Australian Government | Infrastructure Australia

Corridor Protection: Planning and investing for the long term

Detailed Appendices

September 2017

Contents

Introduction

Infrastructure Australia's July 2017 paper, *Corridor Protection: Planning and investing for the long term*, presents the case for protecting corridors for the future development of infrastructure projects. Corridor protection is a vital means of encouraging cost-effective development of Australia's infrastructure. The paper can be downloaded at http://infrastructureaustralia.gov.au/policy-publications/publications/index.aspx?query

The paper presented the results of modelling which estimated the cost savings for governments, taxpayers and infrastructure users if seven transport corridors in the Infrastructure Priority List are protected from other forms of development.

This document provides further information to support the paper. In particular, it sets out more detailed analysis and assumptions underpinning the modelling.

Main assumptions

Development and audit of the model

The spreadsheet model was originally developed for Infrastructure Australia by EY. The assumptions underpinning the model were then developed by Infrastructure Australia with advice from EY and SGS Economics and Planning. The assumptions and spreadsheet model were reviewed and audited by specialist planning and economics firm Urbis.

Defining the corridors

With some exceptions, governments have not yet defined the corridors with precision. The analysis started with the best publicly available information on the likely representation of the corridors. However, the precision of corridor definitions varied greatly, for example:

- Outer Metropolitan Ring/E6 in Melbourne – the Victorian Government has defined a precise corridor, and included that corridor as a 'public acquisition overlay' in statutory land use planning instruments. However, that statutory corridor does not include a proposed intermodal terminal site at Truganina. For the purposes of the modelling, a 650-hectare site and two connecting corridors were included, one from the proposed Outer Metropolitan Ring and one from the existing interstate rail network near Sunshine North.
- East Coast High Speed Rail – The Australian Government's 2013 study into high speed rail defined a corridor with a reasonable degree of precision. For the purposes of modelling, this corridor has been adopted, however it is important to note any future corridor could differ significantly from that identified in the 2013 study.
- Western Sydney Airport Rail Line (south of the airport site) – the NSW Government has publicly exhibited an indicative corridor.
- Outer Sydney Orbital – only the first stage of the corridor, from north-western Sydney to the M5 motorway south of Campbelltown, was modelled.

In the case of the Outer Sydney Orbital, and in other instances, governments have simply identified a broad 'investigation area'. Where this is the case, the analysis uses judgment based on: analysing existing land use zoning and development patterns, an understanding of relevant strategic plans, and balancing the need to moderate costs while minimising disruption to existing development.

The corridors were further divided into a number of segments, mainly reflecting the anticipated future form of the infrastructure; for example, whether the infrastructure is expected to be 'at grade', in tunnel, on a bridge, or in a 'dive' (a transition from surface to tunnel or a transition from the surface to a viaduct).

Approach to determining amount of required land

Infrastructure Australia engaged the urban planning consultancy, SGS Economics and Planning, to assess the amount of land required for each corridor. The firm used a geographic information system (GIS) to identify each corridor. The corridors were then laid over on-line mapping of existing land use zones.

The modelling assumed that only the land required for a corridor itself is acquired. In practice, for some properties, only part of a property will be acquired. In other cases, the whole of a property will have to be acquired and any surplus land after excising the corridor would then be sold. The amount of land assumed to be acquired in the model is therefore likely to be conservative.

Given the purpose of this report – to make the policy case for corridor protection – individual properties were not taken into account. When governments use the model developed to assess the savings from protecting a particular corridor, a detailed analysis can be undertaken, addressing individual property severance issues.

Scenarios

Three scenarios were tested:

1. **Do not protect now and acquire at construction**: a corridor is not reserved and the land required for the corridor is acquired in the two years leading up to the start of construction.
2. **Protect and acquire now**: the corridor is reserved from 2017 and all land for the corridor is acquired within two years.

3. **Do not protect now and tunnel in future**: a corridor is not reserved and: (i) tunnelling is undertaken on parts of the route that were rezoned and developed in the intervening years; and (ii) sections of a corridor not placed in tunnel are acquired in the two years prior to construction.

The first scenario assumes no corridor protection, running the risk that current or future governments may zone for development land that would otherwise be required for the project. Where development occurs on the land needed for the corridor, the developed properties (such as houses and businesses) would need to be acquired.

The second scenario presents what might be considered an 'ideal' corridor protection scenario. It includes early acquisition of properties, minimising the additional costs associated with real increases in urban land prices.

The third scenario explores the circumstance where the corridor has not been protected, development subsequently occurs on the relevant land (in at least part of the corridor), but the government of the day decides that it is too difficult to acquire the houses and other development that have occurred in the interim. As a result, the relevant sections of the project have to be built in a tunnel.

Estimating land acquisition costs

Unimproved land values were estimated for each zoning type by corridor segment. Land values were estimated using publicly available data from the relevant jurisdiction's Valuer General (or equivalent). A development premium was then applied to each value for improved (developed) land. The land values were reviewed as part of the modelling audit.

In practice, land values vary along and within each corridor, reflecting the characteristics of individual parcels of land. However, for the purposes of this strategic modelling, estimated average corridor segment values are considered to be a reasonable guide.

Development premiums

The modelling assumes that land attracts a premium once it has been developed. For example, the cost of acquiring a residential block that has been developed is likely to be significantly higher than a vacant block. The assumed premium ranges from 75-300%, depending on the zoning of the land and where it is located. The premiums were established after considering the results of the audit undertaken by Urbis and reviewing government land value data.

The model assumes any land zoned for residential, commercial or industrial purposes at the start of the model period (2016) is already developed land. If land is rezoned over the model period, for example, from rural to residential, the land is developed (improved) over a five-year period (or 20% per annum). The exception is the Melbourne Outer Metropolitan Ring Road/E6, where the Victorian government has already placed a public acquisition overlay on the land, therefore restricting development.

Real land value growth rates

Land value growth rates are an important factor which can increase the cost of land acquisition over time. The model assumed a range of growth rates, which varied depending on the location of land and its zoning type. Growth rates were based on a range of sources including analysis of state Valuer General data, ABS land value data and a report completed previously for Infrastructure Australia by Urbis entitled *Historic land value growth in east coast capital cities* (available on Infrastructure Australia's website). Growth rates were reviewed as part of the audit process.

Capital cost assumptions

Modelling of capital costs was undertaken at a strategic level for the purpose of presenting the policy case for corridor protection. Detailed studies would need to be undertaken of each project to develop more accurate cost estimates. The model allows for input of average cost per kilometre of at-grade and tunnelled construction. The cost of tunnel 'dives' and bridges were assumed to be the average of these two construction types. Unit cost information from a variety of sources, including from recent projects, was used to develop per kilometre estimates of construction costs. The per kilometre estimates of construction costs were derived as follows:

Surface rail - passenger

The average of the final construction costs per kilometre for the following projects:

- South-west rail link (Sydney)
- Olympic Park (Sydney)
- Mandurah (Perth)
- Robina-Varsity Lakes (South-east Queensland)
- Epping – South Morang (Melbourne)
- Clarkson-Butler extension of the Joondalup line (Perth).

Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date the project was completed.

Rail in tunnel - passenger

The average of the final construction costs per kilometre for the following projects:

- Chatswood-Epping (Sydney)
- Airport rail line (Sydney).

Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date the project was completed.

Surface rail – freight

The average of the final construction costs per kilometre for the following projects:

- Inland Rail (study)
- Southern Sydney Freight Line.

Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date the project was completed.

Rail in tunnel - freight

The average of the cost per kilometre from the Inland Rail Study. Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date of the cost estimate in the study.

Surface road

The average of the final construction costs per kilometre for the following projects:

- M7 motorway (Sydney)
- M4 motorway (Sydney)
- M2 motorway (Sydney)
- M5 West (Sydney).

Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date the project was completed.

Road in tunnel

The average of the final construction costs per kilometre for the following projects:

- Sydney harbour tunnel
- Eastern distributor (Sydney)
- Cross City tunnel (Sydney)
- Lane Cove tunnel (Sydney).

Costs were uplifted by the Consumer Price Index plus a construction cost escalation of 0.57% per year from the date the project was completed.

The Australian Bureau of Statistics' *Road and Bridge Producer Index* was used to determine real increases in construction costs. The 0.57% per year real indexation mentioned above reflects the annual rate of real increases in construction costs from 2007 to 2016. The resulting per kilometre costs of construction for the modelled corridors are shown in **Table 1.**

Table 1: Assumed per kilometre costs of construction ($2016, millions)

Corridor	Surface alignment	Tunnel alignment	Comment
Port of Brisbane Freight Rail	18.6	54.8	
Outer Sydney Road and Rail Link	66.5	407.1	Assumes four-lane road tunnel. Addition of average road and freight rail construction cost.
Western Sydney Airport rail connection	81.9	219.0	
Western Sydney freight line and intermodal terminal	18.6	54.8	

Hunter Valley freight rail realignment	18.6	54.8	
Outer Metropolitan Ring/E6 and Western Interstate Freight Terminal (WIFT)	66.5	407.1	Assumes four-lane road tunnel. Addition of average road and freight rail construction cost. See detailed appendix re WIFT.
High speed rail	48.1	166.0	Based on HSR phase 2 report, uplifted for Consumer Price Index and construction cost escalation

Source: Infrastructure Australia

Revenue assumptions

Under the 'protect and acquire now' scenario, the modelling assumes that:

- 50% of unimproved properties will be rented out for some interim use; for example, as a carpark or an extension of a private garden. The exception was the High Speed Rail project, where the modelling assumed no rental return from rural unimproved land.
- 80% of improved properties will be rented out.

Estimates of net rental revenue take into account normal outgoings associated with rental properties such as lease management and periodic repairs. For modelling purposes, a 4% per year net rental revenue is assumed across all property. In reality, rental revenue yields will vary significantly based on property type, location and other factors.

Assumed project start dates

Table 2 shows the assumed start dates for the projects. The rationale for these dates is set out in the relevant corridor-specific appendix.

Table 2: Assumed start and finish dates for construction of projects in protected corridors

Corridor/Project	Assumed Start Date	Assumed Completion Date
Port of Brisbane dedicated freight rail connection	1 July 2034	30 June 2040
Outer Sydney Orbital Road and Rail Link	1 July 2037	30 June 2042
Western Sydney Airport rail connection	1 July 2035	30 June 2040
Western Sydney freight line and intermodal terminal	1 July 2027	30 June 2030
Hunter Valley freight rail realignment	1 July 2031	30 June 2034
Outer Metropolitan Ring/E6	1 July 2027	30 June 2032
High Speed Rail – Melbourne to Sydney		
Melbourne to Canberra	1 July 2027	30 June 2037
Canberra to Sydney	1 July 2024	30 June 2032
High Speed Rail – Sydney to Brisbane		
Sydney – Newcastle	1 July 2033	30 June 2042
Newcastle to Gold Coast	1 July 2046	30 June 2056
Gold Coast to Brisbane	1 July 2039	30 June 2049

Source: Infrastructure Australia and High Speed Rail Phase 2 study

Note: Construction completion dates differ to operational dates in the high speed rail study due to testing and commissioning works.

Port of Brisbane Dedicated Freight Rail Connection (Eastern Freight Rail Bypass)

Strategic Context and Purpose

Protection of a corridor for a Western Sydney Freight Line and Intermodal Terminal is a high priority initiative in Infrastructure Australia's Priority List.

The Port of Brisbane is one of Australia's most important international gateways. In 2015/16, the port handled 1.147 million Twenty Foot Equivalent (TEUs) container movements – up from just over 900,000 TEUs in 2010/11 - and almost 20.8 million tonnes of non-containerised cargo.[1]

The Bureau of Infrastructure, Transport and Regional Economics projects that container movements through the port will increase at 6.2% per year, reaching 3.56 million TEUs in 2032-33, and that non-containerised trade will grow by 2.8% per year.[2]

The possibility of more substantial growth cannot be ruled out. The Queensland Government has observed that:

> *Development of the proposed inland rail line between Brisbane and Melbourne may change the broader national pattern of freight movement in the long-term, with Brisbane potentially playing an increased role as a trade hub via the Port of Brisbane.*[3]

Population growth in south-east Queensland is leading to congestion on both the road and rail networks, negatively impacting the productivity of greater Brisbane and the Queensland economy as a whole.

In October 2016, the Queensland Government released *Shaping SEQ - draft South East Queensland Regional Plan*, the government's long-term plan for the development of south-east Queensland. The draft plan notes that five percent of containers are moved to or from the port by rail. The plan identifies the development of a dedicated freight rail connection from the proposed Inland Rail line to the Port of Brisbane as one of the Queensland Government's infrastructure priorities.[4]

The owner of the port also anticipates a need to upgrade transport connections to and from the port, including rail, in order to support the port's operations.[5]

Start Date

In the *Inland Rail Programme Business Case*, the Australian Rail Track Corporation concluded "…the number of [train] paths required to support … demand requires construction of the Port of Brisbane Extension in 2040–41 or by 2029–30 if more aggressive land use and complementary investment policies are applied. Policy changes impacting the frequency of the passenger services within Brisbane's rail network could justify earlier freight rail capacity enhancements."[6] The Queensland Government has noted that a dedicated rail connection to the port is likely to be required after 2040, depending on demand.[7]

The modelling for this paper assumed a construction date of July 2034, on the basis that the project could be operational from June 2040.

Alignment

Planning for the corridor is at an early stage. The proposed corridor alignment in **Figure 1** reflects the alignment shown in the *Inland Rail Programme Business Case*.[8] The alignment is indicative. Further project development and detailed design may lead to variations to the corridor shown in the figure.

For the purposes of the modelling, the proposed alignment was broken into three broad segments.

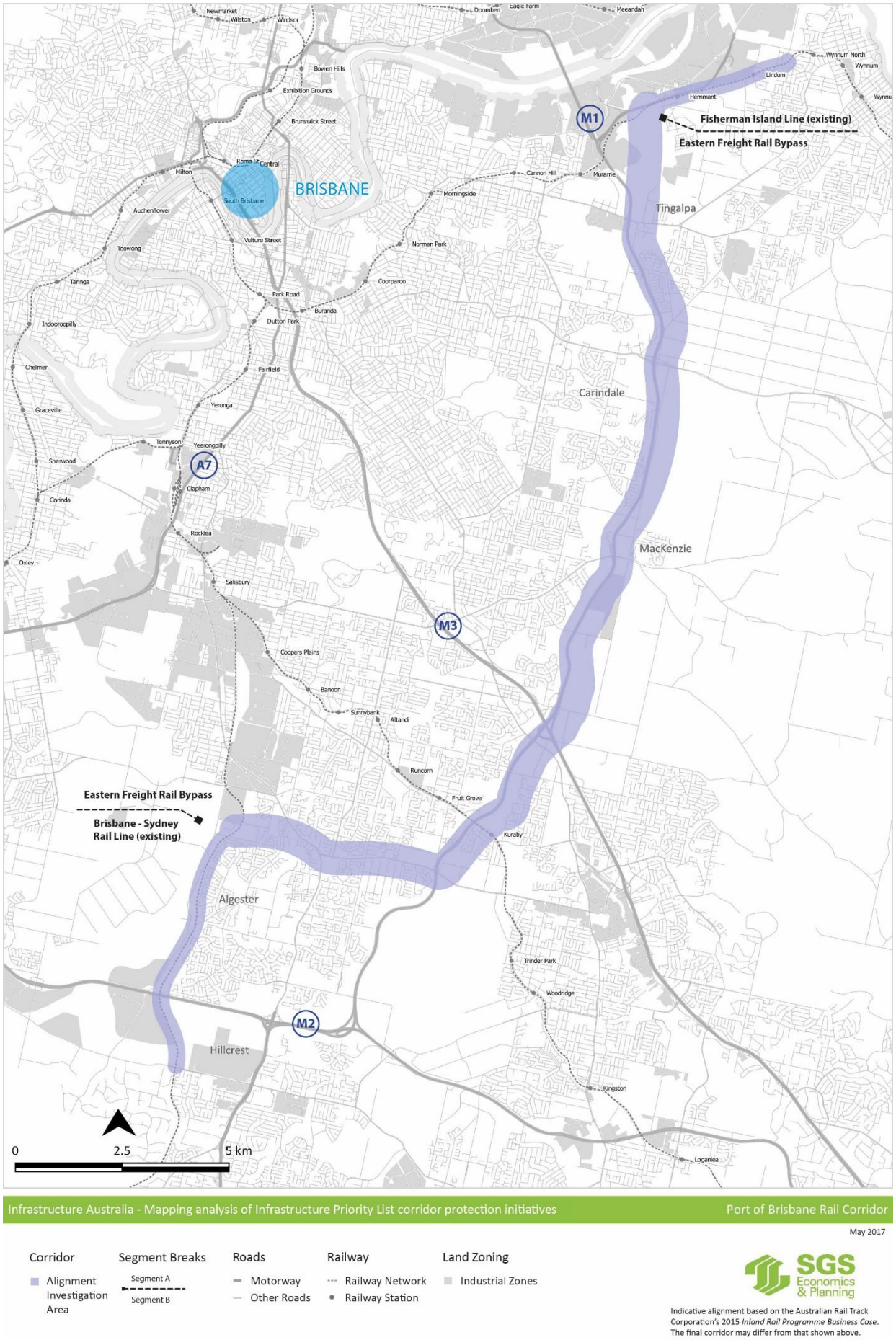
In the main, the first segment covers a section of the existing Brisbane to Sydney rail corridor from Parkinson (south of the Logan Motorway) to Algester (approximately two kilometres south of the existing intermodal freight terminal at Acacia Ridge). The second segment heads east in tunnel under Sunnybank Hills, before broadly running east of the Gateway Motorway to the existing dedicated freight line near Hemmant. As the corridor heads north parallel to the Gateway Motorway, some segments are tunnelled to avoid existing urban areas and the highway. It was assumed that the third segment would run some widening of the existing corridor to the Port of Brisbane.[9]

The following assumptions concerning the corridor's characteristics were applied:

- Corridor width – new (surface section): 40m
- Dive length: 1,500 metres.

A summary of the alignment attributes - including whether the corridor is at grade, in a dive or tunnelled - is provided in **Table 3**.

Figure 1: Port of Brisbane Dedicated Freight Rail Connection



Source: SGS representation of concept alignment in ARTC's 2015 *Inland Rail Programme Business Case*

Table 3: Port of Brisbane Dedicated Freight Rail Connection – Protect and acquire now scenario - Segment summary

Segment	Type of length	Length (km)
Brisbane – Sydney Line	Dive	1.5
	At grade	4.6
Eastern Freight Rail Bypass	Dive	9.4
	At grade	5.4
	Tunnel	10.2
Fisherman Island Line	At grade	3.5
Total		34.6

Source: SGS (2016)

- Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 4 shows the proportion of the corridor currently falling within various broad land use zones. The zoning information has been drawn from relevant local government plans. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category mainly comprises infrastructure and environmental zones.

Table 4: Port of Brisbane Dedicated Freight Rail Connection – Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Brisbane – Sydney Line (existing)	16%	0%	1%	0%	3%	79%
Eastern Freight Rail Bypass	15%	12%	7%	0%	12%	54%
Fisherman Island Line (existing)	10%	0%	10%	0%	1%	80%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

The Queensland Government's *Shaping SEQ - draft South East Queensland Regional Plan* sets out proposals to manage growth in the region to 2041. The draft plan projects that the region's population will grow by approximately two million people over that period, from 3.37 million people in 2015 to 5.35 million (on medium level projections) in 2041.[10] *Shaping SEQ* estimates that an additional 907,200 dwellings will be required over this period, with 447,200 dwellings required in the initial 15 years between 2016 and 2031.

Brisbane – Sydney Line (existing)

This segment largely runs within the existing interstate rail corridor. There do not appear to be any obvious constraints to accommodating an upgrade to the existing freight line in this segment of the corridor. For the purposes of the modelling, it was assumed that there is only limited rezoning of land adjoining the rail corridor to permit higher density residential development.

Eastern Freight Rail Bypass

This segment lies mainly within the Brisbane Local Government Area (LGA). *Shaping SEQ* envisages an additional 223,400 dwellings in the Brisbane LGA between 2011 and 2041, with 94% of new dwellings in the form of infill development. Around 145,400 dwellings are expected over the period 2011 to 2031, with 6,100 of those dwellings expected to be developed in greenfield locations.

The main sections of this segment where development could constrain construction of a surface rail corridor are around the Gateway Motorway. Brisbane City Council's *Brisbane City Plan 2014* includes two 'Future Suburban Living Areas', one of which is near Rochedale east of the motorway. [11] The modelling assumes a small amount of rezoning from rural to residential land in this segment.

Both *Shaping SEQ* and the *Brisbane City Plan 2014* envisage further economic development in areas south-east of Upper Mount Gravatt. The plans seek to encourage technology-based development in sectors such as health, education, and food sciences in this area.

Fisherman Island Line (existing)

A new rail track may be necessary to provide an operationally-effective dedicated freight rail system. However, sections of the existing rail corridor are comparatively narrow. The modelling assumes some land acquisition to widen the corridor, though, as the land will be alongside the existing railway, no zoning changes are forecast.

This segment of the corridor also contains industrial land of regional significance. Both *Shaping SEQ* and the *Brisbane City Plan 2014* recognise the importance of industrial lands around this corridor for the freight and logistics sector. *Shaping SEQ* sets a strategic direction to "enable the intensification and expansion of major enterprise and industrial areas, where appropriate, to improve their capacity and functionality, and increase the potential for interacting with other outward-focused economic areas".[12] The current industrially-zoned land mainly lies north of the rail line.

Assumptions under the 'do not protect' scenarios

In the 'Do not protect now and tunnel in future' scenario, it was assumed that most of the 'Eastern Freight Rail Bypass' segment would be built in tunnel. Summaries of the line segments are shown in **Table 5**.

Table 5: Port of Brisbane Dedicated Freight Rail Connection – Do not protect now and tunnel in future scenario - Segment summary

Segment	Type of length	Length (km)
Brisbane – Sydney Line	Dive	1.5
	At grade	4.6
Eastern Freight Rail Bypass	Dive	1.5
	At grade	2.4
	Tunnel	21.1
Fisherman Island Line	At grade	3.5
Total		34.6

Source: SGS (2016)

Outer Sydney Orbital Road and Rail Link

Strategic Context and Purpose

Protection of a corridor for the Outer Sydney Orbital Road and Rail Link is a high priority initiative in Infrastructure Australia's Priority List.

Sydney is projected to grow appreciably over the next 40 years. In developing a new metropolitan strategy, the Greater Sydney Commission is working on the basis that Sydney's population will grow to 6 million people by 2036 and around 8 million people by 2056.[13] The city's economic product is projected to grow from $378 billion in 2015 to $655 billion in 2036.[14]

The scale of projected population and economic growth is such that new north-south links are likely to be required to connect Sydney and the Central Coast, Hunter and Illawarra regions, and, potentially, within western Sydney itself.

North-south rail capacity in and out of Sydney, especially for freight trains, is constrained. Existing 'curfews' prevent freight trains from using the rail network during weekday morning and afternoon peak periods. North-south road capacity will be increased by the NorthConnex link, which is scheduled to open in late 2019. However, over the longer term, additional road capacity could also be required.

The potential for a future multi-modal transport corridor running north-south across western Sydney has been identified in the NSW Government's strategic planning documents for approximately five years. Protecting a corridor for such a link was identified as an action in the Government's 2012 *Long Term Transport Master Plan*.[15]

The corridor is aimed at providing "an outer north-south multi-modal corridor for a future motorway, freight rail and where practical passenger rail. The corridor would potentially connect to the existing road and rail networks, and extend from the Central Coast through to the Illawarra."[16] The first stage of the "Outer Sydney Orbital corridor will extend approximately 80km between Box Hill in the north and the Hume Motorway at Menangle in the south. Future investigations will identify further extensions connecting the Illawarra and the Central Coast."[17]

Only the first stage of the corridor, between south-west and north-west Sydney, has been modelled. At this time, the first stage faces more significant development pressures than the second and third stages south and north of Sydney.

Start Date

As the corridor is envisaged as a multi-modal link, the timing of its development could be driven by the demand for increased road capacity, demand for freight rail capacity, or both. *A Plan for a Growing Sydney* has a 20-year horizon. The plan does not indicate a likely timing for development of transport links within the corridor, instead noting an orbital connection is important in the "longer-term".

Bearing in mind the comments above, the modelling assumes a construction start date of July 2037, and that the project would be operational from June 2042.

Alignment

In conjunction with other state agencies, Transport for NSW is investigating alignment options for the Outer Sydney Orbital. It sought initial public input on the corridor during 2015. The alignment used in the modelling has been informed principally by the map showing an 'Outer Sydney Orbital study area' in a newsletter released in 2015.[18] **Figure 2** illustrates the broad alignment of the corridor used in the modelling.

For the purposes of the modelling, the corridor has been divided into five segments:

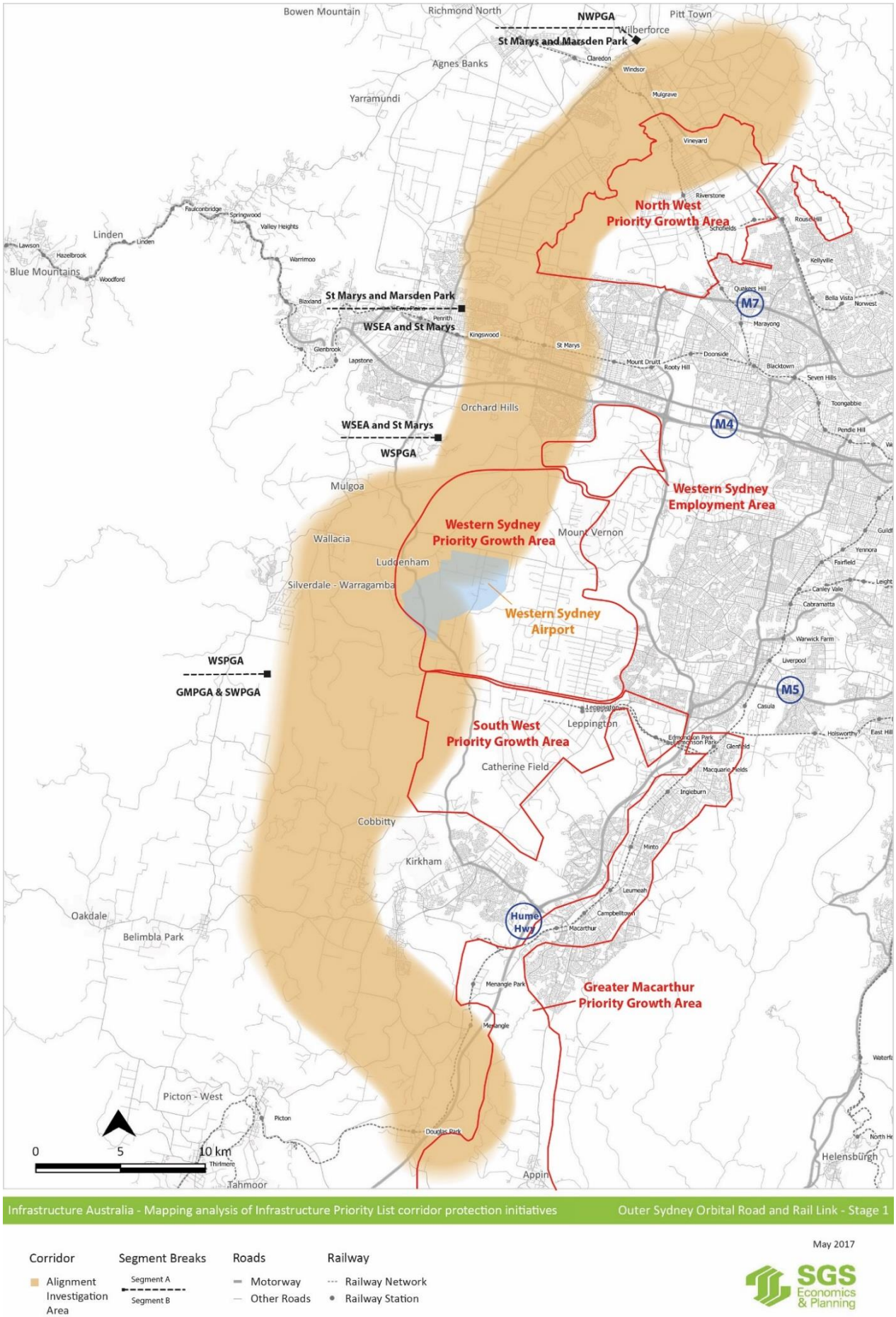
1. North West Priority Growth Area (NWPGA) – covering land north of the Richmond rail line
2. St Marys and Marsden Park – covering land between the Richmond Rail Line and north of St Marys
3. Western Sydney Employment Area (WSEA) and St Marys – covering land between north of St Marys and south of Orchard Hills
4. Western Sydney Priority Growth Area (WSPGA) – covering land from south of Orchard Hills to Bringelly (including land immediately around the proposed Western Sydney Airport)
5. South West Priority Growth Area (SWPGA) and Greater Macarthur Priority Growth Area (GMPGA) – covering land between Bringelly and the M5 and Main Southern Railway near Douglas Park.

For the purposes of the modelling, part of the Outer Sydney Orbital corridor north of the airport is assumed to be co-located with the corridor for the Western Sydney Airport Rail line. At its southern end, the corridor is assumed to connect with both the Main Southern Railway and the M5 motorway near Douglas Park.

The assumed geometric requirements for the corridor are:

- Corridor width:
  - One segment: 200m
  - Four segments: 140m
- Dive length: 1,500m

Figure 2: Outer Sydney Orbital Road and Rail Link



Source: SGS (2017)

Table 6 summarises the base case alignment attributes, including at grade or tunnelling and length.

Table 6: Outer Sydney Orbital Road and Rail Link – Protect and acquire now scenario - Segment summary

Segment	Type of length	Length (km)
North West Priority Growth Area	Dive	1.5
	Bridge	0.4
	At grade	2.6
St Marys and Marsden Park	Dive	1.5
	Tunnel	3.2
	At grade	12.2
Western Sydney Employment Area and St Marys	Dive	4.5
	At Grade	0.7
	Tunnel	3.9
Western Sydney Priority Growth Area	At grade	14.7
South West Priority Growth Area - Greater Macarthur Priority Growth Area	At grade	31.5
Total		**76.6**

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 7 shows the proportion of the corridor falling within various land use zones. The zoning information has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category largely includes infrastructure and environmental zones.

Table 7: Outer Sydney Orbital Road and Rail Link – Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
NWPGA	0%	0%	0%	0%	93%	7%
St Marys/Marsden Park	0%	22%	0%	0%	78%	0%
WSEA/St Marys	8%	0%	0%	0%	92%	0%
WSPGA	0%	4%	0%	0%	87%	9%
SWPGA/GMPGA	1%	5%	0%	0%	88%	7%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

North West Priority Growth Area segment

The NSW Government's North West Priority Growth Area is aimed at providing more land for housing, and ensuring greater access to a range of housing types. The growth area is divided into a number of precincts, most of which have been rezoned or are at an advanced stage of planning. The modelling assumes significant rezoning, largely from rural to residential land, in this segment of the corridor.

St Marys and Marsden Park segment

This segment faces similar issues to those affecting the North West Priority Growth Area segment. Planning for and development within the Marsden Park, Marsden Park North and Shanes Park precincts of the existing North West Priority Growth Area may affect governments' ability to protect a corridor through this segment.

An 'indicative layout plan' has been prepared for the Marsden Park precinct, and development is forecast to occur during this year.[19] Planning for the Shanes Park precinct, in the south-western corner of the growth area, is not proceeding at this time. The modelling assumes some future rezoning from rural to residential and peri-urban residential land in this segment of the corridor.

Western Sydney Employment Area and St Marys segment

This segment falls broadly into two areas:

- the Western Sydney Employment Lands south-west of the intersection of the M4 and M7 motorways
- urban development and some parks (notably the Wianamatta Regional Park) from Llandilo and Shanes Park in the north to the M4 motorway.

The Western Sydney Employment Area (WSEA) has been established by the NSW Government to provide land for industrial development, including transport and logistics, warehousing and office space. Development proposals in the Western Sydney Employment Area must relate to a development control plan which establishes a masterplan for the proposal and surrounding areas. A development control plan for industrial land at Horsley Park is in place, while other plans are under development for land at Ropes Creek and near Orchard Hills.

St Marys is not one of the NSW Government's current priority growth areas or precincts. Nevertheless, the Greater Sydney Commission's draft district plan for West Sydney notes that Penrith Council is to "investigate opportunities to address demand and diversity in around local centres and infill areas particularly in and around … St Marys."[20] The draft plan also confirms that the Outer Sydney Orbital is to accommodate freight rail, and that the corridor would also connect to the proposed Western Sydney Freight Line.[21] The modelling for this segment assumes significant re-purposing of existing land for residential, industrial and commercial purposes.

Western Sydney Priority Growth Area segment

Significant development is expected to occur throughout this segment over the next few decades, driven by construction and operation of the Western Sydney Airport.

The Australian Government has committed to the airport's staged development, with the first stage operating by the mid-2020s. By the early 2030s, the airport is expected to generate 9,000 direct jobs and around 6,900 indirect jobs across western Sydney. The Government expects that, by the early 2060s, the airport will generate 60,000 direct jobs and almost 30,000 indirect jobs across Western Sydney.[22] Although some of the indirect jobs are likely to occur on the airport site itself and more broadly across Western Sydney, many of those jobs are likely to be located in new business parks around the airport. The modelling for this segment assumes substantial rezoning of land for commercial and industrial purposes.

South West Priority Growth Area and Greater Macarthur Priority Growth Area segment

The southern-most segment of the corridor includes land within the South West Priority Growth Area and the Greater Macarthur Priority Growth Area, as well as land that is not presently part of any growth area.[23] The modelling assumes some rezoning from peri-urban residential and rural to higher value residential land in this segment of the corridor.

The South West Priority Growth Area has been the subject of planning and development activity for around a decade. The growth area is aimed at accommodating around 110,000 dwellings, across a number of precincts.

At the segment's southern end, the orbital corridor will need to connect to the M5 motorway and the Main Southern Railway line. Development in the Greater Macarthur Priority Growth Area could affect options for these connections. Planning for this area includes two land releases; the first at Menangle/Mt Gilead and the second at Wilton. Together, these areas are expected to provide up to 35,000 dwellings by 2036 – approximately 18,100 at Menangle/Mt Gilead and 16,600 dwellings at Wilton. The *Greater Macarthur Land Release Investigation Preliminary Strategy and Action Plan* indicates that, beyond 2036, there is potential for a further 33,000 dwellings in subsequent release areas.

Development in the medium to longer term on land beyond the current priority growth areas

Metropolitan-wide demand for housing is likely to remain strong well into the future. Draft district plans prepared by the Greater Sydney Commission refer to the need to provide a minimum of 725,000 dwellings (and potentially up to 830,000 dwellings) across Sydney between 2016 and 2036.[24] Achieving this number of new dwellings will require an historically high rate of dwelling completions.[25]

While housing preferences are changing, many people will still seek to live in detached dwellings in new suburbs. For example, since mid-2013, detached dwellings have continued to form the majority of dwelling completions in the Commission's south west district (approximately 80%) and west district (approximately 70%).[26] Recognising this longstanding demand for detached housing, governments have consistently sought to provide for housing choice. The Commission's draft district plans include a goal to this effect.

Research also suggests that the majority of Sydneysiders tend to move to new housing relatively close to where they have lived (82% move within 15 kilometres).[27] This suggests that many people living or growing up in the outer areas of Sydney now and over the next 10-20 years will look to move to new dwellings in other parts of outer Sydney. These factors point to continuing demand for greenfield development on Sydney's fringe in the medium and long-term.

Governments typically work to ensure a steady 'pipeline' of land for housing, usually with 10 to 15-year lead times reflecting the various stages in the urban development process. These 'pipelines' are an important part of ensuring sufficient land availability to moderate or avoid supply-driven increases in housing costs. *A Plan for Growing Sydney*, the NSW Government committed to identifying "potential locations for new greenfield development giving particular attention to investigating the potential for greenfield development south and south-west of Campbelltown-Macarthur".[28]

In addition, draft district plans released by the Greater Sydney Commission highlight:

- the need for rolling 20-year housing supply plans to meet overall housing targets set by the Commission
- an awareness that "the planning system will need to continue to identify areas of additional capacity"
- an appreciation of the long lead-times associated with "delivering supply to the market".[29]

As the current priority growth areas are aimed at meeting urban land requirements until the early to mid-2030s, a 15 to 20-year lead time suggests planning for future greenfield development could commence in the next five to ten years. The Greater Sydney Commission's forthcoming metropolitan plan is likely to offer a clearer direction on these matters.

Assumptions under the 'do not protect' scenarios

In the 'do not protect and tunnel in future' scenario, it was assumed that the following segments would need to be constructed entirely in tunnel:

- North West Priority Growth Area
- St Marys and Marsden Park
- Western Sydney Employment Area and St Marys
- Western Sydney Priority Growth Area

The reason these segments were assumed to be in tunnel reflected a range of considerations, principally:

- development occurring on potential surface alignments, and future governments deciding not to acquire developed properties for the corridor and construction of the relevant infrastructure
- the number of potential points where dive or rising structures would be required – for example a large number of dives and ramps could prove inefficient, especially for any rail services
- the geophysical characteristics of the corridor, notably the presence of flood liable land.

It was assumed that approximately 35% of the final segment - the Greater Macarthur Priority Growth Area and South West Priority Growth Area - would need to be built in tunnel. For the reasons set out in the preceding sub-section, it was assumed that urban growth requirements would lead to decisions to release and then zone additional land in south-western Sydney for urban development. A summary of the segments and length is shown in **Table 8**.

Table 8: Outer Sydney Orbital – Do not protect now and tunnel in future scenario – Segment summary

Segment	Type of length	Length (km)
North West Priority Growth Area	Dive	1.5
	Tunnel	4.5
St Marys and Marsden Park	Tunnel	16.8
Western Sydney Employment Area and St Marys	Tunnel	9.1
Western Sydney Priority Growth Area	Tunnel	14.7
South West Priority Growth Area Greater Macarthur Priority Growth Area	Dive	7.63
	Tunnel	11.1
	At grade	14.3
Total		**79.6***

Source: SGS (2016)

* This scenario is a slightly longer route, as dives to connect the corridor to existing infrastructure are included.

In the 'do not protect and acquire at construction' scenario, it was assumed that land that has been released and zoned for development would need to be acquired by future governments.

Western Sydney Airport Rail Connection

Strategic Context and Purpose

Protection of corridors for rail connections to the Western Sydney Airport is a high priority initiative in Infrastructure Australia's Priority List.

The Australian Government has committed to the airport's development, with the first stage opening in the mid-2020s. The business case for the airport anticipates passenger throughput growing from 9.7 million passengers in 2031 to 37.4 million passengers in 2052, and over 80 million passengers (approaching the airport's operational capacity) by 2064.[30]

The provision of efficient transport connecting the airport to other key hubs such as the CBD, Parramatta, Western Sydney Employment Area, and North West and South West Growth Centres is critical to avoid unnecessary travel delays and to enable sustained economic growth. Plans for the airport's development are based on the expectation that it will be connected by rail into Sydney's existing rail network.

The need to protect a corridor for an extension of the existing South West Rail Link was also identified in the NSW Government's 2012 *Long Term Transport Masterplan*. However, as a decision on the development of an airport at Badgerys Creek had not been taken at that time, the identified corridor only extended from Leppington to Bringelly.[31]

Western Sydney will also be home to over half of Sydney's population by 2031, with the NSW Government's South West and North West Priority Growth Areas expected to accommodate much of the growth in Sydney's population.[32] The NSW Government has stated, "While the South West Rail Link Extension may connect to the proposed airport, the … extension will be needed regardless of the airport to support population growth in Sydney's south-west."[33] This suggests the rail connection is viewed not just as a means of accessing the airport; it is seen as a part of a broader future transport network for western Sydney.

Start Date

The Australian and NSW Governments will decide the timing of any rail connection to the airport. The modelling assumed a construction start date of July 2035, on the basis that the rail line could be operational from June 2040.

Alignment

For modelling purposes, the alignment of the proposed Western Sydney Airport Rail corridor was informed by:

- the alignment set out in the NSW Government's 2015 information paper, *South West Rail Link Extension – Public transport corridor preservation*[34]
- the broad corridor considered in developing the February 2016 Infrastructure Priority List
- the *Western Sydney Rail Needs Scoping Study Discussion Paper* released in September 2016 by the Australian and NSW Governments. The discussion paper canvasses the need to protect a corridor for an extension of the South West Rail Link, and also presents an initial set of 'rail service options' for the Western Sydney Airport.

Figure 3 shows an indicative corridor investigation area used for the purposes of the modelling. Following consideration of the rail needs study, the two governments may decide to proceed with an alternative rail service option. The modelled corridor is divided into the following segments:

- Bringelly to St Marys
- Bringelly to Narellan
- Leppington to Bringelly
- Narellan to T2 South Line.

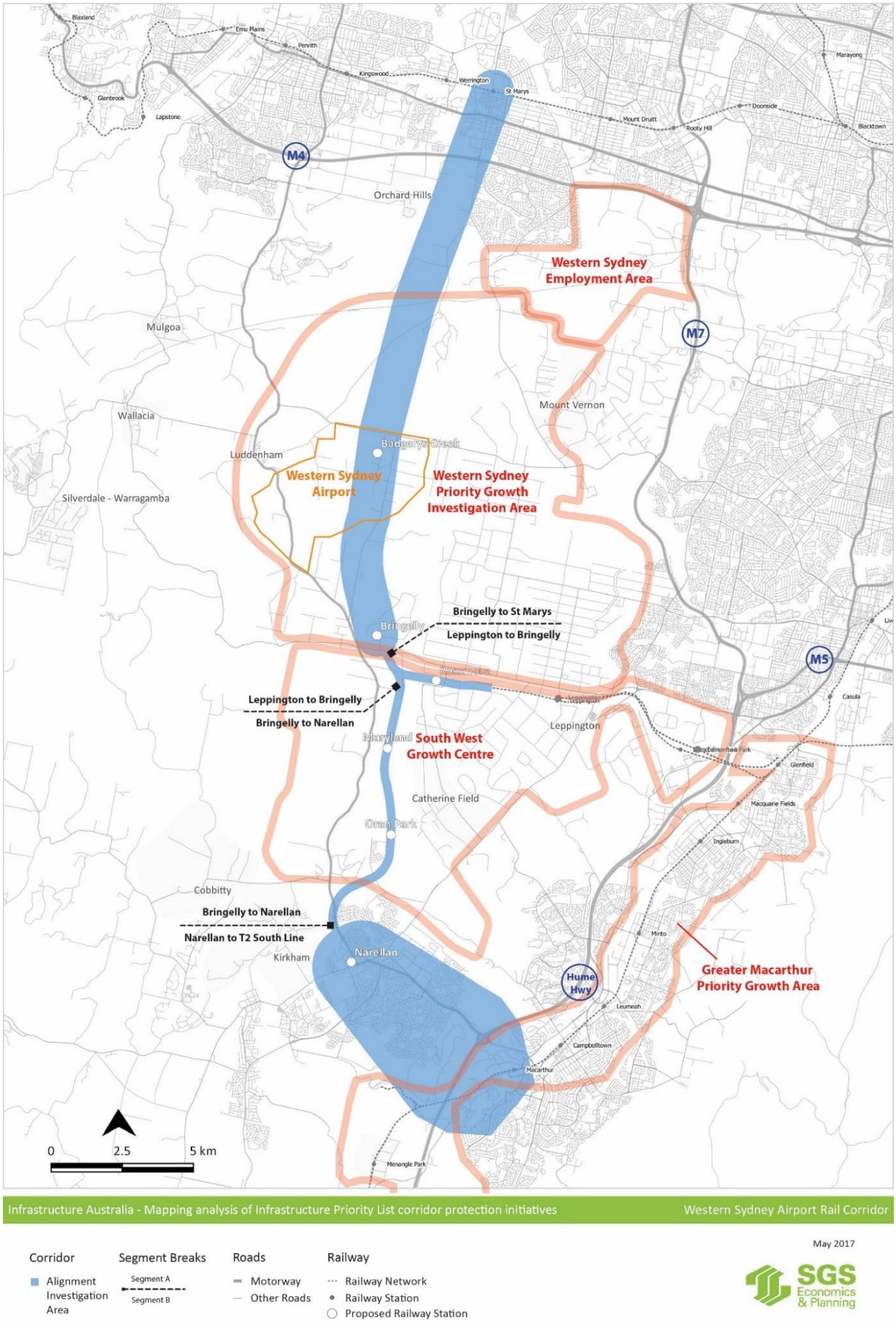
Two segments - Leppington to Bringelly and Bringelly to Narellan - are defined in moderate detail in the NSW Government's 2015 information paper. That alignment has been used in the modelling.

The NSW Government's 2015 information paper and the rail needs study discussion paper both identify a possible rail extension from Narellan to the T2 South Line, without identifying a specific corridor. This potential extension is described as an 'investigation area'.

For modelling purposes, the base case alignment from Narellan is assumed to be largely tunnelled under the existing settlement at Narellan. The corridor is then assumed to ascend to the surface along Narellan Road, bridging over the Hume Highway before descending to Macarthur to join the existing T2 South Line. Macarthur Station was assumed as the point of connection with the T2 line for the following reasons:

- many of the suburban rail services on the T2 line commence and finish at Macarthur
- the station adjoins two major trip generators in south-western Sydney - the shopping centre at Macarthur Square and the Campbelltown campus of Western Sydney University
- Macarthur Station is also a focus for many of the bus services in this part of south-western Sydney – extending the rail line to Macarthur would reinforce the network of public transport in south-western Sydney.

Figure 3: Western Sydney Airport Rail Connection



Source: SGS (2017)

Consistent with an announcement by the NSW Minister for Transport in late 2015, it was assumed that parts of the Bringelly to Narellan segment (around Oran Park and Harrington Grove) would be tunnelled. The corridor is assumed to be tunnelled under Western Sydney Airport and ascend over the water pipeline north of the airport.

The northern segment of the corridor from Bringelly to St Marys is assumed to follow broadly the alignment of the proposed Outer Sydney Orbital. However, this segment is also the subject of further planning and consultation, and is therefore not closely defined. The northern section of the corridor at St Marys is assumed to be tunnelled, given the route is likely to be close to the local centre and existing urban development along the T1 Western train line.

A summary of the alignment attributes, including whether a section is 'at grade', in a dive or in tunnel is provided in **Table 9**. The assumed corridor width and dive length are:

- Corridor width: 60m
- Dive length: 1km.

Table 9: Western Sydney Airport Rail Connection – Protect and acquire now scenario - Segment summary

Segment	Type of length	Length (km)
Bringelly to St Marys	Dive	5.0
	At Grade	7.4
	Tunnel	7.5
Bringelly to Narellan	Dive	2.0
	At Grade	1.3
	Tunnel	8.4
Leppington to Bringelly	At grade	4.9
Narellan to T2 South Line	At grade	2.9
	Dive	3.0
	Bridge	0.6
	Tunnel	1.1
Total		44.1

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 10 shows the proportion of the corridor falling within various land use zones. The zoning information has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category largely includes infrastructure and environmental zones.

Table 10: Western Sydney Airport Rail Connection – Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Bringelly to St Marys	0%	0%	0%	0%	78%	22%
Bringelly to Narellan	5%	22%	14%	0%	14%	44%
Leppington to Bringelly	0%	0%	0%	0%	100%	0%
Narellan to T2 South Line	21%	0%	0%	2%	1%	76%
Station catchments	10%	2%	6%	20%	60%	1%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

Bringelly to St Marys

This segment falls largely within the Western Sydney Priority Growth Area and on land west of the Western Sydney Employment Area. The comments in the relevant section of the appendix above dealing with the Outer Sydney Orbital corridor are therefore relevant, with significant development expected to be attracted to the area as a result of the construction and operation of the Western Sydney Airport. The modelling assumes substantial rezoning of land for industrial purposes.

It has been assumed that any rail line through the airport site would be located largely if not completely underground.

The Australian Government has committed to the airport's staged development, with the first stage operating by the mid-2020s. The first stage is expected to generate 9,000 direct jobs and around 6,900 indirect jobs across western Sydney by the early 2030s. The Government expects that, by the early 2060s, the airport will generate 60,000 direct jobs and almost 30,000 indirect jobs across Western Sydney.[35] Although some of the indirect jobs are likely to occur on the airport site itself, many are also likely to occur in business parks around the airport.

A substantial amount of land is available for development within the Priority Growth Area.

Although St Marys is not one of the NSW Government's current priority growth areas or precincts, some redevelopment is expected, given the centre's proximity to major employment areas and its connections to the M4, Great Western Highway and the main western rail line. The Greater Sydney Commission's draft district plan for West Sydney notes that Penrith Council is to "investigate opportunities to address demand and diversity in around local centres and infill areas particularly in and around … St Marys."[36]

Bringelly to Narellan

This segment includes substantial rezoning for residential and industrial purposes. The segment traverses the South West Priority Growth Area, where significant population growth and transport infrastructure is planned over the next 30 years. Previous plans by the NSW Government for the former South West Growth Centre (now split between the South West Priority Growth Area and the Western Sydney Priority Growth Area) proposed the development of 110,000 dwellings in the area.

The South West Growth Centre (now known as the South West Priority Growth Area) lies within the Camden, Campbelltown and Liverpool local government areas. Development is proposed in 18 land release precincts in the growth area. Precincts that may be affected by the corridor are Oran Park, Marylands, Lowes Creek, Bringelly and North Bringelly.

As noted in the appendix on the Outer Sydney Orbital corridor, Oran Park is the only precinct to have been rezoned. The remaining precincts are in earlier stages of planning, with parts of the Lowes Creek and Marylands precincts released for zoning purposes in 2015.

The draft *South West District Plan* released by the Greater Sydney Commission in November 2016 projects employment in the Narellan district centre to grow from an estimated 10,600 jobs in 2016 to between 14,000 (Baseline Target) and 16,500 (Higher Target) in 2036.

Leppington to Bringelly

While the modelled alignment traverses mostly rural-zoned land, substantial rezoning of land for residential purposes is anticipated. Significant development is expected in this segment over the next 20 years. Leppington is to become a key centre within south-western Sydney, providing employment opportunities and higher order retail services. The draft South West District Plan indicates that Leppington has a job target range of 7,000 (Baseline Target) and 12,500 (Higher Target) by 2036. Rezoning of the Leppington North precinct is already in place. The precinct is serviced by the existing South West Rail Link, providing rail access to Liverpool and beyond to the Sydney and Parramatta CBDs. The proposed rail corridor also passes through the Rossmore precinct, immediately west of Leppington. The precinct has the capacity for 9,000 dwellings and a population of around 25,000 people.

The *Western Sydney Rail Needs Study –Discussion Paper* also refers to a Bringelly Enterprise Corridor through this segment, suggesting land in this area is also being considered for the development of commercial land uses, and not just housing. However, the modelling assumes only that parts of the corridor segment are rezoned for residential purposes.

Narellan to T2 South Line

A Plan for Growing Sydney identifies Campbelltown-Macarthur as a 'Regional City Centre'. At a more local level, planning for the Greater Macarthur Priority Growth Area bears on this segment of the corridor. Planning for the growth area is focussed broadly on:

- urban renewal in areas near the existing rail line
- new greenfield development south of Macarthur.

The modelling assumes a large proportion of this segment is tunnelled. Therefore, only a relatively small amount of potential rezoning is likely to impact the corridor.

The NSW Government released a *Glenfield to Macarthur Urban Renewal Corridor Strategy* in July 2015. The strategy envisages that around 5,000 dwellings will be developed-near Macarthur rail station by 2036. Planning will also aim to support the creation of an additional 4,300 jobs in the centre by that time.[37]

Assumptions under the 'do not protect' scenarios

Under the 'do not protect and tunnel later scenario', it is assumed the great majority of the route would require tunnelling, meaning minimal land acquisition. **Table 11** shows the assumed type of construction and length of the line.

Table 11: Western Sydney Airport Rail Connection – Do not protect now and tunnel in future scenario – Segment summary

Segment	Type of length	Length (km)*
Bringelly to St Marys	Tunnel	19.9
Bringelly to Narellan	Tunnel	11.7
Leppington to Bringelly	Dive	1.0
	Tunnel	3.9
Narellan to T2 South Line	Tunnel	7.5
Total		44.1

Source: SGS (2016)

* Total does not add due to rounding

In the 'do not protect and acquire at construction' scenario, it was assumed that land that has been released and zoned for development would need to be acquired by future governments.

Western Sydney Freight Line and Intermodal Terminal

Strategic Context and Purpose

Protection of a corridor for a Western Sydney Freight Line and Intermodal Terminal is a high priority initiative in Infrastructure Australia's Priority List.

The *Australian Infrastructure Audit* 2015 found that freight rail will need to play a growing role in the movement of goods between ports and inland freight terminals. The role of freight rail will be particularly important for containerised freight.

Currently, approximately 20% of containers are moved by rail[38], compared to 25% around 15 years ago.[39] In order to facilitate a shift from road to rail for containerised freight movement in Sydney, additional capacity and higher levels of service are required on Sydney's rail freight network.

Import and export container movements in and out of Sydney are projected to grow appreciably over the next 20 - 30 years. NSW Ports is projecting container movements to increase from 2.3 million Twenty foot equivalent units (TEUs in 2015 to between 7.5 and 8.4 million TEUs in 2045. Eighty per cent of import containers are delivered within 40 kilometres of Port Botany.[40]

In this context, the Western Sydney Freight Line and Intermodal Terminal corridor has been proposed by the NSW Government to connect Port Botany with logistics and industrial land uses in Western Sydney. The 2013 *NSW Freight and Ports Strategy* states the government's intention to protect a corridor for a dedicated freight rail line and a site for an intermodal terminal in western Sydney.[41]

A future intermodal terminal in Western Sydney is required to connect to the metropolitan freight network and support long term economic and employment growth in Western Sydney. The Strategy highlights Eastern Creek as a possible location for a future intermodal terminal.

The terminal could also serve an important role in providing for interstate freight movements, both by rail and road. Intermodal terminal capacity in the Sydney region is constrained. Although the Moorebank intermodal terminal will have some capacity to handle interstate and intrastate rail freight, additional terminal capacity is likely to be required in the Sydney region in the medium to long term. Development of terminal capacity in Sydney could complement proposals in Melbourne (including the proposed Western Interstate Freight Terminal) and Brisbane for additional interstate rail terminal capacity.

Start Date

The modelling assumed a construction date of July 2027, on the basis that the project could be operational from June 2030.

Alignment

At a broad level, the corridor alignment has been informed by the *NSW Freight and Ports Strategy*, and a high level representation of the corridor in a subsequent NSW Government document.[42] Planning of the corridor is under way [43], although details of corridor options are not yet publicly available. The broad alignment used in the analysis is shown in **Figure 4**. For the purposes of the modelling, the corridor is divided into six segments:

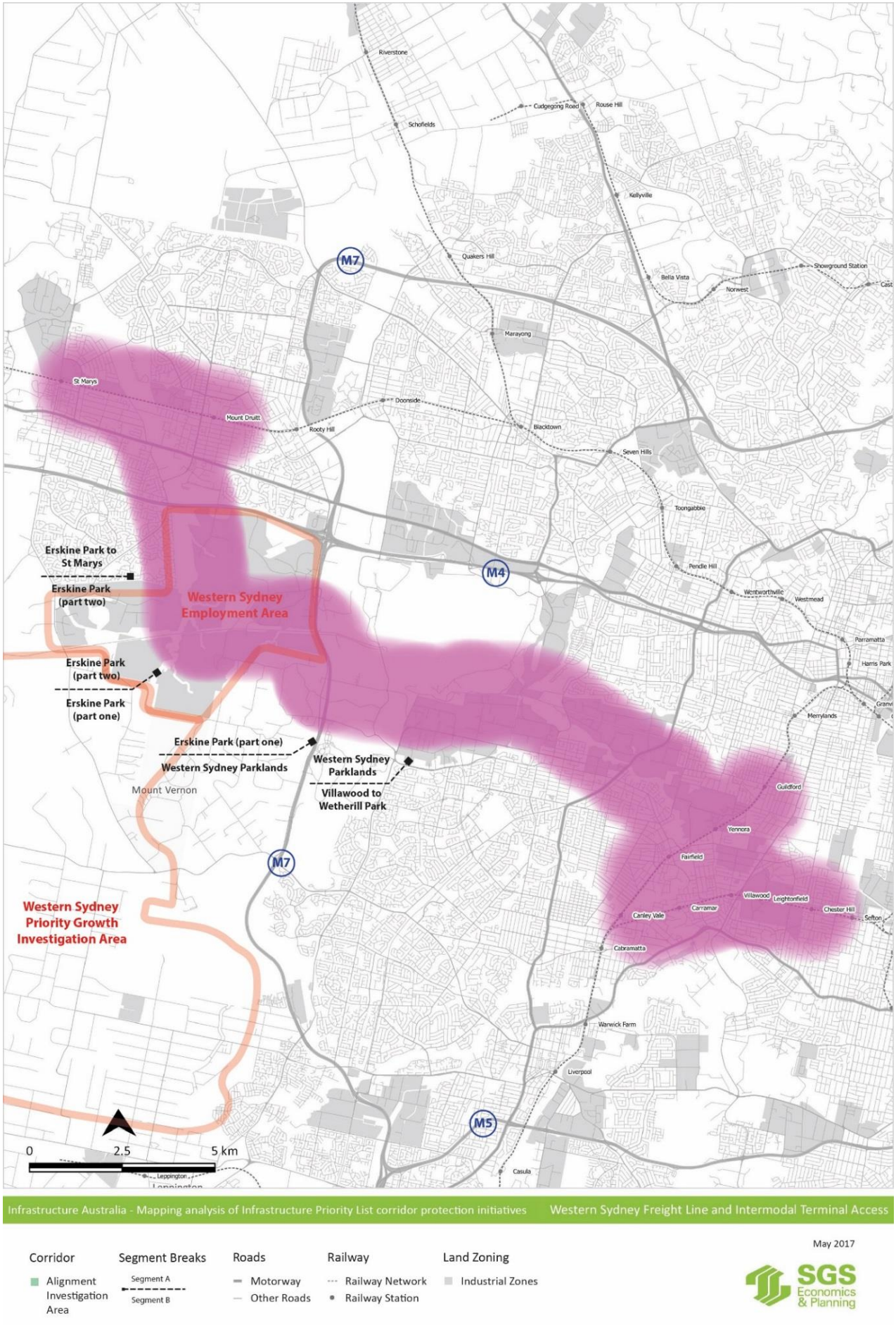
- Villawood to Wetherill Park
- Western Sydney Parklands
- Erskine Park (part one)
- Erskine Park (part two)
- Erskine Park to St Marys
- Intermodal Terminal.

The investigation area assumes acquisition of a 300-hectare site, adjacent to the railway, for an intermodal terminal and connections to the existing Southern Sydney Freight Line, so that freight trains can operate to and from Port Botany. The investigation area also includes provision for south and north-facing connections on the Main Southern rail line so that interstate freight trains could connect with the freight corridor and terminal. The corridor is assumed to be tunnelled at the Western Sydney Parklands, given the parkland's environmental and recreational significance. Near Erskine Park, the corridor is assumed to be wider than elsewhere, in order to accommodate short-term holding of trains. Approaching St Marys, the corridor crosses the M4 (Western Motorway) and is assumed to then connect with the existing T1 rail corridor.

A summary of the assumed alignment attributes is provided in **Table 12**. Key characteristics of the alignment are:

- Corridor width: 40m, except near the IMT, where a 100m corridor was assumed in order to provide room for temporary holding of freight trains when operational needs dictate, for example if a train arrives early or late at the terminal
- Dive length: 1.5km.

Figure 4: Western Sydney Freight Line and Intermodal Terminal



Source: SGS (2017)

Table 12: Western Sydney Freight Line and Intermodal Terminal – Protect and acquire now – Segment summary

Segment	Type of length	Length (km)
Villawood to Wetherill Park	Dive	9.0
	At grade	6.0
	Tunnel	4.4
Western Sydney Parklands	Tunnel	2.4
Erskine Park (part one)	Dive	1.5
	At grade	2.6
	Tunnel	0.2
Erskine Park (part two	At grade	1.6
Erskine Park to St Marys	Dive	4.5
	At Grade	0.7
	Bridge	4.2
Intermodal Terminal	At grade	N.A.
Total		37.2

Source: SGS (2016)

- Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 13 shows the proportion of the corridor falling within various land use zones. The zoning information has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category includes infrastructure and environmental zones.

Table 13: Western Sydney Freight Line and Intermodal Terminal – Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Villawood to Wetherill Park	0%	0%	25%	0%	2%	73%
Western Sydney Parklands	0%	0%	0%	0%	0%	0%
Erskine Park (part one)	0%	0%	24%	0%	13%	63%
Erskine Park (part two)	0%	0%	76%	0%	0%	24%
Erskine Park to St Marys	3%	0%	8%	0%	0%	89%
Intermodal Terminal	0%	0%	94%	0%	0%	6%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

Villawood to Wetherill Park

The segment is substantially developed with a mixture of industrial activities (principally north of Prospect Creek), housing, and some local retail centres. Developed areas are largely tunnelled under and the modelling assumes very little rezoning along the surface sections of this corridor segment.

The segment is near the boundary between the Greater Sydney Commission's west central and south districts. The draft *West Central District Plan* includes a priority to 'Protect and support employment and urban services land.'[44] This

suggests that, in general, the industrial (employment) areas through the segment will continue to operate as, and be developed for, that purpose. This could create potential opportunities to coordinate redevelopment of the employment lands with protection and eventual development of a corridor for the freight line.

The draft *South West District Plan* identifies approximately 110 hectares of undeveloped employment and urban services land in the Fairfield Local Government Area, primarily south of the Sydney Water pipeline, with the remainder in Wetherill Park.[45]

Western Sydney Parklands

The modelling assumes that the rail line would be tunnelled under the Western Sydney Parklands.

Erskine Park (Part 1)

The segment traverses, in part, land covered by the NSW Government's State Environmental Planning Policy (SEPP) for the Western Sydney Employment Area. Given the strong commitment to protecting and developing employment lands in the Greater Sydney Commission's draft plans, no material changes in the underlying intent of the SEPP are anticipated.

Erskine Park (Part Two)

The segment traverses, in part, land covered by the NSW Government's State Environmental Planning Policy for the Western Sydney Employment Area. It was assumed that the terminal site would probably connect with this segment of the corridor. Given the strong commitment to protecting and developing employment lands in the Greater Sydney Commission's draft plans, no material changes in the underlying intent of the SEPP are anticipated.

Erskine Park to St Marys[46]

It is assumed the segment traverses (on a bridge) land covered by the Western Sydney Parklands management plan. Any decision about the design of the rail connection, including for this segment, would be a decision by governments in the future. However, the assumption to use a bridge in this segment is reasonable for the purposes of the modelling. Some redevelopment may occur near St Marys; however, for the purpose of the modelling, it was assumed there were no material zoning changes before the construction date.

Intermodal Terminal Site[47]

The assumed site for an intermodal terminal is located within the area covered by NSW Government's State Environmental Planning Policy (SEPP) for the Western Sydney Employment Area. Given the strong commitment to protecting and developing employment lands in the Greater Sydney Commission's draft plans, no material changes in the underlying intent of the SEPP are anticipated.

Assumptions under the 'do not protect' scenarios

Table 14 provides details of the assumed construction types by corridor segment under the 'do not protect now and tunnel' scenario. Given the nature of the development, the intermodal terminal site is assumed to remain an at grade facility; only additional parts of the corridor are assumed to be in tunnel.

Table 14: Western Sydney Freight Rail Realignment – Do not protect now and tunnel in future scenario - Segment summary

Segment	Type of length	Length (km)
Villawood to Wetherill Park	Dive	9.0
	At grade	3.4
	Tunnel	7.1
Western Sydney Parklands	Tunnel	2.4
Erskine Park (part one)	Dive	1.5
	At grade	2.6
	Tunnel	0.2
Erskine Park (part two	At grade	1.6
Erskine Park to St Marys	Dive	4.5
	At Grade	0.7
	Bridge	4.2

Segment	Type of length	Length (km)
Intermodal Terminal	At grade	N.A.
Total		37.2

Source: SGS (2016)

In the 'do not protect and acquire at construction' scenario, it was assumed that land that has been released and zoned for development would need to be acquired by future governments.

Hunter Valley Freight Rail Realignment

Strategic Context and Purpose

Protection of a corridor for a realignment of part of the Hunter Valley freight rail network is a high priority initiative in Infrastructure Australia's Priority List.

Domestic freight volumes are projected to rise appreciably over the next 25 years.[48] For example, the NSW Government projects road freight tonnages on the Pacific Motorway near the Queensland border to increase from around 15 million tonnes in 2011 to almost 29 million tonnes in 2031. Rail freight on the North Coast line is projected to increase, although from a somewhat smaller base, from around five million tonnes in 2011 to almost 10 million tonnes in 2031. Rail freight tonnages on the rail line between North Strathfield and Newcastle (which also carries some regional freight from north-western NSW), are projected to grow from 10 million tonnes in 2011 to around 20 million tonnes in 2031.[49]

Improvements in the services offered by rail could enable rail to increase its mode share, thereby moderating the social and environmental impacts of road freight. However, population growth in the lower Hunter over the next 20 to 30 years, and associated growth in passenger rail demand, are likely to place increasing pressure on the capacity of the lower Hunter rail network, and, in turn, its ability to maintain or improve service levels.

Recognizing these challenges, the 2013 *NSW Freight and Ports Strategy* proposes a realignment of the rail line through the lower Hunter.[50]

Start Date

The modelling assumes a construction date of July 2031, on the basis that the project could be operational from June 2034.

Alignment

The NSW Government has identified a high-level investigation area traversing an arc between Fassifern and Hexham.[51] Planning of the corridor has commenced [52], although details of corridor options are not yet publicly available.

For the purposes of the modelling, a slightly more detailed investigation area has been identified. The alignment of the investigation area bypasses existing urban areas around the fringe of Newcastle. The corridor commences north of Fassifern station on the Main Northern rail line, and continues north near the settlements of Barnsley and Wallsend and then tunnels under the Pacific Highway to reconnect with the Main Northern rail line north-west of Hexham station.

The broad investigation area used in the analysis is shown in **Figure 5**. A summary of alignment attributes, including at grade or tunnelling and length is in Table 15Error! Reference source not found..

- Corridor width: 40m
- Dive length: 1.5km

Table 15: Lower Hunter Freight Rail Realignment – Protect and acquire now scenario - Segment summary

Segment	Type of length	Length (km)
Segment 1	Dive	4.0
	At grade	16.9
	Tunnel	2.6
Total		23.5

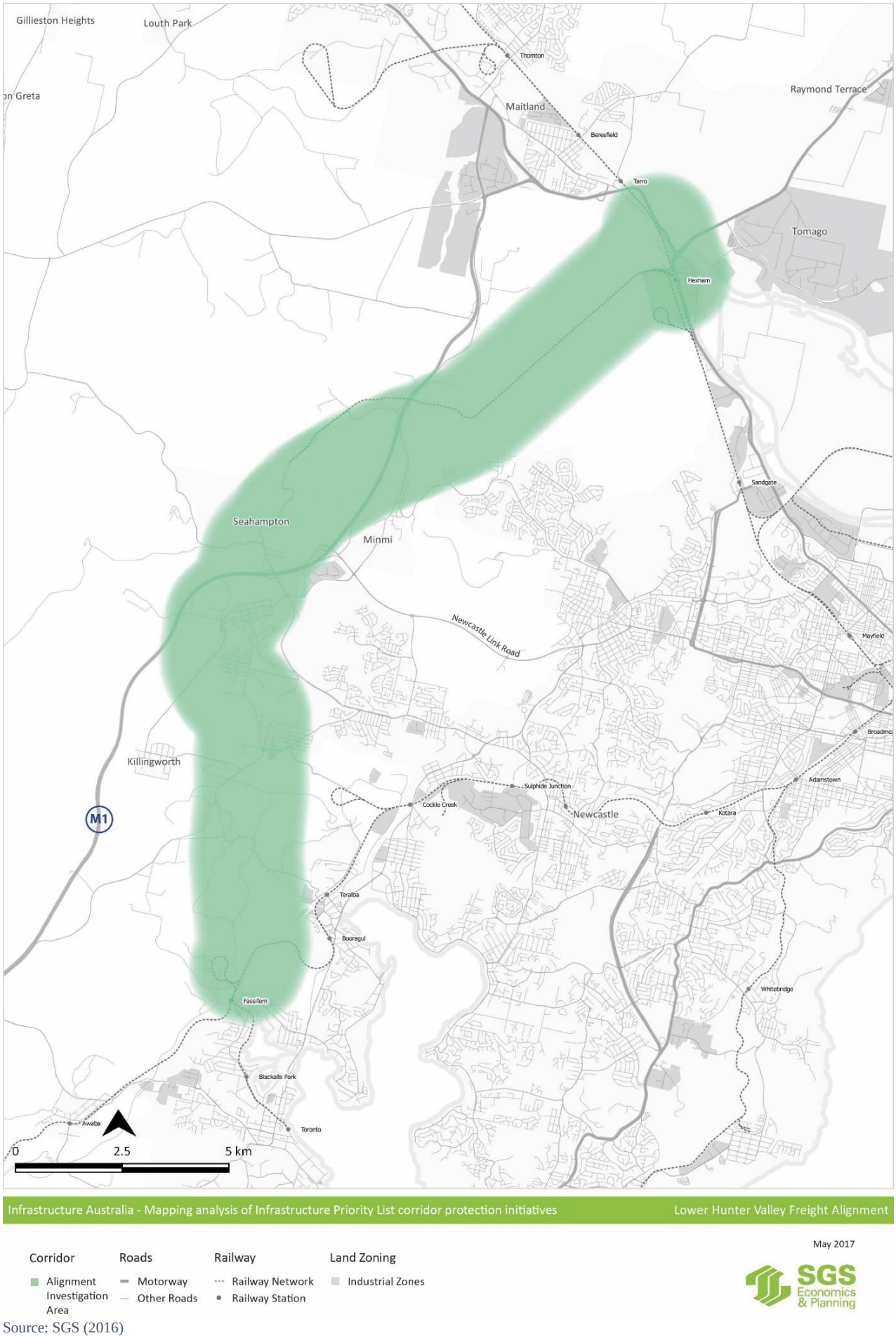
Source: SGS (2016)

** Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.*

Summary of the current land use zoning of the corridor

Table 16 shows the proportion of the corridor falling within various land use zones. The zoning information has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category includes infrastructure and environmental zones.

Figure 5: Lower Hunter Freight Rail Realignment investigation area



Source: SGS (2016)

Table 16: Hunter Valley Freight Rail Realignment - Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Segment 1	2%	0%	1%	0%	1%	95%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The *Hunter Regional Plan 2036* states that 70,000 additional dwellings will be required in the region between 2016 and 2036. It identifies a potential growth area north-west of Glendale which could provide for new development.[53] Dwelling demand is influenced by changing household sizes as well as population growth. Planning of new areas for development is also expected to be influenced by the density of development in existing areas and existing urban release areas, as well as by the rate of population growth. The modelled alignment largely avoids areas that are at material risk of rezoning. This is largely due to environmental constraints that may limit residential development in the area.

Assumptions under the 'do not protect' scenarios

Under the 'do not protect and tunnel later scenario', as the corridor approaches the fringe of Newcastle, tunnelling commences earlier to avoid the urban settlement and any noise impact it could have on potential expansion areas. The alignment then tunnels under the Pacific Highway as it continues to travel north towards the employment lands at Hexham. **Table 17** shows the type of construction and length of the corridor under the 'do not protect and tunnel in future scenario'.

Table 17: Lower Hunter Freight Rail Realignment - Do not protect now and tunnel in future scenario - Segment summary

Segment	Type of length	Length (km)
Segment 1	Dive	4.0
	At grade	14.0
	Tunnel	5.4
Total		23.5

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

Outer Melbourne Ring /E6 (and Western Interstate Freight Terminal)

Strategic Context and Purpose

Protection of a corridor for the Outer Metropolitan Ring/E6 in Melbourne and a connecting Western Interstate Freight Terminal is a high priority initiative in Infrastructure Australia's Priority List.

Melbourne's population is projected to increase from 4.49 million people at the 2016 Census[54] to just over 8 million in 2051.[55] Successive Victorian governments have recognized that strategic upgrades to Melbourne's 'orbital' transport infrastructure will be required over time. *Plan Melbourne 2017-2050* envisages development of both an Outer Metropolitan Ring/ E6 corridor and a Western Interstate Freight Terminal.[56]

Development of an interstate freight terminal in Melbourne would complement other interstate freight terminals, notably:

- the Moorebank terminal in Sydney (which is scheduled to open to interstate rail traffic in 2020)
- the proposed Western Sydney Freight Line and Intermodal Terminal
- initiatives such as the Inland Rail project and associated intermodal terminals in regional Victoria, regional NSW and south-east Queensland.

The Victorian Government protected the Outer Metropolitan Ring/ E6 corridor in 2010 by placing a Public Acquisition Overlay over the relevant land. The 90+ kilometre corridor has been conceived as a multi-modal corridor capable of accommodating a motorway and a freight line.

While the corridor has been protected, project development investigations remain at a comparatively early stage of resolution. Action to protect a site for a Western Interstate Freight Terminal, and associated connections to the existing interstate freight line and to the Outer Metropolitan Ring, has yet to occur.

Start Date

Infrastructure Victoria has recommended that the Outer Metropolitan Ring (including the E6) be delivered in stages within 15-30 years. Infrastructure Victoria also concluded that the Western Interstate Freight Terminal may need to be delivered "in 5-15 years, rather than 10-15 years to better align with planning for the Inland rail."[57]

The modelling assumed a construction start date of July 2027, on the basis that the project could be operational from July 2032.

Alignment

The alignment used in the analysis is shown in **Figure 6.** Detailed information on the OMR/E6 alignment can be found on the VicRoads website.[58]

For the purposes of the modelling, the corridor comprises four principal segments: the Outer Metropolitan Ring Transport Corridor (OMR); the E6 Transport Corridor; the Truganina intermodal terminal; and the rail and road connections to the terminal (Western Rail Line/Connector, Middle Road and Christies Road). As shown in the following tables, some of the segments have been broken into sub-segments.

The main OMR segment is a combined rail and road corridor starting, in the south, at the Geelong - Melbourne railway, south- west of Werribee. This segment of the corridor then heads broadly north along an alignment west of Wyndham Vale and east of Rockbank. West of Calder Park, the alignment turns north-east, and continues north of Melbourne Airport until it intersects the Hume Freeway and existing interstate rail line at Kalkallo.

The E6 is a road-only segment of the corridor starting east of the existing Hume Freeway and interstate rail line and curves towards Epping Road. The segment broadly follows Epping Road, curving east of Wollert before continuing south. The segment finishes at the Metropolitan Ring Road near Thomastown.

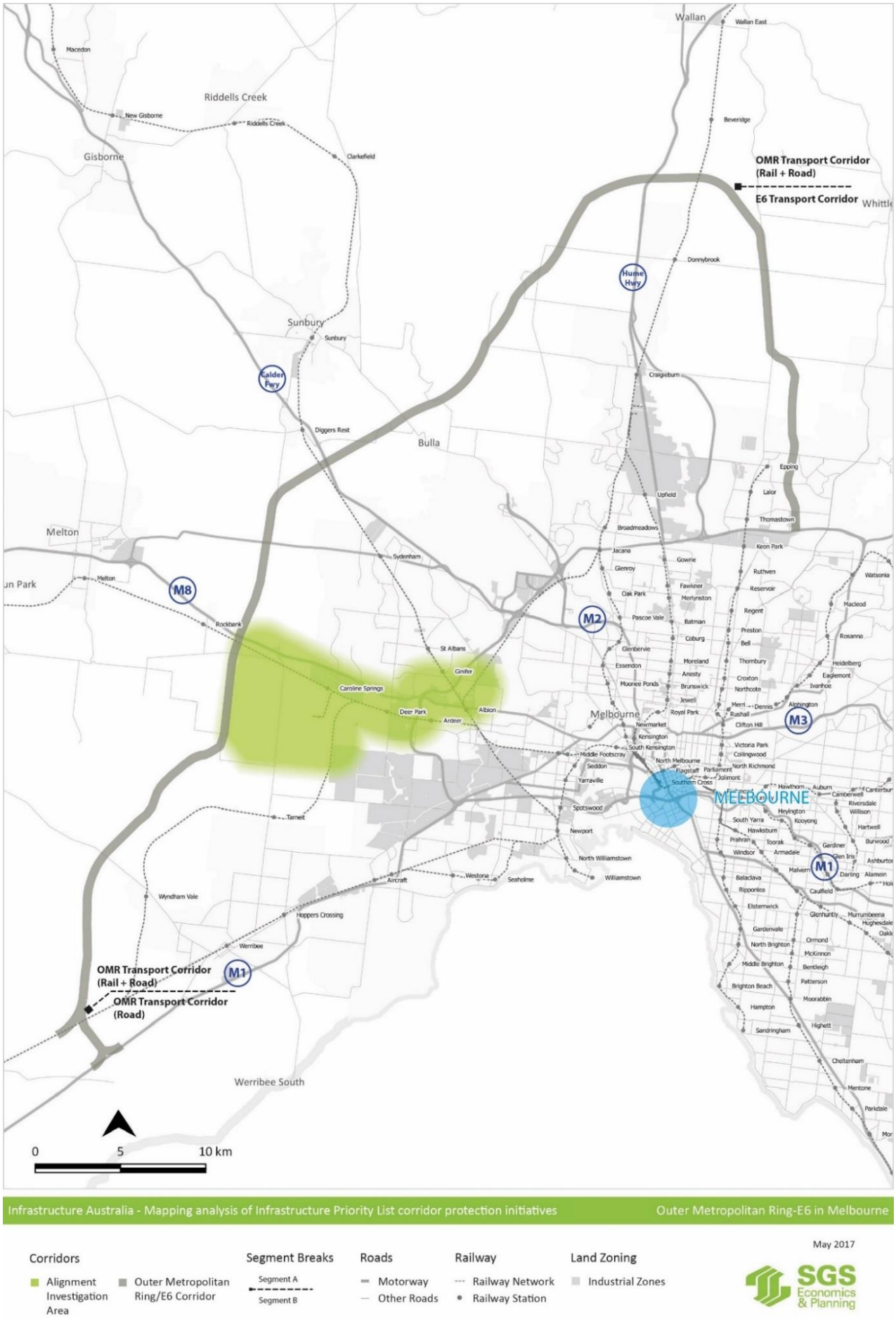
The assumed connections to the Truganina terminal consist of two new rail lines and upgraded roads. The first rail connection branches off the OMR and joins the existing Ballarat line to an assumed terminal site south of the Ballarat line. The second line proceeds from the terminal site to connect with the existing interstate rail line north of Sunshine. Road upgrades include a widening of Christies and Middle Road.

The assumed geometric requirements for the corridor are:

- Rail and Road: 240m
- Road only: 120m
- Rail only: 40m

The assumed breakdown of construction types in the various segments is in **Table 18**.

Figure 6: Outer Metropolitan Ring Road/E6



Source: SGS (2016)

Table 18: Outer Metropolitan Ring/E6 – Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
E6 corridor	At grade	23.4
OMR to Truganina – Rail Line Part 1	At grade	0.7
	Dive	1.0
	Bridge	3.2
OMR to Truganina – Rail Line Part 2	At grade	0.5
	Dive	3.5
	Tunnel	1.9
OMR to Truganina – Rail Line Part 3	At grade	3.4
OMR to Truganina (OMR connector)	At grade	2.3
OMR to Truganina (Middle Road)	At grade	6.4
OMR to Truganina (Christies Road)	At grade	2.2.
Outer Metropolitan Ring Road (OMR)	At grade	74.4
Truganina – IMT	At grade	N.A.
Total		122.8

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 19 shows the proportion of the corridor falling within various land use zones. The zoning has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category includes infrastructure and environmental zones.

Table 19: Outer Metropolitan Ring/E6 – Summary of Present Zoning

Segment	Residential - Urban	Residential – Peri-urban	Industrial	Commercial	Rural	Other
E6 corridor	26%	35%	5%	0%	32%	3%
OMR to Truganina – Rail Line Part 1	1%	0%	7%	27%	0%	64%
OMR to Truganina – Rail Line Part 2	9%	0%	26%	1%	0%	64%
OMR to Truganina – Rail Line Part 3	1%	0%	4%	0%	28%	66%
OMR to Truganina (OMR connector)	94%	0%	0%	0%	0%	6%
OMR to Truganina (Middle Road)	48%	0%	0%	0%	29%	23%
OMR to Truganina (Christies Road)	0%	0%	0%	0%	0%	100%
Outer Metropolitan Ring (OMR)	27%	47%	0%	0%	20%	6%

Segment	Residential - Urban	Residential – Peri-urban	Industrial	Commercial	Rural	Other
Truganina – IMT	0%	0%	0%	0%	0%	100%

Source: SGS (2016)

The corridor for the Outer Metropolitan Ring/E6 is already the subject of a public acquisition overlay, so the percentages above reflect the underlying alternate zoning. For the Outer Metropolitan Ring/E6 corridor itself, the modelling therefore assumes no rezoning occurs in the protected sections of the corridor, and that no development occurs on the corridor. Land acquisition costs for these two segments are assumed to be at the unimproved value of land.

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

E6 Corridor

The E6 segment of the corridor has been reserved for the new road corridor. It has been the subject of a Public Acquisition Overlay since 2010. Given the presence of the overlay, there is a very low risk of development occurring which would materially affect the corridor.

Outer Metropolitan Ring (OMR)

The OMR segment of the corridor has been reserved for the new road corridor. It has been the subject of a Public Acquisition Overlay since 2010. Given the presence of the overlay, there is a very low risk of development occurring which would materially affect the corridor.

Truganina – Intermodal Terminal

Plan Melbourne 2017 - 2050 flags an intention to develop an intermodal terminal near Truganina in western Melbourne. It appears a specific site for the terminal has not been declared publicly, and that a public acquisition overlay has not been created to protect the site. The site modelled for the terminal is largely zoned as 'special use' and the modelling forecasts very little rezoning.

OMR to Truganina

A small section of land is subject to a public acquisition overlay, possibly with the intention of providing for a connection from the OMR (from the south) to the existing Ballarat rail line. A north facing public acquisition overlay from the Ballarat line to the OMR and, therefore to a future rail line in the corridor and on to the interstate line to NSW, has not been provided at this time.

Truganina to Existing Interstate Rail Line

Plan Melbourne 2017 – 2050 proposes development of the 'Sunshine National Employment and Innovation Cluster' in the area through which a rail connection would need to be developed. A section of the line also runs past existing residential land. Some minor rezoning, for residential development, has been forecast in the modeling along this section of the corridor.

Assumptions under the 'do not protect' scenarios

Table 20 provides details of the assumed construction types and by corridor segment under the 'do not protect now and tunnel' scenario. Given the nature of the development, the intermodal terminal site is assumed to remain an at grade facility; only additional parts of the corridor are assumed to be in tunnel.

Table 20: Outer Melbourne Ring Road/E6 - Do not protect now and tunnel in future - Segment summary

Segment	Type of Length	Length (km)
E6 corridor	At grade	23.4
OMR to Truganina – Rail Line Part 1	Dive	4.1
	Tunnel	1.5
OMR to Truganina – Rail Line Part 2	Dive	2.0

Segment	Type of Length	Length (km)
	Tunnel	3.6
OMR to Truganina – Rail Line Part 3	At grade	3.4
OMR to Truganina (OMR connector)	At grade	2.3
OMR to Truganina (Middle Road)	At grade	6.4
OMR to Truganina (Christies Road)	At grade	2.2.
Outer Metropolitan Ring Road (OMR)	At grade	74.4
Total*		123.2

Source: SGS (2016)

* The longer route length in this scenario is due to the dives for additional tunnels.

East Coast High Speed Rail line

Strategic Context and Purpose

Protection of a corridor for an east coast high speed rail line is a high priority initiative in Infrastructure Australia's Priority List.

By 2075, the combined population of Melbourne, Sydney and Brisbane is projected to exceed 30 million people. On current trends, the population of the lower Hunter region could be around one million people, and a number of regional centres could have a population of between 50,000 and 100,000 people.

Protecting a corridor would significantly increase options for future development of high speed rail infrastructure to meet future demand for inter-city and regional travel.

The most recent and detailed analysis for a high speed rail service is in a two-phase investigation, commissioned by the Australian Government, of a high speed rail line connecting Brisbane to Melbourne through Sydney, Canberra and several regional centres. The Phase 1 report, which assessed route options, was released in July 2011. The Phase 2 report, which provided a more detailed analysis of the preferred option from the Phase 1 study, was released in April 2013.[59] The modeling undertaken for this report adopts the route identified in the Phase 2 study.

Start Dates

The start and completion dates for the five stages referred to in **Table 21** were drawn from the High Speed Rail Phase 2 study, specifically Figure 12-2 in Chapter 12 of the study.

Table 21: Assumed start date for construction of stages of the East Coast High Speed Rail

Corridor/Stages	Assumed Start Date	Assumed Completion Date
High Speed Rail –Brisbane to Sydney		
Sydney – Newcastle	1 July 2033	30 June 2042
Newcastle to Gold Coast	1 July 2046	30 June 2056
Gold Coast to Brisbane	1 July 2039	30 June 2049
High Speed Rail – Sydney to Melbourne		
Sydney to Canberra	1 July 2024	30 June 2032
Canberra to Melbourne	1 July 2027	30 June 2037

Source: High Speed Rail Study Phase 2 Report (2013)

Note: Construction completion dates differ to operational dates in the High Speed Rail Phase 2 study due to testing and commissioning phases.

Alignment

The alignment of the East Coast High Speed Rail Corridor used in the modelling is drawn from the *High Speed Rail Study Report – Phase 2 Report* (2013). The proposed alignment is approximately 1,750 kilometres in length, and is shown in **Figure 7**. More detailed maps from the Phase 2 study are available from the Department of Infrastructure and Regional Development.[60]

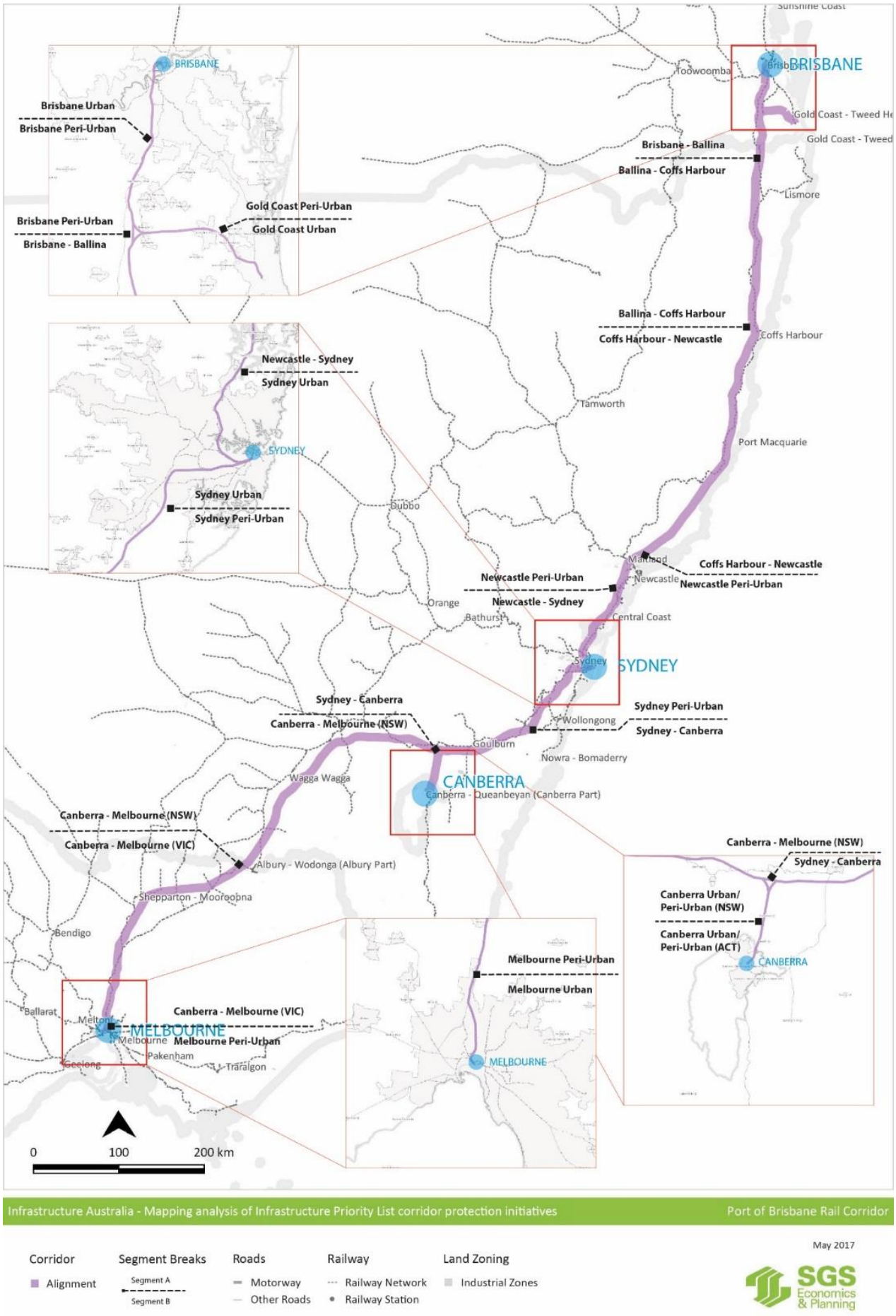
For the purposes of the modelling, the overall corridor was divided into two larger sections: Brisbane to Sydney and Sydney to Melbourne. The segments used for the modelling within each of these two sections were defined by Infrastructure Australia.

Brisbane to Sydney

The initial segment, identified as Brisbane Urban, commences at Roma Street Station in Brisbane. The corridor heads south to the NSW border through two further segments. At Beaudesert, a spur line provides a connection to the Gold Coast. A station is proposed to be located at Robina.

South of the border, the corridor passes around the towns of Casino, Grafton, Coffs Harbour, Port Macquarie and Taree. The corridor proceeds west of Newcastle and then continues south along the NSW central coast, broadly west of Wyong and Gosford. The corridor from the border to Mount Ku-ring-gai on Sydney's northern fringe is 'at grade'. At Mount Ku-ring-gai, the corridor dives into a tunnel and continues in tunnel to a terminus adjacent to Sydney's existing Central Station.

Figure 7: East Coast High Speed Rail – Corridor Overview



Source: SGS (2016)

Sydney to Melbourne

The Sydney to Melbourne section commences at Sydney's Central Station, and remains in tunnel as far as Holsworthy. The corridor ascends to the surface east of Glenfield, and then heads south through Wilton, Bargo and Yerringbool.

The corridor arches west after Moss Vale, passes Goulburn and then splits into two segments at Gunning. The southern segment is a spur line to Canberra, while the main segment of the corridor continues west towards Cootamundra. Following Cootamundra, the corridor travels south-west towards a proposed station at Wagga Wagga. South of Wagga Wagga, the alignment approaches the NSW-Victorian State border. A station is proposed at Albury-Wodonga.

A station is proposed at Shepparton in north-eastern Victoria. After Shepparton, the corridor heads south 'at grade', passing Broadford and Wallan on Melbourne's northern edge. The corridor continues at grade at Gowrie, using the existing interstate rail alignment where possible. At Gowrie, the proposed line descends into a tunnel that leads to a terminus adjacent to Southern Cross Station on the south-western edge of Melbourne's CBD.

A summary of the alignment attributes, including lengths which would be constructed at grade or tunneling is provided in the tables below. Construction type has been simplified for the purposes of high level modelling. The High Speed Rail Phase 2 study shows more detail than was modelled.

- Corridor width: 80m
- Dive length: 1 km

The assumed configuration per segment length, and the amount of land assumed to be acquired in each segment are shown in the tables below.

Table 22: East Coast High Speed Rail – Brisbane to Sydney (QLD component) - Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
Brisbane – Ballina (QLD)	Dive	1.0
	At grade	29.8
Brisbane Peri-Urban	At grade	46.8
Brisbane Urban	Dive	1.0
	At grade	15.2
	Tunnel	8.1
Gold Coast Peri-urban	At grade	36.3
Gold Coast Urban	At grade	19.0
Total		157.2

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the base case are excluded from the area of land that would need to be acquired.

Table 23: East Coast High Speed Rail – Brisbane to Sydney (NSW component) - Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
Ballina-Coffs Harbour (NSW)	Dive	1.0
	At grade	189.7
	Tunnel	16.2
Coffs Harbour - Newcastle	At grade	318.4
Newcastle - Sydney	At grade	73.7
Newcastle Urban/Peri-urban	At grade	51.3
Sydney Urban (Bri – Syd)	Dive	1.5
	At grade	7.6
	Tunnel	35.8

Segment	Type of Length	Length (km)
Total		695.2

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Table 24: East Coast High Speed Rail – Melbourne to Sydney (NSW component) - Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra – Melbourne (NSW)	At grade	308.5
Canberra Urban/Peri-urban (NSW)	At grade	52.7
Sydney - Canberra	At grade	106.9
Sydney Peri-urban (south west)	At grade	81.1
Sydney Urban	Dive	1.0
	At grade	6.4
	Tunnel	30.9
Total		587.5

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Table 25: East Coast High Speed Rail – Melbourne to Sydney (ACT component) - Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra Urban/Peri-urban (ACT)	At grade	7.6
	Tunnel	3.5
Total		11.1

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Table 26: East Coast High Speed Rail – Melbourne to Sydney (VIC component) - Protect and acquire now scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra – Melbourne (VIC	At grade	193.3
Melbourne Peri-urban	At grade	55.4
Melbourne Urban	Dive	1.0
	At grade	32.8
	Tunnel	13.7
Total		296.3

Source: SGS (2016)

* Sections that are assumed to be in tunnel in the protect and acquire now scenario are excluded from the area of land that would need to be acquired.

Summary of the current land use zoning of the corridor

Table 27 and **Table 28** show the proportion of the corridor falling within various land use zones. The zoning information has been drawn from publicly available on-line mapping of current planning controls. Given the range of zones and sub-zones in many land use plans, some judgment has had to be applied to determine the principal land use purposes in the table below. The 'other' category includes infrastructure and environmental zones.

Table 27: East Coast High Speed Rail (Brisbane – Sydney) - Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Brisbane – Ballina (QLD)	0%	0%	0%	0%	99%	1%
Brisbane Peri-Urban	16%	12%	0%	0%	57%	15%
Brisbane Urban	8%	4%	9%	0%	18%	61%
Gold Coast Peri-urban	0%	7%	0%	0%	89%	4%
Gold Coast Urban	26%	15%	0%	0%	36%	23%
Ballina – Coffs Harbour	0%	0%	0%	0%	85%	15%
Coffs Harbour - Newcastle	0%	6%	0%	0%	58%	36%
Newcastle - Sydney	3%	1%	4%	1%	18%	73%
Newcastle Urban/Peri-Urban	6%	2%	0%	0%	46%	46%
Sydney Urban	20%	0%	1%	0%	0%	80%

Source: SGS (2016)

Table 28: East Coast High Speed Rail (Melbourne to Sydney) - Summary of present zoning

Segment	Residential - Urban	Residential - Peri-urban	Industrial	Commercial	Rural	Other
Canberra – Melbourne (NSW)	0%	0%	0%	0%	95%	5%
Canberra Urban/Peri-urban (NSW)	0%	0%	0%	0%	100%	0%
Sydney - Canberra	1%	1%	0%	0%	68%	30%
Sydney Peri-urban (south-west)	0%	0%	0%	0%	19%	81%
Sydney Urban	0%	0%	0%	0%	0%	100%
Canberra Urban/Peri-urban (ACT)	3%	0%	0%	0%	11%	85%
Canberra – Melbourne (VIC)	0%	2%	0%	0%	94%	4%
Melbourne Peri-Urban	3%	4%	0%	4%	82%	7%
Melbourne Urban	16%	1%	14%	4%	20%	45%

Source: SGS (2016)

Summary of potential land use and zoning changes which may affect the corridor

The following sub-sections comment on the potential for land use changes and rezoning of land in each segment of the corridor. Opportunities for changes in the zoning and development of land have been informed by a review of strategic planning documents.

Brisbane to Sydney Alignment

Brisbane Urban

The Queensland Government's draft *Shaping SEQ* plan envisages that 60% of south-east Queensland's demand for new housing will be accommodated in established areas.[61] Much of this section of the corridor is zoned for open space. However, some areas along the corridor could be rezoned for urban development or higher densities. The modelling assumes a small amount of land being rezoned for residential purposes.

Brisbane Peri-Urban

The modelling assumes some rezoning of rural land for residential peri-urban and urban use. The Queensland Government's draft plan for the development of south-east Queensland, *Shaping SEQ*, proposes:

- an additional 223,400 dwellings be developed in the Brisbane LGA between 2011 and 2041, with 210,600 dwellings to be built in infill areas. Around 107,600 dwellings are expected over the period 2016 to 2031
- an additional 98,700 dwellings be developed in the Logan LGA between 2011 and 2041, with 25,000 dwellings to be built in infill areas. Around 44,100 dwellings are expected over the period 2016 to 2031
- an additional 10,800 dwellings be developed in the Scenic Rim LGA between 2011 and 2041, with no additional dwellings to be built in infill areas. Around 5,600 dwellings are expected over the period 2016 to 2031.

The section of the HSR corridor through Logan is likely to come under particular pressure. Logan Council has identified a number of 'Priority Development Areas', notably between Kagaru and New Beith, for example at Flagstone. Other areas in the Scenic Rim Council area may also be considered for development.

The Queensland Government has declared 15,610 hectares of land at Bromelton as a State Development Area for industrial and logistics purposes, particularly those that can take advantage of a location close to the national standard gauge rail network.[62]

The Queensland Government has flagged a need for corridor protection in areas around the existing rail corridor between Salisbury and Beaudesert to permit an upgrade of regional passenger rail services. This initiative has been added to Infrastructure Australia's 2017 Infrastructure Priority List (IPL). The listing in the IPL flags the potential for a shared regional/HSR corridor (where possible).

Gold Coast Peri-Urban

The draft *Shaping SEQ* plan envisages that this area will remain zoned predominantly for rural or scenic/environmental purposes. Given this segment's proximity to the Gold Coast, and long-term demand for housing in south-east Queensland, a small amount of rezoning for residential purposes is assumed in the modelling.

Gold Coast Urban

The modelling assumes some limited rezoning for peri-urban residential use in this segment. The draft *Shaping SEQ* plan expects demand for an additional 176,500 dwellings in the Gold Coast Local Government Area between 2011 and 2041, and that 79% of this demand would be met through infill development.

A part of this segment of the high speed rail corridor (west of the M1 motorway) is zoned 'Emerging Community', which for modelling purposes has been defined as residential land. It is assumed this land will be developed for residential purposes in the medium term.

Brisbane - Ballina (QLD section)

Between now and 2036 (the relevant year before the proposed construction start date in the Phase 2 study), most population growth in this part of south-east Queensland is likely to occur along the Gold Coast and the northern part of the Scenic Rim Council area.

Ballina – Coffs Harbour

The NSW Government's *North Coast Regional Plan 2036* (published in March 2017) identifies the following minimum number of additional dwellings required in each of the relevant north coast Local Government Areas between 2016 and 2036: Tweed – 11,600; Byron – 3,150; Ballina – 2,550; Richmond Valley – 1,550; Clarence Valley – 3,550; Coffs Harbour – 8.950.[63] It seems likely that much of this demand would occur in or near existing urban centres, and therefore have little impact on the proposed rail corridor

Coffs Harbour - Newcastle

The NSW Government's *North Coast Regional Plan 2036* identifies the following minimum number of additional dwellings required in each of the relevant north coast Local Government Areas between 2016 and 2036: Bellingen - 200; Nambucca - 1,150; Kempsey - 1,100; Port Macquarie-Hastings - 8,800. NSW Department of Planning and Environment projections indicate a demand for 5,000 dwellings in the Mid Coast Local Government Area. The modelling assumes the majority of new dwellings will be in established urban areas, with little impact on the rail corridor.

Newcastle Urban/ Peri-Urban

In this segment of the corridor, the modelling assumes some rezoning of land for industrial and residential purposes. There are potential urban development pressures due to an expanding Newcastle and potential development around Raymond Terrace, Gilleston Heights, Black Hill and Beresfield.

The NSW Government's *Hunter Regional Plan 2036* projects demand for an additional 70,000 dwellings in the Hunter region between 2016 and 2036.[64] 16,800 dwellings will be required in Newcastle by 2036. The urban footprint of Newcastle is expanding westwards.

NSW Department of Planning and Environment projections indicate a demand for 11,050 dwellings in the Port Stephens Local Government Area between 2016 and 2036. Proposed urban release areas at Kings Hill in Port Stephens and potential expansion at Raymond Terrace to a 'major regional centre' may impinge on the proposed corridor.[65]

The NSW Government's *Hunter Regional Plan 2036* also identifies a 'current urban release area' near Kings Hill on the west side of the Pacific Highway north of Raymond Terrace. Other land near these locations could also be suitable for future urban or peri-urban development.

The plan also identifies a 'Gateway Determination site' west of Beresfield (near Black Hill), indicating that the site is subject to potential rezoning action. The plan (and earlier documents such as the *Newcastle/Lake Macquarie Western Corridor Planning Strategy* from 2010) proposes a large freight/logistics hub near Black Hill to capitalise on the accessibility offered by the Pacific Highway, Hunter Expressway and potentially improved freight rail connections.

Newcastle - Sydney

The modelling assumes some rezoning of land in this segment for residential and industrial purposes. The *Hunter Regional Plan 2036* identifies Morisset for development as a 'strategic centre'[66], suggesting there is potential for additional urban development (or intensified development) in this area, if not by 2031 (the relevant date for the modelling) then shortly thereafter. The alignment proposed in the High Speed Rail Phase 2 study passes close to Morisset.

The plan also envisages greenfield development in several parts of the lower Hunter. Some of the existing urban release areas at Cooranbong, Wyee, Morisset, Edgeworth, and West Wallsend may affect the corridor, as could longer term growth in the Glendale-Edgeworth corridor.

The *Central Coast Regional Plan 2036* states that 41,500 additional dwellings will be required in the region between 2016 and 2036.[67] The plan notes:

> *The Australian Government is investigating the merits of a high-speed rail network to reduce travel time between capital cities along the east coast.*[68]

The plan identifies a 'Wyong Employment Zone' and 'regional gateway' to be developed west of Warnervale. The alignment in the High Speed Rail Phase 2 study passes through this area. A more detailed *North Wyong Shire Structure Plan* identifies various areas north and west of Warnervale (for example Halloran) as short-term development areas[69], and also identifies areas north and west of Warnervale that might be developed, subject to resolution of offset strategies to address conservation issues.

Sydney Urban

This segment of the corridor is largely in tunnel, meaning forecast growth and rezoning in Sydney will not impact the corridor.

Sydney to Melbourne Alignment

Sydney-Urban

The surface section in the Sydney Urban segment is entirely within the Holsworthy Military Reserve. The likelihood of development occurring in the area, especially before 2021 (the relevant year in the modelling), is very low.

Sydney Peri-urban (SW)

The NSW Government has identified a Greater Macarthur Priority Growth Area. Investigations of the growth area have identified land at Mt Gilead and Wilton capable of providing 35,000 dwellings and around 30,000 jobs. A draft State Environmental Planning Policy (SEPP) was exhibited in June 2016, aimed at rezoning land at Mt Gilead and Wilton for urban purposes. Planning studies for this area also flag the potential for further urban development near Appin (between Mt Gilead and Wilton). [70]

The areas assumed to be rezoned to urban residential account for approximately 8.5km of the proposed HSR corridor (around.10% of the overall segment). The NSW Government has indicated that:

> *Parts of some precincts are ready to deliver homes by early 2018 to 2023. These include:*
>
> - *Mt Gilead and Menangle Park adjoining Campbelltown*
> - *Wilton New Town adjoining the Hume Motorway and Picton Rd Junction.*[71]

Sydney – Canberra (NSW section)

The modelling assumes very little change in land use zoning in this segment of the corridor. The area is experiencing relatively low levels of growth in the major regional centres of Mittagong-Bowral, Goulburn and Queanbeyan. Projected dwelling demand between 2016 and 2036 in this segment is: Goulburn – Mulwaree Local Government Area (LGA) - 3,050 dwellings; Wingecarribee LGA - 3,300 dwellings, and 12,050 dwellings for the Queanbeyan-Palerang Regional LGA.[72] It was assumed that most of this development would occur near the existing town centres.

Canberra Urban/Peri-urban (NSW section)

The modelling assumes very little change in land use zoning in this line segment. Although the area north of Canberra may be suitable or attractive for rural-residential development, it is unlikely that much of this land will be rezoned for that purpose prior to 2021.

Canberra Urban/Peri-urban (ACT)

The *ACT Planning Strategy* (2012) identifies an 'Eastern Broadacre area'.[73] The area has been investigated for potential future light industrial and other uses. A small amount of rezoning is assumed in the modelling.

Canberra – Melbourne (NSW section)

The NSW Department of Planning and Environment projects fairly modest growth in dwelling demand in most relevant local government areas in south-western NSW between 2016 and 2036. The figures are: Yass Valley – 3,000; Gundagai – -450; Junee – 100; Wagga Wagga – 6,800; Greater Hume - 200; Albury – 4,950. The Phase 2 study proposes an alignment clear of the larger towns, where most dwelling demand might occur (Yass, Wagga Wagga and Albury).[74]

Canberra to Melbourne (VIC section)

The Victorian Government's *Victoria in Future 2016* includes projections of household (dwelling) demand between 2031 and 2031. The projected increase in the number of households in Local Government Areas through which the corridor would pass are: Wodonga – 7,300; Indigo – 900; Wangaratta – 900; Moira – 2,600; Greater Shepparton – 5,900; and Strathbogie – 800. The corridor largely bypasses these towns; for example, it runs about 15 kilometres west of Wodonga and 10 kilometres east of Shepparton. The modelling assumes a small amount of rezoning for peri-urban residential purposes along the corridor.

Melbourne – Peri-urban

The modelling assumes a small amount of rezoning for residential peri-urban purposes in this segment of the corridor.

The Victorian Government's *Victoria in Future 2016* projects an additional 17,200 households in the Mitchell Shire between 2011 and 2031.[75] The proposed alignment is close enough to Seymour that the relevant land may be attractive for rural-residential development.

The southern area of Mitchell Shire is on the fringe of Melbourne (approximately 60-70 kilometres from central Melbourne), and immediately outside the current urban growth boundary for Melbourne. In 2016, Mitchell Shire Council adopted a structure plan for the expansion of Kilmore. The Council's August 2016 resolution adopting the *Wandong-Heathcote Junction Precinct Structure Plan* envisages rural-residential development on approximately one kilometre of the rail alignment, and proposes further rural-residential rezoning west of the Wandong town centre. The structure plan acknowledges the proposed high speed rail alignment, although it does not indicate specifically whether and how the alignment would be addressed in future statutory land use plans.[76] In August 2017, the Council resolved to commence the process of rezoning land in accordance with the structure plan.[77]

Melbourne - Urban

Substantial rezoning is anticipated in northern Melbourne. *Plan Melbourne 2017-2050* envisages the development of 340,000 to 355,000 new dwellings in the northern region of Melbourne between 2015 and 2051. Within this range, the plan anticipates between 160,000 and 180,000 new dwellings in greenfield areas in Melbourne's north.[78]

The Phase 2 study concluded that, where possible, through the northern area of Melbourne, the proposed rail alignment should seek to use the existing rail corridor. However, in order to achieve an alignment capable of meeting the target train speeds, the high speed alignment would still need to deviate from the existing rail corridor in four locations (totalling approximately 13 kilometres): east of Wallan (approximately 2.5 kilometres); between Beveridge and Donnybrook (approximately 6 kilometres); at Coolaroo (approximately 2 kilometres); and between Campbellfield and a proposed tunnel portal at Hadfield (approximately 2.5 kilometres). South of Hadfield the alignment continues south in tunnel.

Plans are in place for residential and industrial development in the northern parts of Melbourne, as far north as the current urban growth boundary at Wallan. In conjunction with local councils, the Victorian Planning Authority has finalised or is preparing a number of 'precinct structure plans' (PSPs) for greenfield areas in the north of Melbourne. Together, these PSPs cover approximately 22 kilometres of the surface section of the high speed alignment in northern Melbourne, including approximately 6 kilometres where the HSR alignment would need to deviate from the existing rail corridor.

The Victorian Department of Environment, Land, Water and Planning states:

> *Current land zoned for development will accommodate around 200,000 lots – or enough for about 10 years supply. A further 17 Precinct Structure Plans that are currently being developed will deliver an additional 100,000 lots of zoned land by December 2018.*[79]

The remaining section of the high speed rail alignment where it would be necessary to deviate from the existing rail corridor is located south of Craigieburn, near Roxburgh Park and at Campbellfield/Hadfield. Land in this section is largely already zoned for industrial and commercial purposes. *Plan Melbourne 2017 – 2050*:

- includes a policy to support new housing in activity centres and other places that offer good access to jobs, services and public transport
- identifies Roxburgh Park as a major activity centre
- states an intention to support employment and investment opportunities in the Northern Industrial Precinct (which lies broadly between the M80 and Craigieburn.

Beyond these areas where the proposed high speed alignment departs from the existing rail corridor, there may also be risks to accommodating a high speed service within sections of the existing rail corridor. Parts of the rail corridor already accommodate a number of existing tracks, leaving (in some locations) comparatively little land to accommodate two high speed tracks.

The Victorian Government has a stated policy of improving outer-suburban public transport.[80] There are also plans to improve regional passenger rail services from Seymour, including diversion of such services via the Upfield line (the corridor on which high speed services would also be running).[81] Given these policies and plans, and the scale of projected population growth in northern Melbourne, the scope for accommodating future high speed tracks in the existing corridor boundaries could be more limited than was thought possible at the time of the Phase 2 study.

Plan Melbourne 2017 – 2050 also envisages investment opportunities on the existing and planned transport network (p.39) including development around and over stations. The Victorian Government's plans for development in the north of Melbourne also envisage additional stations for suburban services.

Assumptions under the 'do not protect' scenarios

Table 29 through to **Table 33** provide details of the assumed construction types and by corridor segment under the 'do not protect now and tunnel' scenario.

Table 29: East Coast High Speed Rail – Brisbane to Sydney (QLD component) - Do not protect and tunnel in future scenario - Segment summary

Segment	Type of Length	Length (km)
Brisbane – Ballina (QLD)	Dive	1.0
	At grade	29.8
Brisbane Peri-Urban	Dive	6.0
	Tunnel	19.0
	At grade	21.8
Brisbane Urban	Dive	1.0
	Tunnel	8.1
	At Grade	15.2
Gold Coast Peri-urban	Dive	1.0
	Tunnel	9.2
	At grade	26.1
Gold Coast Urban	Dive	2.1
	Tunnel	5.1
	At grade	11.9
Total		157.2

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

Table 30: East Coast High Speed Rail – Brisbane to Sydney (NSW component) - Do not protect and tunnel in future scenario - Segment summary

Segment	Type of Length	Length (km)
Ballina-Coffs Harbour (NSW)	Dive	1.0
	Tunnel	16.2
	At grade	189.7
Coffs Harbour - Newcastle	At grade	318.4
Newcastle - Sydney	Dive	2.0
	Tunnel	8.5
	At grade	62.8
Newcastle Urban/Peri-urban	Dive	6.1
	Tunnel	21.8
	At grade	23.4
Sydney Urban (Bris – Syd)	Dive	1.5
	Tunnel	35.8
	At grade	7.6
Total		694.8

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

Table 31: East Coast High Speed Rail – Melbourne to Sydney (NSW component) – Do not protect and tunnel in future scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra – Melbourne (NSW)	At grade	308.5
Canberra Urban/Peri-urban (NSW)	At grade	52.7
Sydney - Canberra	At grade	106.9
Sydney Peri-urban (south west)	Dive	4.0
	Tunnel	7.3
	At grade	70.0
Sydney Urban	Dive	1.0
	Tunnel	30.9
	At grade	6.4
Total		587.7

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

Table 32: East Coast High Speed Rail – Melbourne to Sydney (ACT component) – Do not protect and tunnel in future scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra Urban/Peri-urban (ACT)	Dive	1.0
	Tunnel	9.3
	At grade	0.8
Total		11.1

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

Table 33: East Coast High Speed Rail – Melbourne to Sydney (VIC component) – Do not protect and tunnel in future scenario - Segment summary

Segment	Type of Length	Length (km)
Canberra – Melbourne (VIC)	At grade	193.3
Melbourne Peri-urban	Dive	1.0
	Tunnel	2.3
	At grade	52.1
Melbourne Urban	Dive	6.0
	Tunnel	26.4
	At grade	15.1
Total		296.3

Source: SGS (2016)

* Sections that are assumed to be in tunnel are excluded from the area of land that would need to be acquired.

List of Tables

List of Figures

Endnotes

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