

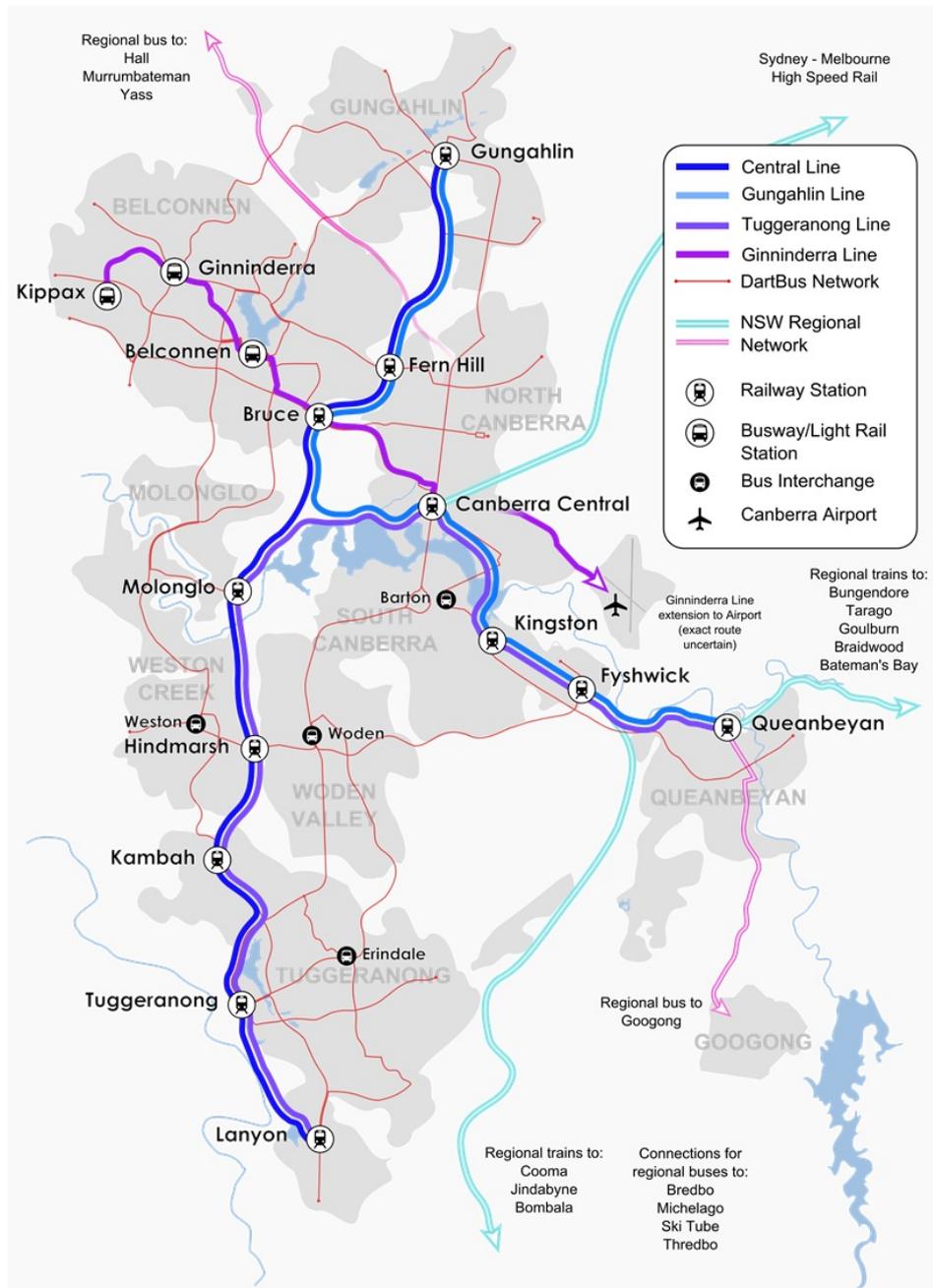
# A Heavy Rail Future for Canberra

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## A vision for heavy rail

Here is what a heavy rail network for Canberra could look like. Three heavy rail main lines connecting Gungahlin, Tuggeranong and Civic would run in empty reserve land alongside the Tuggeranong Parkway and Gungahlin Drive, with one major tunnelling segment beneath Lake Burley Griffin to connect to Kingston, Queanbeyan and the NSW network. A BRT or light rail line could serve Belconnen via an extended Belconnen Busway, running from Civic, beneath Westfield, and westward towards Kippax Centre.



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### Stations and integration with ACTION buses

Most stations would be served primarily by bus connections, allowing a larger catchment than would be possible by walk-on patronage. Due to the limited space for queueing at most station locations, it may not be practical to provide direct connections for all local bus routes, especially if a Timed Transfer system is used. Doing so may also make it difficult to reach some centres as their stations would be located away from nodes of activity. Instead, a limited-stop bus network could connect with local routes at interchanges. This limited-stop bus network (dubbed DartBus) would run on main roads in bus lanes or busways, stopping only at intersections with local routes, and feeding into the bus interchanges and rail stations. Hindmarsh, Molonglo, Bruce, Ginninderra and Fern Hill stations would be served primarily by DartBus.

Station Name	Location	Type*	Catchment	Connections	Notes
Gungahlin	Gungahlin Place	Subsurface	Gungahlin	DartBus, Local buses	
Fern Hill	Ginninderra Dr, east of motorway overpass	Elevated	East Belconnen, North Canberra	DartBus	
Bruce	Belconnen Way, east of motorway overpass	Elevated	East and Northeast Belconnen, South Canberra	DartBus, Ginninderra Line	
Molonglo	At intersection of Tuggeranong pkwy and proposed east-west road	Surface	Molonglo	DartBus, local buses	
Hindmarsh	Hindmarsh Dr, west of motorway overpass	Elevated	Woden Valley, Weston Creek	DartBus, local buses	
Kambah	Near group centre	Subsurface	North Tuggeranong	DartBus, local buses	Optional
Tuggeranong	Intersection of Athllon and Soward	Surface or subsurface	Greenway, Eastern and central Tuggeranong	DartBus, local buses	
Lanyon	Carpark at group centre	Subsurface	Gordon, Conder, Banks, Theodore, Calwell	DartBus, local buses	Optional
Canberra Central	City Hill, bus interchange on Vernon	Underground	City, Central Canberra	DartBus, local buses, Ginninderra Line, regional trains, regional buses, High Speed Rail	
Kingston	Current location	Surface	South Canberra	DartBus, local buses, regional trains, regional buses	Station rebuilt in a cutting for tunnel access.
Fyshwick	Under Newcastle St bridge	Surface	See notes	DartBus, local bus	Facilitates connection with east-west DartBus route.

Queanbeyan	Current location	Surface	Queanbeyan, Googong	Local buses, regional trains, regional buses	New platforms built.
Kippax	Location of current bus terminus, or new terminus closer to Southern Cross Drive	Surface	West Belconnen	DartBus, local buses	
Ginninderra	Intersection of Ginninderra Dr and Kingsford Smith Dr	elevated	Northwest and West Belconnen	DartBus	
Belconnen	Community Bus Station	surface	Central Belconnen	DartBus, local buses	Bypasses Westfield bus station via basement car park.
Airport	Site of open air car park	surface	Airport	Local bus, airlines	

Notes on station type:

- **surface:** entire structure is above ground
- **subsurface:** structure is built below ground level, but with above ground roof or skylight elements
- **underground:** entire structure is below ground
- **elevated:** structure is built above a cross street to enable connections, with a rail bridge over the street to access the station. The station is built either directly on the bridge or on elevated ground adjacent to the cross street.

### Characteristics of the rail corridor



Above Left: Belconnen Busway, northbound.

Above Right: Belconnen Busway, southbound

Left: Tuggeranong Parkway cutting, facing north.

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- **alignment**

The corridor would make use of reserve space alongside the western motorway network, with a junction at Glenloch interchange built either underground or by restructuring the road interchange. Reclaiming about two lanes of width on Parkes Way would allow the line to extend eastward, reaching an underground City Hill Station via a tunnel beneath Edinburgh Avenue. At this station, transfers would be available between local buses and other services, as well as with the High Speed Rail terminal. The opportunity exists to design a modern station with an attractive and accessible City Hill Park on its roof.

- **Tunnelling, reclamation and gradients**

The route would avoid passing through developed areas as much as possible, minimising construction costs and disruption during work, as well as noise and vibration issues both during construction and operation. A major tunnelling project beneath Lake Burley Griffin would be required in order to access the existing NSW rail network, as well as a tunnel for high speed rail down Ainslie Avenue to reach the City Hill station. Access around Glenloch Interchange may or may not require tunnelling, depending on whether the surface roads can be either rerouted or routed around.

The maximum gradient for steel rail adhesion is generally held to be about 7.1%. Parts of the north-south route exceed this grade and may require cutting to maintain a workable grade, such as the sections between Sulwood Drive and Hindmarsh Drive, between Glenloch Interchange and Belconnen way, and across the Molonglo River valley. The latter could be crossed using a combination of embankments and a viaduct across the valley floor.

Reclamation of open areas such as car parks and road lanes would be necessary in some parts of the route to give sufficient space for rail lines.

- Parkes way: two lanes reclaimed, with rail line either in the median or to the north of the road.
- Caswell Drive up to Belconnen Way: this area is a choke point and may need either widening of the cutting or a cut-and-cover tunnel for the railway line.
- Mulanggari Grasslands Nature Reserve: The line would need to pass through this area to access Gungahlin. The reserve could be spared from disturbance if a tunnel is made instead of a surface line.
- Mitchell, Queanbeyan and Tuggeranong: land may need to be reclaimed in these areas for a depot as these are near the termini of the main lines.
- Ginninderra Valley: the Ginninderra line would run through Umbagog District Park for some of its route as either a light railway or busway. The route would stay close to the perimeter of this park for as much as possible to minimise disturbance.
- Kambah: The line must turn a corner at the intersection of Athllon and Drakeford, where there are already some businesses standing - including storage sheds, an early learning centre, a church, and a medical centre. These establishments might have to be displaced to make way for the line, unless a sharper (but slower) turn is made in order to avoid these properties.

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### **Noise, Environmental and heritage issues**

Trains tend to squeak loudly as they brake at, and accelerate from, stations. Most of the alignment and stations in this design would be located away from quiet residential areas, either in already-busy town centres, underground, or on freeway alignments. One new housing development, Fetherston Ridge in north Weston, is being built very close to the proposed alignment and would need some form of sound barrier built to protect it.

Umbagog Park in Belconnen is a woodland, riparian and wetland reserve with significant Indigenous heritage value. The Ginninderra Line is proposed to pass through this area en route to Kippax. The route would stay close to Florey Drive and Ginninderra Drive for as much as possible to minimise incursion and avoid damage to indigenous heritage sites.

Mulanggari Grasslands Nature Reserve protects remnant native grassland habitat in Gungahlin. This reserve, as well as Umbagog Park, contains habitats of endangered local fauna including the golden sun moth and legless lizard. The line must pass through this area to reach Gungahlin town centre, and unless bored underground, disturbance is unavoidable. In this case a cut-and-cover tunnel rather than a surface line would be preferable. Ecological damage can be minimised by keeping the construction site as narrow as possible, relocating animals and plants if necessary, and replanting and monitoring the site following completion of the tunnel.

### **Integration with NSW railways**

Rail journeys in NSW tend to take a long time because of the Sydney-focused network, such that the further away a destination is from Sydney, the longer it takes to get there by train. The proposed high-speed rail line connecting Melbourne, Canberra and Sydney could serve as the main trunk of a multi-nodal 'hub-and-spoke' network, with Canberra as the main hub of the Southern Tablelands region. A similar system is successfully used in Switzerland to connect tiny remote villages to larger towns and cities using a combination of trains and buses, with timed transfers and a regular 'clock face' schedule.

### **Canberra Airport**

Depending on Canberra Airport's future needs as a freight and business hub, it may be possible to provide access to the regional rail or even the high-speed infrastructure for goods transport purposes. Passenger transit service between the airport and Canberra may be sufficiently provided by a combination of local buses and an extension of the Ginninderra Line, while transport around the Majura Park area could be served by an automated Metro Car fleet.

### **Why heavy rail?**

Of course, Canberra's transit mode share is not yet high enough that we need heavy rail (let alone light rail). A similar level of service can be achieved, as it had been in the past, by the old 333

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Intertown bus route, which stopped only at town centre interchanges with no intermediate stops. Resurrecting, expanding and improving this service would provide true rapid transit at a much lower cost than Capital Metro's version of light rail. A heavy rail network would thus be an upgrade of the Intertown service, to be built when passenger demand can no longer be supported by buses alone.

While light rail could be used in a true rapid transit setting, this is not what we would get under the Capital Metro vision. The system proposed has too many stops, too many at-grade intersections, and is restricted by the road speed limit. Even with its own right-of-way down Northbourne Avenue, it would not be much faster than the current bus. A heavy rail train with widely spaced stops running alongside Gungahlin Drive, reaching speeds of up to 130km/h in safety, could carry 600 passengers at a time from Gungahlin to the city centre in just 14 minutes – 11 minutes less than Capital Metro's claimed journey time for the tram. A light rail vehicle, by comparison, could carry only 300 or so passengers – most of them standing.

Furthermore, to extend this network across all of Canberra as outlined in [the master plan](#) would cost *at least* \$8 billion, with a potential blowout cost of over \$10 billion. By contrast, a complete heavy rail network serving all of Canberra could be built for just over \$1 billion – stage 1 of Capital metro could blow out to this much, and that's just for a single line. Which option seems like better value?

## Light Rail

Capital Metro's vehicle capacity will not be much higher than what buses currently provide: it will be mostly standing room only at peak capacity, and altogether the system would carry only 1000 more people per hour. It is just as contentious to claim that trams would have a speed advantage over buses, as the buses on Northbourne Avenue have never had their own lane. The route could be made faster much sooner and at a tiny fraction of the cost by converting the left hand lane into a bus lane. Displaced traffic would simply start taking other routes, or the drivers would start switching to public transport if it was made an attractive choice.

Light rail was originally invented as a scaled-back alternative to heavy rail, providing a similar service but with lower capacity. While street-running light rail systems can approach the capacity of heavy rail, the length of the trainsets needed starts to become impractical if they interfere with cross traffic and pedestrian movement.

Light rail is being promoted as a catalyst for redevelopment and an economic stimulus, as well as a cure for congestion on Northbourne Avenue. While the former claims are tenuous enough, the latter is almost always false. Public transport seldom alleviates congestion, due to the triple convergence principle (as soon as capacity on a road is freed, it will quickly get used up by people converging from other modes, routes and travel times). Public transport's purpose is to provide an *alternative* to sitting in congestion, not to get rid of it.

For a modern public transport system to succeed in a dispersed, car-dominated city, it must be able to compete with the car for both freedom of movement and speed. The Gungahlin to Civic route has been claimed to be faster than traffic on the same route by about 10 minutes, and carry more people per hour than cars on that route. However the light rail's main competition is not traffic on Northbourne Avenue and Flemington Road, but rather traffic on both the Majura Parkway and

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Gungahlin Drive. The simple fact is that cars and public transport are always in direct competition with each other, and promoting one through policy will take customers away from the other. A city government cannot claim to be pro-transit while simultaneously expanding the freeway network.

### What about Transport Corridors?

While transport corridors could still form along arterial roads, they would be served mainly by DartBuses. Very high residential densities would not be necessary to support transit as the effective catchment from connected services is much wider than can be achieved with walk-on patron alone. Instead, the main streets could be lined with low-rise shops, parks and community facilities, and rapid transit would be provided by heavy rail, not traffic-disrupting light rail.

### Notes and References

- **Cost**

Reference set: Perth's Mandurah Line was built at a cost of \$1.66 billion (2007 AUD). Stage 1 of Canberra's light rail line is purported to cost around \$783 million.

- **Capital metro**

Stage 1 initial cost estimate: \$783 million (lowest)

Stage 1 estimated blowout risk: \$1 billion (27.7% increase) <sup>[6]</sup>

Total network length: ~115.49 km <sup>[4][13]</sup>

cost per km: \$70 million/km <sup>[2]</sup>

Total cost Capital Metro network = \$8,084,300,000

plus 27.7% cost blowout = ~\$10.3 billion

- **Heavy rail**

Mandurah Line: \$1.88 billion (2013 adjusted) <sup>[1][7]</sup>

cost per km: \$20.01 million/km (2013 adjusted) <sup>[7]</sup>

cost blowout risk: 17% [8] (n.b.: the above cost already includes blowout)

plus 1 TBM purchase: \$45 million <sup>[5]</sup>

Total HRT network length: ~54km <sup>[4]</sup>

total cost HRT network = \$1,125,540,000

plus 17% cost blowout = \$1,316,881,800

- **Ginninderra Line – BRT (Kippax to city only)**

Liverpool – Parramatta T-way: 30km @ \$345.7 million (2003) <sup>[9]</sup>

BRT cost per km: \$15.08 million (2013)

Cost blowout risk: 128.6% <sup>[9a]</sup>

Total line length: 15.2km

Total cost Ginninderra Line (BRT) = \$229.26 million

plus 128.6% blowout = \$524.9 million

- **Ginninderra Line – LRT (Kippax to City only)**

Assume light rail cost is \$10 million more per km than BRT <sup>[3]</sup>

Cost per km: \$25.08 million

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Total line length: 15.2 km

Total cost Ginninderra Line (LRT) = \$381,216,000  
plus 128.6% blowout = \$871.4 million

- **Speed**

Reference set: Transperth B-Series trainsets have a top speed of 130 km/h<sup>[10]</sup>. Most low-floor LRVs have a top speed of 70 or 80 km/h<sup>[11]</sup> but must obey road speed limits<sup>[12]</sup>.

- **Heavy rail**

Acceleration reference video: [https://www.youtube.com/watch?v=8hGgVC\\_rOi4](https://www.youtube.com/watch?v=8hGgVC_rOi4)

Speed limit on Kwinana Freeway is 100km/h. Therefore I timed the train's acceleration from 0 until it matched the cars' speeds, assuming no vehicles are speeding. Acceleration to 110km/h, 120km/h, & 130km/h were then extrapolated

using  $t = \frac{v_f - v_i}{a}$  and resulting times between stations were calculated using

$s = \frac{1}{2}at^2$ . Dwell times at each station were assumed to be 1 minute.

- **Light rail**

Capital Metro claims a travel time between Gungahlin and Civic of 25 minutes. [14]

- **Capacity**

<http://www.mediastatements.wa.gov.au/pages/StatementDetails.aspx?listName=StatementsBarnett&StatId=8089>

*"B-series trains have a capacity of 600 passengers."*

<http://www.abc.net.au/news/2014-09-16/comparing-capital-metro-with-gold-coasts-light-rail/5747104>

*"[...] a capacity of 309 passengers; 80 seated and 229 standing."*

[1] <http://www.crikey.com.au/2009/03/26/why-rail-projects-in-nsw-cost-three-times-as-much-as-they-should/>

[2] <http://www.actlightrail.info/2012/04/it-costs-870-million-for-12-kilometers.html>

[3] <http://bic.asn.au/information-for-moving-people/bus-rapid-transit> "[...] the build cost of the Busways system in Brisbane is estimated to be \$10million per kilometre less than the costs of an equivalent LRT system [...]"

[4] Google Earth measuring tool

[5] <http://statements.qld.gov.au/Statement/Id/70740>

[6] <http://www.abc.net.au/news/2014-11-01/light-rail-could-cost-up-to-1-billion-says-act-opposition/5859518>

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[7] <http://www.rba.gov.au/calculator/annualDecimal.html>

[8] <http://www.abc.net.au/news/2007-09-03/cost-of-perth-to-mandurah-railway-blows-out-again/658594>

[9]

[http://www.audit.nsw.gov.au/ArticleDocuments/137/146\\_Liverpool\\_Parramatta\\_Bus.pdf.aspx?Emb ed=Y](http://www.audit.nsw.gov.au/ArticleDocuments/137/146_Liverpool_Parramatta_Bus.pdf.aspx?Emb ed=Y)

[9a] from the above: “The unit cost of the LPT project increased from \$4.9 million per km to \$11.2 million per km; unit costs more than doubled. “

[10] [http://en.wikipedia.org/wiki/Transperth\\_B-series\\_train](http://en.wikipedia.org/wiki/Transperth_B-series_train)

[11] [http://en.wikipedia.org/wiki/Flexity\\_%28tram%29](http://en.wikipedia.org/wiki/Flexity_%28tram%29)

[12] <http://www.theage.com.au/news/national/tram-caught-speeding/2006/08/25/1156012716980.html>

[13] <http://www.canthetram.org/images/masterplan.jpg>

[14] [www.capitalmetro.act.gov.au/\\_data/assets/pdf\\_file/0004/655780/Captial-Metro-Business-Case-In-Brief.pdf](http://www.capitalmetro.act.gov.au/_data/assets/pdf_file/0004/655780/Captial-Metro-Business-Case-In-Brief.pdf)

“A Gungahlin to City travel time of 25 minutes.”

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<http://mams.rmit.edu.au/ov14prh13lps1.pdf>

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discussion of the Mandurah Line in a Melbourne context

<http://www.macrobusiness.com.au/2014/04/canberra-to-double-down-on-rail-pork/>

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<https://www.railpage.com.au/f-p1887951.htm>

2009 discussion about heavy rail in Canberra

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<http://www.citylab.com/commute/2014/03/americas-cities-are-still-too-afraid-make-driving-unappealing/8564/>

<http://www.thetransportpolitic.com/2011/05/25/the-silly-argument-over-brt-and-rail/>

<http://www.ppt.asn.au/>

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