b]	Melbourne[c]	Adelaide	Perth	Gold Coast	Canberra[d]	Newcastle[e]
Patronage – heavy rail	55	379.1	243.2	15.6	61.5	-	-	-
Patronage – light rail	-	9.9	205.4	9.4	-	10.75	.9	.46

Notes: [a] Brisbane's patronage figure is based on Queensland Rail's City Train network, whose scope is what it defines as south east Queensland. The quoted patronage also does not include the separately administered Airtrain line.

[b] Sydney's patronage includes Sydney Metro services.

[c] Melbourne's light rail patronage includes the CBD free travel zone which commenced on 1 January 2015.

[d] Canberra figures are for the period from the start of light rail services in April 2019 to 30 June 2019.

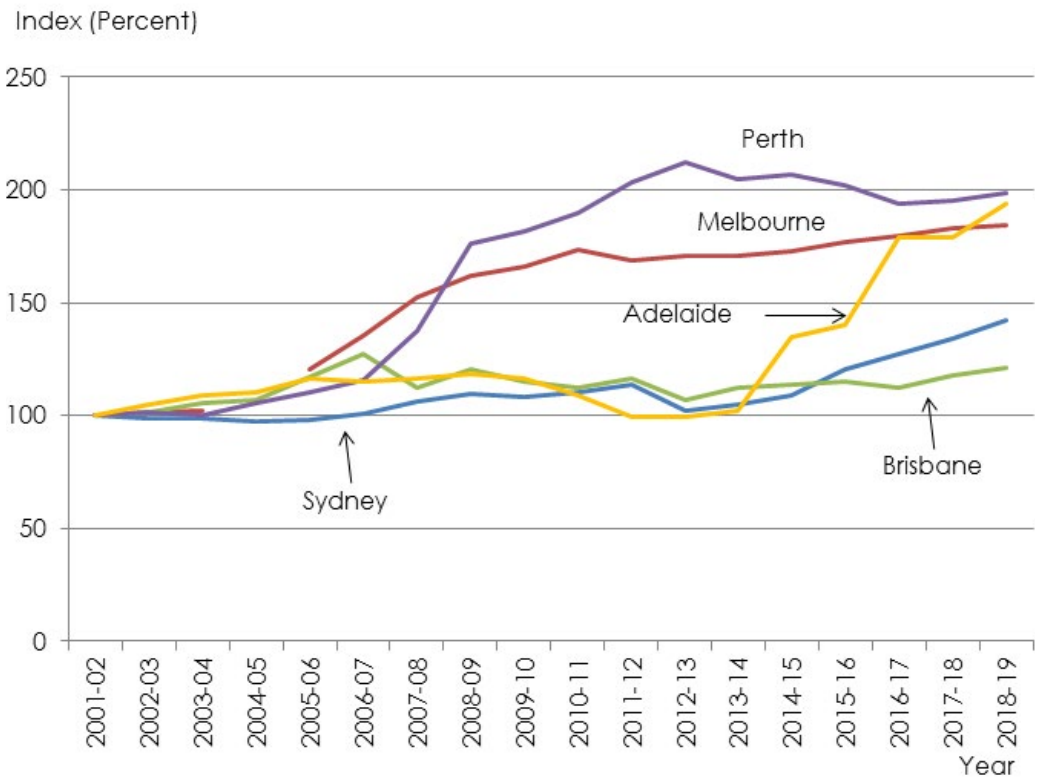
[e] Newcastle figures are for the period from the start of light rail services in February 2019 to 30 June 2019.

Sources: Public Transport Authority of Western Australia (2019), p.19; Advice from Public Transport Authority of Western Australia; Public Transport Victoria (2019), p.20; Department of Planning, Transport and Infrastructure (2019), p.34; Queensland Rail (2019), p.18; Translink (2020), p.5; Transport for NSW (2019), p.15; Transport for NSW (2020a); Sydney Trains (2019), p.9; advice from ACT Government.

Total urban heavy rail patronage for 2018–19 was 754.4 million passenger journeys, up from 726.4 million passenger journeys the previous financial year. Patronage grew in all cities. Adelaide had the greatest percentage growth, at 8.3 per cent. Sydney's patronage grew by approximately 5.4 per cent, Melbourne one per cent, Brisbane 2.6 per cent, and Perth 1.6 per cent.

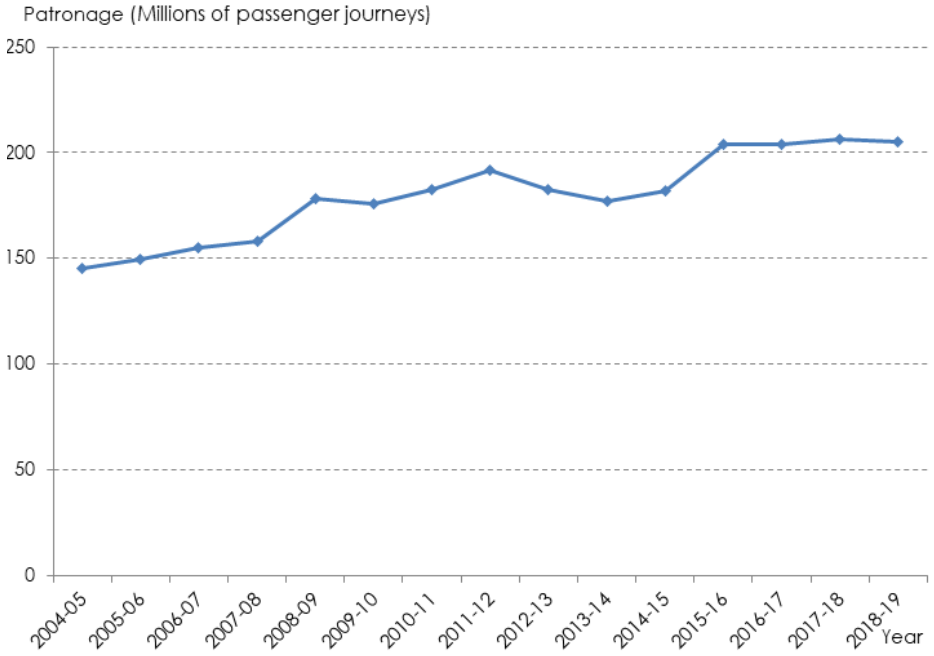
Total light rail patronage for 2018–19 was 236.8 million passenger journeys. Patronage declined slightly in Melbourne and Sydney, remained steady in Adelaide, and grew strongly on the Gold Coast (13.3 per cent).

Figure 25 Index of urban heavy rail patronage in Australian cities



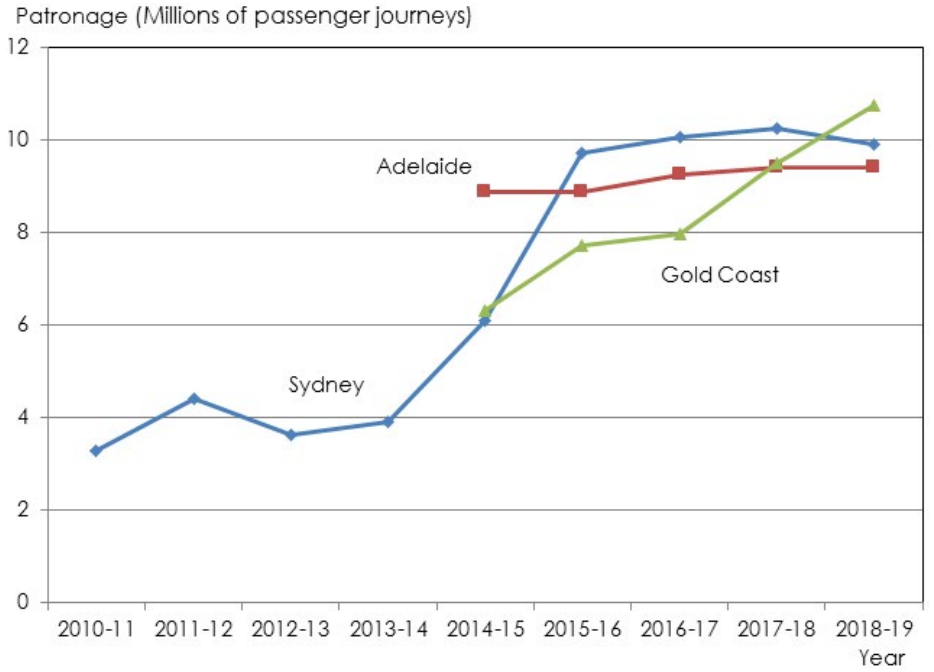
Source: Index based on patronage data from: BITRE (2012) and previous Trainline editions; Public Transport Authority of Western Australia (2019), p.19; Advice from Public Transport Authority of Western Australia; Public Transport Victoria (2019), p.20; Department of Planning, Transport and Infrastructure (2019), p.34; Queensland Rail (2019), p.18; Translink (2020), p.5; Transport for NSW (2019), p.15; Sydney Trains (2019), p.9

Figure 26 Melbourne light rail patronage



Source: Public Transport Victoria (2019), p.20; historical annual reports.

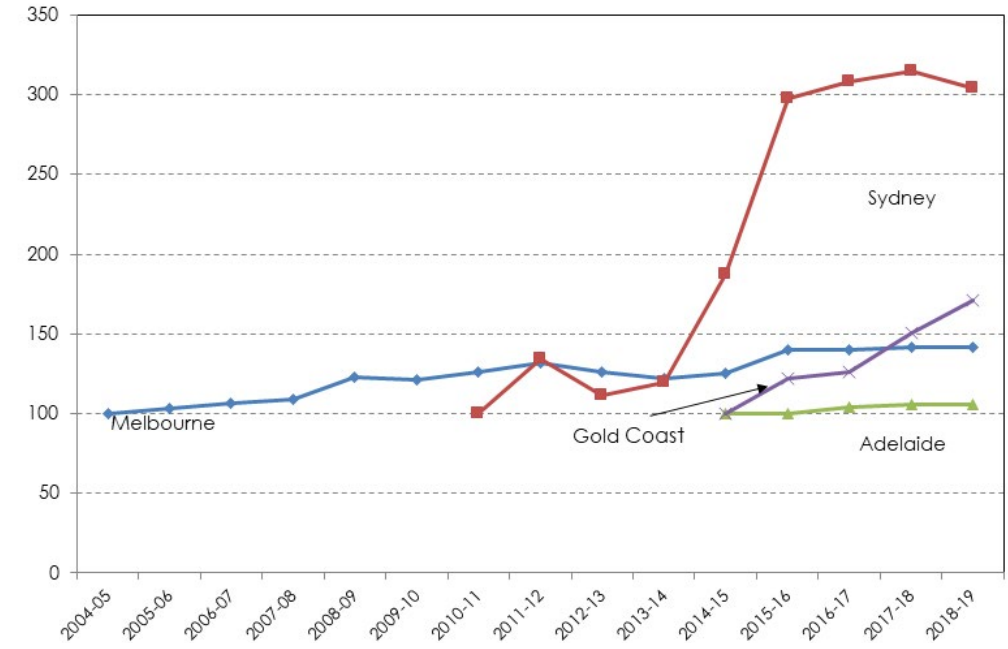
Figure 27 Sydney, Adelaide and Gold Coast light rail patronage



Note: Earlier data for Adelaide is not shown due to a patronage calculation methodology change.

Sources: Department of Planning, Transport and Infrastructure (2019), p.34; Translink (2020), p.5; Transport for NSW (2020a); historical annual reports

Figure 28 Index of light rail patronage Melbourne, Sydney, Adelaide and Gold Coast



Sources: Department of Planning, Transport and Infrastructure (2019), p.34; Translink (2020), p.5; Transport for NSW (2020a); Public Transport Victoria (2019), p.20; historical annual reports

National (external) and local (network-specific) factors affect urban heavy rail and light rail patronage trends. The former includes economic activity (influencing employment and disposable income) and fuel prices. Another factor is the non-financial relative generalised cost of rail travel. This cost includes quality of service, in-vehicle travel times, network scale and the standards of rollingstock and other infrastructure amenity.

Details of patronage changes in 2018-19, where available, are as follows:

- **Sydney.** Part of Sydney's patronage growth is attributable to the start of Sydney Metro services between Chatswood and Tallawong in May 2019. Sydney Trains considers what it describes as accelerated patronage growth as one of the most urgent challenges it faces. (Sydney Trains, 2019, p.28).
- **Perth.** According to the Public Transport Authority of Western Australia 2018-19 annual report, patronage changes reflect changes in the West Australian economy. Previous declines were due partly to a downturn in the resources industry, particularly a drop in Perth CBD jobs. Signs of economic recovery are being reflected in increased public transport patronage. Other factors that the Authority says has contributed to patronage growth was an advertising campaign and the opening of Optus Stadium, which public transport serves. (Public Transport Authority of Western Australia, 2019, p.4).

Table 11 and Table 12, below, shows Sydney Trains' busiest morning peak and afternoon peak hour services, as Transport of NSW Transport Performance and Analytics surveyed in March 2020. For the purpose of the survey, Transport for NSW defined AM peak as services that arrived at Sydney Central Station between 0800-0900 hours and the PM peak as those services that

departed Sydney Central between 1700-1800 hours. The load factor shows how each service was at as it either arrived at or departed from the designated stations during its journey, not at its point of origin or departure.

The results show a major decrease on train loads as sampled in September 2018 (see Trainline 7, pp 48-49). This is almost certainly due to COVID 19 movement restrictions in place in March 2020.

Table 11 AM peak suburban train loads by line 23-27 March 2020

Line	Station	AM Peak busiest hour (0800 to 0900 at Central Station)		
		Scheduled Trains	Average Passengers	Average Load Factor
Central Coast Newcastle via Shore	Milsons Point	4	577	17%
T1 North Shore	Milsons Point	16	2159	15%
T1 Western^	Redfern	16	3574	25%
T2 Inner West^	Redfern	6	1003	20%
T2 Leppington^	Redfern	8	1830	29%
T3 Bankstown^	Redfern	10	2260	25%
T4 Eastern Suburbs	Kings Cross	18	1438	10%
T4 Illawarra^	Redfern	15	3524	28%
T5 Cumberland (Southwest)	Harris Park	3	558	52%
T8 Airport^	Central	10	2140	27%
T8 South^	Redfern	4	995	28%
T9 Northern^	Redfern/Central	8	1328	19%
T8 South[a]	Redfern[a]	118	21386	21%
Total Suburban		**114**	**116 941**	**120%**

Notes: Average load factor = number of passengers / number of seats

Central hour varies slightly for each line to accurately reflect the number of trains in the busiest hour of the peak as per the intent of the timetable.

A load factor of 100 per cent means there is a seat for each customer. At 135 per cent an additional 5 people are standing on each level and 15 in each vestibule.

^ Loads on arrival. All other lines are loads on departure.

Source: Transport for NSW Transport Performance and Analytics (2020)

Table 12 PM peak suburban train loads by line 23-27 March 2020

Line	Station	PM Peak busiest hour (1700 to 1800 at Central Station)		
		Scheduled Trains	Average Passengers	Average Load Factor
Central Coast Newcastle via Shore	North Sydney	4	702	23%
T1 North Shore	North Sydney	12	1731	17%
T1 Western	Redfern	16	3133	22%
T2 Inner West	Redfern	4	719	20%
T2 Leppington	Redfern	8	2147	31%
T3 Bankstown	Redfern	8	1770	26%
T4 Eastern Suburbs	Martin Place	18	2174	10%
T4 Illawarra	Redfern	15	3118	25%
T5 Cumberland (Southwest)	Parramatta	2	371	46%
T8 Airport	Central	10	2043	23%
T8 South	Redfern	4	988	28%
T9 Northern	Redfern/Central	8	1237	17%
Total Suburban		109	20134	21%
Total Suburban		**114**	**116 941**	**120%**

Notes: Average load factor = number of passengers / number of seats

Central hour varies slightly for each line to accurately reflect the number of trains in the busiest hour of the peak as per the intent of the timetable.

A load factor of 100 per cent means there is a seat for each customer. At 135 per cent, an additional 5 people are standing on each level and 15 in each vestibule.

Source: Transport for NSW Transport Performance and Analytics (2020).

Commuting traffic

Urban passenger rail services are largely aligned to service weekday commuter demand to and from city centres. The task is skewed to the morning and afternoon peak periods. In 2016, urban heavy rail's mode share increased in all cities except Brisbane and Perth compared to 2011. Sydney had the highest heavy rail mode share, at 19.1 per cent (See Table 12). Melbourne's combined heavy rail and light rail share was 17.6 per cent, while Brisbane and Perth's rail mode share was 7.3 and 7.5 per cent respectively.

Table 13 Urban rail journey-to-work mode shares, 2016

	Brisbane	Sydney	Melbourne	Adelaide	Perth
Heavy rail (%)	7.3	19.1	13.7	2.8	7.5
Light rail (%)	–	0.2	3.9	0.6	–

Notes: Cities refer to greater metropolitan areas. For the 2016 census, ABS replaced its previous geographical definition system, the Australian Standard Geographical Classification, with the Australian Statistical Geography Standard. This led to some changes in the boundaries of greater metropolitan areas.

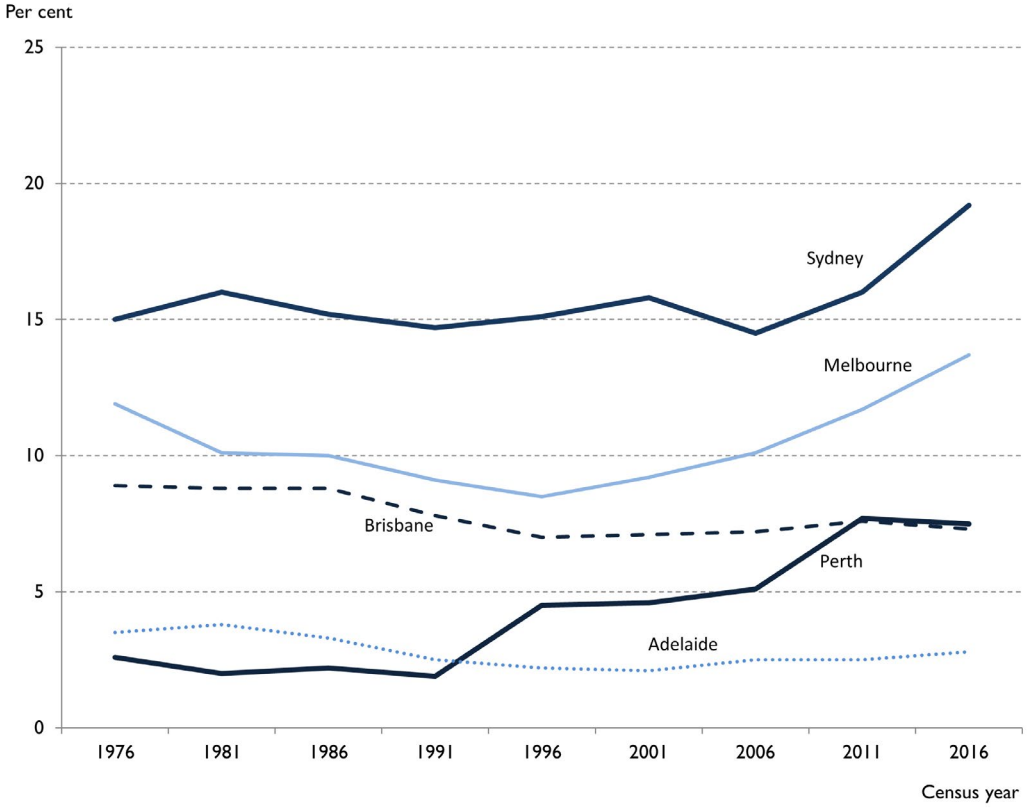
Mode shares defined as persons who caught a train/tram for all or part of their journey to work. Calculations exclude census respondents who did not specify travel mode, worked at home or did not go to work.

Tram/light rail census data includes respondents who: caught a tram/light rail; caught a train and tram/light rail; caught a bus and tram/light rail. The tram/light rail data is therefore an underestimate because it does not include all possibilities, for example, car and tram/light rail.

Source: ABS 2016.

Following long-term declines in urban rail patronage for all cities from the mid-1970s, ridership began recovering in the 1990s. Figure 28 shows the journey-to-work mode share data for heavy rail, derived from the census, since 1976.

Figure 29 Journey-to-work mode share, urban heavy rail, 2016



Note: Cities refer to greater metropolitan areas.

Sources: ABS (2016); Mees and Groenhart (2012).

Box 4 Further reading

For further information on urban passenger trends, see BITRE information sheets: *Urban transport: updated passenger trends—Information Sheet 59* (BITRE 2014c); and *Long-term trends in urban passenger transport—Information Sheet 60* (BITRE 2014d).

BITRE 2012, *Understanding Australia's urban railways* presents an overview of Australia's passenger and freight railway systems.

Non-urban passenger traffic

Figure 30 Non-urban passenger services, by operator

Non-urban passenger traffic, broadly described as day-return (under four-hour) and long-distance (over four hours) travel, can be further classified by the primary travel markets served:

- "Inter-city" or "regional" travel, such as Sydney—Hamilton, Brisbane—Nambour, Melbourne—Ballarat and Perth—Bunbury. Such services could include daily commuting or day-return business or leisure travel;
- Long-distance connections between cities (such as Brisbane—Sydney[21]) and regional centres, such as Melbourne—Warrnambool and Perth—Kalgoorlie;
- Heritage railway travel, for nostalgia and leisure purposes; and
- Tourist-focused services such as the Kuranda Scenic Railway (Queensland Rail), and Adelaide—Darwin (The Ghan) (Great Southern Rail).

The scale of an operator's passenger task is largely determined by the function of their railway. Table 14, below, shows the latest available financial year patronage statistics by operator. Railways with a large commuter task have higher patronage than those which cater largely to long-distance travel. Only a small amount of rail travel for NSW TrainLink, for example, is regional travel.

21 At the time of publication Sydney—Brisbane services were truncated to Casino due to COVID related closure of the NSW-Queensland border.

Table 14 Non-urban rail patronage, by operator, 2018–19

	Queensland Rail	NSW TrainLink		V/Line	Transwa
		Regional	Intercity		
Patronage (million trips)	.77	1.41	41.3	20.8	.18

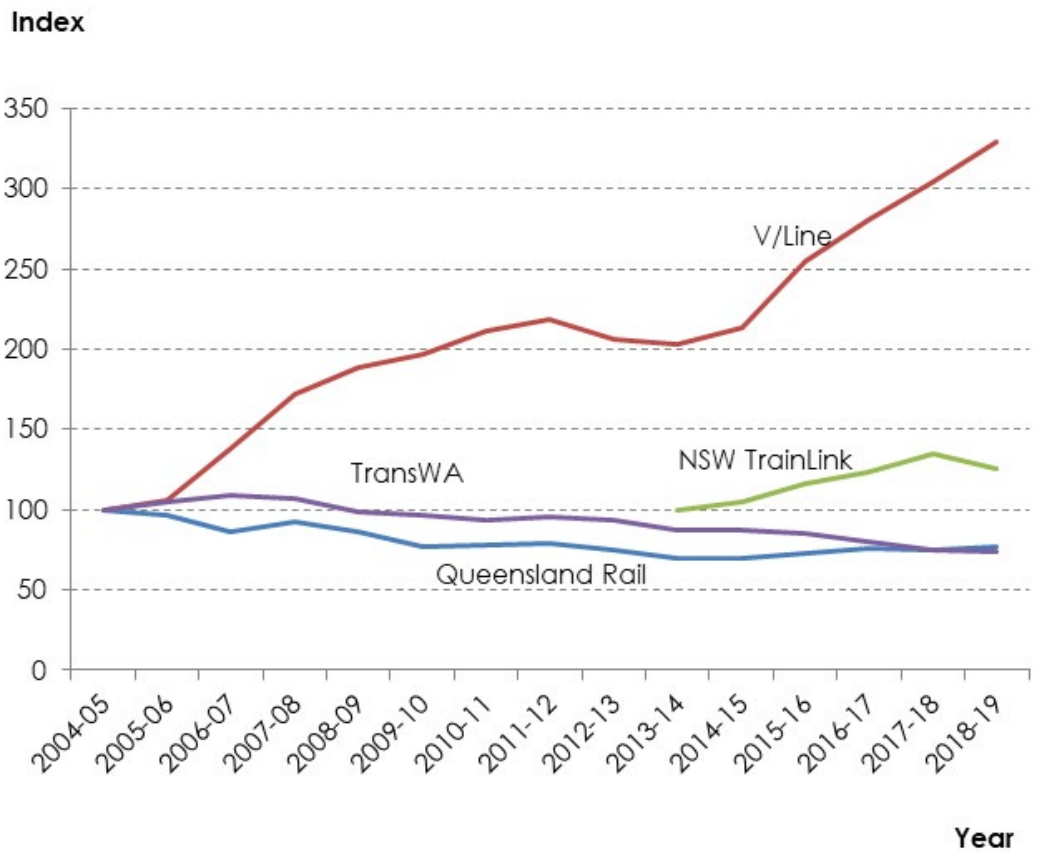
Notes: Data excludes patronage on services delivered under the Queensland "TransLink" brand.

Sources: NSW Trains (2019 p.8); Advice from Transport of NSW; Public Transport Authority of Western Australia (2019). p.25; Queensland Rail (2019 p.34); V/Line 2019, (p. 14).

Similar to urban patronage, non-urban patronage is influenced by broad, macroeconomic factors and local, network specific factors.

Figure 31 shows patronage trends by operator. The index for NSW TrainLink is truncated to 2013–14 due to the patronage data revision.

Figure 31 Index of non-urban rail patronage, by operator



Notes: The NSW TrainLink index is the sum of regional and intercity patronage. There is no New South Wales data shown for the period prior to 2012–13 due to the formation of TrainLink on 1 July 2013, which merged regional and intercity services under one operator. Including previous years' data would not be comparing 'like for like'.

Queensland Rail data exclude services under the TransLink brand on the Sunshine Coast and Gold Coast lines.

Sources: NSW Trains (2019 p.8); Advice from Transport of NSW; Public Transport Authority of Western Australia (2019), p.25; Queensland Rail (2019 p.34); V/Line 2019, (p. 14).

Some noteworthy trends are:

- **Queensland Rail** patronage, which is heavily tourism dependent, grew marginally.
- **NSW TrainLink.** In 2018-2019, overall patronage decreased by 7.1 per cent. Intercity patronage decreased by 7.6 per cent, which was partly offset by regional travel, which increased by 10.1 per cent.
- **Transwa** patronage continued its ongoing decline, which began in 2008-09. In 2018-19 its annual decline was one per cent. The Australind, which accounts for almost half of Transwa's total rail patronage, continued its decline, at 3.4 per cent. The Avonlink and Merridinlink services, each of which have small patronage numbers relative to the Australind and Prospector, had annual patronage growths of 2. 2 and 15.4 per cent respectively. Patronage on the Prospector declined by .2 per cent.
- **V/Line** patronage continued to grow upon previous strong growth, at 8.8 per cent in 2018-19 from the previous financial year, but the rate of growth eased. All corridors had experienced growth, except Gippsland. The Geelong corridor had the largest growth, at 13.8 per cent. Patronage on the Gippsland corridor declined by 4.2 per cent. The Geelong corridor accounts for much of V/Line's recent patronage growth.

Table 15 'Up' boardings at Geelong stations January-June 2020

Station	Jan	Feb	Mar	Apr	May	Jun	Per cent change (Jan-Jun)
Waurn Ponds	22 786	21 824	14 506	927	3 218	5 411	-83.68%
Marshall	17 972	19 305	11 276	971	3 183	4 424	-82.06%
South Geelong	42 137	46 110	27 514	1 724	6 189	9 556	-83.82%
Geelong	67 434	71 006	47 469	5 748	13 676	20 587	-75.99%
North Geelong	23 804	28 365	17 565	1 828	4 899	6 989	-78.90%
North Shore	4 527	4 948	3 741	834	1 923	2 391	-56.93%
Corio	1 948	2 299	1 484	222	569	769	-62.83%
Lara	24 438	28 732	18 302	1 986	4 971	6 996	-78.40%
Total	**205 046**	**222 589**	**141 857**	**14 240**	**33 657**	**57 123**	**-79.06%**

Source: Data provided by V/Line

Figure 32 shows annual 'up' (Melbourne bound) boardings at the City of Greater Geelong Local Government Area's eight stations, excluding boardings of replacement road coaches. It is reasonable to presume the number of 'down' journeys would be roughly the same as 'up'. Some passenger trips captured in the figures may include people travelling wholly within Geelong and those who do not travel to suburban Melbourne, but these would be negligible, given the size of the Geelong-Melbourne task. These figures differ from Geelong line patronage figures as the line patronage figures include passengers boarding and alighting at stations outside Geelong, such as Tarneit and Little River.

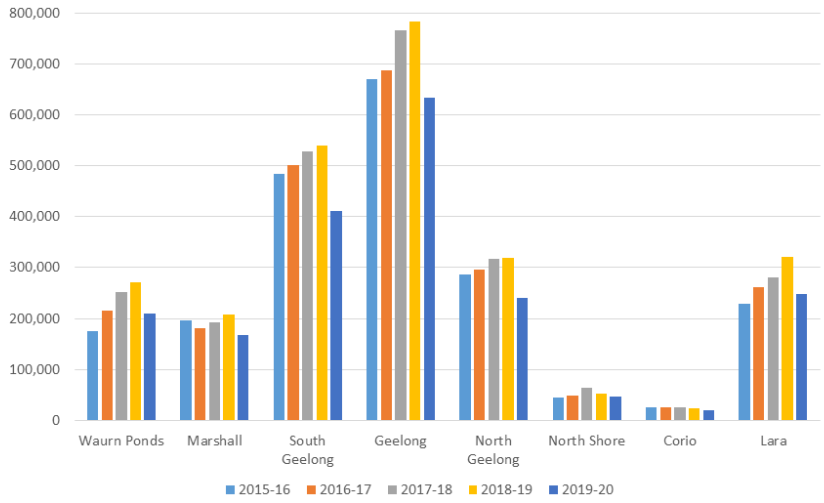
While the results show a patronage decline when comparing 2015-16 to 2019-20, this is probably due to the COVID-19 outbreak and the associated travel restrictions. Analysis of monthly figures shows major declines of as high as 92 per cent beginning in March 2020; when COVID-19 travel restrictions commenced.

Table 16 Annual 'up' boardings at Geelong stations

Station	2015-16	2016-17	2017–18	2018-19	2019-20	2015-16 to 2019–20 change (per cent)
Waurn Ponds	175 505	214 643	251 605	270 590	209 465	19.35%
Marshall	195 640	181 872	191 640	208 575	167 155	-14.56%
South Geelong	484 599	501 581	528 485	539 209	410 974	-15.19%
Geelong	669 706	687 315	765 580	783 802	633 687	-5.38%
North Geelong	287 171	295 318	317 759	319 756	240 437	-16.27%
North Shore	44 249	48 651	63 943	53 513	47 052	6.33%
Corio	26247	25726	26 502	23 627	20 108	-23.39%
Lara	228 505	262 496	280 903	320 801	247 489	8.31%
Total	**2 111 622**	**2 217 602**	**2 426 417**	**2 519 873**	**1 976 367**	**-0.408**

Source: Data provided by V/Line.

Figure 32 Annual 'up' boardings at Geelong stations



Source: Data provided by V/Line.

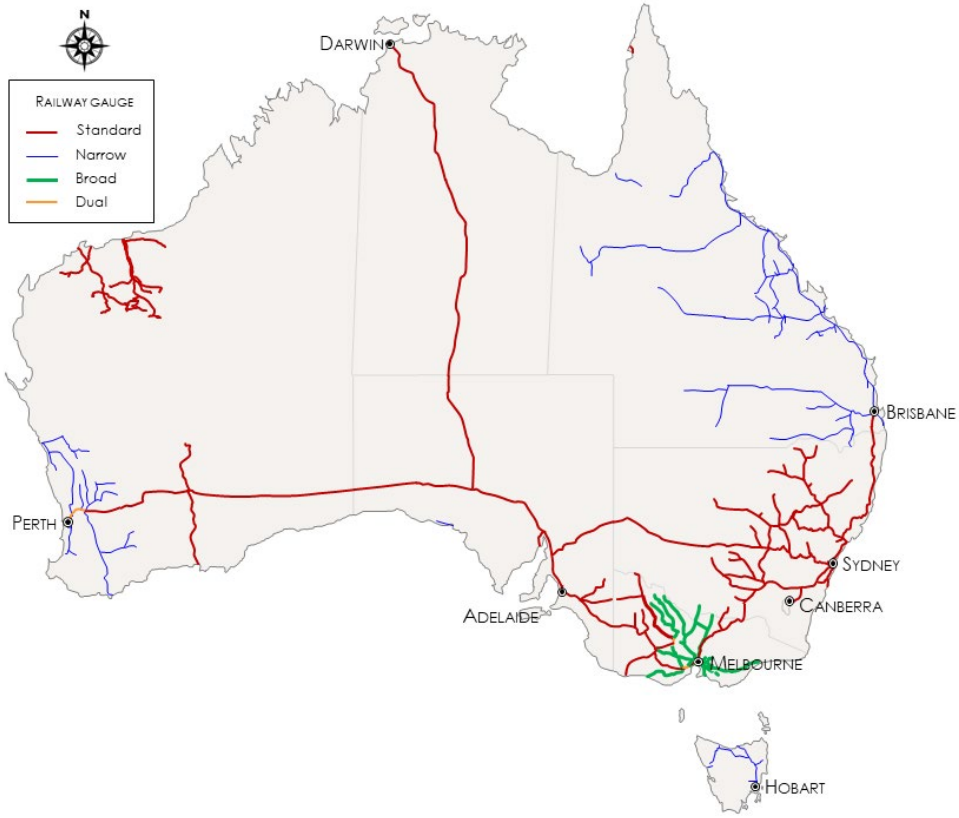
CHAPTER 3

Infrastructure and rolling stock provision

Railway network

Australia's colonies (then states in the post-federation era) built the continent's first railways as separate networks with different gauges. The networks mostly radiated from the state (previously colonial) capitals, with cross-border links coming only after intrastate (intra-colonial) lines met at the borders. The exception is Queensland, whose early railways consisted of a network of disparate railways that connected inland areas with coastal ports. These railways were eventually linked, forming the current Queensland network. While aspects of the break of gauge legacy remain, interstate trains now operate across a continuous 1435 mm 'standard' gauge.

Figure 33 Railway network, by track gauge, September 2020



Notes: The lines shown here are the railways that are open for traffic at September 2020.
Broad ("Irish") gauge is 1600 mm; standard ("Stephenson") gauge is 1435; and narrow ("Cape") gauge is 1067 mm

BITRE estimates there were 32 868 route-kilometres of operational heavy railways in Australia in September 2020.Table 17 shows route kilometres of electrified and non-electrified railways in each jurisdiction. Queensland, Western Australia and New South Wales have similar-sized networks. Most of the network is single-tracked (approximately 89 per cent) with some exceptions, such as most urban network sections, the Sydney—Melbourne line (of which around three-quarters is now double-track) and the East Turner River corridor through the Chichester Range in East Pilbara (with some BHP double track and some Fortescue Metals Group double track).

Table 17 Estimate of route kilometres of open (operational) heavy railways in September 2020, by jurisdiction, gauge and electrification

State or Territory	ACT	NT	NSW	Qld	SA	Tas	VIC	WA	Total
Route kilometres by gauge									
Broad			73		253		2 309		2 635
Narrow		3		8 146	184	611	16	2970	11 930
Standard	6	1 690	7 128	117	2 561		1 904	4 558	17 964
Other			1	4		7	30		42
Dual				36	22		32	207	297
Total	**6**	**1 693**	**7 202**	**8 303**	**3 020**	**618**	**4 291**	**7 735**	**32 868**
1 500V DC			660				383		1 043
25 kV AC				2 173	44			181	2 398
33 kV AC			8						8
Total			**668**	**2 173**	**44**		**383**	**181**	**3 449**

Notes: V denotes volts, kV denotes kilovolts, and Hz denotes hertz. DC denotes 'direct current' and AC denotes 'alternating current'.

Data may not add to totals due to rounding.

Excludes light rail and sugar tramways.

Queensland standard gauge figures include the 19 kilometre railway at the Rio Tinto bauxite mine at Weipa..

Sources: BITRE estimates; Data provided by Sydney Trains; Data provided by Aurizon; Rio Tinto Alcan, and TasRail; Avery (2013, p.144).

Around 10 per cent of the Australian network route-kilometres are electrified. Appendix F provides an overview of the network in terms of infrastructure manager and of management structure (that is, whether the manager is vertically integrated or vertically separated).

Queensland has the largest electrified network, principally due to the electrified line between Rockhampton and Brisbane and a number of coal lines in the Central Queensland coal network. Elsewhere, overhead power systems have been installed on lines with relatively intensive urban and some intercity passenger services.

New railways

Approximately 914 route-kilometres of freight track and 185 route-kilometres of passenger (heavy and light-rail) track have been opened since 2010. Table 18 provides a list of all new rail track additions since 2010, grouped by traffic type/purpose.[22]

Table 18 Railways opened since 2010

Traffic	Location	Year	State	Length (km)	Project	Infrastructure builder
Iron ore	Mesa K – Waramboo (Mesa A)	2010	WA	49	Mesa A	Rio Tinto
Iron ore	Cloudbreak – Christmas Creek	2011	WA	50	Christmas Creek extension	Fortescue Metals Group
Iron ore	Tilley Siding (Morawa) – Karara	2012	WA	85	Karara Rail Spur	Karara Mining Ltd
Iron ore	Solomon Junction – Solomon	2012	WA	130	Solomon extension	Fortescue Metals Group
Iron ore	Hope Downs 4 railway	2013	WA	53	Hope Downs extension	Hope Downs Joint Venture (Hancock – Rio Tinto)
Iron ore	Roy Hill-Port Hedland	2015	WA	344	Roy Hill	Roy Hill Holdings
Coal	Cameby Downs Loop	2010	Queensland	7	Cameby Downs Loop	Queensland Rail
Coal	Goonyella–Newlands	2011	Queensland	68	Northern missing link	Aurizon
Coal	Middlemount Rail Spur	2011	Queensland	16	Middlemount Rail Spur	Macarthur Coal
Coal	Moranbah-Caval Ridge	2014	Queensland	12	Caval Ridge Spur	Billiton Mitsubishi Alliance
Coal	Maules Creek-Werris Creek line	2015	NSW	20	Maules Creek	Whitehaven
Coal	Aldoga-Wiggins Island	2015	Queensland	13	Wiggins Island Coal Export Terminal	Aurizon
Coal	Boggabri	2016	NSW	17	Boggabri Rail Spur	Idemitsu
Coal	Byerwen	2017	Queensland	5	New branch line in GAPE system	Private and Aurizon
Coal	Baralaba	2018	Queensland	6	New branch in Moura system	Private and Aurizon
Intermodal	Sefton–Macarthur	2012-13	NSW	36	Southern Sydney Freight Line	ARTC
Grain	Moree-Broadbent Grain facility	2017	NSW	3.5	Broadbent Grain facility- Moree connection	ARTC
Inter-Urban passenger	Deer Park-West Werribee	2015	Victoria	27	Regional Rail Link	V/Line
Urban passenger	Darra-Richlands	2010	Queensland	4.5	Springfield Branch	Queensland Rail
Urban passenger	Glenfield-Leppington	2015	NSW	12	Leppington line	RailCorp

22 While the Parkes—Narromine section of the Inland Rail project was completed and open to revenue services in September 2020, the line was not a new construction, hence it is not considered a new railway.

Traffic	Location	Year	State	Length (km)	Project	Infrastructure builder
Urban passenger	Epping – South Morang	2012	Victoria	4	South Morang Extension (re-opening)	Metro Trains Melbourne
Urban passenger	Richlands-Springfield	2013	Queensland	9.5	Springfield Branch	Queensland Rail
Urban passenger	Noarlunga–Seaford	2014	SA	6	Noarlunga Line extension	Department of Planning, Transport and Infrastructure
Urban passenger	Clarkson–Butler	2014	WA	8	Joondalup Line extension	Transperth (Public Transport Authority)
Urban passenger	Petrie – Kippa-Ring	2016	Queensland	13	Moreton Bay Railway	Queensland Rail
Urban passenger	South Morang – Mernda	2018	Victoria	8	Mernda Rail Extension	Metro Trains Melbourne
Urban passenger	Sydney	2019	NSW	36	Sydney Metro Northwest	Transport for NSW
Urban passenger light rail	North Terrace – Entertainment Centre	2010	SA	3	Port Road Light Rail Extension	Department of Planning, Transport and Infrastructure
Urban passenger light rail	Gold Coast University Hospital – Broadbeach	2014	Queensland	13	Gold Coast Light Rail	Queensland and Australian governments; Gold Coast City Council, GoldLinQ
Urban passenger light rail	Lilyfield – Dulwich Hill	2014	NSW	6	Inner West Light Rail extension	Transport for NSW
Urban passenger light rail	Gold Coast University Hospital – Helensvale	2017	Queensland	7.3	Gold Coast Light Rail	Queensland and Australian governments; Gold Coast City Council, GoldLinQ
Urban passenger light rail	Kind William Street – East Terrace	2018	South Australia	1	City Tram Extension Project	Department of Planning, Transport and Infrastructure
Urban passenger light rail	King William Street – Festival Plaza Precinct	2018	South Australia	.350	City Tram Extension Project	Department of Planning, Transport and Infrastructure
Urban passenger light rail	Gungahlin – Canberra City	2019	ACT	12	Canberra Metro	ACT government and Canberra Metro consortium
Urban passenger light rail	Newcastle Interchange – Pacific Park	2019	NSW	2.7	Newcastle Light Rail	Transport for NSW
Urban passenger light rail	Circular – Quay Randwick and Junsiors Kingsford	2019-2020	NSW	12	CBD and South East Light Rail	Transport for NSW

Notes: The Epping—South Morang project was a line re–opening, using right-of-way from a railway that was closed in 1959.
A list of network additions since 1980 is at Appendix B.

Sources: BITRE estimates, data provided by Aurizon.

Expansion of the mining industry in the Pilbara region of Western Australia underpins much of the recent rail infrastructure growth and subsequent rail freight task. Development of iron ore mines in the Pilbara region has led to the construction of a network of railways linking mines with ports at Dampier, Cape Lambert (Port Walcott) and Port Hedland. BHP's network in the region began with the opening of the 208 kilometre Goldsworthy—Port Hedland Railway in

1965. Rio Tinto's line between Tom Price and Dampier opened in 1966. The third largest mining company in the region is Fortescue Metals Group, which opened a railway between Cloudbreak Mine and Port Hedland in 2008. In 2015, Roy Hill Holdings added 344 route kilometres of track to the network, connecting the newly developed Roy Hill Mine to the port facility in Boodarie Industrial Estate south of Port Hedland. The operation uses Roy Hill's two new berths, SP1 and SP2, at Stanley Point within the port. Enhancements to track and train specifications mean trains in the region are amongst the longest and heaviest in the world, with scope for additional axle load increases. Following construction of the Roy Hill line, there is currently an estimated 2639 route kilometres of railway in the Pilbara region.

Since 2010, 164 kilometres of railway have been constructed for coal haulage. Coal exports, centred on Queensland's Bowen, Galilee and Surat Basins and the Hunter Valley network in New South Wales, rely on rail transport. New lines and additional capacity have enabled a substantial expansion of exports. Such new lines and additional capacity include the Goonyella–Newlands railway in Queensland, part of the Goonyella to Abbot Point Expansion ("GAPE") project; and the Wiggins Island Rail Project (WIRP), which was completed in December 2015. Other projects have included substantial Commonwealth investment in the interstate network, with new signalling, passing loops and passing lanes, re-railing, re-sleepering and re-ballasting.

The Northern Sydney Freight Corridor Program has eased rail traffic congestion through Northern Sydney and at Gosford. The program included a third track between Epping and Thornleigh, construction of the North Strathfield underpass and two new passing loops at Gosford. There have also been renewal and capacity-enhancing projects on urban passenger networks. Sydney's rail clearways programme enhanced the network's capacity and reliability through targeted works on key bottlenecks.

Adelaide's urban passenger network has undergone extensive track renewal and the Seaford line has been electrified. The Gawler line electrification project is currently in its preliminary stages.

Infrastructure activities extend beyond new railway construction, however, with a range of enhancement projects across the country. This includes Victoria's level crossing removal and NSW Fixing Country Rail rail projects.

As Table 19 , below, shows, 676 route-kilometres of heavy and light railways were under construction in September 2020. Of this, 564 kilometres were heavy rail and 12 were light rail.

Table 19 Heavy and light railways under construction, September 2020

Traffic	Location	State	Length (route km)	Project	Infrastructure builder
Light rail	Parramatta	NSW	12	Parramatta Light Rail	Transport for NSW
Heavy Rail	Perth	WA	8	Forrestfield-Airport Link	PTA WA
Heavy Rail	Chatswood-Bankstown	NSW	30	Sydney Metro City & Southwest	Transport for NSW
Heavy Rail	Melbourne	Vic	9	Metro Tunnel	Melbourne Metro Rail Authority
Heavy Rail	Brisbane	Qld	10.2	Cross River Rail	Cross River Rail Delivery Authority

Traffic	Location	State	Length (route km)	Project	Infrastructure builder
Heavy Rail	Melbourne-Brisbane	Vic, NSW, Qld	600[23]	Inland Rail	ARTC
Heavy Rail	Adelaide	SA	.65	Flinders Link (Tonsley line extension)	Australian and South Australian Governments
Heavy Rail	Tamworth	NSW	6	Tamworth Intermodal Rail Line (rehabilitation of disused line)	Transport for NSW

23 The Inland Rail project consists of 1700 kilometres of upgraded infrastructure and newly built rail infrastructure. Of the 1700 kilometres, 600 will be new construction. Not all sections of the 600 kilometres of new construction are underway.

Dedicated commodity networks

As discussed in Chapter 2, the primary railway traffic flows are iron ore, coal, grains, intermodal, and urban passenger. Major parts of the Australian railway network are dedicated to serving individual commodity flows.

Iron ore and coal networks

The iron ore and coal networks are shown in Figure 8. Mining companies built the iron ore railway networks in the Pilbara region exclusively to serve the iron ore mines, as was the Karara (Western Australia) spur line and the Middleback railways (near Whyalla) in South Australia. As bespoke developments, these lines were generally built to very high standards to accommodate the large envisaged traffic. There has been extensive subsequent capacity expansion (signalling, track and train capacity) on many of the lines.

Coal lines were developed in eastern Australia, generally being grafted onto the existing mixed-traffic networks. While the track standards are high, and include some electrified systems in Queensland, they are generally of a lower standard than the dedicated iron ore lines.

Grain railways

Grain railways usually feed into secondary or main lines. The grain lines are generally of a lower technical and operational standard than iron ore and coal railways. Some are in a poor condition and traffic is seasonal.

The technical and operational diversity of the grain lines, mostly reflecting the varying importance (levels) of different branch traffic flows, has led to the classification of lines according to their technical standards (and, thus weight-bearing capability or train speed), their economic importance, or to their viability. The respective categories across the states[24] are outlined below.

Queensland

The "network capabilities" of railways in Queensland are classified according to the maximum permitted axle loads on a given section of track. Network information packs for access seekers provide details about track standards and permitted axle loads and train speeds[25]. Often the axle-load limits are 15 tonnes. It has been noted that rail cannot be used to haul containerised grain due to these load limits (Transport, Housing and Local Government Committee [Queensland] 2014, p. 24).

New South Wales

While the New South Wales government's grain railways are categorised by class of track – from Class 1 to Class 5, this is an engineering standard only; not an operational standard. Operationally, there is considerable variation within each standard. According to advice from John Holland Rail, for example, a Class 3 track can range in operational capability from 81 to 100 tonnes gross (See Figure 17).

24 Most of South Australia's grain railways have been closed and the remaining four lines have not been classified.
25 An illustration of this information can be seen with the "Information pack" for South Western Queensland (Queensland Rail, 2016) [Network Access], undated.

Victoria

Victoria has six track standard classifications. The highest standard is Class 1, and the lowest is Class 5 (VicSig 2020). Details are as follows:

- Class 1: Sections of the Regional Fast Rail network;
- Class 2: Standard for metropolitan and country passenger lines;
- Class 2U: A modified version of Class 2 for Regional Fast Rail but of a lower standard than Class 1;
- Class 3: Passenger lines with low volumes and some grain lines;
- Class 4: Lesser branch lines; and
- Class 5: Lines that are short or have very little traffic, with minimal track maintenance.

Western Australia

Grain railways in Western Australia are classified by their viability and competitiveness. Tier 1 lines are considered to be competitive with road transport and are perceived to remain competitive given probable future cost increases. Tier 2 railways are currently cost competitive with road, given prevailing rail access prices and train operating costs. Tier 3 lines are regarded as unviable as rail volumes are low and trains are uncompetitive with road transport. The lines are also typified by low (16-tonne) axle loads, with low-standard track structure. (Strategic Design and Development 2009, p. 8). In 2014, a parliamentary inquiry was undertaken to investigate aspects of the Western Australian freight rail network, including the provision of Tier 3 railways; see the Economics and Industry Standing Committee of the WA Parliament Legislative Assembly (2014).

Commodity non-specific networks

Tasmania

According to advice from TasRail, it completed Tranche One of the Tasmanian Freight Rail Revitilsation Program on 30 June 2019. TasRail says the four-year $119.6 million project (funded by the Australian and Tasmanian Governments) "… has seen a significant reduction in percentage of network under Temporary Speed Restriction and improvement in the Track Quality Index." Tranche Two (also $119.6 million over four years) started on 1 July 2019. TasRail further states "The ongoing network investment is seeing TasRail experience record demand for its freight services and likewise derailments are at record lows."

Box 5 Inland Rail

Construction of the Melbourne to Brisbane inland railway is underway. When completed, Inland Rail will provide above rail operators with:

- A 1,700 kilometre inland railway traversing inland Australia from Tottenham in Victoria to Acacia Ridge in Queensland;
- Travel speeds of up to 115 kilometres per hour;
- Container double-stacking;
- Maximum train lengths of 1,800 metres (the equivalent of 110 B-Double trucks);
- 21 tonne axle loads at a maximum speed of 115 kilometres per hour;
- Scheduled transit times not longer than 24 hours, which will be up to 10 hours faster than via the existing coastal route through Sydney; and
- Reduced supply chain costs of an average of $76 per tonne for specific agricultural products (based on the results of a CSIRO pilot study mapping supply chains and modelling potential transport cost savings available in a particular region.)

Inland Rail will serve growing cities of Melbourne and Brisbane, ease congestion on roads and the coastal rail, and connect with interstate lines, ports and other regional trains along the route.

65 per cent of Inland Rail will involve upgrading existing infrastructure ('brownfield' construction). The remaining 35 per cent consists of 'greenfield' construction, chiefly the Narromine-Narrabri section and most sections in Queensland.

Inland Rail is being built through 13 discrete sections. Construction on the first section of track between Parkes and Narromine New South Wales was completed in September 2020 with the first train running a week later. As each section of Inland Rail is finished, it becomes operational and available for regional rail service use.

In late November 2020, Narromine to North Star was the second section to begin construction. Together with the Parkes to Narromine section, more than 38,000 tonnes of steel rail and 530,000 concrete sleepers, have been purchased and delivered.

ARTC will deliver the technically complex 128 kilometres Gowrie to Kagaru section through a Public Private Partnership. This section is the most challenging to deliver from an engineering perspective, and includes 8.1 kilometres of tunnelling through the Toowoomba ranges. ARTC released the Request for Proposal for this section to shortlisted bidders at the beginning on November 2020.

For more information on Inland Rail please see the Australian Government Inland Rail website: https://www.inlandrail.gov.au

Urban heavy-rail passenger networks

Australia's urban heavy rail networks are extensive, even if the network coverage is not dense (see Table 20). The networks are mostly radial, reflecting the historical development of Australian cities, with lines branching from dense Central Business Districts (CBDs) into the surrounding, low density suburbs.

Table 20 Network characteristics of urban passenger heavy railways, September 2020

		Sydney	Melbourne	Brisbane	Adelaide	Perth
Operator	Sydney Trains	Sydney Metro	Metro Trains Melbourne	Queensland Rail	Adelaide Metro	Transperth
Ownership	Public	Public	Private (government franchise)	Public	Public	Public
Dedicated urban passenger lines (km)	n/a	36	220	128	126	180
Shared metropolitan freight/passenger lines (km)	n/a	-	181	268	-	1
Total route length (km)	364	36	401	396	126	181
Electrified route length (km)	364	36	370	396	44	181
Metropolitan stations (number)	175	13	221	152	87	72
Average distance between stations (km)	2.1	2.7	1.8	2.6	1.4	2.5
Metropolitan passenger route length under construction (km)	-	30	9	10.2	.65	8
Passenger network gauge	Standard	Standard	Broad	Narrow	Broad	Narrow

Notes: Distances are route kilometres.

Urban networks are defined by urban passenger operator boundaries. The Brisbane calculations are based on the limits of Queensland Rail's City Train network, including the privately owned Airport line.

The Sydney Trains network figures are revised, based on data which Sydney Trains provided. Due to this revision, BITRE does not currently have an estimate of dedicated passenger lines and shared passenger and freight lines.

Does not include freight only track.

Sources: BITRE estimates; Data provided by Sydney Trains; Public Transport Authority of Western Australia (2019, p. 17); Queensland Rail (2019, p.18); Data provided by Adelaide Metro; Data provided by Aurizon.

The following characteristics and trends make each system distinctive:

- **Sydney Metro.** Sydney Metro Northwest opened on 26 May 2019 and provides driverless services from Rouse Hill to Chatswood. The Metro trains operate on a 'turn up and go' basis rather than by timetable. Construction of further stages of the system to the Sydney CBD and Bankstown is underway.
- **Network expansion.** Perth's system has grown significantly over the last 20 years with new lines from Perth to Joondalup/Currambine/Butler (41 km), and Mandurah (70 km), and the Thornlie branch line (three km). Construction of the 8.5-kilometre Forrestfield-Airport link will provide rail access for Perth's eastern suburbs to the city, via Perth Airport. Construction is due for completion in 2021.

- **In Melbourne,** completion of the metro tunnel, due in 2025, will ease congestion in the city loop by providing two new nine-kilometre tunnels under the CBD, with five new stations and High Capacity Signalling.
- **In Brisbane,** construction of the 10-kilometre Cross River Rail will similarly ease congestion by providing a second Brisbane River crossing and two six-kilometre tunnels, from Dalton Park to Bowen Hills. The project is due for completion in 2024.
- **Network form.** Perth's system is also distinctive relative to the other Australian networks due to the nature of its new railways. Table 20 shows Perth's network is 30 per cent longer than Adelaide's, but has 15 fewer stations. This station spacing facilitates significantly higher average train speeds on Perth's Mandurah line and, to a lesser extent, the Butler line (see Figure 44). With fewer stations, good station access is inherent to station design through rail-bus interchanges, extensive park-and-ride facilities and encouragement of (nearby) Transit Oriented Development (TOD).
- **Shared networks.** Brisbane, Melbourne, Adelaide and Perth use a different track gauge to the interstate network. This has separated most urban passenger traffic from interstate and some intrastate freight trains operating on the standard gauge. Examples of shared track include the north coast intermodal freight and coal from the Toowoomba region into the Port of Brisbane and steel products between Melbourne and Long Island (via the Frankston urban line). Sydney's network is standard gauge throughout. It therefore shares capacity with trains travelling on the interstate North–South and East–West (via Lithgow) corridors, as well as intrastate freight. The Southern Sydney Freight Line provides a dedicated southern access to Sydney freight yards, which has eliminated the previous southern Sydney curfew on freight trains operations during peak passenger commuting periods. The Epping to Thornleigh third track also gives additional train capacity through Sydney's northern suburbs.
- **Electrification.** Electrified services began in Sydney and Melbourne[26] from the early inter-war period using Direct Current (DC) traction power. Cities that electrified their networks later use more advanced Alternating Current (AC) traction. Perth and Brisbane electrified their networks relatively recently—Brisbane from the late 1970s and Perth from the early 1990s. In Adelaide, the Rail Revitalisation Programme includes track enhancements and system electrification. Electric train operation commenced on the Seaford and Tonsley lines in 2014. Construction of the Gawler line is now also underway.

Urban light rail passenger networks

Australia has 326 route kilometres of operational light rail. The technological and operational differences between tramways, light rail and heavy rail are increasingly blurred[27]. This report refers to Australia's light rail operations as having shared characteristics with tramways, particularly in Melbourne. Former heavy rail corridors form parts of the network in Melbourne, Sydney and Adelaide. By route distance, Melbourne has the world's largest light rail network.

26 Only Melbourne's Frankston–Stony Point line remains un-electrified.

27 Tramways generally have short spacing between stations and operate on roads, often sharing a right-of-way way with traffic. Light rail is considered to largely have its own right-of-way with more widely spaced stations. Melbourne's extensive system, in particular, illustrates the flexibility of light rail and its consequent definitional blurring. Melbourne's light rail vehicles operate on former heavy rail lines to St Kilda and Port Melbourne, but most of the network shares right-of-way with road traffic.

Table 21 Network characteristics of light railways, September 2020

	Gold Coast	Sydney	Melbourne	Adelaide	Canberra	Newcastle
Total route length (km)	20.3	24.7	250	16.6	12	2.7
Segregated right of way	segregated	largely segregated	24% segregated	largely segregated	segregated	segregated
Routes (no.)	1	3	24	1	1	1
Number of stops (no.)	19	42	1 717	29	13	6

Sources: Currie and Burke (2013); Advice from Yarra Trams; G:link (2019); Canberra Metro (2020); Advice from Department of Planning, Transport and Infrastructure; Advice from Transport for NSW; BITRE estimates

Melbourne's network is distinct, with only a small proportion of the network segregated from road traffic, and with close spacing between stops. Parts of the network share the close-stop and on-road feature of buses whereas in other parts it more closely resembles the limited-stop, segregated railway. These characteristics mean Melbourne's average speed is significantly lower than other cities.

Sydney and Adelaide had significant tramway systems prior to the middle of the 20th century. Adelaide's single remaining line runs between the Adelaide Entertainment Centre and Glenelg, via the CBD, with two short extensions from North Terrace in the CBD – to Festival Plaza and to the Botanic Gardens. The majority of the route length is in a segregated light rail corridor between the edge of the CBD and Glenelg, using a former heavy-rail corridor.

Sydney now has three light rail routes. The L1 line starts at Sydney Central Station runs to Dulwich Hill via Pyrmont, and Lilyfield. The line runs along a former freight heavy rail corridor, with a small segment of on-road (largely segregated) operation between Haymarket and Central Railway Station. The L2 and L3 lines run from Circular Quay to Centennial Park, via Sydney Central Station on shared track. At Centennial Park the lines diverge. The L2 line continues on to Randwick, while the L3 line continues to Kingsford. The L2 and L3 lines are all new construction and are largely on road segregated.

The Gold Coast light railway runs between the Helensvale and Broadbeach. The line runs along roads but the space is generally not shared with road traffic. The line runs along a dense retail corridor (Currie and Burke 2013, p.12). In December 2017, the 7.3 kilometres Stage 2 expansion from Gold Coast University Hospital to Helensvale railway station opened.

Light railways opened in Canberra and Newcastle in 2019. The Canberra light railway runs from Canberra city to Gungahlin. Relatively long distances between stops enables Canberra's light rail to have the highest point to point average speed in Australia – 30 kilometres per hour. Newcastle's light rail has no overhead wires. Instead, the light rail vehicles recharge at every stop, by raising the pantograph to an overhead power supply located at the stop.

Non-urban passenger network

The non-urban passenger services are almost entirely integrated with other rail operations through shared track access. Typically, the non-urban services share track with urban passenger and freight trains, although the June 2015 opening of the Regional Rail Link reduced this in Victoria..

Table 22 Network coverage of non-urban passenger rail services, 2020

	Queensland Rail	NSW TrainLink	V/Line	Transwa	Great Southern Rail	Heritage operators
Electrified route kilometres	728	445	-	-	-	1
Total route kilometres	4 380	4 261	1 737	836	7 446	511 (approx.)

Notes: This is an estimate of route kilometres. Shared corridors between multiple services are only counted once. For example, TrainLink's Sydney-Brisbane estimate includes all other TrainLink services that operate anywhere on that corridor between Sydney Central and Casino.

The estimate includes the designated urban networks through which non-urban passenger rail services transit.

The Queensland Rail route lengths includes the Varsity Lakes - Brisbane service.

Diesel services may run on electrified track. Where non-urban electrified and diesel services share electrified track (such as Rockhampton–Brisbane), the route is defined as electrified. Where non-urban diesel services share track with electrified urban trains (such as V/Line services on Melbourne's metropolitan network), the route is defined as not electrified.

Source: BITRE estimates.

Train operator equipment stock (excluding freight wagons)

Locomotives

BITRE estimates there were 2 065 operational locomotives in Australia in September 2020 (See Table 23). This excludes locomotives in storage, available for hire, or due for scrapping. The data below uses the age of the locomotive since built new or rebuilt[28].

Figure 34 shows approximately 50 per cent of the fleet was aged approximately 12 years or less in September 2020, which is unchanged from 2019. Figure 33 shows the age distribution by gauge, while Figure 36 shows the age distribution by percentage. The newest locomotives at the time of analysis were 12 EMD SD70s (for use in the Pilbara network), and 24 other standard gauge locomotives, one of which was a CLP Class re-build.

While there are large numbers of old locomotives, such as the NSW 48 Class, operators deliberately keep these locomotives that are light compared to modern locomotives because they can operate on grain lines with low maximum axle loads. Without the light old locomotives rail transport would not be able to serve these lines. NSW environment protection regulations that began to be introduced in May 2020 prohibit the use of these locomotives due their diesel-particulate and noise emissions, but the Save Our NSW Grain Lines is lobbying to have the fleet exempted (Railway Digest, April 2020, pp.10-11).

Approximately 65 per cent of the current fleet was built or rebuilt in Australia, with the remainder being built in the United States of America, China and Germany. Of the 36 locomotives introduced in 2020, approximately 67 per cent were Australian made. All imported locomotives were from the United States of America.

Most locomotives in the fleet perform freight duties exclusively. V/Line is expanding its diesel multiple unit (DMU) VLocity fleet. This rollingstock, by virtue of being DMU, is excluded from the age analysis and affects the broad gauge analysis as new DMU sets replace locomotive hauled

28 Rebuilt locomotives can attain the same (or better) performance and longevity characteristics as a new locomotive.

passenger trains. The lesser freight task on the broad gauge compared to the standard and narrow gauges is also reflected in the relatively small broad gauge locomotive fleet numbers and the lack of new locomotives. Conversion of some lines in Victoria's north west to standard gauge has reduced the size of the broad gauge network further and, thus, the scope of its operations. To illustrate, there are no broad gauge locomotives aged less than 13 years. Due to the lack of new broad gauge locomotives, operators often have to use old locomotives, some of which were built in the 1950s and 1960s.

The status of the locomotive fleet is fluid, with locomotives frequently switching between active operations and being in storage. What the table and figures below also do not show is the degree of and type of locomotive usage. Newer locomotives tend to be assigned primary 'frontline' duties such as hauling intermodal trains across the continent or hauling coal or iron ore trains, while older locomotives tend to be assigned lesser secondary duties such as providing additional motive power behind newer locomotives or doing yard duties only. BITRE is currently unable to measure the degree of locomotive usage.

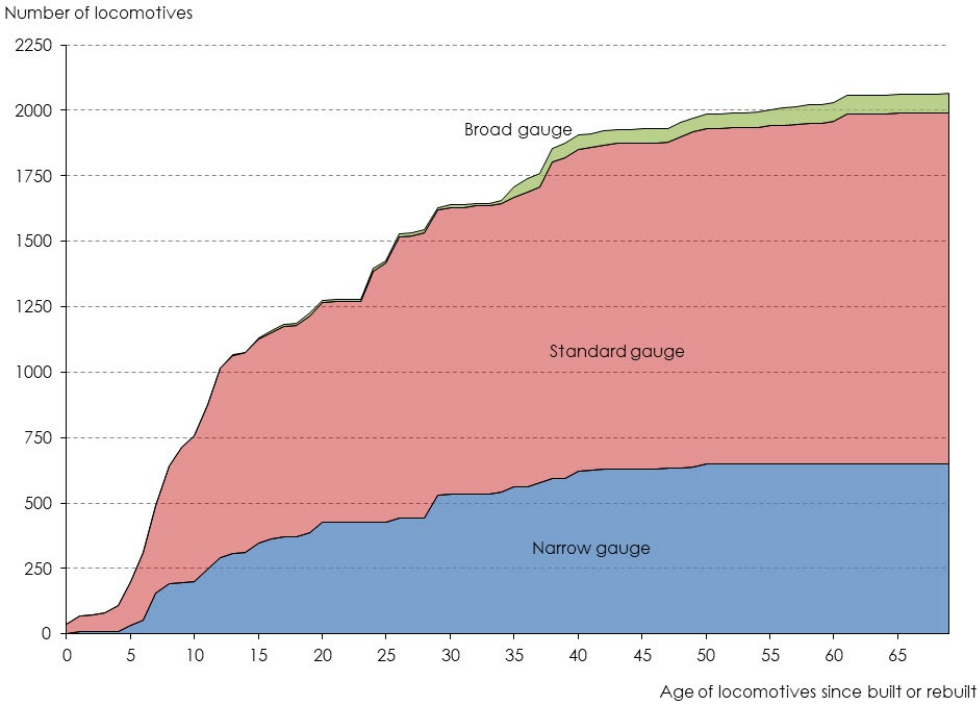
Care is also needed when comparing locomotive ages by gauge, particularly between the broad and standard gauges, where there is considerable re-gauging of the previous Victorian government owned fleet, such as the G, T, and N classes, many of which now operate outside Victoria.

Table 23 Locomotive ages

Age range (years)	Narrow Gauge	Standard Gauge	Broad Gauge	Total
0-5	31	169	-	200
6-10	170	385	-	555
11-15	146	226	2	374
16-20	78	60	8	146
21-25	2	149	0	151
26-30	106	107	0	213
31-35	29	11	28	68
36-40	60	123	16	199
41-45	9	15	0	24
46-50	20	36	1	57
51+	0	58	20	78
Total	**651**	**1339**	**75**	**2065**

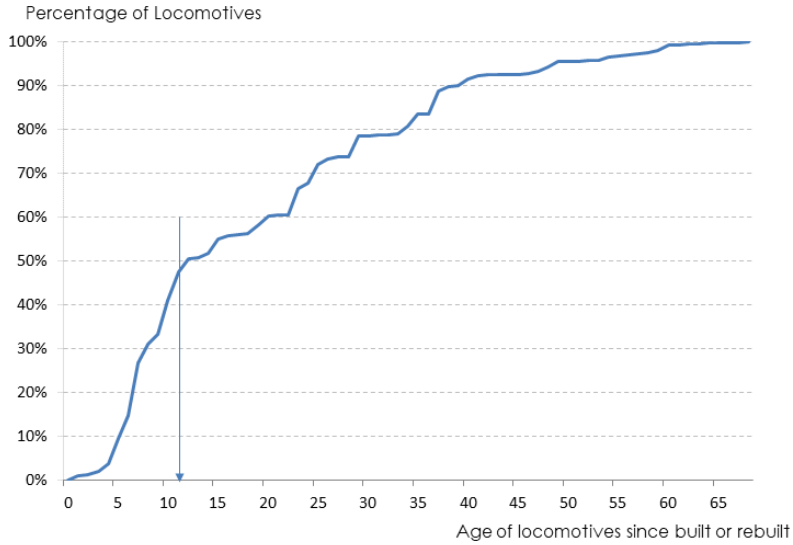
Sources: BITRE analysis of data from Pacific National, Aurizon, BHP, Fortesque Metals Group, One Rail Australia, Rio Tinto, SCT Logistics, Tasrail, Queensland Rail, Roy Hill, Fletcher International, Southern Shorthaul Rail, Public Transport Victoria, and QUBE Logistics; Clark (2015); Railpage (2020).

Figure 34 Cumulative locomotive age profile, by number of locomotives



Sources: BITRE analysis of data from Pacific National, Aurizon, BHP, Fortesque Metals Group, One Rail Australia, Rio Tinto, SCT Logistics, Tasrail, Queensland Rail, Roy Hill, Fletcher International, Southern Shorthaul Rail, Public Transport Victoria, and QUBE Logistics; Clark (2015); Railpage (2020).

Figure 35 Cumulative locomotive age profile, per cent



Source: BITRE analysis of data from Pacific National, Aurizon, BHP, Fortesque Metals Group, One Rail Australia, Rio Tinto, SCT Logistics, Tasrail, Queensland Rail, Roy Hill, Fletcher International, Southern Shorthaul Rail, Public Transport Victoria, and QUBE Logistics; Clark (2015); Railpage (2020).

Box 6 Further resources

The monthly magazines *Railway Digest* compiles a list of current and recently completed rolling stock contracts and deliveries of locomotives, wagons, permanent-way vehicles and passenger stock. This list is published regularly in the magazine. Railpage.com.au also provides regularly updated and historical details of locomotives by gauge, operational status, and current operator..

Urban passenger rolling stock

The levels of rolling stock needed are governed by:

- Traffic levels;
- The network size and length of individual lines;
- The range of services on each part of the network (such as offering stopping, semi-fast, and express services on a given line); and
- The average speed of services (with faster operations requiring fewer train sets).

Passenger heavy rail stock

"Multiple unit" stock using permanently coupled carriages provide most services. Sydney's fleet generally run as four-car units, coupled into eight car trains. Elsewhere, most trains are three-car units, generally paired as six-car trains. Adelaide's rolling stock, with large numbers of one and two-car units, enables Adelaide Metro to cater for modest traffic levels with a broad range of configurations. There are also some two-car and three-car operations in Perth.

Table 24 Urban Heavy rail rolling stock, September 2020

	Brisbane	Sydney[a., b.]	Melbourne	Adelaide	Perth
Vehicles (no.)	897	1749	1389	130	330
Carriage format	Single-deck	Double-deck and single-deck	Single-deck	Single-deck	Single-deck
Multiple-unit format	75 six car 149 three car	22 six car 200 four car 102 eight car	463		48 two car 78 three car
Common train formations	EMUs coupled as six-car sets	EMUs coupled as eight-car sets	EMUs coupled as six-car sets	DMU, up to four-car; EMUs, normally as three-car sets, can couple as six car sets	EMUs coupled as six-car sets on new lines

Notes: [a] The Brisbane and Sydney totals exclude interurban rollingstock.

[b] The Sydney total includes the Alstom Metropolis metro cars.

Sources: Data provided by Queensland Rail, Transport for NSW, Public Transport Victoria, and Adelaide Metro; and Public Transport Authority WA, (2019), p.17.

Sydney is the only system to use double-deck carriages, which it began introducing in 1964, to increase passenger capacity on the existing network. Its double deck trains may have longer dwell times, however, due to passengers from the upper and lower decks converging at the carriage doors and fewer doors per carriage than single deck trains.

Light rail

Melbourne's light rail fleet is much larger and more varied than the other cities; see Table 25. Melbourne's older rolling stock, such as the Z and A classes, introduced between 1975 and 1984 and 1984–1986, respectively, are comparatively short and have low passenger capacity.

Over the past 30 years, there has been a progression towards longer, higher capacity vehicles, using vehicle articulation rather than the coupling of vehicles, although all of Sydney's new Citadis X05 trams now operate as coupled two car sets. Melbourne's E class tram, introduced from 2013, is more than twice the length of the earlier Z and A classes. Similarly, rolling stock introduced in the last decade in other cities is all over 30 metres in length.

The new trams are a mix of imported and locally built vehicles. Bombardier manufactures the Australian built vehicles at its Dandenong plant in Victoria. These vehicles are used in Melbourne and Adelaide. Since 2019, Yarra Trams has received an additional nine E Class trams. Sydney has acquired 60 foreign made Citadis X05 trams for use on the newly opened CBD and South East Light Rail lines.

Table 25 Light rail rolling stock, September 2020

City	Vehicle type	Length (metres)	No. vehicles
Gold Coast	Flexity 2	43	18
Sydney	Urbos 3	33	12
	Citadis X05	33	60
Sydney total			72
Melbourne	A1 class	15	27
	A2 class	15	42
	B2 class	23.6	130
	C1 class	23	36
	C2 class	32.5	5
	D1 class	20	38
	D2 Class (Combino)	29.9	21
	E Class	33.5	85
	Z3 class	16.6	114
	W class	14.2	13
Melbourne total			511
Adelaide	100 Flexity Classic	30	15
	200 Citadis	32	9
Adelaide total			24
Canberra	Urbos 3	32.9	14
Newcastle	Urbos 100	32.9	6

Notes: Fleet numbers are based on rollingstock estimated to be in service.
Adelaide retains two heritage H class trams for tourist trips and special events.

Sources: Advice from G:Link, Adelaide Metro, Transdev NSW, and Transport for Victoria.

Non-urban passenger rolling stock

Like urban rail rolling stock, and reflecting historical acquisitions, the composition of the non-urban passenger stock is a function of:

- Traffic levels;
- Service frequency;
- The size of the network and the length of individual lines;
- The range of different services on each part of the network (such as offering all stopping, semi-fast, and express services on a given line); and
- The average speed of services (with faster operations requiring fewer train sets).

There is a wide range of non-urban passenger services in Australia. Thus, rolling stock, designed for individual markets and service types, vary. Table 26 shows the number of individual vehicles/cars, by type and operator.

Table 26 Non-urban passenger rolling stock in service, by vehicle type and operator, 2020

	Queensland Rail	NSW TrainLink	V/Line	Transwa
Electric multiple unit cars (no.)	143	422	-	-
Diesel multiple unit cars (no.)	-	65	258	14
Locomotives (no.)	34	19	32	-
Carriages (no.)	87	60	139	-
Total cars/vehicles	**264**	**566**	**429**	**14**

Notes: The Queensland Rail total excludes the New Generation Rollingstock. Most of that fleet is used in suburban operations, although they are also used on the Gold Coast Line. The carriages total now includes the five cars in the (isolated from the rest of the network) Gulflander fleet and the five power cars. The diesel multiple unit, which previously included the diesel tilt train sets, is now zero as the diesel tilt train carriages and power cars are counted instead in the carriages and locomotives sections respectively. The electric multiple unit total includes the two six car electric tilt train sets.

The V/Line carriages total includes power vans but excludes the three flat wagons in its fleet.

Rolling stock may also be used in urban operations. Electric multiple units in intercity operations, for example, often act as limited-express urban trains once they enter the metropolitan network.

The above lists individual vehicles rather than sets.

The estimate of Victorian carriages includes those in storage or undergoing repair.

No data is available for Great Southern Rail's trains.

Sources: Data provided by Transport for NSW, Queensland Rail, Public Transport Victoria, and Transwa.

Locomotive hauled trains are primarily used for long-distance routes although V/Line still uses them on some commuter route services, such as Melbourne—Seymour. Some Queensland Rail long-distance services are locomotive hauled. V/Line's N class locomotives typically haul long distance trains on both the broad and standard gauges, but as at October 2020 there were no standard gauge operations due to the Covid-19 related suspension of all Melbourne—Albury services. New South Wales uses both XPT trains and Xplorer DMU sets on its long distance services. While the XPTs are capable of travelling at 160km/h, track conditions such as tight curves restrict their ability to travel at such speeds across much of its network. The New South Wales Government has announced plans to replace the XPT and Xplorer fleet and the first trains are expected to enter service in 2023 (Transport for NSW, 2020c).

Medium-distance regional/commuter services are generally DMU operated. VLocity DMUs, that operate at speeds of up to 160 kilometres per hour, are used on Victoria's Regional Fast Rail services. Transwa uses DMUs for all its rail services. The Perth-Kalgoorlie Prospector DMU also travels at up to 160km/h.

NSW TrainLink and Queensland Rail have large EMU fleets, which are largely used for intercity/commuter services. New South Wales uses its EMU fleet for Sydney—Newcastle, Sydney—Lithgow and Sydney—Kiama (via Wollongong) services. Queensland Rail's intercity EMUs are used on the Sunshine Coast and Gold Coast lines.

A unique passenger rolling stock is Queensland Rail's tilt train (fixed-formation) sets. It has a fleet of electric tilt trains, used on Brisbane—Rockhampton services, and diesel tilt trains for the Brisbane—Cairns services. (BITRE 2014, p. 60 and pp. 161–162, discusses the nature of the tilt-train services and the principles of tilt trains.)

CHAPTER 4
Railway performance

Network indicators

Safety

The Office of the National Rail Safety Regulator (ONRSR), which, in 2018–19, had regulatory safety oversight for all of Australia, stated in its 2018–2019 annual report there were 100 notified fatalities on railways regulated under *Rail Safety National Law (2012)*.These fatalities were:

- 80 acts of suspected suicide;
- 17 incidents of people struck by a train, including people in vehicles at level crossings;
- Two slips, trips and falls; and
- One unspecified other (ONRSR 2019, p.13).

The state by state breakdown is as per the table below.

Table 27 Rail related fatalities by jurisdiction 2018–19

Jurisdiction	Suspected suicide	Struck by a train	Slips, trips, and falls	Other	Total
ACT	0	0	0	0	0
SA	6	1	0	0	7
TAS	0	0	0	0	0
NT	0	0	0	0	0
NSW	20	8	1	0	29
VIC	41	5	0	0	46
QLD	6	2	1	1	10
WA	7	1	0	0	8
Total	**80**	**17**	**2**	**1**	**100**

Notes: Struck by a train includes trains striking people and colliding with road vehicles at railway crossings

Sources: ONRSR, 2019, p.14

There were a further 326 Category A occurrences and 39,867 Category B occurrences (ONRSR 2019, p.14). Category A occurrences are the most serious and must be reported to ONRSR within 24 hours, while Category B occurrences are less serious but must be reported to ONRSR within 72 hours.

Environmental performance

The measurement of the rail industry's emissions is complicated by the need to allocate upstream emissions from power generation sources to downstream energy uses, such as powering electric trains. Emissions data are therefore an approximation.

Changing requirements, such as higher performance and, for passenger rail, air-conditioning and on-board electronics, may increase emissions intensity. Table 28 shows BITRE's revised most recent carbon dioxide equivalent emissions estimate of the rail industry since 2007. According to the current estimate, emissions have increased by approximately 30 per cent since 2007. The increased rail transport of bulk materials, particularly iron ore, is likely to be a cause of the higher level of emissions, as is the increased passenger task.

Table 28 Rail industry's full fuel cycle carbon dioxide equivalent emissions (billion grams)

Year												
2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CO^2 Emissions												
4902.9	5057.6	5130.1	5196.0	5271.0	5405.7	5459.4	5674.5	5974.6	6223.7	6317.5	6363.4	6367.0

Note:: Preliminary/provisional estimate.

Source: Revised BITRE estimates.

Urban passenger rail transport creates less relative pollution than cars, especially during peak period travel. Over the full day, the gap in average emissions intensity is less substantial, however, since off-peak rail services generally have lower patronage and road vehicles are less subject to congestion.

Interstate network indicators

Access revenue yield indicator (ARTC)

The access revenue yield data that ARTC provides is the revenue per '000 GTK that a reference superfreighter train generates for ARTC in specific line segments.

Access revenue is the infrastructure manager's income made from train operators using the railway. ARTC's access charge has two parts: a flagfall charge, which is a reservation charge for booking a train path on a given line segment, invariant with tonnage; and a variable charge, which varies directly with the train operator's gross tonne kilometres. Thus, as a train's tonnage increases, the average access charge per tonne declines.

This access charging regime encourages train operators to operate longer trains. Longer trains enable infrastructure managers to increase tonnage throughput, as there are limited train paths. However, longer trains require track that can accommodate the longer trains. Consequently, interstate network infrastructure managers have upgraded their networks to accommodate longer trains.

Table 29, below, is ARTC's revised index of the maximum access yield for the interstate network it manages. The indicator measures the changes (relative to the base year) in the maximum access revenue yield per gross tonne kilometre. As the access revenue yield is calculated on a nominal reference train, this measure essentially identifies if there have been any real changes in access charges. Changes in this composite indicator may reflect changes in:

- Real access charges (higher charges will increase the indicator);
- Train operators' use of existing capacity (heavier/longer trains will lower the indicator); or
- Enhancements in rail infrastructure and train operators' uptake of those enhancements (more uptake of improvements, through heavier trains, will lower the indicator).

Table 29 Index of real maximum access revenue yield, interstate network (2009-10 = 100)

	2009-10	2010-11	2011-12	2012-13	2013–14	2014-15	2015-16	2016-17	2017-18	2018-19
North–South corridor										
Acacia Ridge – Border Loop	100	100	100	100	100	100	100	100	100	100
Border Loop – Newcastle	100	100	100	100	100	100	100	100	100	100
Macarthur – Albury	100	100	100	100	100	100	100	100	100	100
Albury – Tottenham	100	100	100	100	100	100	100	100	100	100
East–West corridor										
Melbourne – Adelaide	100	100	100	100	100	100	100	100	100	100
Adelaide – Kalgoorlie	100	100	100	100	100	100	100	100	100	100
Cootamundra – Parkes	100	100	100	100	100	100	100	100	100	100
Parkes – Broken Hill	100	100	100	100	100	100	100	100	100	100
Broken Hill – Crystal Brook	100	100	100	100	100	100	100	100	100	100

Note:: Numbers are subject to rounding.

Source: Data provided by ARTC.

Interstate network utilisation

Train frequency on the interstate network

Table 30, below, shows the numbers of scheduled weekly intermodal trains that originate and terminate in the given city pairs. These origins and destinations are those of trains, not those of goods on the trains. For example, Brisbane—Adelaide trains dwell in Sydney where goods are loaded and unloaded. Caution is also needed when comparing train numbers. Lower train numbers can be more than offset by longer train lengths.

The number of scheduled Sydney—Brisbane trains has decreased. While the table shows a decrease in the number of Sydney—Melbourne trains the actual number is unchanged. This is

because *Trainline 7* included QUBE Logistics' intermodal designated services that carried cement products only, whereas *Trainline 8* excludes them. This is because QUBE's Sydney—Melbourne trains are, by nature, bulk produce carriers and they operate to and from Maldon (near Picton), not Sydney.

On the East–West corridor, the number of scheduled intermodal trains is largely unchanged. The number of scheduled Sydney—Perth trains has decreased by one in each direction, but Pacific National, which is the sole operator on the corridor, has introduced Sydney—Parkes shuttle services since the opening of its new Parkes terminal in late 2019. All Sydney to Perth services now operate via Lithgow, whereas most previously travelled the longer but flatter route via Cootamundra West. All Perth to Sydney trains still operate via Cootamundra West.

There has been no change in the number of Adelaide—Darwin services.

Table 30 Number of scheduled weekly intermodal designated train services, by city pair

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
North–South corridor											
Brisbane to Sydney	1	1	2	2	2	2	5	5	6	5	3
Sydney to Brisbane	0	0	0	0	0	2	5	5	4	5	2
Sydney to Melbourne	2	2	3	2	2	1	1	2	2	9	6
Melbourne to Sydney	2	2	3	2	2	0	0	0	3	7	5
Brisbane to Melbourne	15	15	15	15	15	16	12	16	16	10	10
Melbourne to Brisbane	15	15	15	16	16	16	12	16	16	10	10
Brisbane to Adelaide	3	3	2	2	2	2	2	2	1	2	2
Adelaide to Brisbane	3	3	2	2	2	2	2	2	1	2	2
East–West corridor											
Melbourne to Adelaide	11	12	9	9	8	6	6	5	5	5	5
Adelaide to Melbourne	11	12	9	9	9	6	6	6	5	5	5
Melbourne to Perth	18	19	20	20	20	20	18	18	15	13	13
Perth to Melbourne	17	19	20	20	20	20	19	19	15	14	14
Sydney to Perth	7	7	8	9	10	8	7	7	7	7	6
Perth to Sydney	7	7	8	9	10	9	7	7	7	7	6
Adelaide to Perth	0	0	0	0	0	0	0	0	0	0	0
Perth to Adelaide	0	0	0	0	0	0	0	0	0	0	0
Central corridor											
Adelaide to Darwin	7	6	7	6	6	6	6	6	6	6	6
Darwin to Adelaide	6	6	7	6	6	6	6	6	6	6	6

Source: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure and One Rail Australia) as at April 2020..

Weekly trains by interstate line segment

Table 31 shows the number of scheduled weekly interstate intermodal and steel trains on each line segment. This indicates how intensely the interstate network is used, by schedule. Table 31 differs from Table 30 because it includes all interstate trains that travel along a given corridor, including those that continue on to another corridor, and steel trains. For example, BITRE counts a train travelling from Melbourne to Perth on all line segments on that route.

Table 31 also includes interstate trains that do not travel from capital city to capital city, such as the Melbourne—Griffith trains.

Crystal Brook—Port Augusta is still the busiest segment. The segment is a convergence point for interstate intermodal and steel trains travelling to and from Perth; intermodal trains between Adelaide and Darwin; and steel trains from Newcastle, Melbourne, Adelaide, and Perth to Port Augusta and Whyalla.

The Sydney—Cootamundra and Cootamundra—Melbourne segments remain the busiest on the North—South corridor. In addition to intermodal and steel trains, passenger and bulk commodity (mostly grain) trains use these segments extensively. The significant decreases in 2020 are due to the the re-routing of all Sydney to Perth trains and one Brisbane to Adelaide train via Lithgow and the non-inclusion of QUBE's Melbourne—Sydney trains due to their status as carriers of bulk materials (cement)[29].

Table 31 Total scheduled weekly interstate intermodal and steel trains, by line segment

Line Segment	2016	2017	2018	2019	2020
North–South corridor					
1. Brisbane–Sydney	48	58	56	46	40
Sydney–Cootamundra	60	70	71	72	63
Cootamundra–Melbourne	49	58	71	61	55
East–West corridor					
3. Sydney–Crystal Brook via Broken Hill		12	9	9	8
Sydney–Parkes via Lithgow	6	6	6	6	9
Cootamundra–Parkes	22	22	20	22	18
Parkes–Crystal Brook	30	30	32	33	32
4. Melbourne – Crystal Brook		7	8	9	10
Melbourne–Adelaide	55	53	46	43	43
Adelaide – Crystal Brook	60	60	55	52	56
5. Crystal Brook – Perth		0	0	0	0
Crystal Brook – Port Augusta	84	84	80	76	76
Port Augusta – Tarcoola	69	69	63	60	58
Tarcoola – Perth	57	57	51	48	46

Source: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, and One Rail Australia) as at April 2020.

Train flow patterns on the interstate network

Train flow indicators based on scheduled running times provide information about the flow of trains across the network.

Table 32 only provides information about intermodal designated scheduled services, which share the line with other trains such as bulk goods trains, steel designated trains and passenger trains.

29 ARTC's Master Train Plan designates these trains as intermodal, even though they are not intermodal by nature. Because of this Trainline 7 included those trains. BITRE has dedided not to include them now due to them being non-intermodal.

Changes to the nature and scale of other trains types' operations may influence intermodal train flow patterns in the infrastructure managers' path planning. Assessing what influences other trains' operations may have on intermodal train flow patterns is outside the scope of this publication. Train flow patterns are based on scheduled times. Actual times for individual trains may differ due to operational reasons.

Table 32 Scheduled inter-capital intermodal train flow patterns

Line segment/ direction	Number of weekly services		Average speed (km/ph)		Average stops		Average transit time (mins)		Average dwell time (mins)		Percentage dwell time (per cent)		Dwell time	
Year	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
North–South corridor														
Brisbane to Sydney	17	15	54	54	8	8	1081	1074	165	152	15%	14%	21	19
Sydney to Brisbane	16	14	52	55	6	6	1091	1060	194	143	17%	13%	30	22
Sydney to Melbourne	19	16	66	61	3	4	874	952	93	119	11%	13%	29	31
Melbourne to Sydney	17	15	67	68	2	3	855	850	85	58	10%	7%	34	20
Brisbane to Melbourne	10	10	58	58	13	13	1996	1998	266	263	13%	13%	21	21
Melbourne to Brisbane	10	10	62	62	10	10	1894	1890	186	190	10%	10%	19	19
East–West corridor														
Melbourne to Adelaide	18	18	68	69	3	3	738	727	46	46	6%	6%	17	16
Adelaide to Melbourne	19	19	58	58	5	5	862	857	152	150	18%	18%	29	28
Adelaide to Perth	13	13	67	63	11	11	2361	2537	301	316	13%	12%	26	28
Perth to Adelaide	14	14	55	58	17	16	2742	2730	703	671	24%	25%	42	42
Cootamundra to Crystal Brook	3	0	67	n/a	5	n/a	1132	n/a	262	n/a	25%	n/a	56	n/a
Crystal Brook to Cootamundra	7	6	66	63	4	4	1155	1216	291	323	25%	27%	81	74
Brisbane to Adelaide (via Lithgow)	0	1	n/a	51	n/a	15	n/a	3115	n/a	910	n/a	29%	n/a	61
Brisbane to Adelaide (via Cootamundra	2	1	53	53	16	17	3205	3145	902	839	28%	27%	72	49
Adelaide to Brisbane (via Cootamundra, both trains)	2	2	51	51	13	14	3298	3298	975	980	30%	30%	72	70
Central corridor														
Tarcoola to Darwin	6	6	71	71	4	3	1905	1891	266	259	14%	14%	69	77
Darwin to Tarcoola	6	6	68	69	4	5	1976	1960	286	268	14%	14%	69	60

Note: The number of services excludes trains that do not run the entire line segment. Cootamundra to Crystal Brook, for example, excludes Adelaide to Brisbane trains.

Prior to 2020 three Sydney to Perth trains per week rain via Cootamundra. All Sydney to Perth trains now run via Lithgow, hence the 2020 figure for Cootamundra to Crystal Brook is zero.

Source: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure and One Rail Australia) as at April 2020.

North–South corridor

Most indicators have not changed significantly. The following significant changes have occurred:

- The number of Brisbane to to Sydney and Sydney to Brisbane services has each decreased by two.
- While the recorded number of Sydney—Melbourne services has decreased, this is only due to this report no longer counting QUBE's intermodal designated cement train services.

- Average transit times for Sydney to Brisbane servces have decreased by almost half an hour.

East–West corridor

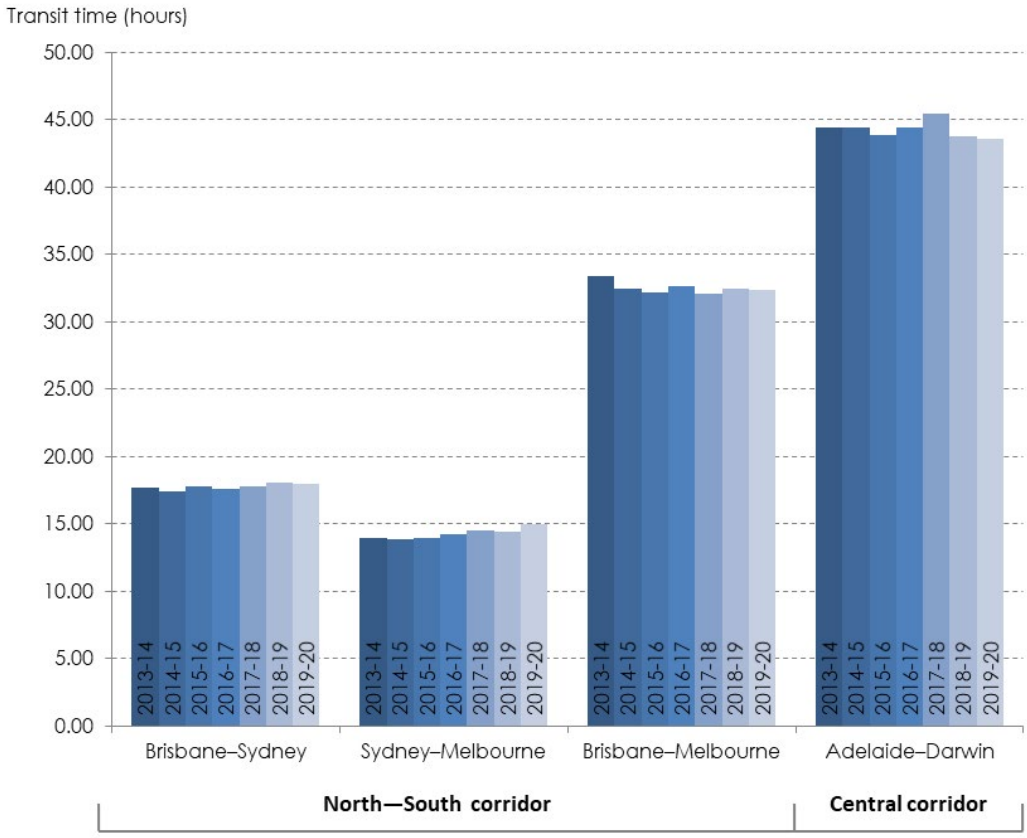
Travel patterns are largely unchanged from 2019. There have been, however, the following notable changes:

- Adelaide to Perth average transit times have increased by approximately three hours. The number of scheduled stops is unchanged but dwell times are longer.
- Average dwell times for Perth to Adelaide trains has decreased by approximately half an hour.
- Average transit times for Brisbane to Adelaide trains have decreased noticeably, which is likely due to one service now travelling the shorter route via Lithgow.

Central corridor

There have been no significant changes in travel patterns since 2019.

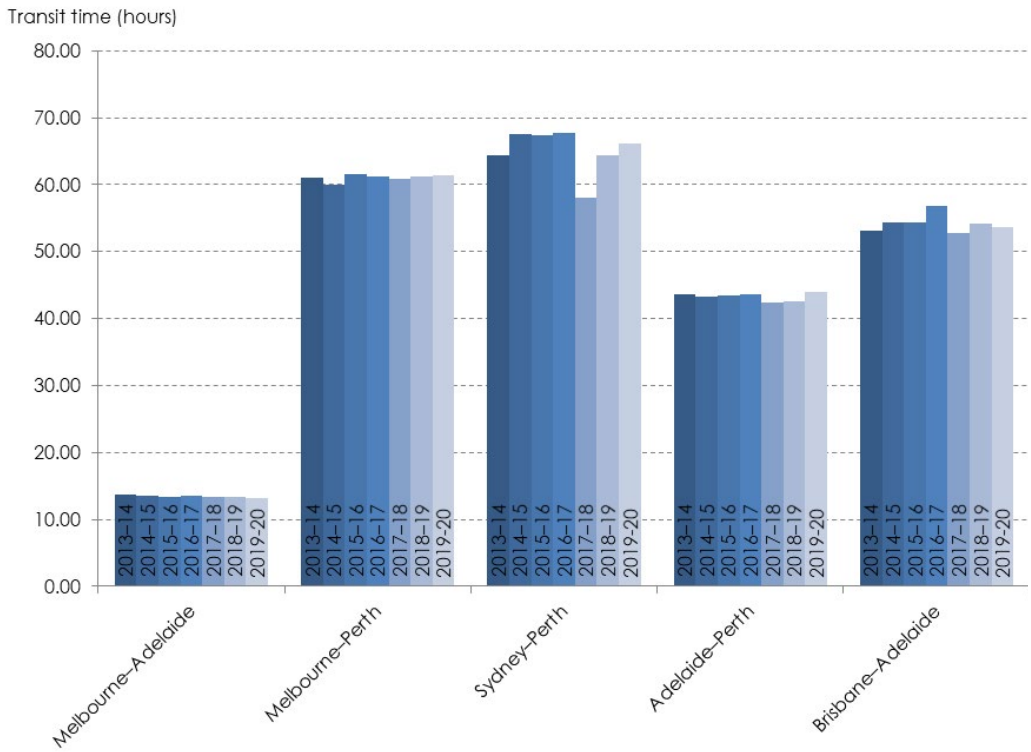
Figure 36 Average scheduled transit times, North–South and Central corridors, 2013–14 to 2019–20



Notes: Calculations include all intermodal designated trains on a given line segment travelling in both directions. The Sydney–Melbourne calculations, for example, include Brisbane–Melbourne trains.

Source: Infrastructure managers' working timetables (ARTC, Sydney Trains, Arc Infrastructure, and One Rail Australia) as at April 2020.

Figure 37 Average scheduled transit times, East–West corridors, 2013-14 to 2019-20



Notes: Calculations include all trains on a given line segment, as at April 2020. The Melbourne–Adelaide calculations therefore include Melbourne–Perth trains.

Source: Infrastructure managers' working timetables (ARTC, Sydney Trains, Arc Infrastructure, and One Rail Australia) as at April 2020.

Train reliability on the interstate network

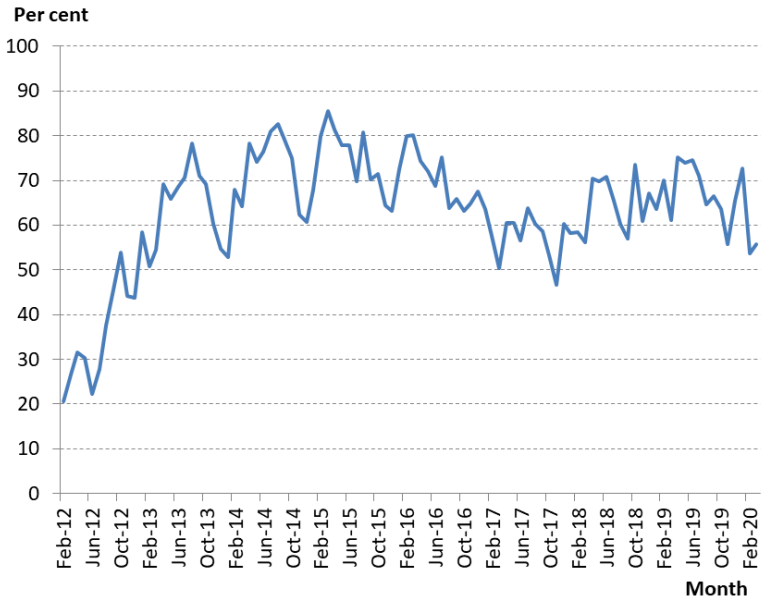
ARTC publishes performance indicators relating to service quality areas including reliability. Detailed information regarding reliability by city pair is available on ARTC's website.

Train and track issues affect reliability. Problems for train operators include mechanical issues with rolling stock, delays at terminals, flow on problems from other operators' delays, and problems beyond operators' control such as trespass and vandalism. These problems can cause significant delays across the network and for trains entering the network. This requires infrastructure managers to allocate train paths without compromising their obligations to other operators.

Infrastructure issues also affect reliability. Track quality problems can result in (temporary) speed restrictions and track closures. Signalling failures also cause delays. Infrastructure maintenance and renewal, as well as weather conditions, are important aspects in infrastructure reliability.

Figure 38 and Figure 39 show the percentage of intermodal trains that left the ARTC network within 30 minutes of schedule. The data are collected monthly and are subject to significant variation due to the impact of individual events.

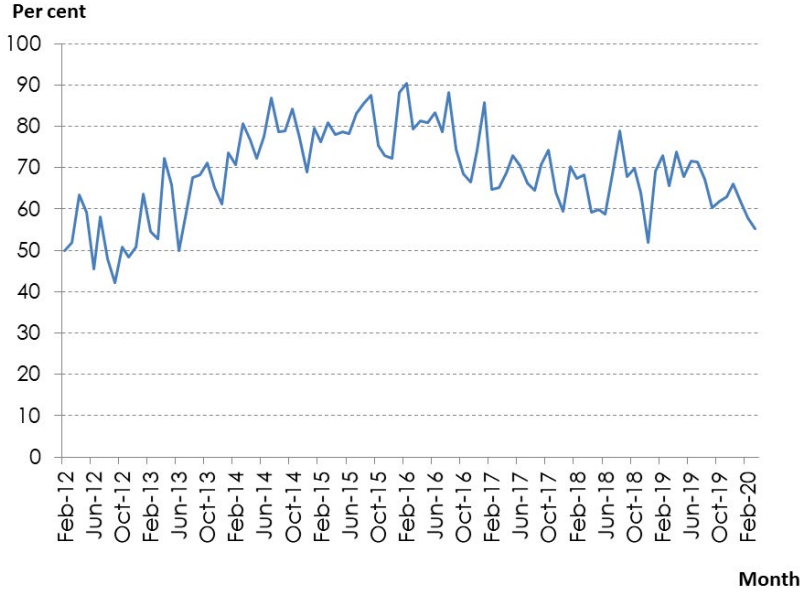
Figure 38 North–South corridor, percentage of intermodal trains exiting the network within 30 minutes of schedule



Source: Data provided by ARTC.

As Figure 382 (above) shows, train timeliness on the North—South corridor has trended gradually upwards since October 2017. Timeliness also increased from February 2012 as ARTC rectified degraded track conditions, particularly between Melbourne and Sydney.

Figure 39 East-West corridor, percentage of intermodal trains exiting the network within 30 minutes of schedule



Source: Data provided by ARTC.

Reliability on the East–West corridor (Cootamundra West/Parkes—Kalgoorlie and Melbourne—Kalgoorlie) has trended slightly downwards since the February 2016 peak.

Permitted train lengths on the interstate network

Permitted train lengths influence track capacity. On Australia's predominantly single track, crossing loops and passing lanes contribute to capacity. Since the mid-1990s in particular, infrastructure managers have built longer crossing loops and passing lanes (approximately 6-8 kilometres in length) across the interstate network. Track alignment and gradients also determine permitted train lengths.

Permitted unrestricted train lengths on the interstate network are as follows:

- 1500 metres Brisbane—Sydney;
- 1500 metres Melbourne—Adelaide (1800 metres restricted); and
- 1800 metres Sydney—Melbourne, Cootamundra—Crystal Brook, Adelaide—Perth, Tarcoola—Darwin.

The 'unrestricted' train length is the maximum length operators can operate any scheduled service without reference to the infrastructure manager. The length is shorter than the standard loop length on the line segment. The 'restricted' train length is the maximum train length permitted on the line segment. Under restricted access terms, trains that exceed the prevailing loop length can be operated by ensuring trains that have to be passed can be accommodated within the prevailing loop length.

Since 2007–08, passing loops have been constructed on the Cootamundra—Parkes section and additional passing lanes[30]. added on the single track sections between Junee and Melbourne to allow the unrestricted use of 1800 metre trains.

Double stacking capability on the interstate network

Double stacking containers on wagons also influences capacity. In Australia, double stacking involves stacking one hi-cube (9 feet 6 inch, or 2.896 metres high) container on top of another in a low-floor (well) wagon. The top of the stack must be no higher than 6.5 metres above the top of the rail, and mass limits must not be exceeded. Double stacking is permitted west of Goobang (Parkes) and west of Adelaide. Figure 40, below, illustrates.

Clearances on the North–South corridor are restricted to single stacking of hi-cube containers. The increasingly prevalent higher maxicube (10 feet 6 inch, or 3.20 metre) containers travel in low-floor well wagons.

30 A passing lane differs from a passing loop by viritue of the fact they are approximately eight kilometres in length, as opposed to approximately 1500 metres and 1800 metres, which is the typical crossing loop length on the interstate network, depending on the corridor. This enables trains to cross each other without stopping, subject to timings.

The central corridor line can accommodate double stacked containers and road freight vehicles 'piggybacked' on rail flat wagons.

Figure 40 Double stacking capability on the interstate network

Track quality of the interstate network

The maintenance and standards of railway infrastructure are important to train operating performance. The infrastructure quality, maintenance regime and underlying economic life of the infrastructure influence the permitted track speed and smoothness of wagon ride.

Figure 41 to Figure 44 show physical measures of average track condition by line segment. These indicators use a 'track quality index' (TQI). Lower index numbers equates to higher track quality.

The figures show trends in track condition for given line segments. The rate of track quality decline is influenced by such factors as the quality of renewal material and work, the level and type of track usage, climatic and local geographical factors, and the skill and timeliness of ongoing maintenance work.

The composition of the index varies between infrastructure managers, reflecting both differences in priority and different operational environments across the network. Therefore, these index numbers should not be used to compare track conditions across line segments managed by different infrastructure managers. However, relative changes in TQIs are comparable.

Train flow indicators based on scheduled running times provide information about the flow of trains across the network.

Box 7 Calculating track quality indices

For safety, maintenance, planning and regulatory reasons, infrastructure managers regularly measure the condition of their track. Managers measure the extent to which the railway track deviates from the 'designated' (or 'true') alignment. Infrastructure managers can report a global indicator of track condition on a given line segment. ARTC produced a 'track quality index' (TQI) as part of their Access Undertaking agreement with the Australian Competition and Consumer Commission. The TQI is a statistical measure calculated from the standard deviations of a number of different track geometry parameters. The TQI for a given line segment is taken as the average of the individual TQI sample readings. The parameters that are measured include rail placement, vertical and horizontal alignment, and twist.

Infrastructure managers regularly operate a train with a 'track geometry measuring car'. The carriage is equipped to measure and record a range of geometric parameters. There is a variety of track geometry measuring cars in Australia and hence a variety means of measuring and analysing the parameters that make up the TQI. Further, track quality is reported as a composite measure of the different geometric parameters. This composite measure can differ between systems depending on the parameters used. Trainline 6, has a case study on ARTC's 'AK Car' track measuring operations (See BITRE, 2018a).

The following are the track quality measurements and indicators for the national network.

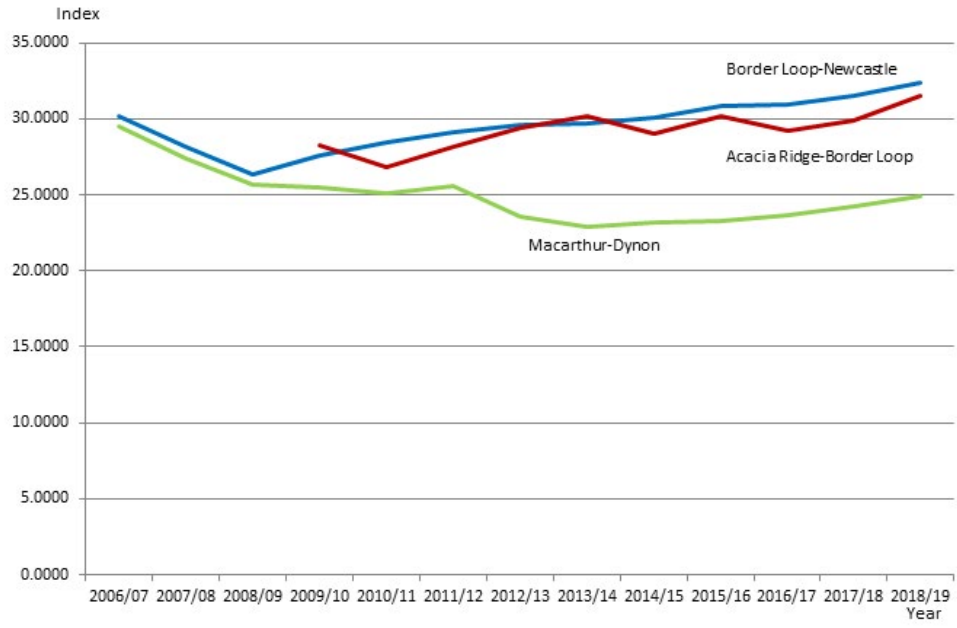
ARTC's and One Rail Australia's TQIs, standardised across both networks, consists of:

- Gauge;
- Twist (short), measured over two metres;
- Vertical irregularities ('top'), deviation over a 20 metre inertial reading (average of left and right rail); and
- Horizontal line irregularities ('versine'), 5/10 metre chord emulation (average of left and right rail).

These are based on average of Standard Deviations over 100 metre sections.

As Figure 41 and Figure 42 show, the track quality decreased on most sections of the ARTC network. One Rail's TQI has continued to fluctuate significantly between Tenant Creek and Darwin and improved slightly between Tennant Creek and Northgate.

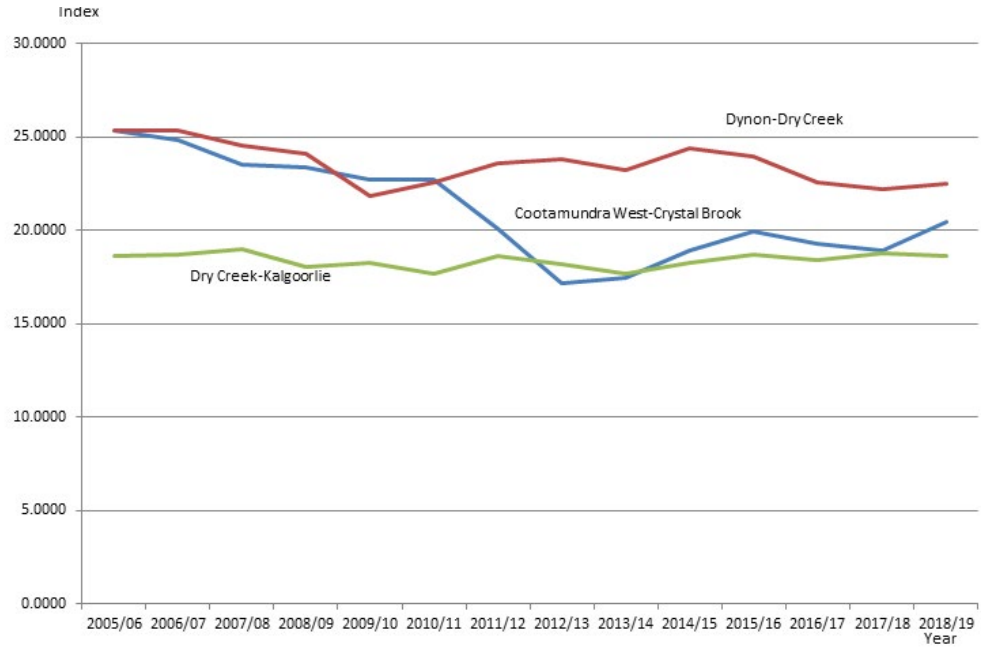
Figure 41 ARTC track quality index, North–South corridor



Note: Lower indices indicate higher track quality.

Source: Data Provided by ARTC.

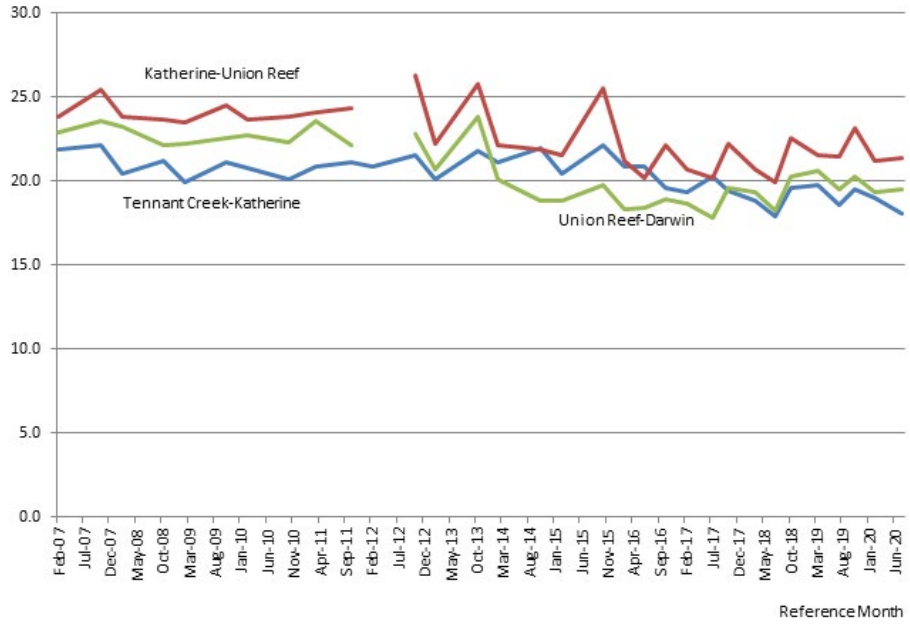
Figure 42 ARTC track quality index, East-West corridor



Note: Lower indices indicate higher track quality.

Source: Data Provided by ARTC.

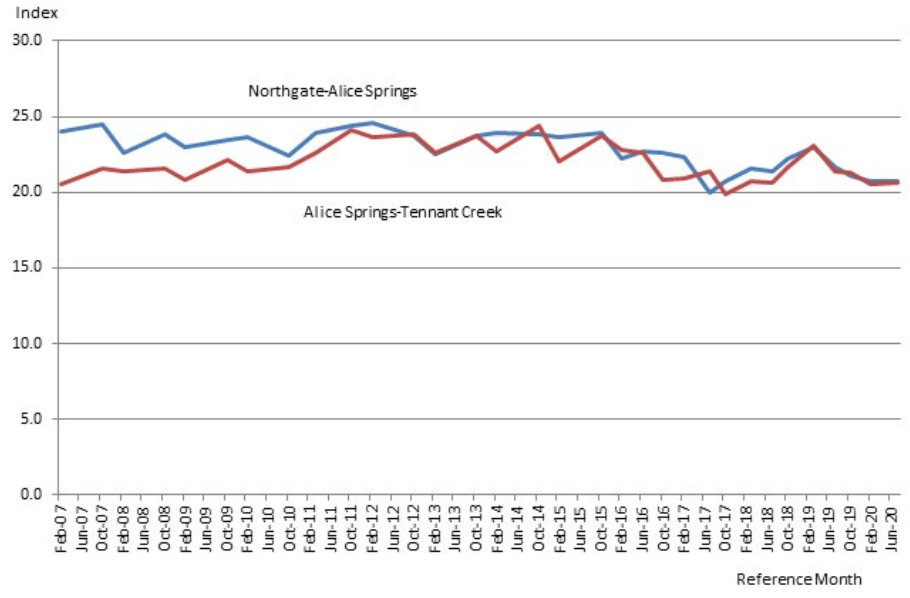
Figure 43 One Rail Australia track quality index, Darwin-Tennant Creek



Note: Lower indices indicate higher track quality.

Source: Data Provided by One Rail Australia.

Figure 44 One Rail Australia Track Quality Index, Tennant Creek-Northgate



Notes: Northgate is the start of the One Rail Australia track. It is located shortly north of Tarcoola, where it separates from the ARTC track.

Lower indices indicate higher track quality.

Source: Data Provided by One Rail Australia.

Intermodal train actual running times

This section compares actual running times of all timetabled Brisbane to Melbourne and Melbourne to Brisbane intermodal designated services against scheduled times, as shown in the ARTC Master Train Plan (timetable). The comparison is for the period 4 January – 31 August 2020.

The start/end point from which travel times were recorded is South Dynon and SCT – Laverton Loop ('Melbourne'), and Acacia Ridge and Bromelton ('Brisbane'). All arrival and departure times are eastern standard time.

The online tracking tool which BITRE used to record actual running times sometimes had no record for a given service or only a partial record. This is why the results, shown in Table 32 and Table 33, below, list more scheduled services than actual recorded services. The fact there is no record for a given service does not in itself mean there was no service. It just means there is no record (available) of the service.

Where there was a partial record of a service, BITRE recorded the information that was available, even though it was unable to record the entire trip details. It is for this reason some of the numbers in the tables below do not balance. The 'number of recorded services' figures are for those services for which there is a complete trip record only.

The analysis recorded and assessed the following:

- the point in time trains commenced their journey;
- the point in time trains completed their journey; and
- total journey times.

BITRE acknowledges there are numerous factors that affect how close to schedule trains run. The analysis is not, and should not, be seen as a performance review of either the infrastructure managers or the train operators. BITRE is also unable to assess the reasons for differences between scheduled and actual running times.

Table 33 and Table 34, below, show the results, noting the number of scheduled services is the sum of those recorded on the corresponding ARTC Mater Train Plans. The number of recorded services are those whose times BITRE was able to record from its online tracking source. A very small number of services travelled via Orange, Dubbo and the Hunter Valley due to track closures. These services were excluded as they are not comparable to the Master Train Plan.

The analysis also excludes services that may have run but did not appear in the Master Train Plan. This is because there were no published scheduled times that would have been needed for comparative purposes.

Table 33 January-August 2020 Southbound

Number of scheduled services	298	Average scheduled transit time	1 day, 08(hours): 59 (minutes):02 (seconds)
Number of recorded services	204	Average actual transit time	1 days 08:54:23
Transit number of services faster than schedule	137		
Transit number of services of services 30 minutes or less slower than schedule	17		
Transit number of services more than 30 minutes slower than schedule	50		
Average early departure from Brisbane	00:24:11	Number of services departing earlier than schedule	163
Average late departure from Brisbane	01:37:28	Number of services departing 30 minutes or less later schedule	15
		Number of services departing more than 30 minutes later than schedule	27
Average early arrival at Melbourne	02:07:48	Number of services arriving earlier than schedule	150
Average late arrival at Melbourne	03:31:46	Number of services arriving 30 minutes or less later than schedule	14
		Number of services arriving more than 30 minutes later than schedule	42

Table 34 January-August 2020 Northbound

Number of scheduled services	342	Average scheduled transit time	1 day, 06:48:16
Number of recorded services	266	Average actual transit time	1 day, 08:47:08
Transit number of services faster than schedule	92		
Transit number of services 30 minutes or less slower than schedule	30		
Transit number of services of services more than 30 minutes slower than schedule	142		
Average early departure Melbourne	00:25:30	Number of services departing earlier than schedule	112
Average late departure Melbourne	00:56:54	Number of services departing 30 minutes or less later schedule	81
		Number of services departing more than 30 minutes later than schedule	96
Average early arrival at Brisbane	00:28:41	Number of services arriving earlier than schedule	112
Average late arrival at Brisbane	03:39:44	Number of services arriving 30 minutes or less later than schedule	31
		Number of services arriving more than 30 minutes later than schedule	170

Table 33 and Table 34, above, show the eight month results for all recorded Melbourne—Brisbane southbound and northbound services. The tables show the following key findings.

Soutbound services:

- Average actual transit times were slightly less than scheduled transit times;
- Most recorded services completed their trip faster than schedule; and
- Most recorded services departed Brisbane early and most arrived in Melbourne early.

Northbound services:

- Average actual transit times were two hours slower than schedule;
- Most recorded services departed Melbourne either early or less than 30 minutes behind schedule; and
- Most recorded services arrived in Brisbane more than 30 minutes behind schedule.

BITRE is able to provide more detailed analysis of the results, such as by month or day of the week, upon request. It cannot provide analysis by train operator, for confidentiality reasons.

Figure 45 and Figure 46, below, show the running times in graph format of one sample Brisbane to Melbourne and one Melbourne to Brisbane service. The Brisbane to Melbourne service ran in May 2020, while the Melbourne to Brisbane service ran in August 2020. Both services ran close to schedule.

Figure 45 Sample running time of a Brisbane to Melbourne intermodal train

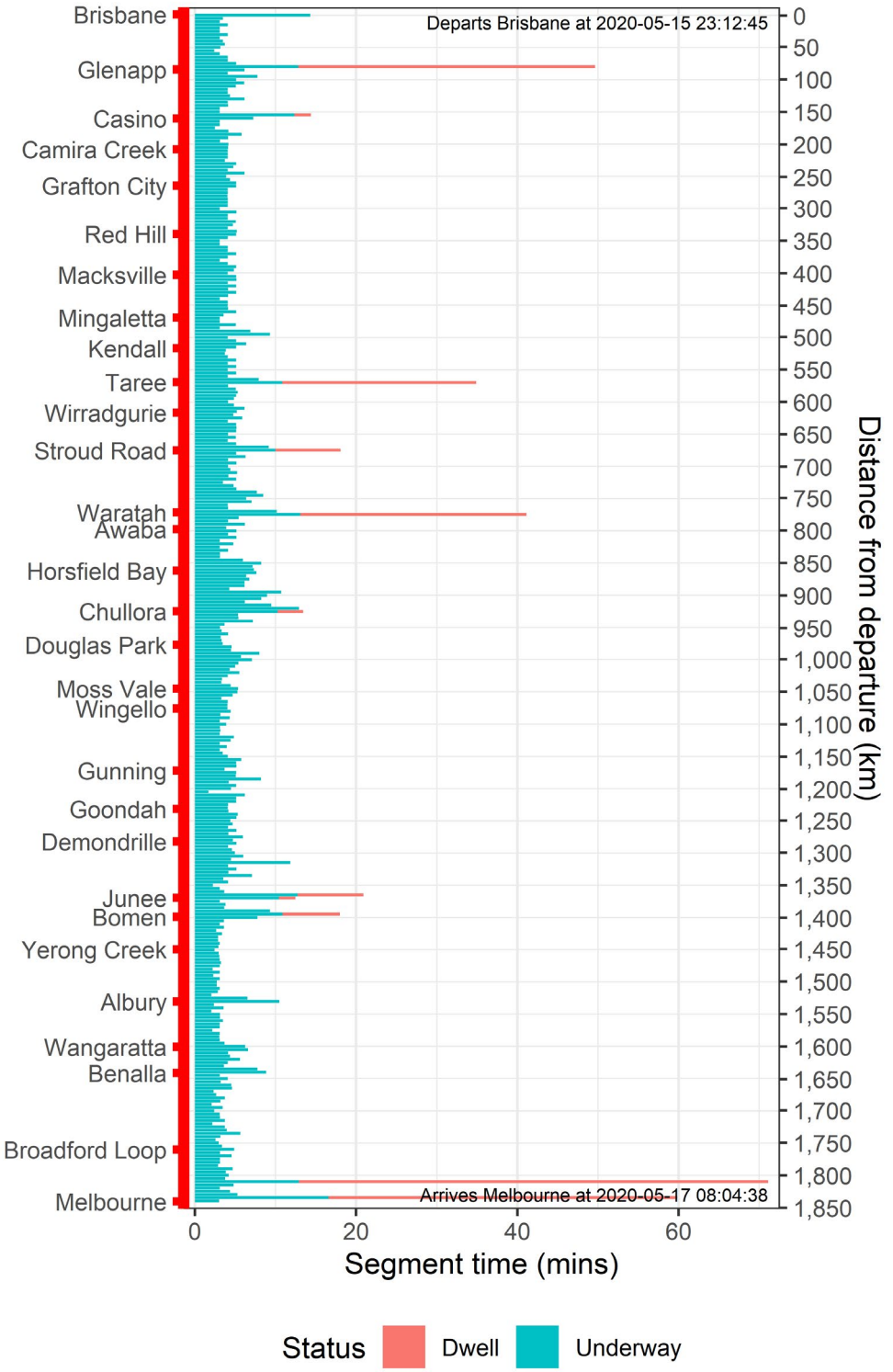
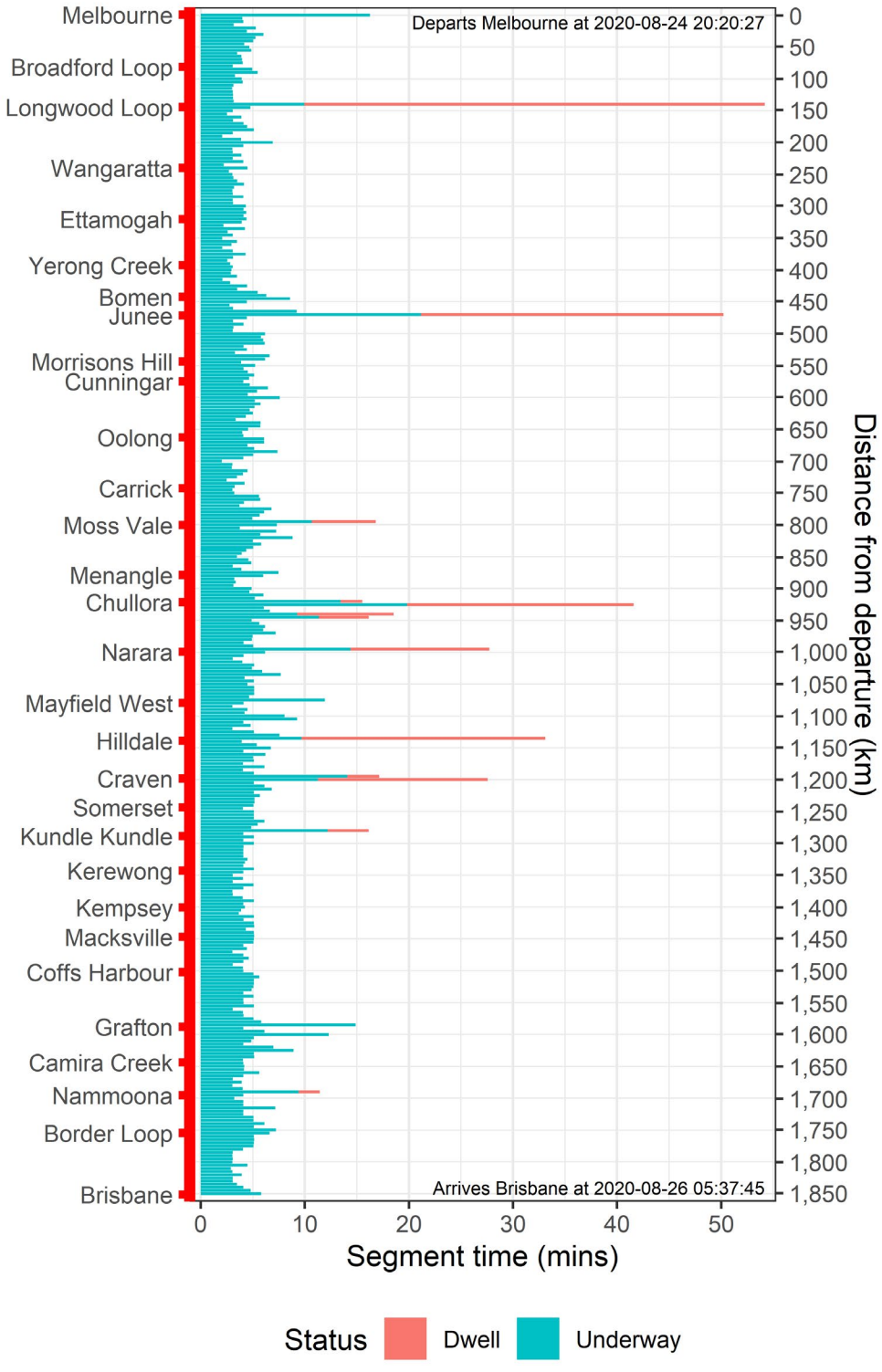


Figure 46 Sample running time of a Melbourne to Brisbane intermodal train



Passenger train indicators

(a) Punctuality

Punctuality is important to rail's competitiveness. The International Transport Forum (2010, p. 5) notes poor punctuality not only worsens the transport "experience" but can affect the commercial (work) and personal activities of those that depend on reliable transport services.

Urban rail punctuality

Customers rely on timetables for infrequent services in particular. Punctuality is therefore part of a journey's perceived time. Punctuality is less significant for frequent "turn up and go" services[31]. Real-time information at railway stations, light rail stops, online and through smart phone applications are playing a growing trip-planning role.

Measures of punctuality are largely determined by the definitions of "on time", which varies between operators. Table 35 and Table 36, below, show operators' targets and results in 2018-19.

Table 35 Urban heavy rail punctuality, on time performance, 2018-19

	Sydney[a]	Melbourne	Brisbane	Adelaide[d]	Perth
Result (%)	91.3	91.1	96.1	96.7	96.3
Target (%)	92	92.5	95	94	95
Measure	Arriving within 5 minutes of schedule at the final destination	Arriving at destination no later than 4 minutes 59 seconds late.	Arriving within 3 minutes 59 seconds of schedule for suburban trains and within 5 minutes 59 seconds of schedule for inter-urban services	No more than 4 minutes 59 seconds after the timetabled arrival time at the destination	Arriving within 4 minutes of schedule

Notes: [a] Sydney heavy rail is "urban lines". It does not include inter-city services that also use the Sydney urban network. Skipped stops are not counted as being punctual.

Sources: Public Transport Victoria (2019, pp. 26); Public Transport Authority of Western Australia (2019), pp. 20-21; Queensland Rail (2019), p.10; Sydney Trains (2019), p.28; advice from Department of Planning, Transport, and Infrastructure.

31 The light rail operators in Sydney and the Gold Coast, for example, do not publish timetables.

Table 36 Light rail punctuality, on time performance, 2018-19

	Sydney	Melbourne	Gold Coast	Adelaide	Canberra	Newcastle
Result (%)	96	83.1	100	94.9		
Target (%)	90	82.9	"at the station for you when it's scheduled to be there"	98	n/a	n/a
Measure		Arrives no later than four minutes and 59 seconds after and departs no earlier than 59 seconds before the timetable.	-	No more than 4 minutes 59 seconds after the timetabled arrival time at the destination	n/a	n/a

Sources: Public Transport Victoria (2019, pp. 26); Public Transport Authority of Western Australia (2019), pp. 20-21; Queensland Rail (2019), p.10; Sydney Trains (2019), p.28; advice from Department of Planning, Transport, and Infrastructure.

Non-urban rail punctuality

Punctuality targets for non-urban rail services are generally higher for markets which are likely to have a higher value-of-time. For example, trains which service intercity commuter corridors, such as NSW TrainLink's peak intercity services and V/Line's commuter services have targets of at least 92 per cent. In contrast, QR Travel, which operates numerous long-distance services, have a punctuality target of only 75 per cent.

Punctuality for all of Transwa's services either increased or were the same as the previous financial year. According to the Public Transport Authority of Western Australia's annual report, the Prospector and MerridinLink services' failure to achieve target results was due to infrastructure works along the line and lost time crossing other trains on the line (Public Transport Authority of Western Australia 2019, p. 25).

According to the NSW Trains annual report, delays on the Central Coast and Blue Mountains lines affected its results. This was due to infrastructure and rolling stock issues. Network congestions and security related incidents also caused delays. Factors affecting regional service punctuality included temporary speed restrictions, extreme weather speed restrictions, and copper wire theft in Victoria that affected Sydney-Melbourne services (NSW Trains, 2019, pp.24-25).

Table 37 Non-urban rail punctuality, on time performance, 2018-19

	Service type	Result (%)	Target (%)	Measurement
Queensland Rail	QR Traveltrain	82	75	Arriving within 15 minutes, excluding the Kuranda Scenic Railway and Gulflander services
NSW TrainLink	Intercity (peak services)	88.9	>92	Arriving within six minutes
	Regional & interstate	79	>78	Arriving within 10 minutes
V/Line	Commuter	87.2	92	Arriving on time to five minutes
	Long distance	84.3	81.9	Arriving on time to 10 minutes
Transwa	*Australind*	91	90	Arriving within 10 minutes
	Prospector	57	80	Arriving within 15 minutes
	MerridinLink	85	90	Arriving within 10 minutes
	AvonLink	98	90	Arriving within 10 minutes

Sources: V/Line (2019), p.15; NSW Trains (2019), pp.23-25; Queensland Rail (2019), p.34; Public Transport Authority of Western Australia 2019, pp. 25-26; Advice from Queensland Rail

(b) Service attributes

Train speeds and station spacing – urban heavy rail

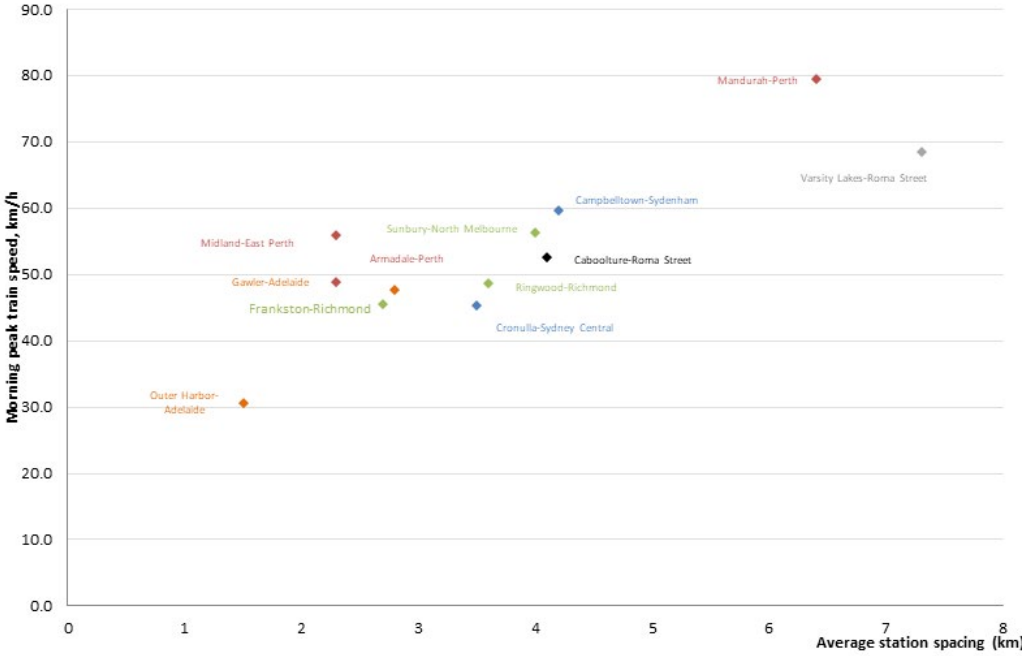
Figure 47 shows relationship between station spacing and corresponding average train speeds for selected Australian urban passenger rail lines. Australia's older passenger lines have relatively short station spacing (for all stops services). Mees and Dodson (2011) observed that Australian lines were often built as a way of supporting urban expansion with consequent short distances between stations[32]. A consequence of this, however, is the regular stops cause slower speeds.

In contrast, newer lines, such as Mandurah—Perth and, to a lesser extent, Clarkson—Butler have wider station spacing, which allows higher average speeds. In addition to speed, wider station spacing allows for simpler train schedules because there is little need for express services. Express services help overcome short station spacing. Wide station spacing, however, reduces the capacity for patrons to access railway stations by walking. Integration of the railway with other modes of transport, such as the provision of feeder bus or tram services and park and ride facilities therefore becomes crucial.

The number of stops between origin and destination for limited stops services varies by time of day and service. For example, the Varsity Lakes line has closer actual station spacing than the Mandurah line, but its limited stops services have greater average station spacing because the services do not stop at every station.

32 Mees and Dodson cite Davison as observing the role of urban railways in urban development (Mees & Dodson 2011, p. 5).

Figure 47 Station spacing and illustrative train speeds 2020



Source: BITRE analysis.

Speeds and station spacing – light rail

Average scheduled light rail speeds also generally correlate to stop spacing. Caution is needed when comparing Melbourne with other networks due to the wide variation in speeds that exist in that city. Currie and Burke (2013) analysed designated stop spacing and average speeds by line on Melbourne's network. Designated stop spacing varies from 100 metres on the East Brunswick—St Kilda Beach line to 317 metres on the Bundoora RMIT—Water Front City Docklands line. Across the entire Melbourne network, average stop spacing is 254 metres.

Table 38 Light rail station spacing and scheduled speeds 2020

	Gold Coast	Sydney (Route L2)	Melbourne (Route 19)	Adelaide[a]	Canberra	Newcastle
Average station spacing (metres)	812	660	254	545	923	450
Average point to point scheduled speed (km/h)	23	15	15	18	30	13.5

a. Calculations are based on travel from Glenelg to Adelaide Railway Station.

Source: Currie and Burke 2013; BITRE analysis.

Light rail average speeds depend largely on a light railway's function and its operating environment. A line designed to operate in a dense pedestrianised zone has lower speeds than vehicles operating in a segregated corridor. Sometimes a single line will have a mixed infrastructure type.

Sydney's light rail, which now includes the L2 and L3 lines operates mostly on segregated lines. Canberra's light rail network is entirely segregated, except for intersectioins, where variable frequency traffic signals prioritise light rail traffic at most intersections. Station spacing is the widest in Australia. This, combined with its traffic segregation and priority traffic signalling, enables Canberra's light rail vehicles to achieve the highest average scheduled speeds in Australia. Newcastle's light rail, which runs on battery power with charging at each stop, has approximately half the average distance between stops and less than half the average speed. Like Canberra, Newcastle's light rail network is segregated except at street crossings.

Frequency

Figure 48 to Figure 53, below, show, urban heavy rail service frequency by the time between arrivals at the relevant city central station, for services originating at different points across the networks. All cities provide express and all stops services, to varying degrees.

Frequency is important to service quality and, therefore, mode choice. Frequency also influences overall travel times. It determines how long passengers wait for a train and how closely the train departure (or arrival) time is to a passenger's preferred time. Passengers' perceptions of service frequency are therefore closely related to their perception of total journey times (including waiting time, in-vehicle journey time and transfer time).

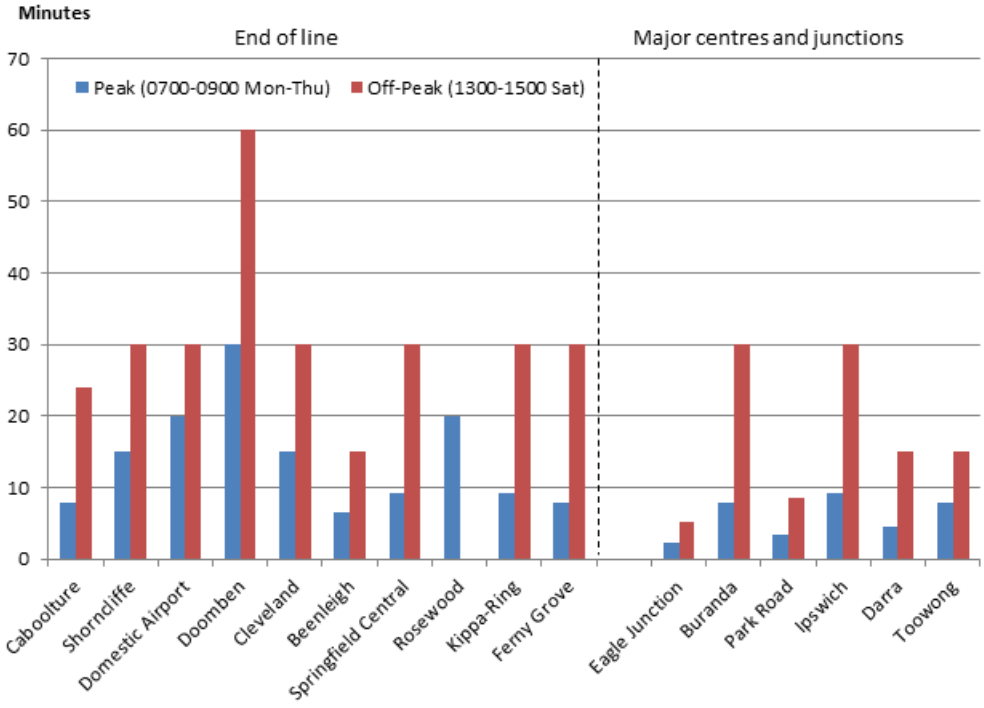
Frequency is also important in integrating rail services both with other rail lines and other transport modes. Services may have coordinated arrival and departure times for passenger interchanges between services. However, the scale of large urban networks can make coordination unfeasible. In these cases, frequency is crucial in reducing passengers' interchange waiting times. Major centres and junction stations generally have high frequencies due to service densification. As Figure 48 to Figure 53, below, show, all Australian capital cities with urban heavy rail services mostly have greater service frequency during peak periods.

Service frequency across the cities in 2020 was largely the same as the previous year. There have been some minor increases and decreases across the times of day periods measured, although this should not be interpreted to mean there are fewer services overall. A train that arrives at its destination at 09:01 hours on a weekday, for example, would be excluded as it is outside the peak period scope.

Brisbane heavy rail

Figure 48 shows average times between trains for arrivals at Roma Street Station in peak and off-peak times, from stations that are at the end of lines or at major centres and junctions. The peak period service frequency is for Monday-Thursday, as trains run to a separate timetable on Fridays. On 2 March 2020, Queensland Rail implemented a new timetable which provided for additional services. In the weekday morning peak measured (trains arriving at Roma Street Station between 0700-0900), service frequency rose mostly by 1-2 services or remained static. Eagle Junction Station had the greatest increase at six additional weekday peak services and five Saturday non peak (measured as trains arriving at Roma Street Station between 1300-1500) services.

Figure 48 Average time between trains for services arriving at Brisbane Central, 2020



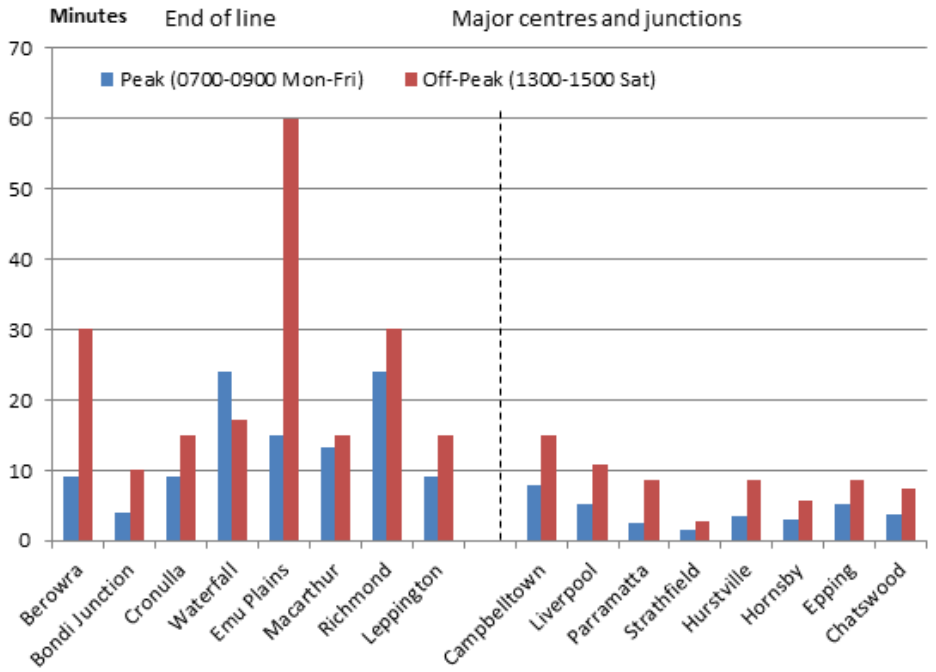
Source: Translink (2020a).

Sydney heavy rail

Sydney Trains frequency depends on the time of day, service demand and network capacity. The Bondi Junction and Metro lines have the most end of line AM peak services, with an average arrival at Sydney Central and Chatswood every four minutes, while the Richmond and Waterfall lines have an average arrival every 24 minutes. Trains arriving from major centres and junctions in the AM peak have average arrivals of between one (Strathfield) to eight (Campbelltown) minutes.

Off-peak service frequencies similarly vary significantly across the network from both points of origin and major centres and junctions. There is on average a train arriving at Central Station every three minutes from Strathfield and one an hour from Emu Plains.

Figure 49 Average time between trains for services arriving at Sydney Central, 2020



Source: Transport for NSW (2020b)

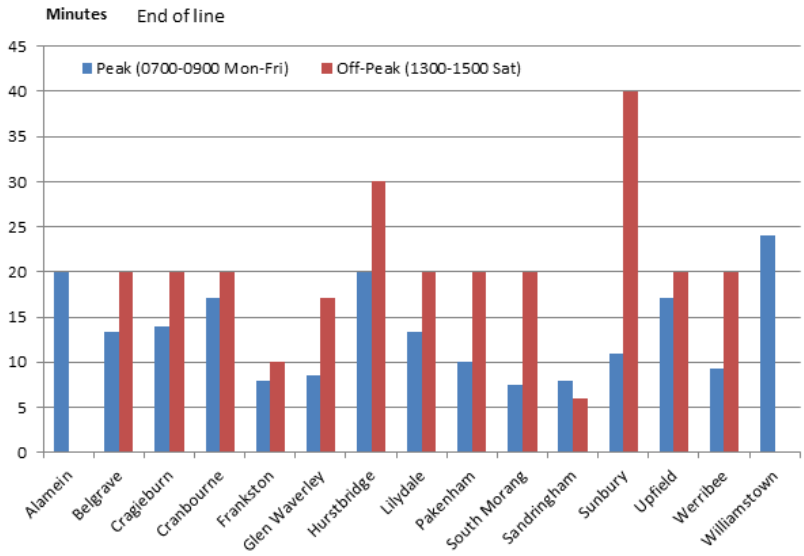
Figure 46 includes a number of stations listed in The New South Wales Government's Long Term Transport Master Plan as being "Regional Cities" (Parramatta and Liverpool) and "Major Centres" (Hornsby, Chatswood, Bondi Junction, Hurstville, Campbelltown, Macarthur)[33] These locations are significant transport interchanges and destinations. Frequencies through these locations provide an important indicator of the value of the network in providing transport services other than radial-based commuting.

Melbourne heavy rail

Melbourne peak hour frequencies similarly vary considerably across services (see Figure 50 and Figure 51), with smaller branch lines running fewer trains. For end of line services, Alamein and Williamstown have the fewest through running peak time services, at intervals of 20 and 24 minutes respectively. Average off peak services vary from six minutes on the Sandringham line to 40 minutes on the Sunbury line. The Alamein and Williamstown lines have no direct services to Flinders Street station in the off-peak period. Rather, shuttle trains run to Camberwell and Newport, where passengers change trains for ongoing travel.

33 The full list of "Regional Cities" is: Paramatta, Liverpool, Penrith. Major centres are: Hornsby, Dee Why, Brookvale, Chatswood, Bondi Junction, Burwood, Bankstown, Kogarah, Hurstville, Campbelltown, Macarthur, Blacktown, Castle Hill. See New South Wales Government (2012, p.46).

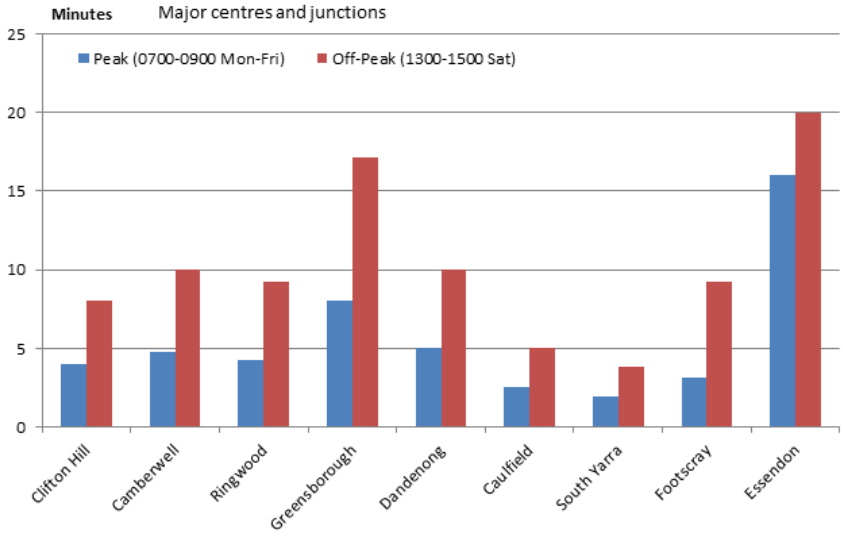
Figure 50 Average time between trains for services arriving at Flinders Street from end of line, 2020



Source: Public Transport Victoria (2020).

South Yarra is the busiest junction station, with an average departure every two minutes in peak hours and four minutes during off-peak hours. This is because trains from the Cranbourne, Pakenham, Frankston and Sandringham lines pass through the station. During off peak periods, service frequency at most of the major centres and junctions as shown in the graph is approximately half that of peak-hour services

Figure 51 Average time between trains arriving at Flinders Street Station from major centres and junctions, 2020

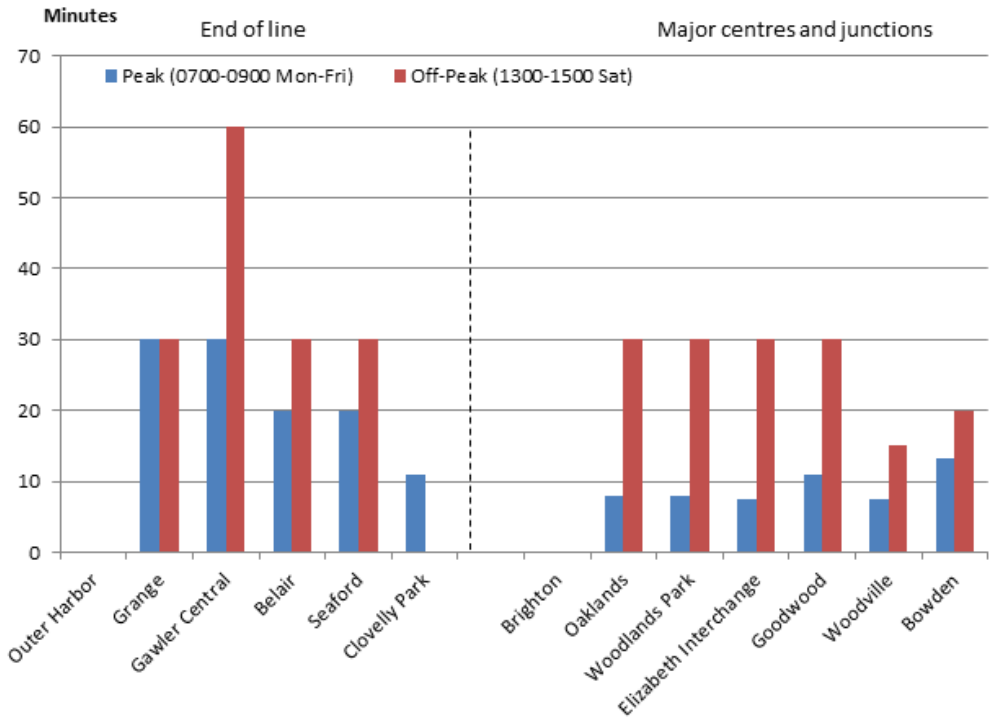


Source: Public Transport Victoria (2020).

Adelaide heavy rail

Adelaide heavy rail service patterns are strongly geared to peak-period commuting to Adelaide Railway Station (See Figure 52). Adelaide's lower service levels reflect its modest patronage compared to the other networks. Services on the Tonsley line are currently truncated to Clovelly Park. This is due to the Flinders Link Project, which involves extension of the Tonsley line to Flinders Medical Centre and building a new Tonsley station[34].

Figure 52 Average time between trains for services arriving at Adelaide Railway Station, 2020



Note: There are no weekend Tonsley line services.

Source: Adelaide Metro (2020).

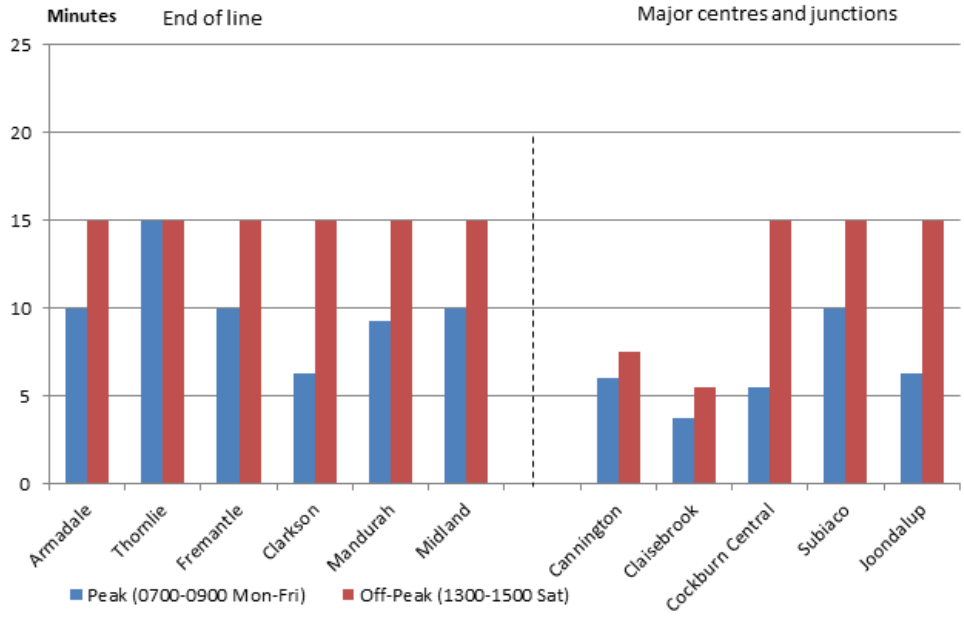
34 For more information on the project see https://www.dpti.sa.gov.au/infrastructure/major_projects/flinders_link

Perth heavy rail

There have been no changes to Transperth's service frequencies since publication of Trainline 7. Transperth's trains mostly stop at all stations. Its focus on maintaining low dwell times and long distances between stations on its Mandurah and Joondalup lines enables relatively high average line speeds. Consequently, there are no express services on these two lines, unlike the city's 'heritage' lines that have closer station spacing.

Having only two junctions outside the city centre reduces the service densification seen in other cities where lines merge, such as South Yarra in Melbourne.

Figure 53 Average time between trains for services arriving at Perth Central, 2020



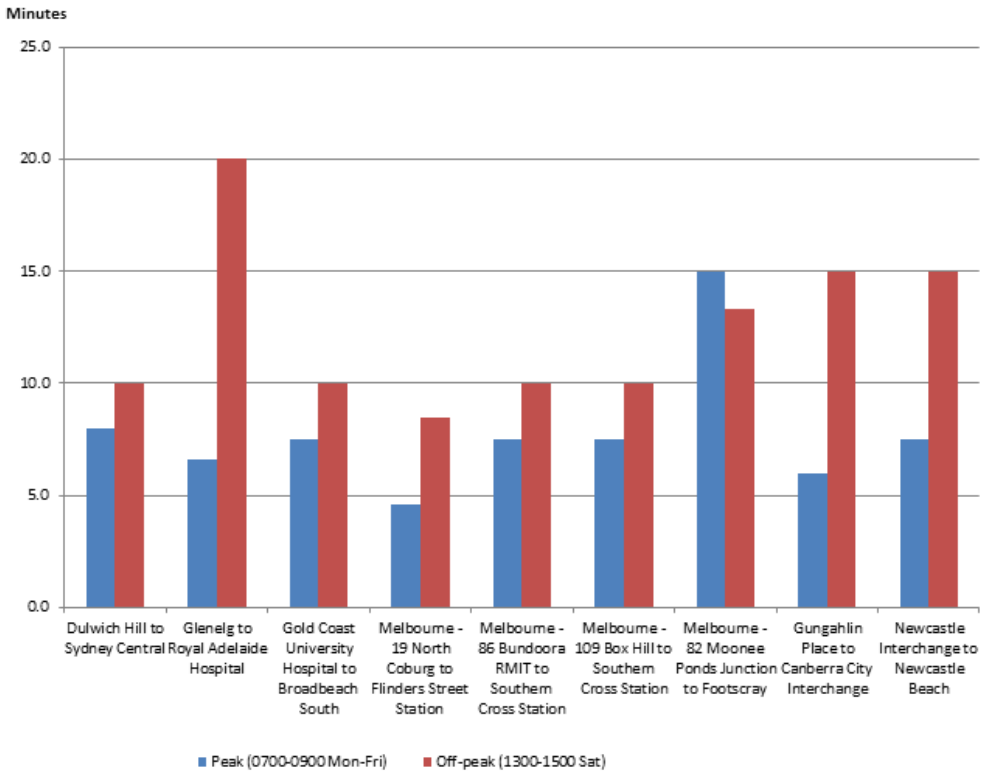
Source: Transperth (2020).

Light rail

Light rail frequencies in Australia vary (see Figure 54). Many Melbourne routes share tracks, meaning a passenger may have more than one tram route option, thus increasing frequency on shared tracks.

The selected routes for Melbourne indicate service frequency across the network's 23 routes. Routes 19 (Flinders Street Station to North Coburg) and 82 (Moonee Ponds Junction to Footscray) have the shortest and longest peak hour intervals on the network, respectively.

Figure 54 Average time between trams, by route and direction, 2020



Notes: Gold Coast operations do not run to timetables. Melbourne tram services have a separate timetable for Fridays. As such, calculated peak hour frequency as shown above is based on the published Monday-Thursday timetables. Peak hour calculations are based on peak hour directions of travel.

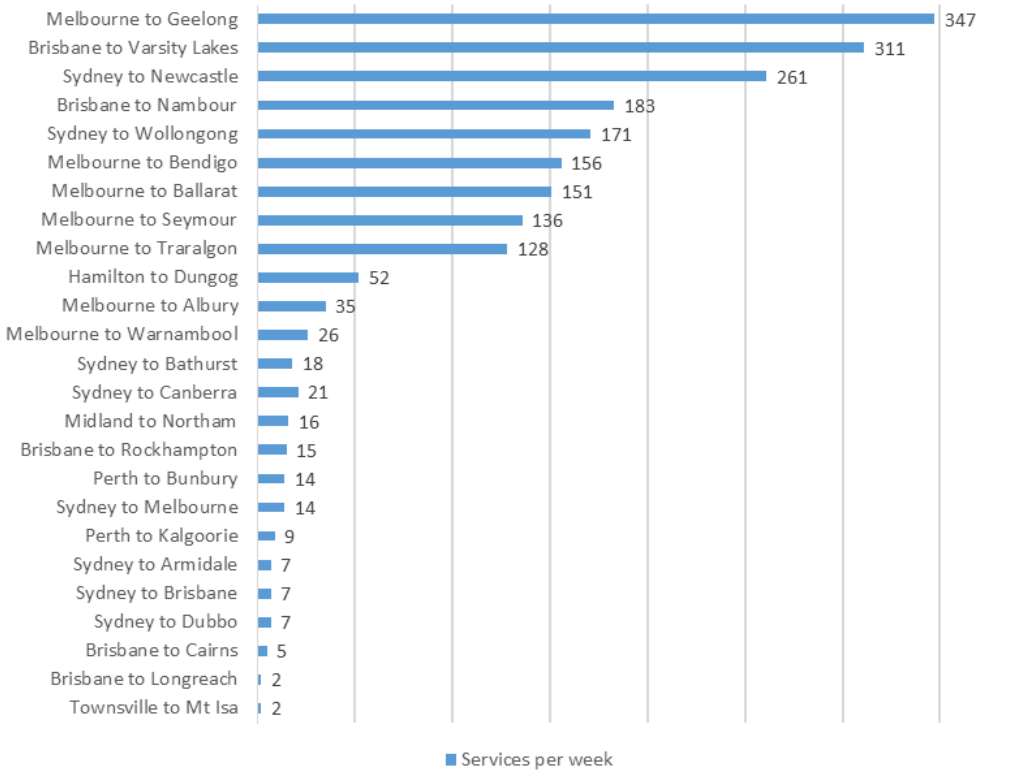
Sources: Transport for NSW (2020d); G:link (2020); Public Transport Victoria (2020); Adelaide Metro (2019a).

Non-urban rail

Frequency is important for non-urban services because it determines how closely a train departure and arrival is to a passenger's preferred time. Service frequencies can also determine the amount of time a passenger waits for a train and is therefore closely aligned with perceptions of total travel time and its generalised cost.

Figure 55, shows the number of weekly services on selected intercity/commuter and regional/interstate passenger rail services. Intercity/commuter services have the highest frequency.

Figure 55 Non-urban passenger rail services per week, 2020



Notes: Based on calculation of outbound 'down' services. Does not include return services.

The Sydney-Wollongong figures exclude truncated services that depart from Waterfall.

The Sydney-Newcastle figures include long distance services that stop at nearby Broadmeadow.

Services include trains that arrive at but do not terminate at destination, for example, Brisbane to Cairns services that stop at Rockhampton.

Sources: Queensland Rail Travel (2020); Transport for NSW (2020b); Translink (2020a) Transwa (2020); V/Line (2020).

Transit times — non-urban

Transit times are important for commuter travel as one factor in determining rail's competitiveness against other transport modes. Commuter travellers may consider comparative door-to-door transit times rather than the top speed of a service when making transport mode choices. For non-urban services, the value of transit time varies according to the market. Time-rich tourist travellers are likely to value comfort ahead of time. The *Indian Pacific, Ghan*, and *Kuranda Scenic Railway* are cases in point. Conversely, the opposite would likely apply to commuters who are time poor. Rail travel also provides a community service to those who do not have access to other transport modes.

Table 39 Key characteristics of selected non-urban passenger services, 2020

	Operator	Gauge	Distance (km)	Electrified	Scheduled transit time	Average speed (km/h)	Stopping stations (no.)
Regional/intercity 3 hour 59 minutes or less							
Brisbane to Nambour	QR (TransLink)	Narrow	105	Yes	1h 52m	56	20
Brisbane to Varsity Lakes	QR (TransLink)	Narrow	89	Yes	1h 20m	67	11
Newcastle Interchange to Dungog	NSW TrainLink	Standard	79	No	1h 20m	58	15
Sydney to Newcastle Interchange	NSW TrainLink	Standard	165	Yes	2h 39m	62	14
Sydney to Wollongong	NSW TrainLink	Standard	82	Yes	1h 27m	56	7
Sydney to Bathurst	NSW Trainlink	Standard	238	No	3h 46m	63	9
Melbourne to Ballarat	V/Line	Broad	118	No	1h 7m	104	3
Melbourne to Bendigo	V/Line	Broad	162	No	1h 33m	104	3
Melbourne to Warrnambool	V/Line	Broad	276	No	3h 45m	74	13
Melbourne to Geelong	V/Line	Broad	81.5	No	50m	97	3
Melbourne to Seymour	V/Line	Broad	99	No	1h 40m	59	9
Melbourne to Traralgon	V/Line	Broad	158	No	2h 19m	68	12
Midland to Northam	Transwa	Standard	102	No	1h 20m	80	1
Perth to Bunbury	Transwa	Narrow	183	No	2h 30m	72	11
Long-distance 4 hours or more							
Townsville to Mount Isa	QR Travel	Narrow	977	No	20h 55m	47	8
Brisbane to Charleville	QR Travel	Narrow	777	No	16h 30m	47	16
Brisbane to Cairns	QR Travel	Narrow	1681	No	24h 20 m	69	26
Brisbane to Rockhampton (electric Tilt Train)	QR Travel	Narrow	639	Yes	7h 45m	82	11
Sydney to Canberra	NSW TrainLink	Standard	330	No	4h 8m	79	9
Sydney to Dubbo	NSW TrainLink	Standard	462	No	6h 26m	72	14
Sydney to Armidale	NSW TrainLink	Standard	579	No	8h 5m	72	19
Sydney to Casino	NSW TrainLink	Standard	805	No	11h 38m	69	21
Sydney to Albury	NSW TrainLink	Standard	646	No	7h 30m	86	12
Perth to Kalgoorlie	Transwa	Standard	653	No	6h 50m	96	17
Adelaide to Darwin	GSR	Standard	2 971	No	53h 15m	56	3

Note: The speed shown is the average over the length of the service, including stops.

Sources: Queensland Rail Travel (2020); Transport for NSW (2020b); Translink (2019a); Transwa (2020); V/Line (2020) Great Southern Rail (2020).

Average train speeds are a function of:

- Track quality, including condition, curves, level crossings and capacity;
- Rolling stock standards and quality, influenced by its power, propulsion, in-cab signalling and the existence of a tilting mechanism;
- Railway procedures, including crew changes, loading and unloading passengers/luggage and right-of-way priority relative to other trains;
- Station spacing and scheduled stopping patterns; and
- For tourist-focused trains such as *The Ghan*, scheduled extended stops en route for passengers to do off train tours.

Comparative times to 2019 show little variance in scheduled transit times. In September 2020, there were no Melbourne—Albury or Sydney—Brisbane services due to Coronavirus and related state border closures. The Sydney—Melbourne XPT services were truncated to Albury while V/Line cancelled all of its Melbourne—Albury train services. The Sydney—Brisbane XPT service was truncated to Casino.

The Brisbane—Nambour, Sydney—Hamilton, and Sydney—Wollongong services continue to have similar, relatively low average train speeds. The services stop at a large number of stations relative to distance travelled. This is because they function as limited-stop and all stops commuter trains in the peri-urban coastal regions and urban areas of Brisbane and Sydney respectively. In addition, the Sydney—Hamilton and Sydney—Wollongong rail corridors are slow and circuitous due to the 'steam era' alignments through the mountainous terrain in which they operate.

There is a wide dispersion of transit times across V/Line services, due to different stopping patterns that cater for different markets and differing track conditions. V/Line's Melbourne—Geelong, Melbourne—Ballarat, and Melbourne—Bendigo commuter services are relatively fast (peak hour direction of travel) due to the VLocity DMU sets used and Regional Rail Link and Regional Fast Rail upgrades. Some peak-hour express services have additionally high average speeds and low travel times because of fewer stops en route. The Melbourne—Ballarat service cited above, for instance, is based on an express peak hour service with only three stops.

While infrastructure upgrades have enhanced services between Melbourne and Geelong, Ballarat, and Bendigo, Melbourne—Traralgon services lack a dedicated corridor through the more expansive south-eastern suburbs of Melbourne, which affects travel times. The Seymour corridor was not included in the Regional Rail Link and Regional Fast Rail upgrades, thus it does not have the high speed running of the other medium-distance services.

Elsewhere in Australia, the following services listed above have average point-to-point speeds of 80 kilometres per hour or greater:

- Midland to Northam, 80 kilometres per hour;
- Brisbane to Rockhampton (electric tilt-train), 82 kilometres per hour;
- Sydney to Albury, 88 kilometres per hour; and
- Perth to Kalgoorlie, 96 kilometres per hour.

Long-distance passenger trains in Australia have uncompetitive transit times compared to air and some road coach travel[35].

35 Long-distance trains provide services for centres along their route, thus acting as medium-distance services also.

Figure 56 Trainlink XPT

Note: The image above shows a Melbourne to Sydney daylight XPT service at Binalong in NSW.

APPENDIX A

Case Study[36] - Fletcher International Export Pty Ltd

Operating its own trains out of Dubbo in central NSW is Fletcher International Exports (Fletcher), an integrated processor and exporter of lamb and sheep meat products, and grain products. Fletcher is a family-owned company whose origins trace back to the 1960s. Unlike other Australian exporters of agricultural products that send their product to port by rail, Fletcher owns and operates its own trains (whose crewing it outsources to Southern Shorthaul Railroad) as part of a wider vertically integrated business model. It has operated its own trains since January 2015. Ninety per cent of the freight that travels on Fletcher trains belongs to the company. Fletcher says the vertical integration of its operations "… ensures we extract the most efficient planning for our trains possible, ensuring trains run full, hitting maximum corridor, rolling stock and port capacities."

It currently operates three return services from Dubbo to Port Botany per week. Each service, at a maximum unrestricted length of 1200 metres, is scheduled to depart Dubbo early evening on Tuesdays, Thursdays, and Saturdays, arriving at Port Botany late morning the following day. Each train returns from Port Botany the same evening, arriving back at Dubbo early the following morning. The trains typically travel from Dubbo south to Orange, then east to Port Botany via the Blue Mountains and through metropolitan Sydney.

Its current fleet consists of three Australian made Fletcher Class C44ACi locomotives, each of which can haul 5000 tonnes of gross weight across the Blue Mountains, and 62 60 foot wagons which total to 186 Twenty Foot Equivalent Unit (TEU) of space. Fletcher's trains are 100 tonne gross weighted and it runs the longest and heaviest container trains into Port Botany. Fletcher supplies its markets by container as it allows customers to take smaller amounts of product which best fits into their business operations.

Fletcher says it has chosen rail transport as it is more cost effective and efficient for them at moving large volumes of freight than road transport. While Fletcher says rail transport is most effective for them it says it has also experienced the following interruptions over the previous 12 months:

- Bushfires, that closed the line between Lithgow and Sydney for three months;
- Post bushfires, two major rain events that washed the track away, caused a derailment, and led to several weeks of further track closures;
- The tail end of the drought;
- COVID-19 related delays; and
- Ongoing industrial action at Port Botany.

36 This case study is for information purposes only.

Fletcher considers the following would make freight transport by rail in Australia more efficient and competitive:

- Faster transit times;
- Lower port charges;
- More incentives to backload imports on rail to regional areas;
- Quicker government write offs (fast track depreciation schedules) on new rail equipment; and
- Encouraging more innovation and investment into new rollingstock, to replace current old rolling stock operating on the freight networks.

Figure 57 Fletcher Train

Note: The image above shows a Fletcher train being prepared at Dubbo during the afternoon of Saturday, 9 March 2019. The photo was taken by the Yarrandale Road level crossing. Photo courtesy of Rodney Avery.

APPENDIX B

Significant railway events since 2000

Date	Event	Description
November 2000	NSW rail industry restructure	Merger of Rail Services Australia and Rail Access Corporation in NSW into Rail Infrastructure Corporation
18 December 2000	Privatisation of Westrail	Consortium of Wesfarmers and Genesee & Wyoming purchased Westrail for $585 million
May 2001	Opening of intermodal terminal	Bowports, in conjunction with FreightCorp, developed an intermodal terminal at Minto, with port shuttle trains commencing in May 2001
30 January 2002	Sale of National Rail and FreightCorp	Consortium of Patrick Corporation and Toll Holdings purchased National Rail Corporation for and FreightCorp for $1.2 billion, forming Pacific National
17 December 2002	National Express abandons franchises	National Express walked away from its V/Line Passenger and Melbourne passenger contracts
31 January 2003	Waterfall accident	Passenger train derailment at Waterfall, NSW
27 March 2003	Bridge closure	Temporary closure, until 23 April, of Menangle Rail Bridge, on Sydney–Melbourne railway line. Interstate trains had to move along alternative circuitous routes
May 2003	Freight competition between Sydney and Melbourne	Freight Australia commenced a daily freight service between Sydney and Melbourne
1 January 2004	RailCorp	Creation of Rail Corporation New South Wales (RailCorp) as the merged entity of the State Rail Authority of New South Wales and the metropolitan functions of the Rail Infrastructure Corporation
16 January 2004	Darwin line opened	First freight train arrived in Darwin
February 2004	Takeover of ATN-Tasrail	Pacific National purchased ATN-Tasrail
April 2004	QRN commences North–South intermodal service	QR National commences intermodal freight service between Brisbane, Sydney and Melbourne
1 September 2004	Takeover of Freight Australia	Pacific National purchased Freight Australia business and track lease for $285 million
5 September 2004	ARTC lease in NSW	ARTC commences 60 year lease of interstate rail network in NSW and management contract of country rail network
1 July 2005	QRN operating in Hunter Valley	QR National commences operating in Hunter Valley (Mount Arthur–Port Waratah)
September 2005	Tasmanian rail freight	Pacific National announced that it intended to withdraw most of its rail freight services in Tasmania leaving only two bulk haul operations
14 February 2006	Sale of WA and SA rail freight operations and track	In a complex sale worth $970 million, Queensland Rail purchased ARG's WA freight business; Babcock & Brown purchases ARG's WestNet infrastructure; and Genesee & Wyoming takes full control of ARG's SA operations
11 March 2006	Toll takeover of Patrick	ACCC approves Toll takeover of Patrick
March 2006	South Maitland Railway	30 km of the South Maitland Railway reopens to service the Austar Coal Mine in the Hunter Valley
17 August 2006	Linfox buys FCL	Linfox buys FCL, a major rail-based freight forwarding company

(Continued)

Date	Event	Description
September 2006	Victorian regional fast trains commence	The start of the first Regional Fast Train service begins. Faster services are introduced from Geelong, Ararat/ Ballarat, Bendigo and the Latrobe Valley
October 2006	End of Sydney–Perth coastal shipping service	Boomerang coastal shipping service, operating between Sydney and Perth since June, ended after financial failure
20 October 2006	SCT commence Parkes service	SCT Logistics commenced freight service between Parkes and Perth
November 2006	Sandgate Flyover	Opening of main line flyover of coal lines, to enable unimpeded movement of coal trains, between Hunter Valley and Kooragang Island
18 December 2006	Pacific National wins 7-year steel contract	PN wins a contract extension, with Bluescope and OnesSteel for 7 years, to shift steel products around the country.
1 January 2007	Tasmanian government takes back rail infrastructure	Tasmanian government resumes financial responsibility for the State's commercial railways; day-to-day infrastructure management remains with Pacific National
3 January 2007	North–South Corridor upgrading	On this date the new Wagga Wagga bridge was opened The construction is a first major milestone in the $1.8 billion North–South Corridor upgrade
15 February 2007	ACCC approval of SCT acquisition	ACCC approved SCT Logistics' purchase of train assets (including 9 locomotives) from Pacific National, as part of Toll's takeover of Patrick
18 February 2007	CRT ceases Melbourne port shuttle	CRT ceased its Altona North–Port of Melbourne shuttle
15 March 2007	Tasrail funding	Australian Government announced $78 funding of remedial work on AusLink section of Tasmanian railway system with $40 million more from the Tasmanian Government and commitment by Pacific National to spend $38 million on locomotive and wagon upgrades
18 April 2007	ACCC approves Toll restructuring, formation of Asciano	ACCC approves Toll Holdings restructure, with new company Asciano, which will include the Pacific National and Patrick Portlink assets
18 April 2007	Toll restructuring	Toll announces split of Toll Holdings, with Asciano Ltd controlling the Patrick and Pacific National assets
4 May 2007	Re-acquisition of Victorian track lease	Victorian government bought back leased intrastate track from Pacific National giving control of the network to V/ Line Passenger, the State's regional rail operator
October 2007	Lang Hancock Railway opens	58km Lang Hancock Railway opens between Hope Downs and existing Rio Tinto railway
November 2007	Asciano announces end of rail services in southern Australia	Asciano announces end of grain and intrastate intermodal services in Tasmania, Victoria and NSW, to take effect from early 2008
16 November 2007	QRN commences Melbourne–Perth service	QRN commences new thrice-weekly Melbourne–Perth service, incorporating the weekday P&O Melbourne–Adelaide train
23 December 2007	Opening of Mandurah railway in Perth	Opening of 70km Perth–Mandurah passenger railway
18 January 2008	Rail competition begins in Victoria	El Zorro begins broad gauge grain train competition in Victoria, the first in that State
March 2008	Opening of Lang Hancock Railway	Opening of 58km Lang Hancock Railway in the Pilbara, linking Hope Down iron ore deposits with Pilbara Rail network
March 2008	Pacific National begins withdrawal from Victoria	Pacific National begins withdrawal of freight services in Victoria, following earlier (Nov. 2007) announcement of closure of operations. El Zorro announces it will take over Warrnambool–Melbourne container operation.

(Continued)

Date	Event	Description
15 May 2008	Opening of Fortescue railway	Opening of Fortescue Metals Group's 260 km Cloudbreak railway in the Pilbara
13 June 2008	Cessation of Tasmanian train operations	Pacific National announced cessation of its Tasmanian train operations, later indicating it would sell the business
25 July 2008	Extension of double-stacking network	Commencement of standard double-stacking operations between Parkes and Perth following ARTC investment
5 August 2008	Pacific National wins Queensland coal haulage contracts	Asciano announces it has signed 10-year contracts with Rio Tinto and Xstrata for coal haulage in Queensland from early 2010
May–September 2008	Grain contracts awarded	GrainCorp, AWB, ABB sign contracts with train operators for grain haulage
15 September 2008	New Portland freight traffic	Commencement of movement of mineral sands between Portland and Melbourne
24 September 2008	Investment in Tasmanian tracks	Announcement by Tasmanian government of upgrading of its railway tracks
2 October 2008	Additional east–west train service	Pacific National adds a third "Express" freight train to its Melbourne–Perth service
27 October 2008	Pilbara railway access decision	The Treasurer, Mr Swan, announces that Fortescue Metals Group has the right to use Pilbara railways built by BHP and Rio Tinto
November 2008	Closure of grain lines	NSW Government announces closure of 5 grain railways in the west of State
November 2008	Construction of Southern Sydney Freight Line	Construction of the 36 km Southern Sydney Freight Line commenced
6 November 2008	Darwin railway operator in administration	FreightLink placed in administration
26 November 2008	Suspension of railway construction	Suspension of work on Fortescue's Cloudbreak–Christmas Creek railway
1 December 2008	Gauge conversion	End of Albury-Wodonga–Seymour broad gauge services marked the commencement of conversion of railway to standard gauge
12 December 2008	Infrastructure investment announcement	Australian Government announces $1.2 billion funding for ARTC for rail projects on interstate and Hunter Valley networks
23 February 2009	Chatswood–Epping	Opening of Sydney's Chatswood–Epping passenger line
3 March 2009	Extra Parkes–Perth service	SCT Logistics commenced second freight service between Parkes and Perth
23 March 2009		
8 April 2009	Grade separation in Melbourne	Opening of Melbourne's Footscray Road rail underpass, as part of Dynon Port Rail Link; opening of Tottenham–Dynon rail link
5 May 2009	PN coal contract in Queensland	Asciano wins 9-year coal-haulage contract with Macarthur Coal (3.7 million tonnes per annum)
15 May 2009-23 June 2009	Temporary mainline closure in Tasmania	Following a derailment, Tasmanian railway was closed to enable significant track renewal task to be brought forward and expedited
29 May 2009	GrainCorp trains	GrainCorp commences train operations in NSW, taking grain trains from NSW government
2 June 2009	QR above-rail privatisation	Queensland Premier announced plan to part-privatise QR, namely, the freight businesses (but not passenger services); and to explore the sale or lease of the regional intrastate infrastructure to ARTC
23 June 2009	Announcement that Tasmanian railways will be nationalised	Asciano agrees the transfer of Tasmanian train operations to Tasmanian government, effective from 30 November 2009

(Continued)

Date	Event	Description
30 June 2009	New train operator	Freightliner Australia, a subsidiary of a major UK freight operator, commenced operating in Australia
June 2009	GrainCorp trains	GrainCorp takes over 18 48-class locomotives and 180 wagons from NSW government; grain trains to be run by Pacific National
22 July 2009	Asciano contract	Asciano signed 10-year contract with Xstrata Coal for moving coal in Hunter Valley
22 Aug 2009	Mildura railway	Completion of upgrade of Mildura railway
October 2009	ARTC lease	ARTC commenced lease of the Benalla–Oaklands railway, from V/Line
30 Nov 2009	Formation of TasRail	Tasmanian government took control of railways, from Asciano, establishing TasRail on 1 December
Dec 2009	Track upgrade	Completion of concrete sleepering of the Cootamundra–Parkes line
17 Jan 2010	ARTC track	ARTC commenced a 60-year lease of the Brisbane–NSW border standard gauge track
22 Feb 2010	Rio Tinto line opens	Opening of 49-kilometre Rio Tinto railway in Pilbara, between Pannawonica and Mesa A
May 2010	Goonyella-Newlands	Commencement of construction of 69 km Northern Missing Link railway linking the Goonyella and Newlands coal systems in Queensland
May 2010	Asciano wins contract from Toll	Toll and Asciano signed a five-year contract for intermodal and car transport
May 2010	Interstate track re-railing	Commonwealth announced programme to re-rail interstate track, Cootamundra–Parkes, Broken Hill–Whyalla, Albury–Melbourne–Geelong, Kalgoorlie–Koolyanobbing
9 June 2010	Freightlink sold	Genesee & Wyoming Australia buys Freightlink, the Darwin line operator. The transaction is expected to take 3 months for completion
30 June 2010	Camellia closed	Asciano closed its Patrick-subsidiary Camellia intermodal terminal in Sydney, along with its Dubbo and Port Botany services
1 July 2010	QR split	QR split into passenger train and non-coal intrastate infrastructure (Queensland Rail); and freight train and coal infrastructure network (QR National)
October 2010	SBR	Commencement of Specialised Bulk Rail services between siding west of Cairn Hill and Outer Harbour (Adelaide). SBR is a subsidiary of SCT Logistics. The service is for IMX Resources.
22 November 2010	QR National float	QR National was floated, while leaving around 25-40 percent of the shares with the Government
January 2011	Widespread flooding	Severe flooding in eastern Australia, especially in Queensland, where train services and coal exports were severely disrupted
January 2011	New Fortescue line	Fortescue commenced commissioning of new 50 km railway between Cloudbreak and Christmas Creek, WA
February 2011	Cyclone Yasi disruption	Cyclone Yasi crossed the north Queensland coast around Cairns, causing disruption to freight, notably coal exports
Late February 2011	Trans Australia Railway	Flooding cut the Trans Australia Railway for a number of days
26 June 2011	V/Line services to Albury-Wodonga	Resumption of V/Line passenger services to Albury-Wodonga, following conversion of broad gauge track between Albury and Seymour
20 July 2011	Roy Hill Holdings	Roy Hill Holdings received permission to build 342 km Roy Hill–Port Hedland railway

(Continued)

Date	Event	Description
19 December 2011	Northern Missing Link	Opening of 68 km "Northern Missing Link", Newlands – North Goonyella, Queensland
27 December 2011 to 29 February 2012	Darwin Line cut	Line broken near Katherine after floodwaters washed away part of the track/bridge work. Goods between Darwin and Katherine were conveyed by road during this period
15 January 2012	NSW regional rail	John Holland took over management of NSW's Country Regional Network from ARTC, under contract from NSW Government
15 January 2012	Karara railway	QR National commenced contract with Karara Mining to haul iron ore over new railway, to Geraldton
30 Jan–27 Feb 2012	Port Botany works	DP World's Port Botany rail yards were closed to enable expansion of the rail facilities
April 2012	South Morang	Opening of Epping – South Morang railway in Melbourne
7 June 2012	Sale of Independent Railways	QUBE Logistics announced it was purchasing Independent Railways of Australia, including the Macarthur Intermodal Shipping Terminal at Minto, Sydney
5 August 2012	ARTC lease in Sydney	Enfield West – Port Botany section (19 km) of Metropolitan Freight Network leased by NSW to ARTC until 2064
14 September 2012	Trans Australian Railway	Centenary of the commencement of construction of the Trans Australian Railway
14 November 2012	MidWest Rail Upgrade	Formal completion of $550 million upgrade of the Morawa–Mullewa–Geraldton Port railway, including installing dual-gauge sleepers
1 December 2012	Aurizon	QR National changed its name to Aurizon
1 December 2012	Fortescue Hamersley Line	First train on the Fortescue Hamersley Line in the Pilbara, serving the Firetail iron ore deposits at Solomon
December 2012	Geraldton upgrade	Completion of substantial track upgrade and capacity expansion of tracks into Geraldton
21 January 2013	Southern Sydney Freight Line	Formal opening of the Southern Sydney Freight Line
29 January–February 2013	Queensland coal disruptions	Queensland's Blackwater and Moura coal systems disrupted by Cyclone Oswald
21 April 2013	Hope Down 4	Opening of Hope Down 4 railway in the Pilbara
June 2013	El Zorro	South-east Australian train operator, El Zorro, ceased operations
1 July 2013	Sydney Trains/NSW Trains	Establishment of Sydney Trains and NSW Trains, from CityRail and RailCorp
October 2013	Roy Hill Railway	Commencement of construction of Roy Hill Railway
1 December 2013	Springfield Railway	Opening of the Springfield urban railway in Brisbane
2 December 2013	Enfield Staging Facility	First train to use the Enfield Staging Facility in Sydney
23 February 2014	Seaford Railway and Adelaide electrification	Opening of the Seaford urban railway extension from Noarlunga, coinciding with first public operation of electric trains in the city on the Adelaide–Seaford line
2 May 2014	Tonsley Railway electrification	The Tonsley railway electrification was commissioned
27 March 2014	Sydney Inner West Light Rail	Sydney light rail extension from Lilyfield to Dulwich Hill opened.
22 June 2014	Hobart/Brighton Hub	Intermodal freight services shifted from Hobart to Brighton Hub (to the north of the city), leading to closure of the Hobart–Bridgewater Junction line
20 July 2014	Gold Coast Light Rail	Gold Coast Light Rail commences operations

(Continued)

Date	Event	Description
27 July 2014	Regional Rail Link	V/Line regional passenger services commenced using new dedicated tracks between Sunshine and Melbourne Southern Cross railway stations, as part of the Regional Rail Link project
5 August 2014	Port Botany Terminal	Opening of the Hutchison rail terminal at Port Botany
21 September 2014	Butler Railway, Perth	Opening of the 9 km Butler urban railway extension from Clarkson
12 November 2014	North Quay Rail Terminal, Fremantle	Opening of extended North Quay Rail Terminal at Fremantle's Inner Harbour
25 December 2014	Newcastle Station Closure	Heavy rail line from Wickham to Newcastle closed
8 February 2015	South West Rail Link	Opening of Sydney's South West Rail Link, between Glenfield and Leppington
23 February 2015	Canberra freight	Resumption of rail freight services on Canberra railway, with containerised scrap metal being shifted by Espee Railroad Services to Port Botany for export
25 March 2015	Sale of Freightliner	Genesee & Wyoming completed its acquisition of 94 per cent of Freightliner Group
30 March 2015	Great Southern Rail	Allegro Funds acquired Great Southern Rail from Serco
21 June 2015	Regional Rail Link	Opening of the Wyndham Vale – Tarneit section of the Regional Rail Link in Victoria
August 2015	Murray Basin Rail Project	Victorian government commits to implementing the project, following the release of the project's business case. The project involves standardising the rail gauge and increasing axle load capacities in the state's Murray Basin region. Associated critical maintenance works commence in October.
October 2015	Sydney CBD and South East Light Rail	Major construction works commence
December 2015	Wiggins Island Rail Project	Completion of (Stage One) of Wiggins Island Rail Project
10 December 2015	Roy Hill Holdings	First shipment loaded, using ore transported on the newly opened rail link from the mine sites to Port Hedland
June 2016	Northern Sydney Freight Corridor Programme	Epping to Thornleigh Third Track line opened
2 July 2016	New Melbourne port shuttle service	SCT Logistics and DP World commence weekly shuttle services from Altona to West Swanston terminal
12 July 2016	ACT Light Rail	Construction commences on ACT Light Rail. Initial work involves construction of the Mitchell depot and maintenance centre
19 August 2016	Asciano Acquisition	Asciano acquisition complete, with business split into three distinct businesses – Patrick, Pacific National, and Bulk and Automotive Port Services (BAPS)
30 August 2016	Aurizon shuttle trains	Aurizon commences freight shuttle trains between Port of Botany and Enfield Intermodal Terminal
3 October 2016	Petrie – Kippa-Ring line	Petrie – Kippa-Ring line officially opened
14 August 2017	Aurizon announcement	Aurizon announces it will cease all intermodal rail operations from December 2017
29 January 2018	Ararat-Maryborough Line Re-opening	Ararat-Maryborough line re-opens following reconstruction of the previously mothballed line.
27 February 2018	Mildura Line Re-opening	Dunolly-Mildura line re-opens following track upgrades and conversion to standard gauge
10 July 2018	Driverless Trains	First Rio Tinto driverless train revenue service. The train carries iron ore from Tom Price to Cape Lambert.
17 February 2019	Newcastle Light Rail	Newcastle light rail commences operation
20 April 2019	Canberra Light Rail	Canberra light rail commences operation

(Continued)

Date	Event	Description
26 May 2019	Sydney Metro Northwest	Sydney Metro Northwest commences operation
14 Dec 2019	Sydney Light Rail	L2 line commences operations
January 2020	GWA Sale	GWA's assets and operations sold to investors, including Brookfield Infrastructure Partners LP and Singapore sovereign-wealth fund GIC. Company is renamed One Rail Australia.
3 Apr 2020	Sydney Light Rail	L3 line commences operations

APPENDIX C

Significant network route additions from 1980

Opened	Route additions	Jurisdiction	Gauge	Route km	Project/market
1980	Alice Springs–Kulgera Kulgera – SA/NT border SA/NT border – Tarcoola	NT/SA	Standard	256.0 15.7 562.5	Interstate
	Vales Point Balloon Loop – Vales Point Junction	NSW	Standard	2.7	Coal
	Golding – Callemondah Yard	Qld	Narrow	8.5	Coal
	Fork at Gladstone	Qld	Narrow	0.5	Port
	Fisherman Islands – Ampol Refinery Junction	Qld	Narrow	3.0	Port
	Fisherman Islands Balloon Loop	Qld	Narrow	1.7	Port
	Gregory Mine – Burngrove Gregory Mine balloon loop and fork	Qld	Narrow	61.1 7.6	Coal
1981	Tahmoor Colliery Junction – Tahmoor Colliery Balloon Loop	NSW	Standard	1.3	Coal
	Kwinana CBH	WA	Narrow	8.0	Grain/port
	Boonal (Yarrabee)	Qld	Narrow	3.5	Coal
	Inner Harbour Balloon Loop	NSW	Standard	2.0	Port
1982	Container Terminal – Outer Harbor	SA	Broad	1.3	Port
	Dry Creek North Junction – Dry Creek East Junction	SA	Broad	0.5	Port
	Lota–Thornside	Qld	Narrow	1.9	Re-opening/Urban passenger
	Elura Mine – Elura (CSA) Junction	NSW	Standard	33.6	Ore
	Glanville – Grand Junction Road Container Terminal – Glanville Container Terminal – Outer Harbor Dry Creek North – Dry Creek East Junction Cavan – Dry Creek East Junction Dry Creek – Gillman Junction Gillman Junction – Port Adelaide Junction Port Adelaide Flat – Gillman Junction	SA	Standard	2.7 10.9 1.3 0.5 1.1 4.7 2.4 3.1	Interstate standardisation
	Saxonvale Junction – Saxonvale Balloon Loop (Bulga Mine)	NSW	Standard	8.0	Coal
	Ulan Junction – Ulan Balloon Loop Sandy Hollow – Ulan	NSW	Standard	2.0 105.2	Coal
	German Creek – Gregory Mine Junction	Qld	Narrow	36.1	Coal
	Snowtown–Kadina Kadina–Wallaroo	SA	Standard	74.4 9.9	Gauge conversion (dual gauge)
	Crystal Brook East Fork	SA	Standard	1.2	Interstate standardisation
	Crystal Brook – Salisbury–Islington	SA	Standard	189.1	Interstate standardisation

(Continued)

Opened	Route additions	Jurisdiction	Gauge	Route km	Project/market
1983	Hamilton–Worsley Worsley North – Worsley East	WA	Narrow	11.0 1.0	Alumina/rural freight
	Norwich Park – German Creek Fork at German Creek	Qld	Narrow	21.7 1.3	Coal
	Oaky Creek Mine Balloon Loop Fork at Oaky Creek Mine balloon Loop	Qld	Narrow	6.1 0.5	Coal
	Riverside Mine Balloon Loop Riverside – Goonyella	Qld	Narrow	7.4 5.2	Coal
	Teralba Colliery Junction – Teralba Colliery Balloon Loop	NSW	Standard	3	Coal
	Watonga – Blair Athol Mine Blair Athol Balloon loop	Qld	Narrow	108.2 6.9	Coal
	Drayton Junction – Drayton Balloon Loop	NSW	Standard	8.0	Coal
	Curragh–Sagittarius	Qld	Narrow	14.0	Coal
	Moss Vale Triangle Loop	NSW	Standard	0.4	Mainline/rural freight
	Abbot Point – Kaili	Queensland	Narrow	16.0	Coal
	Annandale – Boundary Hill Mine	Queensland	Narrow	5.6	Coal
	Torrens Bridge Junction – Mile End Junction Mile End Junction – Mile End Goods Yard	SA	Standard	0.9 2.3	Interstate standardisation
1984	Collinsville – Newlands Mine	Qld	Narrow	75.6	Coal
	Canning Vale – Cockburn South	WA	Narrow	13.0	Urban freight
	Cockburn North – Cockburn East	WA	Narrow	1.0	Urban freight
	Kooragang Island Balloon Loop	NSW	Standard	5.0	Coal
1981-1985	Flagstaff - Flinders Street (City Loop)	Victoria	Broad	3.0	Urban passenger
1985	Altona – Laverton Junction	Victoria	Broad	4.6	Freight/passenger
	Ulan–Gulgong	NSW	Standard	23.8	Coal
1986	Blair Athol Mine – Claremont	Qld	Narrow	22.0	Grain
	Fork at Rocklands	Qld	Narrow	0.8	Freight/non urban passenger
	Roma Street – South Brisbane	Qld	Standard	1.8	Interstate passenger
	Melbourne Yard – Webb Dock	VIC	Broad	7.8	Port
1987	Wellington Point – Cleveland	Qld	Narrow	4.4	Urban passenger
	East Hills – Glenfield	NSW	Standard	8.3	Urban passenger
1987-1988	Blue Cow – Perisher – Bullocks Flat	NSW	Standard	8.5	Rural passenger
1989	Hellyer Mine – Moory Junction	TAS	Narrow	11.5	Zinc ore
1989	Jimblebar – Jimblebar Junction	WA	Standard	32.0	Iron ore
1990	Glenlee Triangle Fork	NSW	Standard	0.3	Mainline Freight
	Mount McLaren Balloon Loop	Qld	Narrow	1.0	Grain
	Yarrowlea–Ebenezer	Qld	Narrow	8.4	Coal
1991	Camberwell Balloon Loop – Camberwell junction	NSW	Standard	4.0	Coal
	Rosella – Brockman 2	WA	Standard	44.0	Iron ore
	Thornton Junction – Bloomfield Colliery Balloon Loop	NSW	Standard	7.5	Coal

(Continued)

Opened	Route additions	Jurisdiction	Gauge	Route km	Project/market
1992	Gidgy Junction – Yandicoogina	WA	Standard	32.0	Iron ore
	Stanwell Power House Balloon Loop	Qld	Narrow	5.1	Coal
	Eraring Junction – Eraring Balloon Loop	NSW	Standard	1.8	Coal
	Gordonstone Junction – Gordonstone Balloon Loop	Qld	Narrow	12.8	Coal
	Joondalup–Perth	WA	Narrow	26	Urban passenger
1993	Currambine–Joondalup	WA	Narrow	3.0	Urban passenger
	Shay Gap–Yarrie	WA	Standard	32.0	Iron ore
	Riverside–North Goonyella	Qld	Narrow	18.8	Coal
	Point "V" – Bowen Junction	Qld	Narrow	0.9	Line deviations
	Mackay – Point "X"	Qld	Narrow	4.3	Line deviations
	Gunnedah Junction – Gunnedah Balloon Loop	NSW	Standard	2.0	Coal
1994	Marandoo–Rosella	WA	Standard	59.0	Iron ore
	Moura Mine Balloon Loop	Qld	Narrow	5.6	Coal
	Owanyilla Balloon Loop	Qld	Narrow	0.2	Woodchips
1995	Apamurra–Monarto	SA	Standard	34.4	Gauge conversion
	Fork at Blackwater	Qld	Narrow	0.6	Coal
	Tottenham Junction – VIC/SA border (via Cressy) VIC/SA border – Goodwood – Mile End Goods	SA/Vic	Standard/ dual	520 309.0	Interstate standardisation
	Hopetoun–Murtoa	VIC	Standard	111.3	Gauge conversion
	Rainbow–Dimboola	VIC	Standard	64.0	Gauge conversion
	Yaapeet–Rainbow	VIC	Standard	17.0	Gauge conversion
	Maroona–Portland	VIC	Standard	171.0	Gauge conversion
	Dartbrook Junction – Dartbrook Balloon Loop	NSW	Standard	4.0	Coal
	Stratford Balloon Loop – Stratford Junction	NSW	Standard	3.2	Coal
1996	Islington Workshops – Kilburn Junction	SA	Standard	0.3	Interstate standardisation
	Fork at Coppabella	Qld	Narrow	1.4	Coal
	Ewington Branch	WA	Narrow	3.0	Coal
	Burton Mine Balloon Loop	Qld	Narrow	5.0	Coal
	Beenleigh–Helensvale	Qld	Narrow	28.0	Urban passenger
	Maryborough–Ararat	VIC	Standard	81	Gauge conversion
	Dunolly–Maryborough	VIC	Standard	15	Gauge conversion (dual)
	Loxton–Tookayerta Tookayerta–Tailem Bend	SA	Standard	8.1 151.2	Gauge conversion
	Granville Triangle Loop	NSW	Standard	0.9	Urban passenger
	Mount Owen Balloon Loop – Glennies Creek Junction	NSW	Standard	6.5	Coal
	Liddell Junction–Ravensworth Washery Balloon Loop	NSW	Standard	3.0	Coal

(Continued)

Opened	Route additions	Jurisdiction	Gauge	Route km	Project/market
1997	Mackenzie – Ensham Mine Balloon Loop	Qld	Narrow	14.9	Coal
	South Walker Branch	Qld	Narrow	2.3	Coal
	Aldoga – East End	Qld	Narrow	11.9	Limestone
	Fishermans Landing – Mount Miller	Qld	Narrow	8.3	Coal and Limestone
	Fisherman Islands – Dutton Park	Qld	Narrow/ Standard	20.4	Urban freight
	Helensvale–Nerang	Qld	Narrow	7.7	Urban passenger
1998	Arriga Junction – Arriga Junction Fork – Arriga	Qld	Narrow	4.1	Rural freight
	Nerang–Robina	Qld	Narrow	9.5	Urban passenger
	Moranbah North Balloon Loop	Qld	Narrow	7.3	Coal
	Pinnaroo – Tailem Bend	SA	Standard	144.5	Gauge conversion
	Olympic Park Flemington – Goods Junction	NSW	Standard	3.9	Urban passenger
1999	Macarthur Junction – Macarthur Balloon Loop	Qld	Narrow	5.1	Coal
	Yandi–Marandoo	WA	Standard	147.0	Iron ore
	Parkes Y-Link	NSW	Standard	0.4	Rural freight
	Mount Thorley Junction – Wambo Balloon Loop	NSW	Standard	16.0	Coal
2000	Sydney Central – Turrella (Airport line)	NSW	Standard	7.3	Urban passenger
2001	Brisbane Airport – Eagle Junction	Qld	Narrow	8.5	Urban passenger
2002	South Walker Junction – South Walker	Qld	Narrow	8.7	Coal
2003	Bidgerley Junction to Hail Creek	Qld	Narrow	46.7	Coal
2004	Darwin – Alice Springs	NT	Standard	1 418	Interstate
	Mt Miller– Comalco Balloon Loop	Qld	Narrow	2.4	Coal
	Clarkson–Currambine	WA	Narrow	4.0	Urban passenger
2005	Beckenham–Thornlie	WA	Narrow	3.0	Urban passenger
2006	South Maitland Railway	NSW	Standard	30.0	Coal (re-opened line)
	Kinrola–Rolleston	Qld	Narrow	110.0	Coal
2007	Hancock Junction – Hope Downs	WA	Standard	58.0	Iron ore
	Perth–Mandurah	WA	Narrow	70.0	Urban passenger
2008	Port Hedland – Cloudbreak Mine	WA	Standard	260.0	Iron ore
	Port River Rail Bridge	SA	Standard	0.3	Port
2009	Lake Vermont – Dysart	Qld	Narrow	18.0	Coal
	Chatswood–Epping	NSW	Standard	15	Urban passenger
	Robina – Varsity Lakes	Qld	Narrow	4.1	Urban passenger
	Oaklands–Benalla	NSW	Standard	125	Gauge conversion
2010	Cameby Downs Loop	Qld	Narrow	7.0	Coal
	Brooklyn Triangle	VIC	Standard	0.5	Interstate
	Mesa K – Warramboo (Mesa A)	WA	Standard	49.0	Iron ore
	Darra–Richlands	Qld	Narrow	4.5	Urban passenger
2011	Cloudbreak Mine – Christmas Creek	WA	Standard	50.0	Iron ore
	Newlands – North Goonyella	Qld	Narrow	69.0	Coal
	Middlemount Rail Spur	Qld	Narrow	16.5	Coal

(Continued)

Opened	Route additions	Jurisdiction	Gauge	Route km	Project/market
2012	Brockman 2 – Brockman 4	WA	Standard	41.0	Iron ore
	Tilley Siding (Morawa) – Karara	WA	Narrow	79	Iron ore
	Solomon Junction – Solomon	WA	Standard	130.0	Iron ore
	South Morang – Epping	VIC	Broad	3.5	Urban passenger (re-opened line)
2012-13	Sefton – Macarthur (Southern Sydney Freight Line)	NSW	Standard	36	Interstate freight
2013	Hope Downs 4 railway	WA	Standard	53.0	Iron ore
	Richlands–Springfield	Qld	Narrow	9.5	Urban passenger
2014	Noarlunga–Seaford	SA	Broad	5.7	Urban passenger
	Clarkson–Butler	WA	Narrow	8.0	Urban passenger
	Moranbah-Caval Ridge	Qld	Narrow	12	Coal
2015	Glenfield-Leppington	NSW	Standard	12	Urban passenger
	Deer Park-West Werribee (Regional Rail Link)	VIC	Broad	27	Intercity passenger
	Roy Hill	WA	Standard	344	Iron ore
	Aldoga-Wiggins Island	Qld	Narrow	13	Coal
	Maules Creek-Werris Creek	NSW	Standard	20	Coal
2016	Boggabri Coal Mine Expansion	NSW	Standard	17	Coal
	Petrie-Kippa-Ring	Qld	Narrow	13	Urban passenger
2017	Moree-Broadbent Grain facility Byerwen branch line	NSW Qld	Standard Narrow	3.5 5	Grain Coal
2018	Baralaba (Moura System)	Qld	Narrow	6	Coal
2018	Mernda Line Extension	Vic	Broad	8	Urban Passenger
2019 2019	Sydney Metro Northwest Inland Rail North West Connection	NSW NSW	Standard Standard	36 5	Urban Passenger Interstate and Intrastate freight

Note: Does not include light rail/tramways.

APPENDIX D

Train operator traffic Asciano and Aurizon 2007–08 to 2015–16

ASX train operator traffic trends (billion net tonne-kilometres)

		Asciano				Aurizon				
Period		Coal	Other bulk	Intermodal (including steel)	Total	Coal	Iron ore	Bulk	Non-bulk — plus residual bulk from 2011–12	Total
	Sep-07	3.0	0.7	6.7	10.4	-	-	-	-	-
	Dec-07	3.1	0.6	6.7	10.5	-	-	-	-	-
1HY-08		6.2	1.4	13.4	21.0	-	-	-	-	-
	Mar-08	3.1	0.7	6.0	9.8	-	-	-	-	-
	Jun-08	3.4	0.7	6.5	10.6	-	-	-	-	-
2HY-08		6.5	1.4	12.5	20.4	-	-	-	-	-
Full year 2007–08		12.7	2.8	25.9	41.4	42.8	-	13.6	4.8	61.2
	Sep-08	3.4	0.8	6.7	10.8	-	-	-	-	-
	Dec-08	3.5	0.8	5.9	10.2	-	-	-	-	-
1HY-09		6.9	1.6	12.6	21.1	-	-	-	-	-
	Mar-09	3.3	1.0	4.8	9.1	-	-	-	-	-
	Jun-09	3.7	1.1	5.1	9.8	-	-	-	-	-
2HY-09		7.0	2.0	9.9	18.9	-	-	-	-	-
Full year 2008–09		13.9	3.6	22.5	40.0	43.5	-	14.3	4.2	62.0
	Sep-09	4.2	0.9	5.7	10.8	-	-	-	-	-
	Dec-09	4.2	0.8	5.9	10.9	-	-	-	-	-
1HY-10		8.4	1.7	11.6	21.7	-	-	-	-	-
	Mar-10	4.4	0.8	5.3	10.5	-	-	-	-	-
	Jun-10	5.2	0.9	5.4	11.5	-	-	-	-	-
2HY-10		9.7	1.7	10.7	22.0	-	-	-	-	-
Full year 2009–10		18.1	3.4	22.2	43.7	45.3	-	15.2	3.7	64.2
	Sep-10	5.3	0.9	5.7	11.9	-	-	-	-	-
	Dec-10	4.2	0.8	5.6	10.6	-	-	-	-	-
1HY-11		9.6	1.6	11.3	22.5	22.6	-	-	10	32.6
	Mar-11	4.1	1.2	5.0	10.3	-	-	-	-	-
	Jun-11	4.6	1.2	5.5	11.4	-	-	-	-	-
2HY-11		8.7	2.4	10.5	21.6	18.3	-	-	8.9	27.2
Full year 2010–11		18.3	4.0	21.8	44.2	40.9	-	-	18.9	59.8
	Sep-11	4.9	1.3	5.8	12.0	-	-	-	-	-
	Dec-11	4.8	1.4	5.9	12.0	-	-	-	-	-
1HY-12		9.6	2.7	11.7	24.0	22	-	9.9	-	31.9
	Mar-12	4.7	1.4	5.6	11.8	-	-	-	-	-
	Jun-12	5.7	1.6	5.7	12.9	-	-	-	-	-

ASX train operator traffic trends (billion net tonne-kilometres)

Period	Asciano				Aurizon				
	Coal	Other bulk	Intermodal (including steel)	Total	Coal	Iron ore	Bulk	Non-bulk — plus residual bulk from 2011–12	Total
									(Continued)
2HY-12	10.3	3.0	11.3	24.6	19.9	-	-	11.1	31.0
Full year 2011–12	20.0	5.6	23.0	48.6	41.9	6.7	-	14.3	62.9
Sep-12	5.3	1.6	5.8	12.7	-	-	-	-	-
Dec-12	6.1	1.3	6.0	13.4	-	-	-	-	-
1HY-13	11.5	2.9	11.7	26.1	21.9	4.8	-	6.8	33.5
Mar-13	6.0	1.5	5.4	12.9	-	-	-	-	-
Jun-13	6.6	1.6	5.5	13.7	-	-	-	-	-
2HY-13	12.6	3.1	10.9	26.6	-	-	-	-	-
Full year 2012–13	24.0	6.0	22.7	52.7	43.6	10.3	-	13.2	67.1
Sep-13	7.1	1.3	5.6	14.0	12.4	3	-	3.3	18.7
Dec-13	7.4	1.2	5.6	14.3	13.1	3.1	-	3.3	19.5
1HY-14	14.5	2.5	11.2	28.2	25.5	6.1	-	6.6	38.2
Mar-14	7.3	1.4	5.1	13.8	11.4	3	-	3	17.4
Jun-14	7.4	1.3	5.1	13.8	12.3	3.1	-	2.9	18.3
2HY-14	14.7	2.7	10.2	27.6	23.7	6.1	-	5.9	35.7
Full year 2013–14	29.2	5.1	21.5	55.8	49.2	12.2	-	12.5	73.9
Sep-14	7.4	1.1	5.5	14	12.6	2.8	-	3.5	18.9
Dec-14	7.8	1.3	5.7	14.8	12.6	2.5	-	3.3	18.4
1HY-15	15.2	2.4	11.2	28.8	25.2	5.3	-	6.8	37.3
Mar-15	7.6	1.4	5.0	14	11.5	2.4	-	2.9	16.8
Jun-15	8.1	1.3	4.7	14.1	12.4	2.7	-	3.2	18.3
2HY-15	15.7	2.7	9.7	28.1	23.9	5.1	-	6.1	35.1
Full year 2014–2015	30.9	5.1	20.9	56.9	49.1	10.4	-	12.9	72.4
Sep-15	-	-	-		-	-	-	-	-
Dec-15	-	-	-		-	-	-	-	-
1HY-16	16.2	2.3	10.2	28.7	25.0	5.0	-	6.5	36.5
Mar-16	-	-	-		-	-	-	-	-
Jun-16	-	-	-		-	-	-	-	-
2HY-16	15.6	2.1	9.4	27.1	24.7	4.6	-	5.8	35.1
Full year 2015–2016	31.8	4.4	19.6	55.8	49.7	9.6	-	12.3	71.6

Sources: Announcements – no longer published, following August 2016 division of Asciano. Saved copies available from BITRE), Aurizon website (ASX Announcements).

APPENDIX E

Aurizon Traffic 2016–17 to 2018–19

ASX train operator traffic trends (billion net tonne-kilometres)				
		Aurizon		
Period	Coal	Iron Ore	Freight	Total
Sep-16	12.3	2.2	3.2	17.7
Dec-16	12.5	2.5	3.4	18.4
1HY-16	**24.8**	**4.7**	**6.6**	**36.1**
Mar-17	11.7	2.2	2.8	16.7
Jun-17	11.1	2.3	2.8	16.2
2HY-17	**22.8**	**4.5**	**5.6**	**32.9**
Full year 2016–17	**47.6**	**9.2**	**12.2**	**69**
	Coal	Bulk[37]	Freight	Total
Sep-17	13.1	3.5	n/a	16.6
Dec-17	12.7	3.5	n/a	16.2
1HY-17	**25.8**	**7.0**	**n/a**	**32.8**
Mar-18	11.8	3.0	n/a	14.8
Jun-18	12.8	3.4	n/a	16.2
2HY-18	**24.6**	**6.4**	**n/a**	**31**
Full year 2017–18	**50.4**	**13.4**	**n/a**	**63.8**
	Coal	Bulk[38]	Freight	Total
Sep-18	12.4	2.5	n/a	14.9
Dec-18	12.7	2.5	n/a	15.2
1HY-18	**25.1**	**5**	**n/a**	**30.1**
Mar-19	12.2	1.7	n/a	13.9
Jun-19	13.2	2	n/a	15.2
2HY-19	**25.4**	**3.7**	**n/a**	**29.1**
Full year 2018–19	**50.5**	**8.7**	**n/a**	**59.2**
	Coal	Bulk	Freight	Total
Sep-19	12.4	n/a	n/a	n/a
Dec-19	12.4	n/a	n/a	n/a
1HY-19	**24.8**	**n/a**	**n/a**	
Mar-20	12.2	n/a	n/a	n/a
Jun-20	13	n/a	n/a	n/a
2HY-20	**25.2**	**n/a**	**n/a**	**n/a**
Full year 2019–20	**50**	**n/a**	**n/a**	**n/a**

Source: Aurizon 2020a, p.15, Aurizon 2020b, p.12.

37 Aurizon reports bulk as including iron ore, agricultural products, and mining and industrial inputs. It no longer reports 'freight' tonnages due probably to its (planned) withdrawal from intermodal operations.

38 Aurizon reports bulk as including iron ore, agricultural products, and mining and industrial inputs. It no longer reports 'freight' tonnages due probably to its (planned) withdrawal from intermodal operations.

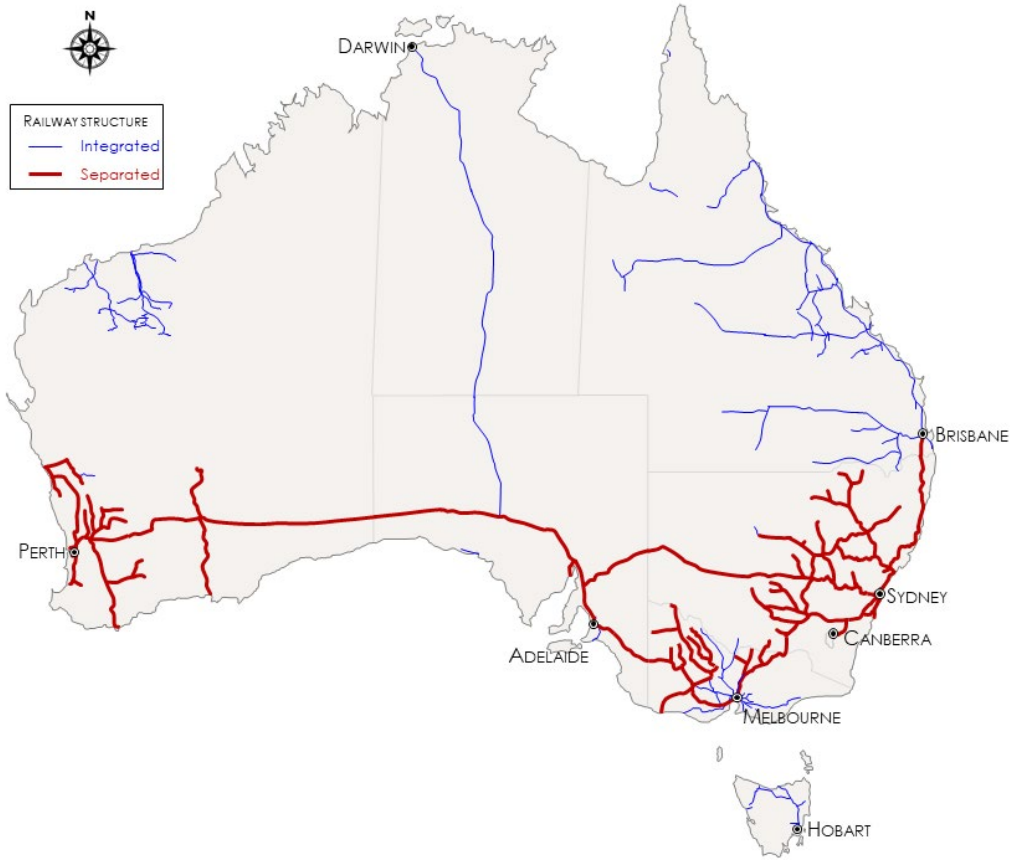
APPENDIX F

Industry structure

The Australian rail industry consists of vertically-separated and vertically-integrated railways.

In vertically-separated railways, the railway infrastructure manager does not operate revenue earning services. Instead, it sells track access to train operators under an "open access" regime. In vertically-integrated railways, the infrastructure manager operates its own trains on the railway. Vertically-integrated railway managers may provide "third-party access" to (other) train operators.

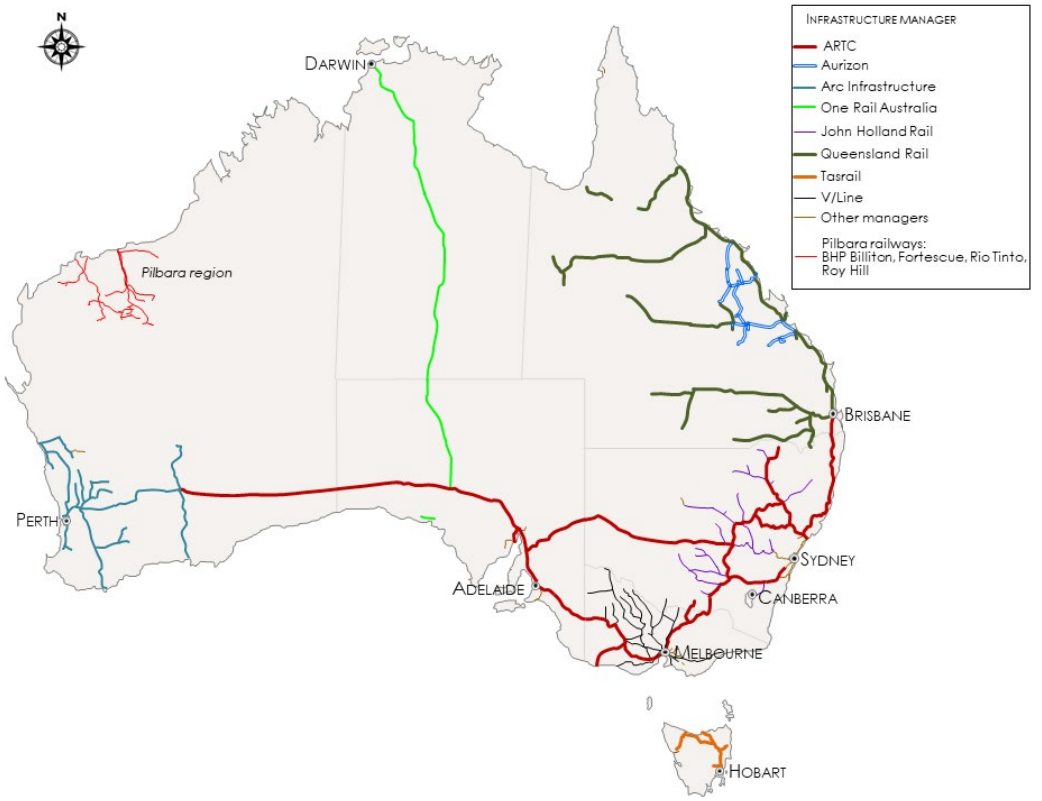
Figure 58 Australian rail industry structure, 2020



Infrastructure management

Australia's infrastructure managers are diverse in structure and operation. Figure 59 shows Australia's railway system by network manager.

Figure 59 Australian railways, by network manager, 2020



Notes: The BHP Goldsworthy line in the Pilbara is shown but it was mothballed in 2014.

The pattern of the network management is, by traffic type:

- **Interstate.** ARTC and Arc Infrastructure manage most of the interstate network. One Rail Australia owns (long lease) the Tarcoola—Darwin line as a vertically-integrated railway. Sydney—Perth trains that travel via Lithgow use John Holland Rail-managed track between Marrangaroo (Lithgow) and Parkes.
- **Iron ore — Pilbara.** These lines are vertically-integrated operations, with lines owned by BHP, Rio Tinto, Fortescue Metals Group and Roy Hill.
- **Coal.** Coal railways in Central Queensland are vertically-integrated. Aurizon manages the infrastructure and operates trains in central Queensland and uses Queensland Rail infrastructure elsewhere. Aurizon provides third-party access to its central Queensland lines. Coal railways in New South Wales are vertically-separated. ARTC manages the Hunter Valley coal network with John Holland Rail managing some other New South Wales coal lines.
- **Mixed.** Tasmania's railways are vertically-integrated. TasRail manages the system and operates the trains.

- **Grain.** Grain railways are vertically-separated in Queensland, New South Wales (ARTC, John Holland Rail), Victoria (V/Line)[39] and Western Australia (Arc Infrastructure). One Rail Australia operates as a vertically-integrated operator in South Australia.
- **Passenger.** Urban systems are vertically-integrated, except for Sydney where Sydney Trains both operates as vertically-integrated operator and provides track access to Trainlink that provides additional limited stops urban services. Non-urban passenger operations are a mix of vertical-integration and separation.

Table 40 Principal infrastructure managers of Australian railways, 2020

Infrastructure manager	Structure	Primary usage
Interstate		
Australian Rail Track Corporation (ARTC)	Separated	Intermodal, grain, ores, steel, passenger
Arc Infrastructure	Separated	Intermodal, grain, ores, steel, passenger
One Rail Australia	Integrated	Intermodal, ores, passenger
Intrastate		
Aurizon	Integrated	Coal
Queensland Rail	Integrated and Separated	Passenger (integrated), grain, coal, cattle, ores, intermodal (separated)
John Holland Rail	Separated	Intermodal, grain, ores, cotton, passenger
ARTC (New South Wales regional and Hunter Valley)	Separated	Intermodal, coal, grain, other agricultural produce, passenger
V/Line	Integrated (passenger); Separated (freight)	Passenger, grains, other agricultural produce, mineral sands, intermodal
ARTC (Portland, Benalla–Yarrawonga)	Separated	Grain, mineral sands
TasRail	Integrated	Intermodal, coal, ores, timber
One Rail (intrastate South Australia)	Integrated	Grain, gypsum, ores
Arc Infrastructure Rail (intrastate Western Australia)	Separated	Grain, ores
BHP	Integrated	Iron ore
Rio Tinto	Integrated	Iron ore
Fortescue Metals Group	Integrated	Iron ore
Roy Hill Holdings	Integrated	Iron ore
MTM (Metro Trains Melbourne)	Separated	Passenger, freight
Sydney Trains	Separated	Passenger, freight
Urban		
Queensland Rail (Brisbane, Gold Coast)	Integrated	Passenger
Airtrain CityLink Limited	Integrated	Passenger
Sydney Trains	Integrated and Separated	Passenger
MTM (Metro Trains Melbourne)	Integrated	Passenger
Adelaide Metro (Department of Planning, Transport and Infrastructure)	Integrated	Passenger
Transperth	Integrated	Passenger

Note: There are a number of other, smaller, infrastructure managers, including heritage railways, totalling an estimated 511 route-kilometres.

Above-rail operators

Numerous organisations provide train operation services.

- **Heavy rail urban passenger** operators are largely integrated. Most are publically-owned entities, with the exception of Metro Trains Melbourne, which is a privately-owned joint venture that operates trains and manages the network on behalf of the Victorian Government under a franchise agreement.
- **Non-urban passenger services** are largely government operated with a few exceptions, including Great Southern Rail, which operates the long-distance *Ghan, Indian Pacific* and *Overland* trains.
- **Heritage passenger railways.** Around 40 heritage volunteer-based organisations manage and operate railways
- **National rail freight operators.** The two largest national rail freight train operators are Pacific National and Aurizon. Both company's core activity is coal haulage in Queensland and New South Wales, with other important ancillary bulk-haulage activities. Pacific National operates intermodal services on the open access interstate network.
- **Regional rail freight operators.** One Rail Australia is a major train operator in South Australia and the Northern Territory, including running intermodal trains from Adelaide to Darwin. Other significant players include Southern Shorthaul Railroad, which provides services in New South Wales and Victoria. TasRail provides all rail freight services in Tasmania while Watco provides grain haulage in Western Australia and Queensland.
- **Logistics companies** — notably SCT Logistics, QUBE Logistics, and Linfox — operate intermodal services for their own logistics chains. They also operate a small number of bulk services. SCT Logistics has a diverse portfolio of rail and road activities. QUBE Logistics also has a diverse intermodal and bulk portfolio, with a primary focus on local and regional port-based operations. Fletcher International provides agricultural product rail services from Dubbo to Port Botany in New South Wales. (Other logistics companies, such as Toll, Sadliers Logistics and Ettamogah Rail Hub, use rail freight operators to undertake their rail haulage.)
- **Mining companies,** such as Rio Tinto, BHP, Fortescue Metals Group and Roy Hill operate trains on their own railways.

Table 41 Principal train operators in Australia, 2020[40]

Train operator	Infrastructure network used	Primary tasks
Aurizon	Aurizon, Queensland Rail, ARTC, Arc Infrastructure	Coal, iron ore, minerals, cattle, grain, mixed bulk
Pacific National	Aurizon, Queensland Rail, ARTC, V/Line, John Holland Rail, Sydney Trains, Arc Infrastructure, Metro Trains Melbourne	Coal, ores, intermodal, steel, grain, mixed bulk
One Rail Australia	One Rail Australia, ARTC, Sydney Trains, John Holland Rail	Intermodal, ores, agricultural produce, coal
SCT Logistics/Specialised Bulk Rail	ARTC, Arc Infrastructure, Sydney Trains	Intermodal, grain, iron ore
QUBE Logistics	ARTC, V/Line, Sydney Trains, John Holland Rail, Metro Trains Melbourne	Intermodal, grain, mixed bulk
Watco	Arc Infrastructure, Aurizon, Queensland Rail	Grain, urban freight
Southern Shorthaul Railroad	ARTC, Sydney Trains, John Holland Rail, V/Line, Metro Trains Melbourne	Coal, grain, intermodal, infrastructure works
TasRail	TasRail	Intermodal, coal, ores, timber
Fletcher International	ARTC, John Holland Rail, Sydney Trains	Agricultural produce
Linfox	Queensland Rail	Queensland intrastate intermodal
Rio Tinto	Rio Tinto	Iron ore
BHP	BHP	Iron ore
Fortescue Metals Group	Fortescue Metals Group	Iron ore
Roy Hill Holdings	Roy Hill Holdings	Iron Ore
Queensland Rail	Queensland Rail, AirTrain CityLink Limited	Heavy Rail Passenger (urban, intercity, and long distance)
NSW TrainLink	Sydney Trains, ARTC, John Holland Rail, V/Line, Queensland Rail	Heavy Rail Passenger (long distance, interstate, intrastate, urban, intercity)
V/Line	V/Line, ARTC, Metro Trains Melbourne	Heavy Rail Passenger (intercity and non-urban)
Transwa	Transperth, Arc Infrastructure	Heavy Rail Passenger (non-urban)
Great Southern Railway	Sydney Trains, John Holland Rail, ARTC, Arc Infrastructure, One Rail Australia	Heavy Rail Passenger (interstate premium tourist oriented)
Sydney Trains	Sydney Trains	Heavy Rail Passenger (urban)
Metro Trains Melbourne	Metro Trains Melbourne	Heavy Rail Passenger (urban)
Adelaide Metro[41]	Adelaide Metro	Heavy Rail Passenger (urban)
Transperth	Transperth	Heavy Rail Passenger (urban)
GoldLinQ	GoldLinQ	Light Rail Passenger
Transdev	Transport for NSW	Light Rail Passenger
Yarra trams	Yarra trams (Keolis Downer EDI Rail)	Light Rail Passenger
Adelaide Metro	Adelaide Metro	Light Rail Passenger
Canberra Metro	Canberra Metro	Light Rail Passenger
Newcastle Transport	Newcastle Transport	Light Rail Passenger
Sydney Metro	Metro North West Line	Fully automated rapid transit passenger

40 Chicago Freight Car Leasing Australia (CFCLA) is a major rail operator in Australia through the leasing of locomotives and other rail rollingstock.

41 From 31 January 2021 Keolis Downer will start an eight year contract to operate Adelaide's heavy rail passenger operations (Rail Express, September 2020a)..

APPENDIX G

Urban heavy rail network maps – December 2020

Figure 60 Adelaide

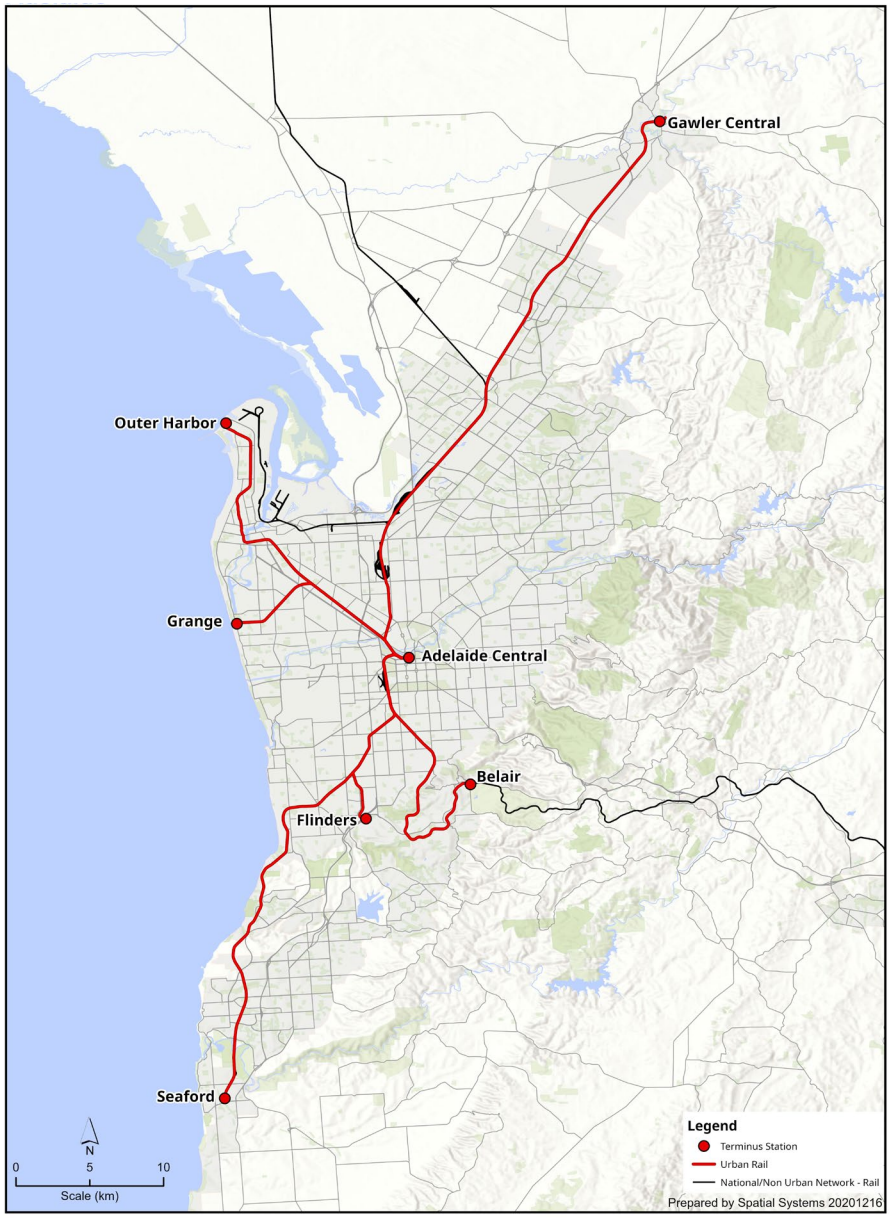


Figure 61 Brisbane

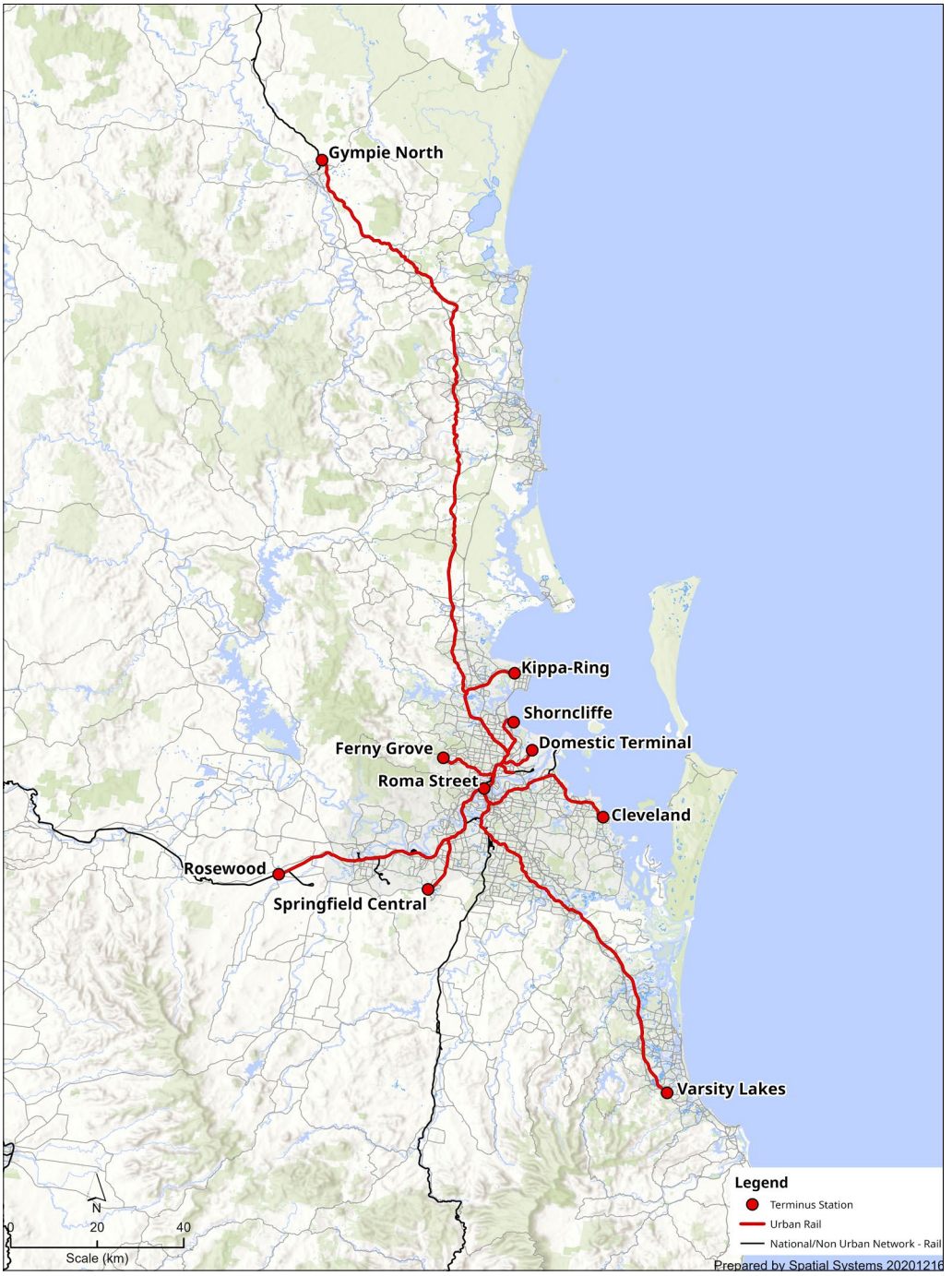


Figure 62 Melbourne

Figure 63 Perth

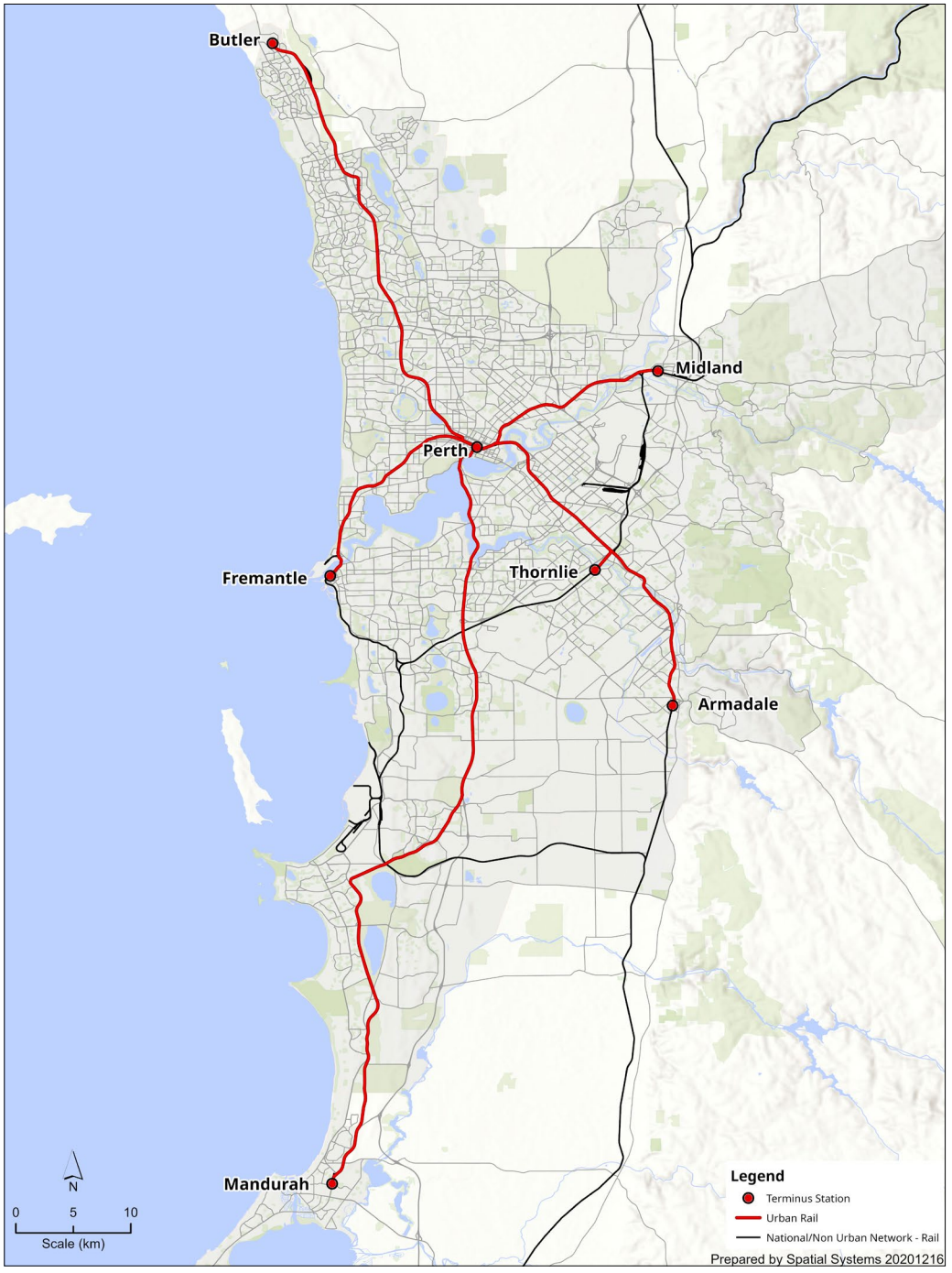
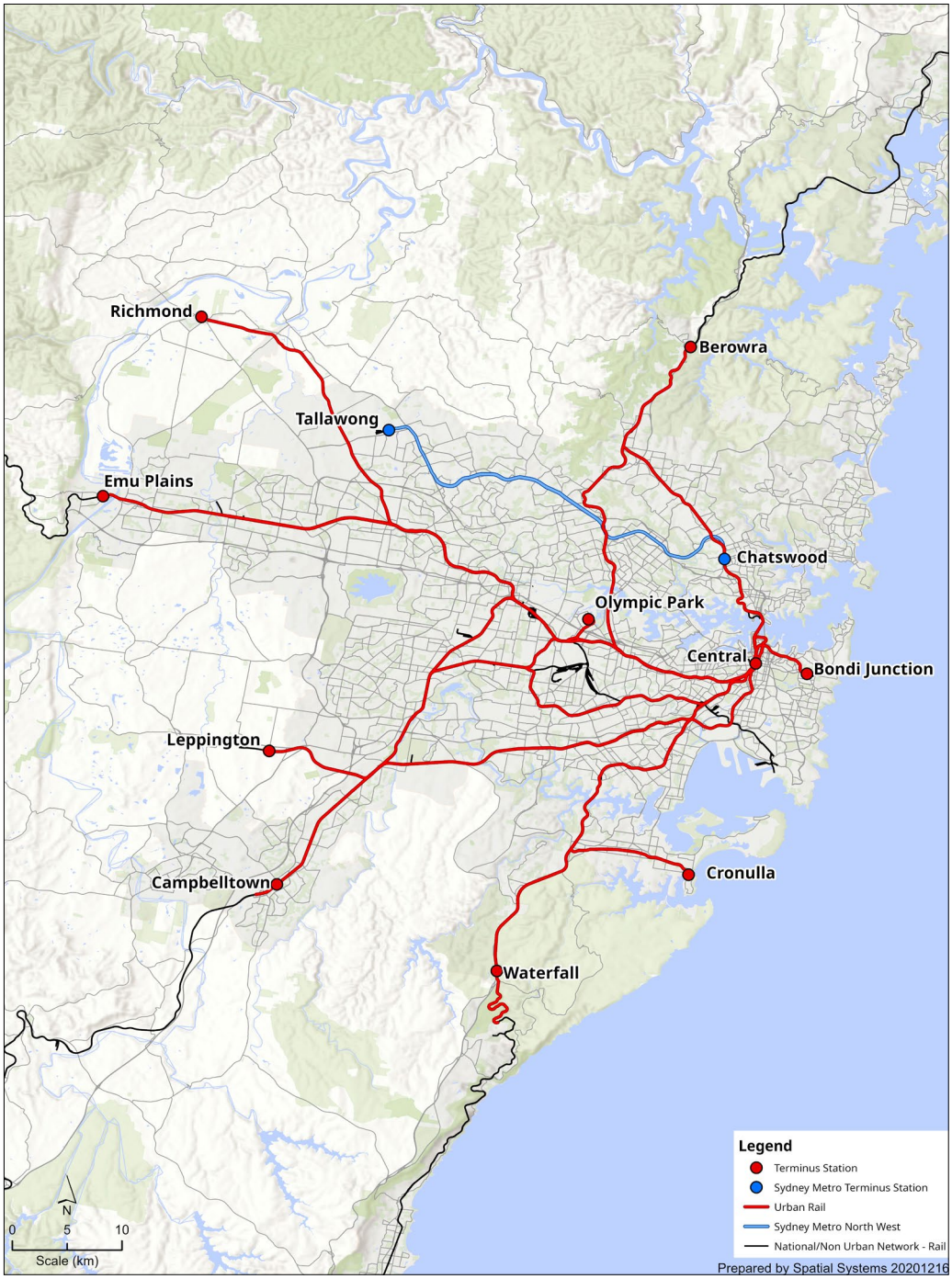


Figure 64 Sydney



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