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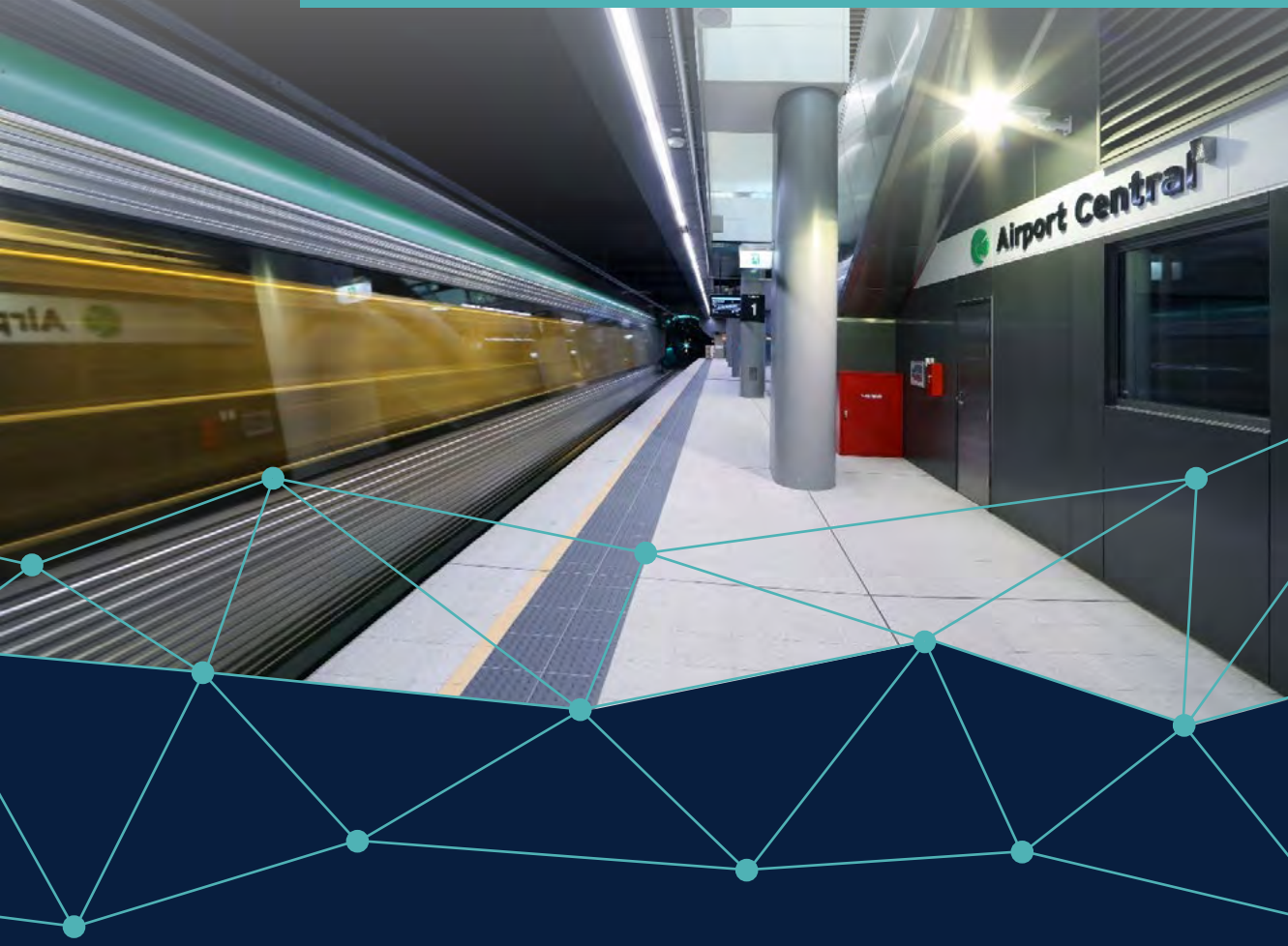
STATISTICAL REPORT



Rail

Trainline 11

June 2024

Bureau of Infrastructure and Transport Research Economics

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Cover photograph: Airport Central Station on Transperth's new Airport line. (Photo courtesy of Public Transport Authority of WA)

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Foreword

Trainline 11 gives an overview of freight, urban and non-urban passenger rail transport in Australia. The report analyses traffic levels, the provision of infrastructure and rolling stock, and railway performance. It is the 11th in the publication series.

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.

This report was prepared by Rodney Avery.

Georgia O'Cianain
Acting Head of Bureau
Bureau of Infrastructure and Transport Research Economics

June 2024

At a glance

Outcomes

- In 2021–22, intermodal freight tonnages reported by infrastructure managers ('below-rail') decreased on most parts of the interstate network. The only exception was southbound traffic from Brisbane to Islington, with increases of approximately one per cent, and westbound traffic from Melbourne to Adelaide and Crystal Brook, which saw increases from 1–9 per cent.
- In 2021–22, there were significant fluctuations in non-intermodal tonnages across the interstate network, mostly in the eastern states. These changes were mostly due to large grain harvests and increased minerals traffic. There were major increases, up to 41.5 per cent, on the sectors between Cootamundra and Broken Hill and a decrease of approximately 31.8 per cent from Tottenham to Albury.
- Pacific National's reported non-coal freight task in 2022 decreased by approximately 13.7 per cent, compared to the previous calendar year, while coal volumes hauled was down by approximately 9.8 per cent.
- In 2022–23, coal volumes hauled by Aurizon decreased by approximately five per cent compared to the previous financial year.
- In 2021–22, TasRail's total freight task, measured in net tonne kilometres decreased by approximately two per cent compared to the previous financial year.
- Iron ore export volumes, almost all of which travels to port by rail, grew by approximately 1.3 per cent in 2021–22 compared to the previous financial year.
- While there were no major changes to scheduled intermodal freight train transit times on the ARTC and Arc Infrastructure interstate corridors in 2023 compared to 2022, there were the following noteworthy changes:
  - On the North—South corridor average transit times mostly increased, up to 104 minutes (for Brisbane to Melbourne services). This was largely due to some services having longer dwell times at points en route where they take on and offload freight, and some services dwelling longer at Taree where they change crews.
  - On the East—West corridor average transit times for Perth to Melbourne services increased by 49 minutes, due to an average one extra stop en route, with slightly increased dwell times.
- In February 2023, the number of scheduled intermodal train services on the North—South corridor increased, while on the East—West corridors they were are largely unchanged, compared to 2022.
- In April 2023, Aurizon began recommencing intermodal services on the East—West and North—South corridors. This was on top of its existing Adelaide—Darwin services.
- An assessment of a sample of Brisbane—Melbourne intermodal services that ran between April-June 2023 shows southbound services tend to be more timely than northbound services.
- Total urban heavy rail patronage for 2021–22 was 328 million passenger journeys, a reduction of approximately 17 per cent from the previous financial year. All cities experienced declines, except Melbourne, where patronage grew by approximately 22 per cent.
- Total light rail patronage for 2021–22 was 115 million passenger journeys, an increase of approximately 22 per cent from the previous financial year. Patronage in Melbourne grew by approximately 38 per cent, while Sydney and the Gold Coast had smaller increases. Adelaide, Canberra, and Newcastle had patronage declines.
- Total non-urban rail patronage in 2021–22 was approximately 24.2 million passenger journeys, a reduction of approximately 18 per cent from the previous financial year, which, in turn, had a 40 per cent reduction from its previous financial year. V/Line and Queensland Rail had patronage increases, while TrainLink and Transwa had decreases.

- All urban heavy rail passenger service operators met or exceeded their punctuality targets in 2021–22, except Perth, which fell marginally short of its target. All light rail service providers exceeded punctuality targets except Sydney on its Central Station-Dulwich Hill route.
- For non-urban passenger services, all operators failed to meet punctuality targets in 2021–22, except for V/Line's commuter designated services.
- The 200-kilometre Bravus Mining and Resources Carmichael line (that connects to the Central Queensland Coal Network) is now operational, transporting thermal coal from the Galilee Basin to the port at Bowen. Bowen Rail Company operates the trains.
- In 2022–23, there were 84 notified fatalities on Australian railways that the Office of the National Rail Safety Regulator regulates.
- BITRE estimates that in 2022–23, rail transport's greenhouse gas emissions in Australia – comprising approximately five per cent of the national transport total – reduced by almost two per cent compared to the previous financial year.
- Approximately 175 route-kilometres of heavy railways and 20 route-kilometres of light railways were under construction. There was construction underway in every state and territory, except for Tasmania and the Northern Territory.
- Ongoing construction of parts of the Melbourne—Brisbane inland railway is underway, with additional sectors now operational.

Infrastructure and assets

In July 2023, Australia had:

- An estimated 31 074 route-kilometres of operational heavy railways. Of these, approximately 11 per cent of were electrified. Approximately 56 per cent of the network was standard gauge, with the remainder being narrow gauge (approximately 35.5 per cent), broad gauge (approximately eight per cent), and dual gauge (less than one per cent). All states and territories had operational heavy railways, to varying degrees and for various purposes.
- An estimated 326 route-kilometres of operational light rail/tramways, all standard gauge, in Melbourne, Sydney, Adelaide, Gold Coast, Canberra, and Newcastle.
- An estimated 196.5 route-kilometres of heavy and light railways under construction.
- An estimated 17 mainline heavy rail infrastructure managers.
- 4 622 urban heavy rail cars (both electric and diesel, formed into multiple unit sets). For urban passenger rail services, an estimated 84 new HCMT electric multiple unit (EMU) cars had entered service in Melbourne in July 2023, replacing the older Comeng EMU sets. There were no changes to light rail fleet numbers (633 vehicles). Adelaide has converted some of its diesel multiple unit (DMU) heavy rail cars to hybrid power.
- 1 115 non-urban cars and carriages (mostly formed EMU and DMU sets, with the remainder being locomotive hauled), and 87 locomotives for non-urban passenger train haulage duties. Victoria had an additional 18 VLocity DMU cars in July 2023 compared to the previous year.

The total number of operational locomotives for freight duties is unknown due to an ongoing lack of data provision from parts of the rail industry.

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Chapter 1
Introduction

Trainline is a compendium of Australia's rail industry. It provides data and an analysis of the industry. This includes:

- **Patronage.** The introduction of frequent urban and interurban rail services with high average speeds, good bus, cycling, and parking links to high amenity stations, along with the opening of new or extended lines has generated strong patronage growth in parts of Australia, although COVID lockdowns in recent years has seen major declines in patronage, particularly in Victoria.
- **Resurgence of light rail.** In addition to Melbourne's extensive tram/light rail network, there are also light rail networks in Sydney, Adelaide, Canberra, the Gold Coast and Newcastle. Construction is underway to extend the Gold Coast and Canberra lines, while construction of the discrete Parramatta light rail in Sydney is also underway. Melbourne is replacing its remaining ageing light rail vehicles with new, locally built, high capacity stock.
- **Regional and inter-urban passenger service.** Regional passenger services, specifically in Victoria, have been upgraded both in rollingstock and infrastructure within the last decade. NSW is due to replace its ageing XPT and Xplorer trains with new stock.
- **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.

Chapter 2
Freight transport results

No current combined data source covers the entire Australian network. Individual data sources report part or aspects of the freight task only, such as by commodity or location. These sources include train operator and track/infrastructure manager data and some of this is not public information. TasRail provides information on tonnages of some commodities that it transports, such as logs and minerals in its annual reports (TasRail, 2022). ARTC reports aggregated Hunter Valley network quarterly coal tonnage throughput (ARTC n.d.). Aurizon publishes some information in its annual investors presentation (Aurizon, 2023). Infrastructure managers provide traffic data and projections to their economic regulators, which may then publish that material[1]. BITRE's *Freightline* series also discuss freight flows by commodity (BITRE 2014 and BITRE 2014a, BITRE 2016, BITRE 2018, BITRE 2018a, BITRE 2028b). 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).

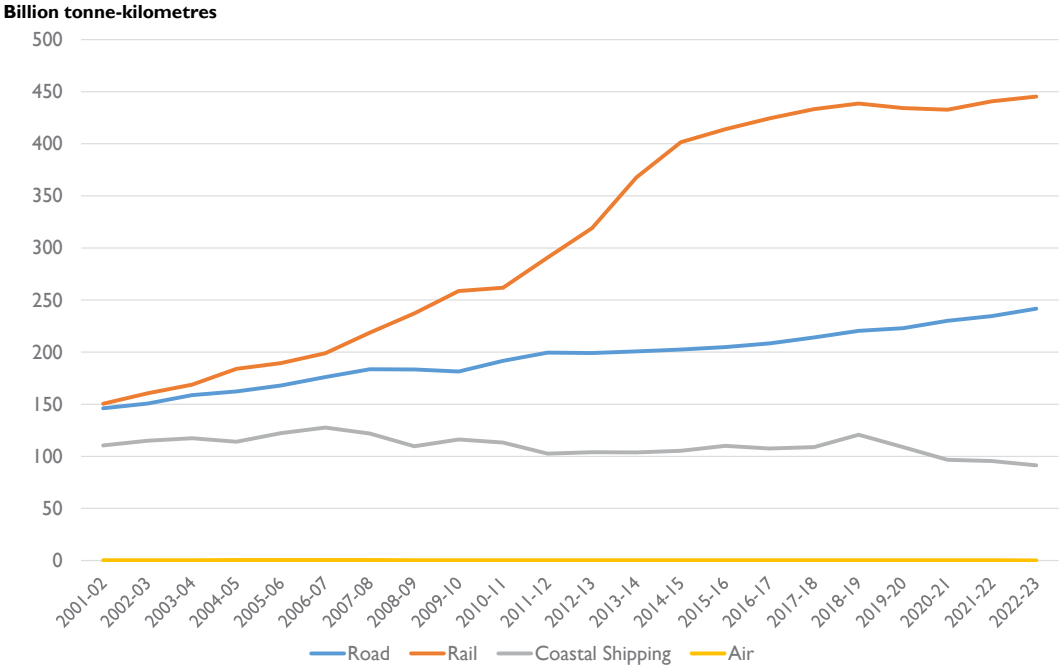
Freight transport by rail's role in the Australian economy has increased sharply this century; see Figure 1. Rail accounts for more than one-half of Australian freight transport activity (approximately 57 per cent in 2022–23, up from approximately 36 per cent at the turn of the century. Rail freight transport's dominance is primarily founded on the transportation of iron ore, coal and other bulk products such as grain, primarily to ports for export.

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].

1 Aurizon's economic regulator is the Queensland Competition Authority (https://www.qca.org.au/project/aurizon-network/); ARTC's is the ACCC (https://www.accc.gov.au/by-industry/rail-shipping-and-ports/interstate-rail-network-access-undertaking); Arc Infrastructure is the Economic Regulation Authority [WA] (http://www.erawa.com.au/rail/rail-access).

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 2014, and other issues in the series) for contextual material on rail and road freight.

Figure 1 Estimated Australian freight volumes by transport mode



Note: See attached spreadsheet for time series data

Source: Figure produced using data from BITRE (2023), (Table 4.1c).

In November 2023, the Australasian Railway Association (ARA) and the Freight on Rail Group (FORG) released The future of freight summary report. According to the report, rail transport has 68 per cent market share of bulk freight transport in Australia, and 17 per cent market share of non-bulk freight transport (ARA/FORG 2023, p.6). The report makes the following specific findings on rail transport's mode share on the following freight corridors:

Table 1 Rail transport mode share

Freight corridor	Headhaul[3]	Backhaul	Comments
North coast line (intrastate Queensland)	53%	42%	Intense competition between road and rail transport. Rail dominates for distances over 1500 kilometres, while road dominates for distances of less than 1000km.
North-south corridor (Vic-NSW-Qld)	11%	7%	Road dominates the market share due to the shorter distances of key routes. Rail's modal share is strongest on the Melbourne–Brisbane route
East-west corridor (Vic-SA-WA)	65%	77%	Rail dominates this corridor, especially between Melbourne, Sydney and Perth.

Source: ARA/FORG (2023), p.7

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.

3 Headhaul is one-way destination for a freight load. Backhaul is freight that is transported on an operator's return journey,

National rail freight task, tonnages

Freight type defined

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, 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 carried in a louvre wagon. Steel may also be deemed intermodal, particularly on trains that carry both intermodal and steel products on intermodal designated trains.

Tonnages, by operator

Due to an ongoing data shortage from freight train ('above-rail') operators, Trainline is unable to report aggregated national above-rail tonnages[4]. There is some publicly-available data on rail freight activity that reports parts of the national freight task.

Aurizon reports its data to the Australian Stock Exchange (ASX) and on its website. That material forms the basis of the data shown in Tables 2-6, below. Table 2, below, shows, Aurizon's above-rail coal and other bulk freight hauled volumes. Table 3 shows the coal hauled in net tonne kilometres. Table 4 shows Aurizon's above-rail coal volumes hauled by system. Table 5 shows below-rail tonnages hauled on the Aurizon managed Central Queensland Coal Network. It thus includes the tonnages of all above-rail operators using the network.

Table 6 is a new metric. In the 2022–23 financial year Aurizon recommenced intermodal operations. This includes its Adelaide—Darwin services following Aurizon's acquisition of One Rail Australia in July 2022, and one initial return Melbourne—Perth service per week. (Aurizon recommenced its Melbourne—Perth services in April 2023 after Team Global Express (TGE) awarded it an 11 year contract to operate intermodal services connecting Perth, Adelaide, Melbourne Sydney and Brisbane. Services began with the Melbourne—Perth service initially, with services connecting all cities by April 2024. (International Railway Journal, 2023).

Table 2 Aurizon above-rail volumes hauled (million tonnes)

Financial Year	2018–19	2019–20	2020–21	2021–22	2022–23
Coal					
CQCN	152.3	150.1	143.7	141.1	133.6
NSW &SEQ	62	63.8	58.4	52.9	51.4
Total	**214.3**	**213.9**	**202.1**	**194**	**185**
Bulk Volumes	44.6	48.1	51.2	50.8	68.2
Coal and Bulk Total	**258.9**	**262**	**253.3**	**244.8**	**253.2**

Note: CQCN = Central Queensland Coal Network, SEQ = South east Queensland

Sources: Aurizon (2023), p.29; Previous editions of *Trainline*, citing Aurizon's public reporting

4 BITRE has been unable to report above rail tonnages since 2015–16. For historical data from 2001–02 to 2015–16, see *Trainline* 9 at https://www.bitre.gov.au/sites/default/files/train_006.pdf.

Aurizon states the reduced coal volumes (approximately five per cent) in 2022–23 compared to the previous financial year was due to prolonged wet weather affecting the rail network. (Aurizon, 2023, p.9) While non-coal bulk volumes increased by approximately 34 per cent, this should be seen in the light of Aurizon's acquisition of One Rail Australia in July 2022 and the increased freight task this provided.

Table 3 Aurizon above-rail coal NTKs hauled (billion tonnes)

Financial Year	2018–19	2019–20	2020–21	2021–22	2022–23
Coal					
CQCN	38.3	37.8	35.3	35.3	33
NSW &SEQ	12.2	12.2	11.3	9.9	9.2
Total	**50.5**	**50**	**46.6**	**45.2**	**42.2**

Note: Totals are subject to rounding

Sources: Aurizon (2023), p.29; Previous editions of *Trainline*, citing Aurizon's public reporting

Table 4 Aurizon above-rail coal hauled by system (million tonnes)

Financial Year	2021–22	2022–23
Central Queensland Coal Network		
Newlands	17.8	16.1
Goonyella	61.5	60.1
Blackwater	49.5	44.4
Moura	12.3	13.0
Total	**141.1**	**133.6**
New South Wales and South East Queensland		
West Moreton	2.7	2.1
Hunter Valley and Illawarra	50.2	49.3
Total	**52.9**	**51.4**
Grand total	**194.0**	**185.0**

Sources: Aurizon (2023), p.38

Table 5 Aurizon network (below-rail) tonnages hauled (million tonnes)

Financial Year	2018–19	2019–20	2020–21	2021–22	2022–23
Total	**232.7**	**226.9**	**208.3**	**206.5**	**207.6**

Sources: Aurizon (2023), p.42; Previous editions of *Trainline*, citing Aurizon's public reporting

Table 6 Aurizon interstate containerised freight twenty foot equivalent units (TEUs)

Quarter	Sep-22	Dec-22	Mar-23	Jun-23
	18400	26481	22681	29368

Note: Does not include Queensland intrastate 'hook and pull' services that Aurizon provides for Linfox.

Source: Aurizon (2023),p.29

Figure 2 Aurizon intermodal train

Note: The image above shows Aurizon Sydney to Perth intermodal service 6SP1 at the Grogan Road level crossing near Stockinbingal, NSW, on 18 November 2023. Photo courtesy of Rodney Avery.

Pacific National publicly reports some details of its freight haulage operations through offering circulars, which it publishes on the Singapore Stock Exchange website. Table 7 below, shows details of Pacific National's freight task, according to its offering circulars. According to the table, the compvany's non-coal freight task in 2022 decreased by approximately 13.7 per cent, compared to the previous calendar year. TEUs were down by approximately 10.2 per cent, and coal volumes hauled was down by approximately 9.8 per cent.

Table 7 Pacific National freight task

Calendar year	Freight (millions of tonnes)	TEUs	Coal (millions of tonnes)
2018	27.6	901000	154.2
2019	24.7	847000	160.8
2020	25.2	872000	138.8
2021	28.4	883000	127.3
2022	24.5	793000	114.8

Note: Freight haulage encompasses interstate containerised freight (intermodal) and break-bulk freight (steel) services; regional freight rail services, including grain and hook and pull services for passenger trains; and various other bulk goods, including minerals concentrate and construction materials. TEUs refers exclusively to intermodal operations.

Pacific National's commentary on what caused changes to its freight task each year can be found in each offering circular. For 2022, it cited (extended) network access issues, due primarily to weather events and competitors' trains derailing.

Source: Singapore Stock Exchange (n.d)

TasRail reports its freight task in its annual report. Table 8, below, shows and compares TasRail's freight task for the 2020–21 and 2021–22 financial years.

Table 8 TasRail freight task (net tonne kilometres)

	2020–21	2021–22	Change (per cent)
Coal	36 038 989	37 660 149	4.50%
Cement	24 357 043	23 085 026	-5.22%
Mineral concentrates	21 519 335	16 837 456	-21.76%
Logs	38 667 048	51 134 439	32.24%
Intermodal general	273 587 415	249 855 828	-8.67%
Paper	114 467 944	120 282 714	5.08%
Total	**508 637 774**	**498 855 612**	**-1.92%**

Source: TasRail (2022), p.18.

According to the annual report: "The rail freight task in 2021–22 was the second highest on record – transporting 499 million net tonne kilometres of freight – down 1.9 per cent as key individual customers suffered from production and export issues. The outstanding result in the forestry sector reflects the strength of the partnerships that TasRail has fostered with its fastest growing market segment." (TasRail 2022, p.18)

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 and some of this is not public information.

TasRail provides information on tonnages of some commodities that it transports, such as logs and minerals. (TasRail 2022)

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 2023a).

Traffic data and projections can also be provided to the infrastructure managers' economic regulators, which may then publish that material5.

While explicit rail traffic data is not available for the Pilbara railways, the export iron 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 2014 and BITRE 2014a, BITRE 2016, BITRE 2018, BITRE 2018a, BITRE 2018b).

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/by-industry/rail-shipping-and-ports); Arc Infrastructure is the Economic Regulation Authority [WA] (http://www.erawa.com.au/rail/rail-access).

Interstate network freight traffic

Table 9 and Table 10, below shows interstate gross freight tonnages 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. The tables show intermodal and total gross tonnes by line segment, with line segments ordered from north to south and east to west. 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.
- All 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's intermodal designated data only includes freight travelling on capital city to capital city trains, inclusive of regional/export traffic that is attached/detached to/from these trains en route. Wimmera Container Line export agricultural produce from Dooen (near Horsham) in Victoria being added to and removed from SCT Logistics' Melbourne—Perth trains is an example. Tonnages for regional intermodal trains, such as QUBE's Bomen—Port Botany trains are captured in 'other' tonnages. 'Other' tonnages can be calculated by subtracting the intermodal component from the total tonnages.

Table 9 Below-rail gross tonnes by line segment, North—South corridor

	Million gross tonnes					
	Intermodal			Total		
Line segment, by direction of freight	2019–20	2020–21	2021–22	2019–20	2020–21	2021–22
Acacia Ridge to Casino	2.22	2.28	2.30	2.30	2.31	2.33
Casino to Acacia Ridge	3.44	3.51	3.44	3.50	3.54	3.47
Acacia Ridge – Casino	5.66	5.80	5.74	5.80	5.85	5.79
Casino to Islington	2.23	2.31	2.33	2.52	2.48	2.51
Islington to Casino	3.45	3.53	3.46	3.77	3.72	3.67
Casino – Islington	5.68	5.84	5.79	6.28	6.21	6.18
Chullora to Sefton Park	5.19	5.49	5.13	15.37	16.79	17.88
Sefton Park to Chullora	6.56	7.02	6.56	19.84	20.83	21.02
Chullora – Sefton Park	11.75	12.51	11.69	35.21	37.62	38.90
Sefton Park to Macarthur	3.66	3.86	3.57	6.26	6.51	6.89
Macarthur to Sefton Park	4.23	4.29	4.03	10.93	11.63	12.17
Sefton Park – Macarthur	7.89	8.15	7.60	17.20	18.13	19.06
Macarthur to Tahmoor	3.70	3.87	3.62	8.86	8.66	8.46
Tahmoor to Macarthur	4.28	4.32	4.06	14.59	14.91	15.08
Macarthur – Tahmoor	7.98	8.20	7.68	23.46	23.57	23.54
Moss Vale to Tahmoor	3.70	3.87	3.62	9.73	9.75	9.53
Tahmoor to Moss Vale	4.28	4.32	4.06	17.08	17.60	17.60
Tahmoor – Moss Vale	7.98	8.20	7.68	26.82	27.36	27.13
Moss Vale to Marulan	3.84	4.04	3.67	10.03	10.88	10.68
Marulan to Moss vale	4.51	4.62	4.22	17.22	19.89	20.10
Moss Vale – Marulan	8.36	8.66	7.89	27.25	30.77	30.78
Marulan to Goulburn	3.84	4.04	3.67	7.66	8.47	8.49
Goulburn to Marulan	4.51	4.62	4.22	15.34	18.25	18.51
Marulan – Goulburn	8.36	8.66	7.89	22.99	26.72	27.00
Goulburn to Cootamundra	3.83	4.05	3.67	5.39	6.46	6.71
Cootamundra to Goulburn	4.50	4.62	4.22	7.60	10.57	11.89
Goulburn – Cootamundra	8.34	8.67	7.89	12.99	17.03	18.60
Cootamundra to Junee	2.82	3.23	2.89	4.63	6.43	6.42
Junee to Cootamundra	2.60	2.85	2.62	5.92	7.08	6.73
Cootamundra – Junee	5.41	6.08	5.50	10.55	13.51	13.15
Junee to Albury	2.82	3.22	2.89	5.55	6.50	6.60
Albury to Junee	2.60	2.85	2.62	7.02	6.99	6.63
Junee – Albury	5.42	6.08	5.50	12.57	13.49	13.23
Albury to Tottenham	2.86	3.44	2.96	5.37	6.31	6.13
Tottenham to Albury	2.58	3.02	2.61	5.02	5.06	4.00
Albury – Tottenham	5.44	6.47	5.57	10.40	11.38	10.14

Note: Totals are subject to rounding.
See attached spreadsheet for longer time series.

Source: Data provided by ARTC.

Table 10 Below-rail gross tonnes by line segment, East—West corridor

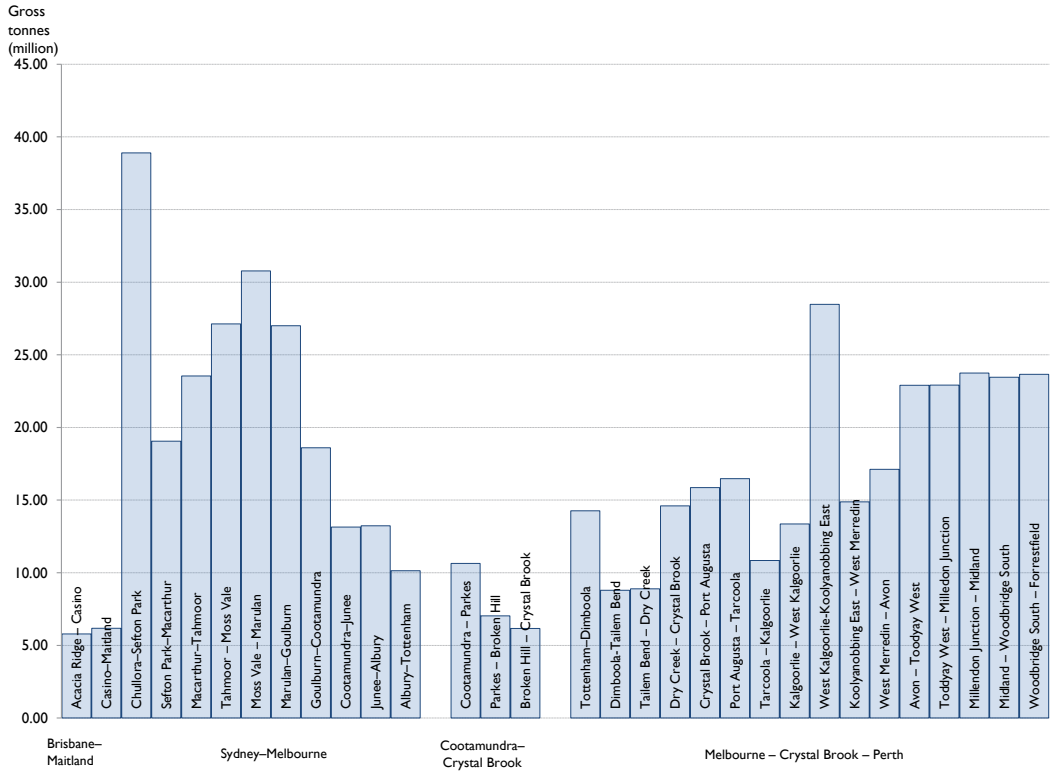
	Million gross tonnes					
	Intermodal			Total		
Line segment, by direction of freight	2019–20	2017–18	2018–19	2019–20	2020–21	2022–23
Cootamundra to Parkes	1.00	0.81	0.82	2.20	2.70	3.06
Parkes to Cootamundra	1.92	1.80	1.65	3.24	5.99	7.58
Cootamundra – Parkes	2.92	2.61	2.47	5.43	8.70	10.64
Parkes to Broken Hill	2.57	2.57	2.34	3.38	3.32	3.11
Broken Hill to Parkes	2.65	2.58	2.28	4.23	3.75	3.92
Parkes – Broken Hill	5.21	5.15	4.62	7.61	7.07	7.03
Broken Hill to Crystal Brook	2.40	2.52	2.24	3.78	3.81	3.45
Crystal Brook to Broken Hill	2.48	2.42	2.16	3.94	2.99	2.70
Broken Hill – Crystal Brook	4.89	4.94	4.40	7.72	6.80	6.16
Tottenham to Dimboola	3.97	4.17	4.54	5.97	6.43	7.01
Dimboola to Tottenham	3.70	3.65	3.64	7.69	7.55	7.25
Tottenham – Dimboola	7.67	7.82	8.18	13.66	13.98	14.26
Dimboola to Tailem Bend	3.54	3.75	3.80	3.99	4.80	5.17
Tailem Bend to Dimboola	3.12	3.12	3.06	3.39	3.58	3.61
Dimboola – Tailem Bend	6.65	6.87	6.86	7.38	8.38	8.79
Tailem Bend to Dry Creek	3.59	3.80	3.84	4.04	4.85	5.24
Dry Creek to Tailem Bend	3.17	3.17	3.10	3.41	3.58	3.65
Tailem Bend – Dry Creek	6.75	6.97	6.93	7.45	8.43	8.89
Dry Creek to Crystal Brook	4.93	5.29	5.40	6.77	6.89	6.78
Crystal Brook to Dry Creek	4.46	4.64	4.57	7.66	8.53	7.82
Dry Creek – Crystal Brook	9.40	9.92	9.97	14.44	15.42	14.60
Crystal Brook to Port Augusta	6.73	7.11	6.86	7.87	8.46	8.17
Port Augusta to Crystal Brook	6.35	6.39	5.97	8.05	8.48	7.69
Crystal Brook – Port Augusta	13.08	13.49	12.83	15.92	16.94	15.86
Port Augusta to Tarcoola	6.84	7.25	6.87	7.23	7.89	7.94
Tarcoola to Port Augusta	6.44	6.42	5.89	7.31	8.21	8.54
Port Augusta – Tarcoola	13.29	13.67	12.75	14.54	16.10	16.48
Tarcoola to Kalgoorlie	5.27	5.69	5.55	5.60	5.98	6.03
Kalgoorlie to Tarcoola	4.35	4.39	4.21	4.90	4.89	4.83
Tarcoola – Kalgoorlie	9.62	10.08	9.76	10.49	10.87	10.85
Kalgoorlie to West Kalgoorlie	5.28	5.69	5.69	6.78	7.32	7.33
West Kalgoorlie to Kalgoorlie	4.36	4.40	4.26	6.14	6.13	6.04
Kalgoorlie – West Kalgoorlie	9.65	10.10	9.95	12.93	13.45	13.36
West Kalgoorlie to Koolyanobbing East	5.21	5.60	5.69	9.37	11.11	10.25
Koolyanobbing East to West Kalgoorlie	4.30	4.33	4.21	16.94	20.69	18.24
West Kalgoorlie – Koolyanobbing East	9.51	9.93	9.89	26.31	31.80	28.48
Koolyanobbing East to West Merredin	5.21	5.57	5.64	7.28	8.13	7.82
West Merredin to Koolyanobbing East	4.30	4.33	4.21	7.04	7.10	7.07
Koolyanobbing East – West Merredin	9.51	9.91	9.84	14.32	15.23	14.88

	Million gross tonnes					
	Intermodal			Total		
Line segment, by direction of freight	**2019–20**	**2017–18**	**2018–19**	**2019–20**	**2020–21**	**2022–23**
West Merredin to Avon	5.22	5.54	5.65	8.94	9.89	9.57
Avon to West Merredin	4.29	4.33	4.21	7.51	7.51	7.55
West Merredin – Avon	9.51	9.87	9.85	16.45	17.40	17.12
Avon to Toodyay West	5.22	5.61	5.65	12.80	13.72	14.09
Toodyay West to Avon	4.29	4.33	4.20	8.57	8.61	8.81
Avon – Toodyay West	9.51	9.95	9.85	21.37	22.32	22.90
Toodyay West to Millendon Junction	5.22	5.60	5.65	13.14	13.97	14.10
Millendon Junction to Toodyay West	4.30	4.33	4.20	8.69	8.70	8.82
Toodyay West – Millendon Junction	9.52	9.93	9.85	21.83	22.67	22.92
Millendon Junction to Midland	5.22	5.63	5.65	13.86	14.54	14.72
Midland to Millendon Junction	4.30	4.33	4.20	8.92	8.87	9.02
Millendon Junction – Midland	9.52	9.96	9.85	22.78	23.42	23.74
Midland to Woodbridge South	5.23	5.64	5.64	13.69	14.43	14.59
Woodbridge South to Midland	4.30	4.33	4.20	8.74	8.73	8.86
Midland – Woodbridge South	9.53	9.97	9.84	22.43	23.16	23.46
Woodbridge South to Forrestfield	5.24	5.65	5.64	13.82	14.53	14.70
Forrestfield to Woodbridge South	4.31	4.33	4.20	8.86	8.83	8.97
Woodbridge South – Forrestfield	9.55	9.99	9.84	22.69	23.35	23.66

Note: Totals are subject to rounding.
See attached spreadsheet for longer time series.

Sources: Data provided by ARTC and Arc Infrastructure.

Figure 3 Total below rail gross tonnes on the interstate network, by line segment, 2021–22



Sources: Data provided by ARTC and Arc Infrastructure.

The following explains some variations in intermodal traffic across the interstate network, in addition to market factors:

- Changing intermodal train composition: ARTC-provided intermodal tonnages are calculated from train type designations (for example 'intermodal' or 'minerals') that trains use, not on the actual products each train carries. Some Pacific National and SCT Logistics intermodal designated trains also carry steel products. This differs from the earlier practice where Pacific National 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 designated 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 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, almost 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. Pacific National operates shuttle trains from/to Sydney and Parkes, where it is consolidated and double stacked on other Sydney—Perth trains. Westbound traffic tends to travel via Lithgow on the Transport for NSW network and details of its tonnages is thus not captured, while eastbound traffic tends to travel via Cootamundra West, on the ARTC network, and details of its tonnages is captured.
- Higher intermodal traffic volumes west of Crystal Brook, where the Melbourne/Adelaide and Sydney/Parkes traffic to and from Perth and Adelaide-Darwin traffic share the track.
- Intermodal flows fall west of Tarcoola; the junction with the Darwin line.
- Some interstate capital city to capital city intermodal trains 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).

According to ARTC's and Arc Infrastructure's data, the following changes occurred to the intermodal task on their networks in 2021–22 compared to the previous financial year:

North—South corridor

- Tonnages on all sectors decreased in both directions of travel, except Acacia Ridge (Brisbane) to Casino and Casino to Islington, where tonnages increased by approximately one per cent in each sector. The greatest decreases were southbound traffic on the sectors from Chullora (Sydney) to Tottenham (Melbourne). Decreases ranged from 6.46 per cent (Macarthur to Tahmoor and Tahmoor to Moss Vale) to 13.95 per cent (Albury to Tottenham), at an average across all southbound sectors of 8.94 per cent.

East—West corridor

- Tonnages decreased on all sectors, except Tottenham to Dimboola, where tonnages increased by almost nine per cent, and onward westbound sectors between Dimboola and Crystal Brook, which had increases of 1-2 per cent. The greatest decreases happened on sectors between Parkes and Crystal Brook, where decreases ranged from approximately 9-12 per cent.
- While westbound intermodal tonnages west of Kalgoorlie show a very small increase, this may be due to data calculation methodology differences between ARTC and Arc Infrastructure and one operator offloading/onloading freight at Kalgoorlie.

Other significant freight flows are as follows:

- Grain movements join the network from various 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. Grain movements occur in Victoria, from both receival sites in Victoria and southern New South Wales. Harvest sizes contribute to variations in the size of the freight task and these sizes can fluctuate significantly depending how much rainfall has occurred during a given season. Such variations flow through to the rail task.
- Minerals traffic contributes to tonnages in New South Wales.
- Aggregate, sand and limestone quarries in the southern New South Wales Southern Highlands boost tonnages between Macarthur and Goulburn.
- Iron Ore from Mount Walton from the Yilgarn Region in Western Australia contributed a major proportion of tonnages on the West Kalgoorlie—Koolyanobbing East line segment, but this task is declining.
- Intermodal freight on regional trains.

There were significant fluctuations in other tonnages across sectors in the interstate network. Some sectors had significant increases while others had (significant) decreases. Notable changes were:

North—South corridor

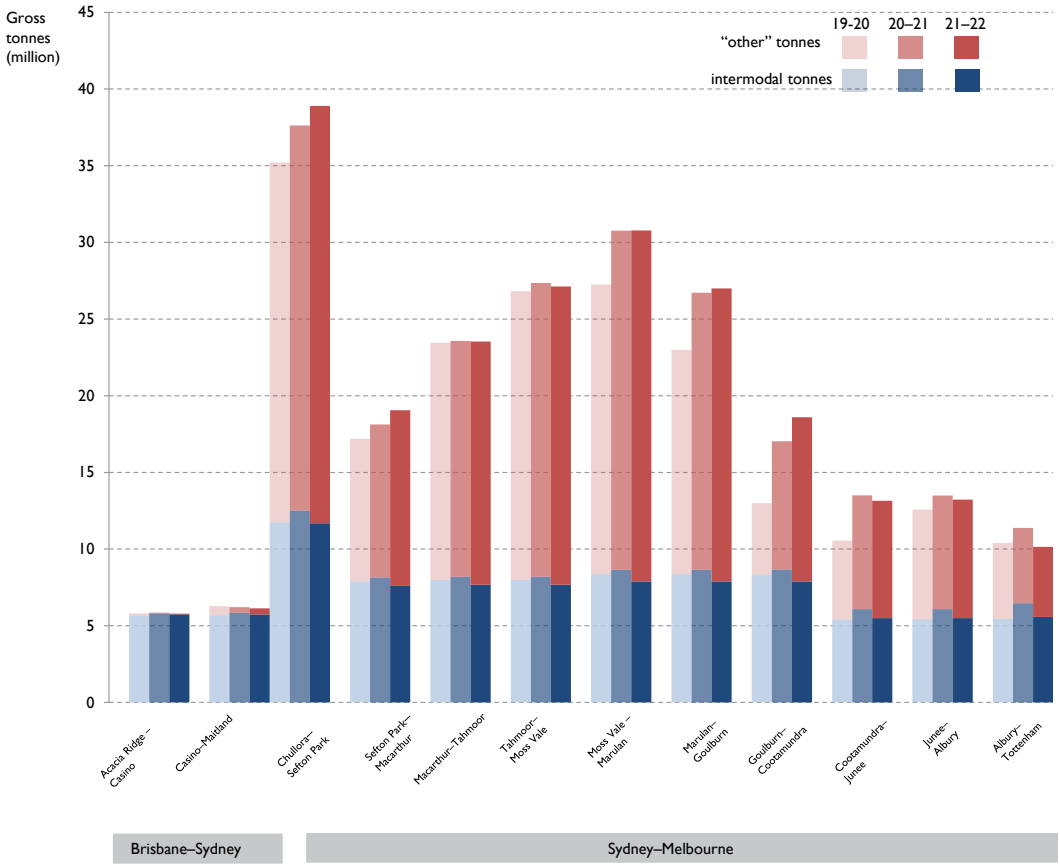
- Tonnages increased on all sectors between Casino and Cootamundra, in both directions of travel. The Cootamundra to Goulburn sector had the greatest increase, at almost 29 per cent. Between Acacia Ridge and Casino, tonnages were unchanged for both directions of travel.
- Cootamundra to Junee tonnages increased by approximately 10.3 per cent, while it decreased by approximately 2.8 per cent for the opposite direction of travel.
- Tonnages from Junee to Albury and Albury to Tottenham increased by approximately 13.1 and 10.4 per cent respectively. For Tottenham to Albury and Albury to Junee, tonnages decreased by approximately 31.8 and 3.1 per cent respectively. According to advice from ARTC, the 31.8 per cent decrease was due partly to the cessation of drought related grain traffic travelling north from western Victoria, and a decline in rail infrastructure construction traffic near Seymour.

East—West corridor

- There were major increases, up to 41.5 per cent, on the sectors between Cootamundra and Broken Hill.
- On the Broken Hill-Crystal Brook sector, there was an approximate 5.3 per cent decrease in combined tonnages for both directions of travel.
- Between Tottenham and Dry Creek there were increases in all sectors for both directions of travel of between approximately 9.3 to 34.2 per cent, except Dimboola to Tottenham, which had a decrease of approximately 7.4 per cent. Similar to the Tottenham to Albury sector, the 34.2 per cent decline was partly due to the cessation of drought related grain traffic.
- Between Dry Creek and Port Augusta there were decreases on all sectors for both directions of travel of approximately 2.9 to 17.7 per cent.
- All sectors between Port Augusta Kalgoorlie had significant increases, for both directions of travel. This ranged from between approximately 24 to 67 per cent. This is due to increased minerals traffic to Whyalla entering the ARTC network at Tarcoola and the Aurizon operated Tronox mineral sands train services from Broken Hill to Kwinana, which began in January 2022[7].
- On the Kalgoorlie—Perth sectors, the West Kalgoorlie to Koolyanobbing East sector had a combined directions of travel decrease of 15 per cent, due to decreased iron ore traffic volumes. There were smaller decreases between Koolyanobbing East and West Merredin. Tonnages on all other sectors between Avon Yard and Perth grew slightly, on average by approximately 3.6 per cent.

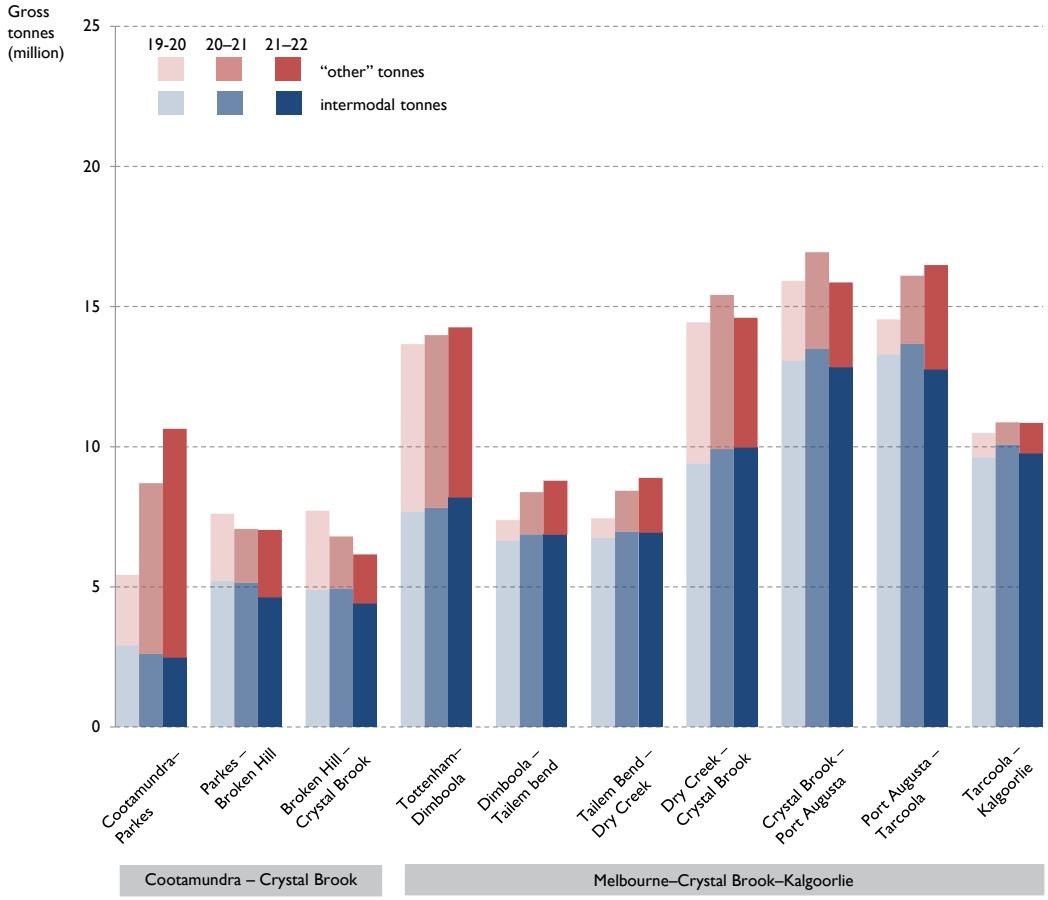
7 For more information on the Tronox services, see Rail Express (2022).

Figure 4 Gross tonnage on the North–South corridor, by line segment, 2019–20 to 2021–22



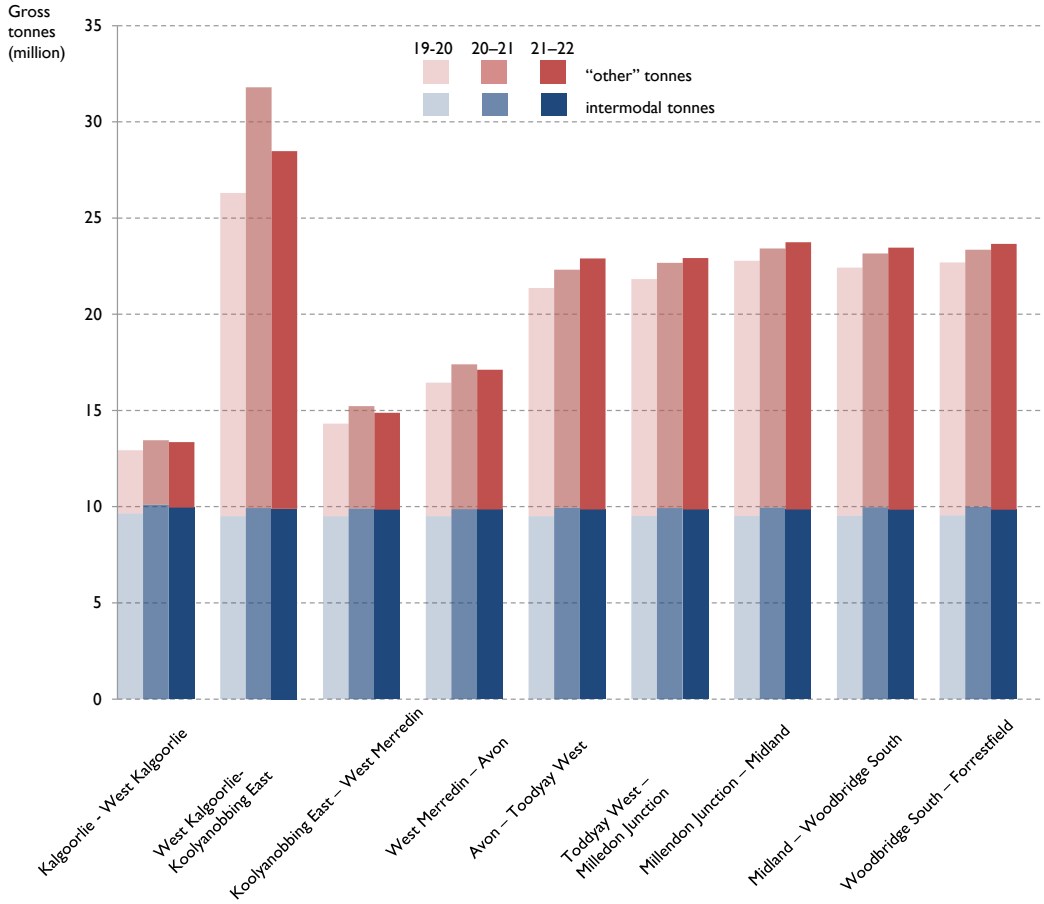
Source: Data provided by ARTC.

Figure 5 **Gross tonnage on the East–West corridor, by line segment, 2019–20 to 2021–22**



Source: Data provided by ARTC.

Figure 6 Gross tonnage on the East–West corridor, by line segment, 2019–20 to 2021–2022



Source: Data provided by Arc Infrastructure.

Figure 7 QUBE steel train

Note: The image above shows QUBE Melbourne to Wollongong steel train 7MW7 at Jerrawa in NSW in August 2023. (Photo courtesy of Rodney Avery)

Intermodal freight train reliability on the interstate network

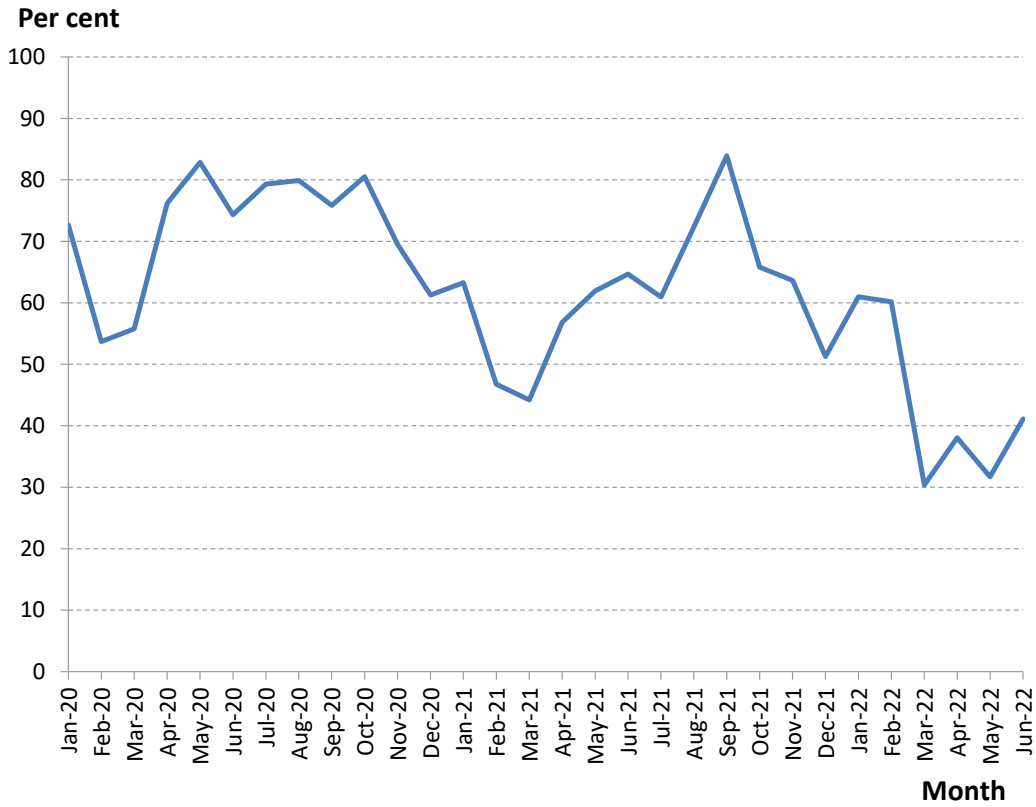
ARTC publishes performance indicators relating to service quality areas, including reliability. Detailed information regarding reliability by city pair is available on ARTC's website.

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 7 and Figure 8 show the percentage of intermodal train services that left the ARTC network within 30 minutes of schedule (reliability) between January 2020 and June 2022.

Figure 8 **North—South corridor, percentage of intermodal trains exiting the network within 30 minutes of schedule**

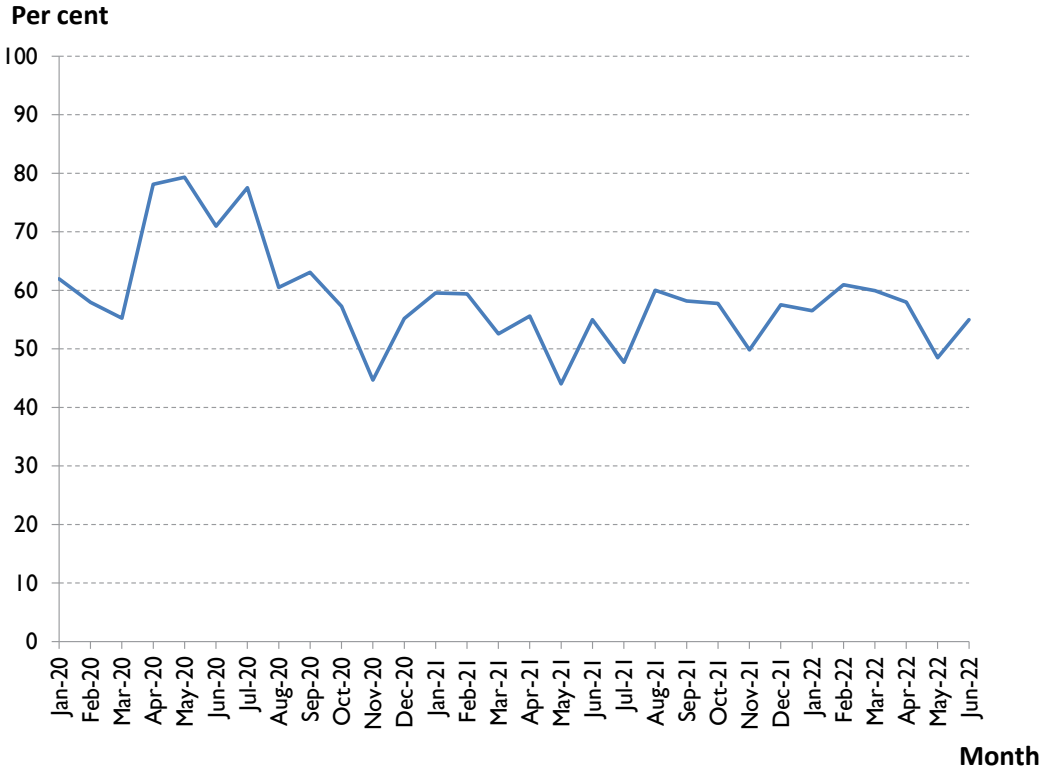


Note: See attached spreadsheet for longer time series.

Source: Data provided by ARTC.

As Figure 8 shows, reliability on the North—South corridor went into decline after October 2020, but began recovering from April 2021. It was at its highest in September 2021, at almost 84 per cent, before going again into decline. It was at its lowest in May 2022 at 32 per cent.

Figure 9 **East—West corridor, percentage of intermodal trains exiting the network within 30 minutes of schedule**



Note: See attached spreadsheet for longer time series.

Source: Data provided by ARTC.

Relative to the North—South corridor, there was less fluctuation in the reliability of train services on the ARTC managed East—West corridor sectors (Cootamundra West/Parkes—Kalgoorlie and Melbourne—Kalgoorlie). It was at its greatest in the months April to July 2020, where the average reliability was 76.5 per cent. From August 2020 to June 2022, reliability was on average 55.5 per cent.

Intermodal train frequency on the interstate network

Table 11, 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 the freight on the trains. For example, Melbourne—Perth trains dwell in Adelaide where freight is loaded and unloaded. Caution is also needed when comparing train numbers. Lower train numbers can be offset by longer train lengths.

The only changes in the number of scheduled services per week from 2022 are:

- Melbourne to Sydney: up by one;
- Sydney to Melbourne: up by one; and
- Brisbane to Melbourne: down by one.

Pacific National also runs shuttle trains from Sydney to Parkes (and return). For westbound services, the freight from these trains is added to other Sydney to Perth trains waiting at Parkes, from where double stacked 1800-metre trains can operate and are formed. The reverse happens for eastbound services at Parkes.

Table 11 Number of scheduled weekly intermodal designated train services, by city pair

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
North—South corridor											
Brisbane to Sydney	2	2	2	5	5	6	5	3	3	4	4
Sydney to Brisbane	0	0	2	5	5	4	5	2	2	2	2
Sydney to Melbourne	2	2	1	1	2	2	5	6	5	5	8
Melbourne to Sydney	2	2	0	0	0	3	5	5	3	2	6
Brisbane to Melbourne	15	15	16	12	16	16	10	10	11	11	10
Melbourne to Brisbane	16	16	16	12	16	16	10	10	12	13	13
Brisbane to Adelaide	2	2	2	2	2	1	2	2	2	2	2
Adelaide to Brisbane	2	2	2	2	2	1	2	2	2	2	2
East—West corridor											
Melbourne to Adelaide	9	8	6	6	5	5	5	5	5	6	6
Adelaide to Melbourne	9	9	6	6	6	5	5	5	5	6	6
Melbourne to Perth	20	20	20	18	18	15	13	13	15	16	16
Perth to Melbourne	20	20	20	19	19	15	14	14	15	16	16
Sydney to Perth	9	10	8	7	7	7	7	6	7	9	9
Perth to Sydney	9	10	9	7	7	7	7	6	7	9	9
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	6	6	6	6	6	6	6	6	6	6	6
Darwin to Adelaide	6	6	6	6	6	6	6	6	6	6	6

Notes: The figures, current in ARTC's February 2023 timetable, pre-date Aurizon's staged return of services on the East—West and North—South corridors, which started in April 2023.

Aurizon's recommenced intermodal services on the East—West and North—South corridors are excluded. This is because it began recommencing these services in April 2023, whereas the figures quoted above are what was current in February 2023.

Sources: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, UGL Regional Linx, and Aurizon) as at February 2023.

Table 11 shows the number of scheduled weekly interstate intermodal and steel trains on each line segment. This shows how intensely the interstate network is used, by schedule. Table 11 differs from Table 12 because it includes all interstate trains that travel along a given corridor, including those that continue on to another corridor, and steel trains. The Cootamundra—Melbourne sector also includes all Melbourne—Griffith intermodal services. For example, BITRE counts a train travelling from Melbourne to Perth on all line segments of that route.

Crystal Brook—Port Augusta remains the busiest segment. This is because it is a convergence point for interstate intermodal and steel trains travelling to and from Perth and Melbourne; intermodal trains to and from Sydney and Perth, and 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 most significant changes since 2022 are the three extra Melbourne to Sydney and two extra Sydney to Melbourne services QUBE operated services. BITRE previously excluded these intermodal designated services as they only carried cement and did not operate across the full Sydney—Melbourne corridor. These services now carry intermodal freight also and operate across the full Sydney—Melbourne corridor, hence their inclusion.

Other changes since 2022 are only minor and reflect the following service changes:

- One less Brisbane to Sydney and Brisbane to Melbourne each (intermodal);
- One more Wollongong to Brisbane (steel);
- One less Newcastle to Whyalla (steel);
- One more Pacific National Sydney to Melbourne and Melbourne to Sydney each (intermodal);
- One more Melbourne to Wollongong (steel);
- One less Melbourne to Junee (intermodal)[8]; and
- One more Junee to Melbourne (intermodal).

Table 12 Total scheduled weekly interstate intermodal and steel trains, by line segment

Line segment	2019	2020	2021	2022	2023
North—South corridor					
1. Brisbane-Sydney	46	40	42	50	48
2. Sydney-Melbourne					
Sydney-Cootamundra	72	63	64	64	70
Cootamundra-Melbourne	61	55	55	54	61
East—West corridor					
3. Sydney-Crystal Brook via Broken Hill					
Sydney-Parkes via Lithgow	6	9	9	11	11
Cootamundra-Parkes	22	18	19	21	20
Parkes-Crystal Brook	33	32	33	36	35
4. Melbourne – Crystal Brook					
Melbourne-Adelaide	43	43	45	48	48
Adelaide – Crystal Brook	52	52	54	54	54
5. Crystal Brook – Perth					
Crystal Brook – Port Augusta	76	76	78	83	82
Port Augusta – Tarcoola	60	58	63	70	70
Tarcoola-Perth	48	46	51	58	58

Sources: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, UGL Regional Linx, and Aurizon) as at February 2023.

8 'Melbourne-Cootamundra' includes Melbourne-Junee services, and Melbourne-Griffith services that depart/enter the North—South line at Junee.

Intermodal train flow patterns on the interstate network

Train flow indicators based on scheduled running times give information about the planned movement of trains across the network. Table 13, below, gives timetable information about intermodal designated services, which share the line with other trains such as bulk goods trains, steel designated trains and passenger trains. Changes to the nature and scale of other train 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 movement patterns is outside the scope of this publication. Actual times for individual trains may differ due to operational reasons.

Table 13 Scheduled inter-capital intermodal train flow patterns

Line segment/ direction	Number of weekly services		Average speed (kph)		Average number of stops		Average transit time (mins)		Average dwell time (mins)		Percentage dwell time (per cent)		Average dwell per stop (mins)	
Year	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**
North—South corridor														
Brisbane to Sydney	17	16	54	54	9	9	1085	1084	163	166	15	15	19	19
Sydney to Brisbane	17	17	55	54	6	7	1056	1075	144	169	14	16	22	25
Sydney to Melbourne	16	18	63	59	4	5	917	978	135	195	15	20	32	38
Melbourne to Sydney	15	19	68	70	3	3	843	828	66	62	8	8	24	20
Brisbane to Melbourne	11	10	58	55	13	14	2000	2104	287	386	14	18	21	27
Melbourne to Brisbane	13	13	61	60	10	10	1915	1938	241	266	13	14	24	27
East—West corridor														
Melbourne to Adelaide	22	22	68	68	3	3	736	738	55	51	7	7	19	18
Adelaide to Melbourne	22	22	59	58	5	6	850	860	150	159	18	20	28	28
Adelaide to Perth	16	16	64	64	14	14	2505	2497	362	352	14	14	26	26
Perth to Adelaide	16	16	59	58	16	17	2695	2751	655	706	24	26	40	41
Melbourne to Perth	16	16	62	62	17	17	3359	3361	618	618	18	18	36	36
Perth to Melbourne	16	16	52	51	23	24	4008	4057	1256	1308	31	32	53	54
Sydney to Perth (via Lithgow)	8	8	64	64	18	18	3730	3730	697	700	19	19	40	38
Sydney to Perth (via Cootamundra West)	1	1	65	65	26	23	3991	3991	798	802	20	20	31	35
Perth to Sydney (all via Cootamundra West)	9	9	59	59	23	22	4213	4214	1095	1103	26	26	48	50
Brisbane to Adelaide (via Lithgow)	1	1	51	51	14	14	3105	3105	922	907	30	29	66	65
Brisbane to Adelaide (via Cootamundra West)	1	1	54	54	17	17	3145	3145	839	838	27	27	49	49
Adelaide to Brisbane (via Cootamundra West)	2	2	52	52	13.5	13.5	3241	3241	915	916	28	28	68	68
Central corridor														
Adelaide to Darwin	6	6	69	68	6	7	2564	2627	360	419	12	16	57	64
Darwin to Adelaide	6	6	65	65	9	9	2748	2745	446	469	16	17	51	54

Notes: 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.

Sources: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, UGL Regional Linx, and Aurizon) as at February 2023.

North–South corridor

Notable changes from 2022 are as follows:

- Average transit times from Sydney to Brisbane have increased by 19 minutes. This is largely due to some services dwelling considerably longer at Taree (crew change point) than in 2022.
- Average transit times from Sydney to Melbourne have increased by an hour. This is due to some services dwelling considerably longer at a point en route where they take on and offload freight, and the effect of changes to the number of services operating.
- Average transit times from Melbourne to Sydney have decreased by 15 minutes.
- Average transit times from Brisbane to Melbourne have increased by 104 minutes. This is largely due to some services dwelling considerably longer at a point en route where they take on and offload freight.
- Melbourne to Brisbane average transit times have increased by 23 minutes. This too is largely due to some services dwelling considerably longer at Taree (crew change point) than in 2022.
- Brisbane to Sydney average transit times and running patterns are largely unchanged.

East–West corridor

Notable changes from 2022 are as follows:

- Average transit times for Perth to Melbourne services increased by 49 minutes, due to an average one extra stop en route, with slightly increased dwell times and dwells time per stop.

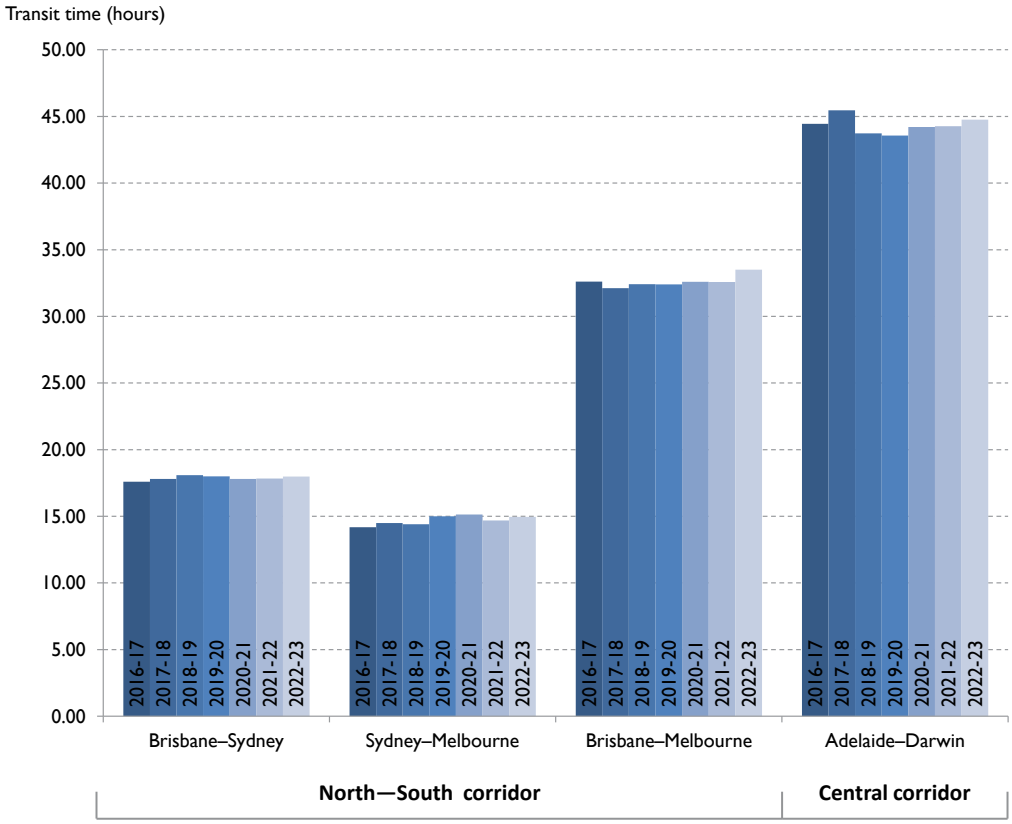
Central corridor

There have been no significant changes in travel patterns since 2022.

Figure 10 QUBE Melbourne to Sydney intermodal service

Note: The image above shows QUBE Melbourne to Sydney intermodal service 6MS7 passing through Gunning in NSW on 27 October 2023. (Photo courtesy of Rodney Avery)

Figure 11 Average scheduled transit times, North–South and Central corridors, 2016–17 to 2022–23

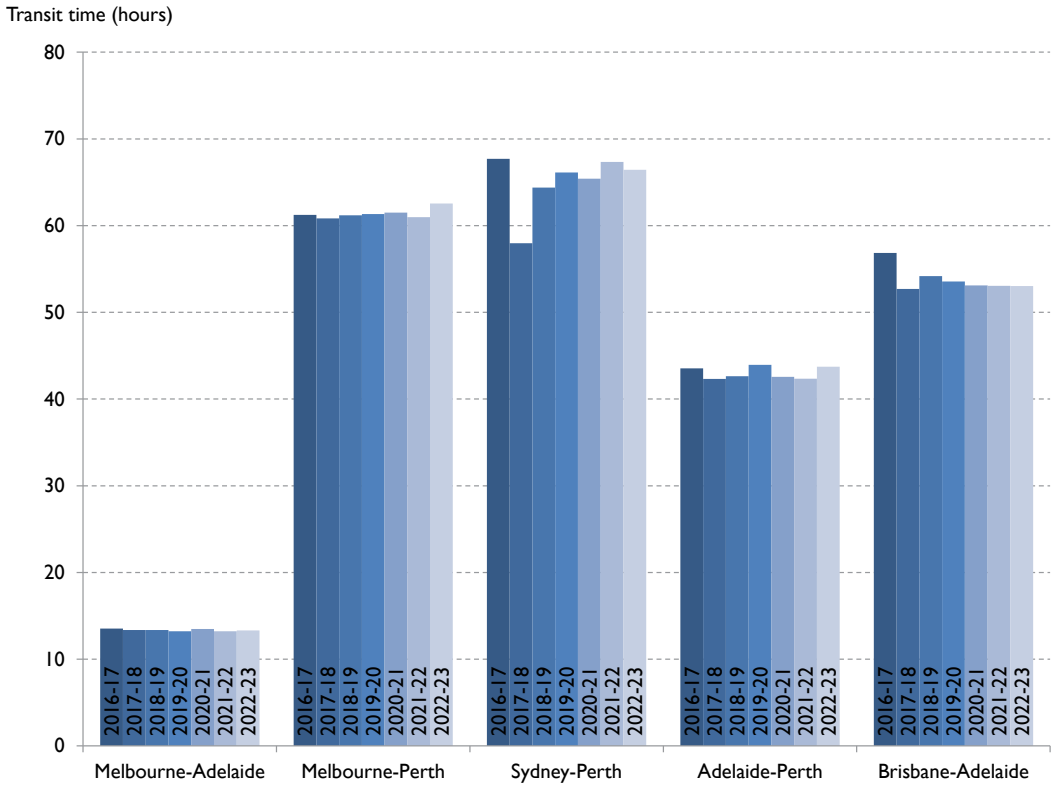


Notes: Calculations include all intermodal designated trains on a given line segment travelling in both directions. The Sydney–Melbourne calculations, for example, include Brisbane–Melbourne trains.

See attached spreadsheet for longer time series

Sources: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, UGL Regional Linx, and Aurizon) as at February 2023.

Figure 12 Average scheduled transit times, East–West corridors, 2016–17 to 2022–23



Notes: Calculations include all trains on a given line segment. The Melbourne–Adelaide calculations therefore include Melbourne–Perth trains.

All but one scheduled Perth to Sydney service per week travels via Lithgow. The other service travels via Cootamundra West. All scheduled Sydney to Perth services travel via Cootamundra West. The figures shown for 2021–22 and 2022–23 is the average of all services, including the westbound service that travels via Cootamundra West.

See attached spreadsheet for longer time series.

Sources: Working timetables of infrastructure managers (ARTC, Sydney Trains, Arc Infrastructure, and UGL Regional Linx) as at February 2023.

Figure 13 Perth to Sydney intermodal train

Note: The image above shows Perth to Sydney intermodal service 4PS6 at Goulburn, NSW, on a freezing July afternoon in 2023. This service would have run double stacked from Perth to Goobang in NSW, where double stacking was removed, due to lower clearances for the onward journey to Sydney. From Goobang, it travelled to Sydney via Cootamundra West and the Main South line through Goulburn. (Photo courtesy of Rodney Avery)

Intermodal train actual running times

This section compares actual running times of all timetabled Melbourne to Brisbane and Brisbane to Melbourne intermodal designated services against scheduled times, as shown in the ARTC Master Train Plan (timetable), and Sydney Trains freight timetable. The comparison is for the period 1 April – 30 June 2023. BITRE used the online 4Trak tool for extracting the trip details from which it did its analysis. For the purposes of this analysis, 'Brisbane' includes the Acacia Ridge intermodal terminal in suburban Brisbane and the Bromelton intermodal terminal, which is located approximately 50 kilometres south of Brisbane. 'Melbourne' includes the South Dynon and Laverton intermodal terminals.

4Trak sometimes had either no record or only a partial record for a given service. This is why the results, shown in Table 14 and Table 15, below, list more scheduled services than fully recorded actual services and why the number of services results do not always balance. The fact there is no record of a given service does not in itself mean there was no service[9]. It just means there is no record (available) of the service under the train's identifier.

9 It is not known why there are sometimes no records or only partial records for a given service. BITRE in no ways claims or suggests there is a problem with 4Trak when this happens.

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. The number of fully recorded services figures are for those services for which there is a complete trip record only.

The analysis recorded and assessed the following:

- the time trains[10] commenced their journey;
- the 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 14 and Table 15, below, show the results, noting the number of scheduled services is the sum of those recorded on the corresponding ARTC Mater Train Plan for the assessed period. Services that commenced their journey before 1 April 2023 (and therefore completed it after 1 April 2023) are excluded. Services that commenced their journey before 30 June 2023 (and therefore completed it after 30 June 2023) are included.

There was one scheduled northbound service and one scheduled southbound service per week that did not operate at all throughout the entire reporting period. These two services are excluded from the scheduled number of services totals. The analysis also excludes services that may have run but did not appear in the timetables. This is because there were no published scheduled times that would have been needed for comparison purposes.

There were two operators running Melbourne—Brisbane services during the period assessed. The results are aggregated. No operator specific results are shown.

Table 14 Northbound train results

Number of scheduled services	156	Average scheduled transit time (days, hours, minutes)	1 days, 08:01
Number of fully recorded services	112	Average recorded transit time	1 days, 10:06
Number of services with travel time faster than schedule or the same as schedule	21		
Number of services with travel time up to and including 30 minutes slower than schedule	14		
Number of services with travel time more than 30 minutes slower than schedule	77		
Average early departure from Melbourne (hours, minutes)	00:39	Number of services departing on time or earlier than schedule	44
Average late departure from Melbourne	03:42	Number of services departing 30 minutes or less than schedule	30
		Number of services departing more than 30 minutes later than schedule	42
Average early arrival at Brisbane	00:26	Number of services arriving on time or earlier than schedule	23
Average late arrival at Brisbane	05:31	Number of services arriving 30 minutes or less than schedule	10
		Number of services arriving more than 30 minutes later than schedule	80

10 All times were standardised to Eastern Standard Time.

Table 15 Southbound train results

Number of scheduled services	128	Average scheduled transit time	1 days, 10:47
Number of fully recorded services	98	Average recorded transit time	1 days, 09:37
Number of services with travel time faster than schedule or the same as schedule	75		
Number of services with travel time up to and including 30 minutes slower than schedule	8		
Number of services with travel time more than 30 minutes slower than schedule	15		
Average early departure from Brisbane (hours, minutes)	00:10	Number of services departing on time or earlier than schedule	60
Average late departure from Brisbane	03:33	Number of services departing 30 minutes or less later schedule	12
		Number of services departing more than 30 minutes later than schedule	30
Average early arrival at Melbourne	01:52	Number of services arriving on time or earlier than schedule	59
Average late arrival at Melbourne	04:23	Number of services arriving 30 minutes or less later than schedule	4
		Number of services arriving more than 30 minutes later than schedule	35

The tables show the following key findings for the recorded services.

Northbound services:

- On average, transit times were approximately two hours longer than schedule.
- Almost 19 per cent of services completed their journeys faster than schedule or the same as scheduled to the minute (one service). Approximately 12.5 per cent of services completed their journeys 1–30 minutes longer than schedule. Almost 69 per cent of services completed their journeys more than 30 minutes longer than schedule.
- Approximately 38 per cent per cent of services departed Melbourne early or on time to the minute. Approximately 27 per cent departed 1–30 minutes later than schedule. Approximately 36 per cent of services departed more than 30 minutes later than schedule.
- Approximately 20 per cent of services arrived into Brisbane early or on time to the minute. Approximately nine cent of services arrived 1–30 minutes later than schedule. Approximately 71 per cent of services arrived more than 30 minutes later than schedule.
- When comparing journey times to departure and arrival times, it can be seen that, on average, train services tended to lose time between Melbourne and Brisbane. (For example, while, on average, 75 per cent of services departed Melbourne early, on time, or no more than 30 minutes later than schedule, 71 per cent of services arrived into Brisbane more than 30 minutes later than schedule.

Southbound services:

- Average actual transit times were about one hour less than schedule.
- Approximately 76.5 per cent of services completed their journeys faster than schedule[11]. Approximately eight per cent completed their journeys 1–30 minutes longer than schedule and approximately 15.5 per cent of services completed their journeys more than 30 minutes longer than schedule.
- Almost 60 per cent of services departed Brisbane early or on time to the minute. Approximately 11.5 per cent departed 1–30 minutes later than schedule. Approximately 29.5 per cent of services departed more than 30 minutes later than schedule.
- Approximately 60 per cent of services arrived into Melbourne early or on time to the minute. Approximately four cent of services arrived 1–30 minutes later than schedule. Almost 36 per cent of services arrived more than 30 minutes later than schedule.
- When comparing journey times to departure and arrival times, it can be seen that while approximately 60 per cent of services departed early or on time, approximately 75 per cent of services completed their journeys at or faster than scheduled transit times. This suggests that services tended to either maintain or gain time between Brisbane and Melbourne.

When comparing the results for each direction of travel, it can be seen southbound services tended to be more timely than northbound services.

BITRE is able to provide more detailed analysis of the results, such as by month or day of the week, upon request.

Bulk rail freight traffic, by commodity

Iron ore and coal are the rail industry's two largest bulk freight flows.

Iron ore traffic

Australia exports most of its iron ore,[12] almost all of which is moved to port by rail. The scale of the task means rail is best suited for transporting iron ore from mine to port. 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, 2014a). For discussion of the iron ore railway's infrastructure see Chapter 5 – Infrastructure.

Table 16 Iron ore exports, million tonnes, 2021–22

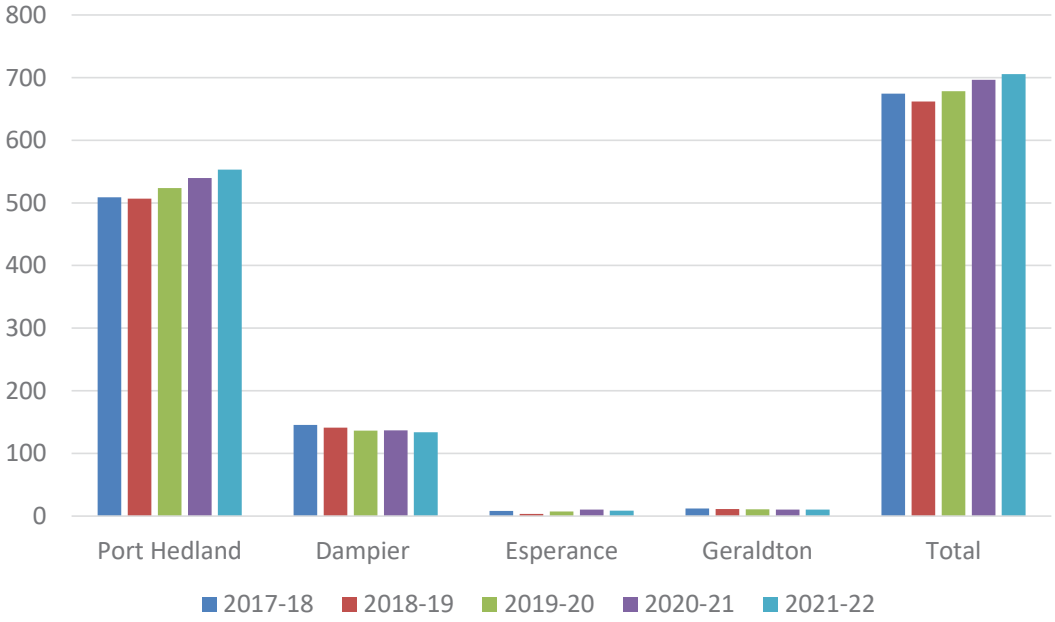
	2020–21	2021–22	Change
Port Hedland	53w8	553.30	2.50%
Dampier	136.6	133.7	-2.12%
Esperance	10.19	8.58	-15.80%
Geraldton	10.121	10.3	1.77%
Total	**696.711**	**705.88**	**1.32%**

Sources: Pilbara Ports Authority (2023); Southern Ports (2022, p.29); Mid West Ports (2022), p.58

11 No service's transit time was the same as the scheduled transit time.

12 There are two domestic manufacturers of steel, Liberty and BlueScope Steel, with a blast furnace at Whyalla and Port Kembla, respectively. Liberty 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.

Figure 14 Iron ore exports (million tonnes) by financial year



Note: See attached spreadsheet for time series.

Sources: Pilbara Ports Authority (2023); Southern Ports (2022, p.29); Mid West Ports (2022), p.58.

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)[13]. For more discussion on the coal network infrastructure, see Chapter 5 – Infrastructure.

Aurizon and Pacific National dominate coal haulage, with involvement also by Bowen Rail Company (Queensland), Southern Shorthaul Railroad (New South Wales),[14] and TasRail. Aurizon is the main operator in Queensland, while Pacific National dominates in the Hunter Valley. Coal extracted in Tasmania is used domestically.

Table 17 shows coal export volumes by port for 2021–22 and Figure 15 shows port specific coal exports over the five years 2017–18 to 2021–22.

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

14 Bowen Rail Company operates coal trains in Queensland for Bravus Mining and Resources, while Southern Shorthaul Railroad operates coal trains in New South Wales for Centennial Coal.

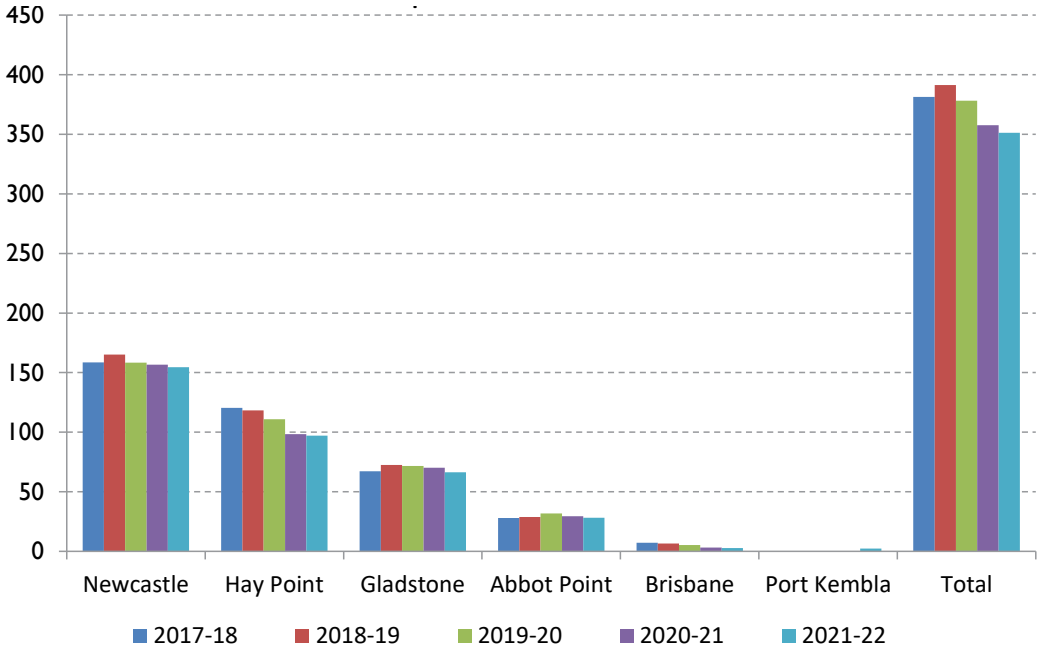
Table 17 Coal exports, by principal ports, (million tonnes), 2021–22

Newcastle[a]	Hay Point	Gladstone	Abbot Point	Port Kembla	Brisbane
154.5	97.1	66.4	28.2	2.3	2.8

Note: Previous results for the Port of Newcastle were for calendar years. The results shown here are for the 2021–21 financial year.

Sources: Port of Newcastle (2023); North Queensland Bulk Ports Corporation (2022), pp.10-11; Gladstone Ports Corporation (2023); Port of Brisbane (2023); advice from NSW Ports.

Figure 15 Coal exports by financial year



Note: Previous results for the Port of Newcastle were for calendar years. The results shown here are for the 2021–21 financial year.

See attached spreadsheet for longer time series.

Sources: Port of Newcastle (2023); North Queensland Bulk Ports Corporation (2022), pp.10-11; Gladstone Ports Corporation (2023); Port of Brisbane (2023); previous editions of Trainline.

Grain traffic

Another major role for Australia's railways is hauling agricultural produce from rural areas to ports for export and, to a lesser extent, domestic consumption. Following bumper harvests rail's grain haulage task increases significantly. 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 or when taking grain from farmgate to consolidation point.

Figure 16 shows grain flows by rail. This traffic largely uses dedicated grain haulage branch lines of varying quality, which connect with main lines. In 2023, 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 rail transport 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 July 2023. 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 it is not shown.

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;
- 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 road transport;
- Increased number of farming cooperatives based around road transport;
- Rail industry restructuring, funding and ownership changes;
- Rail transport and infrastructure availability;

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)

- 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 poor quality 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 in the first place.

Figure 17 Pacific National grain train

Note: The image above shows outbound Pacific National grain train 9325 at Stockinbingal, en route to Combaning (Temora), NSW, at dawn on 18 November 2023. Photo courtesy of Rodney Avery.

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 both containerised and non-containerised. Examples of such non-containerised traffic includes SCT Logistics' louvre wagon trains for their palletised traffic, the Kilmore East quarry train, the Berrima—Maldon clinker train, the Railton—Devonport cement train, the Kevin—Thevenard gypsum train, and the Cooks River—Tarago garbage train. 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 rail 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)[17].

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

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 an 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). (SCT Logistics' daily container shuttle train from its Penfield intermodal terminal to the Port of Adelaide for Treasury Wines Estate is an example.) These local rail services also shift empty containers.
- 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.

Rail (and road) volumes of containers through the primary capital city ports are reported in BITRE's regular Waterline series. (BITRE, 2023a, gives the latest figures.)

Landbridge and regional movements

Port of Brisbane

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

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

In September 2023, Aurizon started Melbourne—Sydney—Brisbane intermodal freight rail services. At Brisbane, these services operate to/from the Brisbane Multimodal terminal at the Port of Brisbane. According to Aurizon, these services cater "...to a range of containerised freight, including local manufactured goods and produce together with import and export traffic, in a co-ordinated port-rail-terminal-rail-port service." (Aurizon, 2023b)

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:

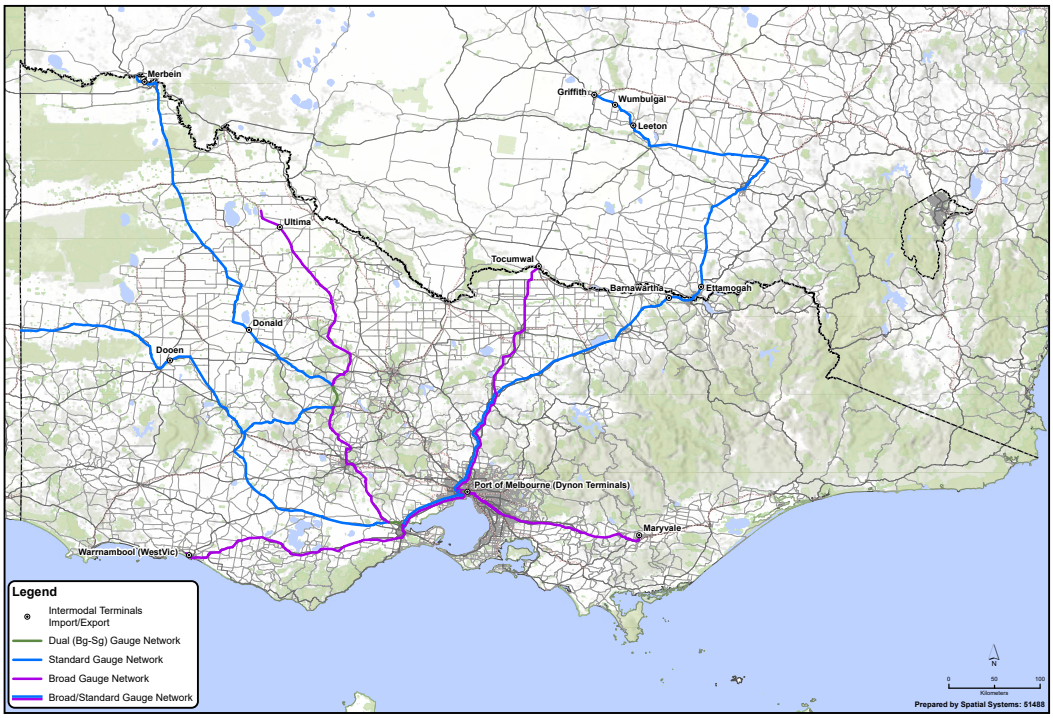
- Specialised grain, conveyed from Narrabri, Dubbo, Coonamble and Narromine;
- Viterra pack cereals (wheat and barley), oilseeds and pulses from Narrabri;
- Cotton from Warren South, Wee Waa, Narrabri, and Trangie South;
- Grain, oilseeds, pulses, and refrigerated meat from Dubbo;
- Containerised grain from Kelso (Bathurst);
- Grain, meat and other agricultural products from Werris Creek; and
- Paper, meat and other agricultural products, and timber from Bomen (Wagga Wagga)[18].

18 This traffic is from the Riverina Intermodal Fright and Logistics Hub that opened in December 2022. Paper products that were previously loaded on to trains at Harefield, about 15 kilometres from the hub, are now loaded at Bomen. For more information about the hub see https://wagga.nsw.gov.au/projects/past-projects/completed-projects/2022-projects/rifl.

Port of Melbourne

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



There are regional flows, both from within Victoria and from and southern New South Wales. Products transported by rail are as follows.

Intrastate Victoria.

- Merbein (Mildura) – grain, wine, grapes, fruit;
- Donald – peas, grain;
- Westvic Container Export Services, at Warrnambool – meat, dairy products, machinery and ingots;
- Wimmera Container Line, at Dooen (near Horsham) – grain, hay, and pulses;
- Maryvale in the Latrobe Valley – containerised paper;
- Ultima – hay, and grain; and
- SCT Logistics rail hub at Barnawartha – import/export trade for solar farms, grain, cotton, resin, meat, biodiesel, machinery and wine.

Due to the cessation of white paper production at Maryvale, rail services from Maryvale have decreased to three days per week instead of 13 services per fortnight. Additional services operate if required, due to additional demand. The previous twice weekly Ultima service, now only operates on an as needed basis.

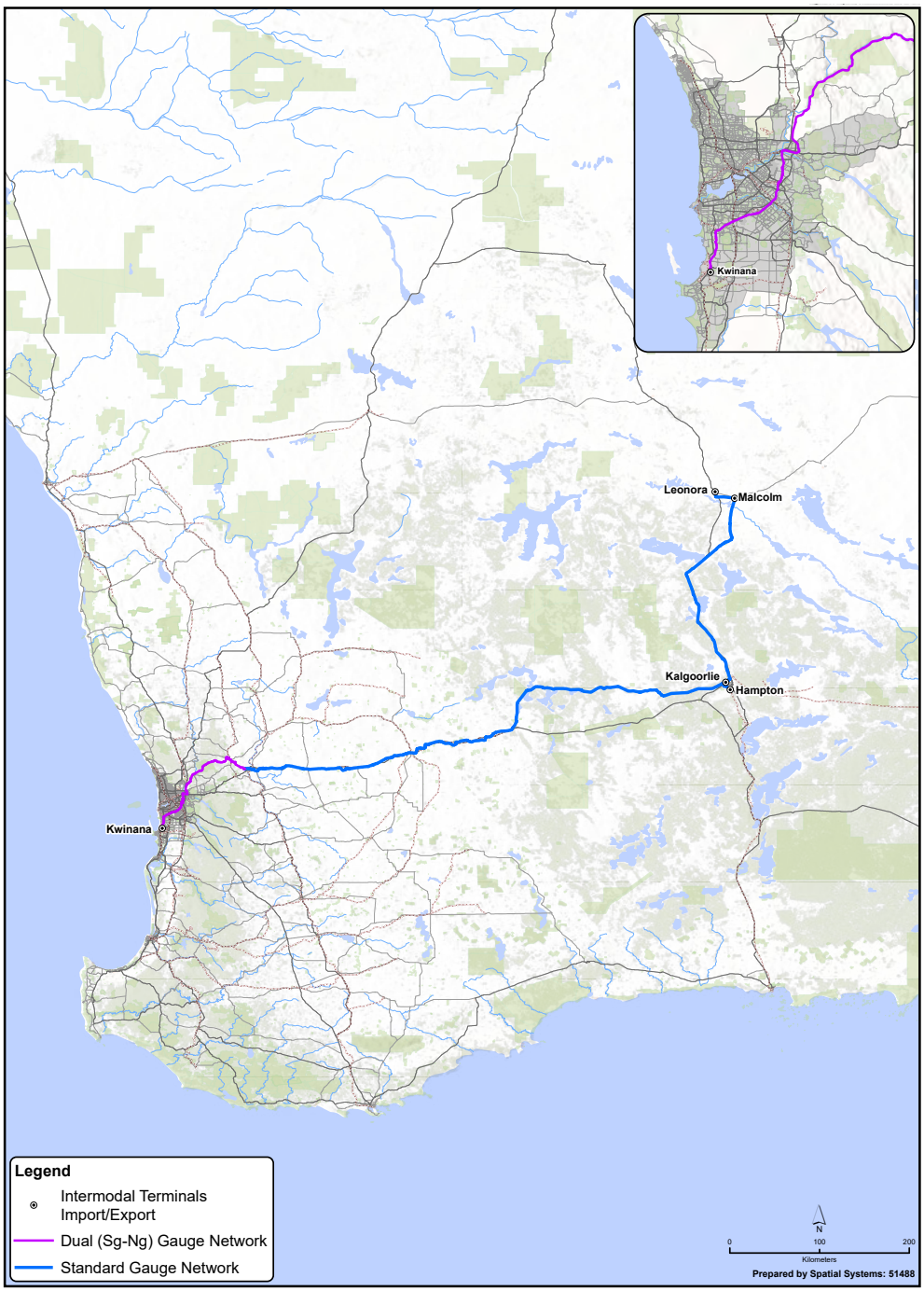
Southern New South Wales.

- Tocumwal – grain and hay[19];
- Griffith and the Wumbulgal terminal – containerised wine, rice, grain, cotton;
- Rice and pelleted feeds for animals, from Leeton; and
- Containerised paper and bottled water from the Ettamogah Rail Hub.

19 Previous rice, potatos, and dairy traffic on this line dropped off from late 2021 due to disruptions on the Shepparton line.

Kwinana

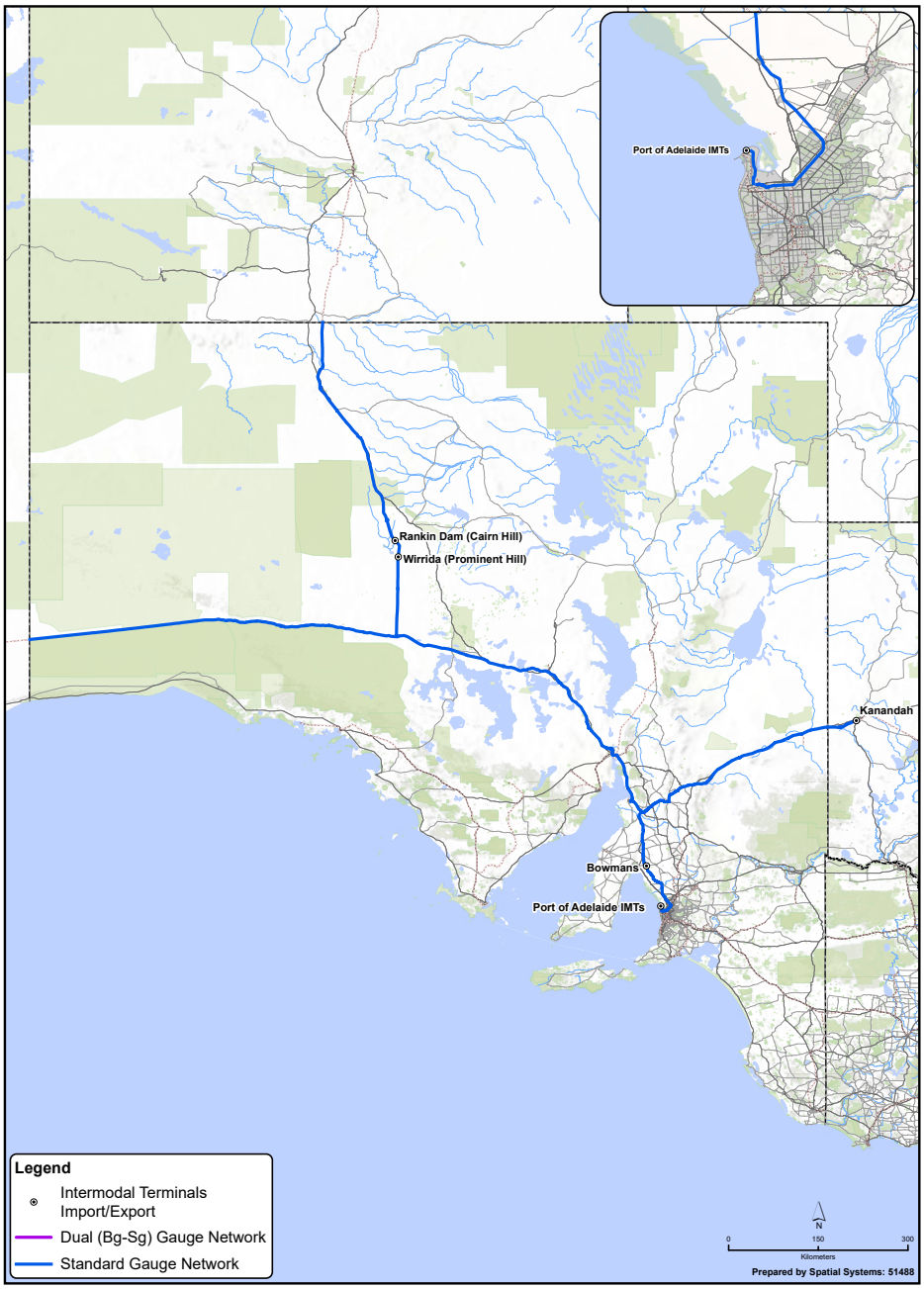
Figure 21 Rail container operations serving Kwinana



The primary regional container export flows are rare earth minerals and nickel from Leonora and Malcolm and nickel products from a nickel smelter south of Kalgoorlie.

Port Adelaide

Figure 22 Rail container operations serving Port Adelaide



There are regional maritime container traffic flows to Port Adelaide. Purpose-built containers are used to haul mineral sands, such as from Kanandah, near Broken Hill, to Port Flat. Minerals Sands are exported through Inner Harbor at Berth 29. The minerals sands travel to the port by rail in purpose built 20 foot bulk containers. One to two trains enter the port per week.

CBH resources use Bowmans Rail to deliver purpose-built containers with zinc concentrates from Rasp Mine at Broken Hill to Port Adelaide every two weeks.

According to advice from Bowmans Rail, regional trains operate between the Bowmans Rail's intermodal terminal (operated by Balco Australia) and the Flinders Adelaide Container Terminal (FACT) (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.

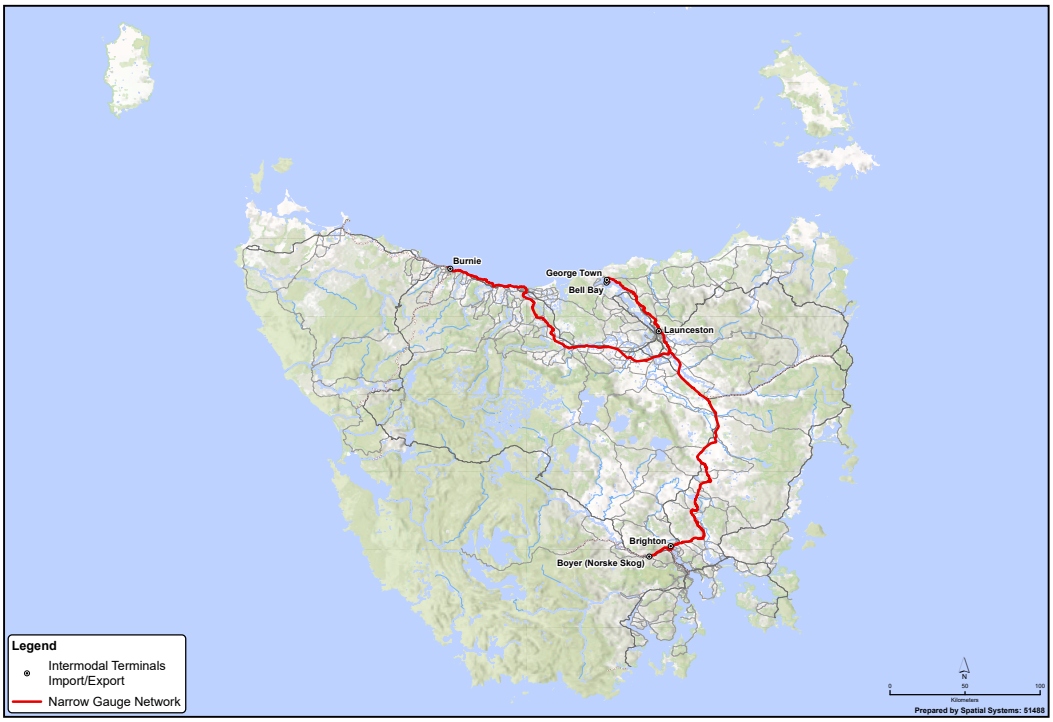
SCT Rail operates a service out of Penfield, on the northern outskirts of Adelaide, used predominantly for wine export (Treasury Wines), this service utilises the same corridor/time as Bowmans trains to the Outer Harbor.

Aurizon transports Oz Minerals copper concentrates for export from Prominent Hill in central South Australia to the Inner Harbour Port Adelaide Berth #29 bulk precinct. The product is transported from the mine to Wirrida by road, where it is transferred to rail transport.

Tasmania

TasRail operates the Tasmanian network, as a 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.

Figure 23 Rail container operations serving Tasmanian ports



Rail traffic terminals in Tasmania include:

- George Town: A multi modal-terminal with a container storage area capable of handling containerised general freight, metal ingots and bulk log freight. TasRail also has direct rail access to two woodchips mills within 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 hauls zinc ingots, bulk minerals concentrates, bulk cement, coal, finished paper products, sugar, recycled metal, glass bottles, fish food, fertiliser, construction materials, consumer goods, groceries and aluminium ingots.

Short-haul urban maritime container movements

Short-haul urban shuttle trains provide a rail link from seaports to nearby 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 include:

- 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 Western Australian Government subsidises (loaded) containers delivered by rail from intermodal terminals at Forrestfield and Kwinana into North Quay at Fremantle. Empty containers and non-metropolitan movements (excluding hay containers) 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 and each one-way service hauling up to 100 import/export containers. Aurizon operate 1–2 trains per day, five days per week between Kwinana and North Quay.

In March 2022, the proportion of containers at the port being moved by rail increased to a record 24.3 per cent. In the 2022–23 financial year, the share of containers transported by rail was 20.1%, surpassing the Western Australian's target of 20 per cent, with a peak of 23.5 per cent in May. (Fremantle Ports, 2023, p.6).

The (Melbourne) 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 a similar basis to 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 include 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.

The project's construction has been completed, but it has not yet been officially opened.

Following an agreement between Salta Properties and Victorian government, construction of a new intermodal terminal in the outer south eastern Melbourne suburb of Dandenong South was to start in 2021. The agreement involved 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 is to 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 October 2021, the media reported the actual cost would be $155 million with construction to commence by year's end with an estimated 24 months completion data (Australasian Transport News, 2021). In September 2022, Salta announced construction of the rail connection to the terminal gate had been completed as part of the Cranbourne line duplication project. (Salta, 2022).

Box 2 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, 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). (See https://www.bitre.gov.au/search?keys=waterline)

Chapter 3

Urban passenger transport results – heavy rail and light rail

Each of the mainland state capital cities operate urban heavy rail passenger rail services. Melbourne, Sydney, Adelaide, Canberra, the Gold Coast, and Newcastle operate light rail services. These services enable the mass movement of passengers. They provide an alternative to private cars, which minimises road congestion.

Patronage

Table 18 Urban rail patronage (millions of journeys), 2021–22

	Brisbane[a]	Sydney[b]	Melbourne[c]	Adelaide	Perth	Gold Coast	Canberra	Newcastle
Heavy rail	32	146	99.5	7.8	42.7	-	-	-
Light rail	-	17.4	82.9	5.5	-	6.3	2.3	.57

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.

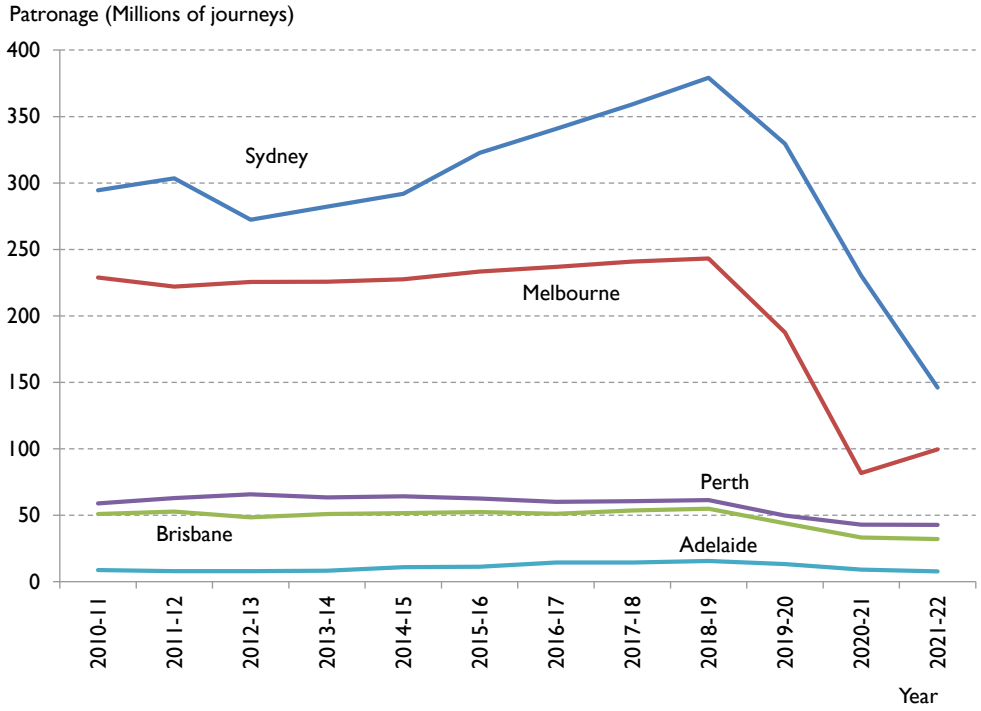
b. Sydney's patronage includes Sydney Metro services.

c. Melbourne's light rail patronage includes the CBD free travel zone.

Sources: Public Transport Authority of Western Australia (2022), p.18; Department of Transport, Victoria (2022), pp.160, 163; Department for Infrastructure and Transport (2022), p.38; Queensland Rail (2022), p.5; Canberra Metro Operations (undated); Department of Transport and Main Roads (2022), p.206; Sydney Trains (2022), p26; Transport for NSW (2022), p.24; advice from Transport for NSW.

Total urban heavy rail patronage for 2021–22 was approximately 328 million passenger journeys, down from 397 million passenger journeys the previous financial year. This was a reduction of almost 17.5 per cent. While a decline, the rate of decline was approximately half that of the previous financial year. Patronage fell in all cities except Melbourne, where patronage grew by almost 22 per cent. Sydney had the greatest decline – approximately 36 per cent, while Perth had the smallest – approximately 0.5 per cent.

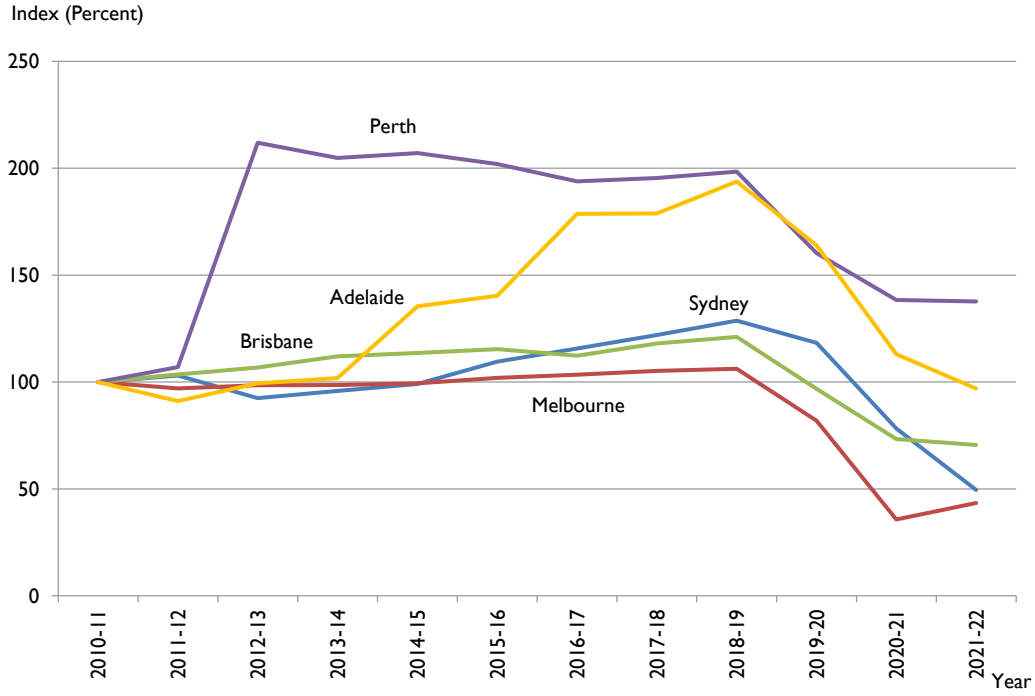
Figure 24 Heavy rail patronage in Australian cities



Note: See attached spreadsheet for time series.

Sources: Public Transport Authority of WA (2022), p.18; Department of Transport, Victoria, 2022, p.160; Department for Infrastructure and Transport (2022), p.38; Queensland Rail (2022); Sydney Trains (2022), p26; Transport for NSW (2022), p.24; historical annual reports.

Figure 25 Index of urban heavy rail patronage in Australian cities



Note: See attached spreadsheet for time series.

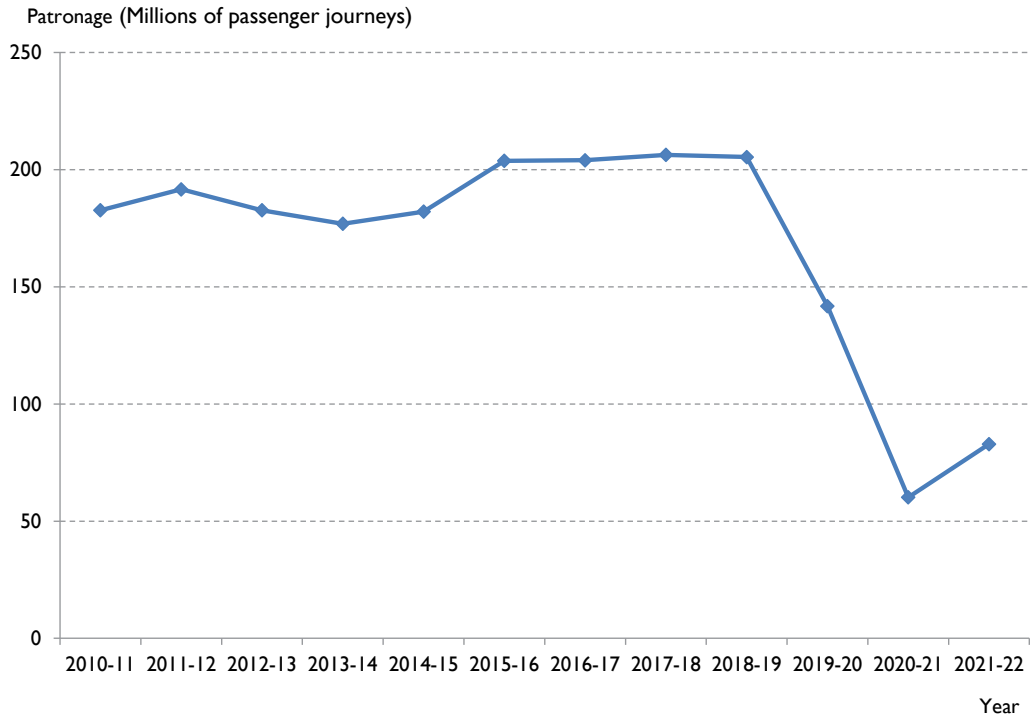
Sources: Index based on patronage data from previous Trainline editions; Public Transport Authority of WA (2022), p.18; Department of Transport, Victoria, 2022, p.160; Department for Infrastructure and Transport (2022), p.38; Queensland Rail (2022); Sydney Trains (2022), p26; Transport for NSW (2022), p.24.

Total light rail patronage for 2021–22 was approximately 115 million passenger journeys, an increase of approximately 24 per cent from the previous financial year. Melbourne, Sydney, and the Gold Coast experienced patronage growth, at approximately 38 per cent, 2.5 per cent, and 3.5 per cent respectively. Adelaide, Canberra, and Newcastle had patronage declines, at approximately 6.8 per cent, 21 per cent, and 22 per cent respectively. While Canberra and Newcastle had relatively large declines, their proportion of total patronage was such that patronage declines experienced had no major impact on total national patronage.

Canberra experienced its greatest patronage declines during the months of Canberra's COVID lockdown, which began in August 2021. For example, patronage in July 2021 was 41.5 per cent higher than the previous July, but in September 2021 patronage was 83 per cent lower than the previous September. As COVID restrictions eased, patronage began recovering. By June 2022, patronage was down 6.1 per cent compared to the previous June[20].

20 CMET, operator of Canberra's light rail services, publishes monthly patronage figures. These can be found at https://cmet.com.au/about/operational-performance/.

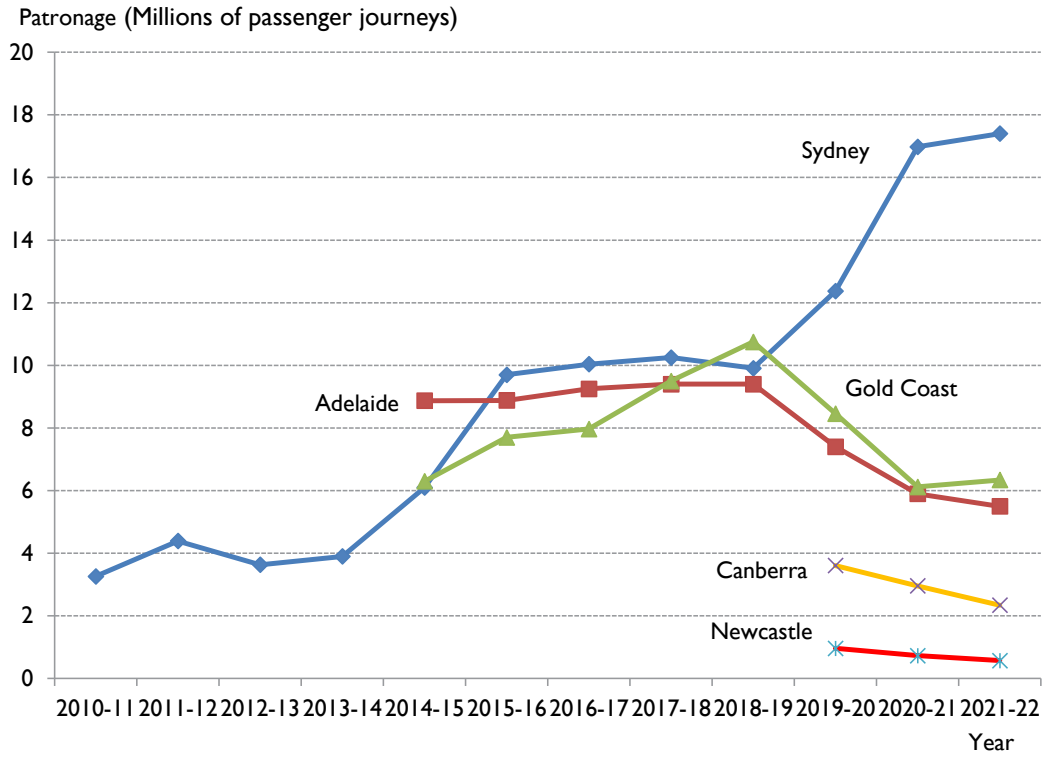
Figure 26 Melbourne light rail patronage



Note: See attached spreadsheet for time series.

Source: Department of Transport, Victoria, 2022, p.163; historical annual reports.

Figure 27 Sydney, Adelaide, Gold Coast, Canberra and Newcastle light rail patronage

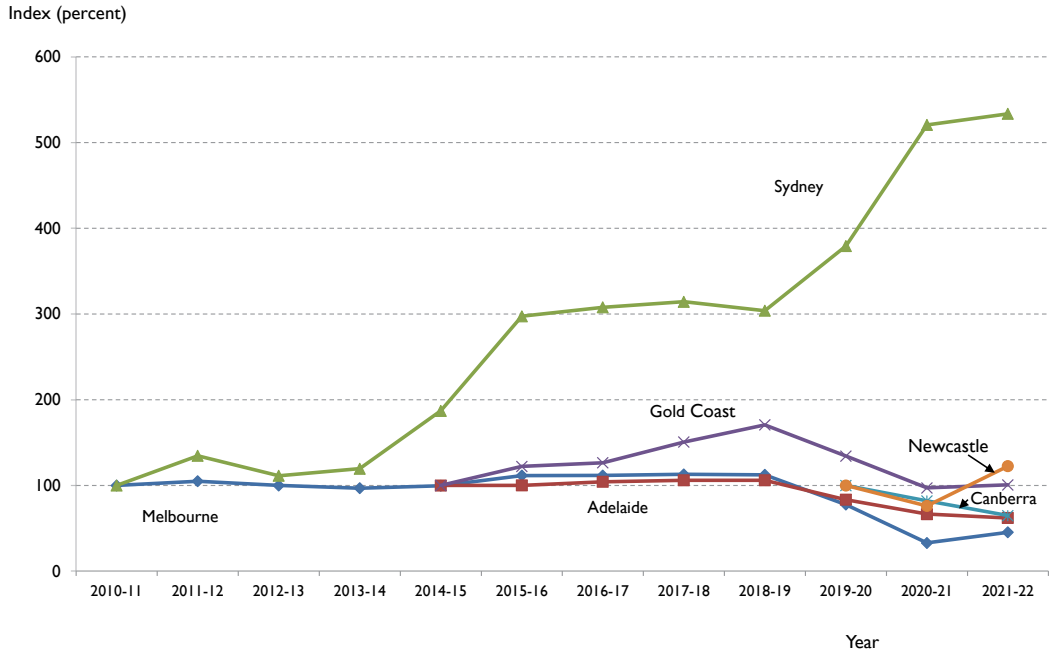


Note: Earlier data for Adelaide is not shown due to a patronage calculation methodology change.

See attached spreadsheet for time series.

Sources: Department for Infrastructure and Transport (2022), p.38; Canberra Metro Operations (undated); Department of Transport and Main Roads (2022), p.206; advice from Transport for NSW; historical annual reports.

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



Notes: The index base for Melbourne has been re-set to 2010-11.

See attached spreadsheet for time series.

Sources: Index based on patronage data from previous Trainline editions; Department of Transport, Victoria (2022), p.163; Department for Infrastructure and Transport (2022), p.38; Canberra Metro Operations (undated); Department of Transport and Main Roads (2022), p.206; advice from Transport for NSW; historical annual reports.

Commuting Mode Share

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.

Table 19 Urban rail journey-to-work mode shares, 2021

	Brisbane	Sydney	Melbourne	Adelaide	Perth	Canberra
Heavy rail (%)	4.8	8.9	6.3	1.7	6.5	-
Light rail (%)	-	0.2	2.0	0.6	-	1.7

Notes: All cities except Canberra refer to greater metropolitan areas. Canberra refers to Canberra and Queanbeyan.

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; or 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: Australian Bureau of Statistics (2022).

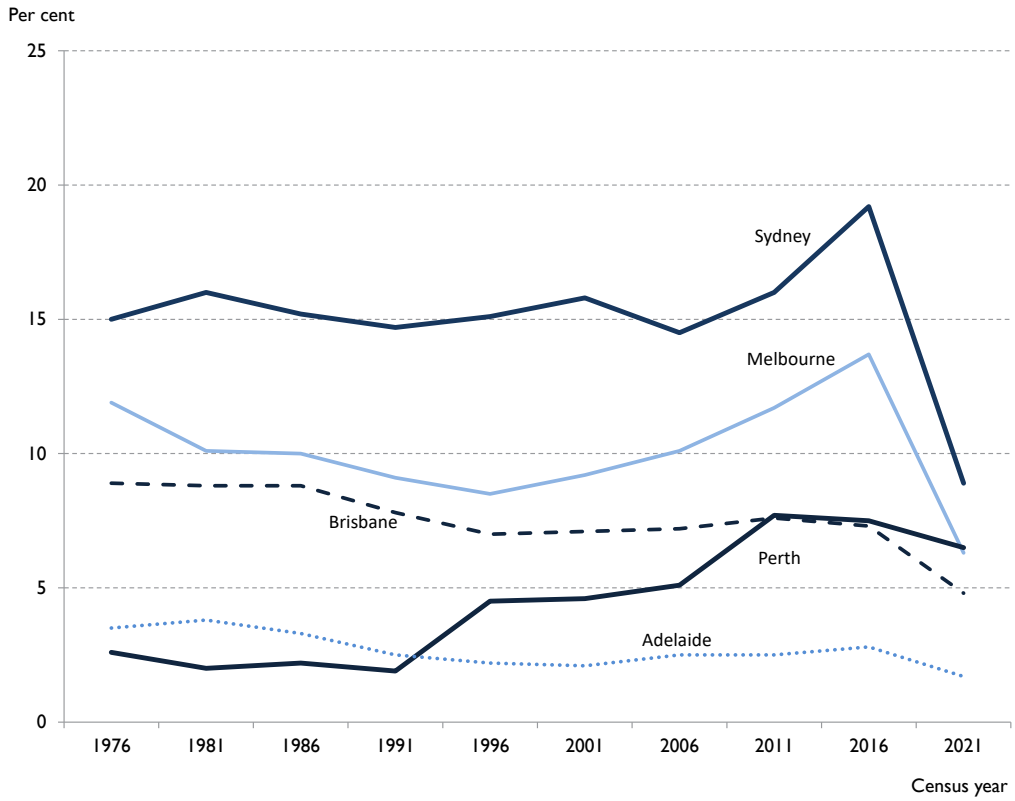
Following long-term declines in urban rail patronage for all cities from the mid-1970s, ridership began recovering in the 1990s. Figure 29, below, shows the journey-to-work mode share data for heavy rail, derived from the census results, since 1976.

In 2021, urban heavy rail's mode share decreased sharply in all cities compared to 2016, except Perth, which had a more modest decline. Details of these declines are as follows:

- Sydney: 54 per cent
- Melbourne: 54 per cent
- Brisbane: 34 per cent
- Adelaide: 39 per cent
- Perth: 13 per cent.

By way of comparison, mode share for travel by bus also halved in Sydney, Melbourne, and Brisbane, while it remained relatively unchanged in Adelaide and Perth. Travel by private motor vehicle as a proportion of total mode share, however, increased in each city.

Figure 29 Journey-to-work mode share, urban heavy rail, 1976–2021



Note: Cities refer to greater metropolitan areas.
See attached spreadsheet for time series.

Sources: Australian Bureau of Statistics (2022), Mees and Groenhart (2012).

Box 3 Further reading

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

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

Punctuality

Punctuality is important to rail's competitiveness. 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.

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. 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 20 Urban heavy rail punctuality, on time performance, 2021–22

	Result (%)	Target (%)	Measure
Sydney	92.1	92	At least 92% of peak services arrive within five minutes for Sydney Trains services and six minutes for NSW TrainLink (Intercity) services.
Sydney Metro	99.5	98	'Headway within tolerance'
Melbourne	95.2	92.5	Arriving at destination no later than 4 minutes 59 seconds late
Brisbane	95.7	95	Arriving within 3 minutes 59 seconds of schedule for suburban trains and within 5 minutes 59 seconds of schedule for inter-urban services
Adelaide	97.2	94	No more than 4 minutes 59 seconds after the timetabled arrival time at the destination
Perth	94.2	95	Arriving within 4 minutes of schedule

Sources: Department of Transport, Victoria (2022), p.145: Public Transport Authority of WA (2022), p.19; Queensland Rail (2022), p.12; Sydney Metro (2022), p.24; Adelaide Metro (undated); advice from Transport for NSW.

Table 21 Light rail punctuality, on time performance, 2021–22

	Result (%)	Target (%)	Measure
Sydney (Central Station-Dulwich Hill)	84	90	Headway achieved within a two-minute tolerance; headway being the time between two light rail vehicles.
Sydney (Circular Quay-Randwick and Randwick-Kingsford)	93	90	Headway achieved within a two-minute tolerance; headway being the time between two light rail vehicles.
Melbourne	89.1	79	Arrives no later than four minutes and 59 seconds after and departs no earlier than 59 seconds before the timetable
Adelaide	99.5	98	No more than 4 minutes 59 seconds after the timetabled arrival time at the destination
Gold Coast		95	Arriving within two minutes of schedule.
Canberra	99.8	98	Arriving at a measuring stop no more than 2 minutes after its scheduled arrival time
Newcastle	n/a	n/a	Neither early nor late. Early is departing before the scheduled departure time and late is departing more than 59 seconds after the scheduled departure time.

Note: The Adelaide result is the average monthly result for the financial year. It is for journeys. The result is based on Adelaide Metro's KPI 1.1 that 'measures all frequent trips (15 minute frequency or less) at the commencement of the trip.'

Sources: Adelaide Metro (undated); Transport for NSW (2022), p.30; advice from Department of Planning, Transport, and Infrastructure; Department of Transport, Victoria (2022), p.145; advice from Transport for NSW; Canberra Metro Operations (undated); Translink (undated).

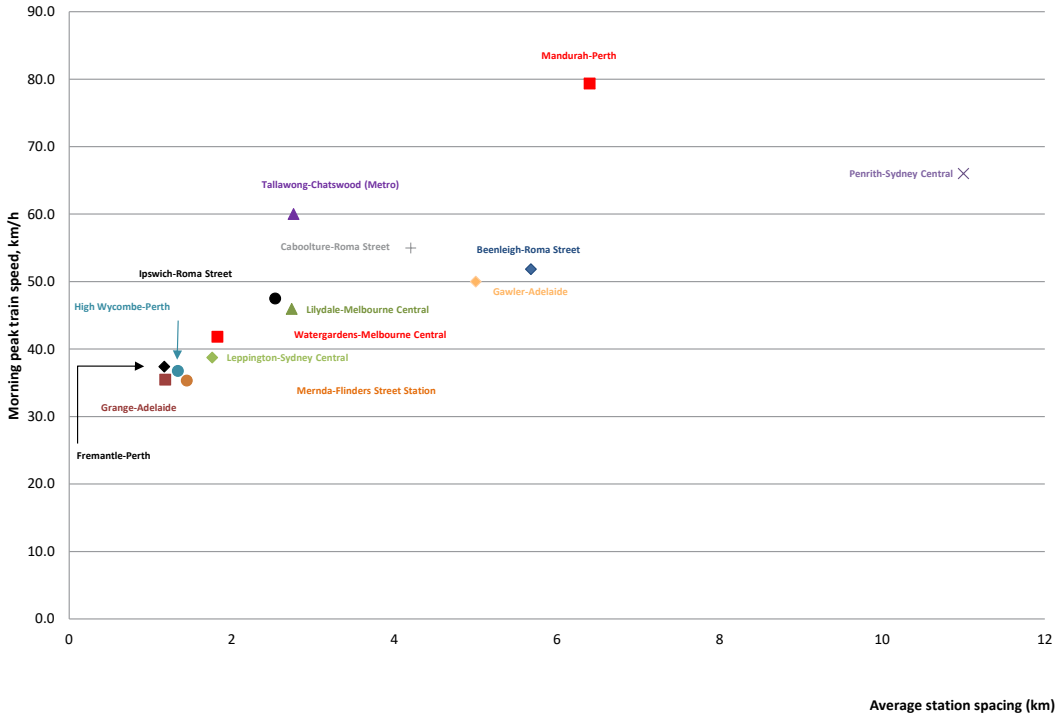
Speed and stopping patterns

Heavy rail

Figure 30 shows the relationship between station spacing and corresponding average train speeds for selected Australian urban passenger rail lines. All station spacing shown is based upon a mix of peak hour limited stops and all stops services. For limited stops services, station spacing is based on distances between stations where the services stop, not the number of actual stations on the line. For example, the Penrith—Sydney Central example is that of a TrainLink service from the Blue Mountains that also provides a limited stops service within suburban Sydney. It only has three stops between Penrith and Sydney Central, with an average station spacing of 11 kilometres and an average point-to -point speed of 66 kilometres per hour. The actual number of stations in service between Penrith and Sydney Central, however, is 31, with an average station spacing of 1.7 kilometres. By way of contrast, the Grange—Adelaide example is that of an all stops service with an average distance between stops of 1.2 kilometres and an average point-to-point speed of 35.5 kilometres per hour.

Australia's older passenger lines have relatively short station spacing (for all stops services) and, thus lower speeds. In contrast, newer lines, such as Mandurah—Perth, have wider all stops 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. 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, whose arrival and departure times are aligned to that of train services, and park and ride facilities therefore become crucial. Limited stops services help overcome short station spacing by skipping certain stations. The number of stops between origin and destination for limited stops services varies by time of day and service origin.

Figure 30 Heavy rail station spacing and illustrative train speeds 2023



Note: See attached spreadsheet for time series.

Source: BITRE analysis.

Light rail

Average scheduled light rail speeds also generally correlate to stop spacing, together with integration with/segregation from road traffic and pedestrian traffic.

Table 22 Light rail station spacing and scheduled speeds 2023

	Gold Coast	Sydney (Route L1)	Melbourne[a] (Route 96)	Melbourne[b] (Route 109)	Adelaide[c]	Canberra	Newcastle
Average station spacing (metres)	1155	580	340	450	545	920	540
Average point to point scheduled speed (km/h)	27	20.3	12.7	19.6	18	30	13.5

Notes: a. Calculations are based on travel from the East Brunswick terminus to Southern Cross Railway Station stop.

b. Calculations are based on travel from Port Melbourne to the Spencer Street/Collins Street stop.

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

Source: 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 with wide station/stop spacing. Sometimes a single route will have a mixed infrastructure type.

Sydney's light rail operates mostly on segregated lines. Canberra's light rail network is entirely segregated, except for intersections, where variable frequency traffic signals prioritise light rail traffic at most intersections. The Gold Coast and Canberra have the widest station/stop spacing in Australia. This, combined with its traffic segregation and priority traffic signalling (in Canberra), enables the 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 stations/stops and less than half the scheduled average speed. Like the Gold Coast and Canberra, Newcastle's light rail network is segregated except at street crossings. Most of the Melbourne light rail network is shared with road traffic. In the example of Route 96 (East Brunswick to Southern Cross Railway Station component) this, combined with narrow spacing between stops, causes it to have an average scheduled speed that is approximately half that of the Gold Coast and Canberra. By way of contrast, in the second Melbourne example, the portion of Route 109, shown above (Port Melbourne-Collins Street/Spencer Street stop), is 76 per cent segregated from road traffic (using the former Port Melbourne heavy rail corridor that was converted to light rail use in 1987), and this is reflected in its higher average speed than Route 96.

Frequency

Figure 31 to Figure 36, below, show, urban heavy rail service frequency by the time between arrivals at the relevant city central stations, for services originating at various designated 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. Greater frequency means less average time between services. Frequency also influences overall travel times. It can affect 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, high frequency is crucial in reducing passengers' interchange waiting times. Major centres and junction stations generally have high service frequencies due to service densification. As Figure 31 to Figure 36, below, show, all Australian capital cities with urban heavy rail services mostly have greater service frequency during peak periods.

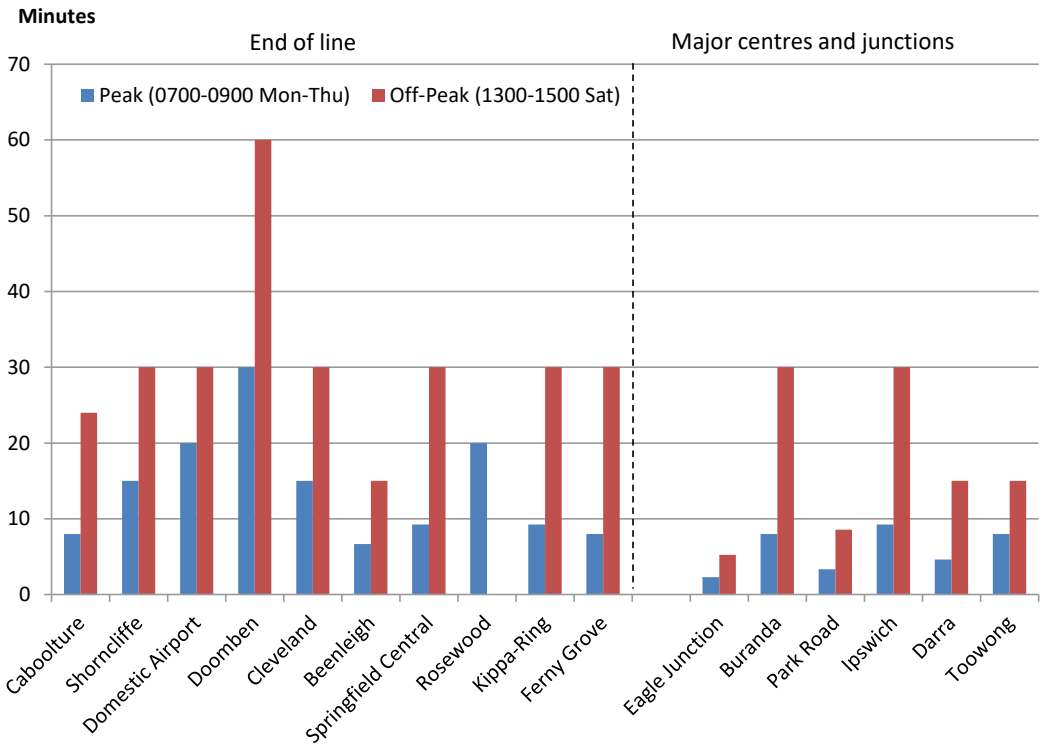
Service frequency across the cities in 2023 was largely the same as 2022. There have been some minor increases and decreases across the times of day periods measured, although this should not be interpreted to mean there are more or fewer services overall. A train that arrives at its destination at 09:01 hours on a weekday, for example, would be excluded as it is outside the peak period scope.

Heavy rail

Brisbane

In 2023, service frequency in Brisbane was unchanged from 2022.

Figure 31 Average time between trains for services arriving at Brisbane Roma Street Station, 2023



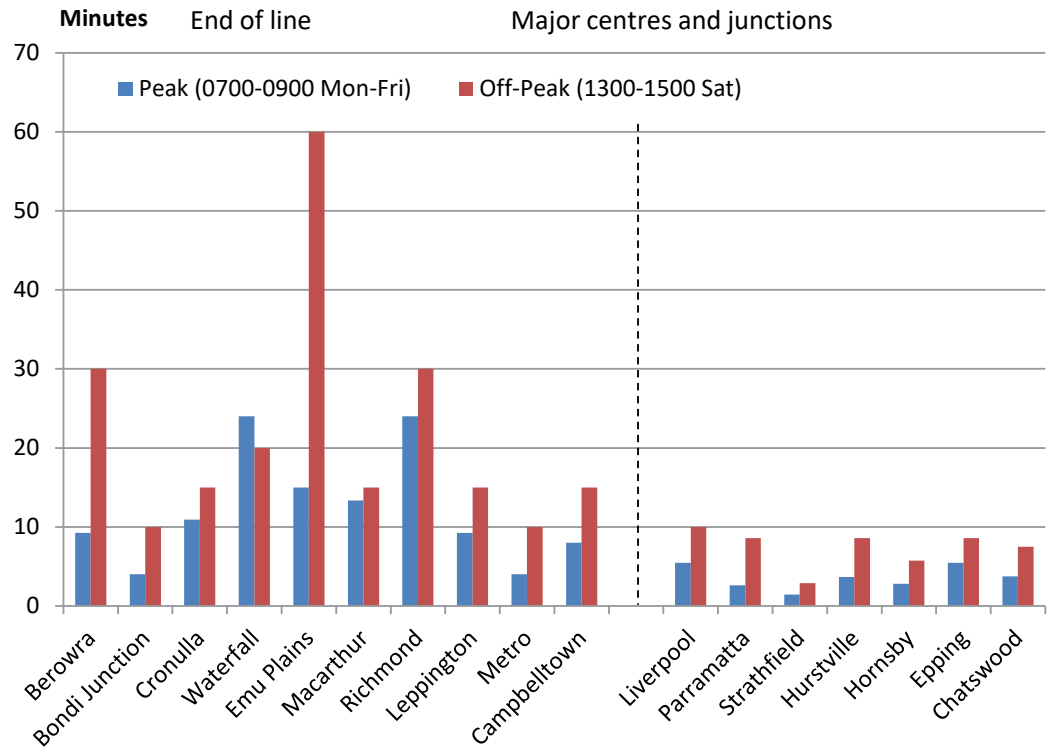
Source: Translink (2023).

Sydney

Sydney Trains frequency depends on the time of day, service demand and network capacity. In 2023, there were no significant changes in service frequency to 2022. The Bondi Junction and Chatswood Metro lines still had the most end of line peak services, with an average arrival at Sydney Central and Chatswood respectively every four minutes, while the Richmond and Waterfall lines each had an average arrival at Sydney Central every 24 minutes. Trains arriving at Sydney Central from major centres and junctions in the AM peak had average arrivals of between one (Strathfield) to five (Liverpool and Epping) minutes.

Off-peak service frequencies similarly varied significantly across the network from both points of origin and major centres and junctions. There was, on average, a train arriving at Sydney Central from Strathfield every three minutes to every 60 minutes from Emu Plains.

Figure 32 Average time between trains for services arriving at Sydney Central, 2023



Note: Metro services are those arriving at Chatswood.

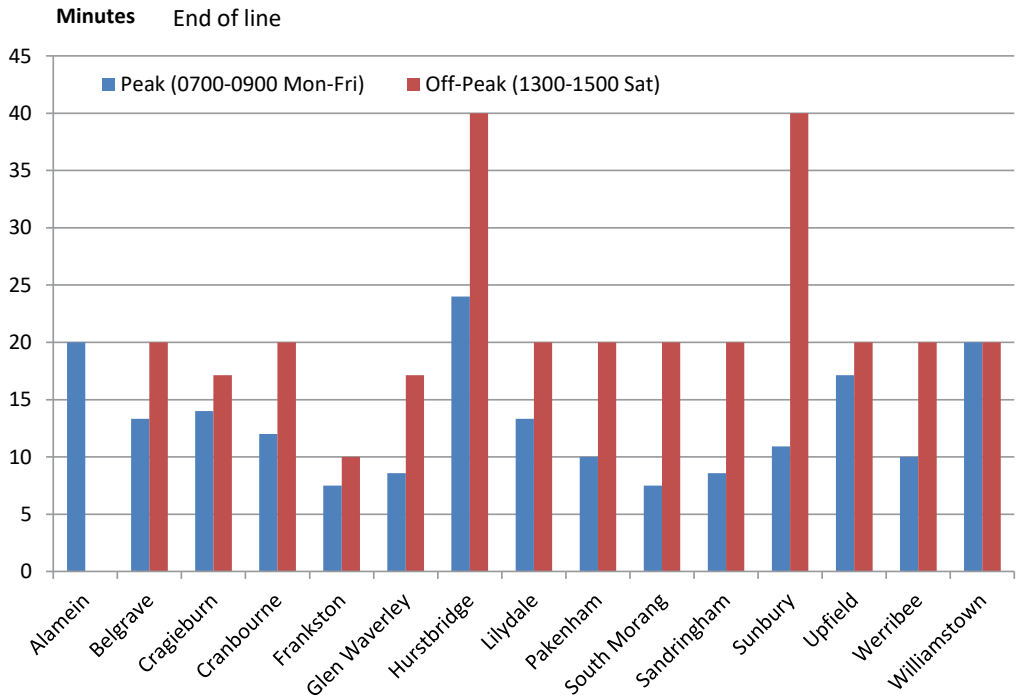
Source: Transport for NSW (2023).

Melbourne

Both peak and off-peak service frequencies in 2023 was unchanged from 2022.

Peak hour frequencies also vary considerably across services (see Figure 33 and Figure 34), with smaller branch lines running fewer services. For end of line services, Frankston and South Morang had the greatest peak service frequency, each with trains arriving at Flinders Street Station on average every eight minutes. Hurstbridge had the fewest peak services, with an average arrival every 24 minutes. Average off peak service frequency varied from 10 minutes on the Frankston line to 40 minutes on the Sunbury line and Hurstbridge lines. Alamein had no direct services to Flinders Street station in the off-peak period. Rather, shuttle trains ran to Camberwell, where passengers changed trains for ongoing travel.

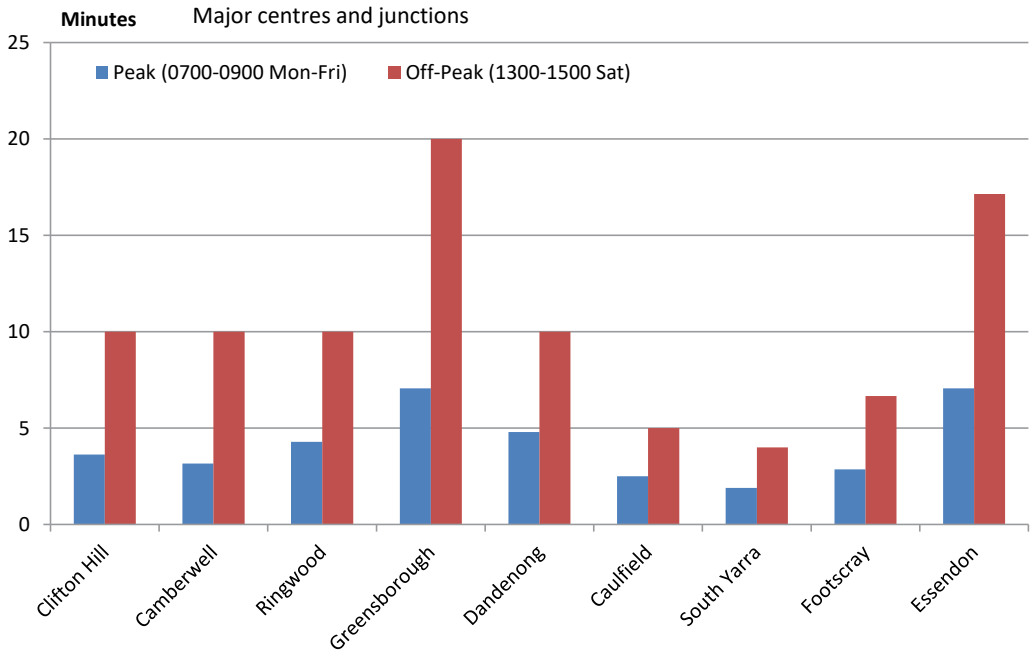
Figure 33 Average time between trains for services arriving at Flinders Street Station from end of line, 2023



Source: Data provided by Public Transport Victoria.

Peak period service frequency from Melbourne's major centres and junctions is high, ranging from 2-7 minutes. South Yarra is the busiest junction/major centre station, with an average arrival at Flinders Street Station every two minutes, while trains arrive at Flinders Street Station on average every seven minutes from Essendon and Greensborough. During off peak periods, service frequency at most of the major centres and junctions is approximately half that of peak period services. In the off-peak, frequency ranges from four minutes (South Yarra), to 20 minutes (Greensborough). South Yarra is the busiest because it channels converged traffic from the Pakenham, Cranbourne, Frankston, and Sandringham lines.

Figure 34 Average time between trains arriving at Flinders Street Station from major centres and junctions, 2023

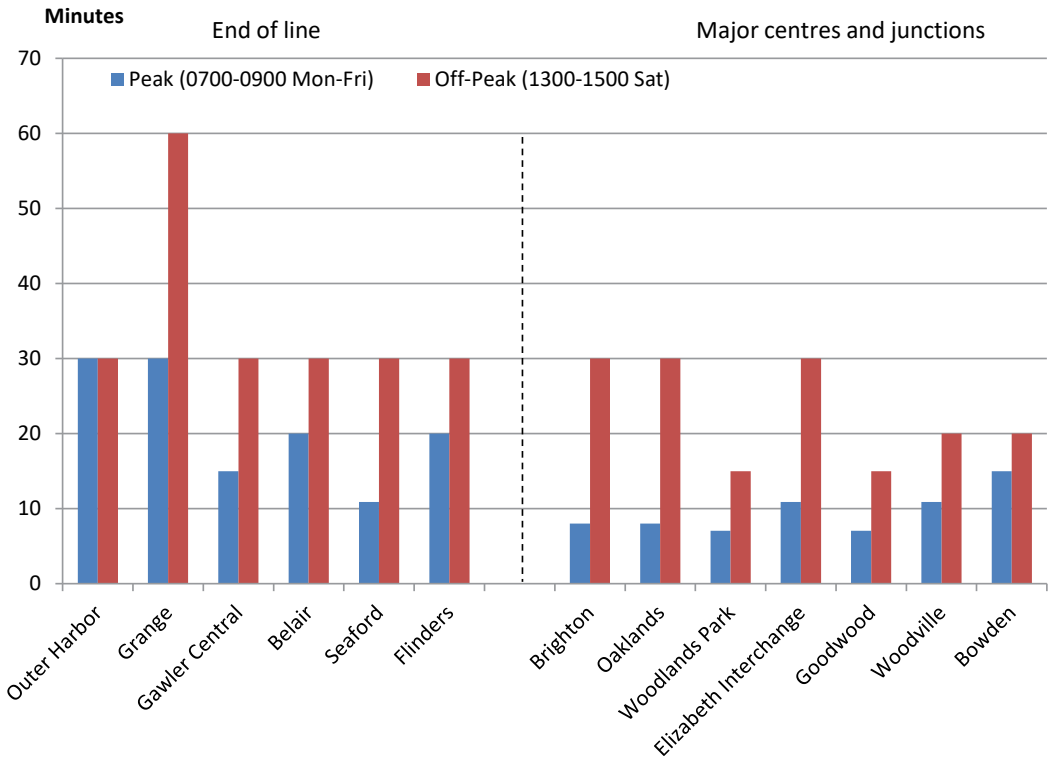


Source: Data provided by Public Transport Victoria.

Adelaide

Adelaide heavy rail service patterns are strongly geared to peak-period commuting to Adelaide Railway Station. Adelaide's lower service levels reflect its modest patronage compared to the other networks. The were no changes in 2023 compared to 2022.

Figure 35 Average time between trains for services arriving at Adelaide Railway Station, 2023



Source: Adelaide Metro (2023).

Perth

There have been notable changes to Transperth's operations and service frequencies since October 2022.

In October 2022, High Wycombe—Perth Central—Claremont services, which use the newly built Airport Line[21], began. Claremont-bound trains from High Wycombe travel through tunnels built for the project to Bayswater Junction. At Bayswater Junction, the trains use the Midland corridor to Perth and, from there, the Fremantle corridor to Claremont. There is, thus, service densification between Bayswater, Perth Central, and Claremont, due to the addition of these services.

For trains travelling from High Wycombe to Perth in 2023, there was an arrival at Perth on average every 12 minutes (peak) and every 15 minutes (off-peak). Claremont is both an end of line and major centre station. There was an arrival at Perth from Claremont on average every six minutes (peak) and every 7.5 minutes (off-peak). Service frequency to Perth is greater from Claremont than High Wycombe because Claremont is both an end of line station for services to Perth (then High Wycombe) and an en route station for Fremantle—Perth services.

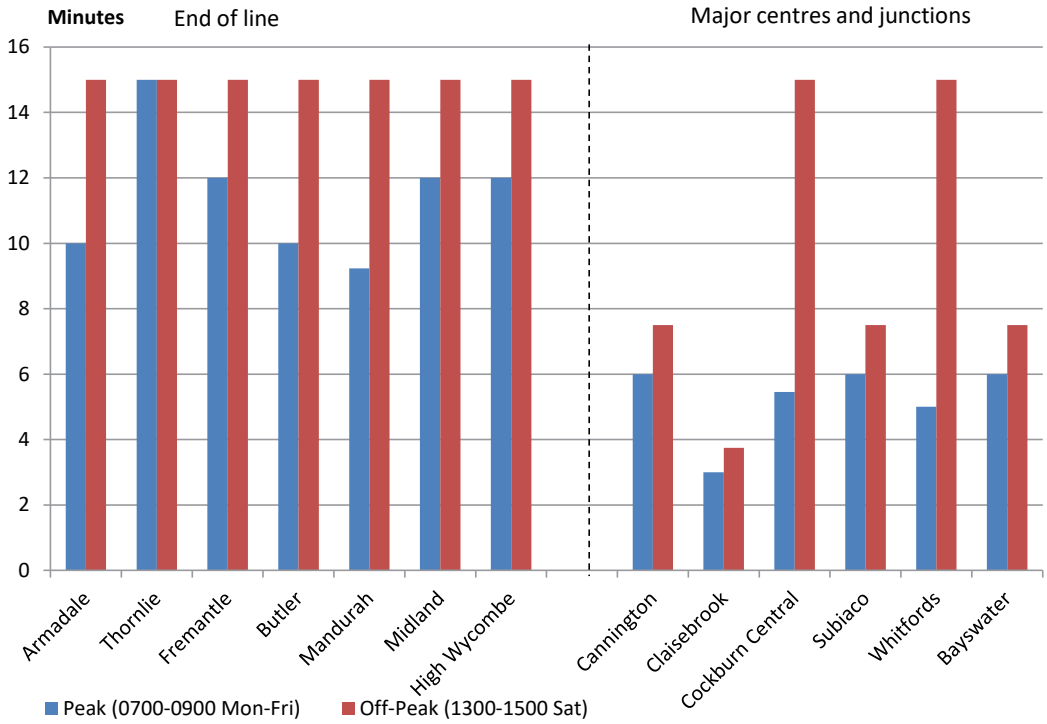
Service frequency to Perth from Claisebrook (where services from Armadale/Thornlie, and Midland/High Wycombe converge) also grew in 2023 in both the peak and non-peak periods, due to the start of High Wycombe—Claremont services. This translated into a reduction in average times between services from every 3.75 minutes to every three minutes (peak), and from five to 3.75 minutes (off peak).

After the start of High Wycombe—Claremont services, Bayswater Station became a junction for services from High Wycombe and from Midland. Average times between services arriving at Perth Central from Bayswater was six minutes (peak), and seven minutes (off-peak).

Both Fremantle and Midland had a slight reduction in peak service frequency compared to 2022. For both lines frequency dropped from an average arrival at Perth every 10 minutes to every 12 minutes (peak). Off-peak frequency was unchanged.

21 The Airport Line is a newly constructed 8.5 kilometre line that runs underground from High Wycombe to Bayswater Junction via Perth Airport.

Figure 36 Average time between trains for services arriving at Perth/Perth Underground stations, 2023

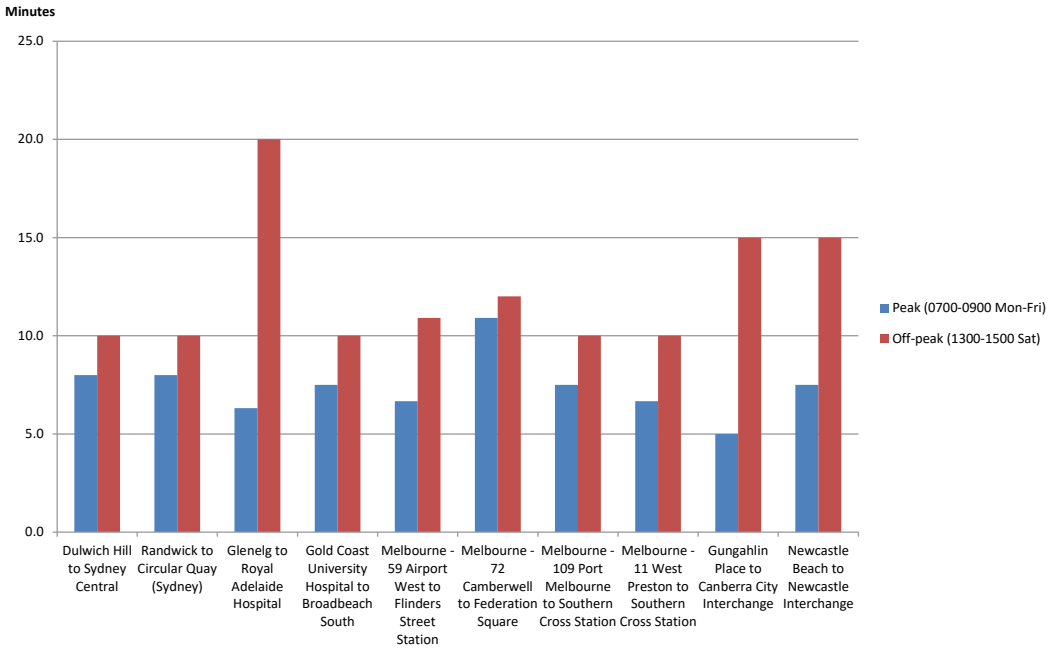


Source: Transperth (2023).

Light rail

Light rail frequencies in Australia vary (see Figure 37). Peak hour frequency in the samples shown in Figure 37 is mostly less than ten minutes. Off-peak times are between 10–20 minutes.

Figure 37 Average time between light rail services, by route and direction, 2023

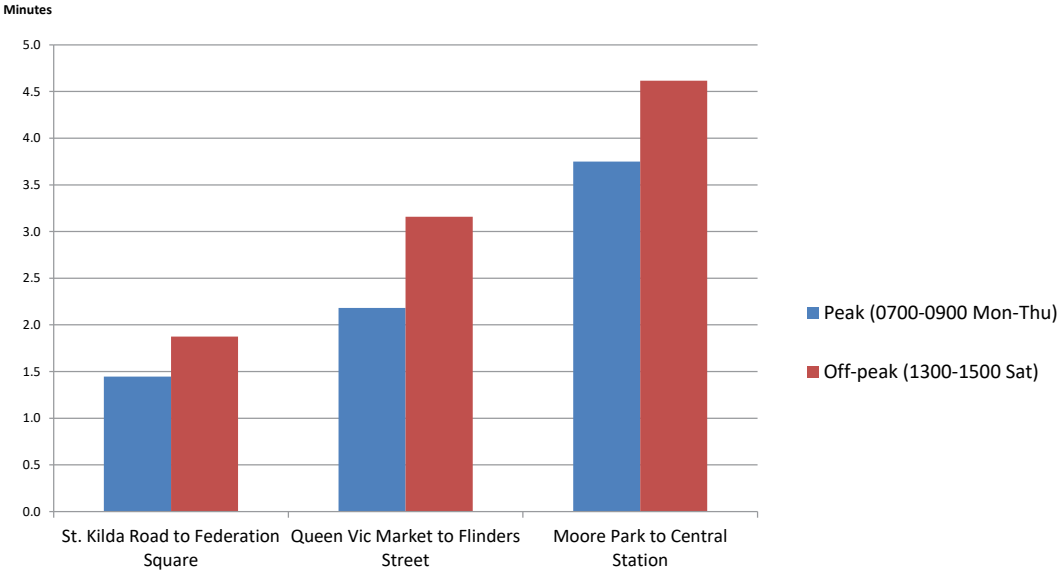


Notes: Gold Coast operations do not run to timetables. Melbourne and Sydney services have a separate timetable for Fridays. As such, calculated peak hour frequency as shown above is based on the published Monday-Thursday timetables. Peak hour calculations are based on peak hour directions of travel.

Sources: Transport for NSW (2023a); G:link (2023); Public Transport Victoria (2023); Adelaide Metro (2023).

Care is needed when comparing Melbourne to other Australian cities with light rail. Many Melbourne routes share tracks (converged routes), particularly in and near the CBD. This means a passenger may have more than one tram route option, thus increasing frequency on shared tracks.

Figure 38 Average times between light rail services – converged routes, 2023



Sources: Public Transport Victoria (2023); Transport for NSW (2023a).

Figure 38, above, shows average times between light rail services on a sample of converged route corridors in Melbourne and Sydney. For Melbourne, it is for seven converged services departing Stop 22 (St. Kilda Road/Toorak Road), with Federation Square as the arrival point[22], and three converged services departing Queen Victoria Markets, with Flinders Street as the arrival point[23]. For Sydney, it is for the L2 and L3 converged services departing Moore Park, with Central Station as the arrival point. Frequency along St. Kilda Road is high because seven routes share the corridor. Frequency is slightly less on the Queen Victoria Markets to Flinders Street corridor due to the lower number of routes serving the corridor. For services to Central Station, frequency is lower again as only two routes serve the corridor.

22 These services are routes 3(a), 5, 6, 16, 64, 67, and 72.

23 These services are routes 57, 59, and 19.

Chapter 4

Passenger transport results – Non urban rail

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—Bendigo 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) and regional centres, such as Brisbane—Rockhampton, and Perth—Kalgoorlie; and
- (Premium) tourist-focused services such as the Kuranda Scenic Railway (Queensland Rail), and Adelaide—Darwin (The Ghan) (Journey Beyond).

Figure 39 **Non-urban passenger services, by operator**

Patronage

The scale of an operator's passenger task is largely determined by the function of their railway.

Table 23, 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.

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

Table 23 Non-urban rail patronage, by operator, 2021–22

		NSW TrainLink				
	Queensland Rail	Regional	Intercity	V/Line	Transwa	Total
Patronage (million trips)	.46	.53	13	10.10	.142	24.23

Notes: Data excludes patronage on services delivered under the Queensland "TransLink" brand. TransLink data is reported in urban patronage.

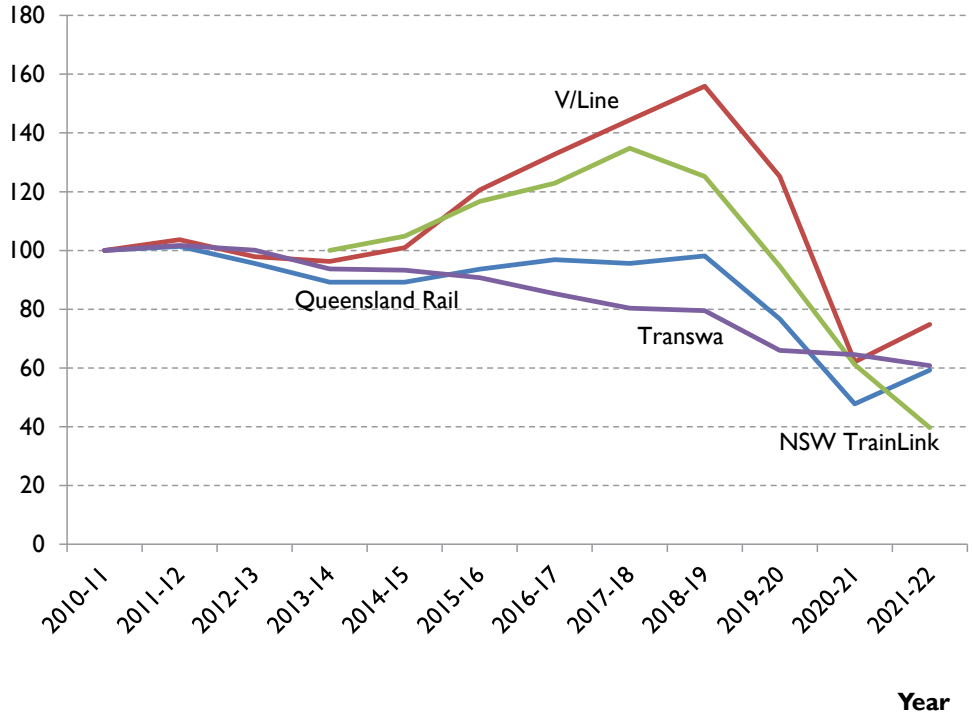
Sources: NSW Trains (2022), p.15; Transport of NSW (undated); Public Transport Authority of Western Australia (2022), p.21; Queensland Rail (2022), p.19; V/Line (2022), p.14.

Total non-urban rail patronage for 2021–22 was approximately 24.2 million passenger journeys, a reduction of approximately 18.5 per cent compared to the previous financial year. While a decline in patronage, the reduction was less than the previous financial year, which was approximately 40 per cent. V/Line and Queensland Rail had patronage increases – approximately 20.5 and 24 per cent respectively. TrainLink and Transwa each had declines – approximately 35 and 5.8 per cent respectively. Due to the relative size of its patronage and the degree of decline, TrainLink's reduction was enough to outweigh V/Line's and Queensland Rail's patronage increases. Like declines in urban patronage, these declines are likely due to COVD-19 related issues throughout the financial year.

The bulk of V/Line's and TrainLink's patronage is inter-urban commuter services, such as Katoomba to Sydney and Geelong to Melbourne, while almost all of Queensland Rail's and Transwa's patronage is from longer distance non commuter travel.

Figure 40, below, shows patronage trends by operator.

Figure 40 Index of patronage, by operator



Notes: The NSW TrainLink index is the sum of regional (train) 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.

See attached spreadsheet for time series.

Sources: NSW Trains (2022), p.15; Transport of NSW (undated); Public Transport Authority of Western Australia (2022), p.21; Queensland Rail (2022), p.19; V/Line (2022), p.14.

Punctuality

Table 24 Punctuality, on time performance, 2021–22

	Service type	Result (%)	Target (%)	Measurement
Queensland Rail	QR Traveltrain	>71.5	75	Arriving within 15 minutes, excluding the Kuranda Scenic Railway and *Gulflander* services
NSW Trainlink	Intercity	86.4	92	Arriving within six minutes
	Regional & interstate	71.2	78	Arriving within 10 minutes
V/Line	Commuter	93	92	Arriving on time to five minutes and 59 seconds
	Long distance	91.4	92	Arriving on time to 10 minutes and 59 seconds
Transwa	Australind	80	90	Arriving within 10 minutes
	Prospector	33.9	80	Arriving within 15 minutes
	MerridinLink	66.8	90	Arriving within 10 minutes
	AvonLink	89	90	Arriving within 10 minutes

Sources: V/Line (2022), p.15; NSW Trains (2022), p.30; Queensland Rail (2023); Public Transport Authority of Western Australia (2022), pp.69-70.

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 92 per cent and smaller margins for being considered on time. In contrast, QR Traveltrain, which operates long-distance services in Queensland, has a punctuality target of 75 per cent and a 15 minute margin.

NSW TrainLink attributes its failure to meet targets in 2021–22 due primarily to COVID-19, major weather events, infrastructure issues, and industrial action (NSW Trains 2022, p.30).

V/Line's punctuality was down marginally (0.7 per cent) from the previous financial year (V/Line 2022, p.17).

Transwa attributes its below target results to train crossing issues, infrastructure issues, mechanical issues, and infrastructure works (Public Transport Authority of Western Australia 2022, pp.69–70).

Travel times

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 travel times rather than the top speed of a given service when making transport mode choices. For non-urban services, the value of travel time varies according to the market and purpose of travel. Time-rich tourist travellers are likely to value comfort ahead of time. The *Ghan* is a case in point. Conversely, the opposite tends to 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.

Transit times shown in Table 23, below, show the running characteristics of selected non-urban passenger rail services. The characteristics of some services, particularly the shorter distance commuter services, can vary. Some services stop at all stations while others, particularly those operating in peak hours, may have only minimal scheduled stops, which enables them to

achieve faster speeds and shorter travel times. For example, the Melbourne to Ballarat service cited below is able to achieve a relatively high average point to point speed by skipping five of the usual 10 stations along its 118 kilometre course. An all stops non peak service on the same line can take approximately 10 minutes longer to complete its journey, at an average point to point speed approximately 10 kilometres per hour slower[24]. The running times of the services cited below show little variance compared to 2022.

Table 25 Illustrative travel times, 2023

	Operator	Gauge	Distance (km)	Electrified	Scheduled transit time	Average speed (km/h)	Stopping stations (no.)
Regional/intercity scheduled 3 hour 59 minutes travel time or less							
Brisbane to Nambour	QR (TransLink)	Narrow	105	Yes	1h 52m	56	22
Brisbane to Varsity Lakes	QR (TransLink)	Narrow	89	Yes	1h 20m	67	11
Newcastle to Muswellbrook	NSW TrainLink	Standard	123	No	1h 36m	77	12
Sydney to Newcastle	NSW TrainLink	Standard	165	Yes	2h 39m	62	14
Sydney to Wollongong	NSW TrainLink	Standard	82	Yes	1h 27m	56	7
Sydney to Lithgow	NSW TrainLink	Standard	156	No	2h 37m	60	7
Melbourne to Ballarat	V/Line	Broad	118	No	1h 16m	93	6
Melbourne to Bendigo	V/Line	Broad	162	No	1h 42m	95	3
Melbourne to Warrnambool	V/Line	Broad	276	No	3h 28m	80	13
Melbourne to Geelong	V/Line	Broad	81.5	No	53m	92	4
Melbourne to Seymour	V/Line	Broad	99	No	1h 35m	62	10
Melbourne to Traralgon	V/Line	Broad	158	No	2h 20m	68	12
Midland to Northam	Transwa	Standard	102	No	1h 20m	80	1
Perth to Bunbury	Transwa	Narrow	183	No	2h 30m	72	11
Melbourne to Albury	V/Line	Standard	307	No	3h 36m	85	10
Long-distance 4 hours travel time 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	1 681	No	24h 45m	68	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	80	9
Melbourne to Swan Hill	V/Line	Broad	345	No	4h 45m	73	7
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 Brisbane	NSW TrainLink	Standard	852	No	14h12m	69	24
Sydney to Melbourne	NSW TrainLink	Standard	946	No	10h50m	87	16
Perth to Kalgoorlie	Transwa	Standard	653	No	6h 55m	96	17
Melbourne to Adelaide	Journey Beyond	Standard	828	No	10h 25m	79	8
Adelaide to Darwin	Journey Beyond	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 (2023); Transport for NSW (2023); Translink (2023); Transwa (2023); V/Line (2023); Journey Beyond Rail Expeditions (2023).

24 This is the 1156 service that arrives at Ballarat at 1321 hours.

Average train speeds are also influenced by:

- Track quality, 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 (stop) spacing; and
- For tourist-focused trains such as *The Ghan*, scheduled extended stops en route for passengers to do off train tours.

The Brisbane—Nambour, Sydney—Newcastle Interchange, and Sydney—Wollongong services have relatively low average point to point speeds, as they have many scheduled stops en route. In addition, the Sydney—Newcastle Interchange and Sydney—Wollongong rail corridors are circuitous due to the 'steam era' alignments through the mountainous terrain in which they operate, which reduces operating speeds.

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. In addition to fewer stops in peak periods, V/Line's Melbourne—Geelong, Melbourne—Ballarat, and Melbourne—Bendigo commuter services are relatively fast due to the VLocity DMU sets used, which are capable of operating at speeds of up to 160 kilometres per hour, and the Regional Rail Link and Regional Fast Rail infrastructure used.

Figure 41 NSW TrainLink XPT service

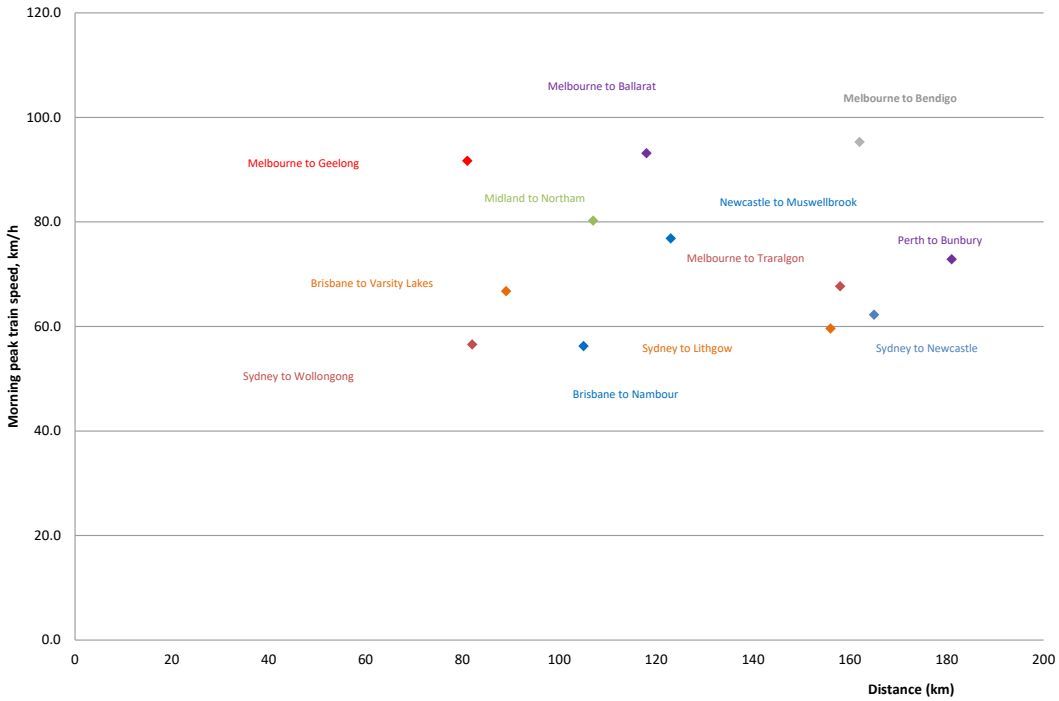
Note: The image above shows Melbourne to Sydney day XPT service ST24 at Goulburn in August 2023. Photo courtesy of Rodney Avery.

The following services listed above have average point-to-point speeds of 90 kilometres per hour or greater:

- Melbourne to Bendigo, 95 kilometres per hour;
- Melbourne to Ballarat, 93 kilometres per hour;
- Melbourne to Geelong, 92 kilometres per hour; and
- Perth to Kalgoorlie, 96 kilometres per hour.

Long-distance passenger trains in Australia typically have uncompetitive transit times compared to air and some road coach travel[25].

Figure 42 Distance and illustrative speeds for selected services, 2023



Note: See attached spreadsheet for time series.

Source: BITRE analysis.

Figure 42 above, shows average timetabled point to point train speeds and distances travelled for non-urban services that are of less than three hours in duration. The calculations are for selected services shown in Table 25. Of particular note is the Melbourne to Bendigo service, which maintains a high average point to point speed over a relatively long distance, and the Sydney to Wollongong service, which is of a relatively short distance, and has a low average point to point speed. The Melbourne to Bendigo service achieves this through having a dedicated corridor through suburban Melbourne (Regional Rail Link), good track infrastructure (Regional Fast Rail), fast rolling stock, and having only three stops en route, while the Sydney to Wollongong service has seven stops, it shares part of the line with suburban services in Sydney, and it is subject to tight curves for much of the journey. The Melbourne to Bendigo service illustrated in the chart travels approximately twice the distance of the corresponding Sydney to Wollongong service and it completes the journey at almost twice the average point

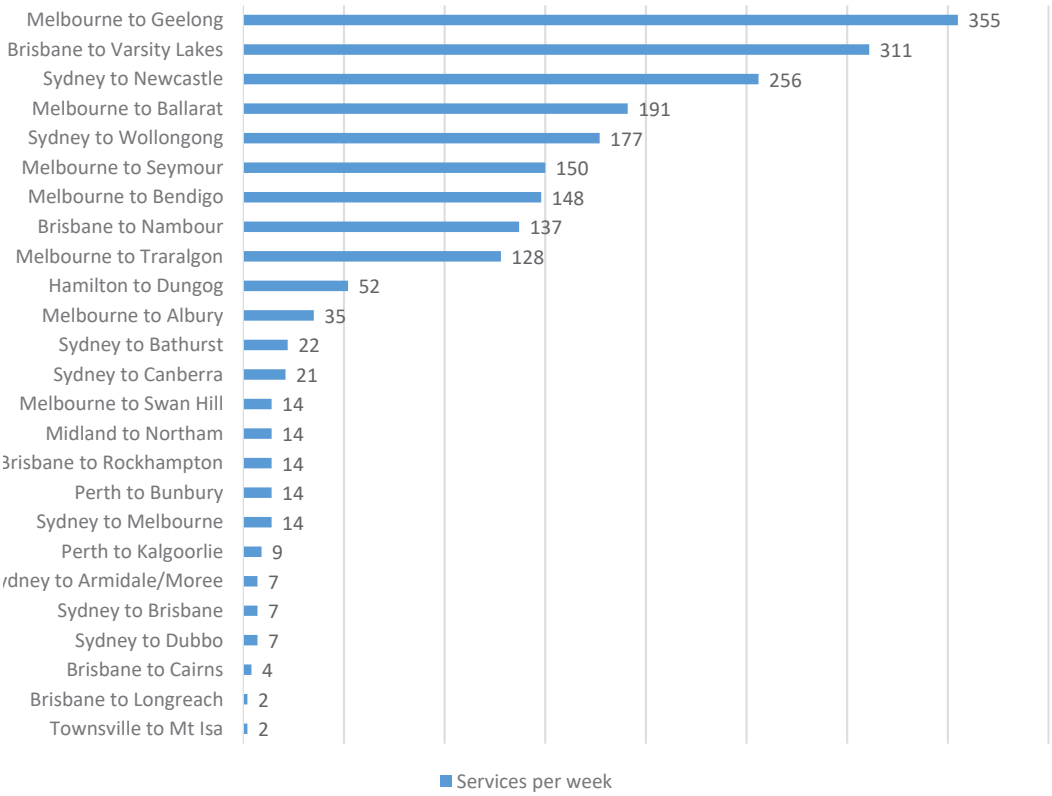
25 Long-distance trains provide services for centres along their route, thus acting as medium-distance services also.

to point speed. The Melbourne to Traralgon service, which also operates on Regional Fast Rail infrastructure, does not have the same average point to point speed as the Melbourne to Bendigo service, as it does not have a dedicated rail corridor through suburban Melbourne, but shares the track infrastructure with Melbourne urban services for approximately 60 of its 158 kilometres route distance.

Frequency

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 43 Services per week, 2023



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 (2023); Transport for NSW (2023); Translink (2023); Transwa (2023); V/Line (2023).

Figure 43, above, shows the number of scheduled services per week on selected intercity/commuter and regional/interstate passenger rail services. Intercity/commuter services have the highest frequency.

Chapter 5
Infrastructure

Australia's colonies (then states in the post-federation era) built the continent's first railways as separate networks, often 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 44 Railway network, by track gauge, July 2023

Notes: The lines shown here are the railways that are open for traffic at July 2023.

Broad ("Irish") gauge is 1600 mm; standard ("Stephenson") gauge is 1435; and narrow ("Cape") gauge is 1067 mm.

Current Network

Table 26 shows BITRE's estimate of operational route kilometres of heavy railways in Australia. BITRE estimates there were approximately 31 074 route-kilometres of operational heavy railways in Australia in February 2024. The national total reported here is lower than the previous reported estimate. This is because BITRE has revised its estimates whereby all non-government/not for profit tourist railways are now excluded. Inconsistencies in previous estimates have also been removed. No railways in Australia that are in scope are known to have closed since the previous estimate was reported. The figures are subject to rounding.

Approximately 7.9 per cent of the network is broad gauge, 35.3 per cent is narrow gauge, 55.9 per cent is standard gauge, and less than one per cent is dual gauge.

Approximately 11.1 per cent of the network is electrified. Queensland has the largest electrified network, principally due to the electrified line between Rockhampton and Brisbane and a number of electrified 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.

Most of the network is single-tracked (approximately 87 per cent). Most urban networks, the Sydney—Melbourne line (of which around three-quarters is 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) is multiple track.

Table 26 Estimate of route kilometres of open (operational) heavy railways, 2023, by jurisdiction, gauge and electrification

	State or Territory								
	ACT	**NT**	**NSW**	**Qld**	**SA**	**Tas**	**VIC**	**WA**	**Total**
Route kilometres by gauge									
Broad			73.0		126.1		2278.0		**2477.1**
Narrow				7581.6	66.0	614.4		2702.6	**10964.5**
Standard	7.5	1690.0	6654.1	141.1	2599.3		1794.8	4483.7	**17370.5**
Dual				37.1			53.5	171.5	**262.0**
Total	**7.5**	**1690.0**	**6727.1**	**7759.7**	**2791.4**	**614.4**	**4126.3**	**7357.7**	**31074.1**
1 500V DC			652.1				373.0		**1025.1**
25 kV AC				2154.6	82.5			190.0	**2427.2**
Total	**nil**	**nil**	**652.1**	**2154.6**	**82.5**	**nil**	**373.0**	**190.0**	**3452.3**

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

Data may not add to totals due to rounding. Excludes light rail, sugar tramways and heritage only railways.

Sources: BITRE estimates; Data provided by Sydney Trains, Aurizon, Rio Tinto Alcan, and TasRail; Advice from Freight Victoria.

Figure 45 Dual gauge in Melbourne

Note: The image above shows dual standard-broad gauge track looking towards the South Dynon Freight Terminal and Southern Cross Station in Melbourne. These are freight only lines, barring passenger services from Melbourne to Sydney, Albury, and Adelaide. The polish on the rails shows broad gauge trains typically use the track on the right side of the photo, because they all go to the Port of Melbourne, while standard gauge trains go to the port or the Dynon terminals. Photo courtesy of Rodney Avery.

New railways

857.5 route-kilometres of freight track and 182.5 route-kilometres of passenger (heavy and light rail) track have been opened since 2013. Table 27, below, provides a list of all new route additions since 2013, grouped by traffic type/purpose.

Table 27 Railways opened since 2013

Traffic	Location	Year	State	Length (km)	Project	Infrastructure builder
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
Iron Ore	Western Hub (Eliwana)	2020	WA	143	Western Hub (Eliwana)	Fortescue Metals Group
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
Coal	Galilee Basin	2022	Qld	200	Carmichael Rail Network	Bravus Mining and Resources
Intermodal	Sefton–Macarthur	2012–13	NSW	36	Southern Sydney Freight Line	ARTC
Intermodal	North West Connection	2019	NSW	5	Inland Rail	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	Glenfield-Leppington	2015	NSW	12	Leppington line	RailCorp
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	Adelaide	2020	SA	.65	Flinders Link	Department of Planning, Transport and Infrastructure
Urban passenger	Perth	2022	WA	8	Forrestfield-Airport Link	Metronet
Light rail	Gold Coast University Hospital – Broadbeach	2014	Queensland	13	Gold Coast Light Rail	Queensland and Australian governments; Gold Coast City Council, GoldLinQ

Traffic	Location	Year	State	Length (km)	Project	Infrastructure builder
Light rail	Lilyfield – Dulwich Hill	2014	NSW	6	Inner West Light Rail extension	Transport for NSW
Light rail	Gold Coast University Hospital – Helensvale	2017	Queensland	7.3	Gold Coast Light Rail	Queensland and Australian governments; Gold Coast City Council, GoldLinQ
Light rail	Kind William Street – East Terrace	2018	South Australia	1	City Tram Extension Project	Department of Planning, Transport and Infrastructure
Light rail	King William Street – Festival Plaza Precinct	2018	South Australia	.350	City Tram Extension Project	Department of Planning, Transport and Infrastructure
Light rail	Gungahlin – Canberra City	2019	ACT	12	Canberra Metro	ACT government and Canberra Metro consortium
Light rail	Newcastle Interchange – Pacific Park	2019	NSW	2.7	Newcastle Light Rail	Transport for NSW
Light rail	Circular – Quay Randwick and Juniors Kingsford	2019–20	NSW	12	CBD and South East Light Rail	Transport for NSW

Source: BITRE estimates

Since 2013:

- 540 route kilometres of iron ore railways in the Pilbara region of Western Australia have been opened. There is currently an estimated 2782 route kilometres of railways in the Pilbara region.
- 273 route-kilometres of railways for coal haulage have been opened, all in Queensland. This includes the 200-kilometre Carmichael Rail Network (Galilee Basin) line, which opened in 2022.
- 44.5 route-kilometres of railways for intermodal and grain traffic have been opened.
- Approximately 128 route-kilometres of heavy railways and approximately 54 route-kilometres of light rail railways have been opened.

As Table 28, below, shows, approximately 196.6 route-kilometres of heavy and light railways were under construction in December 2023. Of this, approximately 176.2 kilometres were heavy rail and 20.4 were light rail.

Table 28 Heavy and light railways under construction, December 2023

Traffic	Location	State	Length (route km)	Project
Light rail	Parramatta	NSW	12	Parramatta Light Rail
Light Rail	Gold Coast	Qld	6.7	Gold Coast Light Rail Stage 3
Light Rail	Canberra	ACT	1.7	Canberra Light Rail Stage 2A
Heavy Rail	Sydney	NSW	30	Sydney Metro City & Southwest
Heavy Rail	Melbourne	Vic	9	Metro Tunnel
Heavy Rail	Brisbane	Qld	10.2	Cross River Rail
Heavy Rail	Perth	WA	17.5	Thornlie-Cockburn Link
Heavy Rail	Perth	WA	21	Morley-Ellenbrook Line
Heavy Rail	Perth	WA	14.5	Yanchep Rail Extension
Heavy Rail	Melbourne	Vic	26	Suburban Rail Loop East
Heavy Rail	Sydney	NSW	24	Sydney Metro West
Heavy Rail	Sydney	NSW	23	Sydney Metro Western Sydney Airport
Heavy Rail	Adelaide	SA	1	Port Dock Station Extension

Figure 46 Redcliffe Station on Transperth's new Airport Line

Note: Photo courtesy of Public Transport Authority of WA.

Dedicated commodity networks

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 networks

Figure 47 Iron ore transport by rail corridors

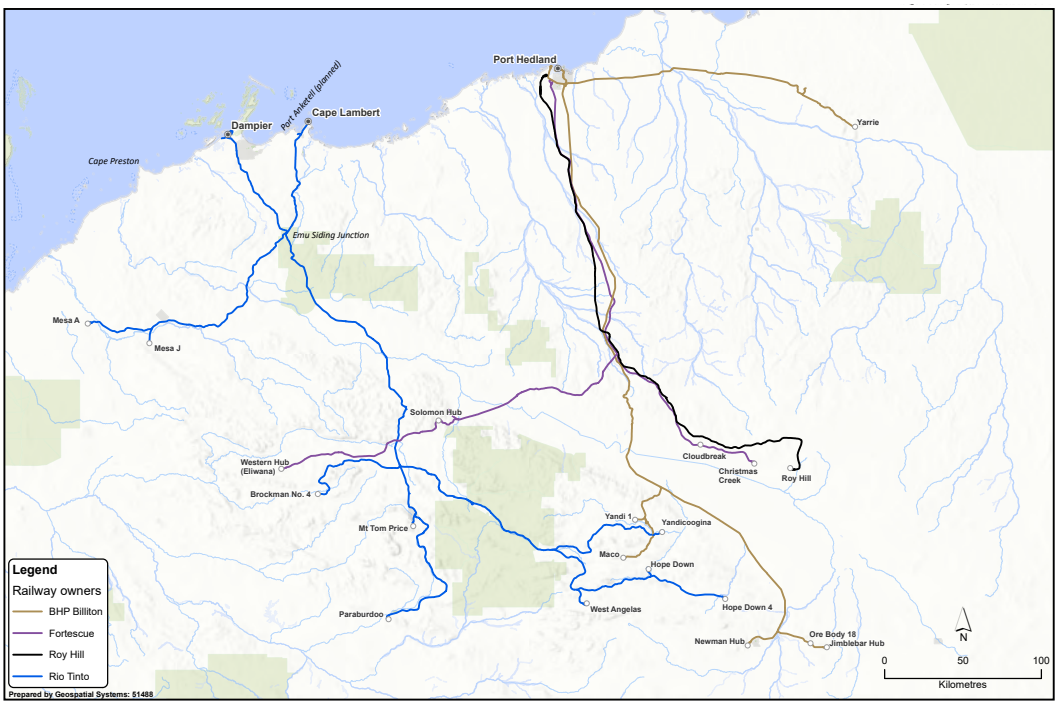
Most iron ore transport by rail in Australia occurs in the Pilbara region of Western Australia. Mining companies built the iron ore railway networks in the Pilbara region exclusively to serve the iron ore mines, as was the Karara (Western Australia) spur line and the Middleback railways (near Whyalla) 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.

The railways of the Pilbara region are all vertically integrated. They are privately owned and operated. There are four operators:

- **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 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 232 cars at 42 tonne axle loads. In December 2020, Fortescue Metals Group opened its 143 kilometre Western Hub (Eliwana) line, as part of the development of the new Western Hub.
- **Roy Hill Holdings:** A 344 kilometre railway from Roy Hill to Port Hedland, which began operations in December 2015. These trains typically haul 232 ore cars, with a payload of more than 32 000 tonnes of ore.

Figure 48 Pilbara iron ore railways, by infrastructure owner



Coal networks

Figure 49 Coal transport by rail corridors

Coal lines occur mostly in eastern Australia, generally being grafted onto the existing mixed-traffic networks. Track standards are high, and there are some electrified systems in Queensland, but they are of a lower standard than the dedicated iron ore lines.

Aurizon manages the Central Queensland Coal Network (CQCN), under an open access regime. The network is narrow gauge with train axle loads of 26.5 tonnes. Bravus Mining and Resources owns the Carmichael Rail Network, which connects to the CQCN. ARTC manages the New South Wales (standard gauge) Hunter Valley system in New South Wales. The systems are:

- **Newlands (CQCN).** Newlands is at the northern end of the Bowen Basin. In 2012, the Newlands system was linked to Aurizon's Goonyella System, which has given additional flexibility to access the Port of Abbot Point. The project included construction of the 69 kilometre 'Northern Missing Link', which connects the two rail systems, along with substantial upgrades to existing Newlands rail infrastructure. (For more details see Aurizon 2023a)
- **Goonyella (CQCN).** Goonyella is an electrified system that services the Bowen Basin coal region. It primarily serves the terminals at Hay Point/Dalrymple Bay near Mackay, and Abbot Point near Bowen. (For more details, see Aurizon 2023a)
- **Blackwater (CQCN).** This system services the Bowen Basin coal region and it is the largest system in Central Queensland in terms of route kilometres. It delivers coal to the two export terminals at the Port of Gladstone of RG Tanna Coal Terminal and the Wiggins Island Coal Export Terminal (WICET). The system consists of mostly electrified duplicated lines that extend west from Rockhampton. (For more details see Aurizon 2023a)

- **Moura (CQCN).** This system runs from Moura to Gladstone where it connects to the two export terminals — the RG Tanna Coal Terminal and the WICET. In late 2015, Aurizon finished the Wiggins Island Rail Project (WIRP), which involved the development of new rail lines and upgrades of existing lines to WICET. The project created a link between the coal terminal and mines in the Southern Bowen and Surat Basins. The project comprised interdependent infrastructure projects across the Blackwater Rail System, the Moura Rail System and the North Coast Line. (For more details see Aurizon 2023a)
- **Galilee/Carmichael Rail Network (Queensland).** This network (line) opened in 2022. Bravus Rail Company hauls thermal coal from the Carmichael mine in the Galilee Basin along a newly constructed 200 kilometre railway that connects to the CQCN Newlands system near Collinsville. Maximum train axle loads are 26.5 tonnes, at maximum speeds of 80 kilometres per hour. Approximately six trains run on the network each day. (Bowen Rail, 2023)
- **South-West Rail Corridor (Queensland).** Aurizon hauls coal from the West Moreton Coal System along the South-West Rail Corridor through to the Port of Brisbane. Axle loads vary across the corridor. (For more details see Aurizon, 2023a)
- **Hunter Valley (New South Wales).** Coal is transported to three coal-loading terminals in Newcastle and to domestic users. Train axle loads are 30 tonnes for most of the network. The North Coast line to Stratford and the lines south to Vales Point on the Central Coast are rated for 25 tonne axle loads. The existing 30 tonne axle load infrastructure can accommodate 32 tonne axle loads but the higher load provides limited benefit unless the outline gauge is increased. Trains consisting of '120 tonne' (30 tonne axle load) wagons are typically restricted to 60 kilometres per hour when loaded and 100 kilometres per hour when empty. Locomotives of up to 30 tonne axle load are authorised to run at 80 kilometres per hour. (ARTC, 2022, p.15) Contracted export coal volumes were 198.9 mega tonnes per annum in the first quarter of 2022, declining to 135 mega tonnes per annum in 2030. (ARTC, 2022, p.5)

Figure 50 ARTC Hunter Valley Coal Network

Map courtesy of ARTC.

Figure 51 Central Queensland Coal Network

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.

Grain railways

Unlike dedicated iron ore and coal railways, grain railways usually feed into main or secondary mixed use lines. Grain lines are generally of a lower technical and operational standard. 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[26] are outlined below.

Despite the enhanced competition from grain transport by road, bulk grain transport by rail in parts of New South Wales is becoming more efficient and competitive as a result of improvements to the NSW Government's Country Regional Network (CRN). 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; 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

26 Most of South Australia's grain railways are not currently operational and the remaining four lines have not been classified.

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 improved line capabilities (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. For details of maximum axle loads across the network see UGL Regional Linx, 2023, p.2.

The current Fixing Country Rail project, which aligns with and complements Fixing Country Roads, is a $400 million NSW Government programme whose aim is:

- moving freight more efficiently around NSW;
- increasing the capacity, access and reliability of the rail network;
- reducing the cost of getting goods to market;
- supporting jobs, growth and economic productivity; and
- supporting a freight modal shift from road to rail. (Transport for NSW, 2022a)

Projects funded under Fixing Country Rail include:

- building new sidings that allow freight trains to load and unload freight, while enabling trains on the same line to pass;
- building and upgrading crossing loops that allow the use of high productivity trains and enable trains to overtake and pass each other more efficiently; and
- upgrading the network so that trains can carry heavier loads. (Transport for NSW, 2022a)

Details of current projects and projects completed since 2021 are shown below.

Table 29 Fixing Country Rail projects

Project	Current Status (2023)
Wumbulgal Siding project	In progress
Gilgandra to Coonamble 25 TAL upgrade	In progress
Junee to Griffith Line Upgrade project	Completed early 2022
Temora to Calleen Upgrade to 25 TAL project	On hold due to price escalation, Transport for NSW considering options
Kandos to Gulgong Feasibility Study	Feasibility study completed
Maryvale to Gulgong Feasibility Study	Feasibility study completed
Narromine to Ulan Upgrade projects	Completed late 2022
Red Bend Rail Siding	Completed 2023
Bellata Rail Siding	Completed 2023
Condobolin Rail Siding	In progress
Berry to Bomaderry Rail Line and the OMEGA tunnel track upgrade	Completed mid 2022
Riverina Intermodal Freight and Logistics Hub project	Completed late 2021
Coolamon – Crossing Loop Extension	Completed September 2023
Pinecliffe Crossing Loop (Molong)	Completed mid 2021
Maryvale Crossing Loop	Completed late 2021
Bumberry Crossing Loop	Completed late 2021
Polona Crossing Loop	Completed mid 2021

Source: Information provided by Transport for NSW.

Box 4 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/
- https://www.emeraldgrain.com

Commodity non-specific networks

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. Often the axle-load limits are 15 tonnes at maximum speeds of 70 kilometres per hour. For more information on Queensland Rail's regional network, including network standards, see (Queensland Rail 2023).

New South Wales

While the New South Wales government's country 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 (in its previous capacity of manager of the CRN), for example, a Class 3 track can range in operational capability from 81 to 100 tonnes gross.

Victoria

Victoria has six track standard classifications. The highest standard is Class 1, and the lowest is Class 5 (VicSig 2023). Details are as follows:

- Class 1: Sections of the Regional Fast Rail network. Maximum speeds are 160 kilometres per hour;
- Class 2: The standard for metropolitan and country passenger lines, with maximum speeds of 115 kilometres per hour and 130 kilometres per hour in some sections for diesel multiple unit sets;
- Class 2U: A modified version of Class 2 for Regional Fast Rail but of a lower standard than Class 1. Maximum speeds are 130 kilometres per hour;
- Class 3: Passenger lines with low volumes and some grain lines. Maximum speeds are 80– 100 kilometres per hour, depending on axle loads;
- Class 4: Lesser branch lines, with maximum speeds of 80 kilometres per hour; and
- Class 5: Lines that are short or have very little traffic, with minimal track maintenance. Maximum speeds are 50 kilometres per hour.

The state's amended Murray Basin Rail Project is ongoing[27]. According to the Victorian Government, the current project includes:

- re-sleepering, adding ballast and adjusting track on the Ouyen to Murrayville Line (complete);
- track upgrades from Ararat to Maryborough (complete);
- new or upgraded sidings at Donald and Merbein (complete);
- new and extended passing loops;
- upgraded signalling at Ararat and Maryborough junctions and the Ouyen yard;
- new turnouts at Dunolly junction;
- re-sleepering from Sea Lake to Dunolly (complete);
- planning and assessment work for further upgrades (Victoria's Big Build, 2023).

The estimated cost of the project is $706.45 million, of which he Commonwealth Government is contributing $454.4. The Australian Government's contribution includes $5 million for additional planning in developing options for full gauge standardisation of the network, which is contingent on an equal contribution from the Victorian Government. (Department of Infrastructure, Transport, Regional Development, Communications and the Arts, 2023)

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 considered 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. They are also typified by low (16-tonne) axle loads, with low-standard track structure. (Strategic Design and Development 2009, p. 8). All Tier 3 lines are currently non-operational.

In September 2020, the Western Australian Government released an independent engineering assessment outlining the estimated cost of restoring each section of the state's Tier 3 rail network, including the potential for some lines to be converted to standard gauge.

Subject to further stakeholder consultation, the first upgrade proposals for Tier 3 lines under consideration for business case preparation were:

- Quairading to York (estimated cost $110.91 million);
- Kulin (via Yilliminning) to Narrogin (estimated cost $164.41 million); and
- Kondinin (via Narembeen) to West Merredin (estimated cost $210.67 million narrow gauge or $238.08 million standard gauge) (Minister for Transport; Planning; Ports, 2020).

Furthermore, the Western Australian Government's Revitalising Agricultural Region Freight (RARF) Strategy identifies investment opportunities in the freight rail line network and provides a list of prioritised rail and intermodal projects on the currently operational Tier 1 and 2 networks (Department of Transport, Western Australia, 2020).

In implementation of the Strategy, the West Australian Government announced in May 2022 a $200 million joint state/Commonwealth ($160 million) funding boost for the state's regional freight network. The funding package was for the following four projects:

- $22 million for four rail siding extensions for CBH grain bins at Moora, Brookton, Cranbrook, and Broomehill, complementing CBH investment in rail loading facilities;

27 For details of the project's original scope, see BITRE, 2017, p.63

- $46 million for seven additional grain rail siding upgrades at Avon, Kellerberrin, Dowerin, Konnongorring, Ballidu, Mingenew, and Perenjori North, which will help CBH load longer trains faster;
- $60 million for the Midland Line Main Line upgrading from 16 to 19 tonne axle loading between Carnamah and Mingenew, allowing heavier trains and a 20 per cent increase in train loads; and
- $72 million for the Southern Wheatbelt region towards the progressive recommissioning of the Narrogin-Kulin rail line (closed since 2013) and associated works to service grain and other potential customers in the Narrogin-Wickepin area. The first stage of this project will be a study to assess the most useful way to implement the investment. (Minister for Transport; Planning; Ports, 2022)

In August 2023, the Western Australian Government announced the Brookton works had been completed and work at Broomehill had commenced, while works were expected to commence at Moora and Cranbrook by the end of 2023. (Government of Western Australia, 2023)

Tasmania

The Tasmanian and Australian governments are jointly funding the renewal of the Tasmanian Rail Network through the Tasmanian Freight Rail Revitalisation Program (TFRRP). The Program continues to be delivered via a series of funding tranches. These tranches focus on the replacement of near life-expired rail and sleepers, structure upgrades (bridges and culverts), level crossing renewals and formation projects. Tranche One was completed in 2018–19 and Trance Two in 2022–23. The $96 million Tranche Three program began in 2020–21 and is due for completion by 30 June 2024. (TasRail, 2023, p.13)

Box 5 Inland Rail

Inland Rail is a strategic national infrastructure project whose aim is to increase resilience and improve supply chain productivity between Melbourne, Brisbane Perth, Sydney, Adelaide, Newcastle, and the Illawarra, to meet Australia's growing freight task.

Inland Rail will connect Melbourne and Brisbane via regional Victoria, New South Wales and Queensland. It will span from a new intermodal terminal at Beveridge on the northern outskirts of Melbourne to the coastal route at Kagaru on the southern outskirts of Brisbane. The project will support double-stacked running between Beveridge and the proposed terminal at Ebenezer in Queensland, with single-stacked onward services to Kagaru (39 kilometres).

The Commonwealth Government is taking a staged approach to the delivery of Inland Rail, prioritising construction from Beveridge to Parkes and Narromine in New South Wales by 2027. North of Narromine, work is underway to complete the required environmental planning approvals and land acquisition needed for the project corridor, to provide more certainty that the project can be built to an agreed budget and timeframe.

When fully completed, Inland Rail will provide freight train operators with:

- A 1 600 kilometre inland railway traversing eastern inland Australia;
- Up to 21 tonne axle loads at maximum speeds of 115 kilometres per hour;
- Container double-stacking;
- Maximum train lengths of 1 800 metres (the equivalent of 110 B-Double trucks), and
- Scheduled transit times of less than 24 hours for Melbourne-Brisbane services, which will be up to 10 hours less than via the existing coastal route through Sydney.

Over 70 per cent of Inland Rail will involve upgrading existing infrastructure ('brownfield' construction). The remaining sections consist of 'greenfield' construction, chiefly the Narromine-Narrabri section and most sections in Queensland.

Construction of the first section of track between Parkes and Narromine was finalised in September 2020 and is now operational. Construction on the northern section of Narrabri to North Star
Phase 1 was completed on 27 October 2023.

In September 2023, major construction activities were completed in Victoria, specifically the Wangaratta Station Precinct, the Beaconsfield Parade bridge at Glenrowan, and the Murray Valley Highway bridge at Barnawartha North. In addition, construction started on the Stockinbingal to Parkes section in New South Wales in September 2023 as staging for further construction early in 2024.

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

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 intermodal 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 infrastructure that can accommodate the longer trains. Consequently, interstate network infrastructure managers have upgraded their networks to accommodate longer trains.

Table 28, 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 of 2009–10, not shown in table) 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 30 Index of real maximum access revenue yield, interstate network (2010-11 = 100)

	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
North-South corridor											
Acacia Ridge – Border Loop	100	100	100	100	100	100	100	100	100	97.63	97.61
Border Loop – Newcastle	100	100	100	100	100	100	100	100	100	97.63	97.61
Macarthur – Albury	100	100	100	100	100	100	100	100	100	97.79	97.67
Albury – Tottenham	100	100	100	100	100	100	100	100	100	97.79	97.67
East-West corridor											
Melbourne – Adelaide	100	100	100	100	100	100	100	100	100	97.99	97.63
Adelaide – Kalgoorlie	100	100	100	100	100	100	100	100	100	97.87	97.67
Cootamundra – Parkes	100	100	100	100	100	100	100	100	100	97.84	97.58
Parkes – Broken Hill	100	100	100	100	100	100	100	100	100	98.00	97.66
Broken Hill – Crystal Brook	100	100	100	100	100	100	100	100	100	97.81	97.66

Note: Numbers are subject to rounding.

Source: Data provided by ARTC.

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.

Passing lanes[28] have been built on the single track sections between Junee and Melbourne, on the Sydney—Melbourne corridor. This, combined with double track between Sydney and Junee, and Albury and Seymour, have enabled the use of unrestricted 1800 metre trains between Sydney and Melbourne.

28 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.

Double stacking capability on the interstate network

Double stacking containers on wagons increases 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 7.1 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 52, 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.

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

Figure 52 Double stacking capability on the interstate network

Track quality of the interstate network

The maintenance and standards of railway infrastructure influence 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 53 to Figure 56 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, weather and local geographical factors, and the skill and timeliness of ongoing maintenance work.

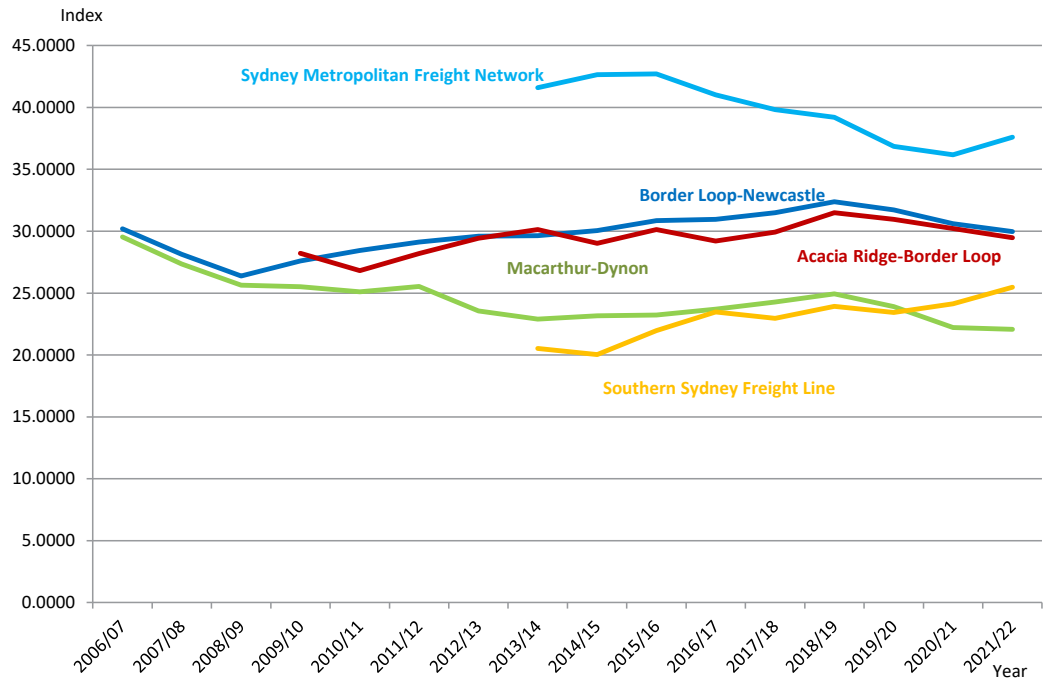
The composition of the index varies between infrastructure managers, reflecting both differences in priority and different operational environments across the network. Therefore, these index numbers should not be used to compare track conditions across line segments managed by different infrastructure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

Figure 53 and Figure 54, below, shows, that, in 2021–22, track quality increased slightly on all sectors of the North—South corridor, except the Southern Sydney Freight Line and Sydney Metropolitan Freight Network, which decreased by up to six per cent. On the East—West corridor, there were no significant changes.

Aurizon's Northgate (Tarcoola)—Darwin line TQI data is divided into five line segments. New data since the previous edition of *Trainline* consists of three measurements on the Northgate—Tennant Creek sectors and two measurements on the Tennant Creek—Darwin sectors[29].

On the Northgate—Tennant Creek sectors, there was an average improvement of 4-5 per cent across the two sectors, compared to the average of the three previous measurements. For the Tennant Creek—Darwin sectors, the track quality improved by four per cent between Tennant Creek and Katherine (compared to the average of the previous two measurements), while for the Katherine—Union Reef and Union Reef—Darwin sectors the track quality decreased by one and five per cent respectively (compared to the average of the previous two measurements).

Figure 53 ARTC track quality index, North—South corridor

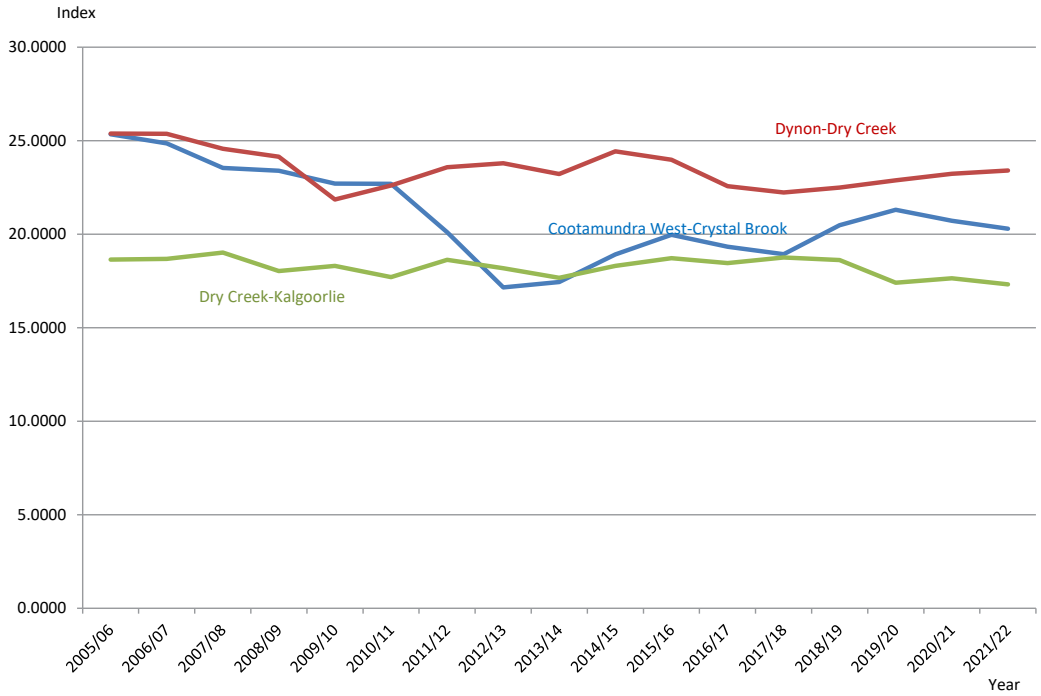


Note: Lower indices indicate higher track quality.
See attached spreadsheet for time series.

Source: Data Provided by ARTC.

29 There is no third measurement (for 2023) due to infrastructure flooding.

Figure 54 ARTC track quality index, East—West corridors



Note: Lower indices indicate higher track quality.
See attached spreadsheet for time series.

Source: Data Provided by ARTC.

Figure 55 Aurizon Track Quality Index, Northgate—Tennant Creek

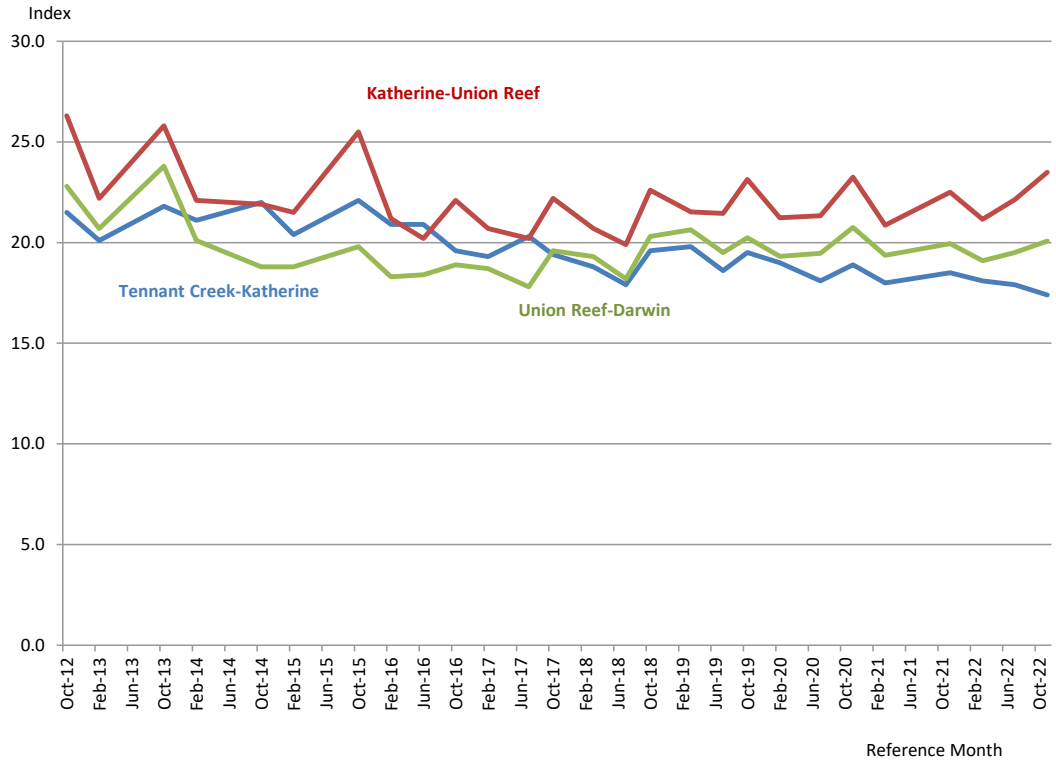
Notes: Northgate is the start of the Aurizon rail infrastructure. It is located shortly north of Tarcoola, where it diverges from the ARTC network.

Lower indices indicate higher track quality.

See attached spreadsheet for time series.

Source: Data Provided by Aurizon.

Figure 56 Aurizon track quality index, Tennant Creek—Darwin



Note: Lower indices indicate higher track quality. Data for 2023 not available due to infrastructure flooding. See attached spreadsheet for time series.

Source: Data Provided by Aurizon.

Box 6 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 (Aurizon) 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.

Urban heavy rail passenger networks

Australia's urban heavy rail networks are extensive, even if the network coverage is not dense (see Table 31). 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. In September 2023, Australia had an estimated 1506 route kilometres of operational urban heavy railways.

Table 31 Network characteristics of urban passenger heavy railways, July 2023

	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	127	188
Shared metropolitan freight/ passenger lines (km)	n/a	-	181	268	-	1
Total route length (km)	357	36	401	396	127	189
Electrified route length (km)	357	36	364	396	44	189
Metropolitan stations (number)	169	13	221	152	88	76
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	62	10.2	-	53
Gauge	Standard	Standard	Broad	Narrow	Broad	Narrow

Notes: Distances are an estimate of 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; Data provided by Adelaide Metro; Data provided by Aurizon; Advice from Public Transport Authority of Western Australia.

Some specific characteristics of the various networks are as follows:

- **Sydney Metro.** Sydney Metro Northwest opened on 26 May 2019 and provides driverless services from Rouse Hill to Chatswood; the first driverless passenger rail service in Australia. The Metro trains operate on a 'turn up and go' basis rather than by timetable. Construction to expand Sydney's Metro line to the Sydney CBD and Bankstown is underway.
- **Brisbane and Perth's** geographical scope arguably includes interurban traffic, in addition to purely urban traffic. This is because the two operators, City Train and Transperth respectively operate services beyond the greater city areas. This includes services to the Gold Coast in Queensland (approximately 88 kilometres from Roma Street Station) and services to Mandurah in Western Australia (approximately 70 kilometres from Perth Underground Station). By way of comparison, these are the approximate distances from Melbourne to Geelong and Sydney to Gosford, which are served by the non-urban rail operators V/Line and TrainLink respectively.

- **Network form.** Perth's system is also distinctive relative to the other Australian networks due to the nature of its new railways. Table 29 shows Perth's network is 30 per cent longer than Adelaide's, but has 13 fewer stations. This station spacing facilitates significantly higher average train speeds on Perth's Mandurah Line and, to a lesser extent, the Joondalup Line (see Figure 27). 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's urban heavy railways use a different track gauge to the interstate network. This separates urban passenger traffic from almost all freight traffic operating on the standard gauge. Examples of shared track where it occurs includes the north coast intermodal freight and coal from the Toowoomba region into the Port of Brisbane (narrow gauge), and steel products from Long Island to Melbourne, via the Frankston urban line (broad gauge). Sydney's urban network is standard gauge throughout. It therefore shares capacity with all freight traffic travelling through suburban Sydney. The Southern Sydney Freight Line provides a dedicated southern access to Sydney freight yards. This segregates freight traffic from passenger traffic along the corridor. The freight line from Chullora/Enfield to Port Botany is also mostly segregated from passenger traffic.
- **Electrification.** Electrified services began in Sydney and Melbourne[30] 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 electrified part of the network. Electric train operations began on the Seaford and Tonsley lines in 2014, and in 2022 on the Gawler line.

Light rail passenger networks

Australia has approximately 326 route kilometres of operational light rail. The technological and operational differences between tramways, light rail and heavy rail are increasingly blurred[31]. 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 networks in Melbourne, Sydney and Adelaide.

By route distance, Melbourne has the world's largest light rail network. There are smaller operations in the other cities that have light rail (see Table 32).

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

31 Tramways generally have short spacing between stations and operate on roads, often sharing a right-of-way with road 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 32 Network characteristics of light railways, July 2023

	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
Route length under construction (km)	6.7	12	-	-	1.6	-

Source: Advice from Yarra Trams; G:link (2023a); Canberra Metro (2023); Advice from Department of Planning, Transport and Infrastructure; Advice from Transport for NSW; Parramatta Light Rail (2023); BITRE estimates.

Melbourne's network is mostly integrated with road traffic. Most of the network shares the close-stop and on-road feature of buses, which increases travel times. Other parts of the network resembles the limited-stop, segregated railway. The lines from Southbank to Port Melbourne and St Kilda, for instance, are former heavy rail lines that were converted to light rail running in the late 1980s.

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 has three light rail routes. The L1 line starts at Sydney Central Station and 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 to Randwick, while the L3 line continues to Kingsford. The L2 and L3 lines are largely on road segregated. Stage 1 of the Parramatta Light Rail, connecting Westmead to Carlingford via the Parramatta CBD and Camellia, is underway with an expected completion in 2024. (Parramatta Light Rail, 2022)

The Gold Coast light railway runs between Helensvale and Broadbeach South. The line runs along roads but the space is generally not shared with road traffic. The line runs along a dense retail corridor. In 2022, construction of Stage 3, a 6.7km extension of the line from Broadbeach South to Burleigh Heads, was underway, with revenue services expected to commence in 2025. (Gold Coast Light Rail Stage 3, 2022)

Canberra's light railway runs from Canberra City to Gungahlin. Relatively long distances between stops and traffic signals priority enables Canberra's light rail to have the highest point to point average speed – 30 kilometres per hour. In late 2022, construction of Canberra's light rail Stage 2A 1.7 kilometre extension, from the Canberra CBD to Commonwealth Park, began. (Light Rail to Woden, 2022)

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 networks

Non-urban passenger services are mostly integrated with other rail operations. 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 Melbourne.

Table 33 Network coverage of non-urban passenger rail services, by operator, July 2023

	Queensland Rail	NSW TrainLink	V/Line	Transwa	Journey Beyond
Electrified route kilometres	728	445	-	-	-
Total route kilometres	4 380	4 261	1 763	836	9 139

Notes: Shared corridors by multiple services by the same operator are only counted once. For example, TrainLink's Sydney-Brisbane estimate includes all other TrainLink services that operate anywhere on that corridor. Conversely, the Sydney-Armidale estimate only includes the section from Maitland to Armidale. Shared corridors by separate operators are counted separately. For example, TrainLink's estimate includes the Albury-Melbourne corridor, which is counted separately to V/Line's estimate that also includes Albury-Melbourne.

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 run on electrified track in places. Where non-urban electrified and diesel services share electrified track (such as Rockhampton–Brisbane), the route is deemed 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 deemed not electrified.

Source: BITRE estimates.

Chapter 6
Rollingstock

Locomotives

Due to an ongoing lack of data provision from some above-rail operators and a scarcity of publicly available information, BITRE is unable to report a current estimate of the total number of operational locomotives in Australia. According to its previous estimate in September 2021, there were approximately 2100 operational locomotives in Australia[32].

According to its website, TasRail has the following 27 operational locomotives:

- 17 TR Class;
- Eight 2000 (DQ) Class; and
- Two 2050 Class (TasRail, 2023).

According to its website, Pacific National has more than 570 active locomotives (without elaboration) (Pacific National, 2023).

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).

Heavy rail rolling stock

"Multiple unit" stock using permanently coupled carriages provide all 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. Melbourne's new HCMT train, which began entering service in December 2020, operate as seven car sets. 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 two-car and three-car operations in Perth.

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.

32 For details of the September 2021 estimate, see BITRE (2022), pp. 61–63

Adelaide is converting its fleet of diesel powered sets into diesel hybrid operations. Through regenerative braking the train sets are able to reduce fuel consumption by up to 20 per cent and provide a more comfortable ride. (Rail Express, 2023) According to advice from Adelaide Metro, conversion to hybrid traction is mainly for reliability purposes, with additional environmental benefits. There was, in October 2023, one two-car hybrid set in operation.

Table 34 Operational urban heavy rail rolling stock, July 2023

	Brisbane	Sydney	Melbourne	Adelaide	Perth
Vehicles (no.)	879	1832	1457	124	330
Carriage format	Single-deck	Double-deck and single-deck	Single-deck	Single-deck	Single-deck
Multiple-unit format	75 six car	22 six car	198 six car	26 three car	48 two car
	143 three car	187 four car	38 seven car	23 two car	78 three car
		119 eight car			

Notes: The Brisbane total includes interurban rollingstock, while the Sydney totals exclude it. This is due to structural differences between operators in each state.

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.

BITRE estimates that in July 2023 Australia had 4 622 urban heavy rail cars (both electric and diesel, formed into multiple unit sets). Compared to 2022 there were the following changes:

- In Melbourne, the number of ageing Comeng class vehicles decreased by 42, while an additional 84 newly built HCMT cars entered service;
- In Sydney there was one less Millennium class car;
- In Brisbane there were nine fewer EMU class vehicles; and
- In Adelaide, there were two fewer 3000/3100 class vehicles.

Light rail rolling stock

In 2023, there were no changes to Australia's operational light rail fleet numbers since 2022. BITRE estimates there were 633 light rail vehicles in service. Melbourne's greater number of rolling stock and rolling stock variety reflects the city's more extensive light rail network than other Australian cities.

As operations have expanded and as Melbourne has updated its fleet, longer, higher capacity vehicles have entered service. Most use vehicle articulation rather than the coupling of vehicles, although all of Sydney's new Citadis X05 vehicles now operate as coupled two car sets. Melbourne's E class vehicle, introduced from 2013, is more than twice the length of Melbourne's older Z and A classes. Victoria is also developing a new G class light rail vehicle, to replace the Z and A class vehicles. The G class vehicles are to be built locally at the Alstom plant in Dandenong. The vehicles will be low floor and able to accommodate up to 150 passengers. 100 vehicles are scheduled to be built, with the first to enter service in 2025. (Infrastructure Magazine, 2023)

The new trams are a mix of imported and locally built vehicles. Alstom manufactures the Australian built E class vehicles at its Dandenong plant in Victoria. Imported vehicles are made in Spain, Germany, and France.

Table 35 Operational light rail rolling stock, July 2023

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	100
	Z3 class	16.6	87
	W class	14.2	13
Melbourne total			**499**
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 current revenue 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.

Figure 57 Canberra Urbos 3 light rail vehicle

Notes: The image above shows a Gungahlin bound light rail service at the EPIC and Racecourse stop in July 2023.
Photo courtesy of Rodney Avery.

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);
- The average speed of services (with faster operations requiring fewer train sets);
- Electrification, where in place; and
- Modernisation and replacement.

There is a wide range of non-urban passenger services in Australia. Thus, rolling stock, designed for individual markets and service types, vary. Table 34 shows the number of individual vehicles/cars, by type and operator in July 2023. BITRE estimates there were 1115 non-urban cars and carriages in service and 87 locomotives in service (including those used for shunting duties).

Table 36 Operational non-urban passenger rolling stock, by type and operator, July 2023

	Queensland Rail	NSW TrainLink	V/Line	Transwa
Electric multiple unit cars (no.)	12	425	-	-
Diesel multiple unit cars (no.)	5	65	339	14
Locomotives (no.)	35	19	33	-
Carriages (no.)	82	60	113	-
Total cars/vehicles	133	569	485	14

Notes: The V/Line carriages total includes four power vans and one flat wagon. While the number of V/Line locomotives has not declined, their usage is declining as new VLocity sets take over previous locomotive-hauled services. The locomotive total also includes four Y Class locomotives that are only used for shunting duties.

The Queensland Rail total excludes the electric multiple unit cars that serve destinations outside Brisbane as services to these destinations form part of an integrated urban/interurban network. The 12 cars listed above form the electric tilt train EMU sets. The five diesel multiple unit cars are of the *Gulflander* fleet. The carriages total includes five power cars.

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.

No data is available for Journey Beyond's trains.

Sources: Data provided by Transport for NSW, Queensland Rail, and Public Transport Victoria; Public Transport Authority WA (2022), p21.

NSW TrainLink and Queensland Rail have large electric multiple unit (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. Victoria and Western Australia have no EMU non-urban trains. Other medium-distance regional/commuter services are increasingly diesel multiple unit (DMU) operated. Transwa uses DMUs for all its rail services.

The use of traditional locomotive hauled passenger trains in Australia continues to be in decline. In Victoria, the expanding fleet of VLocity DMU sets is replacing many previous locomotive hauled trains. In July 2023 an additional This includes standard gauge sets which have replaced all locomotive-hauled trains on the Albury line. Remaining locomotive hauled train sets in Victoria are primarily used for long-distance routes not yet fully served by VLocity sets and some non-urban commuter services. Some Queensland long-distance services are still locomotive hauled.

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. While the diesel tilt train is technically locomotive hauled, it differs from traditional locomotive hauled trains by virtue that the power cars (locomotives) are in a fixed format setting as part of a single train set, with one power car at each end of the trains. This arguably gives them the appearance of a DMU train. (BITRE 2014d, p. 60 and pp. 161–162, discusses the nature of the tilt-train services and the principles of tilt trains.)

New South Wales TrainLink's XPT sets are of the same fixed format structure as Queensland's diesel tilt trains. The New South Wales Government is replacing the XPT and (and diesel multiple unit) Xplorer fleet and the first trains are expected to enter service in the mid to late 2020s.

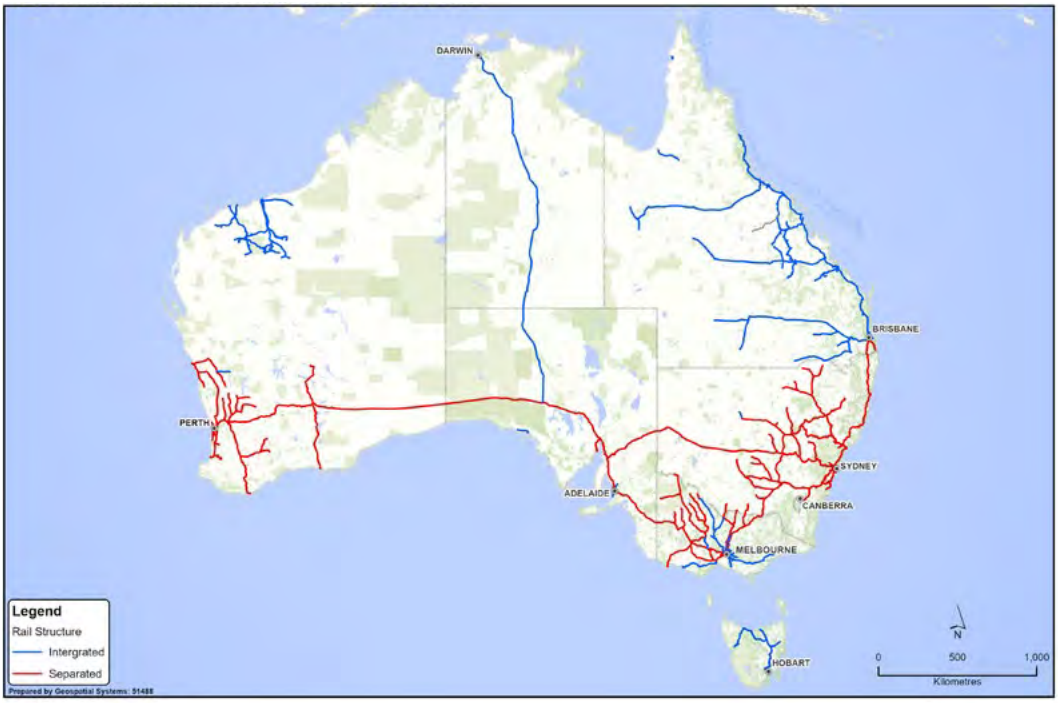
Most modern medium and long-distance DMU passenger trains in Australia are capable of and are timetabled in places to travel at speeds of 130-160 km/h. The XPT and tilt trains (both electric and diesel) also operate at these speeds. Such operations are only possible where the infrastructure used can facilitate such speeds.

Chapter 7

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 both manages the infrastructure and runs revenue earning services on it. Vertically-integrated railway managers may also provide "third-party access" to (other) train operators, such as in the Central Queensland Coal Network.

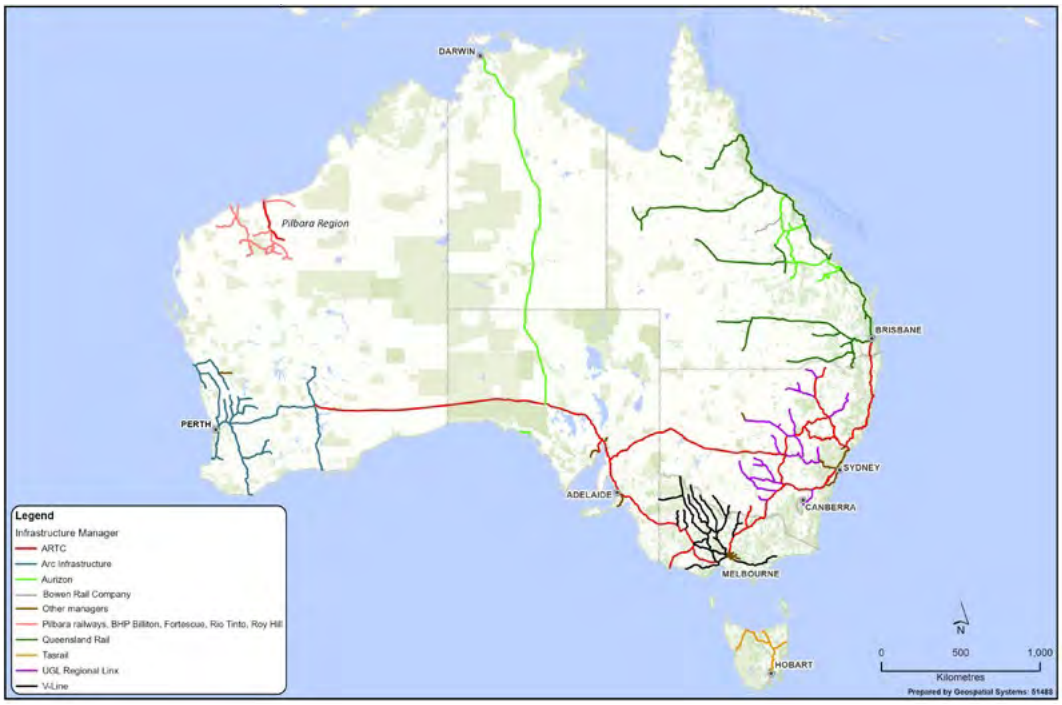
Figure 58 **Australian rail industry structure, July 2023**



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, July 2023



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 manages most of the interstate network. Arc Infrastructure manages the interstate line between Kalgoorlie and Perth. Aurizon owns (long lease) the Tarcoola—Darwin line as a vertically-integrated railway. UGL Regional Linx (UGLRL) manages the line 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 most of the infrastructure and operates trains in central Queensland and uses Queensland Rail infrastructure elsewhere. Aurizon provides third-party access to its central Queensland lines. In 2022, the Carmichael venture commenced operations, using its own 200 kilometre vertically-integrated railway that adjoins Aurizon's network. Coal railways in New South Wales are vertically separated. ARTC manages the Hunter Valley coal network with UGL Regional Linx 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, UGL Regional Linx), Victoria (V/Line)33 and Western Australia (Arc Infrastructure). Aurizon operates as a vertically-integrated operator in parts of South Australia.
- **Passenger.** Urban systems are vertically-integrated. Non-urban passenger operations are a mix of vertical-integration and separation.

Table 37 Principal infrastructure managers of Australian heavy railways, July 2023

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
Aurizon	Integrated	Intermodal, ores, passenger
UGL Regional Linx	Separated	Intermodal, steel, grain, coal, passenger
Intrastate		
Aurizon (Queensland)	Integrated	Coal
Bravus Mining and Resources/Bowen Rail Company	Integrated	Coal
Queensland Rail	Integrated and Separated	Passenger (integrated), grain, coal, cattle, ores, intermodal (separated)
UGL Regional Linx	Separated	Intermodal, grain, ores, 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, quarry products, intermodal
ARTC (Victoria, Maroona-Portland)	Separated	Grain
TasRail	Integrated	Intermodal, coal, ores, timber
Aurizon (South Australia)	Integrated	Grain, gypsum, ores
Arc Infrastructure Rail (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	Passenger
MTM (Metro Trains Melbourne)	Integrated	Passenger
Adelaide Metro	Integrated	Passenger
Transperth	Integrated	Passenger

Note: There are a number of other, smaller, infrastructure managers, including heritage railways, totalling an estimated approximate 500 route-kilometres.

33 Also in Victoria, ARTC manages the Maroona-Portland and Benalla (Victoria)–Oaklands (New South Wales) lines.

Above-rail operators

- **Heavy rail urban passenger** operators are vertically-integrated. Most are publicly-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** government operated except Journey Beyond, 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.** These include Pacific National, SCT Logistics, QUBE Logistics, Aurizon, and Southern Shorthaul Railroad.
- **Regional rail freight operators.** These include Pacific National, SCT Logistics, QUBE Logistics, Aurizon, Southern Shorthaul Railroad, TasRail, and Watco.
- **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 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 38 Principal above-rail operators in Australia, July 2023

Train operator	Infrastructure network used	Primary tasks
Aurizon	Aurizon, Queensland Rail, ARTC, Arc Infrastructure	Coal, ores, minerals, cattle, grain, mixed bulk, agricultural produce, intermodal
Pacific National	Aurizon, Queensland Rail, ARTC, V/Line, UGL Regional Linx, Sydney Trains, Arc Infrastructure, Metro Trains Melbourne	Coal, ores, intermodal, steel, grain, mixed bulk
SCT Logistics/Specialised Bulk Rail	ARTC, Arc Infrastructure, Sydney Trains	Intermodal, steel, grain, iron ore
QUBE Logistics	ARTC, V/Line, Sydney Trains, UGL Regional Linx, Metro Trains Melbourne	Intermodal, steel grain, mixed bulk
Watco	Aurizon, Queensland Rail	Grain, livestock
Southern Shorthaul Railroad	ARTC, Sydney Trains, UGL Regional Linx, V/Line, Metro Trains Melbourne	Coal, grain, intermodal, infrastructure works
TasRail	TasRail	Intermodal, coal, ores, timber
Fletcher International	ARTC, UGL Regional Linx, 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
Bowen Rail Company	Bravus Mining and Resources/Bowen Rail Company, Aurizon, Queensland Rail	Coal
Magnetic Rail Group	Aurizon, ARTC, Queensland Rail	Coal
Bowmans Rail	ARTC	General freight, bulk
Queensland Rail	Queensland Rail, AirTrain CityLink Limited	Heavy rail passenger (urban, intercity, and long distance)
NSW TrainLink	Sydney Trains, ARTC, UGL Regional Linx, 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)
Journey Beyond Rail Expeditions	Sydney Trains, UGL Regional Linx, ARTC, Arc Infrastructure, Aurizon, V/Line	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	Adelaide Metro	Heavy rail passenger
Transperth	Transperth	Heavy rail passenger
GoldLinQ	GoldLinQ	Light rail passenger
Transdev	Transport for NSW	Light rail passenger
Yarra Trams	Yarra Trams	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

Chapter 8
Safety and Environment

Safety

ONRSR, which has regulatory safety oversight for all of Australia34, stated in its 2022–2023 annual report there were 84 notified fatalities on railways regulated under *Rail Safety National Law (2012)*. Suspected suicide continued to be the highest cause of fatalities. The figure of 62 in 2022–23 was nine more than the previous financial year (53). Like previous years, most suspected suicides occurred in Victoria.

Table 39 Rail related fatalities by jurisdiction 2022–23

Jurisdiction	Suspected suicide	Trespasser struck by train	Person/ train interface	Level crossing collisions	Rail Accidents	Other	Total
ACT	0	0	0	0	0	0	0
SA	3	0	0	3	0	0	6
TAS	0	1	0	0	0	1	2
NT	0	0	0	0	0	0	0
NSW	17	4	2	0	0	1	24
VIC	28	0	0	2	2	3	35
QLD	9	1	0	0	0	1	11
WA	5	0	0	0	0	1	6
Total	**62**	**6**	**2**	**5**	**2**	**7**	**84**

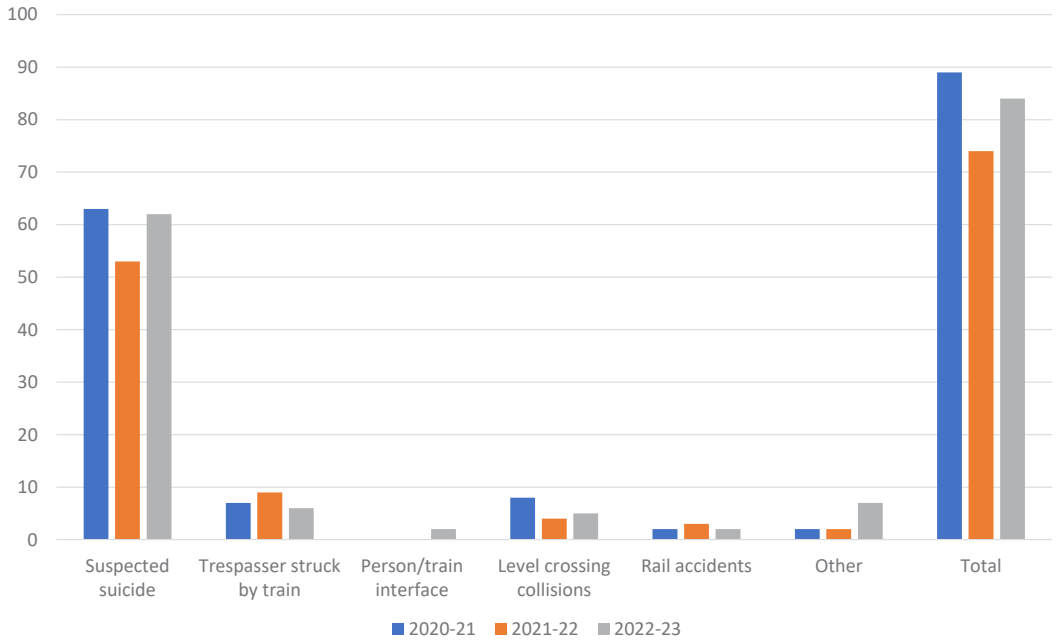
Notes: ONRSR defines a person/train interface as an incident involving a person at the direct interface point with trains that resulted in a risk to safety.

Rail accidents includes collisions between trains and passengers being struck by trains.

Source: ONRSR, 2023, p.17

34 Each Australian state and territory has legislated nationally consistent rail safety law, which ONRSR administers.

Figure 60 Australian rail network fatalities



Notes: There is no 'person/train interface' data for the first two years shown in the chart as it is a new category that ONRSR introduced in its 2023 annual report. It replaces 'slips, trips, and falls', whose definition is not identical to the new category. They are thus not comparable.

See attached spreadsheet for time series.

Source: ONRSR, 2023, p.17; previous ONRSR annual reports

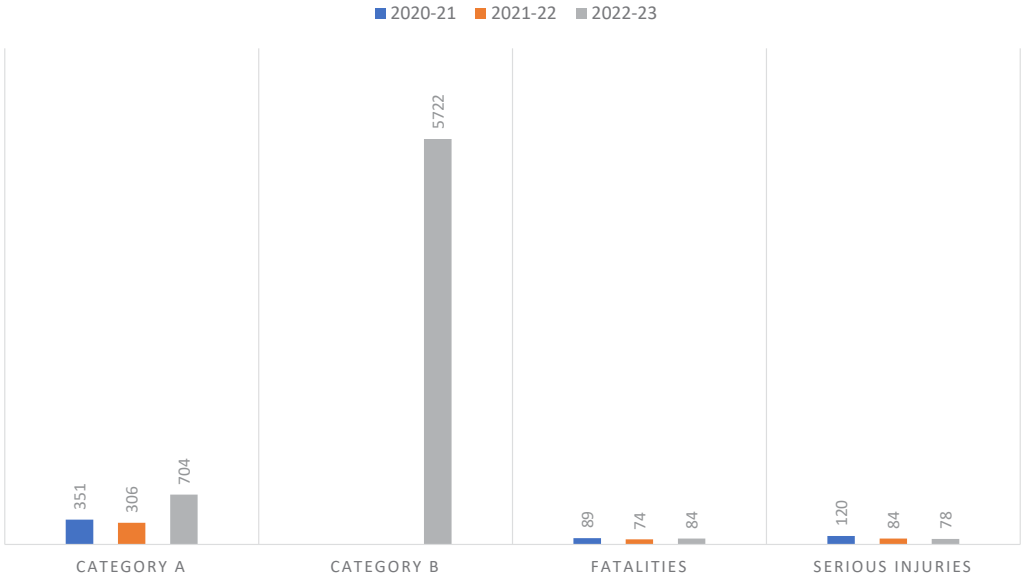
National rail safety laws oblige rail transport operators to report occurrences. A notifiable occurrence is an accident or incident associated with railway operations that has, or could have, caused significant property damage, serious injury or death. Category A occurrences must be reported immediately. Category B occurrences must be reported within 72 hours of the occurrence. (ONRSR, 2023, p.16) Details of Category A and Category B incidents for 2022–23 are shown below.

Table 40 Category A and Category B occurrences injuries by jurisdiction 2022–23

Jurisdiction	Category A	Category B	Fatalities	Serious Injuries
ACT	3	2	0	2
SA	51	497	6	3
TAS	12	76	2	1
NT	2	7	0	2
NSW	162	1398	24	16
VIC	338	1147	35	36
QLD	106	1542	11	12
WA	110	1053	6	6
Total	**784**	**5722**	**84**	**78**

Source: ONRSR, 2023, p.16

Figure 61 Reportable safety occurences on the Australian rail network



Notes: No data for Category B occurrences for 2020-21 and 2021–22 is shown due to reporting requirement changes that started on 1 July 2022. Data for those two years is thus not comparable with 2022–23.

See attached spreadsheet for time series.

Source: ONRSR, 2023, p.16; previous ONRSR annual reports

Figure 61, above, compares numbers of reportable safety occurrences (along with fatalities and serious injuries) on the Australian rail network from 2020–21 to 2020–23.

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 and subject to revision.

Changing requirements, such as higher performance and, for passenger rail, air-conditioning and on-board electronics, may increase emissions intensity. Table 41, below, shows BITRE's revised estimate of full fuel cycle carbon dioxide equivalent emissions estimate by transport mode[35].

According to the latest estimate, rail transport whose emissions decreased in 2022–23 compared to the previous financial year. As Figure 62 (which expresses the emissions shown in Table 41 in percentage terms of the total) shows, however, while rail transport had the only decrease in emissions, road transport's total emissions have been approximately 94 per cent greater than rail's on average each year since 2012–13.

35 BITRE, 2023a, shows full estimates dating back to 1982–83.

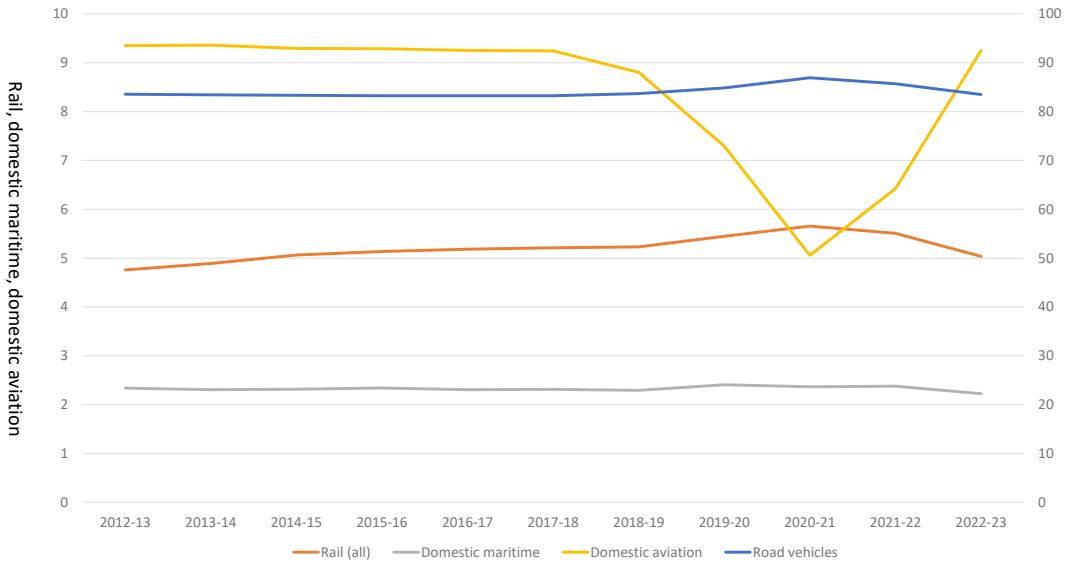
Table 41 Transport full fuel cycle greenhouse gas (carbon dioxide equivalent) emissions, including recreational vehicles, by transport mode

Financial year	Road vehicles	Rail (all)	Domestic maritime	Domestic aviation	Total (direct)
			gigagrams of CO_2 equivalent		
2012–13	99 696	5 678	2 788	11 156	119 318
2013–14	100 636	5 898	2 781	11 289	120 604
2014–15	101 174	6 149	2 812	11 286	121 421
2015–16	102 821	6 346	2 889	11 474	123 530
2016–17	103 974	6 474	2 881	11 555	124 884
2017–18	105 422	6 600	2 927	11 708	126 657
2018–19	105 674	6 605	2 896	11 116	126 291
2019–20	101 545	6 519	2 878	8 722	119 664
2020–21	102 385	6 662	2 788	5 955	117 790
2021–22	101 440	6 520	2 817	7 609	118 386
2022–23	106 355	6 413	2 832	11 784	127 384
Change (2022–23 to 2021–22)	4.85%	-1.64%	0.53%	54.87%	7.60%

Note: Updated Global Warming Potentials have been used in this estimate, slightly altering previously estimated levels.

Source: BITRE, 2023, Table 11.9.

Figure 62 Proportion of greenhouse gas emissions by transport mode – full fuel cycle



Note: See attached spreadsheet for time series.

Source: BITRE Estimates.

Appendix A

Significant railway events since 2013

Date	Event	Description
21 January 2013	Southern Sydney Freight Line	Formal opening of the Southern Sydney Freight Line
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
1 December 2013	Springfield Railway	Opening of the Springfield urban railway in Brisbane
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	Tonsley railway electrification commissioned
27 March 2014	Sydney Inner West Light Rail	Sydney light rail extension from Lilyfield to Dulwich Hill opened.
20 July 2014	Gold Coast Light Rail	Gold Coast Light Rail commences operations
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
21 September 2014	Butler Railway, Perth	Opening of the 9 km Butler urban railway extension from Clarkson
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
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
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)
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

Date	Event	Description
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
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
22 Oct 2021	Aurizon acquisition of One Rail Australia	Aurizon announces acquisition of One Rail Australia, at $2.3 billion, expected to be concluded in April 2022.
Dec 2022	Adelaide Metro Flinders Link Project	Extension of Tonsley Line to Flinders completed and open to revenue services
29 Dec 2021	Standard gauge VLocities	Newly built standard gauge VLocity trains start revenue service on Melbourne – Albury line.
January 2022	NSW CRN	UGL Regional Linx starts 10 year contract managing NSW CRN, replacing John Holland Rail
1 January 2022	Bluescope contract	QUBE Logistics and SCT Logistics start contract with Bluescope for the transportation of its steel products, replacing the former contract holder, Pacific National.
June 2022	Adelaide Metro electrification	Completion of Gawler Rail Electrification Project
29 July 2022	One Rail Australia sale	Aurizon completes its $2.35 billion acquisition of One Rail Australia
9 October 2022	Forrestfield-Airport Link	Newly constructed Perth Forrestfield-Airport Link line open to revenue services
2022	Carmichael Rail Network	Carmichael Rail Network in Central Queensland opens, operated by Bowen Rail Company
April 2023	Aurizon intermodal operations	Aurizon recommences interstate intermodal rail transport operations

Appendix B

Urban heavy rail network maps – July 2023

Figure 63 **Adelaide**

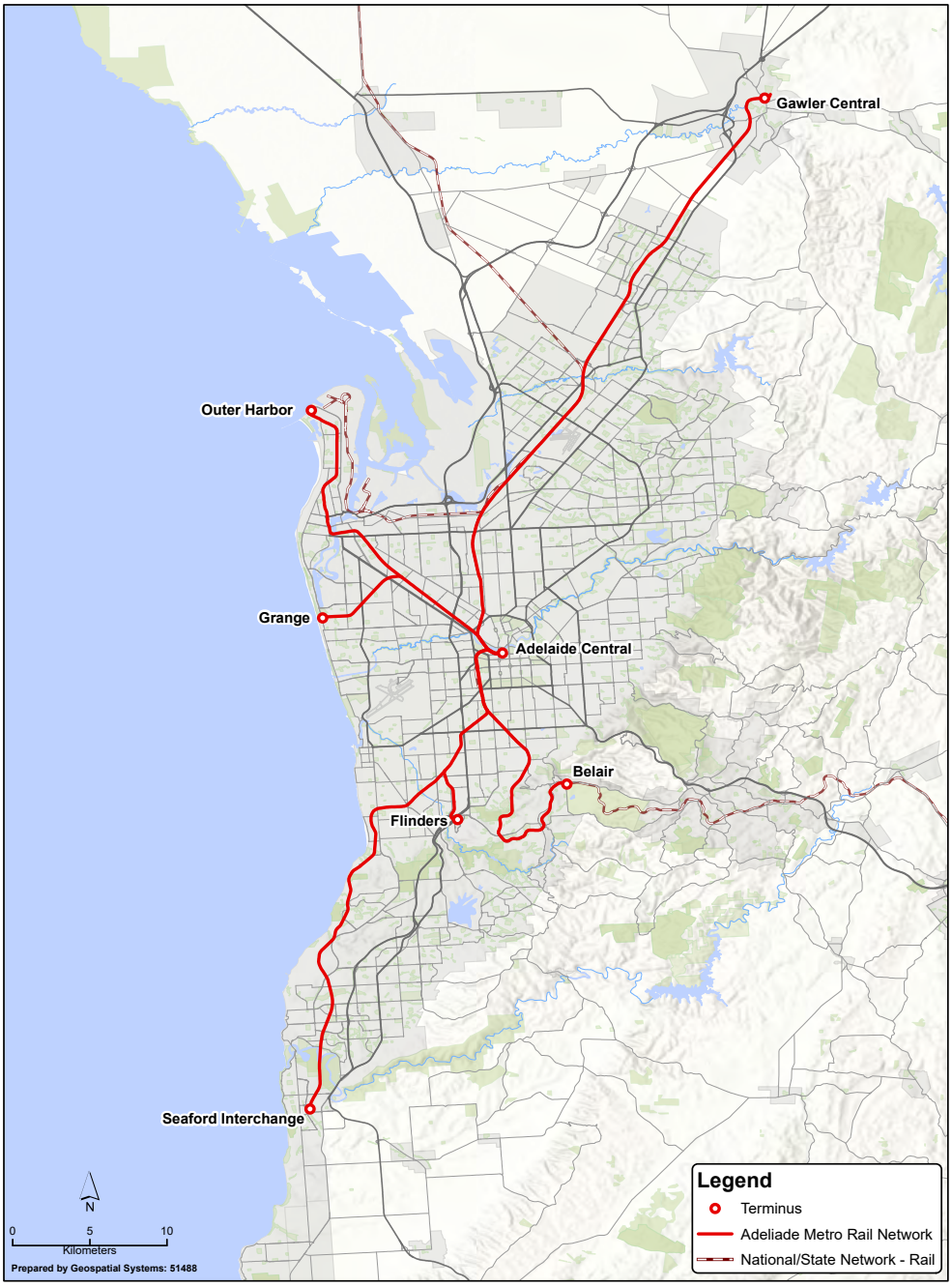


Figure 64 Brisbane

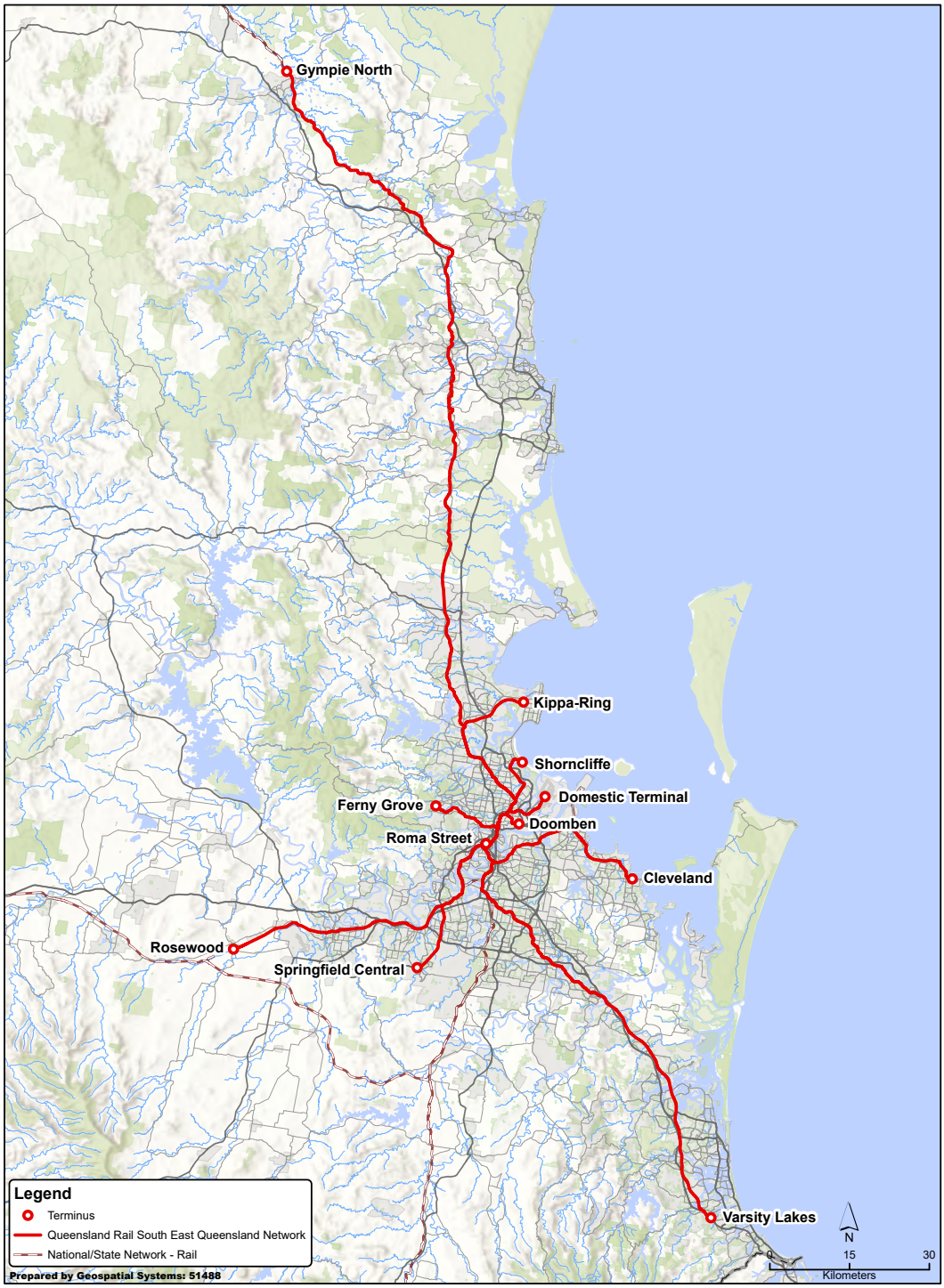


Figure 65 Melbourne

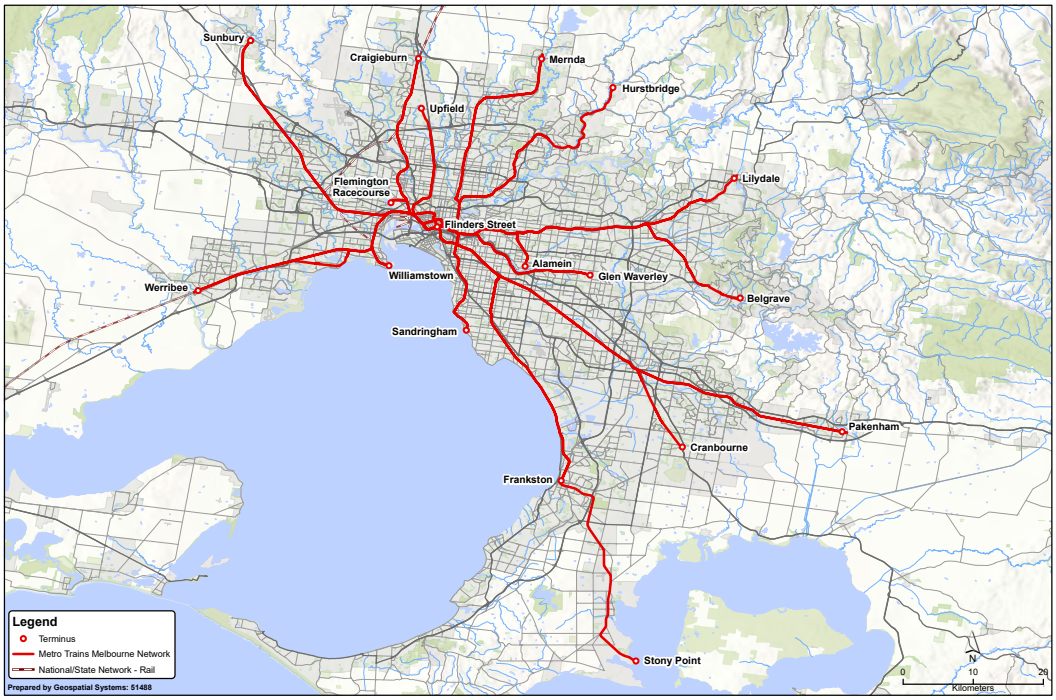


Figure 66 **Perth**

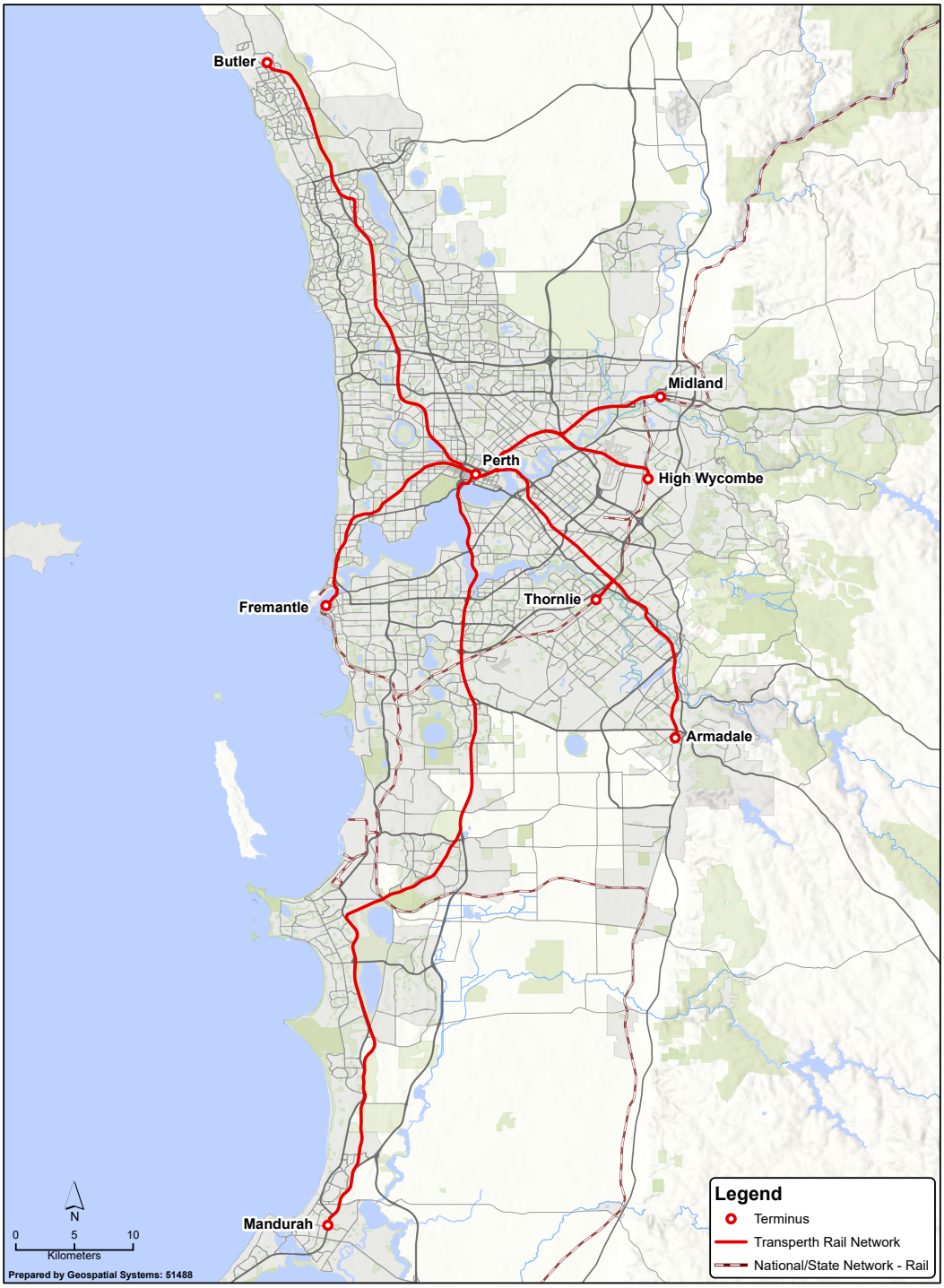
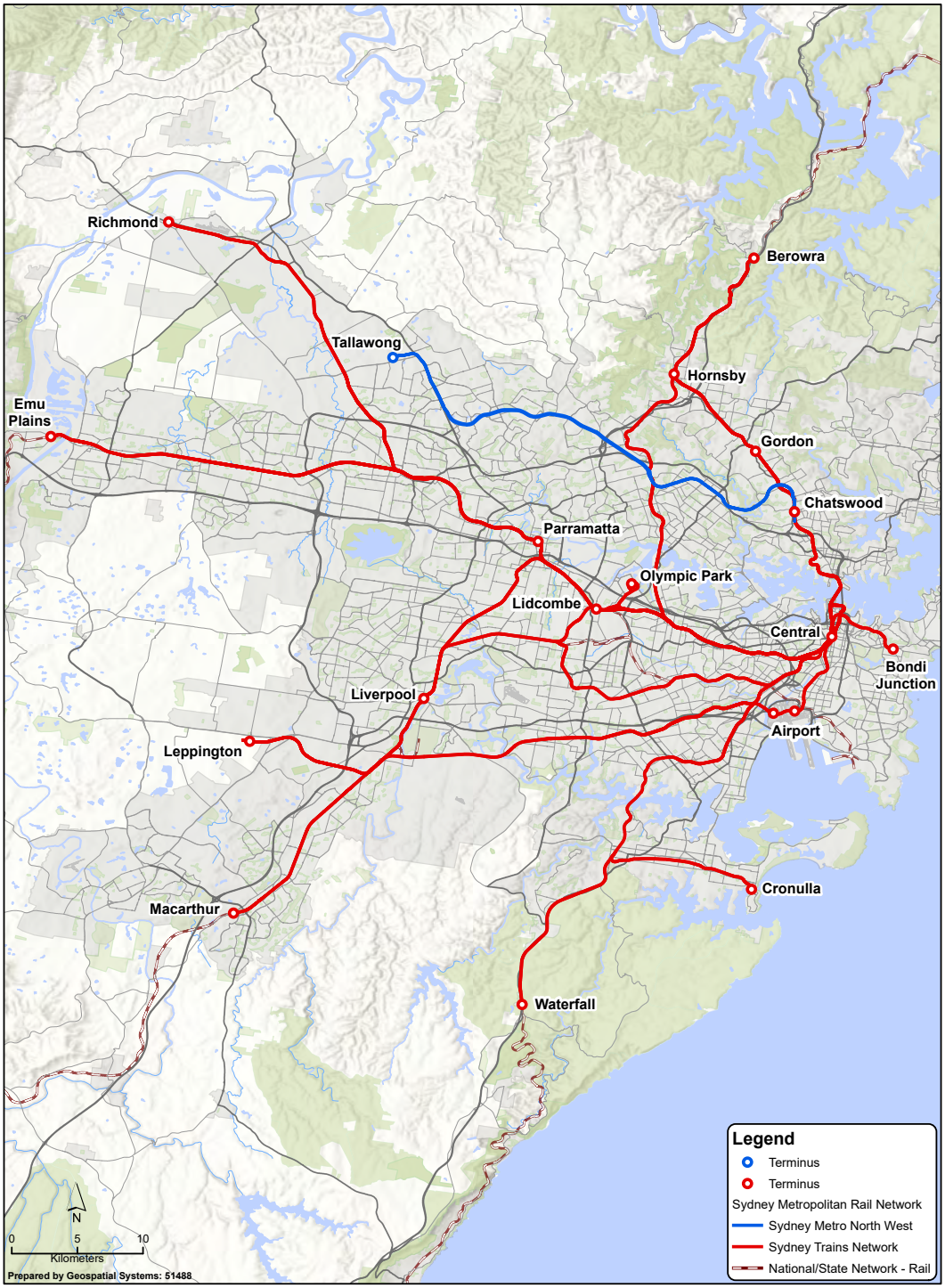


Figure 67 Sydney



Appendix C

Light rail network maps – July 2023

Figure 68 Adelaide

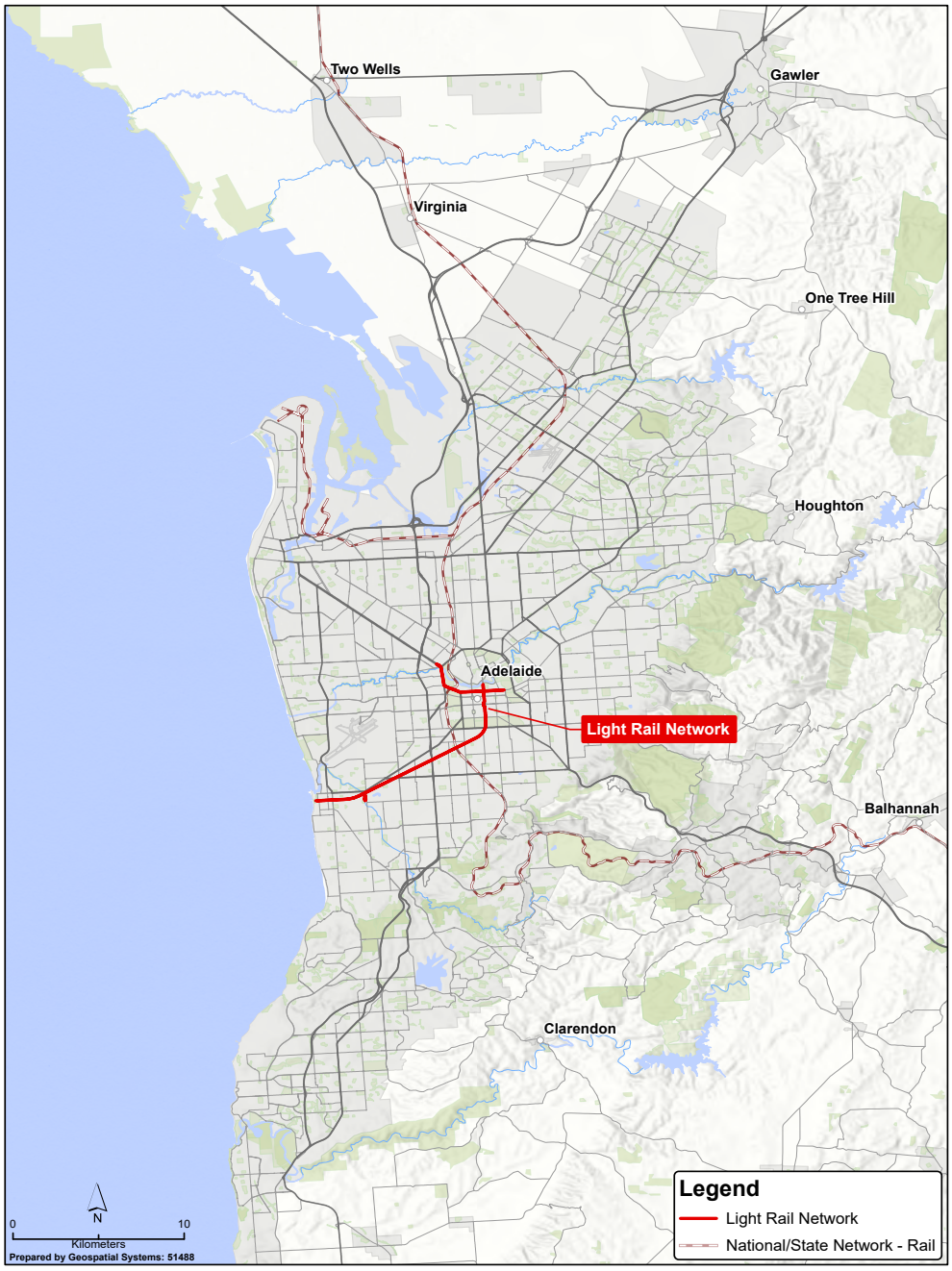


Figure 69 Canberra

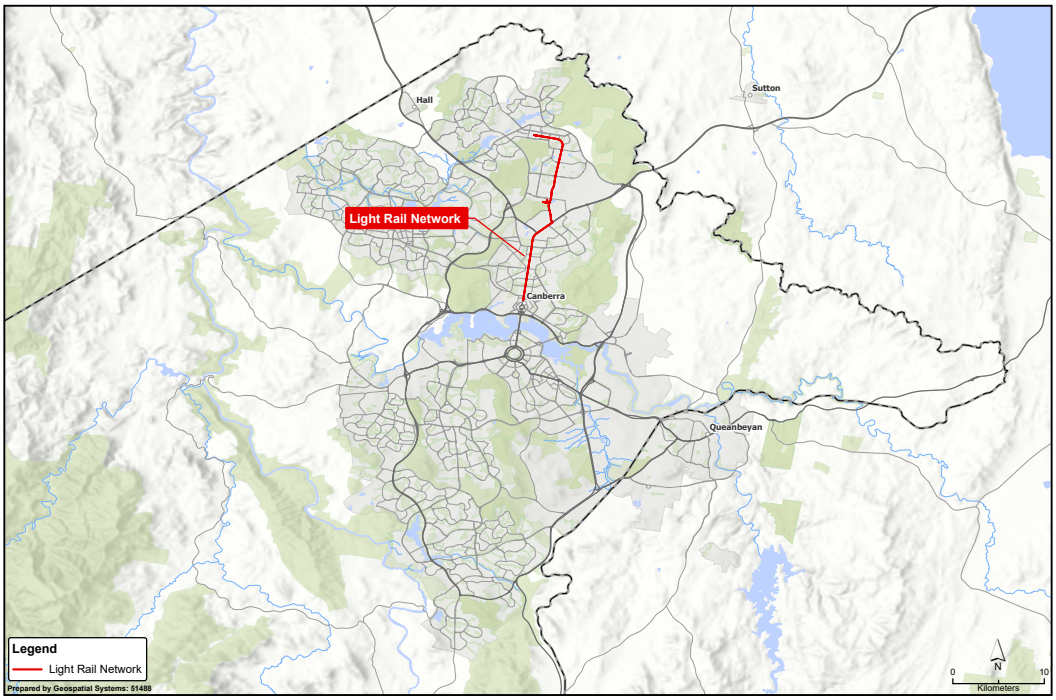


Figure 70 **Gold Coast**

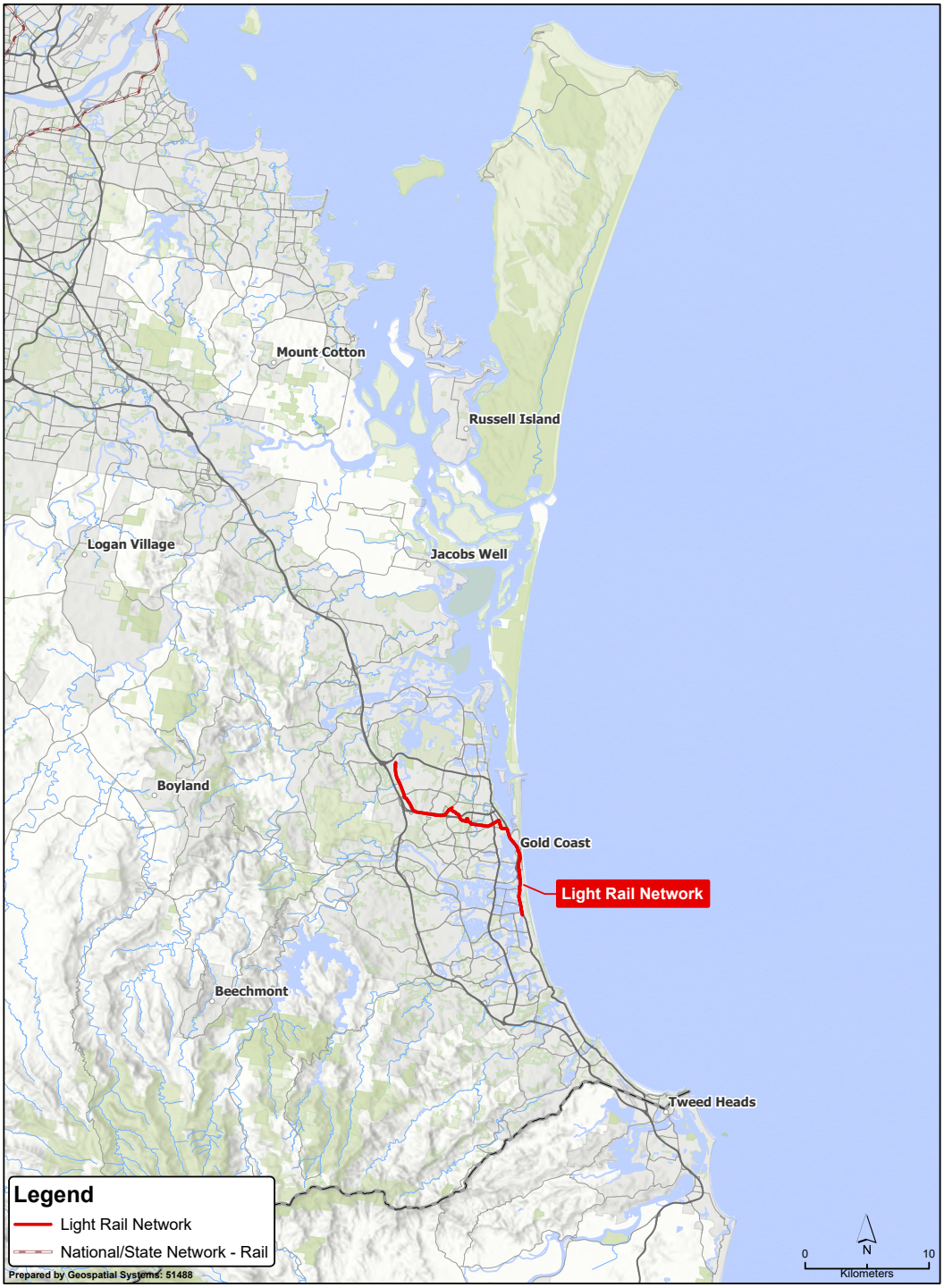


Figure 71 Melbourne

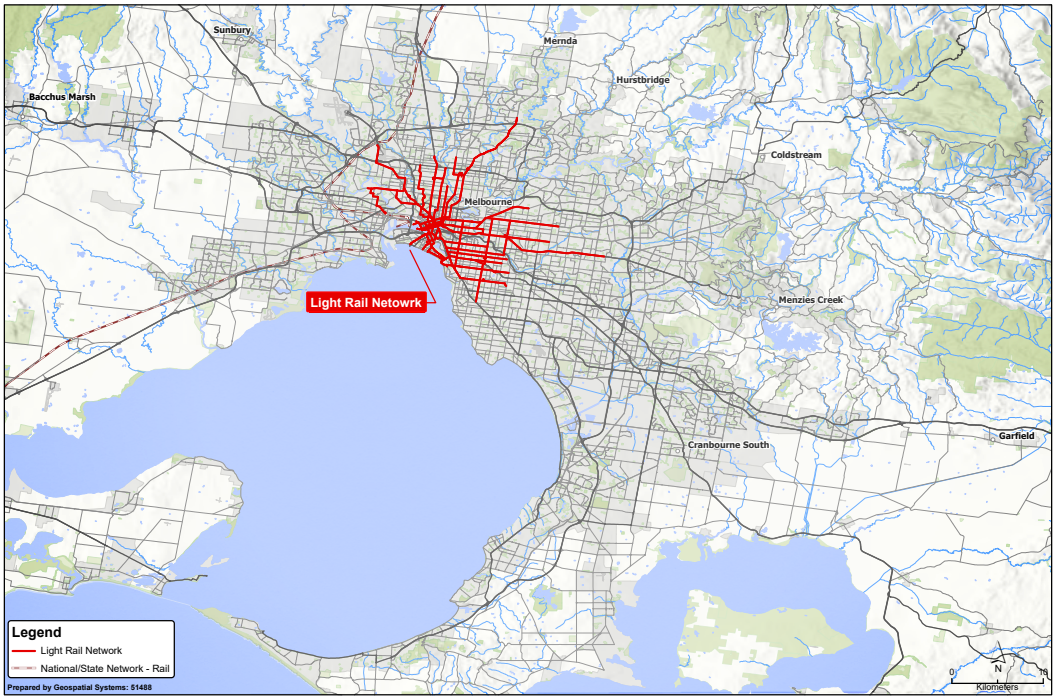


Figure 72 Newcastle

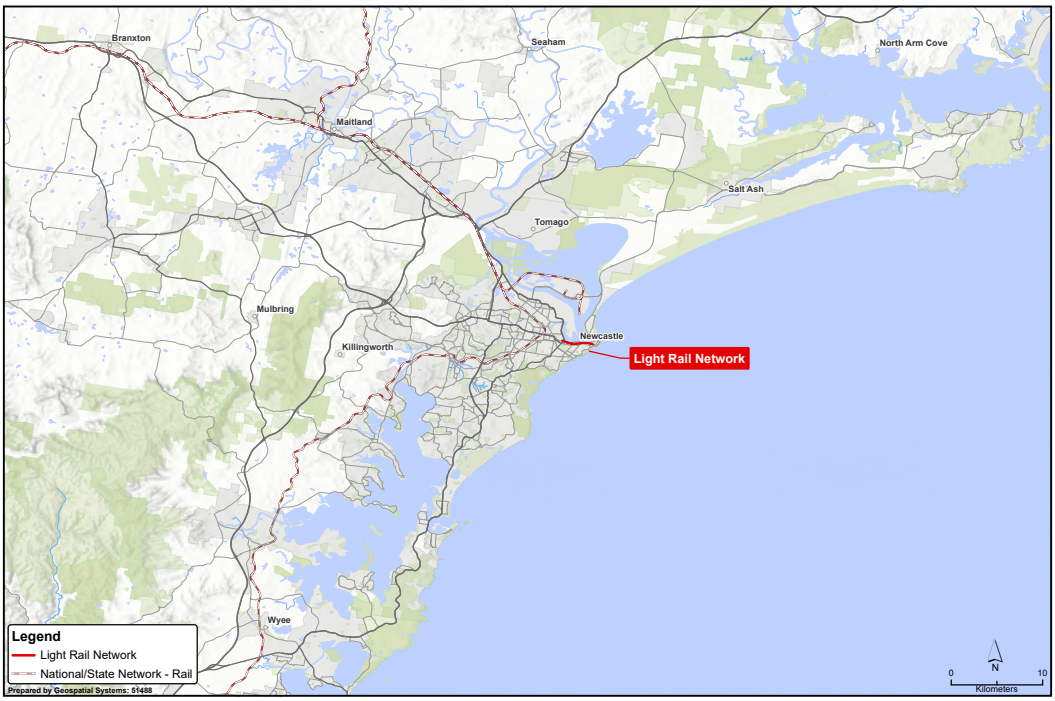
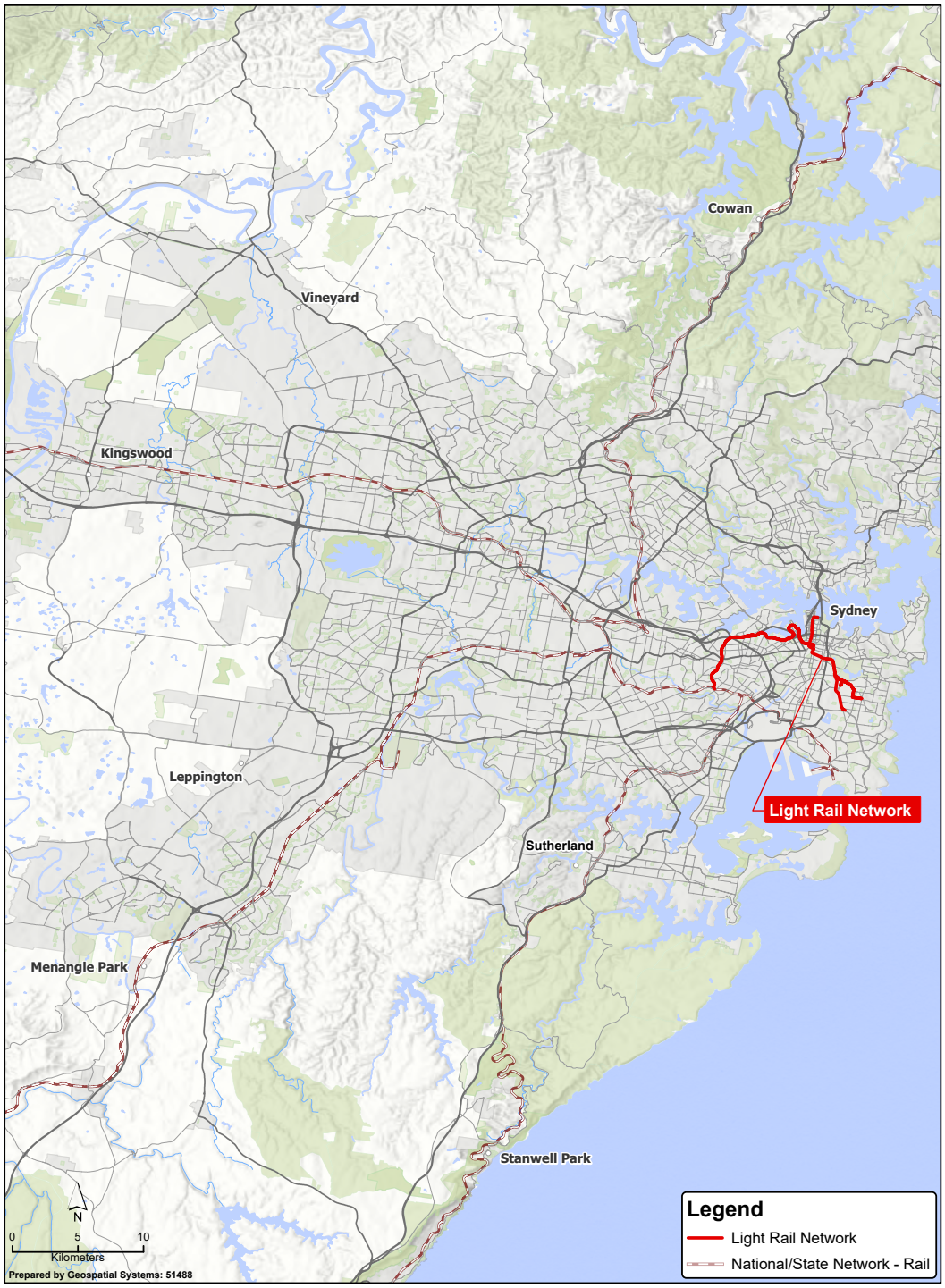


Figure 73 Sydney



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