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MELBOURNE AIRPORT RAIL

Business Case Appendices

September 2022

Australian Government

VICTORIA'S BIG BUILD

VICTORIA State Government

Appendix 1

Sunshine to CBD Alignment Options Analysis

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1
Context and purpose

1. Context and purpose

1.1. Melbourne Airport Rail

1.1.1. Project overview

Melbourne Airport Rail (MAR or the Project) is a major public transport project connecting Melbourne Airport with a rail service for the first time.

The Victorian and Australian Governments have committed $5 billion each to deliver MAR, which will run from the Central Business District (CBD) to Melbourne Airport via Sunshine. The new rail connection will provide a link for tourists and business people to connect to regional Victoria, Melbourne's south-east and the CBD.

1.1.2. History

Over the last six decades, there has been ongoing assessment of alignment options for the airport rail connection. Most recently there have been two major studies conducted.

- In 2002, *the Melbourne Airport Transit Link Study* was conducted which recommended the Albion East route. This resulted in land being reserved between the airport boundary and Albion-Jacana freight corridor for the future rail connection.
- In 2012, *the Melbourne Airport Rail Link Study* assessed three alternative alignments against the base case of Albion East. It confirmed the Albion East route as the preferred alignment, consistent with the 2002 study, and recommended connection with the planned Melbourne Metro project (now referred to as the Metro Tunnel Project (MTP)).

It was necessary to revisit these studies in 2018, in response to substantial growth in rail passenger demand in the outer metropolitan residential growth areas north and west of the airport. The *2018 Melbourne Airport Rail Link Strategic Appraisal* was therefore conducted, which recommended an integrated heavy rail connection as the preferred strategic response and the Sunshine (Albion East) alignment as the preferred route to take forward for further development.

1.2. Purpose of this Appendix

The *2018 Melbourne Airport Strategic Appraisal* noted that city access options (i.e. between Sunshine and the CBD) were to be explored. This Appendix considers the key alignment options available for connecting MAR to the CBD via Sunshine Station (Sunshine to CBD alignment options). It does not re-prosecute the adoption of a heavy rail solution or the Sunshine (Albion East) alignment.

Each Sunshine to CBD alignment option has been assessed against key evaluation criteria developed by Rail Projects Victoria (RPV), which are influenced by transport system objectives in the *Transport Integration Act 2010* (Vic).

This analysis has informed government decision making in relation to the Project and the scope for reference design.

1.3. Network context

There are a range of factors relating to the broader rail network that are relevant for this Sunshine to CBD alignment options analysis, including:

- The western rail network is substantially constrained due to the convergence of regional and suburban services, which limits the potential frequency and speed of services.
- The limited availability of train paths into Southern Cross Station means that delays on one line can create knock-on effects to the punctuality and reliability of services on other lines. Southern Cross Station itself is also approaching full capacity and would require major expansion to manage any substantial increase in the volume of services and passengers.
- There are overcrowding and service reliability issues on existing Geelong / Wyndham Vale and Ballarat / Melton services, which share the Regional Rail Link (RRL) corridor into Southern Cross Station.
- Following the opening of the Metro Tunnel in 2025, Melbourne's western rail network will be connected directly to the Dandenong corridor (Cranbourne / Pakenham lines), with five new underground stations at Parkville, Arden, State Library, Town Hall and Anzac as well as interchanges with Melbourne Central and Flinders Street stations.
- The Victorian Government has also committed to the planning and development of the Western Rail Plan (WRP), a suite of investments designed to improve the frequency and carrying capacity of services to growth areas in Melbourne's west and the travel times of rail services to the regional cities of Geelong and Ballarat. The delivery of MAR will interface heavily with the works required at Sunshine Station under the WRP.

Figure 1: Western rail network context

1.4. Key assumptions

This Appendix does not re-prosecute the adoption of a heavy rail solution or the alignment of MAR via Sunshine (Albion East), which was recommended in the 2002, 2012 and 2018 alignment studies.

The Sunshine to CBD alignment options analysis considers only primary viable options for connecting Melbourne Airport to the CBD via Sunshine. The Department of Transport (DoT) has considered a range of alternative solutions that include a mix of elevated structures and shorter sections of tunnel, but preliminary investigations have proven these to be not appropriate for further examination as they are not technically or operationally feasible.

The works between Albion and Melbourne Airport are assumed to be the same under each option for the purpose of this analysis.

Further detailed technical project options have been considered separately as part of the Business Case and reference design development for the selected Sunshine to CBD alignment option.

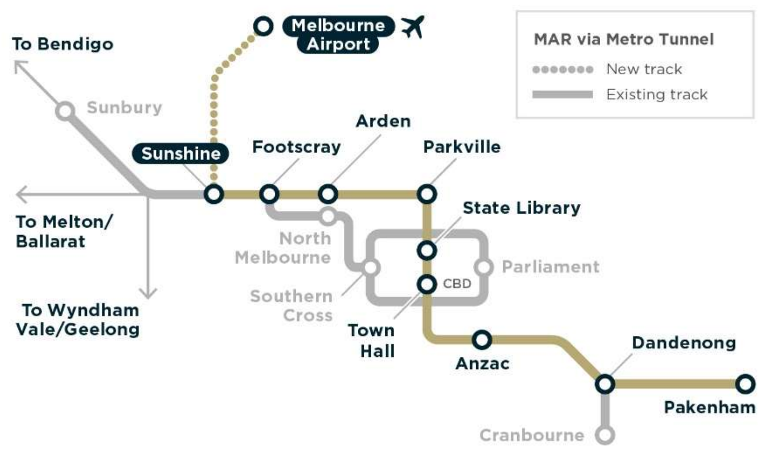
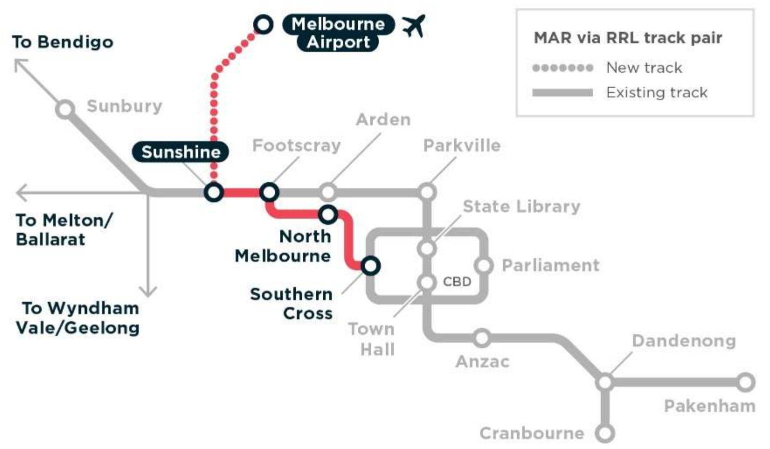
2
Summary of Sunshine to CBD alignment options

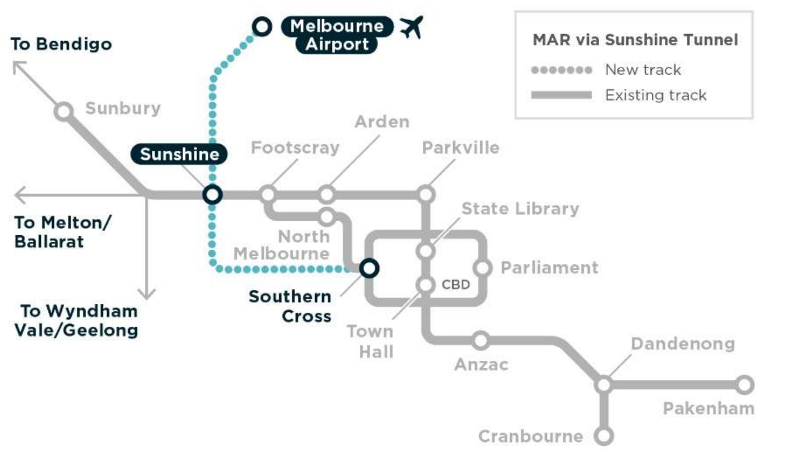
2. Summary of Sunshine to CBD alignment options

2.1. Overview

Three potential Sunshine to CBD alignment options have been developed and considered for the purpose of this options analysis. The alignment and description of each is summarised in Table 1 below.

Table 1: Summary of identified Sunshine to CBD alignment options

Option	Summary description
Option 1: Metro Tunnel	
	The MAR service would connect to the CBD via the Sunbury Line track pair and the Metro Tunnel.
Option 2: Regional Rail Link (RRL)	
	The MAR service would connect to the CBD via the RRL track pair to Southern Cross Station.

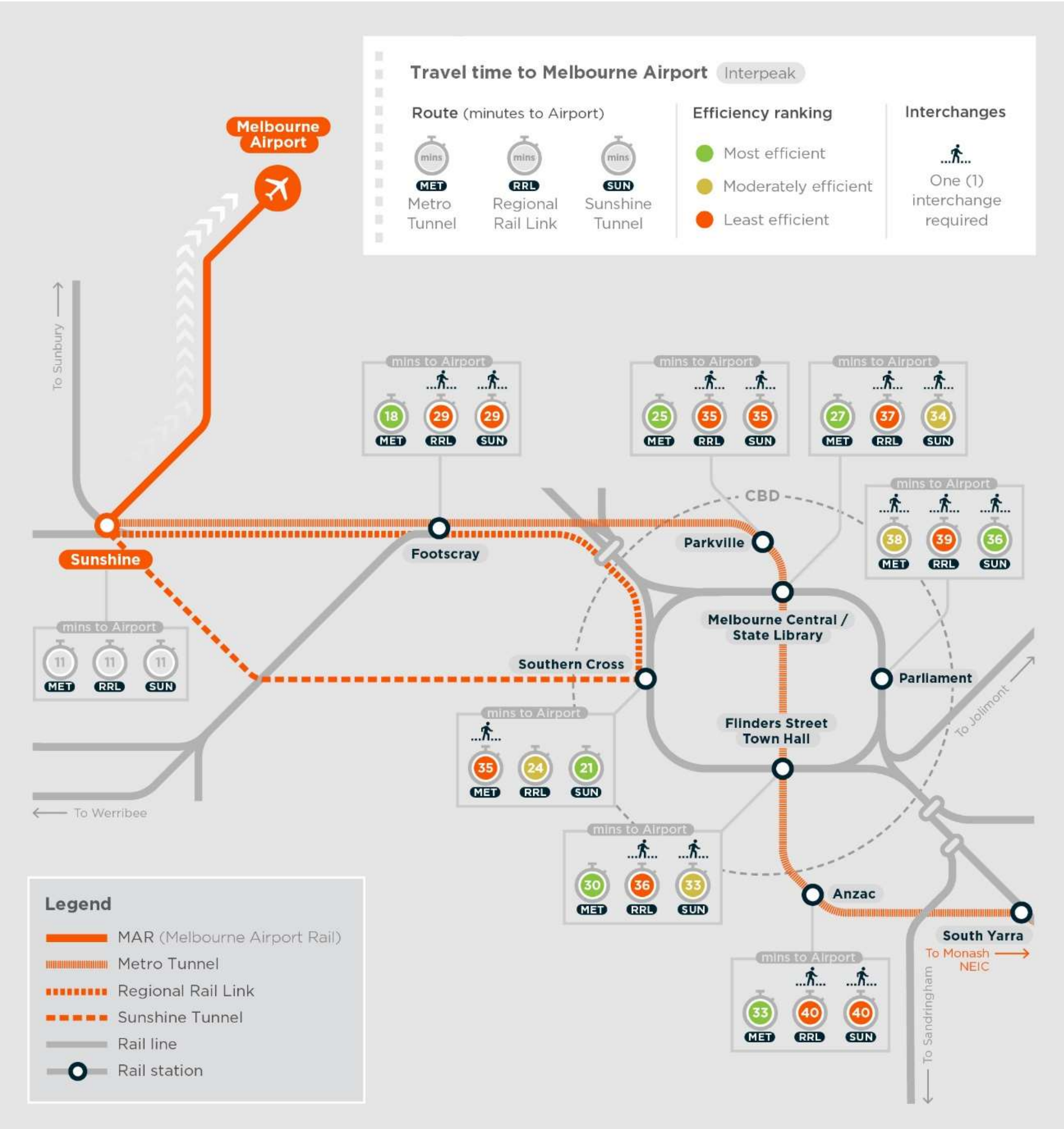
Option	Summary description
Option 3: Sunshine Tunnel	
	The MAR service would connect to the CBD via a new tunnel from the vicinity of Sunshine to Southern Cross Station.

The analysis set out in this Appendix is based on the original concept design for Option 2 and Option 3 completed as at September 2019, with costs reviewed and updated in October 2020. Drawings and figures are indicative and used to support a comparative assessment of the Sunshine to CBD alignment options.

2.2. Key features of each option

This section summarises a range of features of each option to demonstrate key points of differentiation. Figure 2 shows the travel times between Melbourne Airport and a number of key inner-city locations under each option in the interpeak[1]. For journey times to other stations on the network, refer section 2.4. Table 2 identifies other key services features, while Table 3 provides a summary of key delivery and scope features.

Figure 2: Comparison of travel times to Melbourne Airport from key inner-city locations (interpeak)



[1] Based on the proposed service plan at the time of this Business Case.

Table 2: Comparison of key service features

Service features	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
MAR services enabled	• 6 trains per hour (tph) through service	• 3tph shuttle to Sunshine, 3tph through service to Southern Cross Station (peak)[2] • 6tph through service (non-peak)	• 6tph through service[3]
Direct link to stations	• Sunshine and Footscray • Metro Tunnel inner-city stations (Arden, Parkville, State Library, Town Hall and Anzac) • All stations between Caulfield and Dandenong • All stations to Pakenham and Clyde	• Sunshine • Southern Cross Station	• Sunshine • Southern Cross Station
Demand	• Patronage is broadly comparable to the other options • Direct services save journey time for passengers wishing to travel to the central CBD and not alighting at Southern Cross Station	• Patronage is broadly comparable to the other options • Patronage negatively impacted by need to transfer at Sunshine during peak periods	• Patronage is broadly comparable to the other options • Fastest journey time to Southern Cross Station offset by passengers needing to transfer at Southern Cross Station (unless a passenger alights at Southern Cross Station)

Table 3: Comparison of key delivery / scope features

Scope features	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Major civil works (between Albion and the CBD)	• Track work between Albion and Sunshine stations to connect MAR track to Metro Tunnel / Sunbury track pair	• Track work between Albion and Sunshine to connect MAR track pair to RRL track pair • Electrification of RRL track pair and associated works between Sunshine and Southern Cross Station	• Track work between Albion and Sunshine to connect MAR track pair to new platforms • 8.2km of new tunnel to Southern Cross Station from near Tottenham plus significant portal works
Sunshine works	• Modifications at Sunshine to connect MAR into the existing Metro Tunnel / Sunbury line platforms	• Rebuilt Sunshine Station including new platforms	• Rebuilt Sunshine Station including new platforms

[2] To enable MAR to operate in peak periods on the existing RRL tracks without negatively impacting existing service levels, RRL capacity would need to increase from 18 to 21tph.
[3] This option provides capacity for up to 18tph, meaning there would be 12 spare train paths per hour. However, to use this spare capacity, significant additional investment would be required which is not included in the cost estimate for this option.

Scope features	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Extent of brownfield works	• Approximately 3km of brownfield construction on the Sunbury line (between Albion and Sunshine)	• Approximately 3km of brownfield construction on the Sunbury line (between Albion and Sunshine) • Approximately 8km of brownfield work between Sunshine and Southern Cross Station for electrification and signalling	• Approximately 6km of brownfield construction on the Sunbury line (between Albion and Tottenham) • Major brownfield works to the stabling, maintenance and platforms at Southern Cross Station
Land take	• Some land take at Sunshine (less than other options)	• Significant land take required at Albion and Sunshine • Minor land take at South Kensington	• Significant land take required at Albion and Sunshine • Land take at Southern Cross Station and intermediate ventilation shaft locations • Strata land take for full Sunshine Tunnel alignment
Estimated capital cost[4]	• Most cost effective option	• Requires 1.5x the costs of Option 1	• Requires 2.5x[5] the costs of Option 1

[4] The costs presented for Option 2 and Option 3 are based on the original concept design as at September 2019, with costs reviewed and updated in October 2020. These costs should therefore be treated as indicative only for the purposes of this assessment.
[5] Sunshine Tunnel costs do not include all enabling works to fully utilise the capacity of the Sunshine Tunnel option.

2.3. Service specifications

The assumed service specification of each option is summarised in the tables below[6]. Note these assumed service specifications are for the purpose of comparing the options only. All changes to the Base Case under each option are highlighted orange.

2.3.1. Base Case

Table 4: Assumed service specification for Base Case

	Peak Hour	Peak 2-hour	Interpeak	Offpeak
MTP				
West Corridor	**18**	**36**	**12**	**12**
Sunbury	6	12	3	3
Watergardens	6	12	3	3
Sunshine	3	6	3	3
West Footscray	3	6	3	3
Airport	0	0	0	0
East Corridor	**18**	**36**	**12**	**12**
Pakenham	9	18	3	3
Clyde	9	18	3	3
Westall	0	0	6	6
RRL				
Airport	0	0	0	0
Airport	0	0	0	0
Airport (shuttle)	0	0	0	0
Ballarat Corridor	**6**	**12**	**3**	**2.25**
Melton	1.5	3	1.5	1.5
Bacchus Marsh	1.5	3	0	0
Wendouree	3	6	1.5	0.75
Bendigo Corridor	**3**	**6**	**1.5**	**1.5**
Huntly	0.75	1.5	0.75	0.75
Kyneton	0.75	2.25	0	0
Bendigo	0.75	0.75	0	0
Eaglehawk	0.75	1.5	0.75	0.75
Geelong Corridor	**9**	**18**	**6**	**1.5**
Waurn Ponds	6	12	3	1.5
Wyndham Vale	3	6	3	0
Sunshine Tunnel				
Airport	0	0	0	0

[6] Note that the rolling stock for MAR services under each capital option has been modelled as HCMT-7s at project close-out and HCMT-10s from 2041 onwards.

2.3.2. Option 1: Metro Tunnel

Table 5: Assumed service specification for MAR via Metro Tunnel

	Peak Hour	Peak 2-hour	Interpeak	Offpeak
MTP				
West Corridor	**18**	**36**	**12**	**12**
Sunbury	6	12	3	3
Watergardens	6	12	3	3
Sunshine	0	0	0	0
West Footscray	0	0	0	0
Airport	6	12	6	6
East Corridor	**18**	**36**	**12**	**12**
Pakenham	9	18	3	3
Clyde	9	18	3	3
Westall	0	0	6	6
RRL				
Airport	0	0	0	0
Airport	0	0	0	0
Airport (shuttle)	0	0	0	0
Ballarat Corridor	**6**	**12**	**3**	**2.25**
Melton	1.5	3	1.5	1.5
Bacchus Marsh	1.5	3	0	0
Wendouree	3	6	1.5	0.75
Bendigo Corridor	**3**	**6**	**1.5**	**1.5**
Huntly	0.75	1.5	0.75	0.75
Kyneton	0.75	2.25	0	0
Bendigo	0.75	0.75	0	0
Eaglehawk	0.75	1.5	0.75	0.75
Geelong Corridor	**9**	**18**	**6**	**1.5**
Waurn Ponds	6	12	3	1.5
Wyndham Vale	3	6	3	0
Sunshine Tunnel				
Airport	0	0	0	0

2.3.3. Option 2: Regional Rail Link

Table 6: Assumed service specification for MAR via RRL

	Peak Hour	Peak 2-hour	Interpeak	Offpeak
MTP				
West Corridor	**18**	**36**	**12**	**12**
Sunbury	6	12	3	3
Watergardens	6	12	3	3
Sunshine	3	6	3	3
West Footscray	3	6	3	3
Airport	0	0	0	0
East Corridor	**18**	**36**	**12**	**12**
Pakenham	9	18	3	3
Clyde	9	18	3	3
Westall	0	0	6	6
RRL				
Airport	**6**	**12**	**6**	**6**
Airport	3	6	6	6
Airport (shuttle)	3	6	0	0
Ballarat Corridor	**6**	**12**	**3**	**2.25**
Melton	1.5	3	1.5	1.5
Bacchus Marsh	1.5	3	0	0
Wendouree	3	6	1.5	0.75
Bendigo Corridor	**3**	**6**	**1.5**	**1.5**
Huntly	0.75	1.5	0.75	0.75
Kyneton	0.75	2.25	0	0
Bendigo	0.75	0.75	0	0
Eaglehawk	0.75	1.5	0.75	0.75
Geelong Corridor	**9**	**18**	**6**	**1.5**
Waurn Ponds	6	12	3	1.5
Wyndham Vale	3	6	3	0
Sunshine Tunnel				
Airport	0	0	0	0

2.3.4. Option 3: Sunshine Tunnel

Table 7: Assumed service specification for MAR via Sunshine Tunnel

	Peak Hour	Peak 2-hour	Interpeak	Offpeak
MTP				
West Corridor	**18**	**36**	**12**	**12**
Sunbury	6	12	3	3
Watergardens	6	12	3	3
Sunshine	3	6	3	3
West Footscray	3	6	3	3
Airport	0	0	0	0
East Corridor	**18**	**36**	**12**	**12**
Pakenham	9	18	3	3
Clyde	9	18	3	3
Westall	0	0	6	6
RRL				
Airport	0	0	0	0
Airport	0	0	0	0
Airport (shuttle)	0	0	0	0
Ballarat Corridor	**6**	**12**	**3**	**2.25**
Melton	1.5	3	1.5	1.5
Bacchus Marsh	1.5	3	0	0
Wendouree	3	6	1.5	0.75
Bendigo Corridor	**3**	**6**	**1.5**	**1.5**
Huntly	0.75	1.5	0.75	0.75
Kyneton	0.75	2.25	0	0
Bendigo	0.75	0.75	0	0
Eaglehawk	0.75	1.5	0.75	0.75
Geelong Corridor	**9**	**18**	**6**	**1.5**
Waurn Ponds	6	12	3	1.5
Wyndham Vale	3	6	3	0
Sunshine Tunnel				
Airport	6	12	6	6

2.4. Journey time to / from Melbourne Airport

Analysis has been undertaken to determine the estimated journey time and number of interchanges to key stations on the metropolitan and regional networks during the non-peak when majority of MAR services will operate, therefore reflecting the estimated journey time for majority of MAR passengers. The analysis is based on the following assumptions:

- Communication based train control (CBTC) signalling will be extended through Sunshine to Melbourne Airport.
- Most services should achieve these journey times. However, some different stopping patterns might need to be included in the timetable at certain times to balance passenger loadings or protect freight paths which may affect the travel times.
- Operational service plans and journey times will be determined closer to the opening of MAR.

The journey time for each option has been assessed and colour coded for its efficiency relative to the other two options, based on the ranking outlined in Table 8.

Table 8: Journey time efficiency ranking

Efficiency ranking	
Most efficient option	(green)
Moderately efficient option	(yellow)
Least efficient option	(orange)

Table 9 summarises the estimated travel time to key stations under each of the three options during the interpeak period. For all journeys involving an interchange, the travel time estimates include relevant interchange and wait times at each station.

Table 9: Travel time comparisons (interpeak outbound to Melbourne Airport)[7]

Option	Metro Tunnel		RRL		Sunshine Tunnel	
Station	time (minutes)	no. of interchanges	time (minutes)	no. of interchanges	time (minutes)	no. of interchanges
Sunshine	11	0	11	0	11	0
Footscray	18	0	29	1	29	1
Arden	23	0	33	1	33	1
North Melbourne	32	1	36	1	33	1
Southern Cross Station	35	1	24	0	21	0
Parkville	25	0	35	1	35	1
State Library, Melbourne Central	27	0	37	1	34	1
Federation Square, Flinders St, Town Hall	30	0	36	1	33	1

[7] Rail Projects Victoria, travel time analysis, (2020).

Option	Metro Tunnel		RRL		Sunshine Tunnel	
Station	time (minutes)	no. of interchanges	time (minutes)	no. of interchanges	time (minutes)	no. of interchanges
Parliament	**38**	**1**	**39**	**1**	**36**	**1**
St Kilda Rd, Shrine, ANZAC	**33**	**0**	**40**	**1**	**40**	**1**
Richmond	**43**	**1**	**43**	**1**	**40**	**1**
South Yarra	**46**	**1**	**46**	**1**	**43**	**1**
Caulfield	**43**	**0**	**53**	**1**	**53**	**1**
Clifton Hill	**48**	**1**	**48**	**1**	**45**	**1**
Average[8]	**33.9**	**0.5**	**38.4**	**0.9**	**36.5**	**0.9**

[8] Average excludes Sunshine Station as it is equivalent across all three options.

3 Methodology and approach

3. Methodology and approach

In addition to considering the key features of each Sunshine to CBD alignment option (as outlined in section 2.2, section 2.3 and section 2.4), a detailed comparative analysis of the options has been conducted against a set of evaluation criteria.

The evaluation criteria have been developed by RPV and are influenced by transport system objectives in the *Transport Integration Act 2010* (Vic). The Sunshine to CBD alignment options have been assessed against each individual criterion and given scores based on their performance against that criterion. The option that performs the highest is recommended, with the overall preferred option determined based on the option that performs highest against the seven evaluation criteria, collectively.

Table 10: Evaluation criteria

Evaluation criteria	Key considerations
1. Ability to improve customer experience	• Frequency • Impact on MAR patronage • Interchanges • Journey time • Whether the service is a dedicated or integrated fleet • Connectivity to key locations (e.g. CBD and National Employment and Innovation Clusters (NEICs)) through integration with existing/future transport network
2. Ability to improve transport system outcomes	• Impact on transport network patronage • Impact on capacity, resilience and reliability of regional and metropolitan rail services • Potential to accommodate future patronage growth and network changes • Interoperability
3. Environmental and heritage impacts	• Environmental impacts • Heritage impacts
4. Property and community impacts	• Social and community impacts • Extent of rail, road and other disruptions (including property acquisition)
5. Land take	• Land take impacts
6. Schedule and constructability	• Deliverability • Extent of complexity and risk • Impact on program
7. Cost implications	• Overall capital costs • Operating and maintenance costs

In assessing the options, regard has been given to the vision and objectives of the *Transport Integration Act 2010* (Vic), MAR's project objectives and requirements, relevant technical reports, stakeholder views and relevant policies and legislative requirements.

Demand modelling has been undertaken using the Victorian Government's Victorian Integrated Transport Model (VITM) to support the evaluation of customer experience and transport system outcomes. The modelling compared each of the Sunshine to CBD alignment options, where the Melbourne City Express SkyBus (SkyBus) service (from Southern Cross Station) ceases to operate during MAR operating hours, against a Base Case, where the SkyBus service continues to operate as the primary public transport service between the CBD and Melbourne Airport. All non-CBD SkyBus services operate in the Base Case and Project Case for each alignment option. Future years modelled were 2026, 2031, 2036, 2041, 2051 and 2056.

Each option was scored based on a qualitative assessment summary of pros and cons to reach a final rating based on the details summarised in Table 11. Following this assessment, preliminary economic analysis was undertaken on the three options in order to validate the preferred option. This analysis was undertaken to understand the economic benefits of the three options, relative to a Base Case under which SkyBus continues to operate with no additional public transport options introduced.

Table 11: Ratings

Ratings					
Superior benefit	✓✓✓	**Minimal benefit / disbenefit**	-	**Moderate disbenefit**	×
Significant benefit	✓✓			**Significant disbenefit**	××
Moderate benefit	✓			**Superior disbenefit**	×××

4
Summary of options analysis

4. Summary of options analysis

The tables below summarise relative performance of the Sunshine to CBD alignment options in relation to each other. Relatively positive attributes are denoted by (+ve) and relatively negative attributes are denoted by (-ve) and neutral attributes are denoted by (neutral).

4.1. Criterion 1: Ability to improve customer journey experience

Table 12: Relative performance of the Sunshine to CBD alignment options for Criterion 1

Sub-criteria	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Frequency	• (+ve) Enables 10 minute service frequency through provision of 6tph	• (+ve) Enables 10 minute service frequency through interpeak (6tph) • (-ve) Enables 10 minute service frequency between Melbourne Airport and Sunshine, but in peak periods only half of these services would be able to continue through to Southern Cross • (-ve) Inconsistent service pattern during peak periods	• (+ve) Enables 10 minute service frequency through provision of up to 18tph • (-ve) Provides spare capacity for 12tph but these train paths would likely be used for non-MAR services and require significant additional investment
Demand	• (neutral) Patronage is broadly comparable to the other options	• (neutral) Patronage is broadly comparable to the other options	• (neutral) Patronage is broadly comparable to the other options
Interchanges	• (+ve) When considered on a whole of rail network level, requires fewer interchanges than the other two options, terminating at Southern Cross Station (unless a passenger’s destination is Southern Cross Station) • (+ve) Services will stop at Sunshine Station, providing interchange to both the metropolitan and regional rail networks • (+ve) Enables interchange onto MAR services between Sunshine and Melbourne CBD, including at Footscray	• (+ve) Services will stop at Sunshine Station, providing interchange to both the metropolitan and regional rail networks • (-ve) Requires passengers to interchange unless the destination is Sunshine or Southern Cross Station	• (+ve) Services will stop at Sunshine Station, providing interchange to both the metropolitan and regional rail networks • (-ve) Requires passengers to interchange unless the destination is Sunshine or Southern Cross Station
Journey time	• (+ve) Shortest journey time for 8 out of the 13 inner area locations • (+ve) Shortest journey time to the central CBD (Parkville, Melbourne	• (-ve) Shortest journey time for none of the 13 inner area locations	• (+ve) Shortest journey time to Southern Cross Station

Sub-criteria	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
	Central / State Library and Flinders Street / Town Hall)		• (+ve) Shortest journey time for 5 out of the 13 inner area locations
Dedicated MAR fleet / integrated fleet	• (+ve) Provides a direct service to and from Melbourne Airport for passengers on the Dandenong corridor (Clyde / Pakenham lines) – Melbourne's busiest passenger rail corridor • (+ve) Being an integrated fleet provides benefits of not requiring a new class of rolling stock, it is will use HCMTs already being procured by the State • (-ve) Assumes MAR rolling stock will service both airport and metropolitan passengers which may contribute to come crowding in the peak, however, for trips originating from Melbourne Airport or CBD locations, MAR passengers will board relatively empty trains	• (-ve) Assumes MAR rolling stock will service both airport and metropolitan passengers which may contribute to some crowding in the peak • (-ve) Not a dedicated through service in the peak	• (+ve) Enables the use of dedicated MAR rolling stock fleet which could be customised for airport passengers • (-ve) Requires significant investment for dedicated MAR rolling stock not included in the cost of this option, to realise the benefits associated with a dedicated fleet • (-ve) A dedicated fleet results in unutilised patronage capacity where capacity outweighs demand for MAR services
Connectivity to CBD and NEICS	• (+ve) Provides direct connection to the central CBD and NEICs at Sunshine, Monash / Clayton, Dandenong and Parkville • (-ve) No direct airport connection to / from Southern Cross Station, however, provides a direct connection to five other Melbourne CBD locations (Parkville, Melbourne Central / State Library and Flinders Street / Town Hall stations)	• (+ve) Direct airport connection to / from Southern Cross Station and Sunshine NEIC • (-ve) Limited choice as enables interchange at Sunshine or direct access to Southern Cross Station only and no other inner-city locations • (-ve) No material accessibility improvements to Melbourne's south-east	• (+ve) Direct airport connection to / from Southern Cross Station and Sunshine NEIC • (-ve) Limited choice as enables interchange at Sunshine or direct access to Southern Cross Station only and no other inner-city locations • (-ve) No material accessibility improvements to Melbourne's south-east
	✓✓✓	-	✓✓

Conclusion: Option 1: Metro Tunnel performs best in relation to this criterion as it provides greater travel choice and accessibility than the other options that connect only to Southern Cross Station. This is due to the new MAR service being integrated within the existing rail network, including via the Metro Tunnel's five new underground stations and their integration with the existing transport network, in particular Melbourne's south-east. The Metro Tunnel option provides a direct service to and from Melbourne Airport for passengers on Melbourne's busiest passenger rail corridor, the Dandenong corridor (Clyde / Pakenham lines). When considered on a whole of rail network level, this option has the lowest number of interchanges for the majority of passengers, shortest journey time to the central Melbourne CBD (via Parkville, Melbourne Central / State Library and Flinders Street / Town Hall stations) and most direct access to NEICs[9].

Although the Sunshine Tunnel has the potential to deliver more capacity than the Metro Tunnel option (up to spare capacity of 12tph), the additional train paths would likely be used for non-MAR services and require significant investment in order to be realised. This option is therefore unlikely to materially improve MAR passenger outcomes and the dedicated MAR rolling stock results in unutilised patronage capacity where capacity outweighs demand for MAR services. However, depending on the service plan the Sunshine Tunnel option may also service some metropolitan passengers.

The RRL option scores lower than the Metro Tunnel and Sunshine Tunnel options as it provides less capacity through to Southern Cross Station during peak periods. RRL provides limited direct access to stations other than Southern Cross and has an inconsistent service pattern during peak periods.

4.2. Criterion 2: Ability to improve transport system outcomes

Table 13: Relative performance of the Sunshine to CBD alignment options for Criterion 2

Sub-criteria	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Demand	• (neutral) Patronage is broadly comparable to the other options	• (neutral) Patronage is broadly comparable to the other options	• (neutral) Patronage is broadly comparable to the other options
Reliability impact on other services	• (-ve) Journey time reliability for services operating in the MTP may potentially be impacted due to the extension of existing MTP services to facilitate the airport service	• (-ve) Journey time reliability for MAR, Geelong, Ballarat, Bendigo and Wyndham Vale / Melton services are likely to be affected due to high utilisation of RRL tracks between Sunshine and CBD	• (+ve) Potential to provide some reduction in travel times for metropolitan and regional services using the tunnel (noting this is not expected to be significant and can only be achieved through significant additional investment not included in the cost of this option)
Capacity uplift for other passengers	• (+ve) Provides a holistic network benefit via more services between Sunshine and West Footscray (in all periods) • (+ve) Provides a holistic network benefit via more services on Dandenong corridor between West Footscray and Westall (in non-peak periods)	• (+ve) Provides additional capacity between Southern Cross and Sunshine which may be used to provide a capacity uplift for other passengers	• (+ve) Provides up to 18tph in new tunnel. Spare paths could be used for Geelong or other services • (-ve) The significant residual capacity can only be achieved through significant additional investment not included in the cost of this option which is unlikely to be fully utilised, at least in the medium and possibly the long term
Impact on other services (current and future)	• (+ve) Does not impact operation of existing regional and metropolitan services	• (+ve) Does not use spare capacity that will be available after the completion of the Metro	• (+ve) Does not use spare capacity that will be available after the completion of the Metro

[9] Noting journey times are dependent on the station location used to access MAR and vary across metropolitan rail corridors where an interchange is required.

Sub-criteria	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
	between Sunshine and CBD • (+ve) Retains spare capacity in the Metro Tunnel for improved services to the west after completion of MAR • (-ve) Uses some of the spare capacity that will be available after the completion of the Metro Tunnel on the Sunbury / Dandenong trunk	Tunnel on the Sunbury / Dandenong trunk • (-ve) Uses additional capacity on the RRL (to increase from 18 to 21tph) to enable MAR to operate in peak periods without negatively impacting existing service levels • (-ve) Likely limit of three airport trains to Southern Cross Station per hour during commuter peak period until future network investments	Tunnel on the Sunbury / Dandenong trunk • (-ve) Utilisation of residual train paths by non-MAR services will require significant additional investment at substantial cost on these lines and the western network more broadly (e.g. electrifications for Geelong / Wyndham Vale, new rolling stock and stabling, and significant Southern Cross Station works)
Interoperability	• (+ve) Integration with the existing rail network, including use of existing rolling stock (HCMTs) provides interoperability benefits for MAR services • (-ve) Potentially less operational flexibility as airport services will operate on a busy commuter corridor for significant proportion of journey	• (-ve) Any service above 21tph may likely result in operational flexibility issues and frequencies above 22tph will likely require signalling upgrades • (-ve) Platform use and passenger flows at Southern Cross Station to be resolved	• (+ve) Higher operational flexibility • (-ve) Unresolved issues around new tunnel integration with Southern Cross Station including platform use and passenger flows
	✓✓✓	-	✓✓

Conclusion: Option 1: Metro Tunnel performs the best in relation to transport system outcomes as it provides an integrated solution with the existing rail network and increases capacity between Sunshine and West Footscray and on the Dandenong corridor. The integrated nature of this option also retains spare capacity in the Metro Tunnel for additional services to the west after completion of MAR, provides interoperability benefits for operation of MAR services, including use of existing rolling stock[10] (HCMTs) and avoids interoperability issues at Southern Cross Station.

The RRL option creates a number of challenges at Southern Cross Station and operationally on the already congested RRL corridor. It is therefore expected to adversely affect journey time reliability for several metropolitan and regional services.

The Sunshine Tunnel option also has interoperability issues at Southern Cross Station and involves a significant investment which does not, in itself, address key network constraints (refer section 1.3). Although it provides opportunity for significant service capacity uplift for non-MAR services, this cannot be realised without further significant investment.

[10] Noting 5 additional HCMTs would be required.

4.3. Criterion 3: Environmental and heritage impacts

Table 14: Relative performance of the Sunshine to CBD alignment options for Criterion 3

Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
• (+ve) Considerably smaller construction footprint than options as it leverages an existing asset on the network. The other options require significant works between Sunshine and Southern Cross Station, reducing potential construction impacts such as noise, dust and vibration often experienced by communities during delivery • (+ve) Less energy intensive option during construction and operations compared to tunnel option • (-ve) Does not provide an opportunity to explore other, less energy intensive traction power systems (e.g. 25kV AC) due to requirement for compatibility Metro Tunnel's 1500V DC system	• (+ve) Less energy intensive option during construction and operations compared to tunnel option • (+ve) Potential opportunity to explore other, less energy intensive traction power systems (e.g. 25kV AC) • (-ve) Considerably larger construction footprint than Metro Tunnel option, increasing potential environmental and cultural heritage impacts and construction impacts such as noise, dust and vibration often experienced by communities during delivery	• (+ve) Provides opportunity to explore other, less energy intensive traction power systems (e.g. 25kV AC) • (-ve) Greatest volume of removal of waste from excavation works • (-ve) Area is subject to complex land and groundwater contamination issues (including potential PFAS contamination) • (-ve) Most energy intensive option during construction (due to use of tunnelling equipment) and operations (due to tunnel ventilation and other system requirements)
✓✓	✓	××

Conclusion: Option 1: Metro Tunnel is assessed as performing best in relation to this criterion as it is likely to have lower environmental and heritage impacts than the other two options. It has a considerably smaller construction footprint by utilising existing transport infrastructure including the Metro Tunnel and is less energy intensive overall, whereas the other options require significant works at Sunshine and Southern Cross Stations.

The Sunshine Tunnel option has the most significant environmental impacts both during construction and operations due to the footprint, nature and extent of the works.

The RRL option also has significant impacts, specifically in relation to construction footprint but these are less pronounced than the Sunshine Tunnel option as it avoids tunnelling works.

4.4. Criterion 4: Property and community impacts

Table 15: Relative performance of the Sunshine to CBD alignment options for Criterion 4

Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
• (+ve) Minimises disruption during construction by avoiding the need for significant additional development between Sunshine and CBD • (+ve) Provides direct connectivity between Melbourne Airport and key employment clusters around Parkville, the CBD and Anzac stations • (+ve) Option does not preclude redevelopment of Sunshine Station which would provide opportunities for urban renewal and enhanced public realm • (-ve) The acquisition of private land at Sunshine would result in impacts to local businesses operating in the area during construction albeit to a lower extent than the other options	• (+ve) Redevelopment of Sunshine Station would provide opportunities for urban renewal and enhanced public realm • (neutral) Redevelopment of Albion Station would deliver urban renewal benefits • (-ve) Significant disruption during construction, including at Southern Cross Station albeit to a lesser extent than the Sunshine Tunnel • (-ve) The acquisition of private land at Sunshine would result in impacts to local businesses operating in the area during construction	• (+ve) Redevelopment of Sunshine Station would provide opportunities for urban renewal and enhanced public realm • (neutral) Redevelopment of Albion station would deliver urban renewal benefits • (-ve) Significant disruption during construction, including at Southern Cross Station • (-ve) Works required at Southern Cross Station constrain existing land for the future development • (-ve) The acquisition of private land at Sunshine would result in impacts to local businesses operating in the area during construction
✓✓	-	-

Conclusion: Option 1: Metro Tunnel performs the best in relation to this criterion as its property and community impacts are comparatively better than the other options. It is the least disruptive, requires the least property acquisition and provides greater opportunity for inner-city urban renewal due to its connection to various inner-city stations.

Although the RRL and Sunshine Tunnel options may enhance urban renewal and public realm through the redevelopment of Sunshine Station, they will also cause significant disruption during construction.

4.5. Criterion 5: Land take

Table 16: Relative performance of the Sunshine to CBD alignment options for Criterion 5

Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
• (+ve) Lower land take than the tunnel option • (+ve) Some land take at Sunshine. Land take will be lower than other options	• (+ve) Lower land take than the tunnel option • (-ve) Significant land take at Sunshine and Albion • (-ve) Some land take at South Kensington	• (-ve) Highest land take of all three options, including strata title for the full tunnel alignment. • (-ve) Significant land take at Sunshine and Albion • (-ve) Land take at Southern Cross Station and intermediate ventilation shaft locations
✓	-	✗

Conclusion: Option 1: Metro Tunnel performs the best in relation to this criterion as it requires the lowest land take.

The RRL and Sunshine Tunnel options have higher land take requirements than the Metro Tunnel option, including at Sunshine and Albion, as well as at South Kensington and Southern Cross Station respectively.

4.6. Criterion 6: Schedule and constructability

Table 17: Relative performance of the Sunshine to CBD alignment options for Criterion 6

Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
• (+ve) Opportunity for early MAR completion • (+ve) Shortest delivery timeframe • (+ve) Utilises committed infrastructure and rolling stock being delivered by the MTP • (+ve) Civil works required are less complex than tunnelling in the Sunshine Tunnel option • (-ve) Dependent on the MTP being completed and in operation and interfaces with MTP work packages (Tunnels and Stations, Rail Infrastructure Alliance (RIA), Rail Systems Alliance (RSA)) and the HCMT Project	• (+ve) Civil works required are less complex than tunnelling in the Sunshine Tunnel option • (+ve) Potential opportunity for early MAR completion • (-ve) Constraints due to limited width of existing rail corridor • (-ve) Requires relocation / redevelopment of South Kensington station, grade separation of Spion Kop junction and potential track reconfiguration at Southern Cross Station • (-ve) Interfaces with MTP work packages including RIA and RSA • (-ve) Numerous traction power challenges due to existing DC electrification systems and structures, extensive routing of utilities and generally spatially constrained corridor • (-ve) Requires investment in Southern Cross Station to cope with additional services and patronage	• (+ve) Lower impact on surface infrastructure than RRL option • (-ve) Involves 8.2km of deep tunnelling and portal structures, requiring complex equipment and significant excavation • (-ve) Technical and commercial issues associated with increasing patronage and delivering major capital works at Southern Cross Station interface • (-ve) Interfaces with MTP work packages including RIA and RSA • (-ve) Requires significant investment in Southern Cross Station to cope with additional services and patronage • (-ve) Longest delivery timeframe
✓✓	✓	××

Conclusion: Option 1: Metro Tunnel has been assessed as performing best in relation to this criterion due to its integration with the existing rail network and use of infrastructure and rolling stock already being delivered as part of the MTP. Further, the Metro Tunnel option does not require significant additional works between Sunshine and the CBD to deliver MAR.

The RRL and Sunshine Tunnel options involve higher levels of disruption due to complex station reconfiguration works, grade separations, electrification works and / or deep tunnelling. The Sunshine Tunnel option also has a much longer delivery and interface issues at Southern Cross Station.

4.7. Criterion 7: Cost Implications[11]

Table 18: Relative performance of the Sunshine to CBD alignment options for Criterion 7

Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel[12]
• (+ve) Uses committed infrastructure and rolling stock being delivered as part of Metro Tunnel and HCMT projects, avoids costly works at Southern Cross Station and more extensive operational and maintenance costs • (+ve) Most cost effective option	• (+ve) Uses existing RRL tracks from Sunshine to Southern Cross (although they require electrification) • (-ve) Second most cost effective option, an estimated cost of 1.5x more than the Metro Tunnel option	• (-ve) Requires significant additional investment to use extra service capacity • (-ve) Significant ongoing maintenance requirements due to tunnel operations, tunnel ventilation and other systems, creating significant whole of life costs • (-ve) Most expensive option, an estimated cost of 2.5x more than the Metro Tunnel option
✓✓	✓	×××

Conclusion: Option 1: Metro Tunnel performs best in relation to this criterion because it is the most cost effective option, integrating with the existing rail network and using existing infrastructure and rolling stock already being delivered as part of the MTP (noting 5 additional HCMTs would be required). The RRL and Sunshine Tunnel options are significantly more expensive, estimated to require 1.5x and 2.5x more capital costs, respectively, than the Metro Tunnel option. Further, the Sunshine Tunnel option requires significant whole of life costs due to the dedicated tunnel solution.

4.8. Preliminary economic analysis

Preliminary economic analysis was undertaken to understand the economic benefits of the three Sunshine to CBD alignment options, relative to a Base Case under which the SkyBus (from Southern Cross Station) continues to operate. The preliminary analysis focused solely on conventional economic benefits, including user benefits (public transport users and road users), societal benefits (externality effects) and infrastructure residual value. The analysis incorporated costs for Option 2 and Option 3 developed by RPV for the purpose of the Sunshine to CBD alignment options analysis.[13]

Key findings from the analysis are summarised below.

- All options benefit both public transport users and road users by enhancing connectivity to Melbourne Airport and improving overall travel times.
- Public transport user benefits account for the highest proportion of total discounted conventional benefits, making up between approximately half of benefits across the capital options.
- The primary beneficiary of public transport user benefits are air passengers, comprising more than 95 per cent of these benefits across the capital options.
- Road user benefits are driven by a network-wide reduction in road congestion as airport passengers shift from road to MAR.
- The proportion of road user benefits is higher for the Metro Tunnel option compared to the other options. This is driven by a shift to public transport from road users in the south-east, who previously made cross city road-based airport trips on heavily congested parts of the road network.

[11] The costs presented for Option 2 and Option 3 are based on the original concept design as at September 2019, with costs reviewed and updated in October 2020. These costs should therefore be treated as indicative only for the purposes of this assessment.
[12] Sunshine Tunnel costs do not include all enabling works to fully utilise the capacity of the Sunshine Tunnel option.
[13] Same as footnote 12.

- The Metro Tunnel option has the lowest cost and yields the highest conventional benefits. This results in the highest BCR across the options of 1.1 using a 4 per cent discount rate (refer Table 19 below).
- The Sunshine Tunnel option yields the second highest conventional benefits, but the significantly higher cost results in the lowest BCR of 0.5 using a 4 per cent discount rate.

Table 19: Preliminary economic analysis results (4 per cent discount rate)[14]

Economic performance measures	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Benefit Cost Ratio	**1.1**	**0.6**	**0.5**

[14] The preliminary economic analysis for the Metro Tunnel option as part of the capital options analysis presented in **Error! Reference source not found.** is lower than the detailed economic appraisal for the Metro Tunnel option presented in Chapter 11. This is primarily due to the nature of the preliminary analysis being to assess the relative benefits of different options. The detailed economic appraisal of the preferred option (refer Chapter 11) incorporated a range of refinements to the demand and economic modelling as well as the scheme considered. Additional benefits such as option and non-use value and wider economic benefits were also incorporated.

5
Conclusion

5. Conclusion

Based on the analysis set out in this Appendix, **Option 1: Metro Tunnel is the recommended Sunshine to CBD alignment option**. This option scores the best against all seven evaluation criteria, collectively as summarised in Table 20.

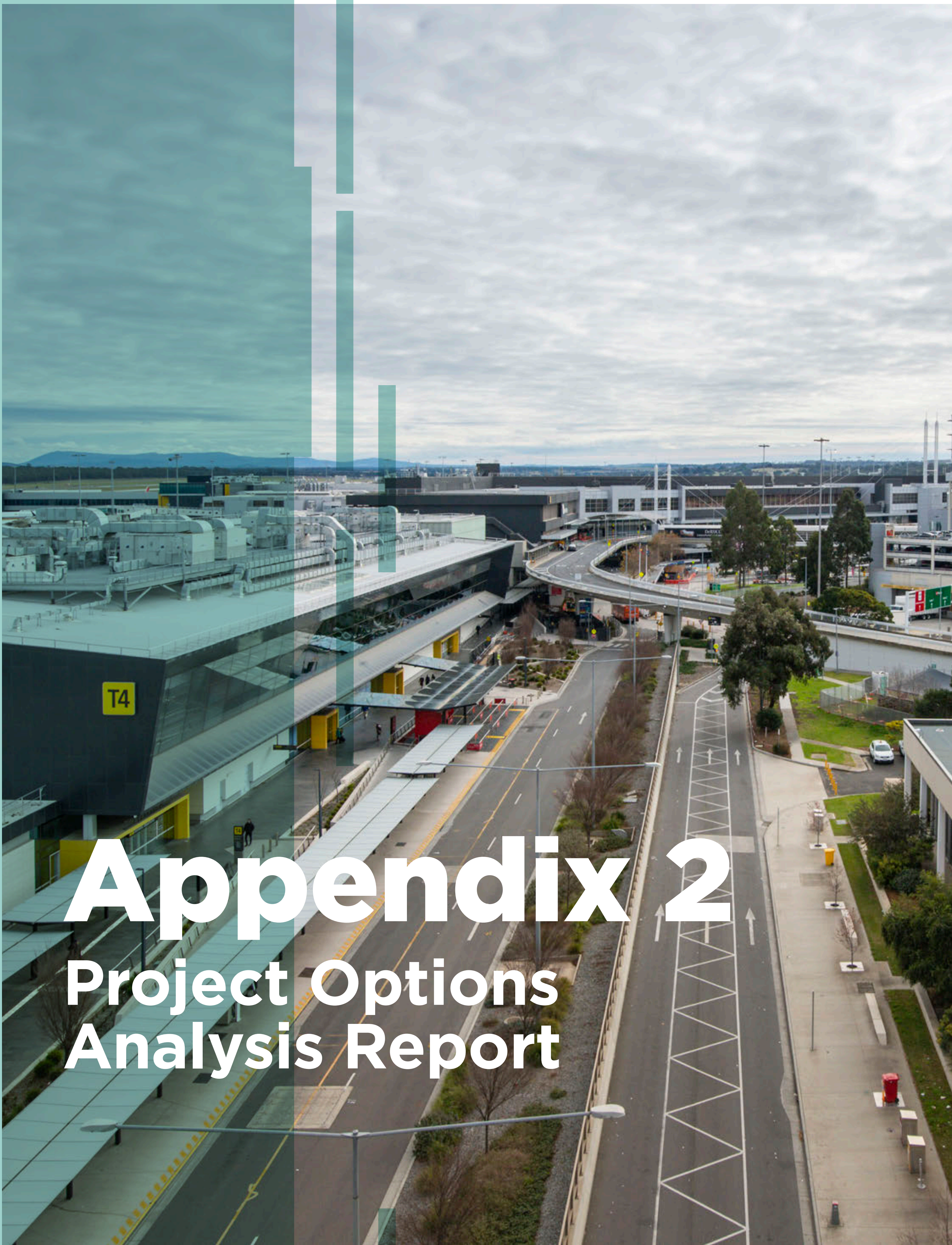
Table 20: Summary of the evaluation criteria analysis

Evaluation criteria	Option 1: Metro Tunnel	Option 2: RRL	Option 3: Sunshine Tunnel
Ability to improve customer journey experience	✓✓✓	-	✓✓
Ability to improve transport system outcomes	✓✓✓	-	✓✓
Environmental and heritage impacts	✓✓	✓	××
Property and community impacts	✓✓	-	-
Land take	✓	-	×
Schedule and constructability	✓✓	✓	××
Cost implications	✓✓	✓	×××
Rank	1	2	3

The key factors differentiating **Option 1: Metro Tunnel** from the other options are that it:

- provides superior travel choice, connectivity and accessibility of the options considered, due to the new MAR service being integrated within the existing rail network, via the Metro Tunnel's five new underground stations that are integrated with the existing transport network – the other two options connect only to Southern Cross Station
- connects directly to 30 stations without needing to change trains, with most other passengers only needing to change once
- supports the need to reduce high levels of road traffic congestion to Melbourne Airport, particularly from Melbourne's south-east due to a significant proportion of trips to and from the airport being cross-city journeys and the disparity between where people live and work adding to congestion on the south-eastern arterial road network, as highlighted in Chapter 2
- has the shortest journey time to the central CBD and most inner-area locations, lowest number of interchanges and most direct access to NEICs at Sunshine, Monash / Clayton, Dandenong and Parkville
- increases capacity between Sunshine and West Footscray, and increases capacity and provides a direct service to and from Melbourne Airport for passengers on Melbourne's busiest passenger rail corridor, the Dandenong corridor
- has the lowest environmental and heritage impacts and requires less land take than the other options
- provides greater opportunity for urban renewal due to its connection to various inner-city stations
- is the most cost effective option by using infrastructure and rolling stock[15] already being delivered as part of the Metro Tunnel Project and does not require significant additional works between Sunshine and the CBD, minimising capital and whole of life costs, disruptions and reducing the delivery timeframe
- has the highest Benefit Cost Ratio of all three options.

[15] Noting 5 additional HCMTs would be required.



Appendix 2

Project Options Analysis Report

Contents

1 Overview

1. Overview

This Appendix provides the detailed assessment tables for each of the key decisions explored in Chapter 6 of the Business Case.

1.1. Approach

Eight separate criteria have been considered as part of the project options analysis process. Although Chapter 6 of the Business Case presents the results under a consolidated list of four criteria, this report provides the detailed analysis against all eight criteria. The alignment between the criteria presented in the Business Case chapter and this report is outlined in Table 1 below.

Table 1: Relationship between evaluation criteria presented in Business Case and this report

Project options evaluation criteria (this appendix)	Project options evaluation criteria (Chapter 6 of Business Case)
1. Achievement of project requirements	**1. Customer experience and transport system outcomes**
2. Ability to improve customer journey experience	
3. Ability to improve transport system outcomes	
4. Environmental and heritage impacts	**2. Environmental, heritage, property and community impacts**
5. Property and community impacts	
6. Land take	
7. Schedule and constructability	**3. Deliverability**
8. Cost implications	**4. Cost implications**

Each option has been given a rating against the evaluation criteria based on the rating system outlined in Table 2 below. Then the options are ranked in order of recommendation, with “1” being the most recommended option.

Table 2: Option rating legend

Rating	Symbol	Rating	Symbol	Rating	Symbol	Rating	Symbol
Superior benefit	✓✓✓	Moderate benefit	✓	Minimal disbenefit	–	Significant disbenefit	××
Significant benefit	✓✓	Minimal benefit	–	Moderate disbenefit	×	Superior disbenefit	×××

2
Study area A: Melbourne Airport

2. Study area A: Melbourne Airport

2.1. Decision A1: Airport station

The detailed assessment for each option described in Chapter 6 for the Airport Station is provided in Table 3 below.

Table 3: Assessment of Decision A1: Airport Station

Evaluation Criteria	Option A1.1 Shallow underground station		Option A1.2 Elevated station	
Achievement of project requirements	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Ability to improve customer journey experience	✓	Provides good visibility and clear lines of sight to the station for arriving passengers	✓	Provides good visibility and clear lines of sight to the terminals for departing passengers
	✓	Shorter horizontal walk times (without travellators) between the terminals and station for arriving passengers	✓	Shorter horizontal walk times (without travellators) between the station and terminals for departing passengers
	✓✓	Provides the opportunity to deliver a world-class design solution that conveys a 'gateway' to Melbourne / Australia, with more flexibility to create gateway moments	✓✓	Provides the opportunity to deliver a world-class design solution that conveys a 'gateway' to Melbourne / Australia, particularly due to enhanced natural light and vistas
	✓	Active ventilation of platform and concourse may occasionally lead to greater passenger comfort than Option A1.2 due to regulated air temperature	×	Natural ventilation of platform and concourse may occasionally lead to lower passenger comfort than Option A1.1
	–	May provide a relatively lower perception of public safety than an elevated station	✓	Elevated stations are perceived by some passengers to provide a greater level of public safety, as there is more visibility and passive surveillance which reinforces better behaviour
	✓		✓	
Ability to improve transport system outcomes	×	Provides fewer options for connecting to a future Suburban Rail Loop station, as the T123 piers impact underground connection locations	✓	Provides more options for connecting to a future Suburban Rail Loop station
	–	No change or impact to taxis, rideshare or buses	–	No change or impact to taxis, rideshare or buses
	✓	Location and alignment consistent with the *Melbourne Airport Master Plan*	✓	Location and alignment consistent with the *Melbourne Airport Master Plan*
	×	Greater ongoing maintenance requirements associated with station ventilation and fire and life safety systems	✓	Reduction in ongoing maintenance requirements associated with station ventilation and fire and life safety systems

Evaluation Criteria	Option A1.1 Shallow underground station		Option A1.2 Elevated station	
	×	Requires portal to be constructed within the long term car park to transition from viaduct to open trench station	✓	Provides generally consistent vertical rail alignment through the Airport precinct
	×		✓	
Environmental and heritage impacts	×	Higher greenhouse emissions and volume of excavated material from construction	✓	Lower embodied emissions from materials, construction and operations
	–	No heritage impacts	–	No heritage impacts
	×		✓	
Property and community impacts	××	Reduction in existing road capacity of the Airport precinct during construction	✓✓	Minimal disruption to existing road capacity of the Airport precinct during construction
	✓	Promotes better visual permeability and connection with the precinct	××	Significant profile and visual presence in the precinct, with trains visible
	××	Greater potential for significant impacts to airport users during construction (e.g. noise and vibrations due to excavating through rock)	✓	Less potential for significant impacts to airport users during construction (e.g. reduced noise and dust through use of pre-cast concrete)
	××		✓	
Land take	××	Temporary land acquisition footprint is generally comparable to Option A1.2 but duration is 21 months longer due to the construction timeframe	✓✓	Temporary land acquisition footprint is generally comparable to Option A1.1 but duration is 21 months shorter due to the construction timeframe
	××		✓✓	
Schedule and constructability	××	Significant construction duration (61 month net build time)	✓✓	Shorter construction duration (40 month net build time)
	××	More complex construction due to rock excavation and greater impact on existing buildings, particularly the Tri-Gen Facility	✓✓	Simpler construction approach due to isolated piles and less impact on existing buildings (e.g. Tri-Gen)
	×	Requires top-down open trench construction, with the majority of concrete to be placed on-site	✓	Increased opportunity for modular and prefabricated construction due to larger structural elements
	×	Estimated to require relocation of 196 utilities and services	✓	Estimated to require relocation of 62 utilities and services
	××		✓✓	
Cost implications	××	Capital cost is approximately two times higher than Option A1.2	✓✓	Capital cost is approximately half of Option A1.1
	–	Operating and maintenance costs and asset renewal costs are comparable to Option A1.2 although slightly more expensive	–	Operating and maintenance costs and asset renewal costs are comparable to Option A1.2 although slightly less expensive
	××		✓✓	

Evaluation Criteria	Option A1.1 Shallow underground station	Option A1.2 Elevated station
Rank	2	1

2.2. Decision A2: Mercer Drive to Sharps Road crossings

The detailed assessment for each option described in Chapter 6 for the vertical alignment of the track between Mercer Drive to Sharps Road crossings is provided in Table 4 below.

Table 4: Assessment of Decision A2: Mercer Drive to Sharps Road crossings

Evaluation Criteria	Option A2.1 Shallow underground		Option A2.2 At-grade		Option A2.3 Elevated viaduct	
Achievement of project requirements	–	No comparable impact or benefit	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Ability to improve customer journey experience	–	No comparable impact or benefit	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Ability to improve transport system outcomes	×	Introduces complications relating to accessibility for maintenance and emergency egress	✓	No introduced complications relating to accessibility for maintenance and emergency egress	×	Introduces complications relating to accessibility for maintenance and emergency egress
	×	Ongoing maintenance requirements (periodic testing of tunnel ventilation and fire and life systems)	✓	No requirement for ventilation and fire and life safety systems	✓	No requirement for ventilation and fire and life safety systems
	✓	No permanent changes to Link Road	×	Requires rail over road grade separation as Link Road	✓✓	No permanent changes to Link Road
	×		✓		✓	
Environmental and heritage impacts	✓✓	Potential for no permanent impacts on surface water flows	××	The surface water flows may require permanent diversions	✓✓	Minimal potential impacts to surface water flows due to the use and placement of piers.

Evaluation Criteria	Option A2.1 Shallow underground		Option A2.2 At-grade		Option A2.3 Elevated viaduct	
	×	Moderate potential impacts to surface including mature trees along Airport Drive and Terminal Drive, and heritage and indigenous sites	××	Significant potential impacts to surface including mature trees along Airport Drive and Terminal Drive, and heritage and indigenous sites	✓✓	Minimal potential impacts to surface including mature trees along Airport Drive and Terminal Drive, heritage and indigenous sites due to the use and placement of piers
	××	High potential embedded greenhouse gas emissions from volume of concrete use	✓	Potential for low embedded greenhouse gas emissions from volume of concrete use	✓	Potential for low embedded greenhouse gas emissions from volume of concrete use for piers and foundations
	××	High volume of excavated material	✓✓	Minimal excavated material	✓	Low volume of excavated material
	××		×		✓✓	
Property and community impacts	✓	Low potential permanent community impacts from noise and visuals due to height	×	Moderate potential for permanent community impacts from noise and visuals	××	Significant potential impacts from noise and visuals due to height
	××	Significant potential for temporary community impacts resulting from noise, vibrations and utility diversions	✓	Minimal potential temporary community impacts resulting from noise, vibrations and utility diversions	✓	Minimal potential temporary community impacts resulting from noise, vibrations and utility diversions
	✓	Moderate potential for construction disruption from accessibility diversions	××	Significant potential for construction disruption from accessibility diversions	✓	Minimal potential for construction disruption
	–		×		–	
Land take	–	No comparable impact or benefit	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Schedule and constructability	××	Significant construction duration	✓	Short construction duration	✓	Short construction duration
	××		✓		✓	
Cost implications	××	Capital cost twice the amount estimated for the other options	✓	Capital cost comparable to Option A2.3	✓	Capital cost comparable to Option A2.2
	×	High operational cost	✓	Low operational cost	✓	Low operational cost
	××		✓		✓	
Rank	3		2		1	

3
Study area B: Albion-Jacana freight corridor

3. Study area B: Albion-Jacana freight corridor

3.1. Decision B1: Sharps Road to Albion Junction including M80 crossing

The detailed assessment for the options for Decision B1, as described in Chapter 6 for the vertical alignment of the track between Sharps Road and Albion Junction, including crossing the Western Ring Road (M80), is provided in Table 5 below.

Table 5: Assessment of Decision B1: Sharps Road to Albion Junction including M80 crossing

Evaluation criteria	Option B1.1 Deep underground		Option B1.2 Shallow underground		Option B1.3 Elevated viaduct	
Achievement of project requirements	–	No comparable impact or benefit.	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Ability to improve customer journey experience	–	No comparable impact or benefit.	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Ability to improve transport system outcomes	×	Introduces complications relating to accessibility for maintenance and emergency egress	×	Introduces complications relating to accessibility for maintenance and emergency egress	×	Introduces complications relating to accessibility for maintenance and emergency egress
	×	Ongoing maintenance requirements (periodic testing of tunnel ventilation and fire and life systems)	×	Ongoing maintenance requirements (periodic testing of tunnel ventilation and fire and life systems)	✓	No requirement for ventilation and fire and life safety systems
	×		×		–	
Environmental and heritage impacts	×	Potential impact to Steel Creek North existing flooding patterns from tunnel portal structures	××	High potential impact on overland water flow paths and the Steele Creek North existing flooding patterns	✓	Low potential impact to overland water flow paths and existing flooding patterns due to piers
	×	Potential impact on existing trees from tunnel portal structures	××	Significant potential impact on existing trees	×	Possible impact to existing trees in Steele Creek North from construction and piers
	×	Potential impacts overland water flow paths due to tunnel portal structures	××	Significant potential impacts to water flow paths	✓	Low potential impacts to water flow paths

Evaluation criteria	Option B1.1 Deep underground		Option B1.2 Shallow underground		Option B1.3 Elevated viaduct	
	××	Significant potential greenhouse gas emissions associated with tunnel boring machine used in construction and ongoing emissions associated with energy usage for tunnel ventilation systems, lighting and pumps	×	Moderate potential greenhouse gas emissions associated with energy usage for underground ventilation systems, lighting and pumps, and moderate potential embedded greenhouse gas emissions from the volume of concrete used	×	Moderate potential embedded greenhouse gas emissions from the volume of concrete use for the viaduct structure
	××	Highest volume of excavated material	×	Moderate volume of excavated material	✓	Low volume of excavated material
	××		××		✓	
Property and community impacts	✓	Limited potential construction impact on community access	××	Potential construction impacts on community access — particularly intersecting roads	×	Some potential for construction impact on community access
	✓	Low potential for operational noise transmission to surrounding areas	✓	Low potential for operational noise transmission to surrounding areas	××	Operational noise will potentially travel further due to height
	✓	Minimal potential impact to shared user path	×	Requires new crossing across shared user path	×	May require rerouting of existing shared user path around piers
	✓	Minimal potential visual impact	×	Moderate potential visual impact	××	High potential visual impact
	×	Limited opportunities for public space enhancement at portals	×	Limited opportunities for public space enhancement	✓	Opportunities for public space enhancement under and around structure
	××	High potential for noise and vibration impact during construction	×	Moderate expected noise and vibration impact during construction	✓	Low potential for noise and vibration impact during construction
	×	Potential for long term community amenity impact to Steele Creek due to proximity of tunnel portal structure	××	Potential for long term community amenity impact to Steele Creek	✓	Low potential impact for long term community amenity impact to Steele Creek
	✓	Anticipated to avoid disruptions to the road network during construction	××	Anticipated long duration lane closures together with an extensive network of temporary road diversions during construction	×	Anticipated partial lane closures and a single overnight closure during construction
	✓		××		×	
Land take	✓	Least land acquisition required	×	Some land acquisition required	×	Some land acquisition required
	✓		×		×	

Evaluation criteria	Option B1.1 Deep underground		Option B1.2 Shallow underground		Option B1.3 Elevated viaduct	
Schedule and constructability	✓	Minimal impact on road network during construction	×	Some impact on road network during construction	××	Significant impact on road network during construction
	××	Significant construction duration	×	Moderate construction duration	✓	Short construction duration
	×		×		–	
Cost implications	××	Capital cost 1.5 times the amount estimated for the other options	✓✓	Capital cost comparable to Option B1.3	✓✓	Capital cost comparable to Option B1.2
	×	High operational cost	×	Moderate operational cost	✓	Low operational cost
	××		✓		✓✓	
Rank	3		2		1	

3.2. Decision B2: Inclusion of an intermediate station at Keilor East (proposed location)

The detailed assessment of the options for Decision B2 as described in Chapter 6 for the inclusion of an intermediate station proposed at Keilor East is provided in Table 6 below. It is noted that the customer experience and transport system outcomes do not yet provide justification for the additional cost to deliver the intermediate station, however, a station in this proposed location has been sufficiently considered to enable a priced option for inclusion in the Project.

Table 6: Assessment for Option B2: Inclusion of an intermediate station

Evaluation criteria	Option B2.1 Intermediate station		Option B2.2 No intermediate station		Option B2.3 Future-proof for a future intermediate station	
Achievement of project requirements	–	No comparable impact or benefit.	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
Ability to improve customer journey experience	–	No comparable impact or benefit.	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–		–	
	✓	Provides rail services to an area where none currently exist	×	Keilor East will not be serviced by rail as a result of MAR	–	Keilor East will not be serviced by rail as a result of MAR on Day 1

Evaluation criteria	Option B2.1 Intermediate station		Option B2.2 No intermediate station		Option B2.3 Future-proof for a future intermediate station	
Ability to improve transport system outcomes	✓	Increases overall patronage on MAR (however the station does not increase passengers travelling to Melbourne Airport)	–	Reduces overall patronage on MAR, but conversely slightly increases the number of passengers travelling to Melbourne Airport	–	Reduces overall MAR patronage on MAR for Day 1, but conversely slightly increases the number of passengers travelling to Melbourne Airport
	✓	Provides minor relief on the Sunbury – Albion and Craigieburn – North Melbourne sections of the network	×	No relief to metropolitan passenger services on the Sunbury – Albion and Craigieburn – North Melbourne sections of the network	×	No relief to metropolitan passenger services on the Sunbury – Albion and Craigieburn – North Melbourne sections of the network on Day 1 of MAR operations
	✓	Enhances network resilience (e.g. in the event the Sunbury line was closed, Keilor East could provide a convenient station to feed bus replacement services)	×	No resilience enhancement on the Sunbury line	×	No resilience enhancement on the Sunbury line
	×	Additional network improvements (e.g. connecting bus services) are required to fully integrate a new station into the broader transport network	✓	No need to complete additional network improvements associated with integrating a new metropolitan train station	✓	No need to complete additional network improvements associated with integrating a new metropolitan train station
	×	Keilor East is adjacent to the M80, Tullamarine (M2) and Calder (M79) freeways providing good road access, reducing the need for public transport connections	✓	Existing transport network in the area used	✓	Existing transport network in the area used
	×	Adds an additional 2 minutes to the journey time for Airport passengers	✓	Reduces journey time for Airport passengers, relative to an option that includes an intermediate station	✓	Saves 2 minutes to the journey time for Airport passengers for Day 1
	–	State is locked into investment	××	If the State decides to invest in a station at the Keilor East location in the future the cost and effort may be higher due to constraints imposed from infrastructure delivered by this Project	✓	Enables the State to make a further investment in the future to achieve the positive attributes of Option B3.1 at a later date in an efficient (cost and disruption) manner
	✓		–		✓	
Environmental and heritage impacts	×	If the station is located at the Keilor Park Drive location, there are cultural and historic heritage interfaces	✓	No environmental or heritage impacts	✓	No environmental or heritage impacts for Day 1

Evaluation criteria	Option B2.1 Intermediate station		Option B2.2 No intermediate station		Option B2.3 Future-proof for a future intermediate station	
	×		✓		✓	
Property and community impacts	✓✓	Supports urban development outcomes among a significant existing population with poor public transport connectivity	×	Results in poor urban development outcomes among a significant existing population with poor public transport connectivity	✓	Supports urban development outcomes among a significant existing population with poor public transport connectivity
	✓	Aligns with Moonee Valley City Council Advocacy Strategy (dated May 2018) which supports a station at Keilor East	×	Does not align with the Moonee Valley City Council Advocacy Strategy (dated May 2018) which supports a station at Keilor East	✓	Aligns with Moonee Valley City Council Advocacy Strategy (dated May 2018) which supports a station at Keilor East
	×	The acquisition of private land would result in impacts to local businesses operating in the area. The potential acquisition of a section of Border Drive Reserve would result in a loss of community facilities and a reduction of public open space	✓	Reduction in the overall social and business impacts of the Project by avoiding the acquisition of private businesses and public open space	✓	Reduction in the overall social and business impacts of the project by avoiding the acquisition of private businesses and public open space for Day 1
	×	Noise and amenity impact to sensitive receptors east of the rail corridor, including residential land uses and some aged care facilities (e.g. Mekong Aged Care Facility and Cyril Jewell House)	✓	Avoids impacts on sensitive receptors east of the rail corridor	✓	Avoids impacts on sensitive receptors east of the rail corridor on Day 1
	✓		–		✓	
Land take	✓	A Public Acquisition Overlay – Schedule 7 (PAO7) applies to land west of the rail corridor at Terror Street, implying that the local community has an understanding that the land is under consideration for works associated with a rail link to Melbourne Airport	–	No Public Acquisition Overlay required	✓	Presents the opportunity to apply a Public Acquisition Overlay to land for future acquisition for an intermediate station
	×	Based on the design work undertaken, the Terror Street and Keilor Park Drive locations are both assumed to require commercial land acquisition	✓	Saves on land take for the Project	–	The absence of a new intermediate station will save on land take for the project on Day 1, but acquisition is not avoided if the station is needed in the future

Evaluation criteria	Option B2.1 Intermediate station		Option B2.2 No intermediate station		Option B2.3 Future-proof for a future intermediate station	
	×		✓		✓	
Schedule and constructability	✓	Avoids substantial reconfiguration and associated disruption of the rail corridor at a future date, should the station be required later	×	Requires substantial reconfiguration and associated disruption of the rail corridor, should the station be required at a later date	✓	Reduces reconfiguration and associated disruption of the rail corridor compared to Option B2.2, should the station be required at a later date
	××	Additional time and resources will be required to construct the supporting infrastructure, and the proposed station is in close proximity to a road bridge which would need to be enlarged to support a new station	✓	Does not require additional time and resources to construct the supporting infrastructure	✓	Does not require additional time and resources during the initial build to construct the supporting infrastructure
	×		✓		✓	
Cost implications	✓	Escalation cost savings, and potentially base capital cost savings, should the station be required later	×	Should the station be required later without the benefit of having the track alignment future-proofed, with escalation, occupations and the increased cost of changing the track alignment, the total costs will be much greater than Option B2.3	–	Should the station be required in the future, with the benefit of having the track alignment future-proofed, the cost is higher than Option B2.1 due to escalation and the cost of additional occupations to complete the work
	×	Significant capital costs and land acquisition costs	✓	Capital and operational cost and land acquisition savings	–	Estimated at less than 15 per cent of the cost to deliver the intermediate station
	×	Involves higher operating costs which are unlikely to be offset by farebox revenue generated by the new station	✓	No additional operating costs from an intermediate station	✓	No additional operating costs from an intermediate station on Day 1 of MAR operations
	×		✓		–	
Rank	3		2		1	

4
Study area C: Sunshine and Albion

4. Study area C: Sunshine and Albion

4.1. Decision C1: Albion Junction to Hampshire Road track configuration

The detailed assessment of the options for Decision C1 as described in Chapter 6 for the track configuration of track between Albion Junction and Hampshire Road is provided in Table 7 below.

Table 7: Assessment of Decision C1: Albion Junction to Hampshire Road track configuration

Evaluation criteria	C1.1 Double track flyover		C1.2 Single track flyover	
Achievement of project requirements	✓	Achieves project requirements	✓	Achieves project requirements
	✓		✓	
Ability to improve customer journey experience	×	Platform extension at Albion Station may result in longer load times resulting in a nominal impact for some passengers on other metropolitan services; it will not be largely different to existing access	✓	Albion Station rebuild, including works to meet *Disability Discrimination Act 1992* (Cth) (DDA) requirements and removal of existing underpass, improves customer experience and safety for non MAR passengers taking metropolitan services to and from this station
	×		✓	
Ability to improve transport system outcomes	×	Minor speed changes to Bendigo services in the vicinity of Sunshine/Albion	××	Constrains train length for Bendigo services which allows for 6 car VLocity sets but is not viable for N-class 6 carriage sets and more significant speed changes in the vicinity of Sunshine/Albion
	✓	Greater operational resilience for MAR services in normal operations and when disruptions occur, and futureproofs for any increased frequency of MAR services through separation of the MAR line on an elevated viaduct through the Albion area	××	Increased travel time and less operational flexibility through the Albion area resulting from track arrangement and speed constraints
	–		××	
Environmental and heritage impacts	××	Greater embedded and direct greenhouse gas emissions from the increased concrete use and increased energy consumption from the amount of energy required for trains to traverse the vertical grades of track	×	Embedded and direct greenhouse gas emissions from the increased concrete use and increased energy consumption from the amount of energy required for trains to traverse the vertical grades of track
	–	Does not require the rebuild of Albion Station, Ballarat Road Bridge and St Albans Road Bridge, which better utilises carbon already expended in the construction of these assets	××	Requires rebuild of Albion Station, Ballarat Road Bridge and St Albans Road Bridge, increasing expenditure of carbon

Evaluation criteria	C1.1 Double track flyover		C1.2 Single track flyover	
	–	Does not require dual gauging of the ARTC line, which better utilises carbon already expended in the construction of these assets	×	Requires dual gauging of ARTC line, increasing expenditure of carbon
	××	Likely impacts to the sightline to the John Darling and Son Flour Mill and the Albion Substation which are on the Victorian Heritage Register	×	Likely impact on the Albion Substation which hosts the Maltese Cultural Association, with 15 trains per hour going directly past the building on the Sunbury line
	×		×	
Property and community impacts	–	Does not require the re-build of Albion's Station which removes the opportunity to provide improvements to public safety and amenity at the station	✓	Provides the opportunity to provide improvements to public safety and amenity at Albion station
	✓	Minimises impacts to HV McKay Memorial Gardens	×	Likely to more significantly impact HV McKay Memorial Gardens
	–	The flyover structure will have some visual impacts, and may have some impacts to the current strategic planning for the area by the local council and government however this is offset by the opportunity for an urban design response using the iconic piece of railway infrastructure to identify Sunshine-Albion as a landmark gateway on the journey to Melbourne	–	The single-track flyover is shorter and is less likely to have as significant visual impacts, however it does not result in an opportunity for an iconic urban design response
	–		✓	
Land take	–	No comparable impact or benefit	×	Likely to require land at HV McKay Memorial Gardens and Gilmour Road as well as access to a number of properties
	–		×	
Schedule and constructability	✓	Shorter Construction duration (subject to confirmation that an Environmental Effects Statement (EES) is not required)	×	Longer construction duration and difficulties in integrating the program with the delivery of the Metro Tunnel.
	✓	No ARTC dual gauge scope	×	Risk associated with delivery complexity and assumptions on construction methodology for the ARTC dual gauge scope
	✓		×	
Cost implications	✓✓	Significantly less capital cost of 15 per cent less to implement than Option C1.2	×	High capital cost
	✓✓		×	
Rank	1		2	

4.2. Decision C2: Sunshine Station scope

The detailed assessment of the options for Decision C2 as described in Chapter 6 for the scope of work at Sunshine Station is provided in Table 8 below.

Table 8: Assessment of Decision C2: Scope of works at Sunshine

Evaluation criteria	Option C2.1 Standard scope		Option C2.2 Additional scope	
Achievement of project requirements	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Ability to improve customer journey experience	✓	Includes upgrades and extensions to local active transport network	✓✓	Includes a new east-west road bridge connection, shared user path and active transport connection
	×	Excludes any improvements to the bus interchange	✓	Includes a new bus interchange to the east of Sunshine Station
	✓		✓✓	
Ability to improve transport system outcomes	✓	Enables MAR services to run via Sunshine	✓	Enables MAR services to run via Sunshine
	✓	Provides an additional platform for regional services and future proofing for future planned investments at the station and surrounding precinct	✓✓	Provides a redeveloped Sunshine Station with 3 new dedicated Regional Rail Link (RRL) platform faces, and 3 new dedicated metropolitan platform faces for services uplifts
	✓		✓✓	
Environmental and heritage impacts	✓	Minimal spoil management issues associated with potentially contaminated land in the area	×	Greater impacts on sites containing potentially contaminated land
	×	Potential visual and landscape impacts associated with the new Albion flyover	××	Additional potential visual and landscape impacts compared to Option C2.1 associated with additional new infrastructure around the Sunshine Station precinct
	×	Potential noise impacts from increased train volumes that may require acoustic treatment measures	×	Potential noise impacts from increased train volumes that may require acoustic treatment measures
	×	Potential heritage and visual impacts to historically significant HV McKay Memorial Gardens	××	Greater impacts on heritage places due to more significant scope
	✓	Consistent with the State and local planning policy and aspirations for the Sunshine Priority Precinct to manage future population growth, transport demand and economic development	✓	Consistent with the state and local planning policy and aspirations for the Sunshine Priority Precinct to manage future population growth, transport demand and economic development
	×		××	

Evaluation criteria	Option C2.1 Standard scope		Option C2.2 Additional scope	
Property and community impacts	✓	Less road network disruption due to avoiding east-west road relocation	××	Greater road network disruption due to relocation of east-west road connection
	✓	Minimises social and business impacts due to no residential and community land acquisition	×	Social and business impacts due to displacement of residents and business from required land acquisition
	×	Significant disruption for metropolitan, freight and regional rail networks and road networks during construction	××	Greater disruption for metropolitan, freight and regional rail networks and road networks during construction
	×	Does not preclude urban renewal opportunities from redeveloped Sunshine Station	✓✓	Urban renewal opportunities including improved integration between the retail precinct and station
	–	No additional traction power substation required at Sunshine	×	Visual impacts to residents due to construction of new traction power substation
	–		×	
Land take	✓	Minimal land take required	××	Greater amount of land take required due to east-west road connection which requires residential and commercial / industrial land acquisition on both sides of the rail corridor
	–		××	
Schedule and constructability	✓	Shorter construction duration	×	Longer construction duration
	–	Requires works to be delivered in a highly constrained brownfield environment	–	Requires works to be delivered in a highly constrained brownfield environment
	✓		×	
Cost implications	✓	Lowest capital cost	×	Requires a significant additional capital commitment by the State compared to Option C1.1 and is inclusive of additional scope and infrastructure outside of what is needed for MAR
	✓	Lowest operational cost	×	Requires significant additional operational costs to operate additional services on the new regional platforms
	✓		×	
Rank	1		2	

5
Study area D: Line wide

5. Study area D: Line wide

Decision D1 did not involve a detailed assessment of options.

5.1. Decision D2: Traction power intake configuration

The detailed assessment of options for Decision D2 as described in Chapter 6 for the high voltage supply to substations for traction power is provided in Table 9 below.

Table 9: Assessment of Decision D2: Traction power intake configuration

<table>
<tr><th>Evaluation criteria</th><th colspan="2">Option D2.1
Single 66 kilovolt (kV) intake</th><th colspan="2">Option D2.2
Multiple intakes</th></tr>
<tr><td rowspan="2">Achievement of project requirements</td><td>–</td><td>No comparable impact or benefit</td><td>–</td><td>No comparable impact or benefit</td></tr>
<tr><td colspan="2">–</td><td colspan="2">–</td></tr>
<tr><td rowspan="2">Ability to improve customer journey experience</td><td>–</td><td>No comparable impact or benefit</td><td>–</td><td>No comparable impact or benefit</td></tr>
<tr><td colspan="2">–</td><td colspan="2">–</td></tr>
<tr><td rowspan="3">Ability to improve transport system outcomes</td><td>✓</td><td>Provides the Department of Transport (DoT) with the ability to use the single intake to support other railway power loads (e.g. at train stations) by expanding the distribution ring without applying for additional supplies from the electricity service provider, providing more flexibility for future power needs of the transport network</td><td>×</td><td>DoT will need to apply to the electricity service provider for future railway power loads</td></tr>
<tr><td>××</td><td>Introduces operation and maintenance of high voltage by the metropolitan rail network franchisee, Metro Trains Melbourne (MTM) which requires significant capability uplift including updates to key safety processes</td><td>✓✓</td><td>Avoids significant capability uplift associated with introducing the operation of high voltage power by MTM</td></tr>
<tr><td colspan="2">×</td><td colspan="2">✓</td></tr>
<tr><td rowspan="2">Environmental and heritage impacts</td><td>××</td><td>Additional infrastructure required compared to Option D2.2 results in a minimal increase in the potential environmental impacts with respect to excavation and embedded greenhouse gas emissions associated with concrete use</td><td>×</td><td>Potential environmental impacts with respect to excavation and embedded greenhouse gas emissions associated with concrete use</td></tr>
<tr><td colspan="2">××</td><td colspan="2">×</td></tr>
</table>

Evaluation criteria	Option D2.1 Single 66 kilovolt (kV) intake		Option D2.2 Multiple intakes	
Property and community impacts	××	Additional infrastructure required compared to Option D2.2 results in a minimal increase in the potential community impacts with respect to noise and disruption during construction	×	Potential community impacts with respect to noise and disruption during construction
	××		×	
Land take	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Schedule and constructability	✓	The 66 kV supply is highly likely to be available from the electricity service provider with limited works required by them	×	The supplies required at multiple locations are unlikely to all be available from the electricity service provider without significant works and upgrades to their infrastructure
	×	Complications associated with distributing 22kV along the railway including provision pf appropriate bending radius in cable containments, appropriately sized pits, separation from other services and the weight associated with pulling the cable through conduit	✓	Construction of substations using supplies form the electricity service provider is a well-known and streamlined process
	–	Additional infrastructure required compared to Option D2.2 may result in a minimal increase in the delivery schedule	–	May have a slightly reduced delivery schedule than Option D2.1 as less infrastructure will need to be delivered by the project
	–		–	
Cost implications	××	Additional infrastructure required compared to Option D2.2 will increase the capital cost of the works	×	If the electricity service provider needs to upgrade the network to provide separate supplies to each of the substations this is likely to incur additional costs
	××		×	
Rank	2		1	

5.2. Decision D3: Train control and signalling solution

The detailed assessment of options for Decision D3 as described in Chapter 6 for the train control and signalling solution for Day 1 of MAR operations is provided in Table 10 below.

Table 10: Assessment of Decision D3: Train control and signalling solution for Day 1 of MAR operation

Evaluation criteria	Option D3.1 Conventional train control and signalling		Option D3.2 High Capacity Signalling	
Achievement of project requirements	×	Less flexible to meet required run times between Airport Station and Sunshine Station resulting in a more severe impact to run times in degraded mode scenarios until HCS is introduced at a later date	✓	Meets required run times between Airport Station and Sunshine Station from Day 1 of operations
	×	Introduces additional degraded mode scenarios with increased impacts until HCS is introduced at a future date	✓	Does not introduce additional degraded mode scenarios
	×		✓	
Ability to improve customer journey experience	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Ability to improve transport system outcomes	✓	Faster operational response to any system failures as use of technology in operations is mature	×	Use of technology in the Victorian transport network is immature which may decrease the operational response to any systems failures
	✓	Expected that when HCS is introduced later the operation of the new technology would have matured to reduce risk of transition into service	×	There is a risk of transition into service as the HCS is not yet commissioned into the Victorian transport network (but will be prior to the delivery of MAR)
	✓	Enables non-HCS fitted rolling stock to operate between Albion and Sunshine stations should there become an opportunity or need to run a shuttle service in the future using existing fleet	×	Restricts rolling stock fleet to High Capacity Metro Trains (HCMT's) as the only fleet compatible with HCS which removes any opportunity to run a shuttle service in the future using existing fleet
	×	Introduces loss journey time at Sunshine to transition from HCS to conventional signalling until HCS is introduced at a future date	✓	Avoids transition between HCS and conventional signalling on the MAR service
	×	No reduction in signalling works for future Melton services	✓	Minimises additional signalling works for future Melton services
	×	Cannot implement platform screen doors in line with the Metro Tunnel Project for MAR from Day 1 of operations	✓	Can implement platform screen doors in line with the Metro Tunnel Project for MAR from Day 1 of operations
	×	Introduces additional line side infrastructure which increases the time spent by maintenance staff working in a hazardous environment	✓	Reduces line side infrastructure which improves safety for maintenance staff for MAR from Day 1 of operations

Evaluation criteria	Option D3.1 Conventional train control and signalling		Option D3.2 High Capacity Signalling	
	✓	Known disruption impact of changes to signalling on the corridor	×	Unclear how update of HCS system for MAR will disrupt the other services on the corridor
	–		✓	
Environmental and heritage impacts	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Property and community impacts	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Land take	–	No comparable impact or benefit	–	No comparable impact or benefit
	–		–	
Schedule and constructability	✓	High degree of delivery certainty from mature technology and supplier/contractor experience with deploying technology in Victorian transport network	×	Single precedent project for delivery of this technology in the Victorian transport network
	×	Deployment risks due to complexity at Sunshine with interface between metro, regional and freight trains, while maintaining freight connectivity	××	Higher deployment risks due to complexity at Sunshine with interface between metro, regional and freight trains, while maintaining freight connectivity
	×	Dependent on the transition between HCS operations and conventional operations to be delivered by the Metro Tunnel Project	××	Highly dependent on the completion of the Metro Tunnel Project
	×		××	
Cost implications	✓	Reduced cost associated with reduced deployment risk	×	Increased cost associated with increased deployment risk
	✓	Ability to procure through competitive bid process	×	Some proprietary scope items may need to be sole sourced
	×	Higher labour costs for maintenance of line-side equipment	✓	Lower labour costs by eliminating line-side equipment
	×	Depending on timing of future HCS rollout could be a “sunk cost”	✓	Eliminates risk of “sunk cost”
	–		–	
Rank	**2**		**1**	

Appendix 3

MAR Investment Context on a Page

Major precursor projects interdependent with MAR

Under construction (funded)

- Metro Tunnel Project
- HCMT Project
- Cranbourne Line Duplication

In development (not funded)

- Dandenong Corridor Readiness Works
- Works to support longer regional trains at Sunshine

Melbourne Airport Rail

- Premium station at Airport
- Two tracks and supporting systems and infrastructure from Airport station to Sunshine station through the Albion-Jacana Corridor
- Additional HCMTs to support MAR services
- HCS deployment from West Footscray to Ginifer

Additional regional platform and concourse extension at Sunshine Station (Western Rail Plan)

Operational Phase Costs

Suburban Rail Loop Project North Section (Box Hill – Airport)

Melbourne Airport Elevated Road Project – Stages 3 and 4

Intermediate station at Keilor East

Major precursor projects interfacing with MAR

Under construction (funded)

- Regional Rail Revival
- Melbourne Airport Elevated Road Project – Stage 1
- ARTC North East Rail Line Upgrade

Major concurrent projects interfacing with MAR

Under construction (funded)

- Inland Rail Project

In development (funded)

- Geelong Fast Rail Stage 1

In development (not funded)

- Clyde Rail Extension
- MR5

Major projects interfacing with MAR – timing and scope unconfirmed

- Melbourne Airport Elevated Road Project – Stage 2
- Complementary surface transport to MAR
- Next generation ticketing systems
- Digital Train Radio System Replacement
- Development of the Sunshine Precinct (DJPR)
- VicTrack Transport and Government Secure Network
- Western Rail Plan Investments

LEGEND

- Scope to be funded by the Business Case
- Melbourne Airport Rail Scope
- MAR scope included in the economic analysis for the Business Case
- Critically Interdependent Scope
- Optional scope
- Funded
- Not Funded
- Projects interdependent with MAR (i.e. where the benefits of one project is dependent on the delivery of the other project)
- Projects interfacing with MAR (i.e. where the projects should keep abreast of each other's scope and program at a high level due to geographical, system, stakeholder and construction interfaces)

Appendix 4

Detailed Value Creation and Capture Plan

Table of Contents

1 Executive Summary

1. Executive Summary

This Detailed Plan is submitted to the Department of Premier and Cabinet for endorsement in accordance with the requirements of the Victorian Government's Value Creation and Capture Framework.

Melbourne Airport Rail (MAR or the Project) is a key component of the Victorian Government's extensive program of planned infrastructure investments across the State. Rail Projects Victoria (RPV) is the agency responsible for the development and delivery of MAR and, through the Department of Transport (DoT), will submit a Business Case for consideration in the Victorian Government 2020/21 budget cycle.

The Victorian Government introduced the Value Creation and Capture Framework (VCC Framework) in 2017 to guide business case proponents to develop mechanisms to maximise the value created by major investments such as MAR.

RPV has submitted a Statement of Intent and a Strategic Value Creation and Capture Plan (SVCCP) to the Department of Premier and Cabinet (DPC) that sets out the steps undertaken by RPV to apply the Value Creation and Capture Guidelines (VCC Guidelines) to comply with the VCC Framework.

This Detailed Value Creation and Capture Plan (DVCCP) focuses on providing further information on RPV's application of the VCC Guidelines since the SVCCP was submitted to DPC.

The following Value Creation and Capture Mechanisms (VCC Mechanisms) have been developed from the analysis of 225 opportunities identified from stakeholder consultation:

- Mechanism 1 – Digital Engineering.
- Mechanism 2 – Urban Design Strategy.
- Mechanism 3 – Creative Strategy.
- Mechanism 4 – Procurement Conditions.
- Mechanism 5 – Sustainability Strategy.
- Mechanism 6 – MAR Project Hub.
- Mechanism 7 – Partnership with Tertiary Education.
- Mechanism 8 – Active Transport Networks.
- Mechanism 9 – Digital Maps.
- Mechanism 10 – Advertising Opportunities.
- Mechanism 11 – VicTrack Infrastructure.
- Mechanism 12 – Farebox Revenue.
- Mechanism 13 – Partnership with Airlines.

These VCC Mechanisms are planned for implementation as part of the Project scope in accordance with the existing project governance framework, including existing departmental and reporting requirements.

2
Introduction

2. Introduction

This DVCCP is submitted to DPC for endorsement in accordance with the requirements of the VCC Framework for MAR.

RPV has submitted a Statement of Intent that sets out the steps undertaken and planned by RPV to apply the VCC Guidelines, and a SVCCP which sets out the VCC Mechanisms to be further developed in this DVCCP.

The Statement of Intent includes an overview of the VCC context and the project context, including the objectives, problem statements, benefits and stakeholders. This overview is provided in Appendix A.

2.1. Purpose of this Detailed Plan

This DVCCP provides an overview of RPV's progress in applying the VCC Guidelines to MAR including:

- detail on each of the VCC Mechanisms chosen for the Project with:
  - rationale and supporting analysis for each mechanism's inclusion
  - evidence supporting its deliverability and expected impacts
  - quantification of expected value creation and capture where possible
  - identified beneficiaries and net value created taking to account any associated costs
  - any challenges or risks that may be introduced to the Project and how these will be managed.
- a description of how RPV plans to deliver VCC Mechanisms within the existing project governance structure
- an overview of inter-departmental collaboration outcomes in relation to issues, impacts on interdependent projects and the roles of third parties
- a summary of the overall funding and financial impact of the plan
- a description of how any revenue from value capture mechanisms will be used.

2.2. Limitations

The extent of the work undertaken to develop and analyse the VCC Mechanisms considered in this DVCCP reflect the current level of development for MAR.

At the time of preparing this DVCCP, RPV has completed a Concept Design and has begun the first step of a three-step process for developing the reference design. Confidence about the scope, cost and value of the VCC Mechanisms is affected by the current design environment where detailed scope items are subject to change. Accordingly, the VCC Mechanisms presented in this DVCCP reflect the level of detail achievable at this time, and it is anticipated that some of the details presented may change as the project progresses.

Additionally, any VCC Mechanisms that are critically dependent on negotiations with Australia Pacific Airports (Melbourne) Pty Ltd (APAM) are not discussed in this plan.

The costs shown in this DVCCP are high-order-of-magnitude costs represented in real dollars at the time of finalising and are subject to ongoing refinement.

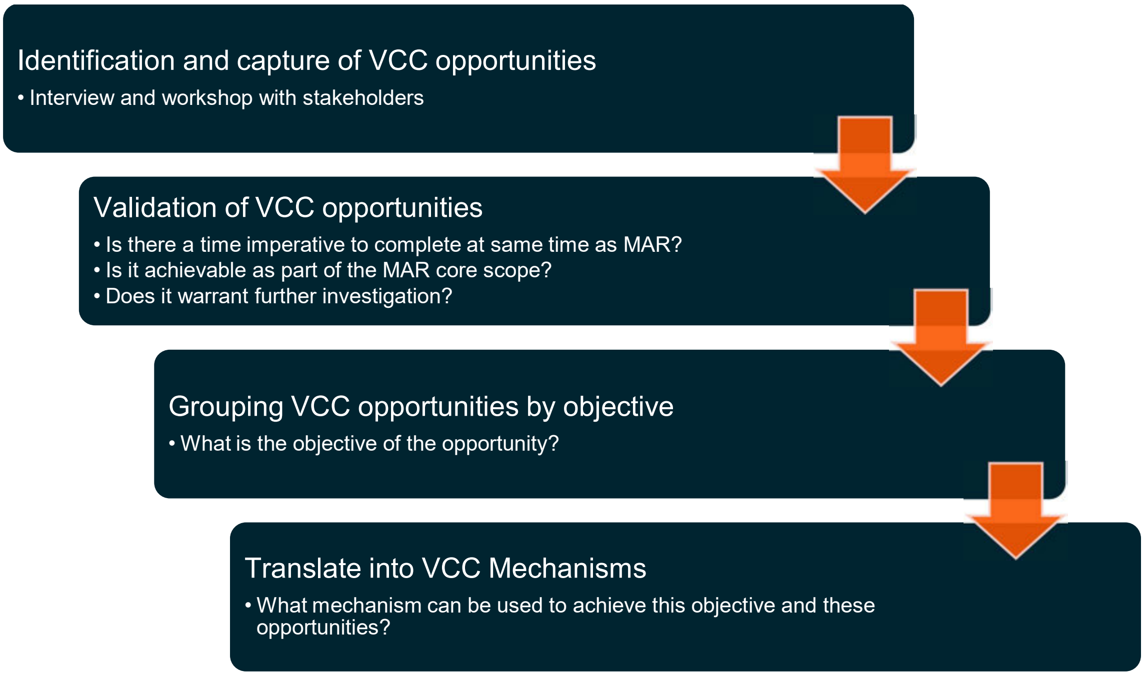
3
VCC Mechanisms and analysis

3. VCC Mechanisms and analysis

3.1. Context

The development and initial analysis of the VCC Mechanisms is described in the SVCCP, an overview of this is provided in Appendix B. The general approach taken to develop the VCC Mechanisms is illustrated in Figure 1 below.

Figure 1: General approach to developing VCC Mechanisms



This approach facilitated the alignment of VCC objectives, mechanisms and outcomes as shown in Table 1 below.

Table 1: Alignment between VCC objectives, mechanisms and outcomes.

Primary Objective	VCC Mechanisms	VCC Outcomes
Improve skills training	• Mechanism 7 - Partnership with Tertiary Education	Improved productivity, economic growth, and employment
Improve the passenger experience	• Mechanism 2 - Urban Design Strategy • Mechanism 3 – Creative Strategy • Mechanism 9 - Digital Maps	Enhanced public safety and amenity
Improve exposure and access to local history and culture	• Mechanism 2 - Urban Design Strategy • Mechanism 3 – Creative Strategy	Increased social capital
Increase and improve community spaces	• Mechanism 2 - Urban Design Strategy	Increased social capital. Enhanced public safety and amenity
Improve the local environment	• Mechanism 5 - Sustainability Strategy	Increased environmental capital
Reduce the environmental impact of the project	• Mechanism 4 - Procurement Conditions	Increased environmental capital

Primary Objective	VCC Mechanisms	VCC Outcomes
	• Mechanism 5 - Sustainability Strategy	
Increase access and connectivity	• Mechanism 8 - Active Transport Networks	Improved access to jobs, education, services, affordable housing and recreation
Increase employment opportunities and access to them	• Mechanism 4 - Procurement Conditions • Mechanism 6 – MAR Project Hub	Improved productivity, economic growth, and employment
Develop a procurement strategy that drives enhanced economic outcomes	• Mechanism 1 - Digital Engineering • Mechanism 4 - Procurement Conditions	Improved design quality in the built environment Increased social and environmental capital
Investigate opportunities for additional revenue streams	• Mechanism 10 – Advertising Opportunities • Mechanism 11 - VicTrack Infrastructure • Mechanism 12 - Farebox Revenue • Mechanism 13 - Partnerships with Airlines	Improved productivity, economic growth, employment and government revenue

This DVCCP includes the results of further development and analysis of the VCC Mechanisms.

3.2. Further Development and Analysis

The VCC Mechanisms were further developed and analysed through consultation with subject matter experts and the project team. Activities to achieve this included:

- agreeing on high-level scope for basis of order of magnitude cost estimates
- reviewing additional processes and stakeholder consultation that will be required to confirm scope and impacts of scope
- determining the expected risks and methods for managing
- developing clear qualitative benefits with evidence.

3.3. Value Creation Mechanisms

3.3.1. Mechanism 1 – Digital Engineering

Table 2: VCC Mechanism 1 – Digital Engineering

Mechanism #	1	Title	Digital Engineering
Description			
The Office of Projects Victoria (OPV) describes digital engineering as a convergence of technologies such as Building Information Modelling (BIM), Geographic Information Systems (GIS) and other related systems for driving better businesses, projects and asset management outcomes. RPV has developed a Digital Engineering Data Package Completion Guideline (DE Guideline) to provide package delivery partners. This guideline is currently being updated by RPV for MAR. The project DE implementation will include the use of BIM, GIS and tagged data relating to asset classes at different levels. MAR will be implementing some new DE initiatives including providing digital information to the market during the procurement process, asking delivery partners to use a shared DE platform when collaborating, and improvements to the asset information handover process. This digital information will include a higher quality of existing information relating to existing infrastructure and feature surveys.			

<table>
<tr><th colspan="2">Risks</th></tr>
<tr><td colspan="2">There is a risk that potential delivery partners will not wish to commit to all digital engineering requirements and obligations due to concerns relating to Intellectual Property (IP) and RPV’s ongoing use of that data. They may also have some sensitivity about:
• the specific data that is required to be provided (particularly where that data involves reports, involving interpretation, rather than just providing 'raw' data)
• being able to pass through the data sharing requirements downstream (e.g. the contractor may agree the DE requirements with RPV but then not be able to negotiate the corresponding rights from subcontractors)
• potential liability to third parties (e.g. where the contractor provides information to the State, the State provides information to third parties, and those third parties bring a claim against the contractor) – at present, the State does not indemnify contractors against third party claims arising out of the State's use of that data
• the provision of data on a reliance versus non-reliance basis. Additionally, there are risks associated with compatibility of digital engineering platforms and data, and the security and redundancy of the stored information.
This risk will be managed through early market engagement to inform potential delivery partners of the proposed DE initiatives and to understand willingness of the market to still participate.</td></tr>
<tr><th colspan="2">Possible Benefits</th></tr>
<tr><td colspan="2">Asking delivery partners to use digital engineering to deliver MAR may improve communication between all stakeholders from the ability to visualise what is to be built, improve budgeting and cost-estimating capabilities, reduce the number of corrections made on site by improving collision-detection during design, increase the reliability of expected field conditions, reduce costs by using more prefabricated materials (possible with increased design certainty), improve safety (from improved accuracy of existing condition information), reuse of information from previous projects, reuse of information on subsequent projects, improved project handover, and improved asset information leading to greater asset management outcomes.
By providing digital information to the market during the procurement process, the respondents can be more efficient in developing their response and their response will be of improved quality.
The improvement of the asset handover process through the enhancement of digital information management will facilitate the improvement of a whole of the Major Transport Infrastructure Authority (MTIA), and potentially DoT, asset information DE platform.</td></tr>
<tr><th colspan="2">Timeframes</th></tr>
<tr><th>Milestone</th><th>Action</th></tr>
<tr><td>Stakeholder Engagement</td><td>Consult with all organisations that will be receiving asset information (including rail operators, councils) to ensure that the information is provided in a useable format</td></tr>
<tr><td>Reference Design</td><td>Produce reference design on RPV DE platform</td></tr>
<tr><td>Early Market Engagement</td><td>Determine market capability and interest in implementing new, innovative DE initiatives</td></tr>
<tr><td>Procurement</td><td>Include digital engineering project scope, technical requirements, and contract clauses
Provide existing site information on DE platform where possible and appropriate</td></tr>
<tr><th colspan="2">Costs</th></tr>
<tr><td>Project Resources</td><td rowspan="2">Redacted
Commercial-in-confidence</td></tr>
<tr><td>Capital Investment</td></tr>
<tr><td>Operational Costs</td><td>No project specific operational costs</td></tr>
<tr><th>Next Steps</th><td>To deploy the new Digital Engineering platform prior to going to market to procure the first works package</td></tr>
</table>

3.3.2. Mechanism 2 – Urban Design Strategy

Table 3: VCC Mechanism 2 – Urban Design Strategy

<table>
<tr><th>Mechanism #</th><td>2</td><th>Title</th><td>Urban Design Strategy</td></tr>
<tr><th colspan="4">Description</th></tr>
<tr><td colspan="4">Develop and implement an Urban Design Strategy which sets out the design vision, key directions and requirements for the design of the stations, structures and public realm along MAR.
The Urban Design Strategy will be provided to the Office of the Victorian Government Architect’s Victorian Design Review Panel (VDRP) which aims to improve the quality of design in the built environment by providing independent, expert advice on significant projects.</td></tr>
<tr><th colspan="4">Risks</th></tr>
<tr><td colspan="4">More detail on the risks will be available once the Urban Design Strategy is implemented further as part of the development of reference design.</td></tr>
<tr><th colspan="4">Possible Benefits</th></tr>
<tr><td colspan="4">Implementation of the Urban Design Strategy will support the delivery of high-quality and context-sensitive design outcomes that will improve local amenity, enhance the function and identity of activity centres along the rail corridor and ensure a positive passenger experience.
Evidence of the benefits of using the VDRP can be observed through examples where the Office of the Victorian Government Architect has influenced better design outcomes for some of Victoria’s most successful projects, such as the Melbourne Recital Centre, AAMI Park and the Melbourne Convention Centre.</td></tr>
<tr><th colspan="4">Timeframes</th></tr>
<tr><th>Milestone</th><th colspan="3">Action</th></tr>
<tr><td>Stakeholder Engagement</td><td colspan="3">Consult with all organisations that will be impacted by urban design outcomes to ensure urban design is aligned with precinct and community design objectives</td></tr>
<tr><td>Reference Design</td><td colspan="3">Produce reference design aligned to Urban Design Strategy and undergo independent design review by the VDRP</td></tr>
<tr><td>Procurement</td><td colspan="3">Include urban design and architectural project scope, technical requirements, performance benchmarking and contract clauses</td></tr>
<tr><th colspan="4">Costs</th></tr>
<tr><td>Project Resources</td><td colspan="3" rowspan="3">Redacted
Commercial-in-confidence</td></tr>
<tr><td>Capital Investment</td></tr>
<tr><td>Operational Costs</td></tr>
<tr><th>Next Steps</th><td colspan="3">Finalise the Urban Design Strategy for stakeholder engagement and consultation before developing the reference design</td></tr>
</table>

3.3.3. Mechanism 3 – Creative Strategy

Table 4: VCC Mechanism 3 – Creative Strategy

Mechanism #	3	Title	Creative Strategy
Description			
Develop and implement a Creative Strategy that sets out the vision and requirements for creative outcomes to support the design vision and directions of MAR. The Creative Strategy identifies key temporary and legacy creative opportunities and intervention sites along the alignment, including at Melbourne Airport. Temporary interventions are expected to use construction hoardings and structures as canvases for creative expression to make construction sites welcoming, engaging, and colourful. Additionally temporary intervention look for innovative ways to improve spaces impacted by construction. Legacy interventions will include high quality public artworks, spaces, community assets, and civic enhancements.			
Risks			
More detail on the risks will be available once the Creative Strategy is implemented further as part of the development of reference design.			
Possible Benefits			
Implementation of the Creative Strategy will deliver high quality creative outcomes that will improve the identity and amenity of the local environment, enhance the passenger experience, and improve engagement between the project and local communities.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with all organisations that will be impacted by creative outcomes to ensure alignment with precinct and community design objectives		
Reference Design	Produce reference design aligned to Creative Strategy		
Procurement	Include project scope, technical requirements, and contract clauses that support creative outcomes in line with the Creative Strategy		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Finalise the Creative Strategy for stakeholder engagement and consultation before developing the reference design		

3.3.4. Mechanism 4 – Procurement Conditions

Table 5: VCC Mechanism 4 – Procurement Conditions

Mechanism #	4	**Title**	Procurement Conditions
Description			
Conditions will be included in the procurement of work packages to achieve policy objectives such as industry and skills development, preferential procurement or employment outcomes (e.g. for disadvantaged employees or traditional owner groups), open space, community facilities, resilience of infrastructure to climate change, or management of worker well-being, among others. Work is being undertaken to determine the appropriate conditions, tools and targets to use to achieve the desired outcomes. A key target for social procurement will be to use Victorian based Aboriginal and/or Torres Strait Islander owned enterprises. Additionally, potential delivery partners will be encouraged to suggest new ways to meet broader social procurement objectives in their responses.			
Risks			
More detail on the risks will be available once the project determines the appropriate tools and targets to use to achieve the desired outcomes.			
Possible Benefits			
Alignment of procurement activities under MAR to the Victorian Social Procurement Framework will support the delivery of multiple social and sustainable outcomes that benefit all Victorians. More detail on the possible benefits will be available once the project determines the appropriate tools and targets to use to achieve the desired outcomes. Evidence of the benefits of social and sustainable procurement practices can be observed through examples where transport projects have already incorporated specific local content and training requirements such as the Caulfield to Dandenong Level Crossing Removal Project (LXRP) and the High Capacity Metro Train (HCMT) project.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with communities and stakeholders that will be impacted by the Project to understand any specific desired outcomes		
Procurement	Include the use of targets and tools associated with social and sustainable procurement in the project scope, technical requirements, and contract clauses		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Review works packages to determine appropriate conditions, tools and targets specific to each package before releasing a Request for Proposal (RFP) to the market		

3.3.5. Mechanism 5 – Sustainability Strategy

Table 6: VCC Mechanism 5 – Sustainability Strategy

Mechanism #	5	**Title**	Sustainability Strategy
Description			
Develop and implement a Sustainability Strategy that will inform the reference design and contractual requirements. This will in turn inform the design and construction activities undertaken by delivery partners.			
Risks			
There is risk that the sustainability technical requirements (informed by the process outlined in the Sustainability Strategy) that are included in the work packages are constrained by financial, delivery (procurement approach), time and key stakeholder considerations.			
Possible Benefits			
The benefits targeted by the Sustainability Strategy include: • reduced greenhouse gas emissions over the asset's lifecycle • reduced energy consumption • reduced waste being disposed of in landfills • maximised use of recycled and reused materials • improved management of water resources • enhanced health, wellbeing and quality of life of staff, commuters and adjoining communities • support the project to achieve a positive and enduring legacy • build resilience to the projected impacts of climate change.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with communities and stakeholders that will be impacted by sustainability outcomes to ensure alignment of expectations		
Reference Design	Produce reference design aligned to Sustainability Strategy		
Procurement	Include Project scope, technical requirements, and contract clauses that support sustainable outcomes in line with the Sustainability Strategy		
Costs			
Project Resources	***Redacted*** ***Commercial-in-confidence***		
Capital Investment			
Operational costs			
Next Steps	Finalise the Sustainability Strategy for stakeholder engagement and consultation before developing the reference design		

3.3.6. Mechanism 6 – MAR Project Hub

Table 7: VCC Mechanism 6 – MAR Project Hub

Mechanism #	6	**Title**	MAR Project Hub
Description			
Establish and operate a MAR Project Hub that: • provides information to the community and answers their questions or concerns in person • employs and trains local community members to staff the office • provides space to display local artwork and showcase community opportunities • is a starting point and briefing zone to commence tours for schools, students and stakeholders • provides events space to celebrate Project milestones and hold major Project briefings.			
Risks			
There is a risk that a stand-alone MAR Project Hub may result in a lack of coordination in relation to communication on the State's Big Build program.			
Possible Benefits			
Establishment and operation of a MAR Project Hub may support economic stimulus and diversification of the workforce, it will also increase community engagement on the Project. Evidence of the benefits of project hubs can be observed through examples where transport projects have already established project hubs such as the Metro Tunnel Project and the Mordialloc Freeway project.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Determine communities and stakeholders with the most interest and engagement in the Project and accessibility to inform the location of the MAR Project Hub including possible benefits of co-locating with the existing Metro Hub set up by the Metro Tunnel Project Confirm APAM position on having a MAR Project Hub at Melbourne Airport		
Procurement	Decide level of involvement, if any, of delivery partners		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Further develop the scope and nature of MAR Project Hub before finalisation of the Business Case to confirm any additional funding requirements		

3.3.7. Mechanism 7 – Partnership with Tertiary Education

Table 8: VCC Mechanism 7 – Partnership with Tertiary Education

Mechanism #	7	Title	Partnership with Tertiary Education
Description			
Establish a partnership with tertiary education provider/s to target initiatives that: • increase participation in Science, Technology, Engineering, Arts, and Maths (STEAM) education and research • support innovation in the fields of transport and aeronautics • support an increase in manufacturing in Australia • increase the use of technology to improve Project delivery. Work is being undertaken to determine whether MAR should leverage existing partnerships between the rail industry and tertiary education providers, or to establish a new partnership. Additionally, the Project is considering what the nature of the partnership should be, if delivery partners will be involved and the process to determine which tertiary education providers to partner with.			
Risks			
There is a risk that the rail skills centre or links with international business will divert students and international business from other Victorian construction projects.			
Possible Benefits			
Establishment of a partnership between MAR and tertiary education for rail skills centres and innovation may support economic outcomes through diversification of workforce, improving skills training, increasing the skilled workforce and increasing student enrolments in tertiary education. Evidence of the benefits of this mechanism can be observed through examples where transport projects have already established partnerships with tertiary education such as the Metro Tunnel Project and LXRP.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Determine level of interest and existing programs or initiatives to collaborate with		
Procurement	Decide level of involvement, if any, of delivery partners		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Further develop the scope and nature of partnerships with tertiary education before finalisation of business case to confirm any additional funding requirements		

3.3.8. Mechanism 8 – Active Transport Networks

Table 9: VCC Mechanism 8 – Active Transport Networks

Mechanism #	8	Title	Active Transport Networks
Description			
Delivery of new and upgraded active transport connections along the rail corridor and around station precincts. Work is being undertaken to refine and confirm the potential scope items.			
Risks			
There is a risk that dis-benefits arise such as increases to collision risk resulting from an increase in traffic volumes as a result of the improved connectivity.			
Possible Benefits			
Delivery of new and upgraded active transport connections along the rail corridor and stations will enhance community access to public transport, employment, recreation, green spaces, goods and services, and potentially a reduction in the use of motor vehicles. Evidence of the benefits of this mechanism can be observed through examples where transport projects have already delivered active transport networks such as the Caulfield to Dandenong LXRP that delivered a new 12km shared path.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with all communities and councils to align project scope and stakeholder expectations		
Reference Design	Produce reference design for active transport networks scope		
Procurement	Include the project scope, technical requirements, and contract clauses relating to the scope		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Develop the scope during reference design in consultation with DoT and relevant stakeholders		

3.3.9. Mechanism 9 – Digital Maps

Table 10: VCC Mechanism 9 – Digital Maps

Mechanism #	9	Title	Digital Maps
Description			
Install digital screens for displaying network maps instead of static maps at Albion and Airport stations. This would be aligned with a DoT strategy for a whole-of-network rollout of digital maps.			
Risks			
There is a risk that the DoT whole-of-network rollout of digital maps does not go ahead which would result in inconsistent passenger experience and urban design outcomes.			
Possible Benefits			
Decreased operational expenditure to update maps each time the rail network is augmented, possibility to enhance passenger experience outcomes depending on final functionality.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with stakeholders, including the metropolitan rail network franchisee, Metro Trains Melbourne (MTM), to align project scope and stakeholder expectations		
Reference Design	Include digital maps in reference design at stations		
Procurement	Include the project scope, technical requirements, and contract clauses relating to the scope		
Cost			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Develop the scope during reference design in consultation with DoT and relevant stakeholders and confirm DoT strategy and timelines for the delivery of the whole-of-network rollout of digital maps before the relevant works package is procured		

3.4. Value Capture Mechanisms

3.4.1. Mechanism 10 – Advertising Opportunities

Table 11: VCC Mechanism 10 – Advertising Opportunities

Mechanism #	10	**Title**	Advertising Opportunities
Description			
Delivering infrastructure and allowing for space and access for advertising opportunities at stations and along the corridor.			
Risks			
Identified risks include: • advertising at the Airport Station may divert advertising industries from advertising within the airport which would impact APAM. This in turn may impact on dialogue and negotiations with APAM and approvals for the Project • negative impacts to passenger experience and design outcomes if the inclusion of advertising opportunities is not appropriately managed • some stakeholders may object to or not support some advertising mediums.			
Possible Benefits			
Provision for advertising opportunities on MAR will generate revenue and may contribute to increasing employment opportunities and economic stimulus. The revenue generated from advertising will help to offset the cost of operating the network (as per current franchise agreements).			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with stakeholders, including MTM and APAM, to align project scope and stakeholder expectations		
Reference Design	Include infrastructure, space and access for advertising opportunities in reference design at stations		
Procurement	Include the project scope, technical requirements, and contract clauses relating to the infrastructure, and space and access allowance for the advertising opportunities		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Develop the scope during reference design in consultation with DoT and relevant stakeholders		

3.4.2. Mechanism 11 – VicTrack Infrastructure

Table 12: VCC Mechanism 11 – VicTrack Infrastructure

Mechanism #	11	Title	VicTrack Infrastructure
Description			
Delivering VicTrack telecommunications infrastructure along the rail corridor. The Project will consult with VicTrack to determine the number of new optical fibre cores to be delivered between Sunshine Station and Melbourne Airport. VicTrack will manage on-selling telecommunications services over the fibre or selling cores as dark fibre to capture value for the State.			
Risks			
There is a risk that in delivering the additional telecommunication infrastructure, which will interface with the existing VicTrack networks, that the Project causes an unplanned disruption to VicTrack services which may have follow on impacts to operations that use the impacted service. The cost for additional communications infrastructure is not currently included in the order of magnitude cost, however it is possible that VicTrack will request the Project to provide additional infrastructure as they have for other major projects.			
Possible Benefits			
Provision of VicTrack infrastructure will contribute to the overall economic outcomes of the VicTrack telecommunications networks to generate revenue through selling telecommunications services and provide cost effective telecommunications services to State entities. The revenue is used to offset other VicTrack activities such as the remediation of contaminated land.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with VicTrack to align Project scope and expectations		
Reference Design	Include provision of VicTrack infrastructure in reference design		
Procurement	Include the project scope, technical requirements, and contract clauses relating to the VicTrack infrastructure		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Further develop scope detail during the reference design phase		

3.4.3. Mechanism 12 – Farebox Revenue

Table 13: VCC Mechanism 12 – Farebox Revenue

Mechanism #	12	Title	Farebox Revenue
Description			
The Project will present an opportunity to capture additional revenue from farebox. Work is currently being undertaken to determine the nature and scale of this additional revenue and to what extent it can be monetised to offset the capital and operational funding required.			
Risks			
There is a risk that a premium price may affect patronage (airport users only).			
Possible Benefits			
The premium fare will generate revenue which could be used to offset the operational cost of MAR.			
Timeframes			
Milestone	**Action**		
Procurement	Include the project scope, technical requirements, and contract clauses relating to implementing the MAR fare in the State ticketing solution		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational Costs			
Next Steps	Finalise the decision on ticket price for the purposes of the finalisation of the Business Case Consult with DoT to ensure any future upgrades/amendments to the network's ticketing system take MAR requirements into account		

3.4.4. Mechanism 13 – Partnership with airlines

Table 14: VCC Mechanism 13 – Partnership with Airlines

Mechanism #	13	Title	Partnerships with Airlines
Description			
Establish a partnership with airlines where the airline contributes funding to the State to receive in kind services such as: • discounted MAR fare for airline employees • discounted MAR fare for airline passengers • method to package MAR fare with airfare (end-to-end intermodal travel) • advertising (see section 3.4.1) • free fares for passengers affected by airline disruption • passengers can purchase MAR fare with airline points • passengers can gain airline points for purchasing MAR fares • passenger travel data (not including private information) is provided to the airline.			
Risks			
There is a risk that: • negative impacts to passenger experience if the provision of in-kind services is not appropriately managed • some stakeholders may object to or not support the partnership • financial pressures on airlines may reduce likelihood of financial contributions.			
Possible Benefits			
Funding from airline partnerships could be utilised to offset the operational cost of MAR.			
Timeframes			
Milestone	**Action**		
Stakeholder Engagement	Consult with airlines to determine possibility and nature of partnership Consult with the Department of Treasury and Finance (DTF) and the operator to determine what in-kind services could be offered and what the appropriate funding contribution would be		
Costs			
Project Resources	*Redacted* *Commercial-in-confidence*		
Capital Investment			
Operational costs			
Next Steps	Stakeholder engagement at any time through development and in the future		

4
VCC Delivery

4. VCC Delivery

4.1. Inclusion in core scope

It is important to note that a key aspect of the VCC Framework is to create and capture additional value which are above and beyond the core Project scope. In recognition of this, Table 15 below identifies which VCC Mechanisms are anticipated to be included in core scope, which VCC Mechanisms are complementary, and which VCC Mechanisms can be described as both. This will facilitate planning for VCC delivery and prioritisation.

Table 15: VCC Mechanisms – Inclusion in core scope

#	VCC Mechanism	Type (core/complementary/both)
1	**Digital Engineering**	Both. Whilst some aspects of Digital Engineering such as use of GIS platforms and Building Information Models are included in core scope, other aspects of Digital Engineering, such as the use of a shared platform and the transfer of asset information, is anticipated to be enhanced for MAR to create additional value for the State.
2	**Urban Design Strategy**	Both. The Urban Design Strategy is certain to be included in the Projects core scope, however the Strategy can be leveraged to create additional value for the passengers and the community.
3	**Creative Strategy**	Both. The Creative Strategy is certain to be included in the Project's core scope, however the Strategy can be leveraged to create additional value for the passengers and the community.
4	**Procurement Conditions**	Both. MAR will include procurement conditions as per the Victorian Social Procurement Framework, however the procurement conditions can be enhanced and targeted to create additional value for the environment, local businesses, disadvantaged employees or traditional owner groups.
5	**Sustainability Strategy**	Both. The Project's core scope includes a Sustainability Strategy, however the strategy can be leveraged to enhance and target additional value for the local and greater environment.
6	**MAR Project Hub**	Complementary. It is not yet confirmed whether the proposed MAR Project Hub will be established and what form it will take.
7	**Partnership with Tertiary education**	Complementary. It is not yet confirmed whether the Project will establish partnerships with tertiary education and what the partnerships would entail.
8	**Active Transport Networks**	Both. It is highly likely that the core Project will include the addition or upgrade of active transport networks, however there is still an opportunity to create further value by either increasing or enhancing this scope in the right locations.
9	**Digital Maps**	Complementary. It is not yet confirmed that the Project will supply and install digital maps, this will depend on the next level of design development and the establishment of a separate project to deliver the core infrastructure to support the digital maps.

#	VCC Mechanism	Type (core/complementary/both)
10	**Advertising Opportunities**	Both. The Airport and Albion stations will include spaces for advertising opportunities, however it is not yet confirmed the number, size and location of the spaces, nor whether infrastructure will be provided for digital billboards. These factors will directly affect the amount of value that can be captured from this mechanism.
11	**VicTrack Infrastructure**	Both. The core Project scope includes the delivery new VicTrack infrastructure. However, during the next level of design, studies will be undertaken on whether the infrastructure should include the next generation of networking technology which will greatly affect the cost of implementation and the value captured long-term. Value could also be added through laying of additional dark fibre in key locations where there is a substantial customer base for telecommunications services and infrastructure.
12	**Farebox Revenue**	Both. The Project will capture value via farebox revenue, however the final decision on pricing is still to be confirmed and will greatly affect the value captured by this mechanism.
13	**Partnerships with Airlines**	Complementary. It is not yet confirmed whether the State would partner with airlines, what this would entail, and how much value this mechanism would create.

4.2. Project VCC Governance and Delivery

The VCC Mechanisms that get included in the Project scope will be implemented in accordance with the project governance framework, including existing departmental and reporting requirements. However, separate planning and environmental approvals may be required for some VCC Mechanisms that have not been included in the planning and environmental approvals for the Project.

The project sponsor and project client is DoT. However, RPV manages the delivery of the Project's VCC Mechanisms on behalf of DoT as with other Project scope. RPV also provides subject matter expertise and an assessment of the appropriateness of the delivery of each mechanism to the rail environment.

DPC is responsible for ensuring the VCC Framework is implemented in accordance with policy requirements.

For VCC Mechanisms yet to be included in core scope, or that require further development, the Project will undertake further investigations and advancement of the VCC Mechanisms with governance provided by the nominated project lead roles as per Table 16 below.

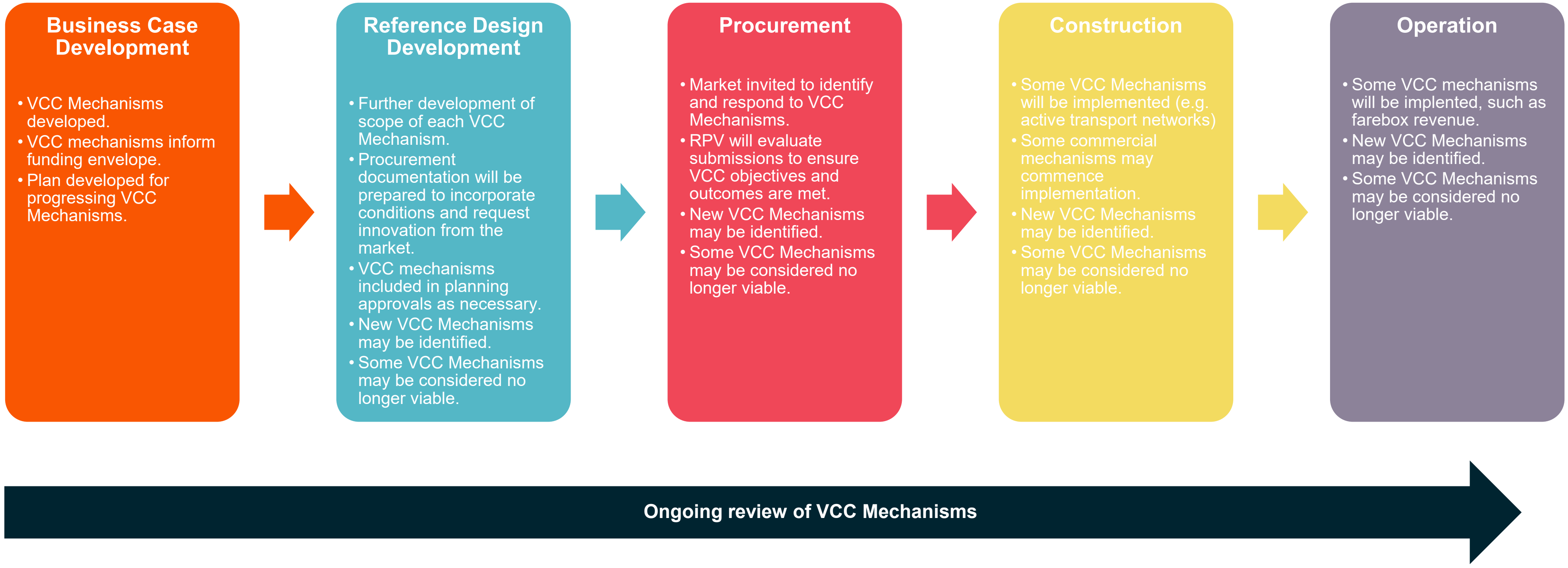
Table 16: Project Roles and Responsibilities for VCC Mechanisms

Project Role	Responsibility
Commercial Manager	Accountable party for VCC activities and outcomes. Reviewing reports and progress of the VCC activities and outcomes. Provide the reporting pathway to DTF and DoT for business case requirements, procurement conditions and process, and, further development of value capture mechanisms. Provide the reporting pathway to DPC on application of the VCC Framework and VCC Guidelines. Include opportunity for the market to identify and propose addition VCC Mechanisms through the procurement process.
Package Leads	Engagement with VicTrack and APAM for technical scope items.

Project Role	Responsibility
Digital Engineering Asset Manager	Provide the reporting pathway to DoT for asset information handover requirements.
Communications and Stakeholder Engagement Director and Deputy Director	Engage with stakeholders on all relevant, proposed VCC Mechanisms.
Senior Estimator	Produce high-level estimates for VCC Mechanisms. Include budget for VCC Mechanisms once confirmed as core Project scope.
Manager, Urban Design and Strategy	Provide reporting pathway to the Office of the Victorian Government Architect.
Senior Sustainability Advisor	Provide a reporting pathway to DTF for procurement conditions relating to sustainability.

Additionally, as the Project progresses, some VCC mechanisms may be identified that had not been previously, or that were identified but did not appear viable initially. Also, after further development, some VCC mechanisms may be assessed as no longer viable and therefore will not end up being implemented. An overview of VCC activities across the remaining project lifecycle is provided in Figure 2 on the next page.

Figure 2: Summary of VCC activities across the remaining project lifecycle



4.3. Collaboration and Integration

4.3.1. Policy Alignment

Table 17 below provides details on policies that are supported by the VCC Mechanisms as per the VCC Guidelines and VCC Framework.

Table 17: Policies that are supported by the VCC Mechanisms

#	VCC Mechanism	Policies
1	**Digital Engineering**	• Plan Melbourne 2017-2050 (Victorian Government, 2017) • Victorian Infrastructure Plan (Victorian Government, 2017) • Victorian Digital Asset Strategy (Victorian Government, 2019) • National Digital Engineering Policies (Australian Government, 2016) • Australian Infrastructure Plan (Australian Government, 2016)
2	**Urban Design Strategy**	• Creating Places for People: An Urban Design Protocol for Australian Cities (2011) • Plan Melbourne 2017-2050 (Victorian Government, 2017) • Plan Melbourne Addendum (Victorian Government, 2019) • Good Design and Transport (Office of the Victorian Government Architect, 2015) • Urban Design Guidelines for Victoria (Department of Environment, Land, Water and Planning, 2017) • Draft Sunshine National Employment and Innovation Framework (Victorian Planning Authority, 2017) • Transport Priority Strategy (Brimbank City Council, 2018) • RPV Urban Design Framework (Rail Projects Victoria, 2018) • Sunshine to Melbourne Airport Rail Corridor Urban Design Principles (Brimbank City Council, 2020) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019) • *Public Participation in Government Decision-making: Better practice guide* - Published by the Victorian Auditor-General's Office, Level 24, 35 Collins Street, Melbourne. www.audit.vic.gov.au ISBN 978 1 925226 04 1 January 2015
3	**Creative Strategy**	• Plan Melbourne 2017-2050 (Victorian Government, 2017) • Creative State Strategy 2016-2020 (Creative Victoria, 2016) • Public Art Policy and Plan 2018-2023 (Brimbank City Council, 2018)

#	VCC Mechanism	Policies
		• Cultural Strategy 2018-2022 (Brimbank City Council, 2018) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019) • *Public Participation in Government Decision-making: Better practice guide* - Published by the Victorian Auditor-General's Office, Level 24, 35 Collins Street, Melbourne. www.audit.vic.gov.au ISBN 978 1 925226 04 1 January 2015
4	**Procurement Conditions**	• Victorian Social Procurement Framework (Victorian Government, 2018) • Northern Metro Region Five Year Plan for Jobs, Services and Infrastructure 2018-2022 (Victorian Government, 2018) • Western Metro Region Five Year Plan for Jobs, Services and Infrastructure 2018-2022 (Victorian Government, 2018) • TAKE2: Acting now on climate change (Victoria Government, 2016) • Victoria's Climate Change Framework (Victoria Government, 2016) • *Climate Change Act 2017* (Vic) • Plan Melbourne 2017-2050 (Victorian Government, 2017) • Sustainable Procurement Guide (Australian Government, 2018) • Procurement Policy (Brimbank City Council, 2019) • Sustainability Policy (Brimbank City Council, 2019) • Sustainability Framework (Brimbank City Council, 2019)
5	**Sustainability Strategy**	• TAKE2: Acting now on climate change (Victoria Government, 2016) • Victoria's Climate Change Framework (Victoria Government, 2016) • *Climate Change Act 2017* (VictVict) • Greening the West – a regional approach • Protecting Victoria's Environment – Biodiversity 2037 (Victorian Government, 2017) • Water for Victoria (Victorian Government, 2016) • Sustainability Policy (Brimbank City Council, 2019) • Sustainability Framework (Brimbank City Council, 2019) • Climate Change Adaptation Framework (Brimbank City Council, 2017) • Plan Melbourne 2017-2050 (Victorian Government, 2017) • Biodiversity Strategy 2012-2022 (Brimbank City Council, 2012) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019)

#	VCC Mechanism	Policies
		• Brimbank Council Plan 2017-2021 (Brimbank City Council, 2017) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020) • *Public Participation in Government Decision-making: Better practice guide* - Published by the Victorian Auditor-General's Office, Level 24, 35 Collins Street, Melbourne. www.audit.vic.gov.au ISBN 978 1 925226 04 1 January 2015
6	**MAR Project Hub**	• Victorian Planning Authority Growth Corridor Plans (Victorian Government, 2016) • Community Facilities and Reserves Allocation Policy (Brimbank City Council, 2014) • A guide to Governing Share Community Facilities (Victorian Government, 2010) • Plan Melbourne 2017-2050 (Victorian Government, 2017) • Plan Melbourne Addendum (Victorian Government, 2019) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019) • Sunshine Rising Action Plan 2019-2024 (Brimbank City Council, 2019) • Brimbank Council Plan 2017-2021 (Brimbank City Council, 2017) • Brimbank Economic Development Strategy 2016-2020 (Brimbank City Council, 2016) • Brimbank Activity Centre Strategy 2018 (Brimbank City Council, 2018) • *Public Participation in Government Decision-making: Better practice guide* - Published by the Victorian Auditor-General's Office, Level 24, 35 Collins Street, Melbourne. www.audit.vic.gov.au ISBN 978 1 925226 04 1 January 2015
7	**Partnership with Tertiary Education**	• Plan Melbourne 2017-2050 (Victorian Government, 2017) • Plan Melbourne 2017-2050 Five Year Implementation Plan (Victorian Government, 2017) • Victoria's 30-year Infrastructure Strategy (Victorian Government, 2019) • Victorian Planning Authority Growth Corridor Plans (Victorian Government, 2016) • Sunshine Rising Action Plan 2019-2024 (Brimbank City Council, 2019) • Brimbank Council Plan 2017-2021 (Brimbank City Council, 2017) • Brimbank Economic Development Strategy 2016-2020 (Brimbank City Council, 2016) • Brimbank Youth Strategy 2015-2019 (Brimbank City Council, 2015) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019)

#	VCC Mechanism	Policies
8	**Active Transport Networks**	• Plan Melbourne 2017-2050 (Victorian Government, 2017) • Plan Melbourne 2017-2050 Five Year Implementation Plan (Victorian Government, 2017) • TAKE2: Acting now on climate change (Victoria Government, 2016) • Victoria's Climate Change Framework (Victoria Government, 2016) • *Climate Change Act 2017* (Vic) • Victoria's 30-year Infrastructure Strategy (Victorian Government, 2019) • *Transport Integration Act 2010* (Vic) • Victorian Infrastructure Plan (Victorian Government, 2017) • Western Metro Region Five Year Plan for Jobs, Services and Infrastructure 2018-2022 (Victorian Government, 2018) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019) • Brimbank Council Plan 2017-2021 (Brimbank City Council, 2017) • Cycling and Walking Strategy (Brimbank City Council, 2016) • Transport Priorities Paper 2018 (Brimbank City Council, 2018) • Unlock the opportunity – transport priorities (Brimbank City Council 2018) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020) • *Public Participation in Government Decision-making: Better practice guide* - Published by the Victorian Auditor-General's Office, Level 24, 35 Collins Street, Melbourne. www.audit.vic.gov.au ISBN 978 1 925226 04 1 January 2015
9	**Digital Maps**	• Urban Design Guidelines for Victoria (Victorian Government - Department of Environment, Land, Water and Planning, 2017) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020) • Sunshine to Melbourne Airport Rail Corridor Urban Design Principles (Brimbank City Council, 2020)
10	**Advertising Opportunities**	• Victorian Visitor Economy Strategy (Victorian Government, 2016) • Plan Melbourne 2017-2050 (Victorian Government, 2017) • Plan Melbourne 2017-2050 Five Year Implementation Plan (Victorian Government, 2017) • Central Highlands Regional Growth Plan (Victorian Government, 2014) • Visitor Experience & Local Participation Strategy 2018-2023 (Brimbank City Council, 2018)

#	VCC Mechanism	Policies
		• Brimbank Council Plan 2017-2021 (Brimbank City Council, 2017) • Sunshine Station Super Hub Urban Design Principles (Brimbank City Council, 2019) • Albion Station Precinct Urban Design Principles (Brimbank City Council, 2020)
11	**VicTrack Infrastructure**	• *Transport Integration Act 2010* (Vic) • Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019)
12	**Farebox Revenue**	• *Transport Integration Act 2010* (Vic) • Brimbank Economic Development Strategy 2016-2020 (Brimbank City Council, 2016)
13	**Partnerships with Airlines**	• Western Rail Plan, including Melbourne Airport Rail Link and Sunshine Super Hub – Brimbank Response Strategy (Brimbank City Council, 2019)

4.3.2. Collaboration

It is anticipated that while developing these mechanisms further, RPV will collaborate with the following organisations / project delivery teams.

- DPC for reviewing and providing feedback on RPV's application of the VCC Framework.
- RPV representatives that are responsible for delivering the Metro Tunnel Project, for:
  - understanding opportunities to leverage existing partnerships between Metro Tunnel Project, Holmesglen, RMIT, and University of Melbourne
  - exploring any sustainability initiatives that could be leveraged and extended to MAR
  - sharing of digital engineering models around the interface at Sunshine Station to increase the benefits of digital engineering
  - exploring connecting to any active transport networks that will be provided in proximity to Sunshine by the Metro Tunnel Project.
- LXRP for:
  - understanding opportunities to leverage existing partnerships between LXRP and tertiary institutions
  - sharing standard designs built into digital engineering models and other related value engineering solutions
  - exploring any sustainability initiatives that could be leveraged and extended to MAR.
- DoT for:
  - defining the asset information handover requirements to optimising the benefit from applying digital engineering to MAR
  - exploring any initiatives related to the HCMTs
  - providing guidance on active transport network strategies and opportunities to connect with future networks
  - exploring any sustainability initiatives that could be leveraged and extended to MAR.
- Creative Victoria for exploring any creative initiatives or programs that could be incorporated into the Creative Strategy.
- Office of the Victorian Government Architect, Department of Jobs, Precincts and Resources, and the Victorian Planning Authority for inputs into the Urban Design Strategy.

- Department of Environment, Land, Water and Planning for:
  - determining appropriate ongoing monitoring for sustainability targets and initiatives
  - providing information on innovative ways infrastructure projects are developing and delivering sustainability outcomes.
- Environmental Protection Authority for:
  - determining appropriate ongoing monitoring for sustainability targets and initiatives
  - providing information on innovative ways infrastructure projects are developing and delivering sustainability outcomes.
- DTF for:
  - reviewing the appropriateness of the proposed value capture mechanisms
  - determining the potential revenue of the proposed value capture mechanisms.

4.4. VCC in Procurement Phase

RPV is planning to ask shortlisted respondents for work packages to identify and propose opportunities to deliver or capture additional value on MAR. This request will be made with accompanying principles and guidelines for appropriate VCC opportunities.

Additionally, RPV will explore asking shortlisted respondents for work packages to propose interventions relating to specific VCC Mechanisms such as the Urban Design Strategy, Sustainability Strategy and Creative Strategy.

To achieve the potential value of the above processes, RPV is working to determine the appropriate associated budget to request for these potential initiatives.

Where appropriate, shortlisted respondents will also be asked to propose their solution for meeting local content, sustainability and recycling targets that RPV are currently working to develop, under Mechanism 4 – Procurement conditions.

Work is currently being undertaken to determine what will be expected from shortlisted respondents with respect to the documentation included in their proposals.

4.5. VCC Funding and Financial Impacts

Funding for the majority of the proposed VCC Mechanisms will need to be requested in the Business Case for the project. Some funding or in-kind contributions may be available through partnerships.

VCC Mechanisms that are employed on the Project will have funding and financial impacts on the Project. The scale of impact will depend on to what level each VCC Mechanism is applied. To determine to what level each VCC Mechanism is appropriate to employ on the Project, RPV will analyse the estimated cost and outcomes associated.

5
VCC Outcomes

5. VCC Outcomes

5.1. Value Creation Outcomes

The value creation outcomes targeted by the VCC Mechanisms for MAR have been further developed as follows:

- Improved productivity, economic growth, employment and government revenue achieved by:
  - providing employment opportunities at MAR Project Hub
  - providing employment opportunities in the advertising industry by increasing advertising opportunities, in the construction industry through the additional scope to be delivered, and in the creative industry by providing opportunities
  - providing local employment opportunities through the application of social and sustainable procurement
  - improving productivity and employment by improving accessibility via active transport networks
  - generating government revenue through farebox, advertising opportunities, retail spaces, telecommunications services, and from airlines.
- Improved access to jobs, education, services, affordable housing and recreation by providing active transport networks.
- Increased social and environmental capital through the application of the Creative Strategy and the Sustainability Strategy.
- Enhanced public safety and amenity through the application of the Urban Design Strategy.
- Improved design quality in the built environment through the use of digital engineering.

5.2. Value Capture Outcomes

The value capture outcomes targeted by the VCC Mechanisms for MAR are:

- increased capacity to fund additional projects and services by capturing revenue from, advertising opportunities, and telecommunications services
- beneficiaries contributing to Project costs in a fair and equitable way by applying farebox charges, and considering other sources of 'user' revenue.

5.3. Key Performance Indicators

RPV will further develop the draft Key Performance Indicators (KPIs) in Table 18 below to monitor the impact of each mechanism. This activity will be undertaken once the scope if developed further to provide the detail required to set an appropriate KPI.

Table 18: VCC draft KPIs

#	VCC Mechanism	Draft KPI	Draft KPI Measure
1	**Digital Engineering**	• Improved quality of asset information • Reduced design process • Accelerated project delivery • Improved safety • Improved ease of access to information • Decreased designed cost	• Assessed against evaluation criteria during design process • Shorten delivery program for comparable work • Reduced whole-of-life costs • Reduced review cycles (i.e. decrease in number of drawing and documents requiring revision)

#	VCC Mechanism	Draft KPI	Draft KPI Measure
		• Improved interface management	• Reduced number of near misses and incidents • Reduced response time to information requests • Increased design re-use (on MAR from other projects and on future projects from MAR) • Reduced risk relating to interface management
2	**Urban Design Strategy**	• Increased amenity values • Increased asset values • Increased perception of safety	• High level of stakeholder engagement
3	**Creative Strategy**	• Increased amenity values • Increased use of local content and diverse creative practitioners including Indigenous artists	• High level of stakeholder engagement
4	**Procurement Conditions**	• Increased employment outcomes • Increased social outcomes • Increased environmental outcomes	• Assessed against evaluation criteria during design process
5	**Sustainability Strategy**	• Decreased greenhouse gas emissions • Increased use of recycled materials	• Decreased construction and operational energy emissions • Improving on the amount of recycled materials used from what will be incorporated into the contract
6	**MAR Project Hub**	• Increased social outcomes	• Increase in community engagement
7	**Partnership with Tertiary education**	• Increased social outcomes	• Increase in local capability
8	**Active Transport Networks**	• Increased public safety • Increased perception of safety • Increased amenity values • Increased asset values • Improves access to jobs, education and services	• Number of local trips made by walking, cycling and public transport • Increase diversity of active transport network users
9	**Digital Maps**	• Increased social outcomes	• Increase in customer satisfaction • Decrease in cost of future roll-out of changes to network maps
10	**Advertising Opportunities**	• Increased public revenue	• Value of public revenue
11	**VicTrack Infrastructure**	• Increased public revenue	• Value of public revenue
12	**Farebox Revenue**	• Increased public revenue	• Value of public revenue
13	**Partnerships with airlines**	• Increased public revenue	• Value of public revenue

Appendix A

Appendix A

This Appendix A provides a contextual overview of MAR, relevant policy objectives, and the problems to be addressed and expected benefits to be delivered through the Project.

Overview

The construction of MAR via Sunshine was announced by the Victorian Government in June 2018. The Project will create a new public transport connection along the existing Albion-Jacana corridor, transporting high volumes of passengers efficiently and reliably between Melbourne Airport and the CBD via Sunshine Station. This 'Sunshine Route' was chosen because it offers superior connections to both Melbourne, and regional Victoria, through its connections to Bendigo, Ballarat and Geelong. The Sunshine Route also enables earlier deliverability at a lower cost than other route options.

Problem Definition

Victoria's growing population and strong economy are major factors behind the significant growth in passenger numbers at Melbourne Airport. Increased export capability and demand, as well as the rise of e-commerce, is also leading to increases in air freight to and from Melbourne Airport. As a result, MAR addresses two key problems, defined by seven sub-problems:

Table 19: Problem summary

Problem	Sub-problems
Problem 1 Limited public transport connections to Melbourne Airport constrain passenger access	• There are few practical public transport options for the majority of airport users • Travel to Melbourne Airport is heavily reliant on private vehicles • Growing airport patronage and population is exacerbating congestion on airport access routes • Travel times to the airport can vary significantly during peak hours
Problem 2 Increasingly congested links to Melbourne Airport limit Victoria's economic prosperity	• Growing congestion impacts supply chain efficiency for air freight • Congestion reduces accessibility to employment opportunities for people in Melbourne's north and west • Poor quality access to employment hubs limits Victoria's economic potential

Policy Objectives

The Victorian Government's policy objectives for MAR are largely outlined in the *2018 Melbourne Airport Rail Link Strategic Appraisal*. These policy objectives frame MAR as an investment that is critical for Melbourne's identity as an international city. They also emphasise the benefits that construction of MAR will bring to a broad range of Victorians in terms of economic stimulus.

Key policy comments are outlined below:

- *'Melbourne Airport provides access to interstate and international markets. It connects our businesses and institutions to knowledge, education and innovation. It also brings people to Victoria, allowing the State to capitalise on growing domestic and international travel markets. Melbourne Airport is vital to Victoria's ongoing prosperity, both for Melbourne and the regions.'*[1]
- *'By improving connectivity to Melbourne Airport, surrounding suburbs can also gain significant benefit. Greater public transport network coverage and capability will promote economic development of Melbourne's inner north-west by attracting commercial and residential development, leading to the greater availability of jobs locally and stimulating economic activity in the area. The north-west is also an important catchment for airport employees. Employees who currently drive to work have limited alternative transport options that meet their access needs. And as new jobs associated with the growth of the airport are generated, they will need to be in reach of prospective employees.'*[2]

Project Benefits

The provision of an integrated heavy rail link between Melbourne Airport and the broader metropolitan and regional rail network through Sunshine will deliver significant benefits to the Victorian community. In particular, addressing the two key problems discussed will deliver the following benefits to the Victorian community:

- enhanced travel outcomes and choice for airport users travelling to and from Melbourne Airport
- improved productivity and competitiveness for Victoria.

Project Objectives

The Victorian and Australian governments agreed objectives for the Project are to:

- support Victoria's and Australia's economic growth by improving access to international and interstate labour, knowledge, services and visitor / tourism markets
- address growth pressures in Melbourne and regional Victoria, including population growth and increasing congestion
- ensure financial and economic sustainability with consideration given to patronage and precinct development
- maximise service offerings to passengers through frequent and reliable services and passenger amenity
- integrate the transport service into the urban and regional transport network to facilitate broader economic and social development goals for Victoria
- catalyse viable urban and economic development opportunities
- maximise other government policy outcomes through route options, with regard to housing affordability, transport mode connections and access to employment.

[1] Transport for Victoria, *Melbourne Airport Rail Link Sunshine Route Strategic Appraisal* (2018), 4.
[2] Transport for Victoria, *Melbourne Airport Rail Link Sunshine Route Strategic Appraisal* (2018), 11.

Appendix B

Appendix B

Traceability Overview

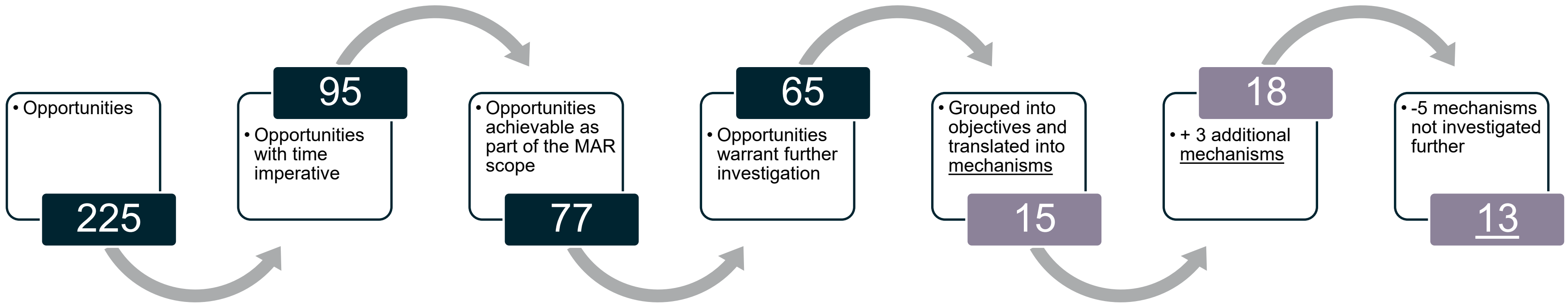
There were 225 VCC opportunities identified as part of RPV's research and consultations. Given the breadth of opportunities, RPV developed a process from the VCC Guidelines to assess whether the opportunities warranted further investigation and development into VCC Mechanisms. The process includes the following steps:

- **Step 1** – Identify which VCC opportunities have a time imperative to be completed concurrently to MAR.
- **Step 2** – F rom Step 1, identify which VCC opportunities are considered achievable as a result of the core Project scope being developed.
- **Step 3** – From Step 2, analyse and determine which deliver the greatest VCC benefits for the associated costs and therefore warrant further investigation.
- **Step 4** – Each time the MAR scope is refined, run through Steps 1 to 3 to re-validate that the VCC opportunity still warrants further investigation and development into a VCC Mechanism for MAR.

The remaining VCC opportunities were then further shortlisted by grouping them based on common objectives. The grouped VCC opportunities were then translated into the VCC mechanisms included in this DVCCP.

An additional 5 VCC mechanisms were identified after the development of the initial 15.

Figure 3: Process to assess the 225 VCC Opportunities into VCC Mechanisms



Step 1 – Time Imperative

130 of the proposed 225 VCC opportunities **did not have a time imperative to be completed concurrently to MAR.**

50 of these are listed below to provide an understanding of the type of opportunities included in the 130.

The remaining 80 are related to the clarification of the scope at Sunshine Station which resulted in many VCC opportunities no longer having a time imperative to be completed concurrently to MAR.

95 opportunities progressed to Step 2 of the process.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station
VCC Opportunities in **BOLD** will be referred on to DPC, DELWP and DJPR. VCC Opportunities in *ITALICS* will be referred on to DoT.	

Table 20: VCC opportunities that do not have a time imperative to be completed concurrently to MAR

Research into Indigenous/colonial history of Tullamarine to leverage in the context of tourism	Accelerated planning and environmental approvals to stimulate growth at Solomon Heights	**Remove or relax planning controls to stimulate investment**	***Improvements to the Ballarat Road intersection***	**Air-city infrastructure e.g. hire car facilities, accommodation, conference centres**
Airport Rail Link app with information and tourism discounts	***Viewing platforms of the rail corridor and surrounding environmental assets***	Arts and cultural regeneration (e.g. Abbotsford Convent)	**Commercial development on the corner of St Albans Road**	*Emphasis on major transport interchange with integrated bus connections*
Shuttle bus from Sunbury to support commuting workers	*Road bridges between industrial centres*	**Additional parks, gardens and community squares**	**New community sport and recreational infrastructure**	**Innovation centres and incubator spaces**
Roving tourism ambassadors	Long term Melbourne Airport car-parking	**Markets/fresh produce showcase**	*Expanded bus hub*	*Driverless vehicles fleet location*
Wifi connectivity	**Biodiversity enhancements**	*Decked car parking*	**Albion precinct urban renewal**	Accelerate NBN rollout in Sunshine
Extension of rail to Broadmeadows and Sunbury	Improved access to Solomon Heights	**Heritage flour mills interface and opportunities for tourism**	***Improved connections to Sunshine Hospital***	**Infrastructure improvements to support a vibrant night life**
Internal bike share scheme within Airport precinct	**Reinvigoration of the Airport West shopping centre**	Future proofing for industry transition west of Ballarat Road	**Planning controls to deliver more commercial space**	**Luxury accommodation and shopping precinct**
Anchor institutions/companies incentivised by the Government	**Affordable housing at Solomon Heights**	*Accelerated application of Transport for Victoria (TfV's) Tram West plans*	*Link the two sides of Sunshine through the station*	Link Grieve Parade to Sunshine Road
Improved bus connections with local routes	*Extended tram routes to Airport West shopping centre*	*Extending tram tracks down Ballarat Road*	**Increased accommodation density**	*Hampshire Road relocation optimisation*
Infrastructure for the medical tourism precinct	**Public spaces for markets, fairs, showcases etc.**	*Improved connections to Victoria University*	*Bikes paths connected to the CBD*	*Additional car parking for rail passengers*
Commercial development opportunities in areas where car parking is no longer required	*Supporting community groups activation to remove rubbish along the corridor*	**Albion triangle opportunities including commercial development**	*Improved bus network to Altona, Sunshine, Werribee*	***Fast tracking Government land redevelopment***

Step 2 – Achievable under MAR Scope

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station
VCC Opportunities in **BOLD** will be referred on to DPC, DELWP and DJPR. VCC Opportunities in *ITALICS* will be referred on to DoT.	

RPV found that 18 of the remaining 95 remaining VCC opportunities **were not considered "achievable as a result of the core project being developed"**. They are listed below with rationale.

77 opportunities progressed to Step 3 of the process.

Table 21: VCC opportunities that are not considered achievable as a result of MAR development

VCC Opportunity	Rationale
Road bridges between housing and shopping areas	MAR rail alignment does not provide this opportunity.
Aligning with a potential future Tulla Widening	
Additional station at Keilor Downs	
Transition zone opportunities (Assumed that this refers to transition between Airport Station and airport terminal buildings)	These opportunities are the outside realm of what the Project can deliver on behalf of the State on the allocated space on Airport land shown in the Melbourne Airport Master Development Plan.
Sculpture park	
Shopping complex	
Additional stations at the Airport for different terminals	
Education tourism facilities	
Conference facilities	
Innovation incubators	
Improved hotels and accommodation	
Tourism support services	
Concierge services infrastructure	
Pet services infrastructure	
Innovative cultural investments	
Local gallery/museum outpost e.g. National Gallery of Victoria (NGV)	
Accredited Melbourne Visitor Centre	
Rolling stock stabling	

Step 3 – Warrant Further Investigation

12 of the remaining 77 proposed VCC opportunities **have been analysed and determined to deliver the least benefit for the associated costs, and therefore do not warrant further investigation under MAR.** They are listed below with rationale.

The remaining **65** opportunities were then developed into VCC Mechanisms.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station
VCC Opportunities in **BOLD** will be referred on to DPC, DELWP and DJPR. VCC Opportunities in *ITALICS* will be referred on to DoT.	

Table 22: VCC opportunities that do not warrant further investigation under MAR

VCC Opportunity	Rationale
Additional station in the business park	Decision paper completed to exclude from scope.
Future proofing for additional stations at Melbourne Airport for different terminals	Low benefit as solution to service individual terminals is unlikely to be heavy rail.
Reconfiguration and upgrades to the McIntyre Road area	Extremely high associated cost, should be considered as a separate major road project.
Maintenance facilities along corridor	High associated cost, use of HCMT fleet with maintenance facilities in Pakenham.
Allow freight movements along the corridor	The associated load change to bridges would significantly increase cost.
Improved freight connections to Melbourne Airport	
Redevelop heritage bridge across Maribyrnong River	Too challenging with the heritage overlays. The scope is to protect the bridge and replicate its design.
Re-scoping Albion as a station on the MAR route	Increased journey time to above project objectives.
Improved connectivity across Anderson Road	High associated cost.
Reconfiguration of Albion Station and the Ballarat Road intersection	High associated cost
Future proofing for over site development	Analysis completed – limited benefits – recommended not to proceed.
Check in/bag drop for Airport customers	Decision paper completed – recommended not to proceed.

VCC Opportunities to VCC Mechanisms

The remaining **65** proposed VCC opportunities were **grouped according to the VCC Objectives** that they *primarily* correspond to. The VCC Objectives were established in the VCC Statement of Intent.

The table below shows the number of opportunities grouped against each objective and how these then translated into VCC Mechanisms. The following sections provide further detail on what VCC opportunities were included in each of the groups and a short description of the VCC Mechanisms.

Table 23: Mapping of VCC objectives to VCC Mechanisms

VCC Mechanisms -> *Primary* **Objective**	**# Opportunit**	**Active Transport**	**Urban Design Strategy**	**Partnerships with Airlines**	**Commercial Opportunities**	**Advertising Opportunities**	**VicTrack Infrastructure**	**Creative Strategy**	**Digital Engineering**	**Procurement Conditions**	**MAR Project Hub**	**Sustainability Strategy**	**Partnership with Tertiary**	**Improvement of Services**	**Ticketing System**	**Park and Ride at MAR**
Promote tourism opportunities to interstate and international tourists	0															
Improve skills training	1												x			
Improve the passenger experience	8		x												x	
Improve exposure and access to local history and culture	5							x								
Increase and improve community spaces	3		x													
Improve the local environment	7											x				
Consideration of proposed future developments	1													x		
Reduce the environmental impact of the project	13									x		x				
Increase access and connectivity	9	x														x
Increase employment opportunities and access to them	7									x	x					
Develop a procurement strategy that drives enhanced economic outcomes	4								x							
Investigate opportunities for additional revenue streams	7			x	x	x	x									
Investigate opportunities for negotiated beneficiary payments and in-kind contributions	0															
Investigate opportunities to leverage land holdings and planning controls	0															

Increase Access and Connectivity

9 VCC opportunities were grouped into the VCC Objective – "**Increase access and connectivity"**.

These have contributed to the development of VCC Mechanisms on **Active Transport Networks** and **Park and Ride at MAR Stations**.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

Table 24: VCC opportunities that correspond to the VCC objective "increase access and connectivity".

Proposed VCC opportunities that correspond to the VCC objective "Increase access and connectivity"		
Increased cycling and pedestrian connections over the corridor	**VCC Mechanism**	Active Transport Networks
Foot bridges	**Description**	This involves including the upgrades, connection and creation of active transport networks along the rail corridor and around stations.
Integration with Principal Bike Network policies		
Maintain access points to the public land around the Maribyrnong River		
Improved cycling and pedestrian access		
Improved connections to Station from residential areas		
Improved accessibility		
Improved connections into the Albion triangle		
Multi-storey car parking	**VCC Mechanism**	Park and Ride at MAR stations
	Description	Delivering infrastructure for ticketed park and ride at MAR stations. Work is being undertaken to consider the potential revenue of park and ride at MAR stations, and the associated cost with providing the associated infrastructure.

Increase and Improve Community Spaces and Improve Passenger Experience

3 VCC opportunities were grouped into the VCC Objective – "**Increase and improve community spaces**".

8 VCC opportunities were grouped into the VCC Objective – "**Improve the passenger experience**".

These have contributed to the development of VCC Mechanisms on **Urban Design Strategy** and **Ticketing System**.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

Table 25: VCC opportunities that correspond to the VCC Objectives "increase and improve community spaces" and "improve passenger experience"

Proposed VCC opportunities that correspond to the VCC objective "Increase and Improve Community Spaces"	**VCC Mechanism**	Urban Design Strategy
Street-scaping	**Description**	This involves the development and implementation of an Urban Design Strategy that will inform the public realm and architectural design and identity of the stations and corridor.
Green space developments		
Green streetscapes, rooftop greening and canopies		
Proposed VCC opportunities that correspond to the VCC objective "Improve the passenger experience"		
Intuitive way finding		
Urban design for Victoria's 'first impression'		
Facilities for families		
Emphasis on amenity improvements for local residents (in comparison to the superhub at Sunshine)		
Improved safety e.g. CCTV facilities, well-lit open areas, better design outcomes		
Ensure facilities at Sunshine are comparable to major international airport transit stations		
Simple ticketing systems	**VCC Mechanism**	Ticketing System
Pre-paid tickets scheme	**Description**	Using the State ticketing solution for trains, trams and buses (except SkyBus) for MAR. To provide best passenger experience outcomes.

Investigate Opportunities for Additional Revenue Streams

7 VCC opportunities were grouped into the VCC Objective – **“Investigate opportunities for additional revenue streams”**.

These have contributed to the development of the below VCC Mechanisms.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

Table 26: VCC opportunities that correspond to the VCC Objective “investigate for additional revenue streams”

Proposed VCC opportunities that correspond to the VCC objective “Investigate opportunities for additional revenue streams”		
Partnerships with Airlines	**VCC Mechanism**	Partnerships with airlines
	Description	Establish a partnership with airlines where the airline contributes funding to MAR to receive in kind services.
Commercial opportunities for export companies	**VCC Mechanism**	Commercial opportunities at Melbourne Airport
	Description	Delivering infrastructure for small retail opportunities at the Melbourne Airport Station and surrounds.
Banners, brochures, touch screens	**VCC Mechanism**	Advertising opportunities
Advertising along rail corridor	**Description**	Delivering infrastructure and allowing for space and access for advertising opportunities at stations and along the corridor.
Innovative tourism advertising along the corridor		
Audio-visual advertising to highlight tourism opportunities in regional areas		
Install and upgrade fibre connections along the corridor	**VCC Mechanism**	VicTrack Infrastructure
	Description	Delivering VicTrack telecommunications infrastructure along the rail corridor. The Project will consult with VicTrack to determine the number of new optical fibre cores to be delivered between Sunshine Station and the Airport. VicTrack will manage on-selling telecommunications services over the fibre or selling cores as dark fibre to capture value for the State.

Improve Exposure and Access to Local History and Culture

5 VCC opportunities were grouped into the VCC Objective – **"Improve exposure and access to local history and culture**".

These have contributed to the development of a VCC Mechanism on the **Creative Strategy**.

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

Table 27: VCC opportunities that correspond to the VCC objective "improve exposure and access to local history and culture"

Proposed VCC opportunities that correspond to the VCC objective "Improve exposure and access to local history and culture"	VCC Mechanism	Creative Strategy
Public artwork to improve journey for tourists	Description	This involves including the development and implementation of a Creative Strategy that will provide cultural and creative considerations to inform contractors delivering design and construction activities associated with MAR. The Creative Strategy is related to the Urban Design Strategy.
Community artwork		
Public artwork to improve journey for tourists		
Creative strategy for the line that emphasises Indigenous history		
Community art integrated into design		

Develop a Procurement Strategy that Drives Enhanced Economic Outcomes

4 VCC opportunities were grouped into the VCC Objective – **"Develop a procurement strategy that drives enhanced economic outcomes".**

These have contributed to the development of a VCC Mechanism on **Digital Engineering**.

Table 28: VCC opportunities that correspond to the VCC objective "develop a procurement strategy that drives enhanced economic outcomes"

Proposed VCC opportunities that correspond to the VCC objective "Develop a procurement strategy that drives enhanced economic outcomes"	VCC Mechanism	Digital Engineering
Building Information Modelling	Description	This involves determining to what extent the Victorian Digital Asset Strategy will be applied to MAR.
Building Information Modelling		
Building Information Modelling		
Building Information Modelling		

Improve Skills Training

1 VCC opportunity corresponded to the VCC Objective **"Improve skills training"** and was developed into a VCC Mechanism on **partnering with tertiary education.**

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

Table 29: VCC opportunity that corresponds to the VCC objective improve skills training"

Proposed VCC opportunity that corresponds to the VCC objective "Improve skills training"	VCC Mechanism	Partnership with Tertiary Education
Partnership with Victoria University: • Address national rail skills shortage - e.g. signalling centre, driver training simulation • Linking with international businesses • Integrate into over site development • Partner with construction/signalling/aviation company.	**Description**	Establish a partnership with tertiary education providers to: • establish a rail skills centre to address national rail skills shortage and provide further education and employment opportunities to the community • link with international businesses for innovation in rail. This could include sponsorship or partnership with rail infrastructure managers, rail operators, constructors, and design firms. It is noted that the under Metro Tunnel Project's Tunnels and Stations Package, the Cross Yarra Partnership (CYP) and Holmesglen TAFE have established Metro Hub as a jobs and training centre for the work package. Additionally the Metro Tunnel Project has built the Victorian Tunnelling Centre (VTC) at Holmesglen Institute's Chadstone campus.

Consideration of proposed future developments

1 VCC opportunity corresponded to the VCC Objective **"Consideration of proposed future developments"** and was developed into a VCC Mechanism on **improvement of services around the airport.**

Table 30: VCC opportunity that corresponds to the VCC objective "consideration of proposed future developments"

Proposed VCC opportunity that corresponds to the VCC objective "Consideration of proposed future developments"	VCC Mechanism	Improvement of Services around Melbourne Airport
Improvements in services to Melbourne Airport e.g. drainage	**Description**	Upgrade service lines to and from Melbourne Airport such as power, water, drainage, sewage, telecommunications, fuel and gas. Work is being done to determine areas where MAR may upgrade services to and from the airport that need to be relocated during delivery of MAR.

Increase Employment Opportunities and Access to Them

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

7 VCC opportunities were grouped into the VCC Objective – **"Increase employment opportunities and access to them".**

These have contributed to the development of VCC Mechanisms on **Procurement Conditions** and **MAR Project Hub.**

Table 31: VCC opportunities that correspond to the VCC objective "increase employment opportunities and access to them"

Proposed VCC opportunities that correspond to the VCC objective "Increase employment opportunities and access to them"		
Implementation of the Local Jobs First Policy	**VCC Mechanism**	Procurement Conditions
Social procurement framework Social procurement framework Social procurement framework Implementation of the Local Jobs First Policy Social procurement framework	**Description**	Involves aligning the MAR Procurement Strategy to the Victorian Social Procurement Framework to consider how RPV can use best-placed approaches to address entrenched disadvantage, support regional small and medium enterprises, and support environmental sustainability.
Big Build Office	**VCC Mechanism**	MAR Project Hub
	Description	Involves the establishment and operation of a MAR Project Hub in Sunshine.

Improve the Local Environment

Legend	
Melbourne Airport Station	Rail Corridor
Albion Station	Sunshine Station

7 VCC opportunities were grouped into the VCC Objective – **"Improve the local environment".**

These have contributed to the development of a VCC Mechanism on **Sustainability Strategy**.

Table 32: VCC opportunities that correspond to the VCC objective "improve the local environment"

Proposed VCC opportunities that correspond to the VCC objective "Improve the local environment"	**VCC Mechanism**	Sustainability Strategy
Plant trees	**Description**	Involves the development and implementation of a Sustainability Design Strategy that will inform the design and activities undertaken during delivery.
Maribyrnong River environmental improvements		
Activation of green areas near Maribyrnong River for public use		
Cleaning up rubbish along the corridor as part of project delivery		
Climate change resilience opportunities		
Water capture mechanisms		
Increased protection of rare orchid		

Reduce the Environmental Impact of the Project

13 VCC opportunities were grouped into the VCC Objective – **"Reduce the environmental impact of the project".**

These have contributed to the development of a VCC Mechanism on **Social and Sustainable Procurement** and **Sustainability Strategy**.

Table 33: VCC opportunities that correspond to the VCC objective "reduce the environmental impact of the project"

Proposed VCC opportunities that correspond to the VCC objective "Reduce the environmental impact of the project"		
Sustainability target (as part of procurement strategy)	**VCC Mechanism**	Social and Sustainable Procurement
ISCA Green Energy rating	**Description**	Involves aligning the MAR Procurement Strategy to the Victorian Social Procurement Framework to consider how RPV can use best-placed approaches to address entrenched disadvantage, support regional small and medium enterprises, and support environmental sustainability.
Sustainability target (as part of procurement strategy)		
ISCA Green Energy rating		
Implementation of a sustainability target (as part of procurement strategy)		
Implementation of a sustainability target (as part of procurement strategy)		
Install solar panels along the rail corridor	**VCC Mechanism**	Sustainability Strategy
Install wind turbines along the rail corridor	**Description**	Involves the development and implementation of a Sustainability Design Strategy that will inform the design and activities undertaken during delivery.
Integrate water catchment with the rail corridor infrastructure		
Innovative renewable energy opportunities		
Opportunities to use contaminated soil safely including opportunities for community infrastructure		
Green station including climate resilience elements		
Improved energy ratings for station buildings		

Additional VCC Mechanisms

3 additional VCC Mechanisms have been identified after the development of the VCC Mechanisms detailed in the previous sections. These are detailed below.

Table 34: VCC Mechanisms identified outside of the 225 VCC opportunities

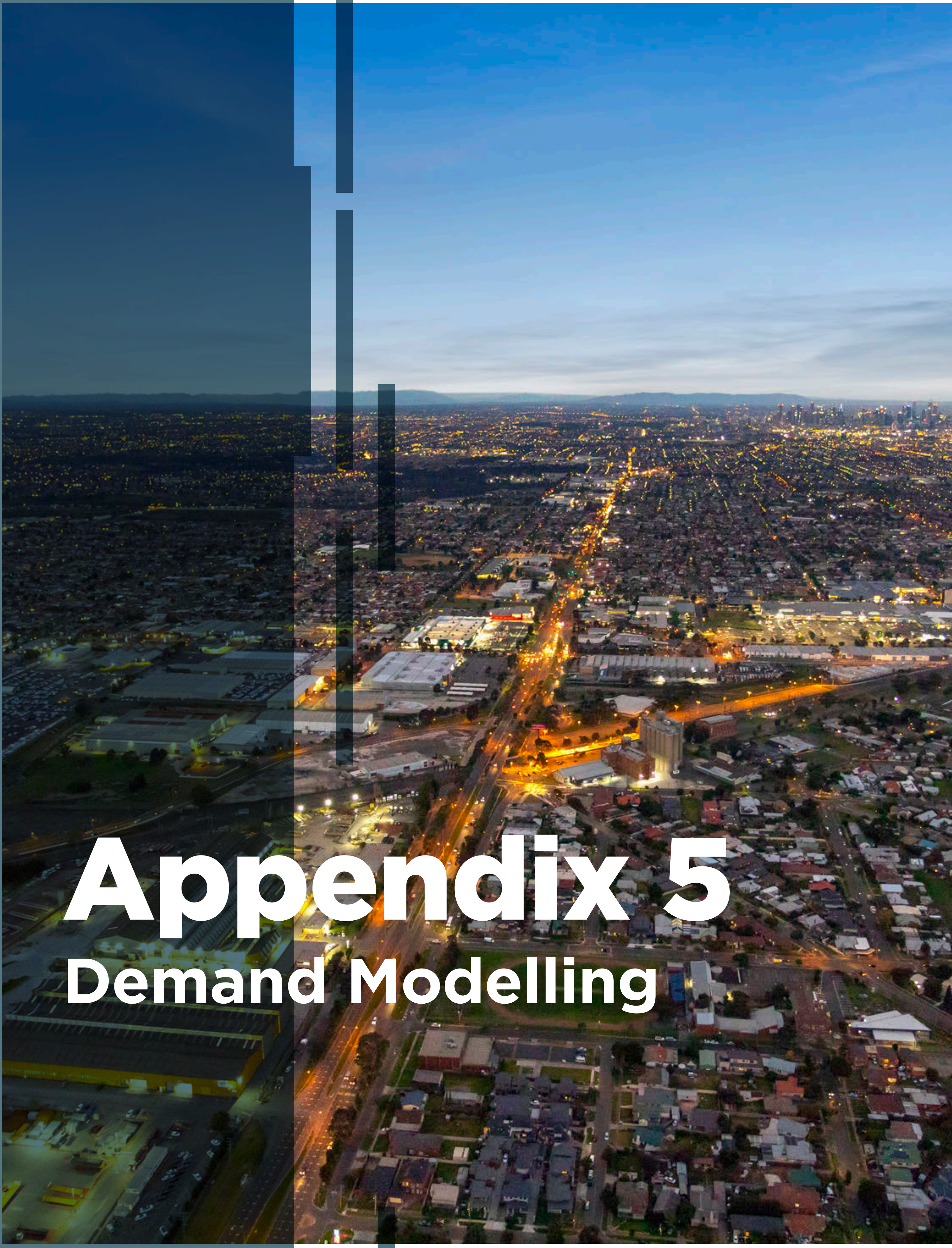
VCC Mechanism	Description
Farebox Revenue	The Project will present an opportunity to capture additional revenue from farebox. Work is currently being undertaken to understand the nature and scale of this additional revenue and to what extent it can be monetised to offset capital and operational funding required.
Digital Maps	Install digital screens for displaying network maps instead of static maps at Albion and Airport stations. This would be aligned with a DoT strategy for a whole-of-network rollout of digital maps.
Infrastructure Levies on Development	Securing funding through infrastructure levies on development. Work is being undertaken to consider if funding is available and appropriate for MAR through infrastructure levies.

VCC Mechanisms not investigated further

Table 35: VCC Mechanisms not being investigated further under MAR with rationale

VCC Mechanism	Rationale
Improvement of utility services around the airport	The Project has included a provision of funding in the Business Case for the relocation of utilities as necessary around Melbourne Airport. Increased capacity may result from this relocation if it involves re-configuration of the services network. The project team determined that it was unlikely to obtain additional funding available to upgrade service lines to create additional project value due to the high associated cost.
Ticketing System	The ticketing system VCC Mechanism arose from two VCC opportunities, one for “simple ticketing systems” and another for a “pre-paid tickets scheme”. These opportunities were able to be realised through the incorporation of the existing State ticketing system for MAR. However, the decision to proceed with the State ticketing system for MAR was made independently to these VCC opportunities. This means that a simple ticketing system with a pre-paid tickets scheme was already included in project scope and therefore this cannot be considered as a mechanism for creating additional value.
Park and Ride at Stations	Multi-storey parking at Albion and Sunshine stations was considered in the Project options analysis and not included in the final Project scope. Additional parking at stations in the south-east where the MAR services stop was considered but not pursued further as there is no time imperative to complete works at stations not currently included

VCC Mechanism	Rationale
	in the project scope. This mechanism has been referred on to DoT for further consideration outside of MAR.
Commercial opportunities at the airport	Provision of small retail opportunities at Melbourne Airport Station (within the areas managed and operated by the State / Rail Franchisee) and surrounds was considered in the development of the package scope and not included due to space and perceived commercial activity constraints on airport land.
Infrastructure Levies on Development	Work was undertaken to consider if it would be appropriate and possible to obtain funding through infrastructure levies on development. It was determined that this mechanism would not be appropriate to consider due to the low value and high availability of the surrounding land outside of the airport boundary which would mean that additional development levies would impede further development in the area. Additionally, as the MAR service provides value to beneficiaries outside of the Project location, it was determined that broader beneficiary levies through farebox is a more appropriate value capture mechanism.



Appendix 5

Demand Modelling

Disclaimer and limitations

Inherent limitations

This report has been prepared as part of the project scope. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

Model outputs are always an approximation of what can be expected in the real environment. The Victorian Integrated Transport Model (VITM) is a strategic planning tool that is best at representing strategic level demands and patterns at a network wide and corridor level, rather than individual links within a transport network. Notwithstanding this, there will usually be differences between forecasts or projected and actual results because events and circumstances frequently do not occur as expected or predicted, and those differences may be material. KPMG does not make any confirmation or assessment of the commercial merits, technical feasibility or compliance with any applicable legislation or regulation of the transport policy reforms, technology interventions and/or major transport projects described in this report.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by Rail Projects Victoria (RPV) management and personnel consulted as part of the process. The VITM (including its associated output reporting modules) is a Victorian Government model and KPMG does not accept any liability arising from errors that might be embedded in the model. KPMG was provided the VITM by the Victorian Government and has not sought to independently verify the inputs, model logic or outputs (aside from those expressly discussed within the validation section of this report). The Victorian Integrated Transport Model– Model Inputs and Parameters 2020 was used which was provided to KPMG by the Department of Transport (DoT) in March 2020.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

COVID-19

The current COVID-19 crisis poses a range of risks to global and Victorian economic conditions, and the length and severity of these impacts remain unknown. COVID-19 has contributed to significant change in work and travel patterns. It is uncertain however to what extent these immediate impacts will result in a permanent change to travel behaviour. The current assumptions underpinning VITM as provided by DoT (including trip generation rates, airport patronage forecasts, population forecasts and employment forecasts) are based on pre-COVID-19 data. Given the uncertainty of COVID-19 and its long-term impacts, it is likely that there may be material differences between forecasts or projected and actual results.

The VITM outputs and associated forecasts and projections contained in this report need to be interpreted with an understanding of the above as well as the specific strengths and weaknesses of the VITM.

Third party reliance

This report is solely for RPV's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This report has been prepared at the request of the RPV in accordance with the terms of KPMG's engagement letter / contract dated 3 September 2018. Other than our responsibility to RPV, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Contents

Glossary

AJM	Aurecon Jacobs Mott McDonald
ASCs	Alternative Specific Constants
AV	Autonomous Vehicle
DEWLP	Department of Environment, Water, Land and Planning
DoT	Department of Transport
HCMT	High Capacity Metro Train
IA	Infrastructure Australia
LUTI	Land Use Transport Interaction
MAR	Melbourne Airport Rail
MTP	Metro Tunnel
NEICs	National Employment and Innovation Clusters
RPV	Rail Projects Victoria
SALTM	Sydney Airport Landside Transport Model
SRL	Suburban Rail Loop
VITM	Victorian Integrated Transport Model

Executive summary

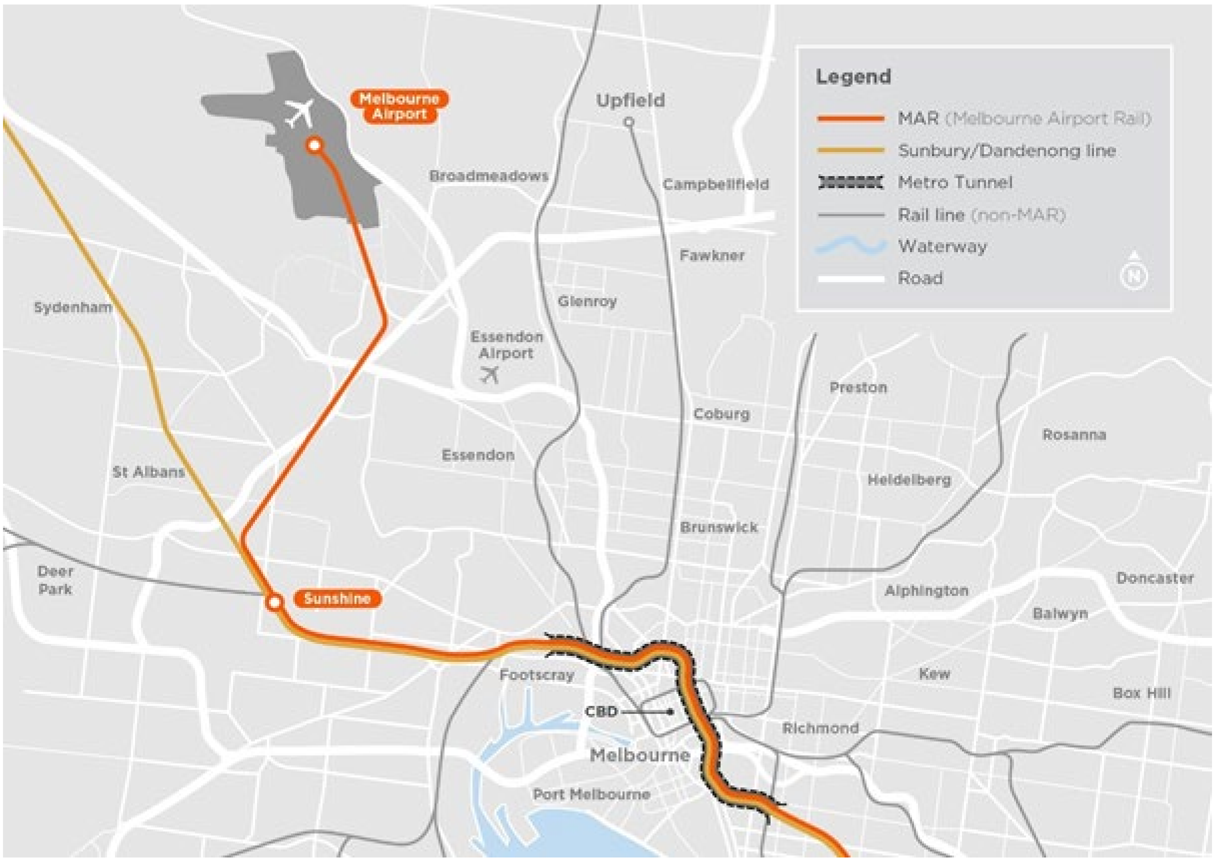
This report details the methodology and results of the patronage demand forecasting undertaken for the Melbourne Airport Rail (**MAR**) project.

MAR provides a rail connection between Melbourne Airport and the CBD via Sunshine. MAR will connect airport services with the rest of the metropolitan rail network, providing multiple entry and exit points within the Melbourne CBD via the five new stations along the Metro Tunnel (**MTP**) corridor, and link to the City Loop via Melbourne Central and Flinders Street stations.

The improved service provision between Sunshine and Pakenham / Clyde, particularly in the non-peak periods, will also result in better connectivity to Melbourne's south-east and the National Employment and Innovation Clusters (**NEICs**) along this corridor. The ability to transfer at Sunshine also provides connectivity to the regional Victorian lines of Bendigo, Ballarat and Geelong, as well as the Wyndham and Melton growth areas.

Figure 1 illustrates the MAR alignment in the context of the Melbourne transport network.

Figure 1: MAR alignment in the context of the Melbourne transport network



Strategic transport demand modelling for MAR was undertaken by KPMG using the Victorian Integrated Transport Model (**VITM**). The modelling draws upon relevant transport demand modelling guidelines and key assumptions and inputs were sourced from / agreed with a range of stakeholders, including DoT and Rail Projects Victoria (**RPV**).

The demand modelling assessed the incremental impact of MAR on the future transport network by comparing the Project Case scenario (with MAR) to the Base Case scenario (without MAR), as described below:

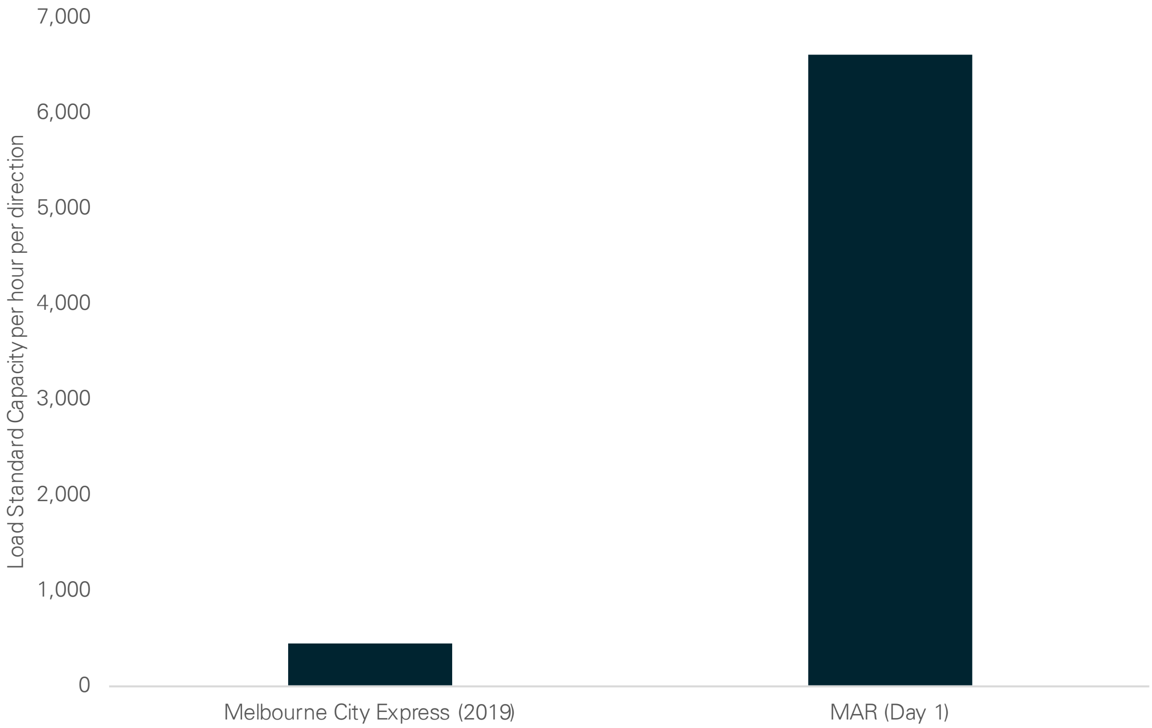
- **Base Case** – The Base Case is the reference point for the analysis and considers future transport network assumptions and land use projections consistent with the DoT Reference Case (refer Section 3.3), but excludes MAR. Under the Base Case, the SkyBus between Southern Cross and Melbourne Airport (**Melbourne City Express**) is the primary means of public transport connecting Melbourne CBD to the airport until Suburban Rail Loop (**SRL**) North connects to the airport in 2051. Both Melbourne Airport Rail and SRL East (from Cheltenham to Box Hill) are currently expected to commence construction in 2022, with SRL North (from Box Hill to Melbourne Airport) to be delivered later. In consideration of this, the demand modelling has been undertaken both with and without the SRL North connection to Melbourne Airport in 2051 in the Base Case,
- **Project Case –** The Project Case incorporates the Base Case described above, plus the changes to the transport network required to deliver the proposed service plan for MAR. Under the Project Case, the Melbourne City Express SkyBus ceases service during MAR hours of operation.

MAR provides an alternative mode of airport ground access that is independent of road congestion. The demand modelling results show that MAR delivers improved public transport connectivity to the airport by increasing public transport capacity, facilitating easier transfers and reducing overall journey times.

The delivery of MAR will significantly increase public transport capacity to the airport, as outlined in Figure 2. The Melbourne City Express service has a capacity of 75 passengers and currently runs every nine to ten minutes, resulting in a one-way capacity of 450 passengers per hour. MAR will operate with the 7-car High Capacity Metro Train (**HCMT-7**) on day one of operations, which has a capacity of 1,100 passengers. With a service every 10 minutes, MAR will deliver a one-way capacity of 6,600 passengers per hour, significantly increasing the capacity available compared to the current Melbourne City Express SkyBus service.[1]

[1] It is likely that the Melbourne City Express capacity will be expanded to cater to increased demand over the next decade. However, this will be limited by constraints at Melbourne Airport / Southern Cross Station and the maximum capacity of buses.

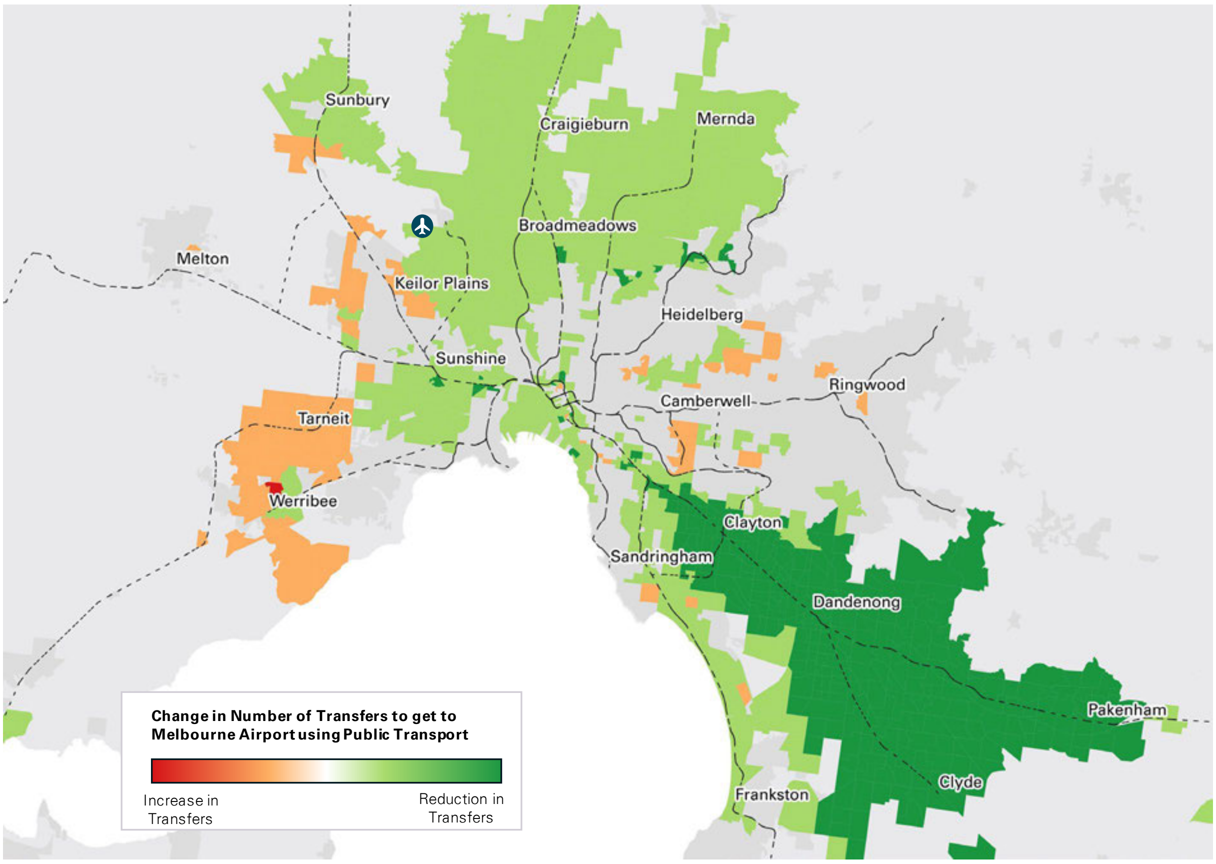
Figure 2: Capacity uplift delivered by MAR (compared to the 2019 Melbourne City Express)



Source: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.

MAR also reduces the number of transfers required to access Melbourne Airport by public transport. The modelling shows that this will primarily benefit people residing along the Metro Tunnel corridor between Sunshine and Pakenham / Clyde, where a vast majority of the population will be able to travel to Melbourne Airport without transferring (refer Figure 3). Reducing transfers will provide airport users with more comfortable trips, by minimising the need to negotiate heavy luggage between transfers, and reducing time spent waiting and transferring between services.

Figure 3: Change in number of transfers required to reach Melbourne Airport by public transport with MAR (2031)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

The modelling shows that MAR provides improved public transport travel times to the airport in the AM peak and PM peak. During these times, MAR delivers a faster journey (30 minutes) compared to the Melbourne City Express, where the journey time is 40 minutes in 2031 and 66 minutes in 2056. During the interpeak and off-peak periods, the travel time between Melbourne Airport and the CBD via MAR is approximately 27 minutes. This is initially a longer travel time compared to the Melbourne City Express. However, due to worsening road congestion in later years, MAR is able to provide competitive travel times in all periods from 2051 onwards.

Improvements in connectivity, capacity and travel times drive mode shift to public transport. Figure 4 illustrates the increasing public transport patronage trend both in the Base Case (Melbourne City Express) and Project Case (with MAR). This shows that public transport patronage increases significantly under MAR with patronage increasing from 20,000 to 51,000 from 2031 to 2056. Across the same period, Melbourne City Express patronage grows from 19,000 to 28,000 under the Base Case, highlighting the capacity constraints associated with SkyBus as the primary public transport service to the airport.

Figure 4: MAR patronage compared to SkyBus patronage

***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

The enhanced public transport connectivity provided by MAR increases the number of people travelling to the airport by public transport. This mode shift reduces the number of vehicles on the road network, providing congestion relief for cars and enhancing travel to Melbourne Airport by road across the entire network.

Beyond improved access to and from the airport, MAR results in a mode shift to public transport with more people choosing to travel using MAR to the Melbourne Airport rather than drive. This results in a significant drop in the number of vehicles on the Victorian road network, especially on the Tullamarine Freeway and Citylink, resulting in higher road network speeds and improved travel time for both airport users and other road network users (i.e. non-business and business trips). Coupled with improved road travel time reliability on key links surrounding the airport, MAR reduces contingencies / input costs for businesses and contributes to minimising impediments to productivity growth.

The ongoing COVID-19 pandemic may also affect future use of MAR. COVID-19 has already induced significant changes to work and travel patterns, and its highly fluid nature means that the length and severity of its impacts still remain unknown. As such, the demand impact of the pandemic was assessed through a sensitivity scenario which considered lower population and employment growth, an increase in working from home and a short-term reduction in air travel. Under this scenario, daily MAR patronage decreased by between 5 and 6 per cent when compared to the core Project Case.

1 Introduction

1.1 Overview

This report details the methodology and results of the patronage demand forecasting undertaken for MAR to support a business case being prepared by the Victorian Department of Transport (**DoT**).

The demand modelling has been undertaken to understand the impact of MAR, an investment designed to enhance travel choice and outcomes for users travelling to and from Melbourne Airport, while also contributing to enhanced productivity and competitiveness for Victoria.

1.2 Background

Despite the recent widening of the CityLink-Tullamarine Freeway corridor, the forecast sustained increase in airport patronage and freight demand will continue to impact travel times on this key airport access route. The ongoing concentration of employment in Melbourne's CBD and population growth in areas along the Melbourne Airport-CBD corridor will also put further pressure on Melbourne's arterial network.

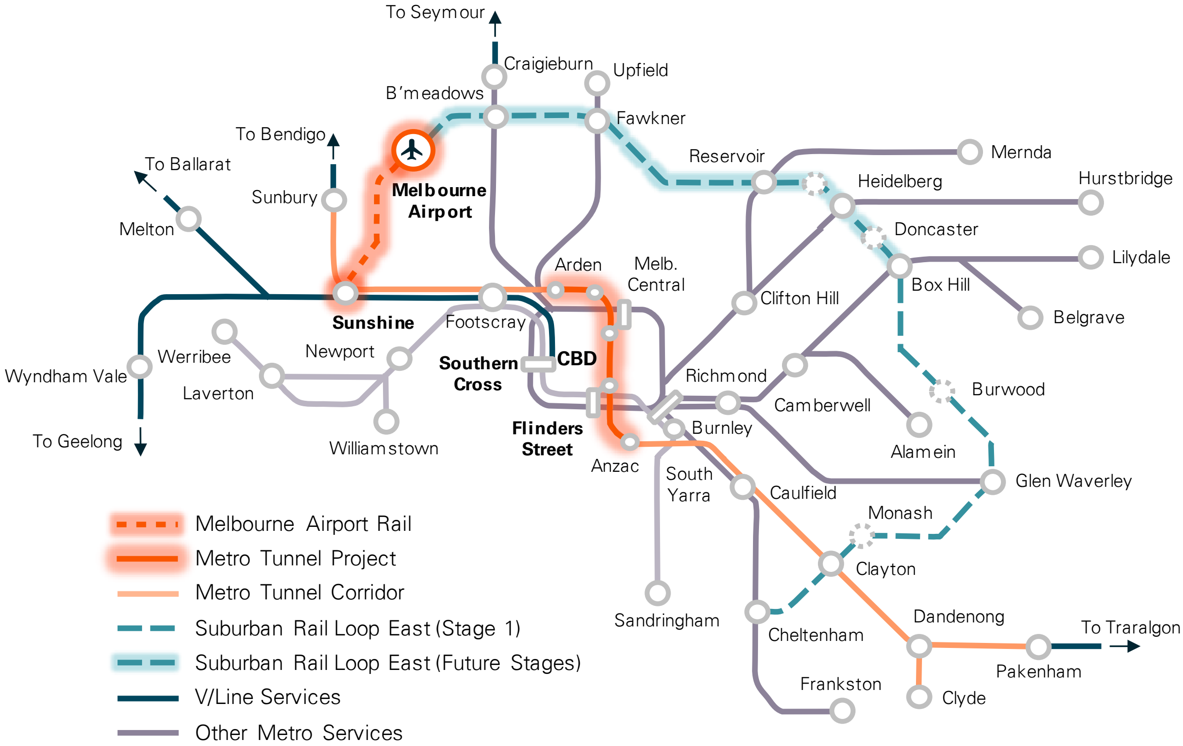
MAR addresses the project objectives specified in Section 1.3 below, including improving travel choice and reliability of ground access options to the airport, and reducing the impact of congestion on the CityLink-Tullamarine Freeway corridor. The project has been listed as a national priority by Infrastructure Australia (**IA**).

MAR will run via Sunshine and connect to the Metro Tunnel. As a result, MAR will directly connect airport services with the rest of the metropolitan rail network, providing multiple entry and exit points within the Melbourne CBD via the five new stations along the MTP corridor, and link to the City Loop via Melbourne Central and Flinders Street stations. The improved service provision along the Metro Tunnel corridor (between Sunshine and Pakenham / Clyde), particularly in non-peak periods, will also result in better connectivity to Melbourne's south-east and the NEICs along this corridor. The route via Sunshine and Footscray also provides connectivity to the regional Victorian lines of Bendigo, Ballarat, and Geelong, as well as the Wyndham, Melton, Cardinia and Casey growth areas.

MAR is expected to deliver benefits to airport passengers and also generate and enhance economic, social and environmental value for road users along key access routes across the network.

Figure 5 provides an overview of MAR in the context of the Melbourne passenger rail network. This figure also highlights how MAR interacts with the future SRL North project.

Figure 5: Schematic of the proposed MAR project



The MAR scope of works are detailed in Chapter 6 of the MAR Business Case and summarised below:

- an elevated station at Melbourne Airport
- a track pair starting at the Airport Station and transitioning into an elevated viaduct at Mercer Drive that continues across Sharps Road and over the Western Ring Road (M80) – the track continues on an embankment toward and through the Albion-Jacana freight corridor from Steele Creek, including a new bridge crossing over the Maribyrnong River, and a double track flyover past Albion Station after which the track merges into the Sunbury line just before entering Sunshine Station
- future proofing for an intermediate station (proposed at Keilor East)
- works at Sunshine Station to enable delivery of MAR
- line-wide rolling stock, traction power, train control and signalling solutions.

1.3 MAR objectives

The agreed objectives of the Australian and Victorian governments for MAR are to:

- address growth pressures in and around Melbourne, including population growth and increasing congestion
- increase public transport services, options and accessibility to and between Melbourne Airport and the CBD
- ensure financial and economic sustainability with consideration given to patronage and precinct development

- maximise service offerings to passengers with frequent and reliable services, and improved passenger amenity
- support Victoria's and Australia's economic growth by improving access to international and interstate markets
- integrate the Project into the urban and transport network to facilitate broader economic and social development goals for Victoria
- catalyse viable urban and economic development opportunities
- maximise other government policy outcomes with options for corridors including with respect to housing affordability, transport mode connections and access to employment.

1.4 Outcomes

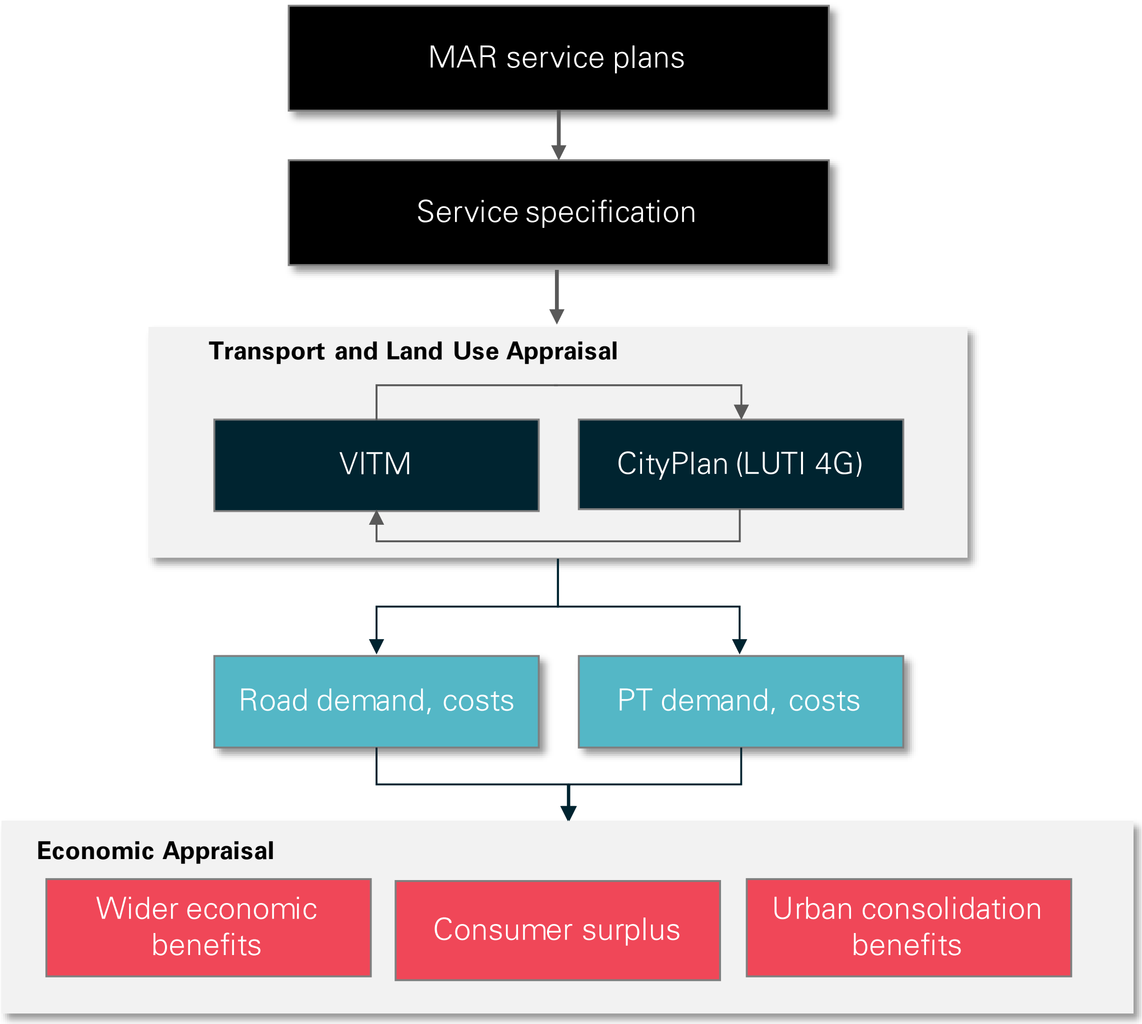
The anticipated MAR project outcomes are provided below. The outcomes align with the benefits of addressing the overarching problems identified in the MAR Business Case:

- **Enhanced travel choice and outcomes for airport users travelling to and from Melbourne Airport** – the project provides a foundation for enhanced accessibility and connectivity to and from Melbourne Airport by offering a faster and more reliable alternative to road-based travel, particularly in peak periods. This higher quality service will promote increased public transport usage and release capacity across the road network, particularly on the key access routes to the airport.
- **Improved productivity and competitiveness for Victoria** – Beyond improved access to and from the airport, the mode shift to public transport due to MAR reduces congestion on key arterial roads across Melbourne. As Melbourne's arterial network is a key carrier of the city's freight task, the travel time savings will reduce input costs and help boost productivity for local exporters and businesses importing goods.

1.5 Scope of demand modelling

Strategic transport demand modelling has been undertaken by KPMG using VITM. The modelling draws upon the relevant transport demand modelling guidelines and assumptions agreed with key stakeholders, including DoT and RPV. Figure 6 summarises the demand modelling framework adopted for the project. While CityPlan modelling was undertaken to understand the land use impacts of MAR, the land use changes were not material and as such the results were not iterated through VITM (refer to Section 7.6).

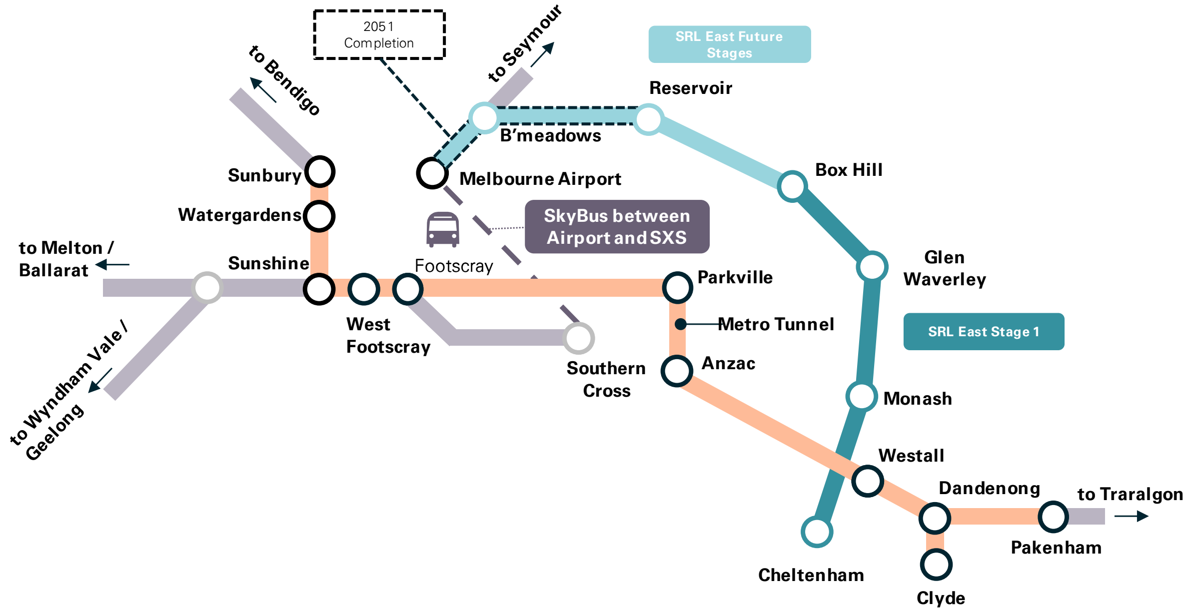
Figure 6: Demand modelling framework



The demand modelling assessed the incremental impact of MAR on the future transport network by comparing the Project Case scenario (with MAR) to the Base Case scenario (without MAR), as described below:

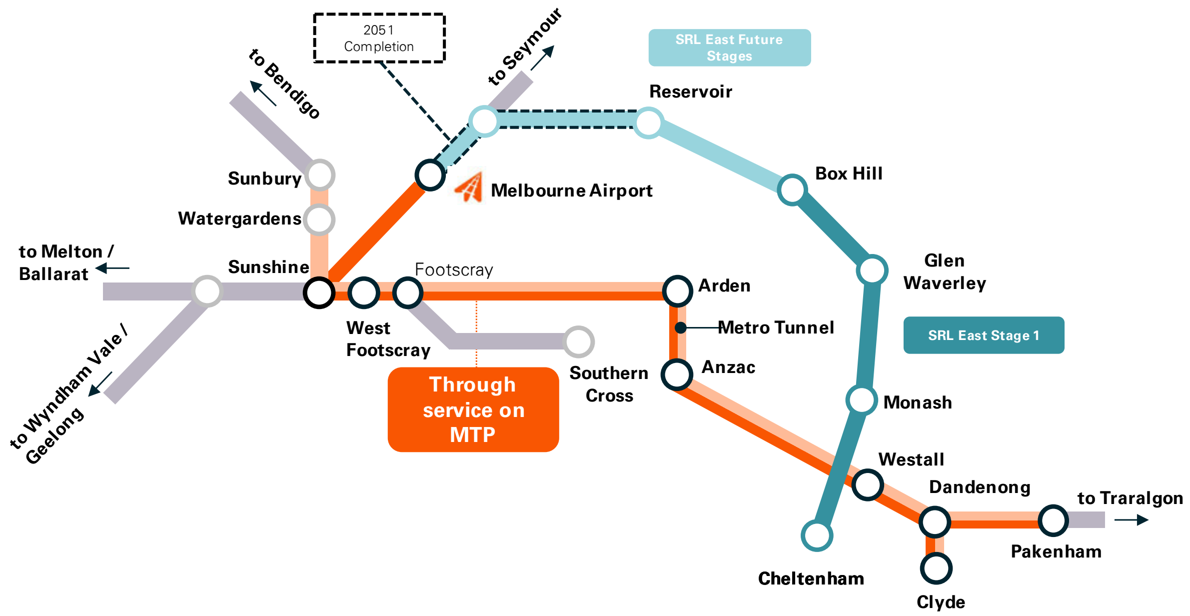
- **Base Case** – The Base Case is the reference point for the analysis and considers future transport network assumptions and land use projections consistent with the DoT Reference Case (refer Section 3.3), but excludes MAR. The Base Case network configuration is presented in Figure 7. Under the Base Case, the Melbourne City Express is the primary means of public transport connecting Melbourne CBD to Melbourne Airport until SRL North connects to the airport in 2051.
- Both Melbourne Airport Rail and SRL East (from Cheltenham to Box Hill) are currently expected to commence construction in 2022, with SRL North (from Box Hill to Melbourne Airport) to be delivered later. In consideration of this, the demand modelling has been undertaken with and without the SRL North connection to Melbourne Airport in 2051 in the Base Case.

Figure 7: Base Case network configuration



- **Project Case** – The Project Case incorporates the Base Case described above, plus the changes to the transport network required to deliver the proposed service plan for MAR. The network configuration associated with the Project Case is detailed in Figure 8. Under the Project Case, the Melbourne City Express SkyBus ceases service during MAR hours of operation.

Figure 8: MAR Project Case network configuration



1.6 Purpose

The purpose of this report is to provide detail regarding the strategic transport demand modelling undertaken to support the MAR Business Case.

The demand modelling outputs have primarily been used to inform the MAR economic appraisal but are also used as a key source to illustrate and evidence the problems and benefits sections identified in the MAR Business Case.

This report details the transport demand modelling process and reports the scenarios modelled, transport demand forecasts and key findings from analysis of the demand modelling outputs, including sensitivities and scenario testing undertaken. In particular, the demand modelling considers how MAR will:

- impact travel behaviour in Victoria
- contribute to meeting the projected demand growth at Melbourne Airport
- change how people travel to and from the airport
- reduce congestion on the Melbourne road network, especially the key access routes to Melbourne Airport.

1.7 Report structure

The remainder of this paper is structured as set out below:

- **Section 2** provides the background context for MAR
- **Section 3** provides an overview of the demand modelling methodology
- **Section 4** describes access to Melbourne Airport in the Base Case
- **Section 5** details the improved public transport and road accessibility resulting from MAR
- **Section 6** discusses the broader impacts of MAR on the Victorian economy from a demand modelling perspective
- **Section 7** details the demand related impacts due to changes to key modelling assumptions
- **Section 8** details the findings of the CityPlan modelling undertaken for MAR.

2 Context

Melbourne Airport is a critical piece of infrastructure to the Victorian economy. It connects people from across Australia and the world to Victoria. It plays a crucial role in opening up local businesses to new markets for trade and tourism. As Melbourne's population and economy has expanded, so too has activity at the airport. In the last year, over 37 million passengers passed through the airport, 52 per cent higher than volumes from a decade ago.[2]

The airport is also the most significant economic hub in Melbourne's west, directly employing over 20,700 people and supporting an additional 20,900 jobs in the business parks and employment centres surrounding the precinct.[3] In 2015-16, it was estimated that activities within the airport generated over $7 billion in direct economic activity for Victoria, and $20.7 billion in flow-on economic benefits to Australia.[4]

The airport's role in facilitating economic activity requires a high degree of landside accessibility. Currently, ground access is wholly reliant on road-based transport. While the roads surrounding the airport have served it well in the past, rapid urbanisation in Melbourne's north and west, and sustained airside patronage growth, have increased demand on roads connecting the airport. As more people travel to, from and past the airport precinct, the airport's primary access routes have become increasingly congested.

The impacts of congestion are most acutely felt on the Tullamarine Freeway, where nearly all airport traffic from across Melbourne is ultimately funnelled. The resulting bottleneck can double travel times to the airport from the CBD during the morning peak, and delay time-sensitive passengers en route to catching scheduled flights.

Congestion on airport access routes has broad implications. Alongside facilitating trips to the airport, these arterials connect people to jobs, education and social opportunities, and enable the movement of goods across the city to their final customers. Decline in the quality of airport access routes results in:

- eroding travel time reliability to the airport for all users including passengers travelling via private vehicle or public bus, employees and commercial vehicles
- smaller labour and customer catchments for Melbourne's businesses and employment clusters, as accessibility to employment and other economic opportunities declines
- increasing supply chain costs caused by goods spending more time in traffic, diminishing the competitiveness of Victorian businesses
- constraints on economic benefits which can be generated from emerging knowledge clusters, impacting Melbourne's reputation as an attractive place to live and invest.

This congestion is likely to worsen over time. By 2048, the number of passenger movements at Melbourne Airport is expected to nearly double to 87 million per annum, and result in more cars on already-congested roads.[5] At the same time, continued population growth in Melbourne's outer north and west will place further pressure on the Tullamarine Freeway and impact the journeys of nearly all airport users.

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[2] Department of Economic Development, Jobs Transport and Resources, *Jet Fuel Study,* (2018).
[3] Melbourne Airport, *Melbourne Airport Master Plan,* (2018). Jobs quoted are full-time equivalent.
[4] Ibid.
[5] Department of Economic Development, Jobs Transport and Resources, *Jet Fuel Study,* (2018).

Planning for the continued pressures on ground access to Melbourne Airport is important for both airport users and the broader community. In line with national trends, the fastest growing sectors of the Victorian economy are service and knowledge-based industries concentrated in Melbourne's CBD and around key health and education precincts, mostly based in Melbourne's eastern and south-eastern suburbs. This will concentrate vehicles on the diagonal formed by the Tullamarine and Monash Freeways, extending from the airport to Dandenong, and will impact the efficiency of all landside movements to the airport.

Given land use constraints which prevent further widening of the Tullamarine Freeway, the continued reliance on private vehicles (including taxis and ridesharing) to get to the airport is not sustainable. To this end, the transport demand forecasting undertaken for MAR seeks to assess the demand for travel to Melbourne Airport under a scenario where MAR is operational compared to a scenario where MAR is not operational (and the Melbourne City Express is the primary means of public transport connecting Melbourne CBD to Melbourne Airport until SRL North connects to the airport in 2051).

3 Methodology

3.1 Governance

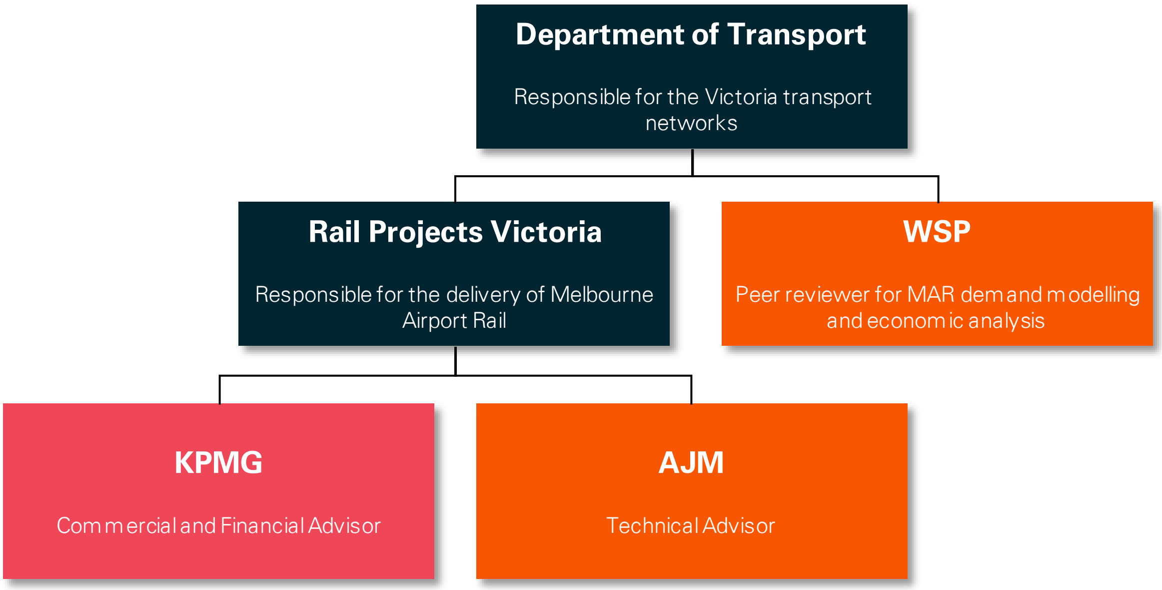
Governance arrangements for the MAR Business Case have been established by DoT to provide inquiry and oversight of transport demand modelling in Victoria (refer Figure 9). These arrangements aim to ensure a high degree of rigour and consistency in transport modelling undertaken on behalf of the Victorian Government.[6]

RPV is a Victorian Government body responsible for the delivery of MAR, the MTP, Regional Rail Revival, and the Western Rail Plan. RPV managed the development of the MAR Business Case and is accountable to the DoT.

The VITM is a strategic transport model owned and managed by the Victorian State Government and key inputs have been provided by RPV, DoT or its advisors to inform the demand model runs. Demand forecasting for the economic analysis has been undertaken by KPMG while demand forecasting for design purposes has been undertaken by Aurecon Jacobs Mott McDonald Joint Venture (**AJM**). AJM were engaged as the technical advisor to undertake the engineering design for MAR and develop the airport module within VITM.

KPMG undertook demand modelling for the Business Case using the latest version of VITM (provided by DoT), the DoT Reference Case and the updated airport module developed by AJM. The outputs of VITM modelling have been used for multiple purposes as described in Section 1.6.

Figure 9: Governance Framework for MAR



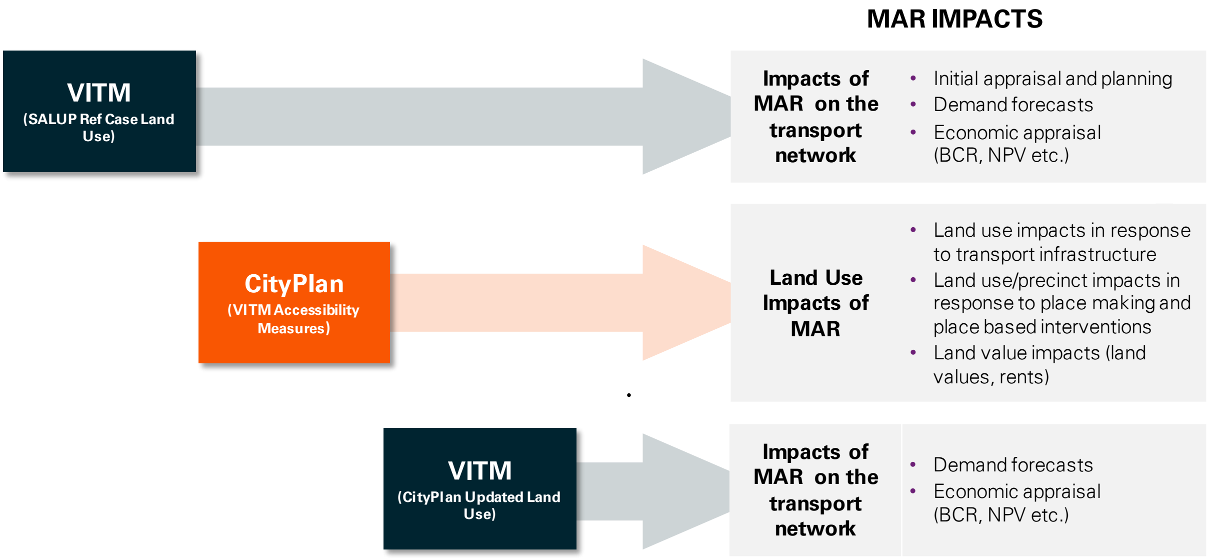
[6] Department of Transport (2019). *The standard approach to transport modelling and economic evaluation in Victoria, 2019-20.*

3.2 Modelling roles and stages

3.2.1 Models used

VITM and CityPlan were both used to inform the transport demand forecasts and subsequent economic appraisal for MAR. The roles of these two strategic modelling tools are summarised in Figure 10.

Figure 10: Roles for the strategic transport modelling tools



Victorian Integrated Transport Model

Primary transport network forecasts were undertaken using VITM. VITM is the Victorian Government's 'four-step' transport network-wide model which is used to develop forecasts for public transport and private vehicles trips. Broadly speaking, four-step models involve:

- trip generation to identify the number of trips from a particular location
- trip distribution to identify where these trips are destined
- mode choice to identify what proportion of trips use car, public transport, etc.
- service selection to identify what combination of services are used to complete public transport trips.
- VITM was selected as the primary forecast model due to its model performance and validation.

CityPlan

When used in conjunction with the VITM, CityPlan is an advanced dynamic disequilibrium land use transport interaction (**LUTI**) model, owned and maintained by the Department of Transport. CityPlan projects how the city may evolve under different conditions (e.g. with and without a major transport infrastructure project). The primary inputs to CityPlan are travel costs (arising from transport network assumptions coded in VITM) and land use assumptions relating to capacities and allowable rates of development for different land uses per small area. The current version of CityPlan covers Greater Melbourne, Geelong, Ballarat and Bendigo. Refer to Section 7.6 for further detail on CityPlan modelling for MAR.

3.2.2 Model application

Key interactions between the transport models are described below:

- Transport network impacts (including road network impacts) are informed by VITM, which provides public transport loads on each mode.
- CityPlan provides land use impacts of the project driven changes to accessibility as estimated using VITM.
- If there are material land use impacts from CityPlan, these changes are then modelled using VITM to quantify the network impacts of the changes.
- The economic assessment is done using the VITM economic module which draws on outputs from VITM.
- Local area and construction impacts, including traffic, meso and micro-simulation models and station precinct impact assessments, and detailed station modelling, are undertaken by RPV and its technical advisors (AJM).

3.2.3 Model enhancements

VITM was refreshed in December 2019 by KPMG[7] and the Airport Module was updated in March 2020 by AJM. This aimed to make the model more robust and fit for purpose and enabled it to be used for Melbourne Airport Rail Demand Modelling. The Airport Module has since been peer reviewed by WSP.

Further to this, minor enhancements were made to the model to improve model stability and improve the ability to model airport trips. The key enhancements include:

- The Reference Case has been updated, including significantly increased population, employment and education forecasts through *Victoria in Future 2018*.
- Minor updates were also made for the business case demand modelling to further improve model stability and accuracy. These measures included increasing the number of iterations in the highway and public transport assignment and reading in costs from a reference model for each model year to be used as starting costs.

Broadly speaking, the enhancements focused on improving model performance and refining the model in the vicinity of areas affected by the project. The VITM and CityPlan enhancements also improved timetable alignment and representation of stations.

3.2.4 Validation and model confidence

This section highlights the performance of VITM used for MAR modelling against observed data for key criteria including total weekday trips, public transport boardings, daily screenline totals, train cordon volumes and SkyBus boardings. The enhancements made to the model for MAR aimed to improve model performance (refer Section 3.2.3).

Detailed information on the validation can be found in the MAR Demand Modelling Validation Report, while further information relating to the VITM Refresh can be found in Victorian Integrated Model Refresh Report.

[7] KPMG (2019). *Victorian Integrated Transport Model Refresh – Final Report.*

Observed Data

The modelled data is compared against observed data from 2018 provided by DoT for the purposes of validation. This observed data comes from multiple sources and has varying levels of accuracy, as outlined in Table 1.

Table 1 Key sources of Observed Data

Data	Source/Collection Method	Accuracy
VISTA data (Victorian Integrated Survey of Travel and Activity)	Household travel and activity survey time series data (survey is undertaken over multiple years) Approximately 46,000 respondents from 18,000 households across Victoria in 2012-2016 dataset	Limited sample size Data is normalised to reflect sample rates
Screenline traffic volumes	VicRoads annual traffic volumes, utilises permanent traffic monitoring stations, loop data and other sources, and includes estimates in some locations	VicRoads does not guarantee the accuracy of this data
DOT patronage estimates by mode	Based on estimates derived from Myki PT ticket data and patronage survey data	Estimated data
CBD cordon loads	Annual CBD cordon passenger load survey conducted in May	The manual collection methodology does not cope well when train loads exceed 1,000 passengers per train Peak period numbers may therefore be under-represented

Global validation

Table 2 Global validation - Total weekday Melbourne trips

	Observed	Modelled	Difference (%)	Pass/Fail
Total Trips	1,407,000	1,393,000	1%	Pass
Criteria			±5%	1/1 (100% pass)
Importance			Very Important	Very good

When comparing the observed and modelled data, the modelled trip numbers are within 1 per cent of observed data, which is within the criteria, confirming that the model is fit for purpose to model the impacts of MAR.

Table 3: Total PT Boarding by time period

	Observed	Modelled	Difference (%)	Pass/Fail
AM Period	438,000	466,000	6%	Pass
IP Period	181,000	169,000	-6%	Pass
PM Period	379,000	389,000	3%	Pass
OP Period	147,000	140,000	-4%	Pass
24 Hour	1,990,000	1,979,000	-1%	Pass
Criteria			±10%	5/5 (100% pass)
Importance			Very Important	Very good

Total modelled PT boardings are marginally higher than observed in the AM Peak and PM peak, but are within the expected criteria of ±10 per cent, while the modelled interpeak trips and off-peak trips are marginally below the observed figures. Given that the boardings numbers in all four time periods are within the expected bound, the model validates and can be used to model the impacts of MAR without further enhancements.

Table 4: 24 hour Screenline totals - all vehicles

	Observed	Modelled	Difference (%)	Pass/Fail
Inbound	6,405,574	6,089,423	-5%	Pass
Outbound	6,383,290	5,991,300	-6%	Pass
Two - way	12,788,864	12,080,722	-6%	Pass
Criteria			±10%	3/3 (100% pass)
Importance			Very Important	Very good

Total screenline counts in a 24 hour periods are within the identified criteria and as such can be used without any post processing or adjustment. It also confirms that the model can be used to model the impacts of MAR without further enhancements.

Study area validation

Table 5: Train Cordon Volumes AM Peak

	Observed	Modelled	Difference (%)	Pass/Fail
Newport Corridor	16,789	14,945	-11%	Pass
Sunbury Line	12,721	14,476	14%	Pass
Craigieburn Line	13,128	13,922	6%	Pass
Upfield Line	4,107	3,890	-5%	Pass
Camberwell Corridor	26,132	24,248	-7%	Pass
Glen Waverley Line	8,323	7,861	-6%	Pass
Dandenong Corridor	19,132	17,973	-6%	Pass
Criteria			±20%	7/7 (100% pass)
Importance			Very Important	Very good

The key train lines that influence the performance of MAR are listed above. All these lines validate within the bounds of the ±20 per cent validation criteria in the AM peak. This result shows that the model validates well in the areas that most influence the outcome of MAR.

3.2.5 Model uncertainty

VITM is a strategic multi-modal model used to estimate levels of transport demand for future transport corridors or for major transport infrastructure projects. The model estimates the demand response to changes in land use and transport supply. In doing so, the model uses mathematical equations and assumptions, which in part are determined by data availability and computing constraints. To achieve a practical and workable model, VITM simplifies some real-life behaviour so it is important to understand the limitations of the model when making an assessment based on outputs from the model.

The demand forecasts for MAR necessarily involve risk and uncertainty because they are dependent on events and circumstances that will occur in the future. The rate of population growth and the nature of infrastructure developments are examples. Furthermore, there is the uncertainty resulting from using a model to simplify real world interactions.

Base year model validation

The base year validation can provide an indication of how well the model replicates base year conditions. This provides an indication of how well the model performs when forecasting, however, it may identify some areas where the model is deficient or provide an indication of the model's level of precision.

This report summarises the VITM base year validation with respect to the transport measures that are important for modelling the MAR (refer Section 3.2.4).

Input assumptions used for forecasting

These can again be broadly separated into three categories, these being:

Input assumptions have provided by DoT and are document within Section 3.3 of this report. These can broadly be classified into three categories:

- future year public transport and highway networks
- future year demographic and land use information

- future year transport behaviour and cost parameters.

Steps taken to minimise model uncertainty

There are a number of factors that could cause actual MAR demand to differ materially from the forecasts presented in this report. In recognition of the inherent uncertainty and to reduce the risk of the actual demand differing materially from the reported forecasts, a number of mitigating steps were undertaken. These steps focused on reducing the risk related to model inputs and understanding the behaviour of the transport model and included:

- validating the model with a focus on the key corridors of influence on MAR (and providing a level of importance to each validation measure)
- conducting a number of sensitivity tests where the model inputs were varied across possible future values
- enhancing the model processes within VITM to improve the stability of the model and help make the forecasts intuitive and explainable. This included the number of iterations within the model and improving the starting point of each model run
- model results being circulated amongst experienced public transport professionals including the peer review
- demographic forecasts being provided by experienced specialists
- following generally accepted practice with respect to strategic modelling processes.

3.3 Key inputs and assumptions

The demand modelling undertaken for MAR relied on a range of inputs and assumptions which were agreed with and / or provided by key stakeholders. The key inputs and assumptions underpinning the modelling are summarised in Table 6. These inputs and assumptions have been agreed with RPV and DoT. Further detail on the scenarios modelled is provided in Section 3.5.

Table 6: Key inputs and assumptions

Input / assumption	Description
Transport network and land use inputs	The DoT Reference Case formed the basis of the transport network and land use inputs used for the demand modelling. Refer Section 3.4 for further details.
SRL North connection to Melbourne Airport	Demand modelling has been undertaken for both with and without the SRL North connection to Melbourne Airport in the Base Case, as agreed with DoT. The scenario with the SRL North connection assumes an opening year of 2051, as per the DoT Reference Case.
MAR to SRL interchange time at Melbourne Airport	Interchange time between MAR and SRL at Melbourne Airport is approximately 3 minutes (based on a 250m walk link).
PT fare at Melbourne Airport	For entry/exit at Melbourne Airport, the core scenario assumes the following PT fares (2016 dollars, real – consistent with all other VITM cost inputs): ***Redacted***
Melbourne City Express SkyBus	The following headway and capacity assumptions have been agreed with DoT: • Headway – the Southern Cross SkyBus service operates with 5-minute headways in the Base Case, as per the Reference Case received from RPV in December 2019. • Capacity – the service is assumed to have a seated capacity of 50 and a crush capacity of 75. This reflects the bus vehicle type within the VITM.
MAR journey time	Demand modelling has been undertaken based on a 30-minute travel time between Melbourne Airport and the CBD.

3.4 Reference Case

3.4.1 Description

For each future year, the VITM transport modelling assumptions will be based on the standard set of networks, land use and transport cost assumptions as per the latest version of DoT's Transport Modelling Reference Case (the 'Reference Case'). The Reference Case is the key platform for transport modelling in Victoria and is developed and managed by DoT's Transport Analysis and Assessment branch.[8] The Reference Case transport network includes committed projects in addition to an agreed set of projects, including arterial road upgrades, rail service upgrades, motorway improvements, tram and bus upgrades and upgrades to service levels to supply a reasonable capacity that is supportive of the future demand associated with the Reference Case land use.

Inclusion of transport projects in the Reference Case does not imply any commitment from the Government or DoT to undertake these projects. It merely indicates that DoT has determined that it is reasonable to represent the project, or a similar investment, in the future network for the purposes of modelling demand in the transport system.

The latest Reference Case includes key transport modelling inputs, such as:

- new government policies or strategies
- population and employment forecasts
- updated travel survey data
- significant changes to transport networks.

Responsibilities for the various inputs to the Reference Case are shown in Table 7.[9]

Table 7: Inputs to Reference Case

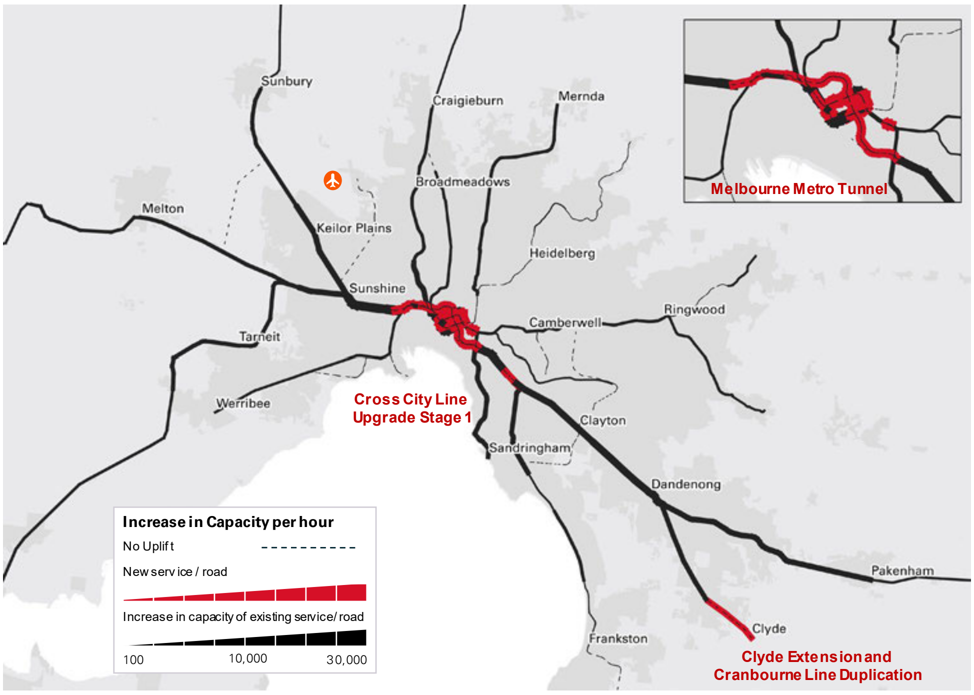
<table>
<tr><th>Reference Case Inputs</th><th>Responsibility</th><th>Version</th></tr>
<tr><td>Population Forecasts</td><td>DoT, Department of Environment, Land, Water and Planning (DELWP), Planning</td><td rowspan="7">Victorian Integrated Transport Model Reference Case – Model Inputs and Parameters 2020</td></tr>
<tr><td>Employment Forecasts</td><td>DoT, Department of Jobs, Precincts and Regions (DJPR)</td></tr>
<tr><td>Road Network</td><td>DoT (Network Planning)</td></tr>
<tr><td>Public Transport Network and Service Plans</td><td>DoT (Network Planning)</td></tr>
<tr><td>Transport Modelling Parameters</td><td>DoT (Transport Analysis and Assessment Branch, Economic Reform Branch)</td></tr>
<tr><td>Freight Network and Forecasts</td><td>DoT (Freight Victoria)</td></tr>
<tr><td>Airport Forecasts</td><td>DoT</td></tr>
</table>

[8] Department of Transport (2019). *The standard approach to transport modelling and economic evaluation in Victoria, 2019-20.*
[9] Ibid.

3.4.2 Public transport network

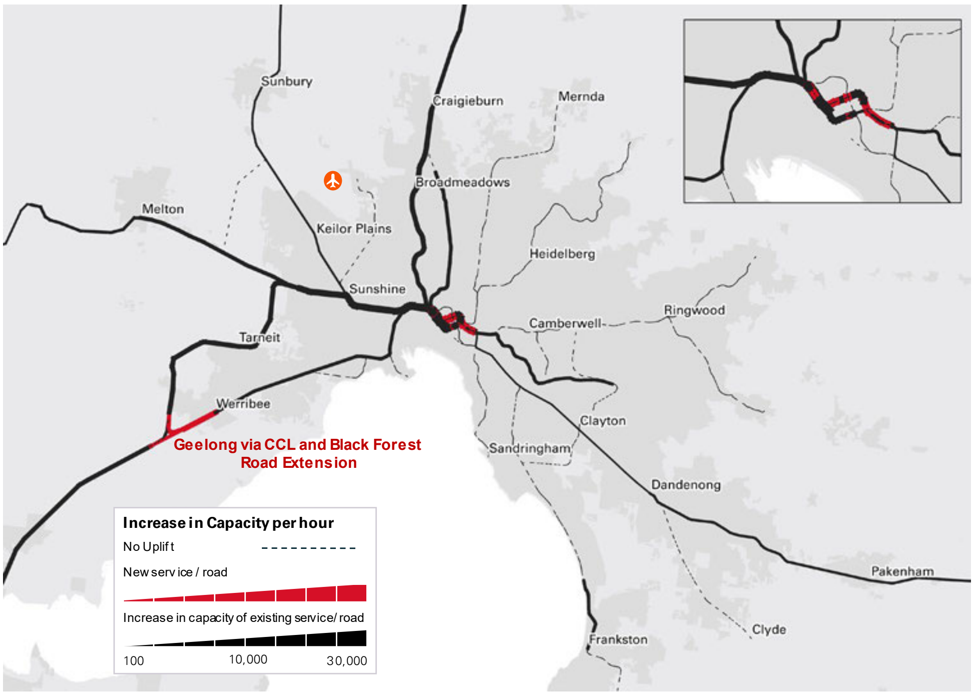
Figure 11 to Figure 15 highlight the key public transport investments included in the DoT Reference Case across the model years used in the MAR demand modelling.

Figure 11: Public transport projects included in the 2026 Reference Case



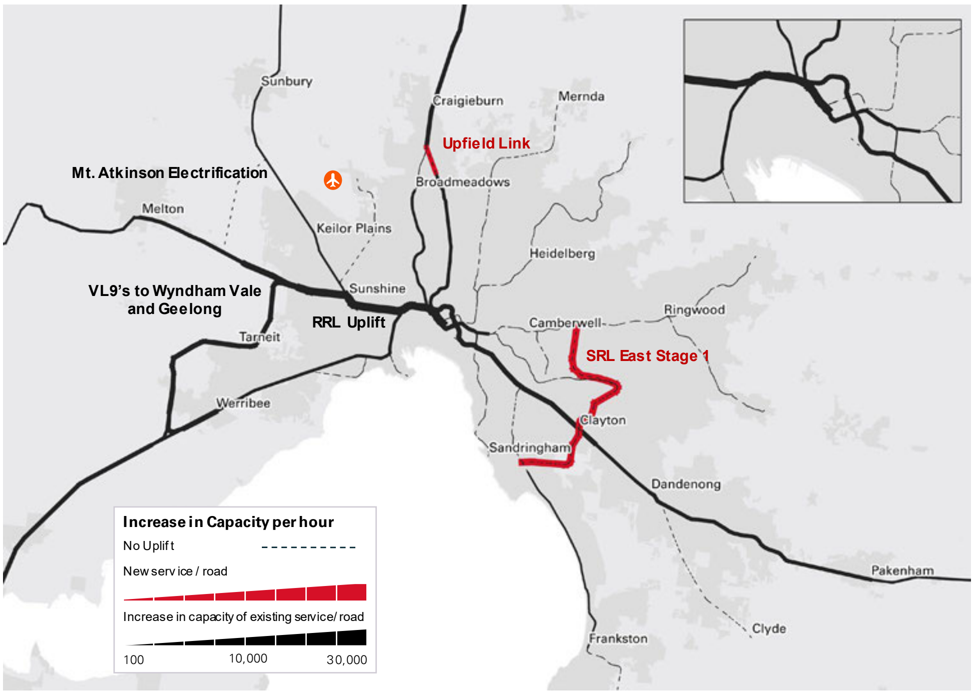
***Source**: KPMG based on DoT Reference Case.*

Figure 12: Public transport projects included in the 2031 Reference Case



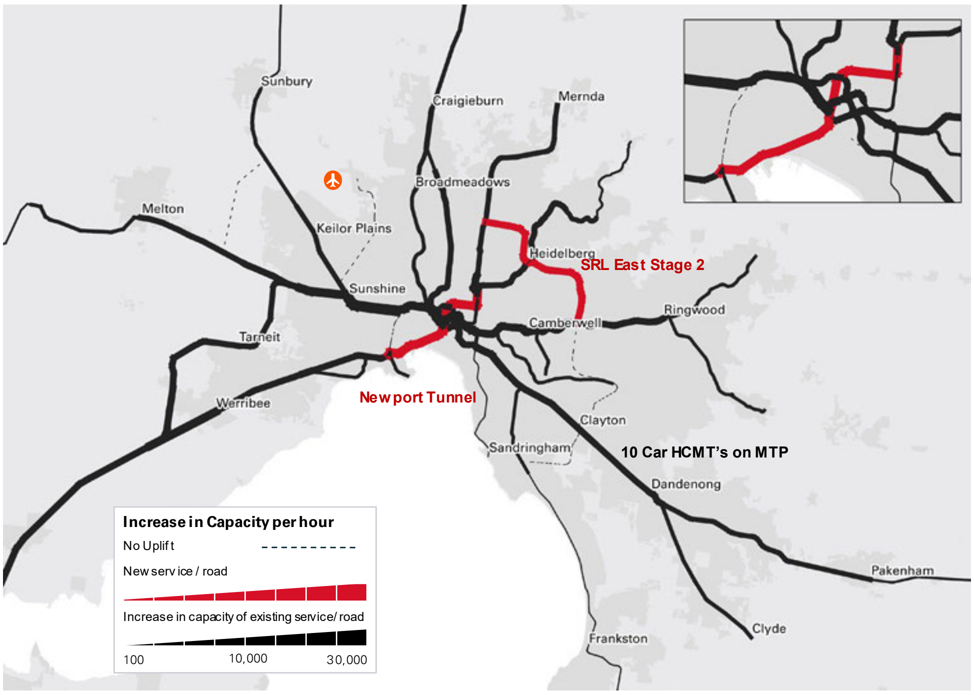
***Source**: KPMG based on DoT Reference Case.*

Figure 13: Public transport projects included in the 2036 Reference Case



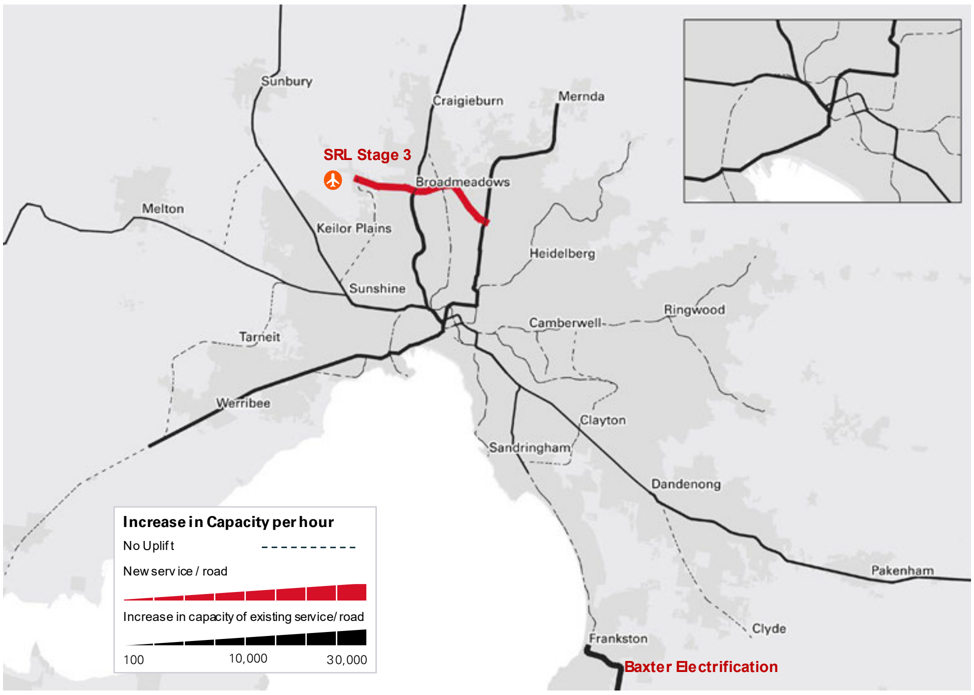
***Source**: KPMG based on DoT Reference Case.*

Figure 14: Public transport projects included in the 2041 Reference Case



***Source**: KPMG based on DoT Reference Case.*

Figure 15: Public transport projects included in the 2051 Reference Case

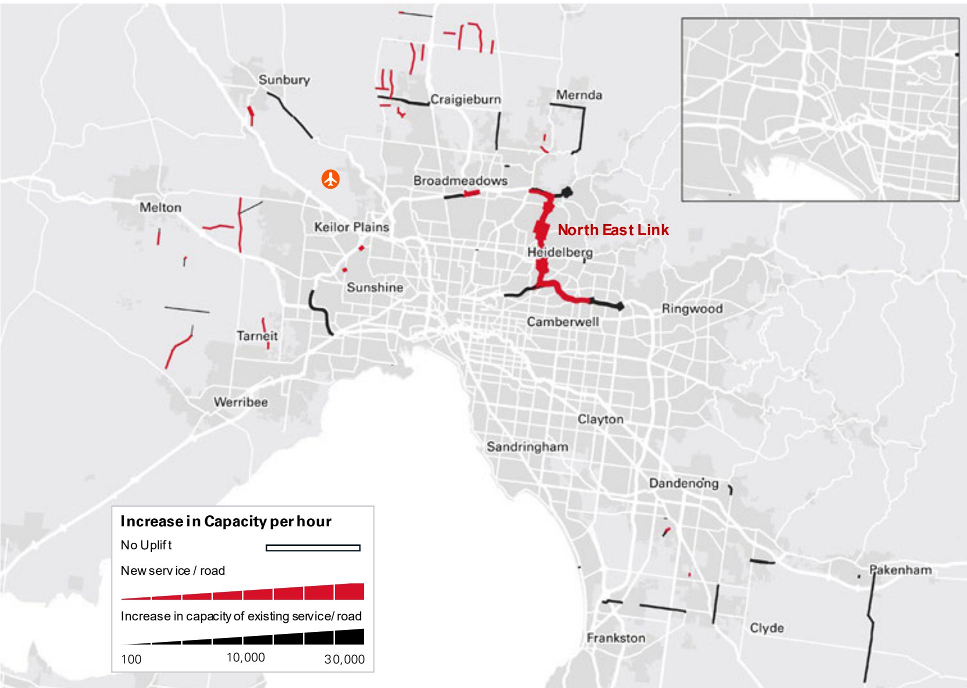


Source: *KPMG based on DoT Reference Case.*

3.4.3 Road network

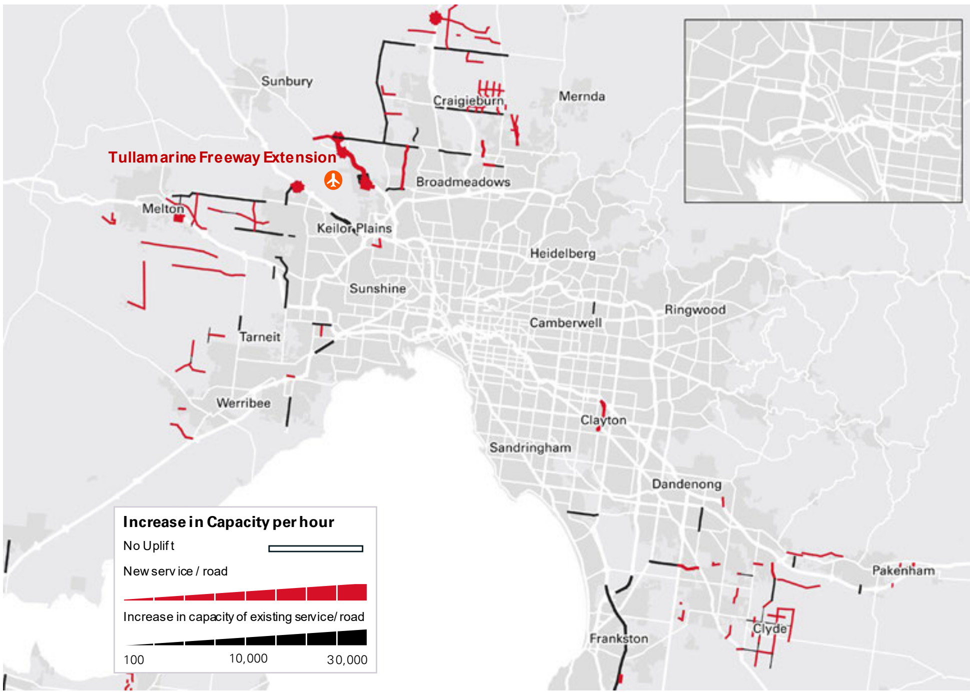
Figure 16 to Figure 20 highlight the key road network investments included in the DoT Reference Case across the model years used in the MAR demand modelling.

Figure 16: Road projects included in the 2026 Reference Case



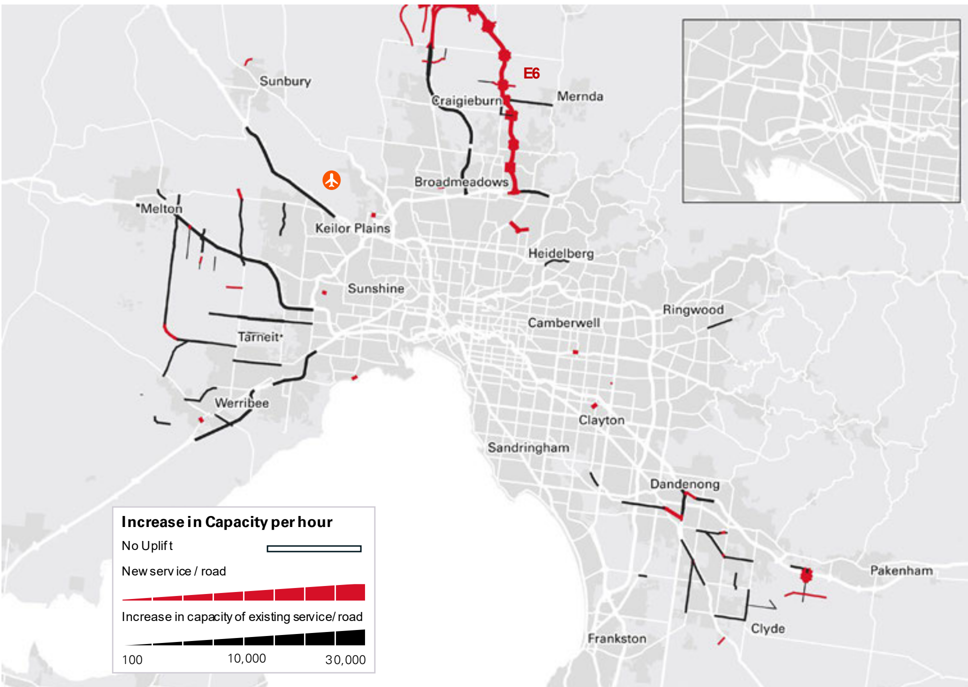
Source: *KPMG based on DoT Reference Case.*

Figure 17: Road projects included in the 2031 Reference Case



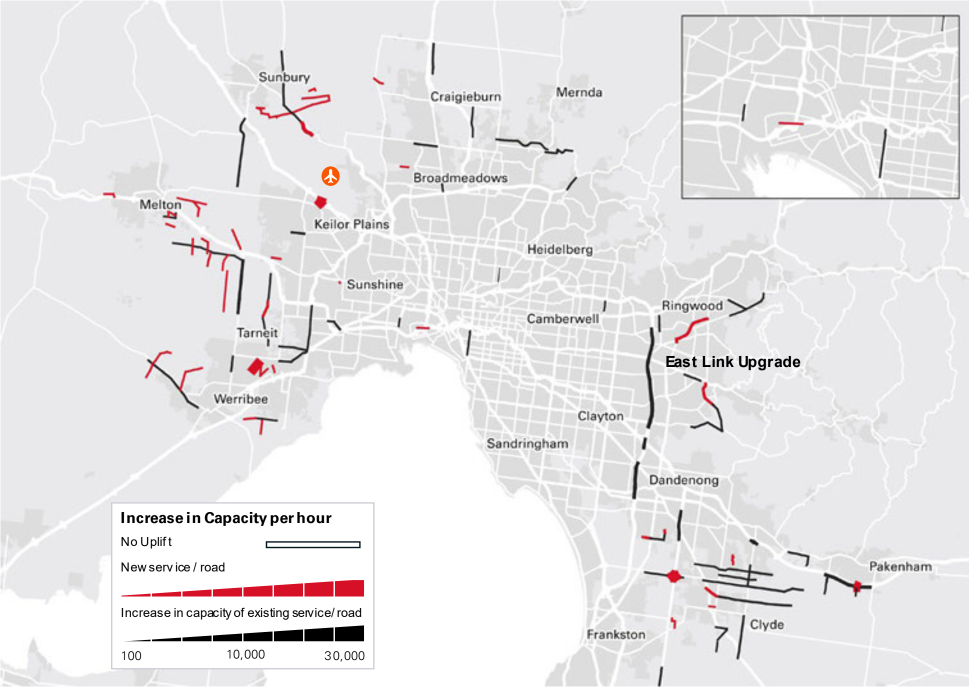
Source: *KPMG based on DoT Reference Case.*

Figure 18: Road projects included in the 2036 Reference Case



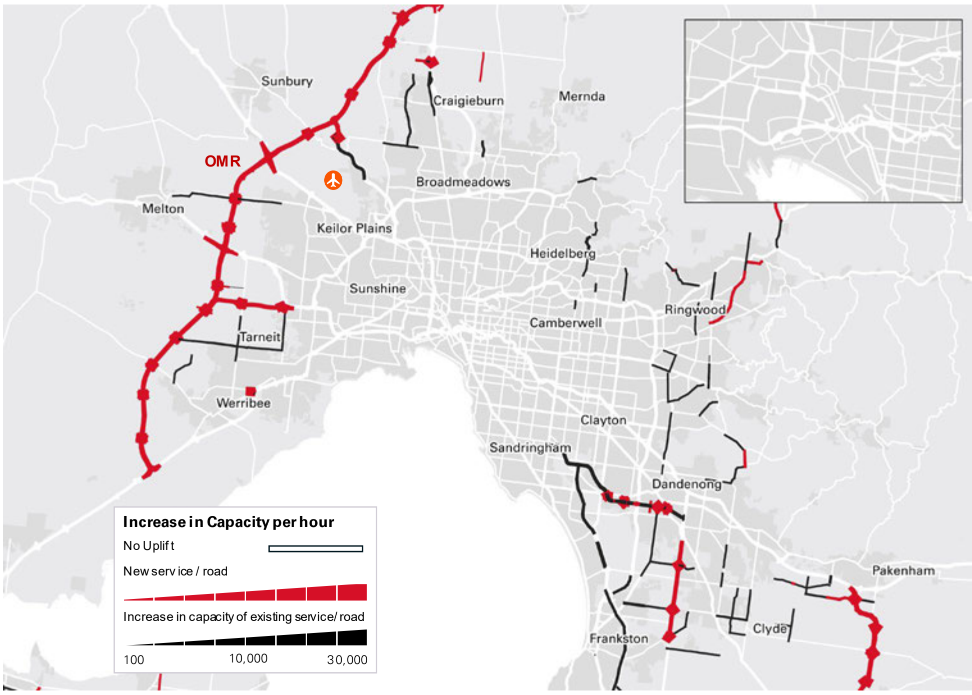
Source: *KPMG based on DoT Reference Case.*

Figure 19: Road projects included in the 2041 Reference Case



Source: KPMG based on DoT Reference Case.

Figure 20: Road projects included in the 2051 Reference Case

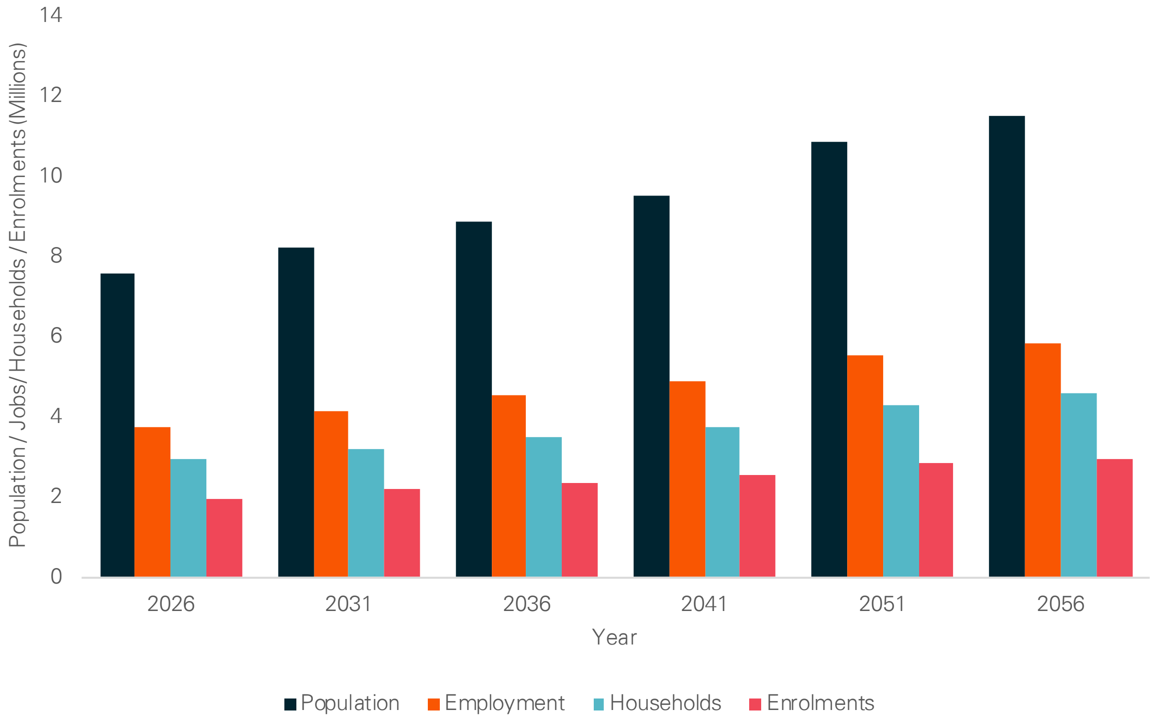


Source: KPMG based on DoT Reference Case.

3.4.4 Land use

Figure 21 shows the forecast population, employment, households, and enrolments which are included in the DoT Reference Case and are used as an input to VITM. Between 2026 and 2056, Victoria's population grows from 7.5 million to 11.5 million people, while employment, households and enrolments also increase significantly.

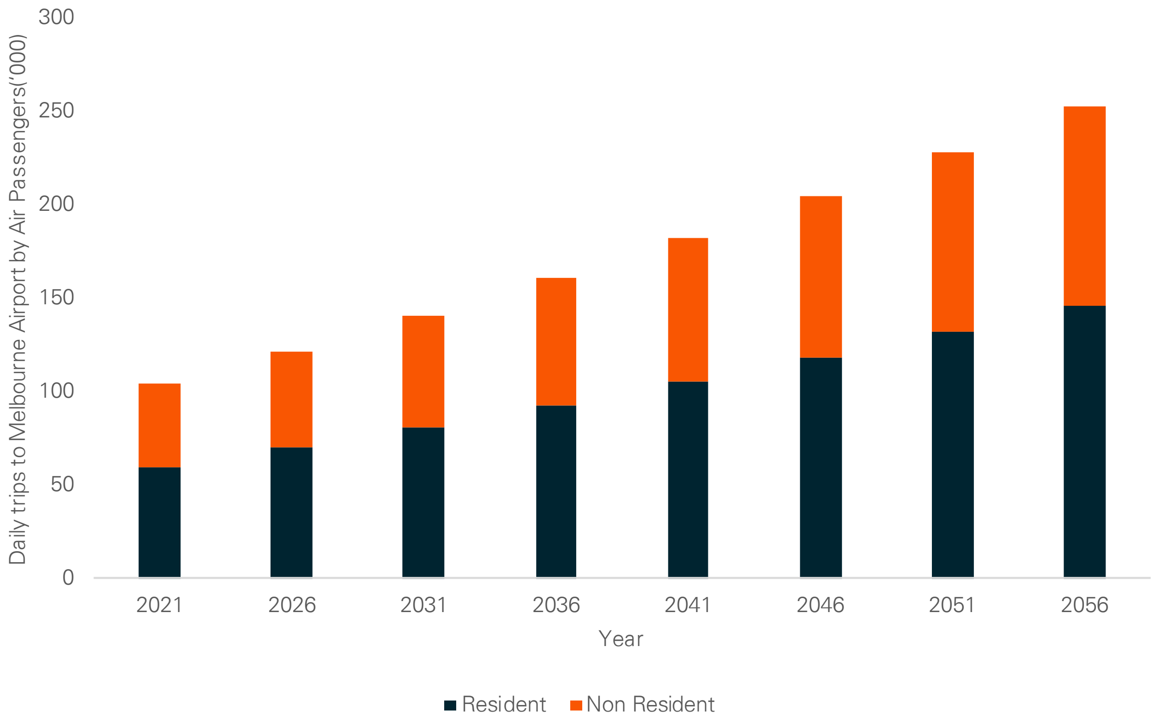
Figure 21: Land use and demographic forecasts



Source*: KPMG based on DoT Reference Case.*

Air passenger forecasts are another key input within the DoT Reference Case. Figure 22 shows the daily air passenger trips to / from Melbourne Airport between 2021 and 2056 – split by resident and non-residents.

Figure 22: Daily air passenger trips to / from Melbourne Airport



***Source**: KPMG based on DoT Reference Case.*

The ratio of trips made by Victorian residents remains constant over time, while the number of trips increases almost three-fold through to 2056.

3.5 Scenarios modelled

3.5.1 Forecast years

Strategic transport demand forecasts were developed for the 2021, 2026, 2031, 2036, 2041, 2051 and 2056 model years (refer Table 8), with a separate validation run undertaken using the 2018 model year. The sensitivity tests / alternative future scenarios were undertaken for the scenario without SRL North connecting to Melbourne Airport in 2051.

Table 8: Purpose of model runs

Demand modelling scenario	Model year						
	2021	2026	2031	2036	2041	2051	2056
Core demand modelling for MAR Business Case							
Base Cases without SRL North connecting to Melbourne Airport	✓	✓	✓	✓	✓	✓	✓
Base Cases with SRL North connecting to Melbourne Airport						✓	✓
Project Case without SRL North connecting to Melbourne Airport		✓	✓	✓	✓	✓	✓
Project Case with SRL North connecting to Melbourne Airport						✓	✓
Sensitivity tests and alternative future scenarios							
Base Case and Project Case for COVID-19 impact		✓	✓	✓	✓	✓	✓
Base Case and Project Case with alternate public transport fare structure		✓	✓	✓	✓	✓	✓
Project Case with intermediate station at Keilor East		✓	✓	✓	✓	✓	✓
Base Case and Project Case with alternate alternative-specific constants (**ASCs**) for rail		✓	✓	✓	✓	✓	✓
Base Case and Project Case with high private use of Autonomous Vehicles (**AVs**)		✓	✓	✓	✓	✓	✓
Base Case and Project Case with high shared use of AVs		✓	✓	✓	✓	✓	✓
Base Case and Project Case with alternate transport network pricing		✓	✓	✓	✓	✓	✓

3.5.2 Base Case

The Base Case scenario is the starting point for demand modelling. It consists of the Reference Case transport network for a given year, but excludes infrastructure projects related to MAR, along with enabled projects and critically interdependent projects. As such, the Base Case for this appraisal reflects the highway and public transport network without the improvements delivered by MAR. The Base Case also includes land use assumptions as per the Reference Case, but without the MAR investment.

Under the Base Case, the Melbourne City Express SkyBus service is the primary public transport connection between the CBD and Melbourne Airport. Currently, the Melbourne City Express service operates 24/7 at frequencies of approximately nine to ten minutes during the day to and from Southern Cross Station. According to the SkyBus website, travel times between Southern Cross Station and the airport can be 35 minutes, but passengers are advised to allow extra travel time during peak periods. An average journey time of 22 minutes is published.

The modelled SkyBus fare for the Melbourne City Express is Redacted , and the modelled headway for the service is five minutes.[10] This is double the current Melbourne City Express frequency and also double the frequency within the DoT Reference Case provided to the project team in March 2020. As a result, the Base Case effectively doubles current capacity of the Melbourne City Express.

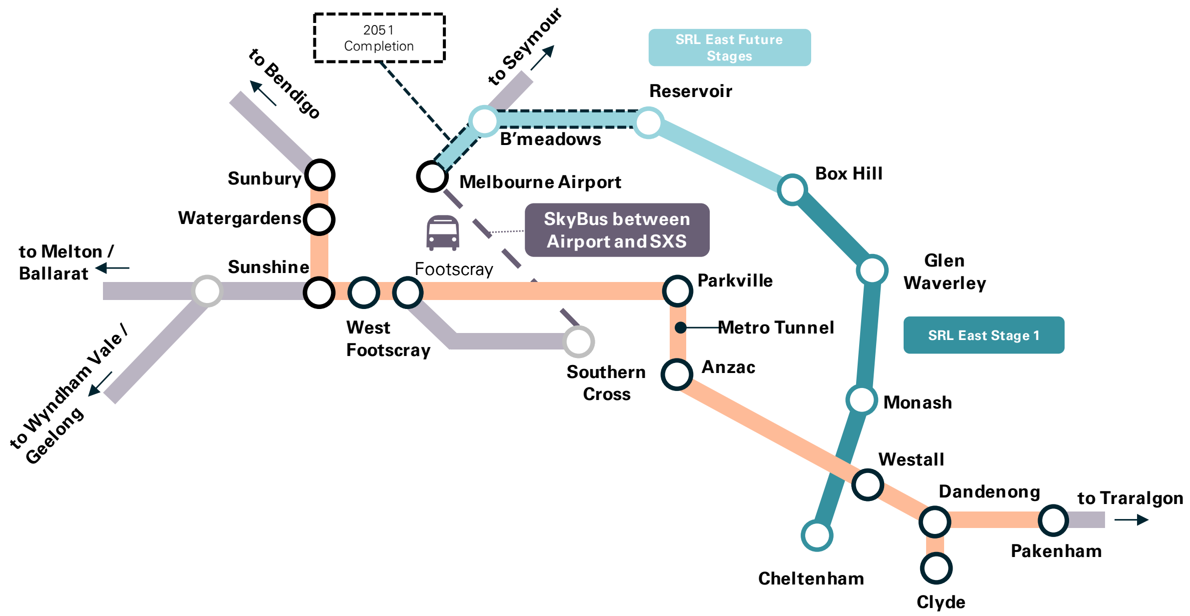
In addition to the Melbourne City Express, SkyBus provides connectivity across Melbourne via an additional five services that operate to:

- Southbank (Southbank Docklands Express)
- St Kilda (St Kilda Express)
- Frankston (Peninsula Express)
- Croydon (Eastern Express). Note that this service is not included within the DoT Reference Case and is not modelled within the Base Case.
- Werribee (Western Express).

In 2051, the DoT Reference Case incorporates the SRL North connection to Melbourne Airport (refer Figure 25), providing an additional means of accessing the airport via public transport. Both Melbourne Airport Rail and SRL East (from Cheltenham to Box Hill) are currently expected to commence construction in 2022, with SRL North (from Box Hill to Melbourne Airport) to be delivered later. In consideration of this, the economic appraisal has been undertaken with and without the SRL North connection to Melbourne Airport in 2051 in the Base Case.

10 Redacted

Figure 23: Base Case network configuration



3.5.3 Project Case

The Project Case uses the Base Case described in Section 3.5.2 as a starting point and then incorporates the network improvements delivered by MAR. This involves the extension of short starters at Sunshine and West Footscray via a new track between Sunshine and Melbourne Airport. In the Project Case, the Melbourne City Express SkyBus ceases service during MAR hours of operation.

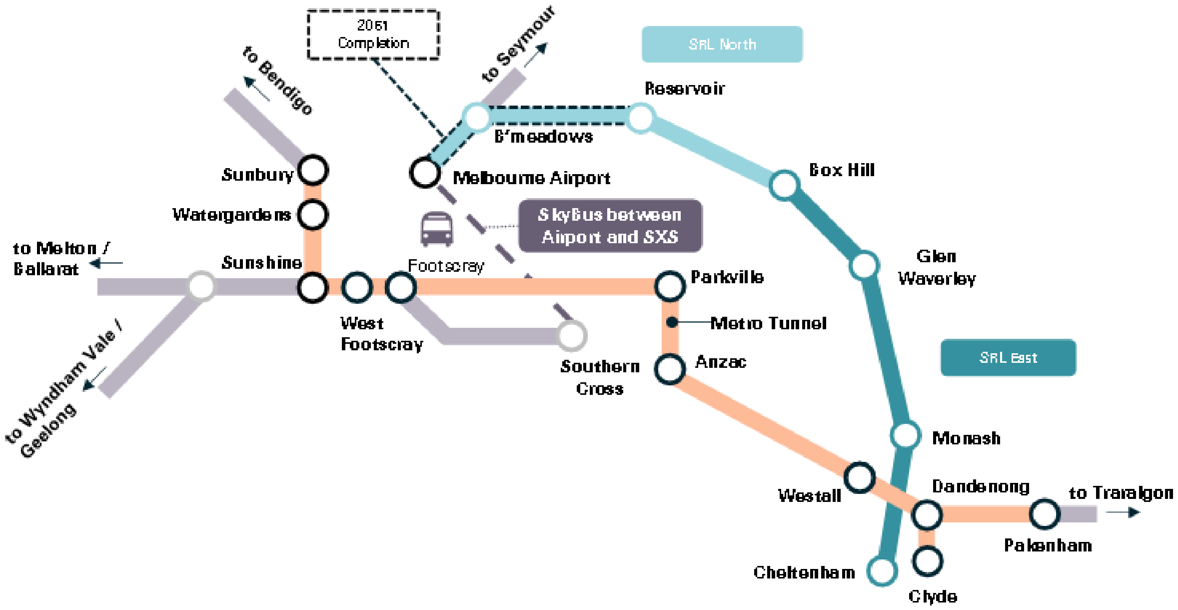
MAR offers a heavy rail link from the airport to the CBD via Sunshine with a service frequency of six trains per hour. The travel time between Melbourne Airport and the CBD is approximately 30 minutes.[11] The MAR fare modelled for demand modelling purposes is the same as the Melbourne City Express SkyBus service, ***Redacted*** .[12] The modelled rolling stock for the MAR service is the 7-car High Capacity Metro Train (**HCMT-7**) on day one of operations.

The network configuration associated with the Project Case is provided below in Figure 24. This figure also highlights that the infrastructure associated with MAR forms an integral part of SRL North by providing a link to the western network between Broadmeadows and Sunshine.

As described in Section 3.5.2, the demand and economic analysis has been undertaken both with and without the SRL North connection to Melbourne Airport in the Base Case in 2051.

[11] Operational modelling undertaken by RPV indicates that journey time will be approximately 27 minutes to 30 minutes within non-peak and peak periods, respectively.
[12] ***Redacted***

Figure 24: MAR network configuration



In terms of public transport access to Melbourne Airport, the key difference between the Base Case and Project Case is the inclusion of MAR and cessation of the Melbourne City Express during MAR hours of operation. Table 7 compares the fare, frequency, journey time and capacity of these two services.

Table 9: Key differences between Melbourne City Express and MAR services modelled using VITM

Parameter	Melbourne City Express (Base Case)	Melbourne Airport Rail (Project Case)
Airport fare	***Redacted***	***Redacted***
Frequency	5 minutes	10 minutes
Journey time (Peak direction)	31 minutes (in 2026) – 66 minutes (in 2056)	30 minutes
Journey time (other time periods)	24 minutes (in 2026) – 32 minutes (in 2056)	30 minutes
Capacity	Seated: 50 passengers per service Crush: 75 passengers per service	Seated: 510 passengers per service Load standard: 1,100 passengers per service Crush: 1,433 passengers per service

Source: *Assumptions advised by DoT and RPV.*

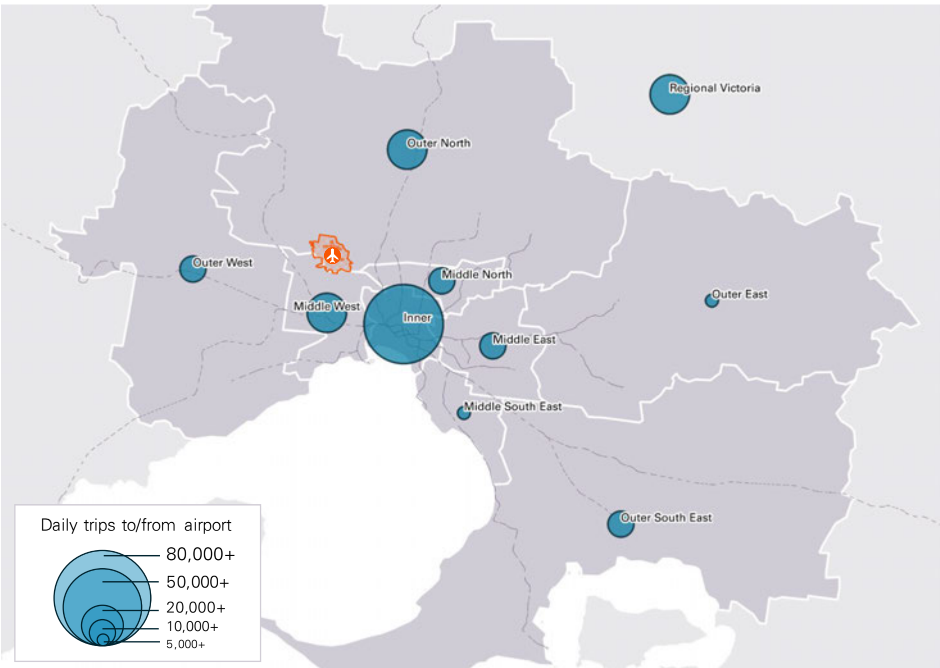
4 Access to Melbourne Airport in the Base Case

4.1.1 Trips to Melbourne Airport

Landside trips to Melbourne Airport come from across Greater Melbourne and add considerable vehicle volumes to Melbourne's road network. Historically, the airport's Tullamarine location in Melbourne's outer north-west was chosen for its lack of surrounding land use constraints.[13] However, the areas surrounding the airport have been developed and are now home to a significant proportion of Victorians. As a result of this population growth, airport trips are now impacted by worsening road conditions.

In 2021, pre-COVID forecasts indicated that 180,000 trips were expected to be made to and from the airport by air passengers and airport employees. Figure 25 shows that Inner Melbourne accounts for the largest number of air passenger trips at close to 50,000, while regional Victoria is the second largest source of trips at 25,000. The south east and east of Melbourne are also the source of a large number of trips. In terms of trips made by airport employees, 28,000 out of the total 60,000 trips come from north west of Melbourne, while the west of Melbourne is the second largest source at 15,000.

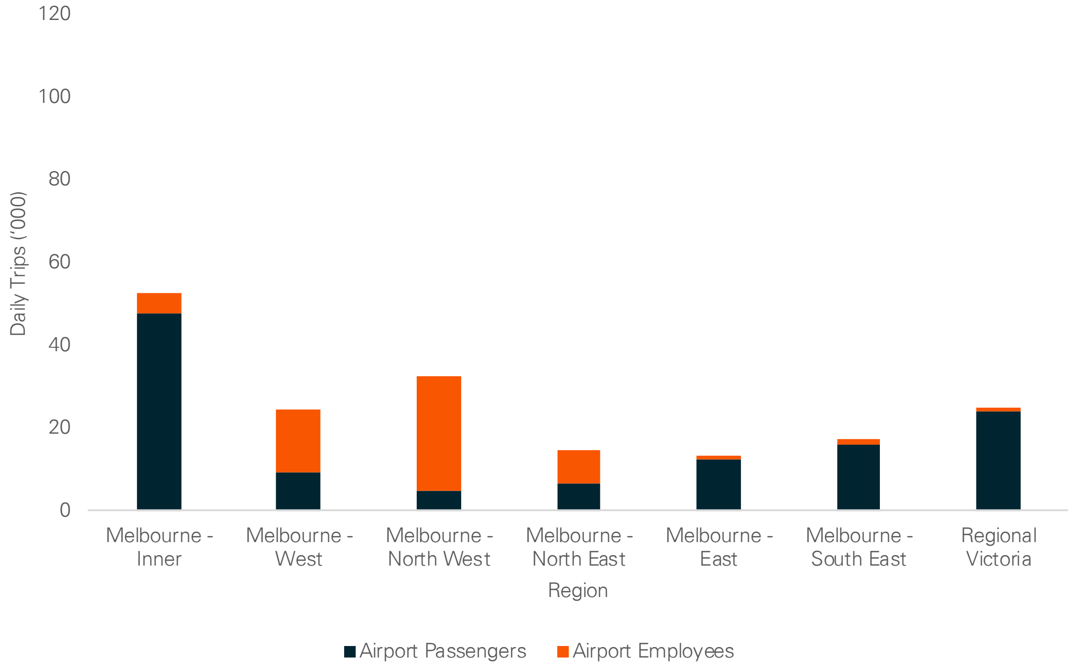
Figure 25: Melbourne Airport catchment (employee and passengers) in 2021[14]



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

[13] Arun Chandu, *The world's first purpose-built Airport City: Melbourne Airport, Tullamarine*, Planning Perspectives, 32:3, pp. 373-400, (2019).
[14] The inner, middle and outer boundary definitions are consistent with the definitions in Infrastructure Australia, *Outer Urban Public Transport – Improving accessibility in lower-density areas,* (2019). The definitions for west, north, east and south-east are broadly consistent with the VIFSA definitions for west, north, east and south respectively. The CBD is defined as the Melbourne SA2.

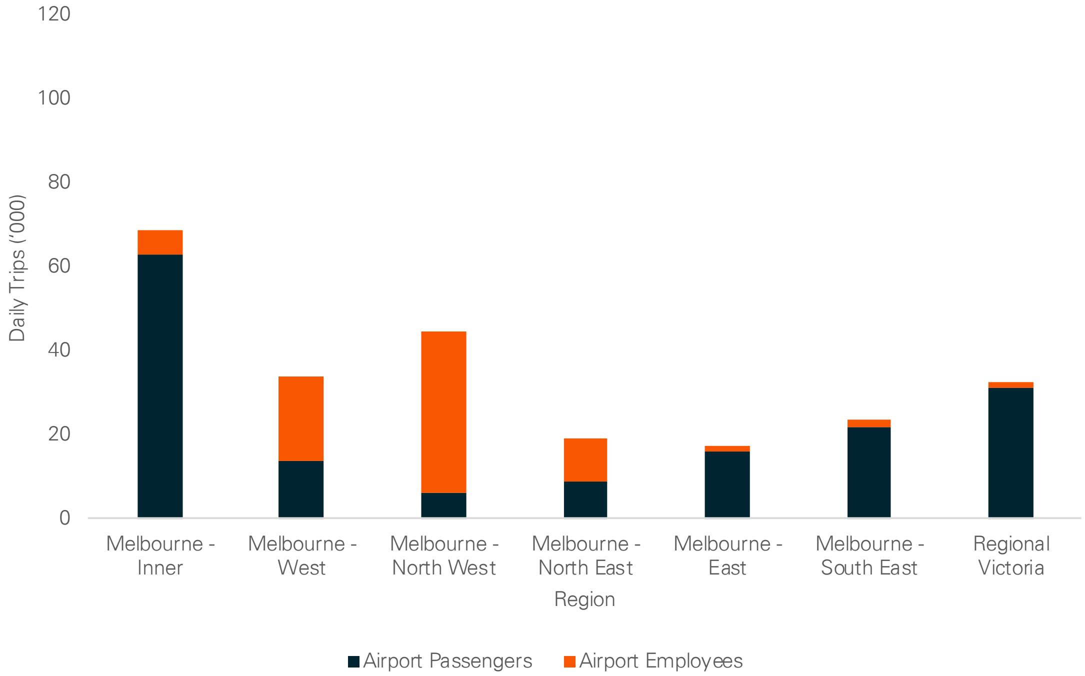
Figure 26: Melbourne Airport passenger catchment 2021 – Airport employees and passengers



Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

In 2031, it is expected that there will be around 160,000 passenger trips and 80,000 employee trips to Melbourne Airport. There is an increase in passenger trips across all regions, with employee trips increasing primarily in the north and west of Melbourne.

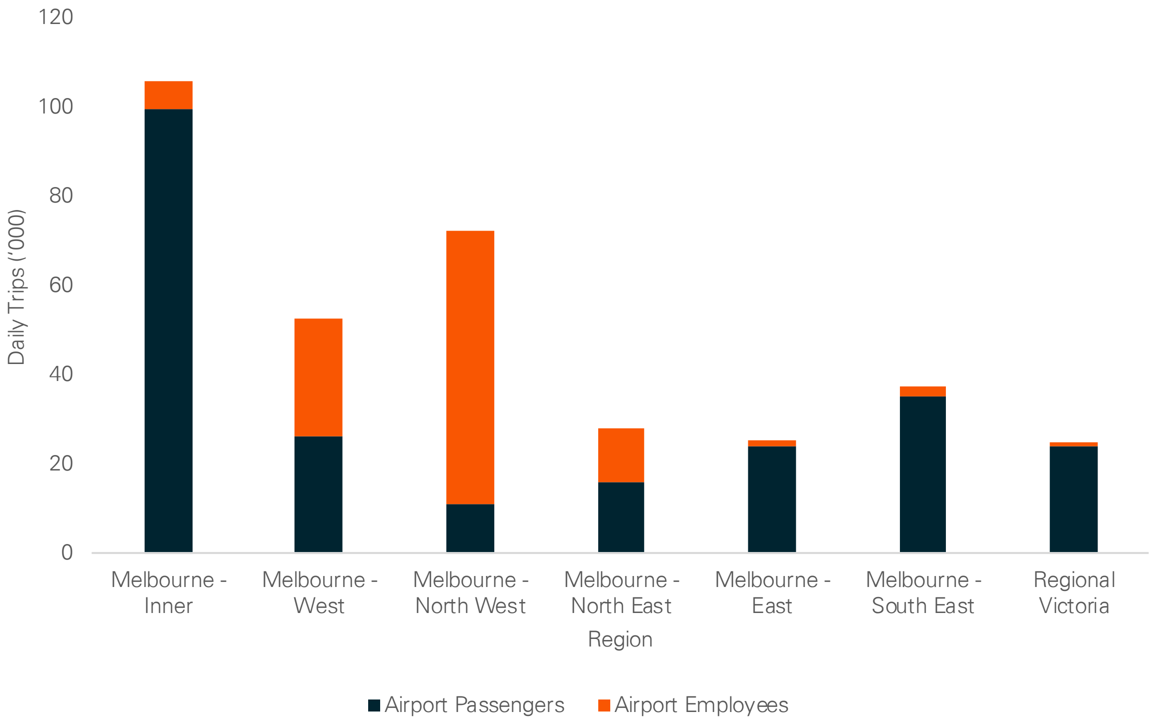
Figure 27: Melbourne Airport passenger catchment 2031 – Airport employees and passengers



Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

This trend continues into 2051 where there are 260,000 passenger trips and 110,000 employee trips to Melbourne Airport forecast. As with 2031, passenger trip growth is experienced across all regions while employee trip growth is focused in the north and west of Melbourne. Landside trips to the airport made by passengers are forecast to grow annually at an average rate of 3 per cent through to 2051 which is higher than employee trips (2 per cent).

Figure 28: Melbourne Airport passenger catchment 2051 - Airport employees and passengers



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

In summary, the majority of air passenger trips are from Inner Melbourne, Regional Victoria, and the south east and east of Melbourne in early years. The number of trips from these areas nearly double between 2031 and 2051, driven by population growth across the state. The number of trips from the west, north west and north of Melbourne also grow significantly in this time.

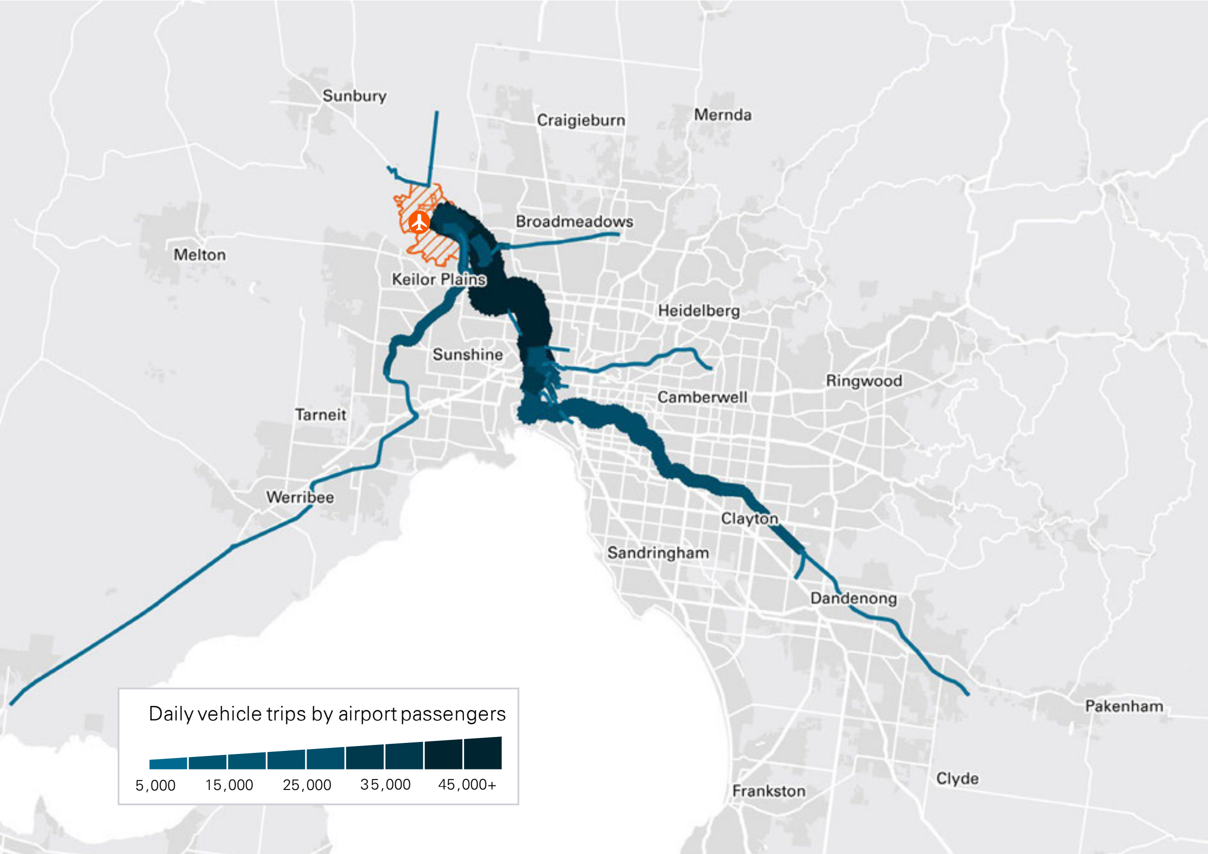
In terms of the trips by airport employees, 85 per cent of trips are from the west and north of Melbourne, whose close proximity to the airport implies that they are less impacted by the worsening road conditions across Melbourne.

4.1.2 Access to Melbourne Airport

Figure 29 shows that most cross-city vehicle journeys to the airport are made on the Monash Freeway and the CityLink, the major arterial roads traversing Melbourne's most populated areas. It also shows that most traffic converges at the Tullamarine Freeway, particularly as the freeway approaches the airport past the Western Ring Road. At the Melbourne Airport exit on the Tullamarine Freeway, airport passengers and employees comprise an estimated 84 per cent of total vehicle volumes.[15]

[15] VITM modelling by RPV, (2020). Accounts for both inbound and outbound daily vehicle trips.

Figure 29: Traffic demand to/from Melbourne Airport (including employees, 2021 AM peak trips)[16]



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

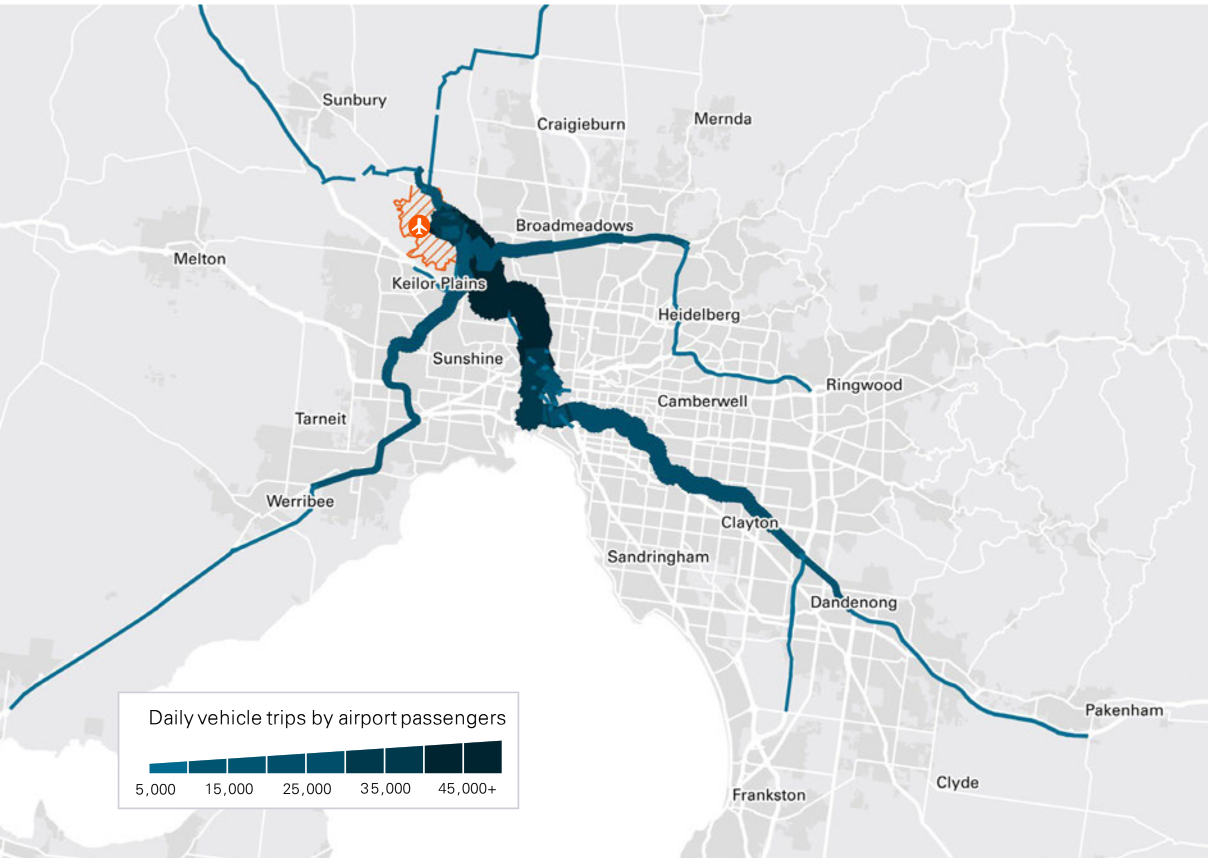
The Tullamarine Freeway is the primary arterial road connection to the airport. It connects airport passengers from the CBD, inner suburbs, and western regions to Melbourne Airport. Vehicle numbers increase on the Tullamarine Freeway as distance to the airport declines and more arterial roads feed airport user vehicles onto the freeway.

4.1.3 How the Base Case highway network meets airport demand growth

Landside trips to Melbourne Airport come from across Greater Melbourne and add considerable vehicle volumes to Melbourne's road network. These journeys are made almost wholly on Melbourne's arterial road network. As highlighted in Section 3.4.3 there are significant road network investments assumed under the Reference Case across all model years. Figure 30 and Figure 31 show how air passengers travel to and from the Melbourne Airport following these network improvements.

[16] VITM modelling by RPV, (2020).

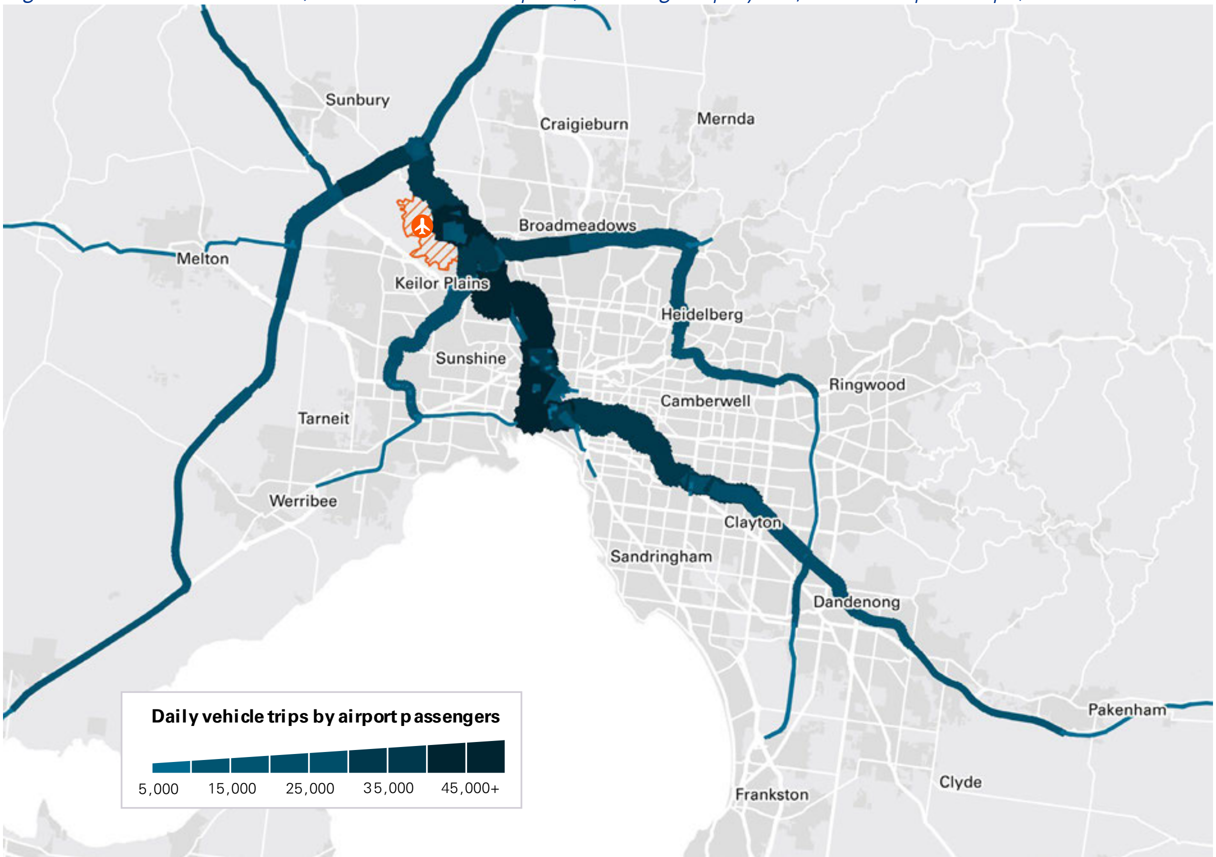
Figure 30: Traffic demand to/from Melbourne Airport (including employees, 2031 AM peak trips)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Figure 30 shows an increasing number of people accessing Melbourne Airport from the north in 2031 which reflects the upgrades of Sunbury Road to Tullamarine Freeway. It also shows air passengers from the east, using the newly built North East Link to travel to the Melbourne Airport via the M80 Freeway. However, even after these network improvements there is still significant reliance on the Monash Freeway, CityLink and Tullamarine Freeway to access Melbourne Airport, with around 37 per cent of all air passengers using CityLink to access Melbourne Airport.

Figure 31: Traffic demand to/from Melbourne Airport (including employees, 2056 AM peak trips)

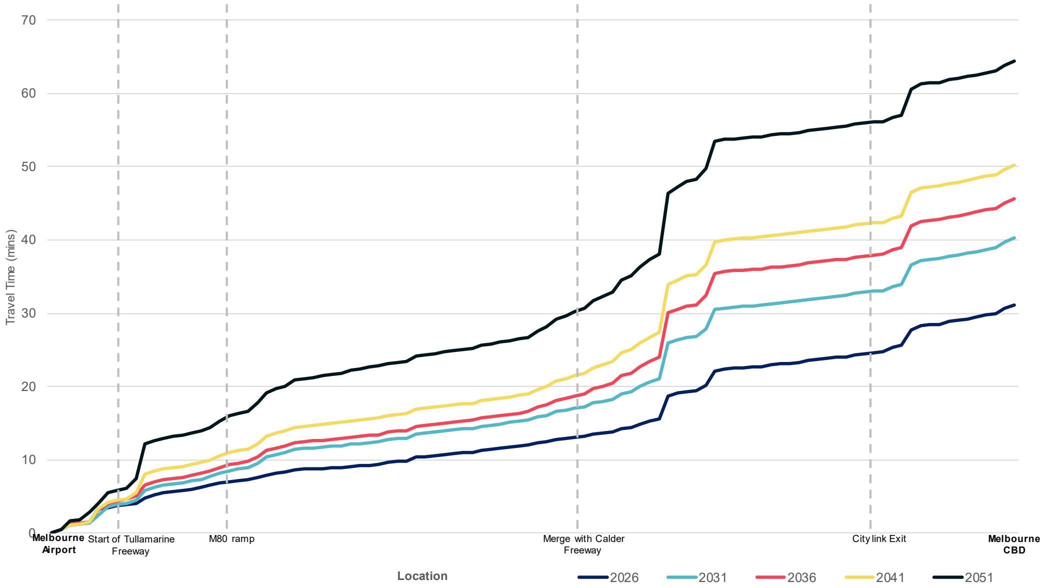


***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Figure 31 highlights how access to the Melbourne Airport changes by 2056, following the completion of OMR and its connection to the Tullamarine Freeway. This new link is a key access route to Melbourne Airport with around 13 per cent of all air passengers using it to access Melbourne Airport from the outer suburbs of Melbourne's north and west, which have experienced significant population growth in the years prior. The M80 as well as the North East Link also see a rise in number of air passengers with more passengers choosing to travel around the city rather than through the city.

However, even in 2056, the Tullamarine Freeway continues to play a key role in airport accessibility, with 34 per cent of air passengers using the Tullamarine Freeway and CityLink to get to Melbourne Airport (as seen in both Figure 30 and Figure 31). Despite the Reference Case network enhancements included in the Base Case, road conditions deteriorate significantly across the network – particularly on the Tullamarine Freeway (refer Figure 32).

Figure 32: Melbourne Airport to CBD highway travel - Base Case



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

The congested areas of the journey are evidenced by the sharp increases in travel time in Figure 32 which are a result of connections to other arterial roads.

Travel times via the Tullamarine Freeway from Melbourne Airport to the CBD more than double between 2026 (30 minutes) and 2051 (64 minutes), driven by growing airport demand and forecast population growth.

4.1.4 Performance of key access roads to Melbourne Airport

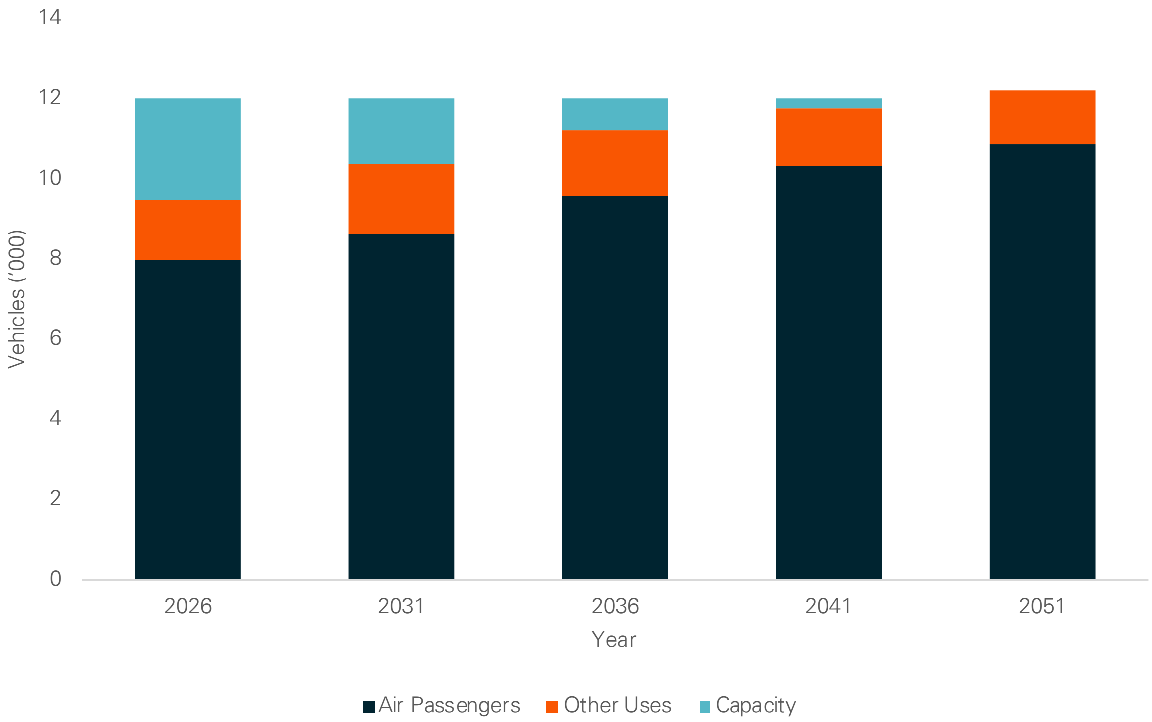
This section focuses on the performance of key access roads to Melbourne Airport at the following locations:

- Tullamarine Freeway (South of Melbourne Airport) – between Mickleham Road and Mercer Drive towards Melbourne Airport
- Sunbury Road / Tullamarine Freeway (North of Melbourne Airport) – prior to the Centre Road for traffic traveling towards the City / Melbourne Airport
- Airport Drive – between Apac Drive and ramp to T4

Tullamarine Freeway (South of Melbourne Airport)

Figure 33 identifies that the Tullamarine Freeway (South of Melbourne Airport) is at 80 per cent capacity in 2026, and is over 90 per cent capacity by 2036, resulting in flow breakdowns and significant congestion on the freeway in the AM Peak towards Melbourne Airport, between Mickleham Road and Mercer Drive. The congestion further worsens by 2051 when the Tullamarine Freeway South is over benchmark capacity in the AM peak. Approximately 85 per cent of all users on the Tullamarine Freeway South are air passengers which reflects the sizeable proportion of airport trips between the CBD and inner, east and south east suburbs (Figure 25).

Figure 33: Tullamarine Freeway volume vs capacity (South of Melbourne Airport) in the AM Peak

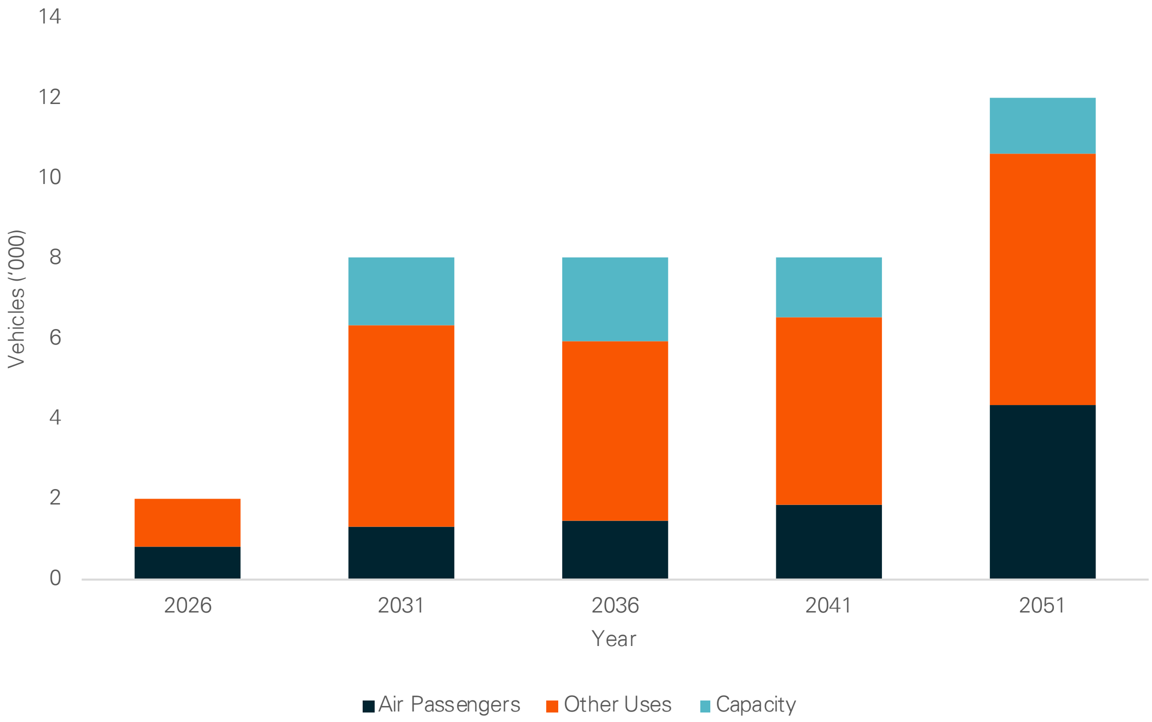


Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Sunbury Road / Tullamarine Freeway (North of Melbourne Airport)

There are two road upgrades to Sunbury Road between 2021 and 2051 which deliver significant spare capacity north of the airport, as shown in Figure 34. In 2031, Sunbury Road is upgraded to form part of the Tullamarine Freeway and capacity is further increased when the freeway is connected with the OMR in 2051. Approximately 20 per cent of users on this section of the Tullamarine Freeway are air passengers.

Figure 34: Sunbury Road / Tullamarine Freeway volume vs capacity (North of Melbourne Airport) in the AM Peak



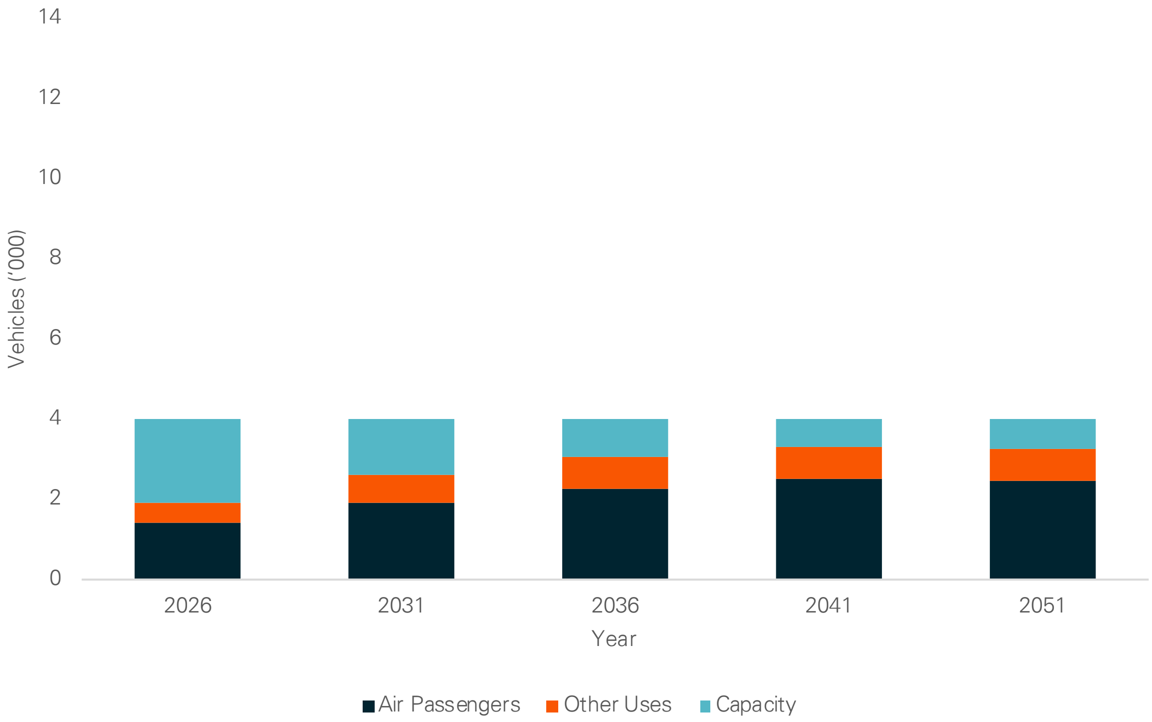
***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Airport Drive (between Apac Drive and ramp to T4)

Airport Drive is the other key access route to Melbourne Airport. Airport Drive is predominantly used by those exiting M80 Freeway and the M79 on to Keilor Park Drive, as well as local residents who are not reliant on the freeway network. Around 60 per cent of the users on this road are air passengers.

It must be noted that even though there is remaining capacity on Apac Drive, the number of air passengers using it has increased by 73 per cent between 2026 and 2051.

Figure 35: Airport Drive volume vs capacity (North of Melbourne Airport) in the AM Peak



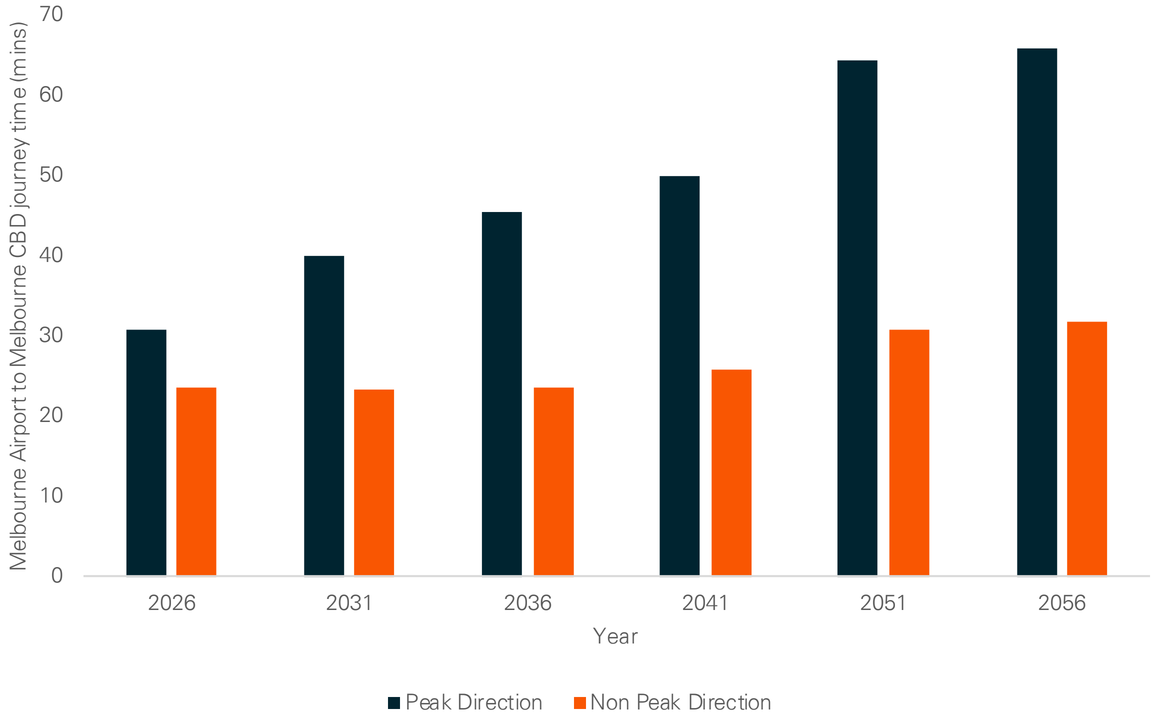
***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Even with the Reference Case projects, the analysis indicates that the Base Case road network is not able to maintain or improve accessibility to the airport, given the increased demand for airport travel in Victoria. In particular, the analysis of the 2031 Base Case highlights that airport journeys will become constrained without investment in additional transport network capacity.

4.1.5 How the Base Case public transport network meets airport demand growth

Melbourne City Express is the key public transport option available to those travelling to and from the Melbourne Airport in the Base Case. Figure 36 shows that modelled Melbourne City Express travel times, particularly during the peak periods, progressively deteriorate over time, increasing from 31 minutes in 2026 to 66 minutes in 2056 in the AM peak.

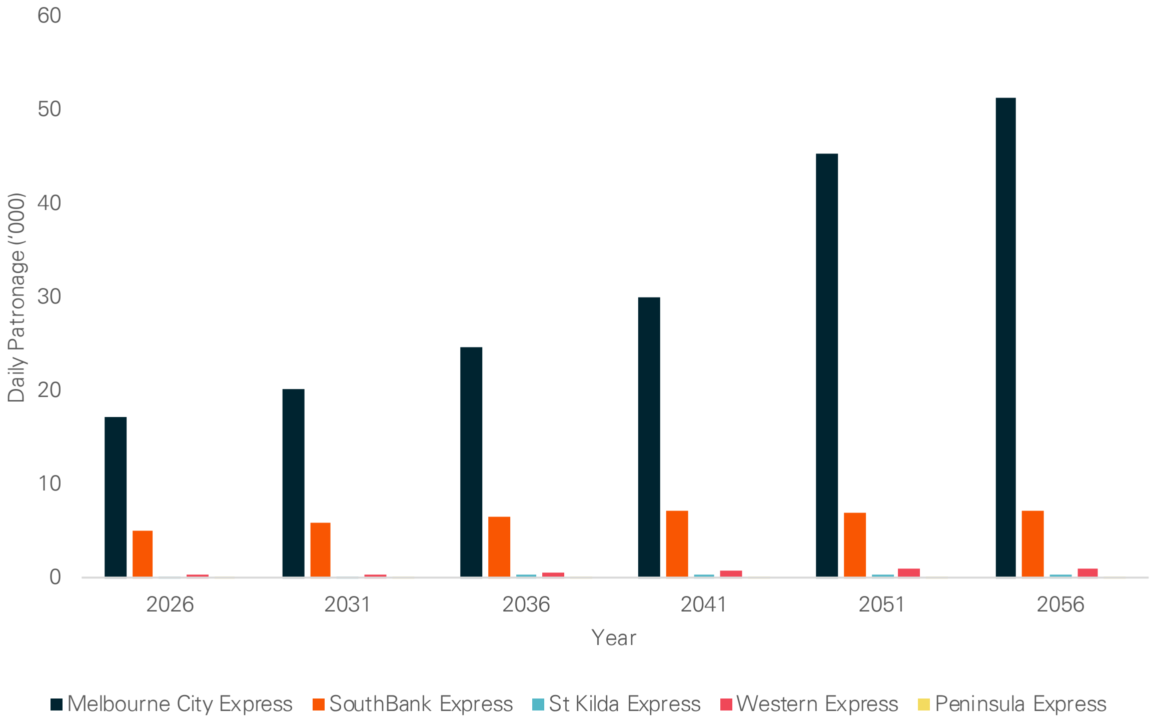
Figure 36: Melbourne Airport to CBD travel times – Melbourne City Express



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Given the increasing travel times due to worsening congestion and underlying capacity constraints, the demand modelling indicates that Melbourne City Express patronage grows at a lower rate than the overall growth in air passengers at Melbourne Airport (refer Figure 37). This figure also shows that passengers predominantly use the Melbourne City Express compared to other SkyBus services.

Figure 37: Daily Patronage on SkyBus services



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

4.1.5.1 Suburban Rail Loop

The Victorian Government has separately committed to delivering Suburban Rail Loop (SRL) – an integrated program of rail and precinct development initiatives, with a 90-kilometre orbital rail line extending around Melbourne from Cheltenham to Werribee. SRL will intersect the city's major metropolitan rail lines, linking middle suburbs and connecting people to major job centres, health services and education institutions. Figure 38 shows how Melbourne Airport Rail (MAR, or the Project) integrates with SRL.

Figure 38: MAR as part of the SRL network plan

* SRL is being assessed as part of a separate investment case

SRL has been considered in three sections. The section from Cheltenham to Box Hill is referred to as SRL East. The section from Box Hill to Melbourne Airport is referred to as SRL North. The third section from Melbourne Airport to Werribee is SRL West, which is in the early stages of planning.

All projects underway in Melbourne's West, including MAR, Metro Tunnel, Geelong Fast Rail and the Western Rail Plan (WRP) will make provision for SRL West to allow for the earliest possible delivery of SRL around to Werribee. A description of the WRP is provided in the next section.

The integration of MAR with SRL is expected to further improve the quality of public transport options to the airport for people from across Melbourne. Accessibility and travel times for passengers arriving at Melbourne Airport will improve and there will be more direct rail connections to metropolitan and regional Victorian destinations.

The considerable scale and complexity of SRL means that it will be completed in several stages over multiple decades. MAR will form the initial segment on the western side, while SRL East, which is due to commence construction in 2022 and commence operations in 2035, will be the next segment delivered.

The Victorian Government has developed the SRL Business and Investment Case with a focus on SRL East and SRL North. The development of the SRL Business and Investment Case has been undertaken in parallel with this Business Case.

This Business Case focuses on MAR as a stand-alone component of SRL. Details relating to SRL are provided in the SRL Business and Investment Case. However, given the long-term nature of SRL delivery, particularly the connection to the airport on the eastern side, the economic analysis in Chapter 9 of this Business Case is provided for two scenarios:

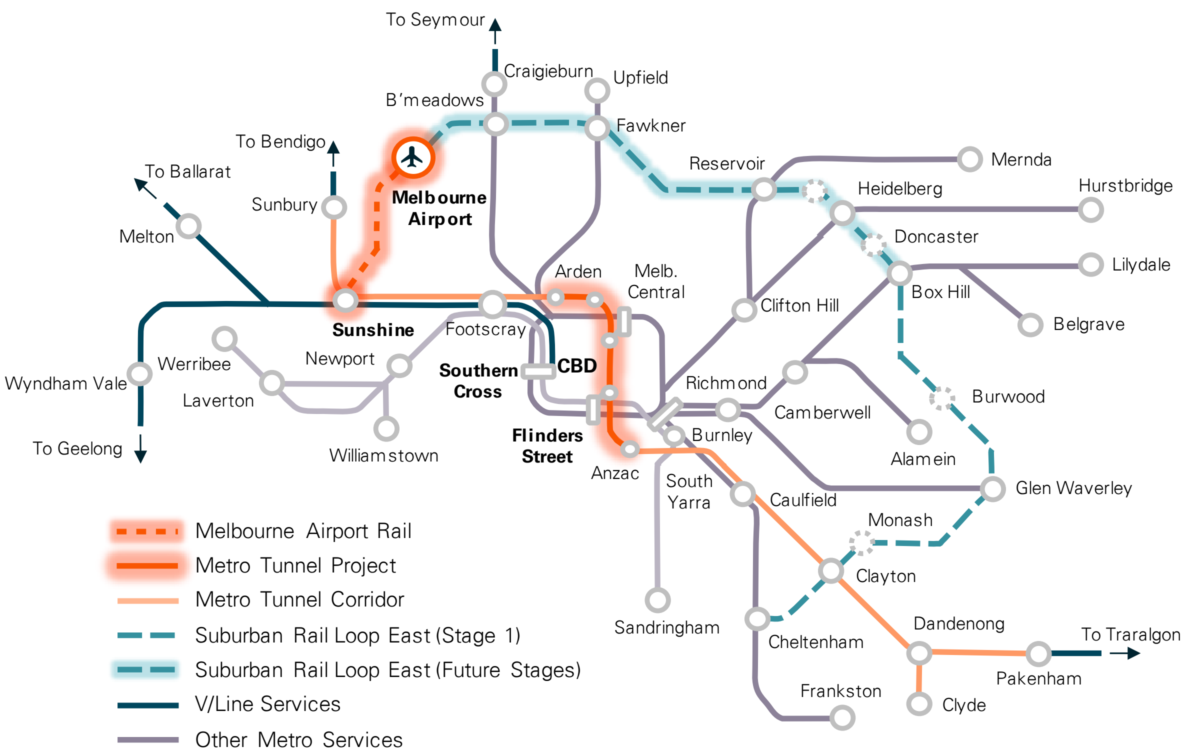
- In the first scenario, MAR is analysed as a stand-alone project to enable an assessment of its merits without the SRL North connection to the airport.
- In the second scenario, MAR is analysed with the SRL North connection to the airport completed by 2051.

5 Enhancing travel to Melbourne Airport

5.1 Service uplift enabled by MAR

The implementation of MAR will provide a new rail connection to Melbourne Airport. MAR will provide direct access to the rest of the metropolitan rail network and enable transfer to the regional rail network via Sunshine (refer Figure 39). This creates multiple entry and exit points for airport services within the Melbourne CBD via the five new stations along the MTP corridor, and through indirect links to the City Loop via Melbourne Central and Flinders Street stations. Routing airport services via Sunshine and Footscray also enables transfers to the regional Bendigo, Ballarat and Geelong lines. Connection to the metropolitan and regional rail networks provides airport passengers a choice of travel options and convenience of access to Melbourne Airport.

Figure 39: MAR alignment in the context of the Melbourne transport network



The service uplift due to MAR includes:

- Direct 6tph service from the airport to the south-east of Melbourne via Sunshine and the CBD. This will reduce travel times for air passengers along this corridor and enable a one seat journey to / from the airport (compared to the Melbourne City Express), while also enhancing capacity from Sunshine following the extension of West Footscray short-starters

- Travel time of approximately 27 to 30 minutes between Melbourne Airport and the CBD during non-peak and peak periods, respectively[17]
- Provision of HCMT-7 rolling stock, delivering public transport capacity of 6,600 people per hour (one way) from the CBD to Melbourne Airport during the AM peak.

5.2 Enhancing travel by public transport to and from the airport

5.2.1 Improved public transport connectivity to and from the airport

MAR provides an alternative choice to road transport for accessing Melbourne Airport. MAR delivers improved public transport connectivity to and from the airport by increasing public transport capacity, facilitating easier transfers and providing a one seat journey for airport users in the south east of Melbourne. These factors contribute to increased public transport use and mode shift from road to public transport.

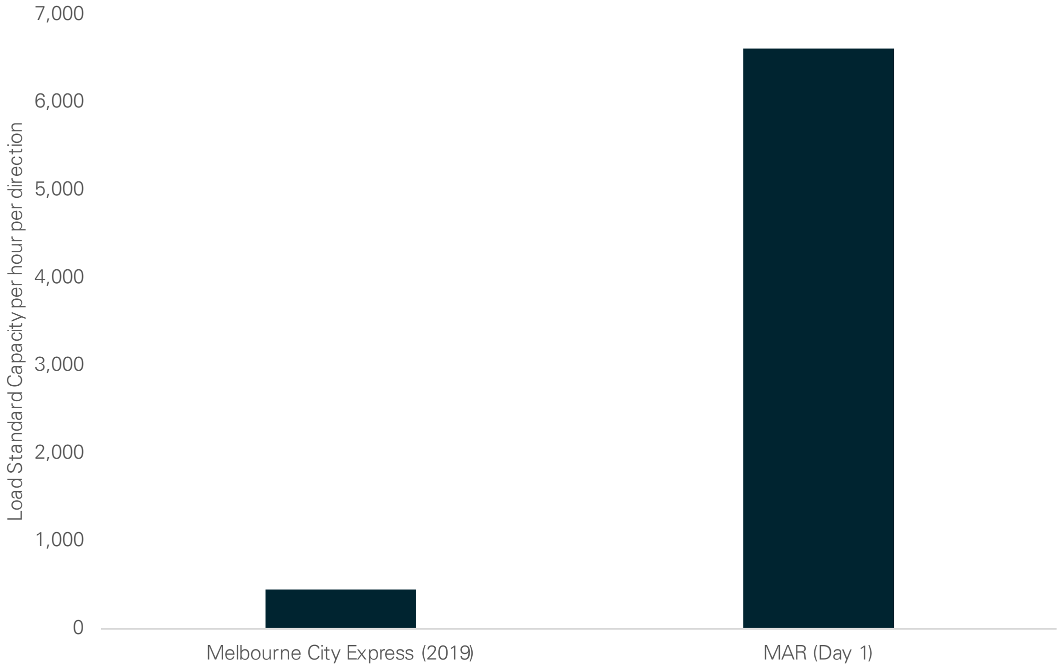
Delivering greater public transport capacity

The delivery of heavy rail to Melbourne Airport significantly increases the public transport capacity to and from Melbourne Airport. The Melbourne City Express service has a capacity of 75 passengers and currently runs every 9 to 10 minutes, providing a one-way capacity of 450 passengers per hour.

MAR will operate with the HCMT-7 on Day 1 of operations with a capacity of 1,100 passengers. With a service every 10 minutes, MAR will deliver a one-way capacity of 6,600 passengers per hour, significantly increasing the capacity available compared to the current Melbourne City Express SkyBus service.[18]

[17] Based on operational modelling undertaken by RPV.
[18] It is likely that the Melbourne City Express capacity will be expanded to cater to increased demand over the next decade. However, this will be limited by constraints at Melbourne Airport / Southern Cross Station and the maximum capacity of buses.

Figure 40: Capacity uplift delivered by MAR to and from Melbourne Airport (per hour, per direction)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Facilitating easier transfers across Victoria's rail network

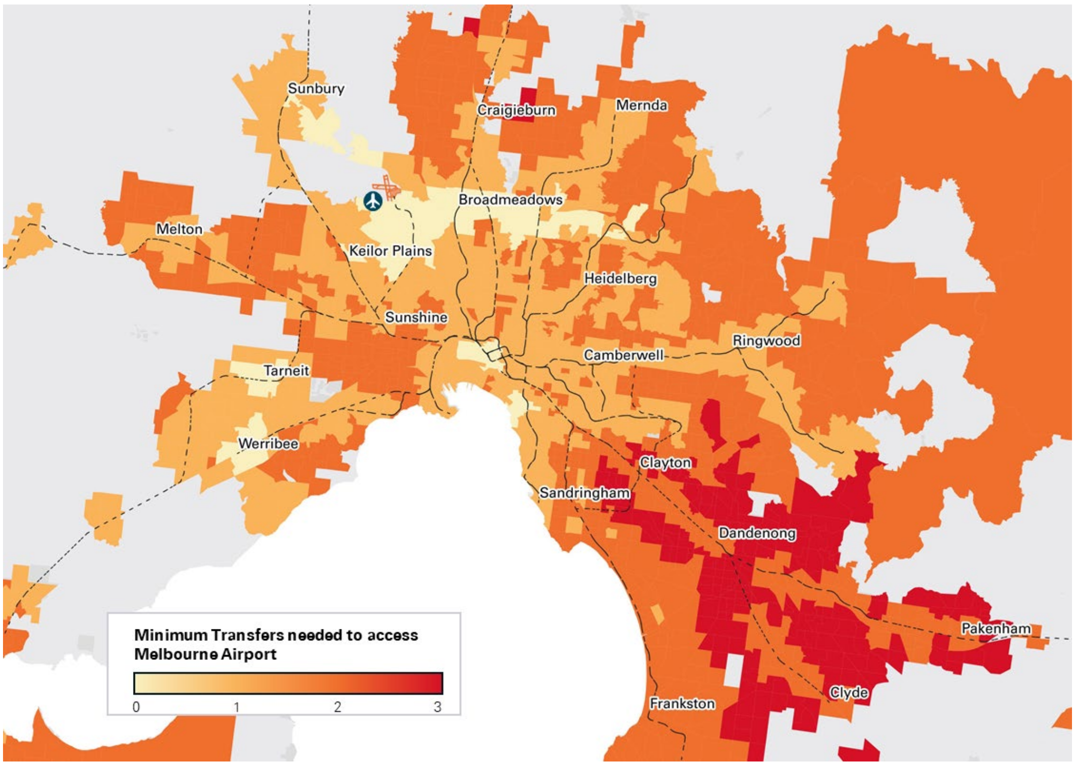
MAR facilitates easier transfers for airport users travelling by public transport. The MTP stations link MAR to the wider rail network which enhances network-wide connectivity for airport passengers. Stopping airport services at Sunshine improves airport accessibility for people in regional areas as regional passengers can transfer to the regional Geelong/Ballarat/Bendigo lines, as well as lines accessible via Southern Cross and the City Loop stations.

Enabling a one-seat journey for users along Melbourne's busiest rail corridor

Figure 41 shows that the majority of people across Melbourne need to make at least one transfer to get to Melbourne Airport in the Base Case, with the majority of journeys in the south east requiring two to three transfers.

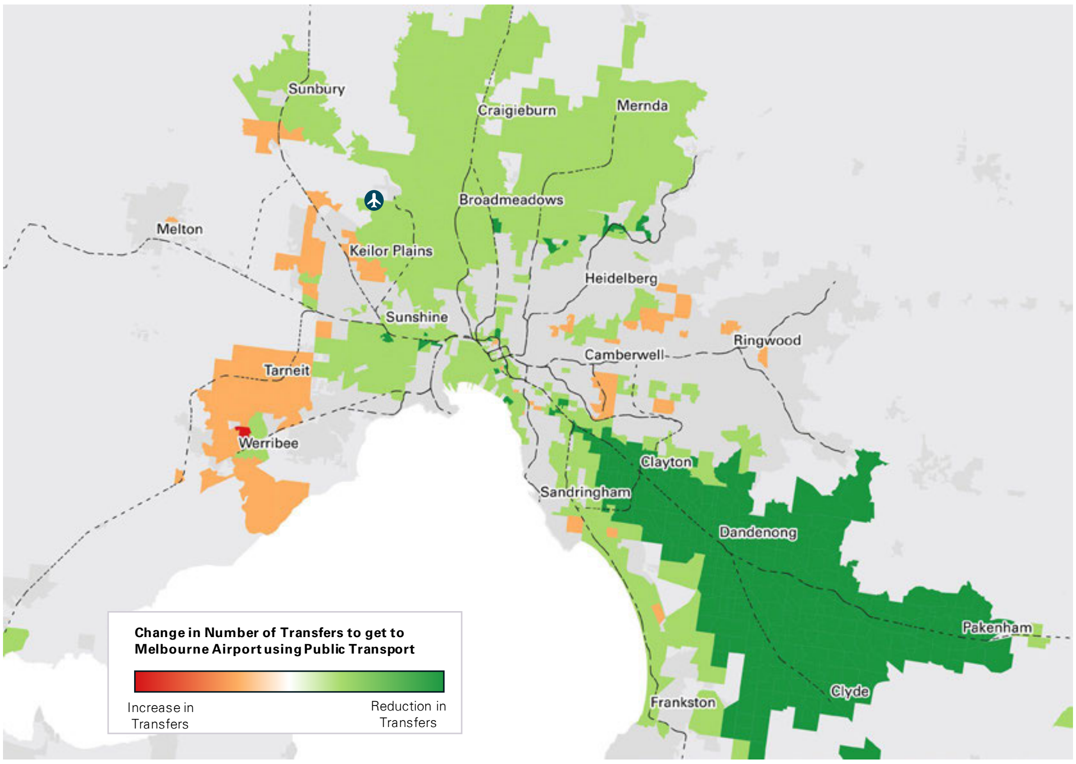
MAR reduces the number of transfers required to access the airport by public transport. Figure 42 shows that the greatest benefit will be to those people residing along the Dandenong corridor, where a vast majority of the population will be able to travel to Melbourne Airport without transferring.

Figure 41: Minimum transfers required to reach Melbourne Airport by public transport without MAR (2031)



Source: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.

Figure 42: Change in number of transfers required to get to Melbourne Airport by public transport (2031)



Source: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.

5.2.2 Reduced travel times to and from the airport by public transport

Continued population growth and growing airport patronage will place further pressure on the Tullamarine Freeway, increasing Melbourne City Express travel times and impacting the journeys of nearly all airport users. MAR provides an alternative mode of airport ground access which is independent of road congestion and will be especially beneficial to airport users travelling to and from the airport during the peak periods.

Figure 43 shows that MAR provides improved public transport travel times between the airport and the CBD in the AM peak and PM peak. During these times, MAR delivers a faster journey (30 minutes) compared to the Melbourne City Express, where the journey time is 40 minutes in 2031 and 66 minutes in 2056.

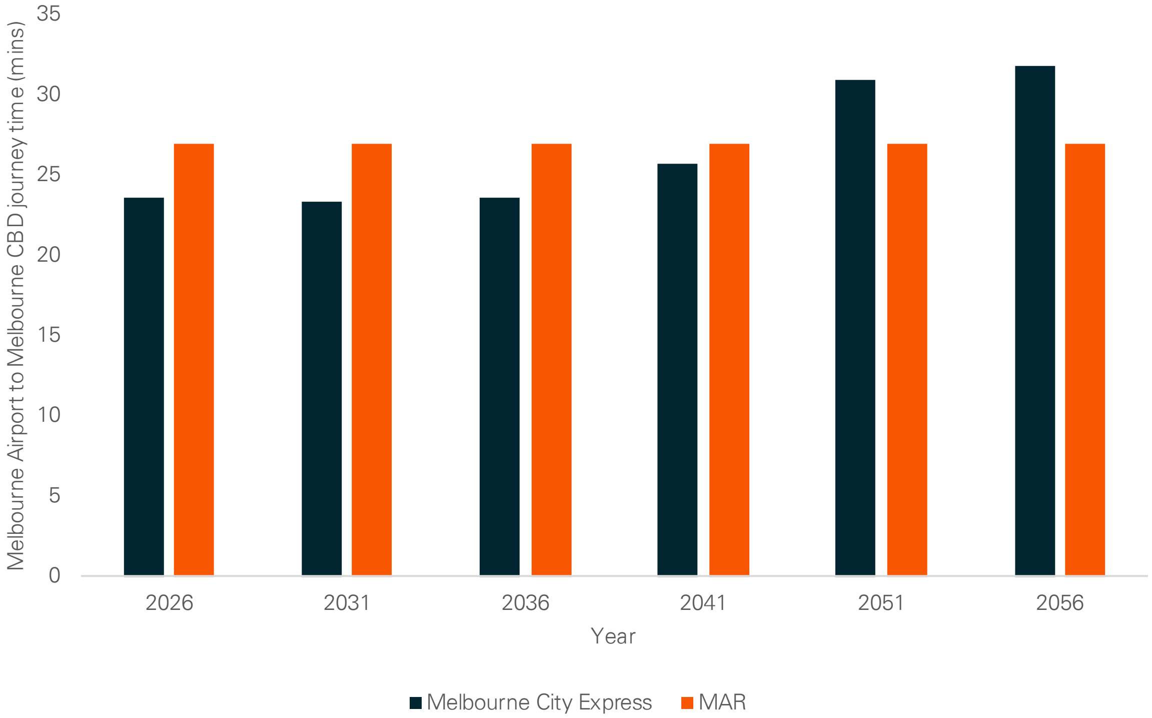
Figure 43 Travel times via public transport from Melbourne Airport to CBD (AM peak)[19]

***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

During the interpeak and off-peak periods, the travel time between Melbourne Airport and the CBD via MAR is approximately 27 minutes.[20] This is initially a longer travel time compared to the Melbourne City Express, as shown in Figure 44. MAR provides comparable travel times in all periods in later years, driven by worsening road congestion.

[19] For the Melbourne City Express, travel times reflect the journey between Melbourne Airport terminal and Southern Cross Station terminal in the AM peak period. For the MAR service, travel times reflect the journey between Melbourne Airport station and State Library station in the AM peak period. The travel times reflect journey time only and do not account for initial wait time, transfers, walk times or other aspects of the trip.
[20] Based on operational modelling undertaken by RPV.

Figure 44 Travel times via public transport from Melbourne Airport to CBD (Interpeak)[21]



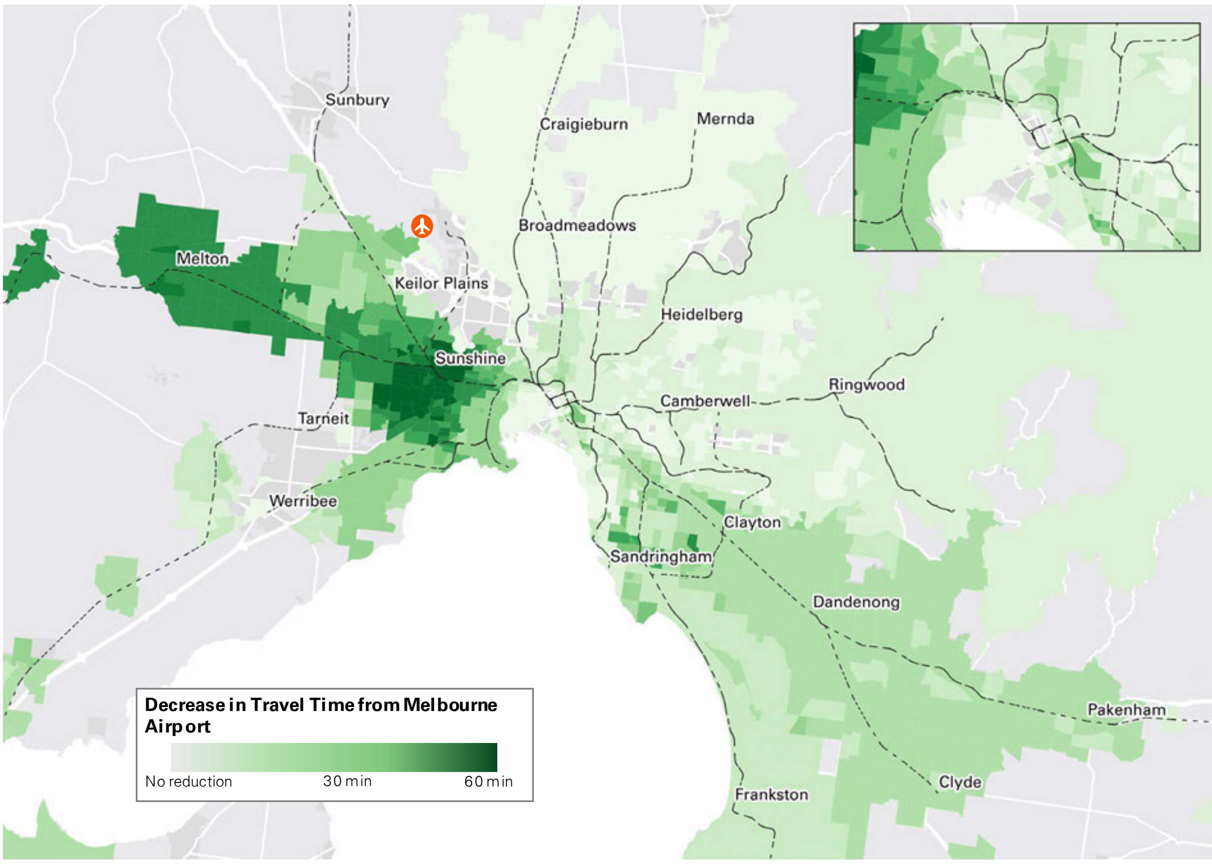
***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

MAR initially improves travel time for people residing in Melbourne's west, as shown in Figure 45. These airport users are able to access the MAR service from Sunshine without having to travel via the CBD or rely on local bus services, resulting in significant travel time savings. These travel time benefits are further increased for these residents by 2056.

The difference in travel time between MAR and Melbourne City Express service is marginal in 2031 when travelling from the Melbourne Airport to the CBD. As a result, any journey to the airport which requires crossing the CBD does not see a material benefit in the form of travel time. By 2056, road congestion worsens between Melbourne Airport and the CBD. This results in travel time savings for MAR users of 35 minutes when compared to the Melbourne City Express service in the AM peak. As a result of these travel time savings, accessibility is substantially improved for those who travel to and from Melbourne Airport via the CBD.

[21] For the Melbourne City Express, travel times reflect the journey between Melbourne Airport terminal and Southern Cross Station terminal in the interpeak period. For the MAR service, travel times reflect the journey between Melbourne Airport station and State Library station in the interpeak period. The travel times reflect journey time only and do not account for initial wait time, transfers, walk times or other aspects of the trip.

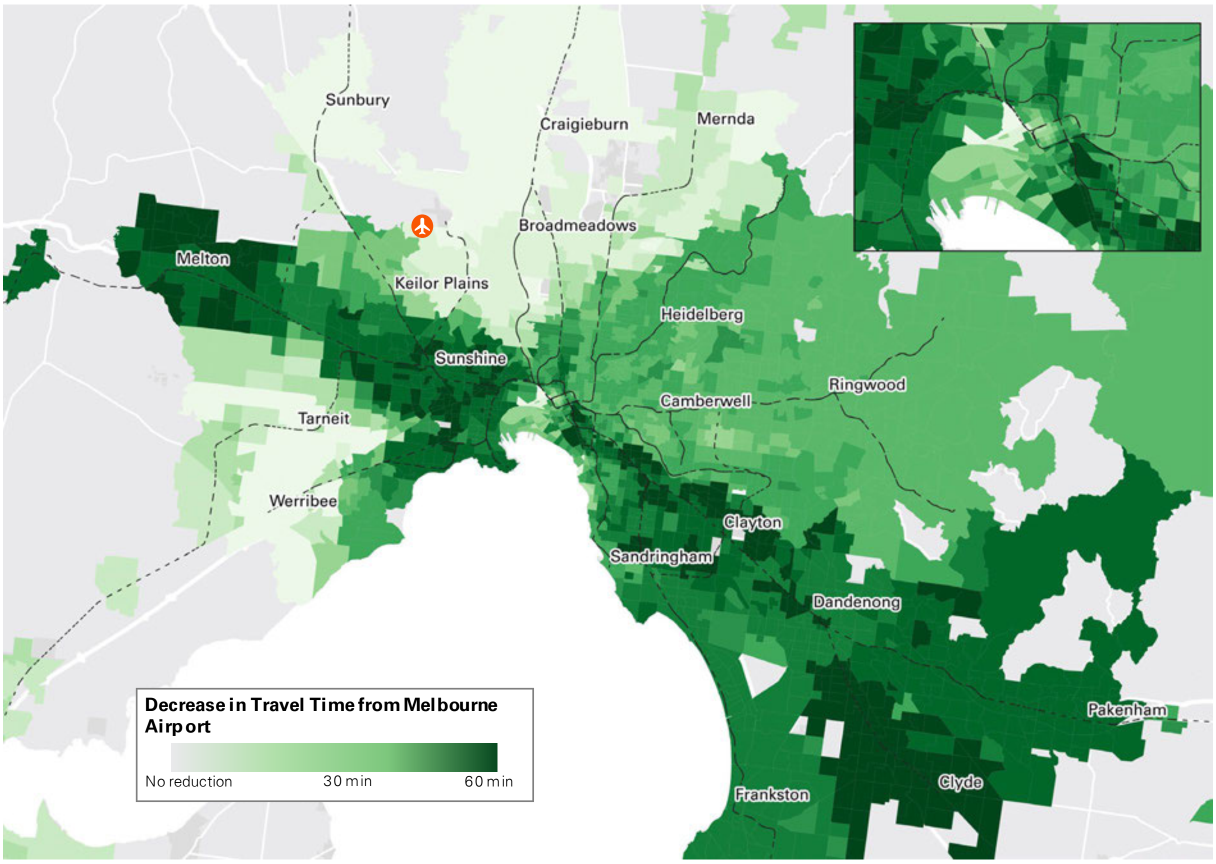
Figure 45: Change in travel time for public transport trips from Melbourne Airport (AM Peak, 2031)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

As road congestion worsens, the project progressively delivers improvements more broadly across the south-east and east of Melbourne (refer Figure 46).

Figure 46 Change in travel time for public transport trips from Melbourne Airport (AM Peak, 2056)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Across Melbourne, MAR delivers improved door-to-door travel times to and from Melbourne Airport by public transport. In this context, door-to-door travel times reflect all components of the journey, including station access time, initial wait time, time spent on the service, transfer time (if needed) and walking between the airport station and Melbourne Airport. Table 10 outlines the door-to-door travel time savings delivered by MAR in the AM peak.

In 2031, people travelling from the airport to Sunshine experience significant travel time savings with travel time reducing by more than half. These passengers will realise 49 minutes of door-to-door travel time savings as MAR provides a direct public transport link between the airport and Sunshine. Under the Base Case, these passengers would be required to take a Melbourne City Express service from the airport to Southern Cross Station, where they would transfer to a public transport service to Sunshine.

In 2056, travel time savings are further increased as a result of the growing congestion on the road network. Travel time savings are greatest for airport users in the CBD and south-east. Both of these locations are substantially impacted by the worsening congestion on the Tullamarine Freeway which leads to the greater travel time savings for MAR journeys. In addition, these passengers are serviced by a one-seat journey, further improving airport accessibility.

Table 10: Comparison of forecast travel time by public transport from Melbourne Airport, AM Peak

Suburb / Locality	2021	2031			2056		
	Base Case- No MAR	No MAR	MAR	Travel time savings with MAR	No MAR	MAR	Travel time savings with MAR
Sunshine *North-west Melbourne*	80 mins	82 mins	33 mins	**49 mins**	88 mins	33 mins	**54 mins**
Flinders Street *Melbourne CBD*	59 mins	60 mins	49 mins	**11 mins**	87 mins	47 mins	**40 mins**
Cheltenham *South-east Melbourne*	96 mins	98 mins	80 mins	**18 mins**	132 mins	87 mins	**45 mins**
Clayton *South-east Melbourne*	95 mins	102 mins	80 mins	**22 mins**	130 mins	80 mins	**50 mins**
Dandenong *South-east Melbourne*	117 mins	122 mins	100 mins	**22 mins**	167 mins	108 mins	**59 mins**
Wyndham Vale *West Melbourne*	80 mins	88 mins	69 mins	**19 mins**	93 mins	72 mins	**21 mins**
Travel times detailed above are door to door travel time from Melbourne Airport to a sample of suburbs / localities. Door to door travel times include time spent walking to the station, waiting for a service, time taken to transfer if needed and walking between the airport station and the airport.							

Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

5.2.2.1 Reduced public transport travel times from Melbourne Airport to Regional Victoria

Given MAR travels via Sunshine, Melbourne CBD, Clayton and Dandenong it not only integrates with the metropolitan rail network, but also with the regional rail network.

Table 11 outlines the door-to-door travel time savings MAR will deliver to key regional cities in Victoria. The analysis in the table shows that passengers travelling from Melbourne Airport to Ballarat and Geelong will experience significant travel time savings as they are now able to transfer from MAR at Sunshine rather than travel via Southern Cross Station as a result of using the Melbourne City Express SkyBus service.

Regional passengers from Traralgon also see significant travel time benefits in 2056, driven by growing congestion on the Tullamarine Freeway and easier transfers on to MAR.

Table 11: Comparison of forecast travel time by public transport from Melbourne Airport, AM peak

Regional City	2021 Base Case No MAR	2031			2056		
		No MAR	MAR	Travel time savings with MAR	No MAR	MAR	Travel time savings with MAR
Geelong *Barwon*	106 mins	120 mins	96 mins	**23 mins**	121 mins	102 mins	**19 mins**
Ballarat *Central Highlands*	173 mins	175 mins	126 mins	**49 mins**	179 mins	126 mins	**53 mins**
Bendigo *Loddon*	163 mins	146 mins	136 mins	**9 mins**	148 mins	136 mins	**12 mins**
Shepparton *Goulburn*	No data	214 mins	212 mins	**2 mins**	229 mins	223 mins	**6 mins**
Traralgon *Gippsland*	201 mins	201 mins	191 mins	**10 mins**	232 mins	191 mins	**41 mins**
Travel times detailed above are door to door travel time from Melbourne Airport to a sample of suburbs/localities. Door to door travel times include time spent walking to the station, waiting for a service, time taken to transfer if needed and walking from the airport station to the airport.							

Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

5.2.3 Increased public transport use

The delivery of MAR results in an increase in the public transport trips to and from the airport. This is driven by improvements in the public transport journey to Melbourne Airport, including reduced travel times and improved travel experience through reduced transfers (as described in Section 5.2.1 and 5.2.2).

Figure 47 illustrates the trend in public transport patronage (in the Base Case and Project Case) and the mode shift to MAR evident by the growing gap between the Melbourne City Express and MAR patronage. The figure shows that public transport patronage increases significantly under MAR with patronage increasing from 20,000 to 51,000 from 2031 to 2056. Across the same period, Melbourne City Express patronage grows from 19,000 to 28,000 under the Base Case.

Under the scenario which includes the SRL North connection to Melbourne Airport, public transport patronage in both the Base Case and Project Case is lower compared the scenario without the SRL North connection. SRL North provides a second rail connection to the airport and a more direct connection to the airport for people in parts of Melbourne's east. The decline in patronage is a result of some airport users no longer travelling via the CBD as they are able to access a more direct route to the airport via SRL North. This reflects the muted incremental impact that MAR has in a future transport network that contains the SRL North connection to the airport. Notwithstanding this marginal impact, even with SRL, MAR still delivers an improved offering and therefore increased patronage relative to the Melbourne City Express.

Airport precinct employees, who primarily reside in the northern and western regions of Melbourne, have the option to use MAR or continue to undertake trips via private vehicle – taking advantage of the road network improvements that occur following implementation of MAR (refer Section 4).

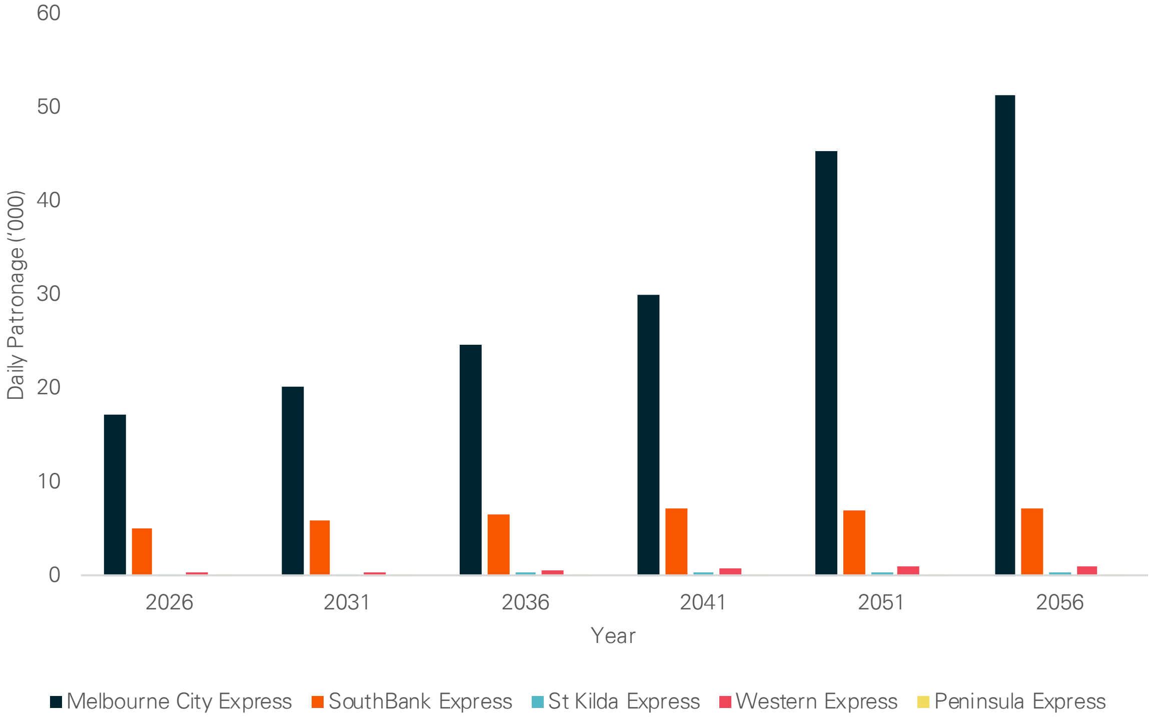
Figure 47: MAR daily patronage compared to Melbourne City Express patronage

***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

SkyBus Patronage

In the Base Case, Skybus patronage continues to grow steadily over time (refer Figure 48). The Melbourne City Express service has the greatest patronage in the Base Case but no longer operates in the Project Case as it is replaced by MAR. The delivery of MAR significantly increases patronage to the airport by public transport compared to the remaining SkyBus options (refer Figure 49).

Figure 48: SkyBus daily patronage without MAR (Base Case)

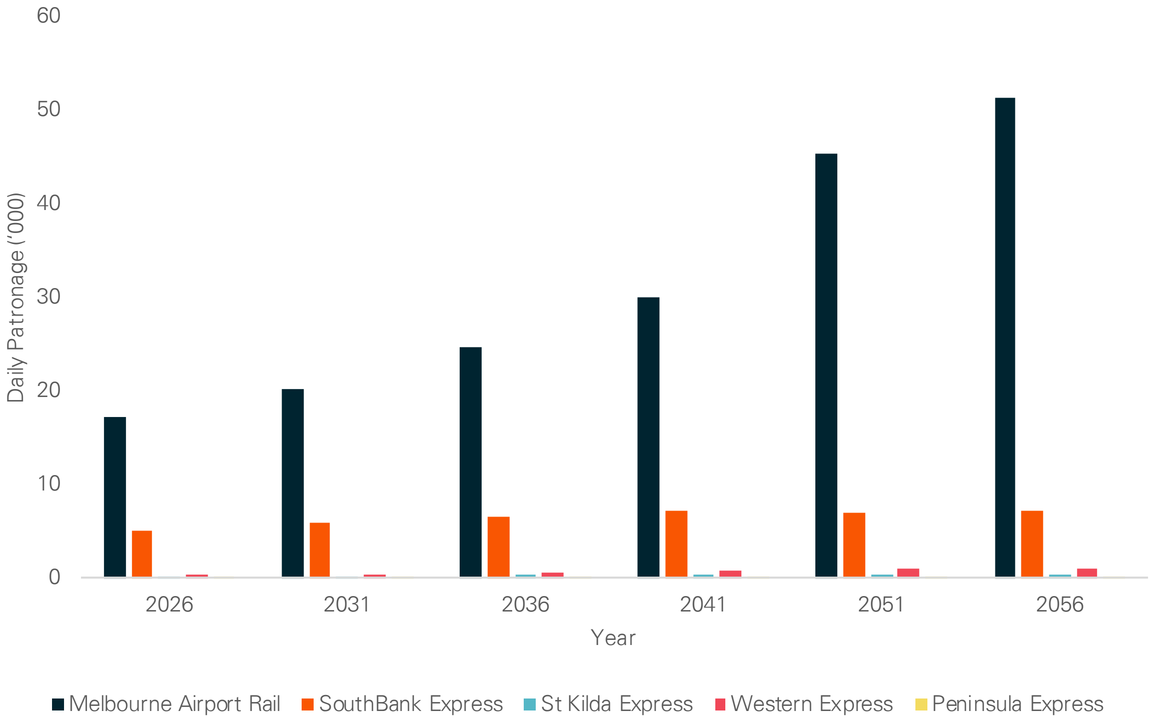


***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Under the Project Case, the daily patronage on the Southbank Express Skybus provides effective connectivity to the airport for airport passengers in these areas evidenced by the growing patronage. Figure 48 and Figure 49 show that, in 2026, patronage for the Southbank Express Skybus under the Base Case is 2,000 people, increasing to 5,000 in the Project Case.

The other Skybus services, including the St Kilda Express, Western Express and Peninsula Express, have low patronage in both the base case and project case. This is driven by lower number of airport trips from those areas, longer journey times on those services and infrequent services (every 30 minutes) resulting in passengers opting to drive rather than rely on public transport.

Figure 49: Skybus patronage with MAR (Project Case)



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

Public transport trips to Melbourne Airport across Melbourne

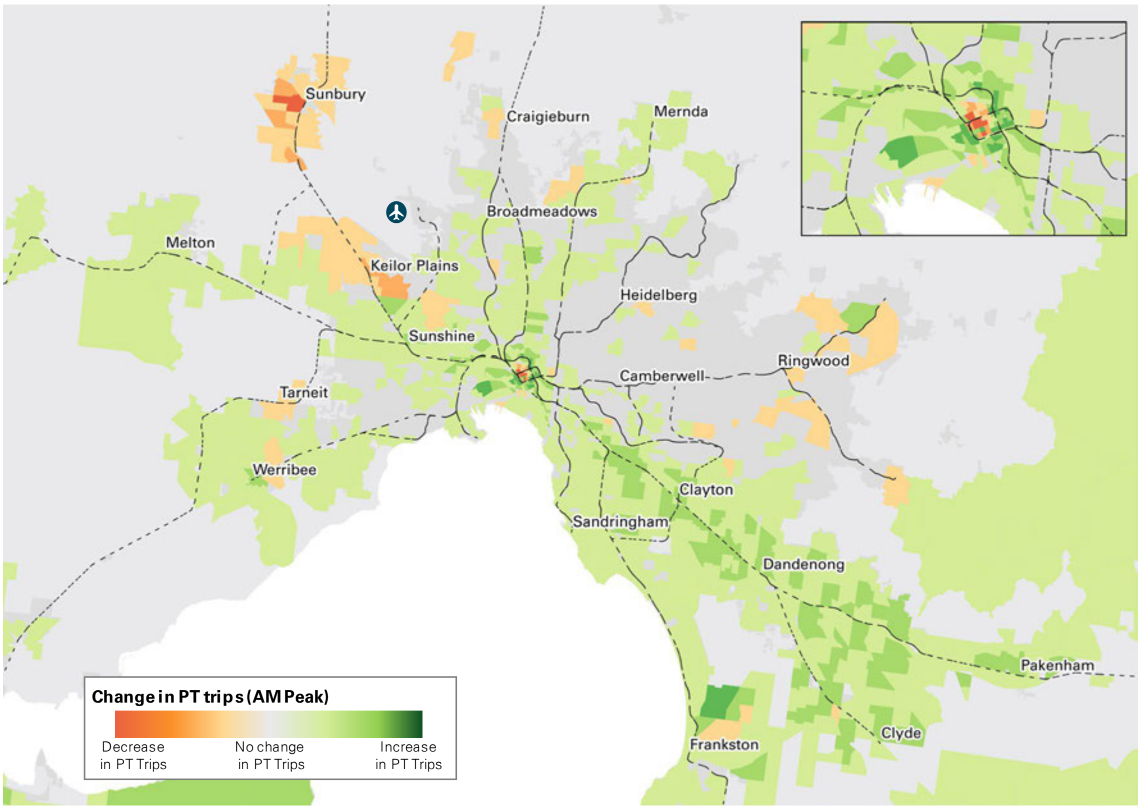
MAR increases the number of airport trips made by public transport across all regions, with the most considerable increases occurring along the Melton-CBD-Dandenong corridor. A sizeable proportion of these public transport trips occur during the peak periods, taking cars off the road in the most congested period.

In 2031, MAR delivers an uplift in public transport trips across most parts of greater Melbourne. The greatest uplift in public transport patronage is in the east and south-east of Melbourne. Figure 50 shows a number of increased public transport trips from the east, in Melton, across the CBD to the Dandenong corridor.

Patronage along the Dandenong corridor reflects the improved accessibility to the airport delivered by MAR. MAR provides these airport users a zero-transfer trip to the airport and an airport connection from the CBD that is faster than Melbourne City Express.

A decrease in public transport trips is observed in and around Sunbury and Keilor Plains as those residing in these areas benefit from improved road conditions in and around the airport.

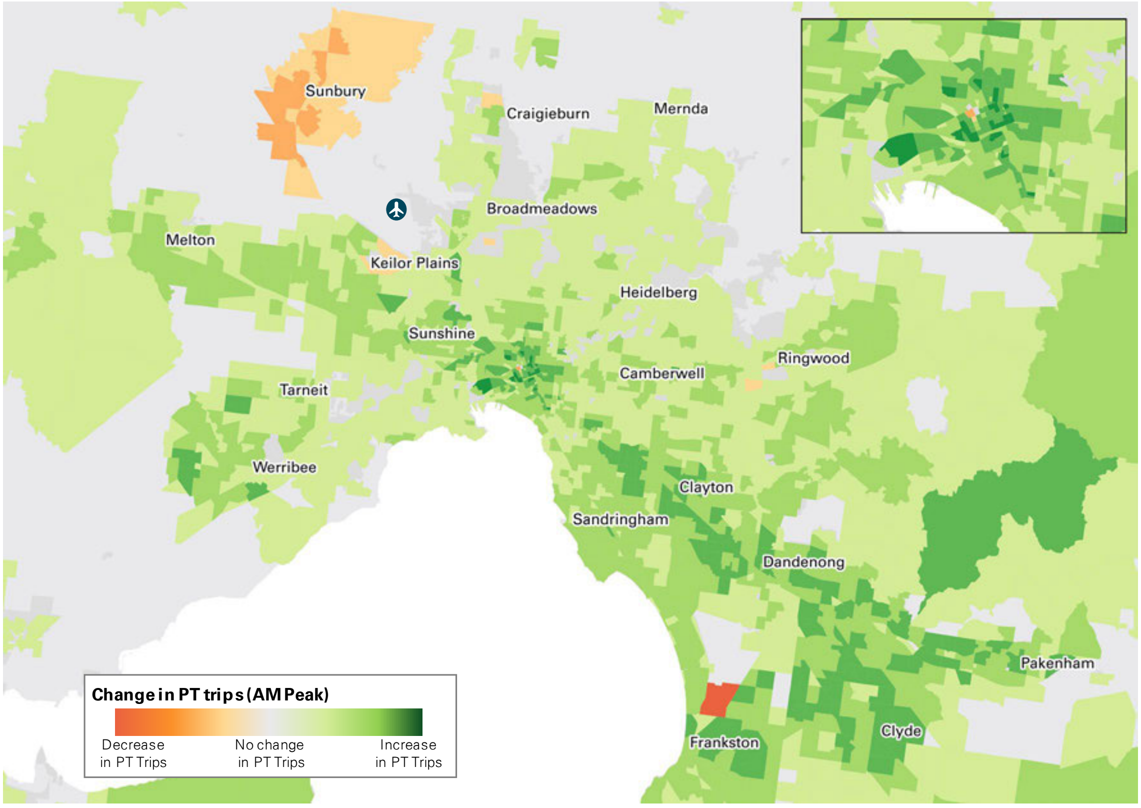
Figure 50: Change in public transport trips to and from Melbourne Airport - AM peak, 2031



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

In 2056, the number of public transport trips in the AM peak along the Dandenong corridor increases significantly. There is also a notable increase in trips west of Melbourne, particularly along the Melton corridor and near Werribee. This increase in trips is likely driven by users switching to MAR as a result of a faster overall journey compared to either existing public transport options or by road.

Figure 51: Change in public transport trips to and from Melbourne Airport - AM peak, 2056



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

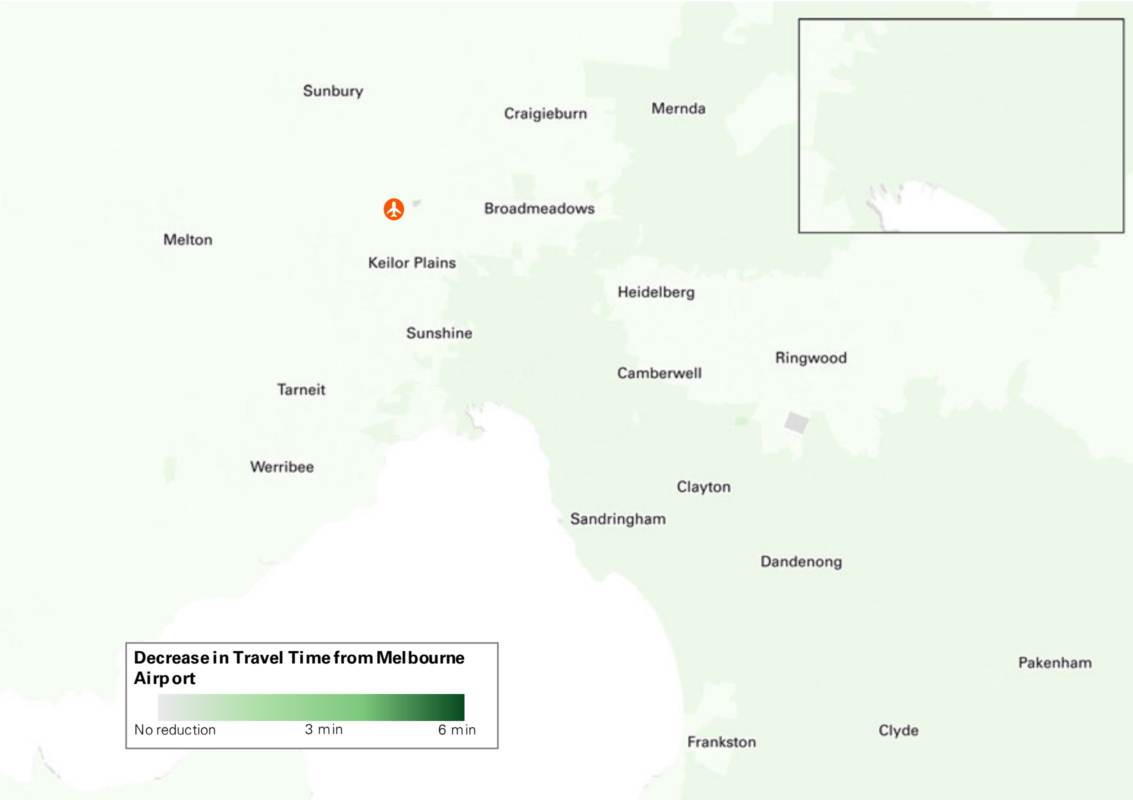
5.3 Enhancing travel to Melbourne Airport by road

5.3.1 Improved road access from the airport

The enhanced public transport connectivity to and from the airport increases the number of people travelling by public transport. This mode shift reduces the number of vehicles on the road network, providing congestion relief for cars and enhancing travel to and from Melbourne Airport by road across the entire network. There are also significant impacts on the broader road network which contribute to reduced travel time for non-business users and productivity improvements for business users. These broader road network impacts are discussed in Section 6.

In 2031, the magnitude of mode shift is not significant and hence the improvement in road conditions for those travelling from Melbourne Airport will be minimal (refer Figure 52).

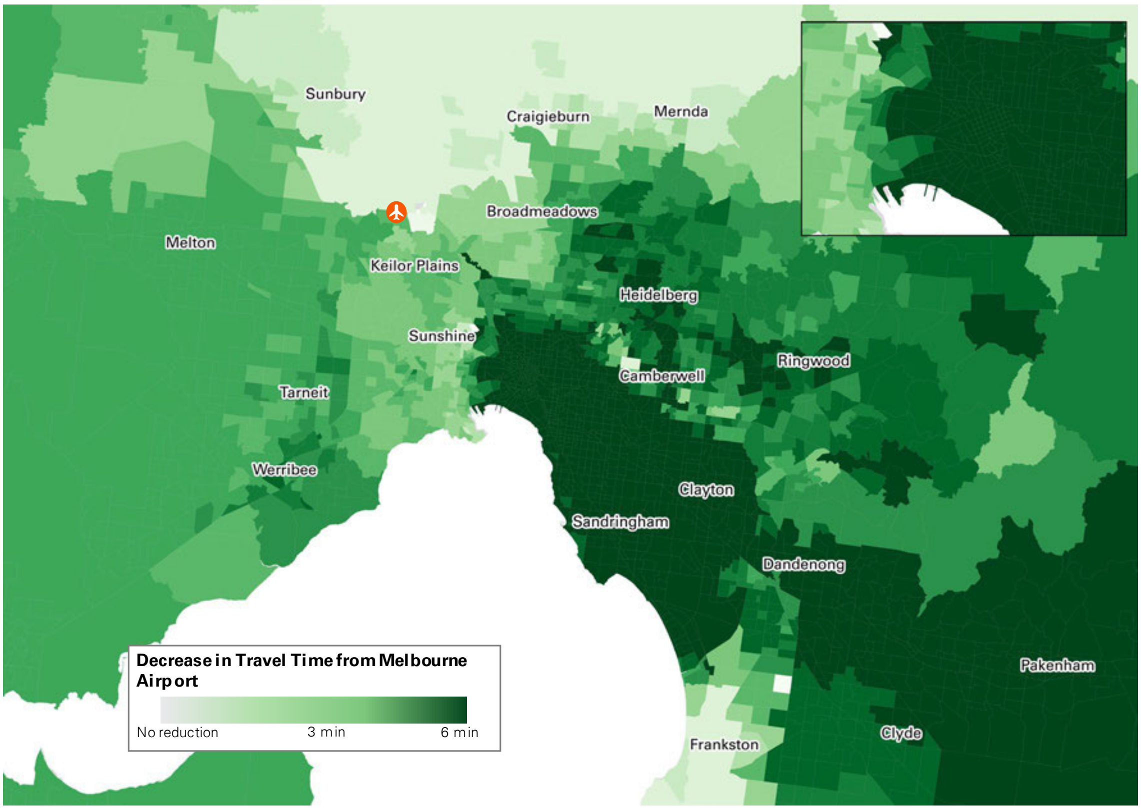
Figure 52: Change in car journey times from Melbourne Airport following delivery of MAR (AM peak, 2031)



Source*: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

However, by 2056 this mode shift is significant and results in larger travel time savings for those travelling longer distances from the airport, even after the impact of induced demand is incorporated (refer Figure 53). Those travelling longer distances benefit from the cumulative impact of congestion relief and improved travel speeds across the network resulting from mode shift to public transport due to MAR. It is primarily non-air passengers who benefit from the improved road network (this is discussed further in Section 6.1).

Figure 53: Change in car journey times from Melbourne Airport following delivery of MAR (AM peak, 2056)



Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

6 Improving productivity and competitiveness for Victoria through an enhanced transport network

Capacity issues on airport access routes have wide-ranging implications. Melbourne's arterial roads serve a broad user base and form critical links connecting people to jobs, education and social opportunities. They also facilitate the movement of goods across the city from sites of production to their final customers. Beyond the improvements in road access to and from the airport shown in Section 5, the modelling shows that MAR delivers material benefits to the broader transport network primarily through reduced travel time on key road links. This will contribute to improved productivity and competitiveness for Victoria by reducing costs associated with travel. The improvements to the broader transport network resulting from MAR are discussed in this section.

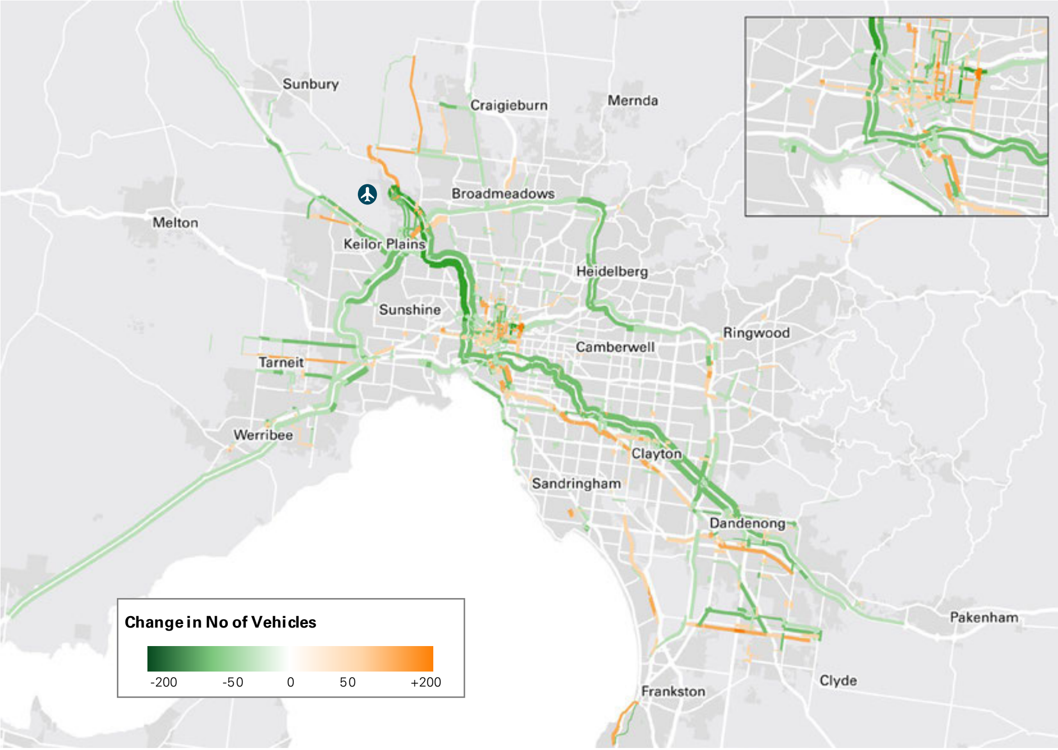
6.1 Reduced travel time on key road links

Beyond improved access to and from the airport, the mode shift to public transport due to MAR reduces congestion on key arterial roads. Figure 54 and Figure 55 show the change in number of vehicles travelling across the road following the introduction of MAR. By removing airport users from the road network, MAR reduces road congestion by shifting inbound and outbound airport traffic to alternative routes and modes. This results in higher road network speeds and improved travel time for both airport users and other road network users (i.e. non-business and business trips). Melbourne's arterial roads are key carriers of the city's freight task, with travel time one of the largest cost inputs into the transportation of goods. As such, any intervention which produces travel time savings will reduce input costs and help boost productivity for local exporters and businesses importing goods.

In 2031, the areas with the greatest reduction in vehicle numbers reflect the areas with the greatest public transport accessibility improvements resulting from MAR. These areas include the south-east road corridor (CityLink / Monash Freeway) and the CBD-airport corridor (CityLink / Tullamarine Freeway). There are also reduced vehicle numbers on the south-west corridor (Princess Freeway / Western Ring Road) and the north-east corridor (Metropolitan Ring Road).

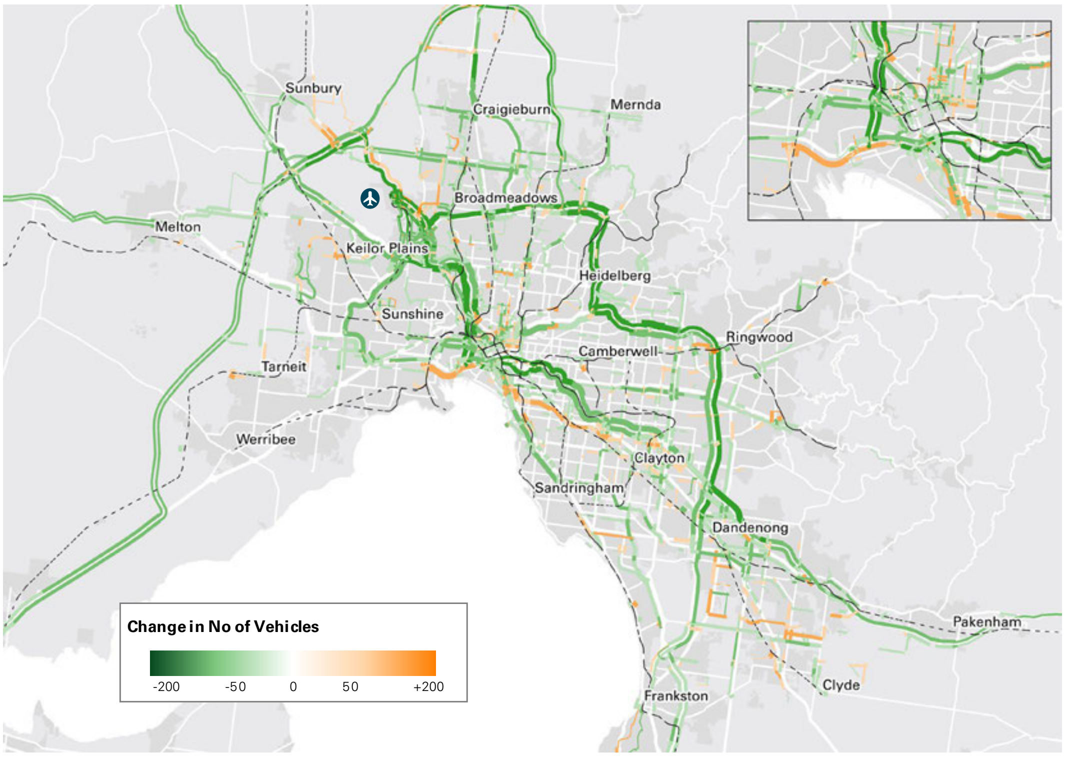
The number of vehicles removed by MAR increases further by 2056 as a result of the higher mode shift to public transport when MAR is operational. There is significant reduction in the number of cars travelling along the Monash Freeway, CityLink, Tullamarine Freeway, EastLink, North East Link, M80 Ring Road and the OMR.

Figure 54: Change in the number of vehicles on the road network with MAR– AM Peak, 2031



Source: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.

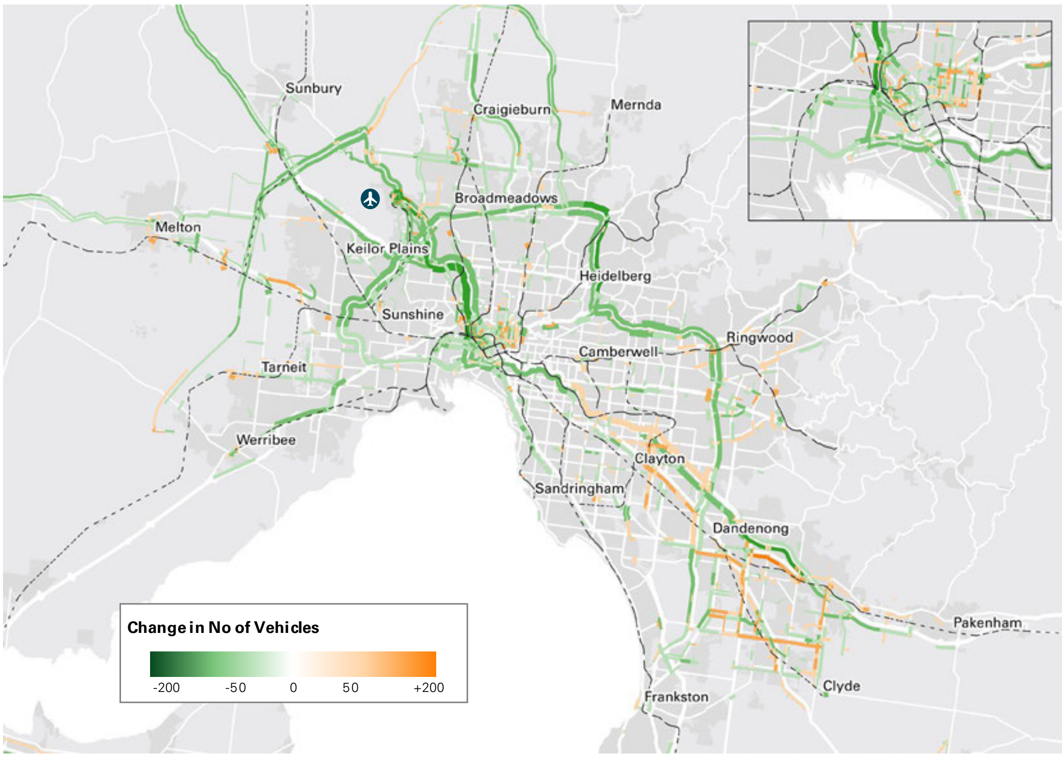
Figure 55: Change in the number of vehicles on the road network with MAR – AM Peak, 2056 (No SRL North connection to Melbourne Airport)



Source: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.

The demand modelling shows that MAR has a lesser impact on the road network when the SRL North connection to Melbourne Airport is included within the Base Case (refer Figure 56). SRL North provides an additional rail connection to the airport and will remove a large number of cars from the road previously attributed to MAR. However, MAR still reduces the number of cars travelling on the road network, as shown in Figure 56.

Figure 56: Change in the number of vehicles on the road network with MAR – AM Peak, 2056 (with SRL North connection to Melbourne Airport)



Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7 Sensitivities and scenario testing

Sensitivity analysis and scenario testing play an important role in assessing the robustness of the demand modelling findings and conclusions based on primary analyses. This testing is critical to assessing the impact, effect or influence of key assumptions or variations. The sensitivity analysis and scenario testing assesses the impact of COVID-19, alternate public transport fares, an intermediate station at Keilor East, alternate airport user preferences (alternative-specific constants), autonomous vehicles and transport network pricing. This section outlines the impact of these sensitivity and scenario tests.

7.1 Impact of COVID-19

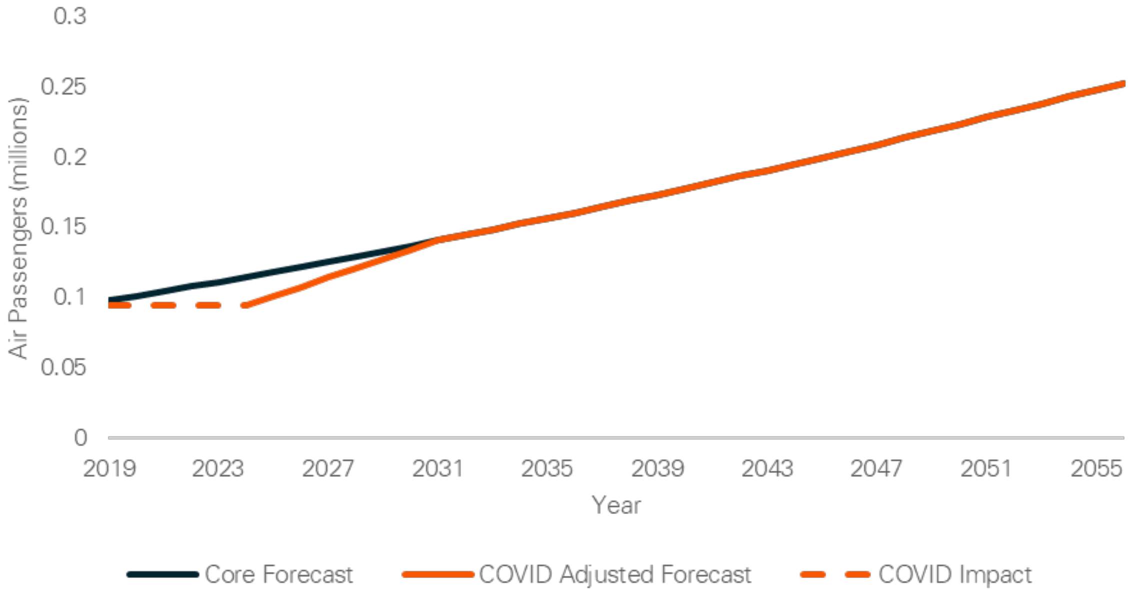
At the timing of writing this Business Case, the COVID-19 pandemic continues to pose risks to global and Victorian economic conditions, and the full length and severity of these impacts are still unknown.COVID-19 has already changed how some industries work, with a large uptake in people working remotely due to government restrictions, more local trips and a shift from public to active and private transport. It is uncertain how much these immediate impacts will mean a permanent change to travel patterns.

While the length and severity of the COVID-19 pandemic remains uncertain, it is likely the majority of these impacts will continue to be felt during the first months or years of recovery. Despite many unknown variables, it is possible that COVID-19 reduce population growth, airport patronage and travel demand, at least over the next few years. To understand the potential demand and patronage impacts of COVID-19 on MAR, a sensitivity test was undertaken with the following revised modelling assumptions[22]:

- Based on DELWP analysis, population and employment are expected to be delayed by two years in early model years, increasing to delay of four years by 2056. For example, the growth originally forecast for 2020 is expected to be realised by 2022, while 2052 growth levels are expected to be realised by 2056.
- Based on DoT and DJPR analysis, 29 per cent of Victorian jobs are suited for remote work and those employed in these jobs will work from home for two to three days a week
- Air passenger numbers will reduce in the short term, with travel returning to 2019 levels by 2023 for domestic and short haul travel, and by 2024 for all travel. By 2031, travel forecasts will revert to pre-COVID levels.

[22] Department of Transport (2020). *COVID-19 impacts on demand forecasts – sensitivity and scenario testing project analysis.* Note that air passenger assumptions are based on IATA and Qantas announcements and have been agreed with RPV / DoT.

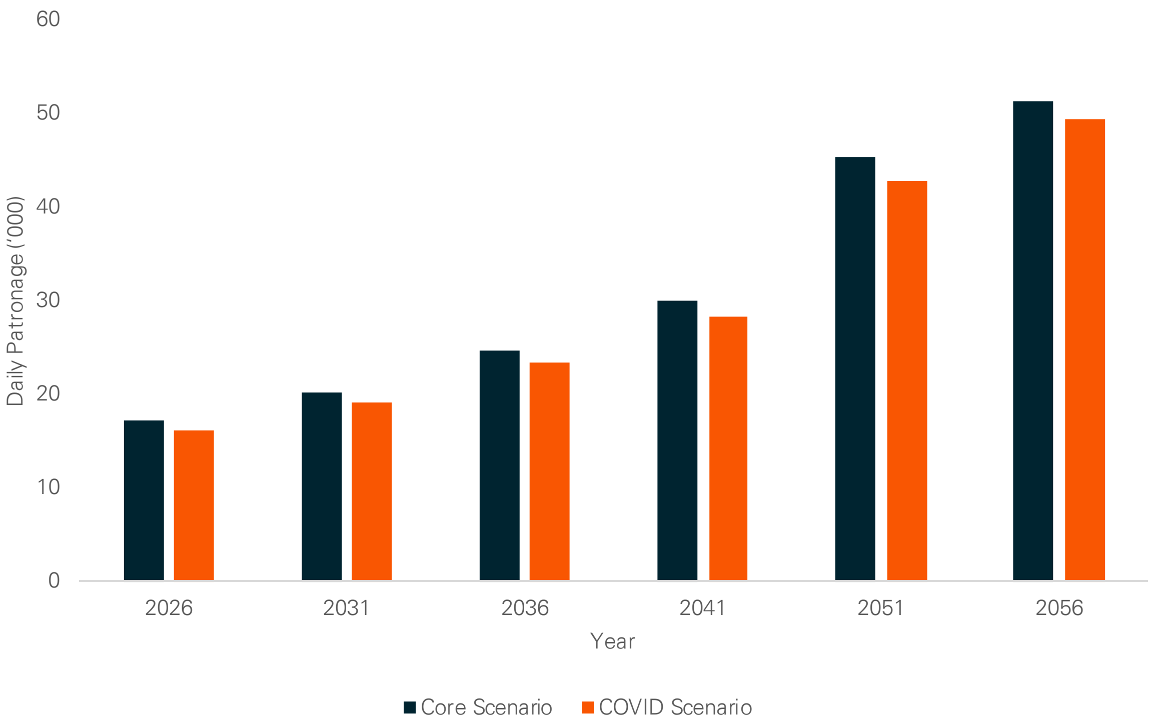
Figure 57: Impact of COVID-19 on air passengers



Source: *KPMG based on IATA and Qantas announcements.*

The demand impact of the COVID-19 sensitivity is shown below in Figure 58, with daily MAR patronage forecast to decreased 5 to 6 per cent in the modelled years when compared to the core Project Case. Note that the economic impact of this sensitivity is reported in Chapter 11 of the Business Case and Appendix 9: Economic appraisal.

Figure 58: Impact of COVID-19 on daily MAR patronage



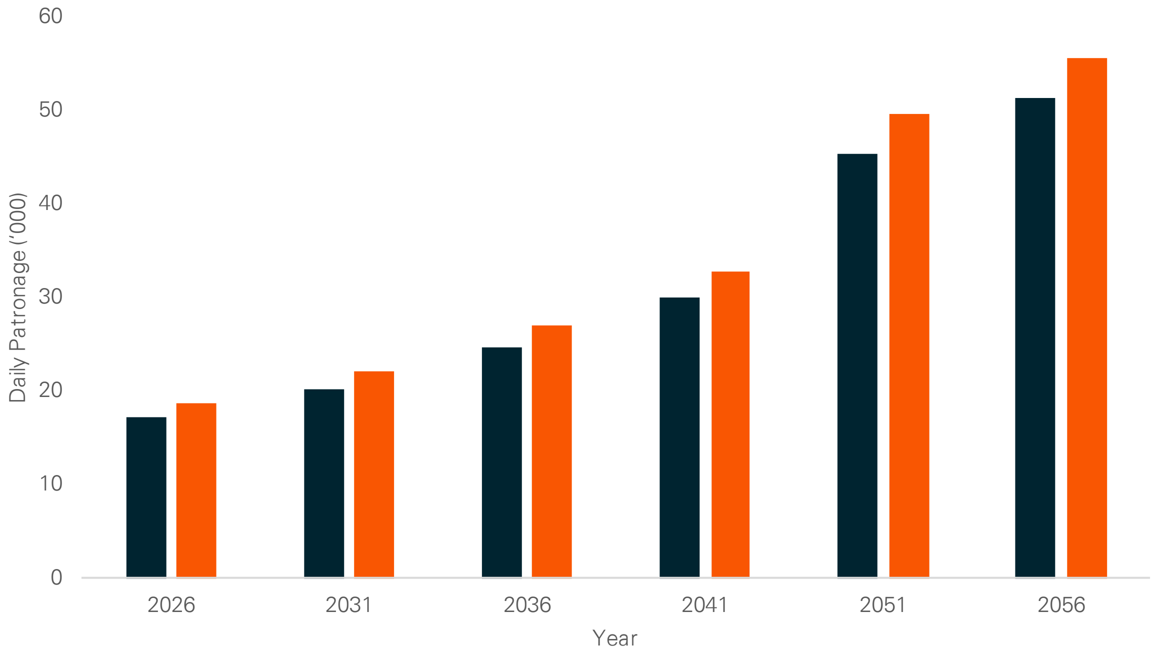
Source*: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7.2 Public transport fares

Public transport fares are a cost perceived by users and therefore influence mode choice and overall patronage on public transport. For example, a price decrease may motivate consumers to use a mode of transport more or shift to another mode of transport. Price sensitivity of public transport fares identifies the degree to which consumer behaviour is affected by the price of the service.

A sensitivity was undertaken with a reduced fare premium of **Redacted** to understand the impacts of a lower fare on patronage. Figure 59 shows the impact of the reduction in MAR fares from **Redacted** to **Redacted** between 2026 and 2056[23].

Figure 59: Impact of public transport fares on MAR daily patronage



Redacted

***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7.3 Keilor East intermediate station

This scenario considers the impact of an intermediate station on the MAR line at Keilor East, a suburb located between Sunshine and Melbourne Airport. A new station at Keilor East enables improved access for airport passengers as well as better public transport accessibility to those living in Keilor East and surrounding areas. However, an additional station impacts the overall journey time of MAR and airport users' perceptions of service efficiency.

[23] The actual fare premium for MAR will be subject to a separate analysis and determined at a later point in time by the Victorian Government

Figure 60: Keilor East station

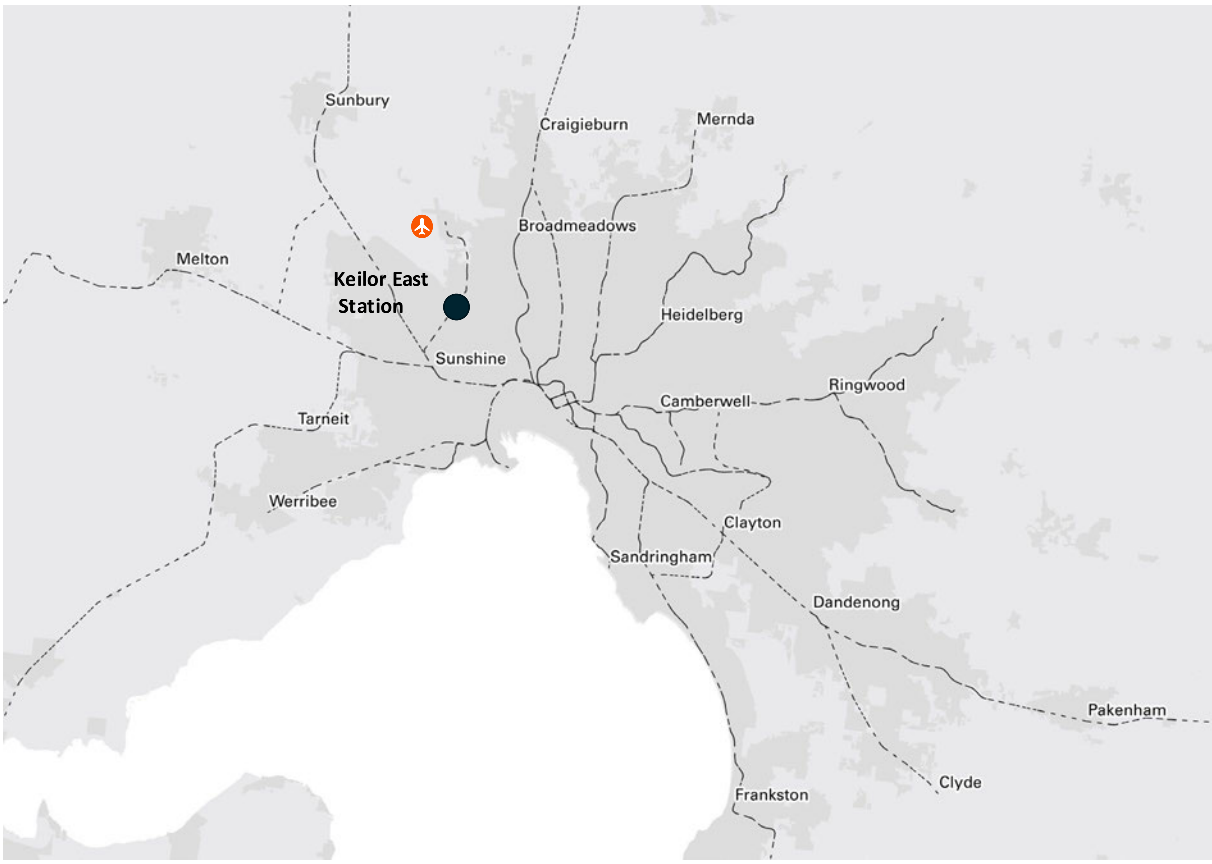
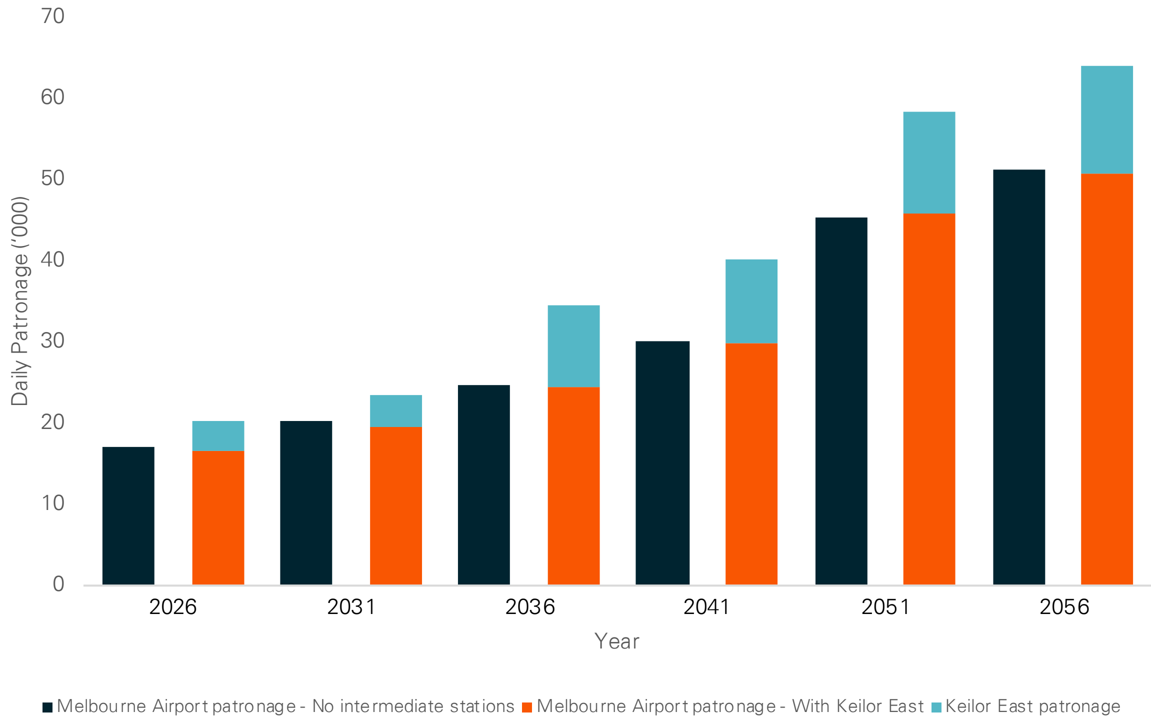


Figure 61 compares the Project Case (no intermediate station) with a scenario where the service stops at the Keilor East intermediate station. Servicing the intermediate station increases the overall patronage of the service, resulting in higher utilisation of the HCMT's and greater public transport accessibility in an area with a low level of accessibility.

There is a marginal drop in patronage at Melbourne Airport in early model years due to the increase in travel time to and from Melbourne Airport as a result of stopping at the new station.

Figure 61: Impact of an intermediate stations at Keilor East on MAR daily patronage



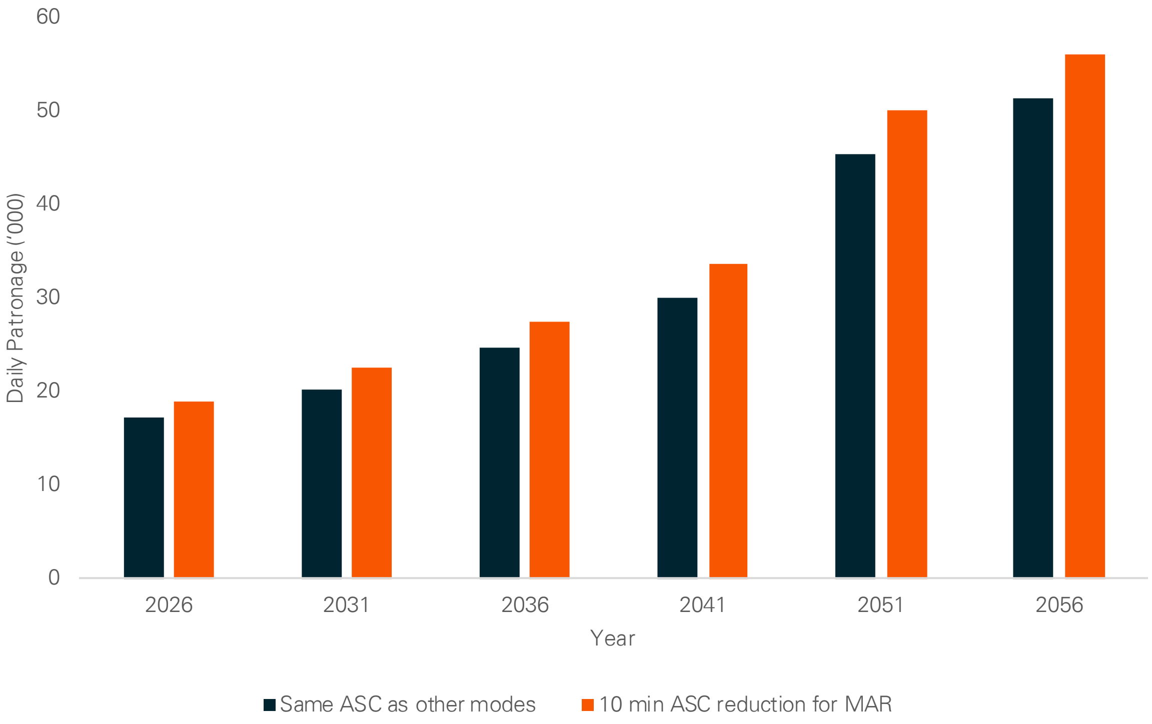
Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7.4 Airport user public transport preferences

The core demand modelling runs undertaken have considered observable trade-offs such as journey time, public transport fares and public transport transfers. The modelling has not considered an inherent preference to rail, over and above the observable attributes of the generalised cost equation.

To understand the impact of an inherent use preference for travel by rail compared to bus, a scenario using alternative-specific constants (**ASC**) has been undertaken. The ASCs in the VITM Airport Module account for the unobserved attributes not captured by the time and cost incurred by a user which impact air passenger mode choice. The use of alternative ASCs aims to test the variability of the unobserved user attributes on modelled results (e.g. sensitivity of mode share). The approach models MAR with a 10-minute journey time reduction (compared to other modes) to understand the impact of a potential user preference for rail. Figure 63 shows the results of the 10-minute ASC preference for MAR over SkyBus, with MAR patronage increasing by over 5,000 in later years.

Figure 62: Impact of ASC – 10-minute ASC preference for MAR



Source: *KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7.5 Autonomous Vehicles

In the future, Autonomous Vehicles (**AVs**) are expected to provide new mobility solutions for travellers. By removing the human element of driving, AVs could deliver numerous benefits such as increasing accessibility for travellers who are unable to drive, reducing the demand for off-street parking and increasing road safety and capacity. It is therefore necessary to understand their potential impacts on travel behaviour. However, there is still a range of uncertainty regarding how travellers will utilise AVs. Work undertaken by IV suggests two possible pathways:

- People adopt AVs as their personal vehicles, potentially increasing the number of multi-car households; or
- People do not own AVs and instead, AV usage is shared.

Furthermore, the proportionate share of traditional conventionally driven vehicles and AVs is unknown. Given this uncertainty, two scenarios were implemented to assess the indicative impact of AVs. These assumptions were informed by work undertaken by DoT and consider both a high private use scenario and a high shared use scenario. Table 11 details these assumptions.

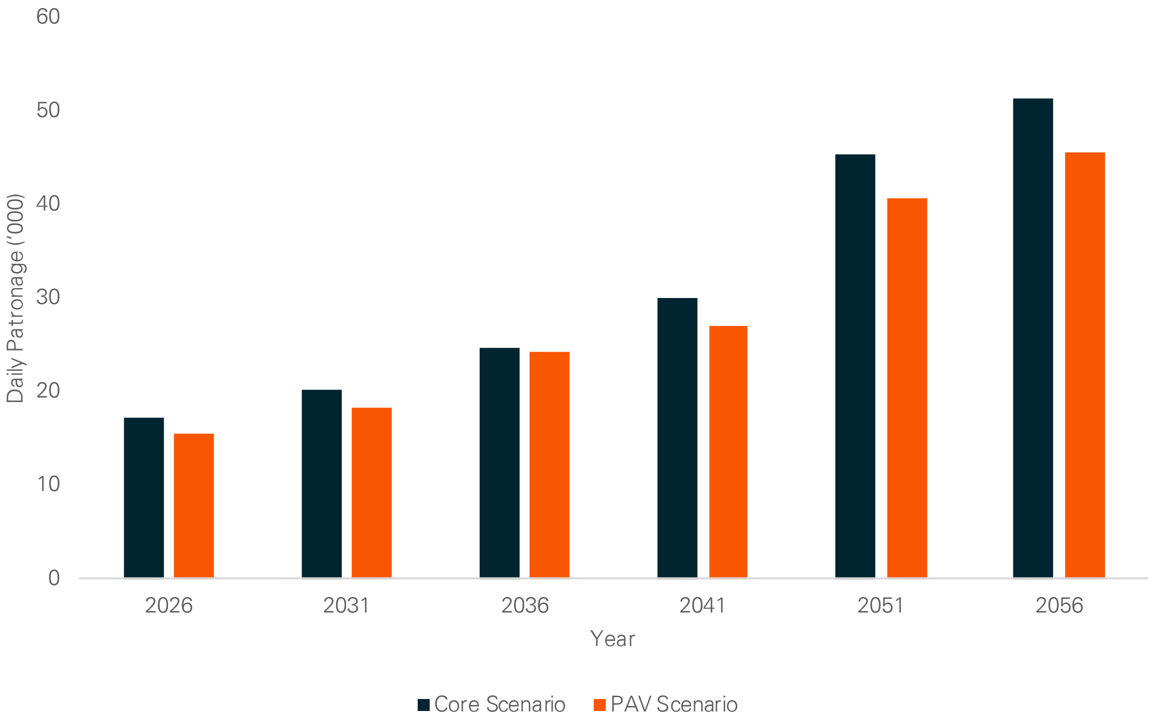
Table 12: Autonomous vehicle scenarios for sensitivity testing

Scenario	CDV	PAV	SAV
Base case (no automation)	100%	0%	0%
High automation, high private use	35%	65%	0%
High automation, high shared use	21%	39%	40%

Note: *CDV refers to conventionally driven vehicle share, PAV refers to private autonomous vehicle share and SAV refers to shared autonomous vehicle share. All vehicles in this scenario are assumed to be Electric Vehicles (EV's).*

The high private use scenario assumes that AVs will be privately owned. As such, 35 per cent of travellers will still own conventional vehicles, while the remaining 65 per cent own private AVs. This scenario significantly reduces MAR daily patronage as shown in Figure 64, with a decrease of 9 to 10 per cent across all years apart from 2036.

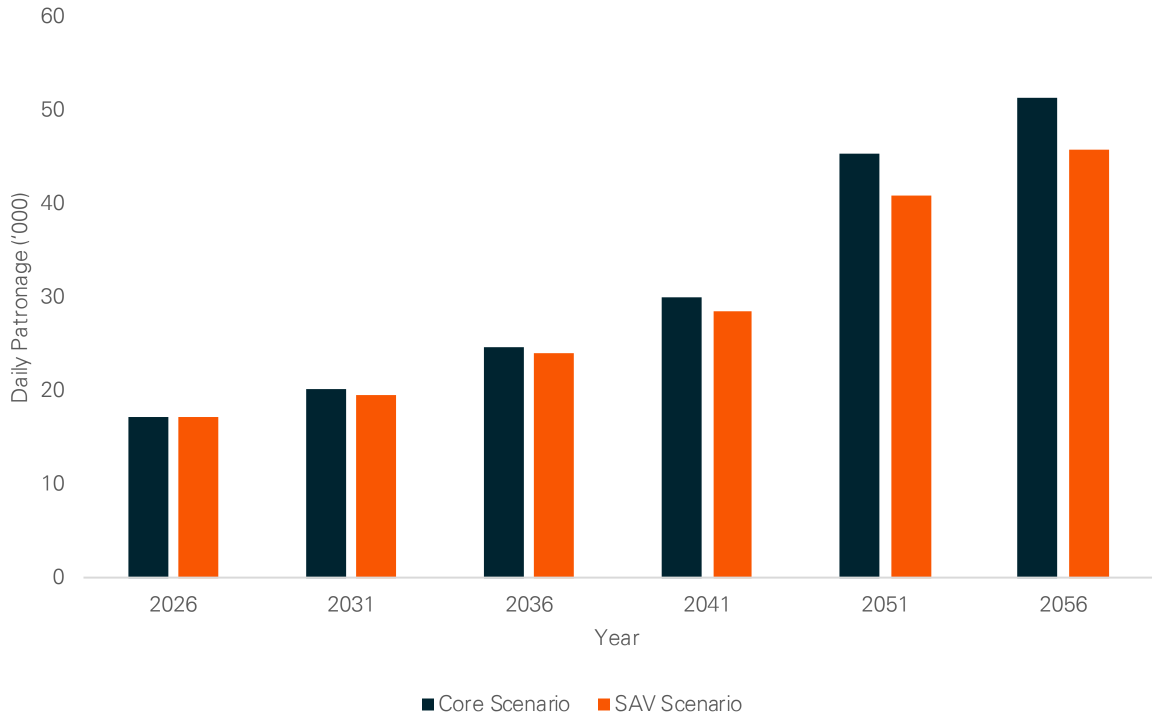
Figure 63: Impact of introducing privately-owned AVs



Source*: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

The high shared use scenario assumes that AVs would consist of both privately owned cars as well as shared, on-demand vehicles. Subsequently, only 21 per cent of travellers own a conventional vehicle, 39 per cent own a private AV and the remaining 40 per cent partake in shared AV travel. In this scenario, MAR daily patronage is marginally reduced in early years. However, from 2041, this trend changes and there is a significant decrease in MAR patronage, reaching 10 per cent in 2051 and 2056.

Figure 64: Impact of introducing privately-owned and shared AVs



***Source**: KPMG based on VITM modelling undertaken using assumptions provided by / agreed with DoT.*

7.6 Transport network pricing

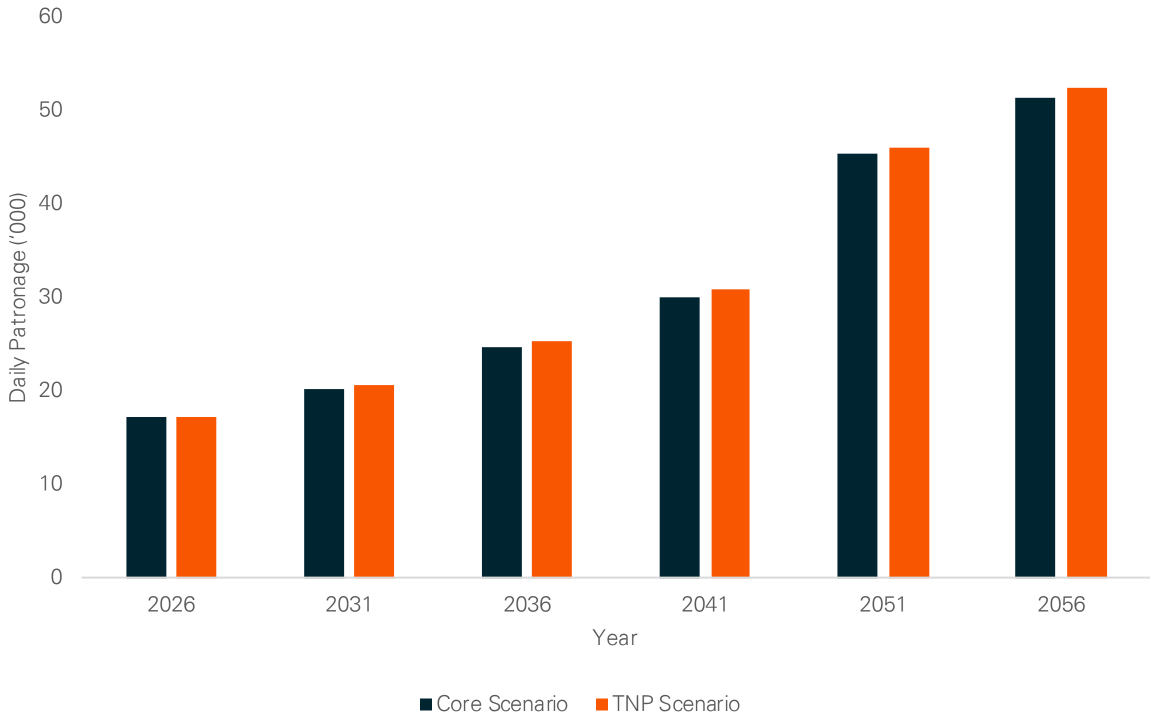
Victoria's current transport network pricing typically consists of fixed upfront charges and uniform fares. However, Infrastructure Victoria suggests replacing these with flexible charging options based on time of day, mode of transport and location.[24] With these changes, people would be incentivised to reschedule their trips away from peak periods and adopt alternative transport modes, subsequently easing road congestion and public transport congestion. To model these using the VITM, the prices shown in Table 12 were implemented. Ultimately, the introduction of transport network pricing increases MAR daily patronage by 2 to 4 per cent across all model years as shown in Figure 66.

Table 13: Transport network pricing depending on mode, time of day and location

Mode	Period	Pricing
Public transport pricing	Peak	$1.70 flag fall and $0.09/km
	Off-peak	$1.50 flag fall and $0.07/km
Road pricing	All day	$0.165/km

[24] Transport network pricing has been considered in a number of Infrastructure Victoria publications including *Victoria's 30-Year Infrastructure Strategy* (2016) and *Good Move: Fixing Transport Congestion* (2020).

Figure 65: Impact of introducing transport network pricing



Source: *KPMG based on VITM modelling undertaken using assumptions based on research by Infrastructure Victoria.*

8 Land use impacts of Melbourne Airport Rail

Land use modelling plays an important role in understanding the city-shaping impacts of major infrastructure projects. This chapter provides an overview of the land use modelling undertaken for Melbourne Airport Rail (MAR) using the CityPlan model.

8.1 Background: Land use modelling

In recent years, awareness of the role of major transport projects on the evolution of land use has increased significantly. Despite the significance of land use on demand, these impacts are often omitted from the appraisal process or considered as a high-level sensitivity only. This development has driven an increased demand for more sophisticated and granular modelling tools.

In 2019, a scoping study was undertaken by the Victorian Department of Transport (DoT) to assess the requirement and options for a land use transport interaction model (LUTI) suitable for the appraisal of major transport infrastructure projects within Victoria. The study recommended a bespoke implementation of UrbanSim; an open-source agent-based land use modelling framework. Subsequently, CityPlan, a Victorian implementation of the UrbanSim modelling tool was developed by DoT with input from across Victorian government.

8.2 CityPlan

CityPlan is a dynamic urban simulator, it simulates how land use is likely to evolve under different potential future scenarios. This capability can aid in informing long-term strategic policy and planning decisions. CityPlan works in parallel with the Victorian Integrated Transport Model (VITM), the four-step transport demand model used for demand modelling. In combination, CityPlan and VITM form an advanced land-use transport interaction model. Used in parallel, these models can inform key questions in the context of transport planning, policy and strategy. These questions help inform demand forecasting and economic appraisal for major transport infrastructure, including those of MAR.

For further detail on CityPlan including the model specification, calibration and validation see:

1. Volume 1: CityPlan Model Specification Report
2. Volume 2: CityPlan Calibration Report.

These documents are available on request from DoT.

8.3 Modelling scenarios

Two scenarios were tested:

1. MAR without SRL North connection to Melbourne Airport (versus Base Case without SRL North connection to Melbourne Airport)
2. MAR with SRL North connection to Melbourne Airport in 2051 (versus Base Case with SRL North connection to Melbourne Airport in 2051).

Overarching assumptions for each of the scenarios include:

- MAR opening year being 2030[25]
- CityPlan base year 2031
- SRL Future Stages coming online in 2051
- MAR connecting to the SRL in 2056.

8.3.1 Land use and travel costs

Table 13 outlines the four model runs and their corresponding land use and travel cost source assumptions. Note that the Ultimate Capacities and Development Rates are held constant as per the reference case land use across all scenarios. The only difference are the travel costs associated with the projects.

Table 14: MAR scenarios source of land use and travel costs

Scenario Name	Land Use Capacities	Travel Costs
Base Case without SRL North connection to Melbourne Airport	As per reference case	Travel cost inputs and assumptions as agreed with RPV and DoT.
Base Case with SRL North connection to Melbourne Airport in 2051	As per reference case	
MAR without SRL North connection to Melbourne Airport	As per reference case	
MAR with SRL North connection to Melbourne Airport in 2051	As per reference case	

**See Section 3.3 for detailed outline of DOT's Reference Case.

Scenario 1: MAR without SRL North connection to Melbourne Airport

VITM outputs noted in Table 13 have been utilised, with Scenario 1 testing MAR without SRL North connection to Melbourne Airport in 2051.

Scenario 2: MAR with SRL North connection to Melbourne Airport in 2051

VITM outputs noted in Table 13 have been utilised, with Scenario 2 testing MAR with SRL North connection to Melbourne Airport in 2051.

[25] MAR costs used from the CityPlan base year, which is 2031.

8.4 Modelling outputs/results

For each scenario, detailed results are provided for:

- Accessibility change
    - C2J – Commuter to Jobs; and
    - B2B – Business to Business.
- Land use change
    - Change in households; and
    - Change in jobs.

8.4.1 Scenario 1: MAR without SRL North connection to Melbourne Airport

Accessibility

Figure 67 and Figure 68 show difference in C2J and B2B accessibility in 2031, 2041 and 2056 between the Base and Project Cases. Changes in C2J accessibility are minimal, with limited visible improvement being attributable to MAR. B2B accessibility improvements are more systematic with increases observed around Sunshine and along the Cranbourne-Pakenham corridor.

Figure 66: Difference in C2J (left) and B2B (right) between the Base and Project Case in 2041.

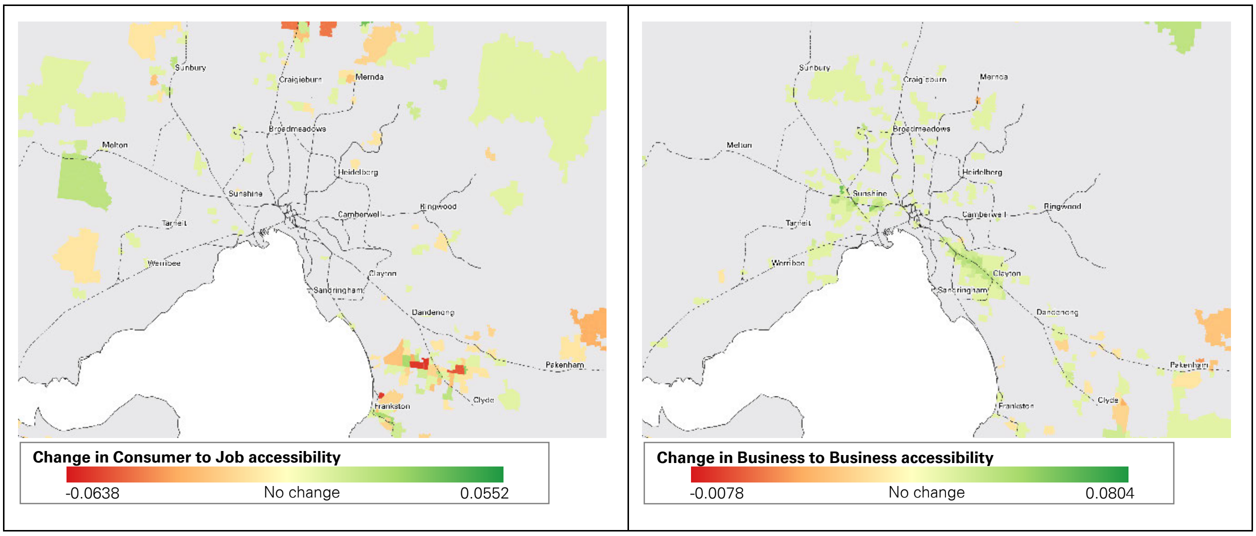
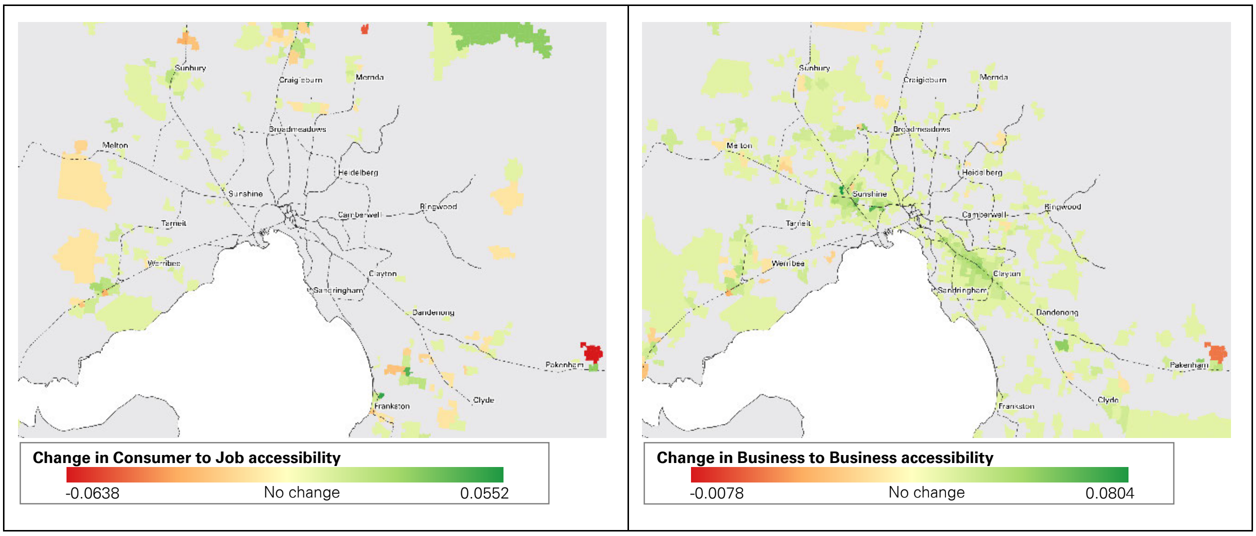


Figure 67: Difference in C2J (left) and B2B (right) between the base and project case in 2056.



Households and jobs

Figure 69 and Figure 70 show differences in the density of households and jobs in 2041 and 2056 between the Base and Project Cases. It is evident that in the case of both households and jobs that no significant or systematic differences are observed between the Base and Project Cases.

Figure 68: Difference in households (left) and jobs (right) between the base and project case in 2041.

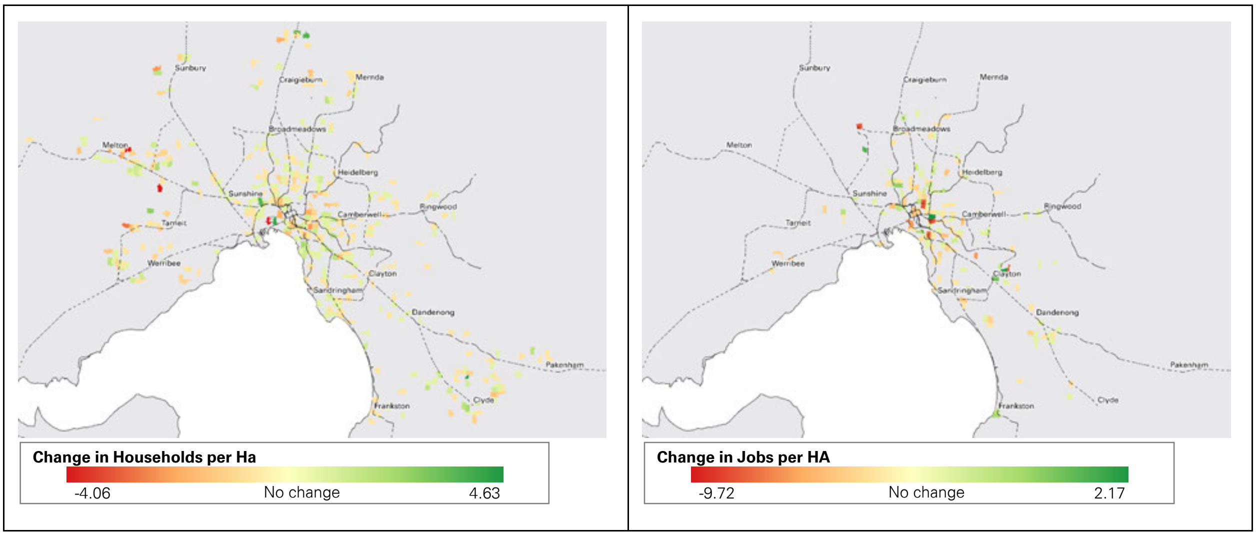
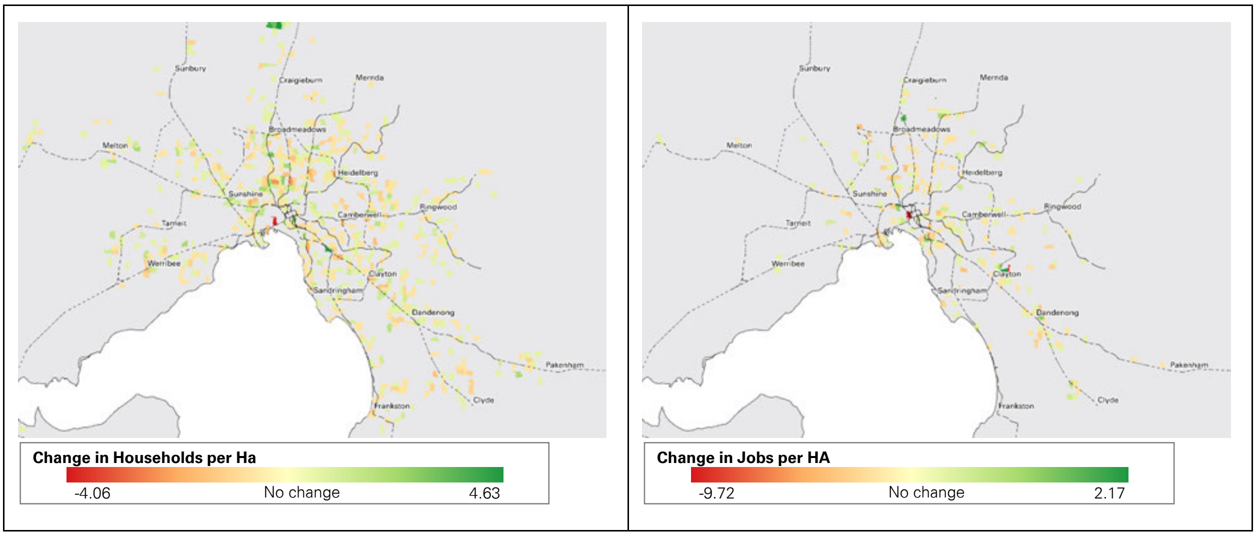


Figure 69: Difference in households (left) and jobs (right) between the base and project case in 2056.



8.4.2 Scenario 2: MAR with SRL North connection to Melbourne Airport in 2051

Accessibility

Figure 71, and Figure 72 show difference in C2J and B2B accessibility in 2031, 2041 and 2056 between the Base and Project. As observed in Scenario 1, difference in C2J are generally of minor magnitude, with little systematic improvement attributable to the project. B2B accessibility improvements are more systematic with increases observed around Sunshine and along the Cranbourne-Pakenham corridor.

Figure 70: Difference in C2J (left) and B2B (right) between the base and project case in 2041.

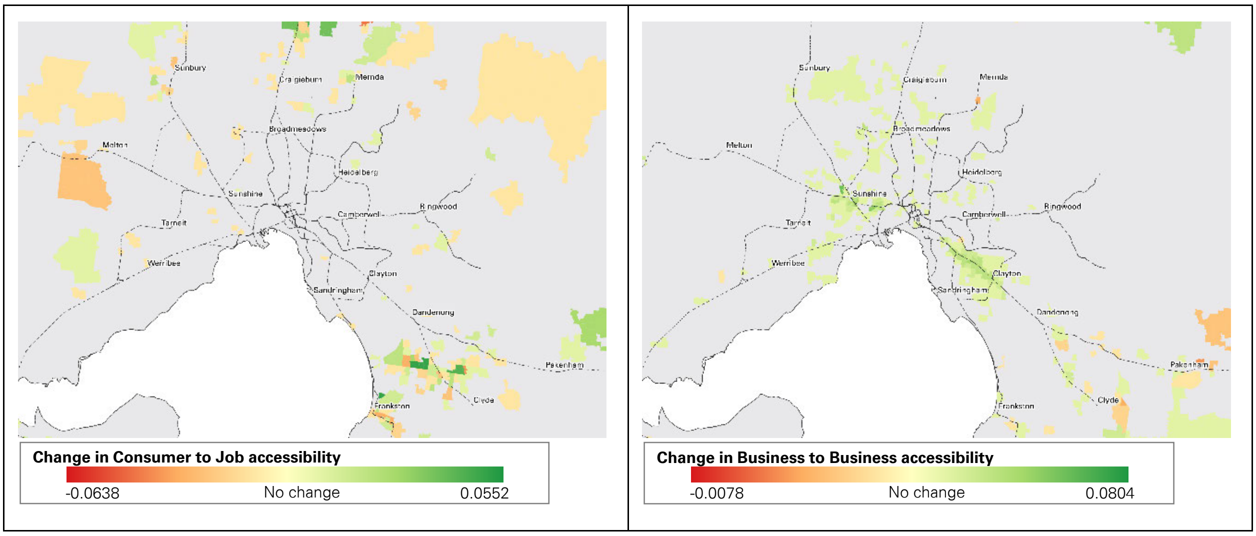
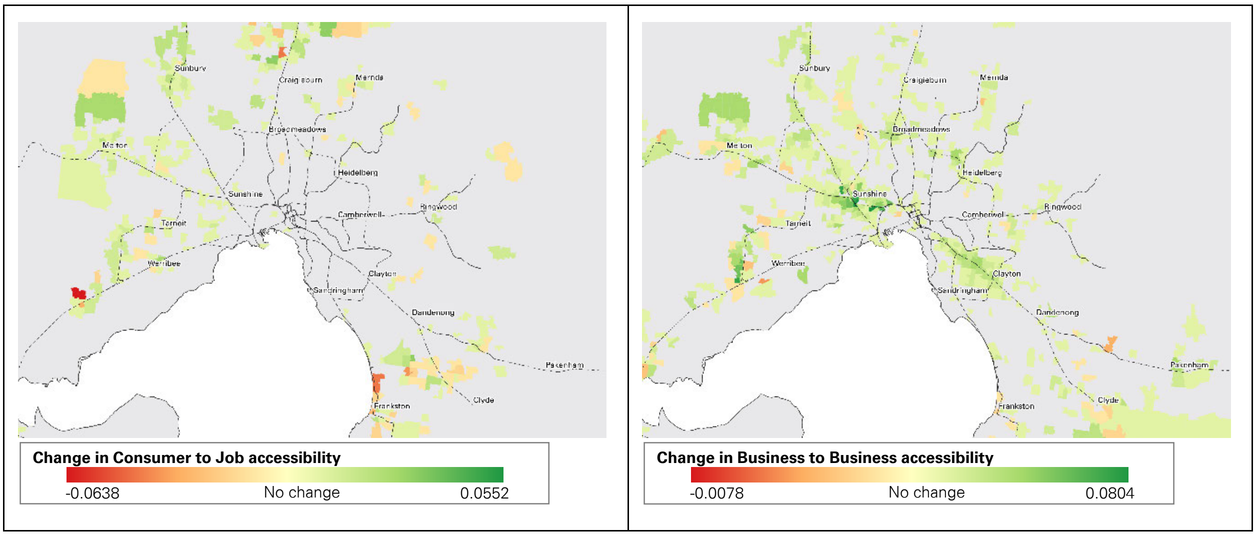


Figure 71: Difference in C2J (left) and B2B (right) between the base and project case in 2056.



Households and jobs

Figure 73 and Figure 74 show differences in the density of households and jobs in 2041 and 2056 between the Base and Project. It is evident that in the case of both households and jobs that no significant or systematic differences are observed between the Base and Project Cases.

Figure 72: Difference in households (left) and jobs (right) between the base and project case in 2041.

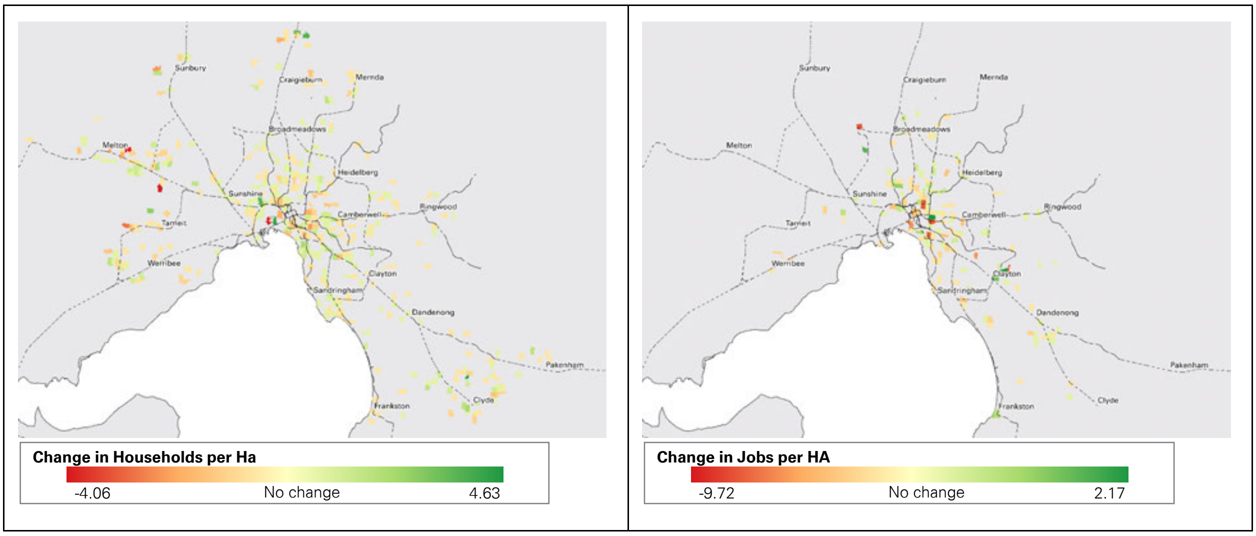
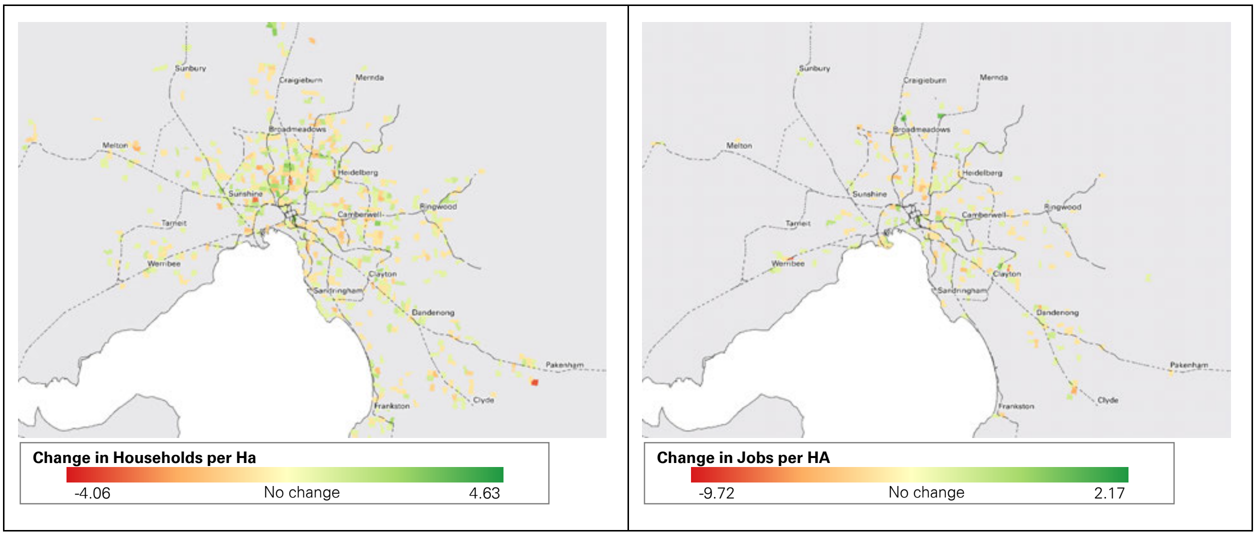


Figure 73: Difference in households (left) and jobs (right) between the base and project case in 2056.



8.5 Conclusion

CityPlan modelling was undertaken to test two alternative Project Cases. MAR with SRL and MAR without SRL. The objective was to analyse the impact that the delivery of MAR would have on land use across Metropolitan Melbourne, Geelong, Ballarat and Bendigo assuming no additional interventions. As is evident through the results and discussion, the effect of MAR on land use, with or without SRL, is minimal, with only minor deviations observed between Base and Project Cases. This lack of change is evident across Metropolitan Melbourne as a whole, and more specifically within the MAR corridor. In conclusion, neither project scenario has a material effect on land use.

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Appendix 9
Economic Appraisal

Contents

Disclaimer and limitations

Inherent limitations and economic projections

This report has been prepared as part of the project scope. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

Model outputs are always an approximation of what can be expected in the real environment. The Victorian Integrated Transport Model (VITM) is a strategic planning tool that is best at representing strategic level demands and patterns at a network wide and corridor level, rather than individual links within a transport network. Notwithstanding this, there will usually be differences between forecasts or projected and actual results because events and circumstances frequently do not occur as expected or predicted, and those differences may be material. KPMG does not make any confirmation or assessment of the commercial merits, technical feasibility or compliance with any applicable legislation or regulation of the transport policy reforms, technology interventions and/or major transport projects described in this report.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by Rail Projects Victoria (RPV) management and personnel consulted as part of the process. The VITM (including its associated output reporting modules) is a Victorian Government model and KPMG does not accept any liability arising from errors that might be embedded in the model. KPMG was provided the VITM by the Victorian Government and has not sought to independently verify the inputs, model logic or outputs (aside from those expressly discussed within Appendix 5: Demand modelling). The Victorian Integrated Transport Model – 2020 was used which was provided to KPMG by the Department of Transport (DoT) in March 2020.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

COVID-19

The current COVID-19 crisis poses a range of risks to global and Victorian economic conditions, and the length and severity of these impacts remain unknown. COVID-19 has contributed to significant change in work and travel patterns. It is uncertain however to what extent these immediate impacts will result in a permanent change to travel behaviour. The current assumptions underpinning VITM as provided by DoT (including trip generation rates, airport patronage forecasts, population forecasts and employment forecasts) are based on pre-COVID-19 data. Given the uncertainty of COVID-19 and its long-term impacts, it is likely that there may be material differences between forecasts or projected and actual results.

The VITM outputs and associated forecasts and projections contained in this report need to be interpreted with an understanding of the above as well as the specific strengths and weaknesses of the VITM.

Third party reliance

This report is solely for RPV's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This report has been prepared at the request of the RPV in accordance with the terms of KPMG's engagement letter / contract dated 3 September 2018. Other than our responsibility to RPV, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

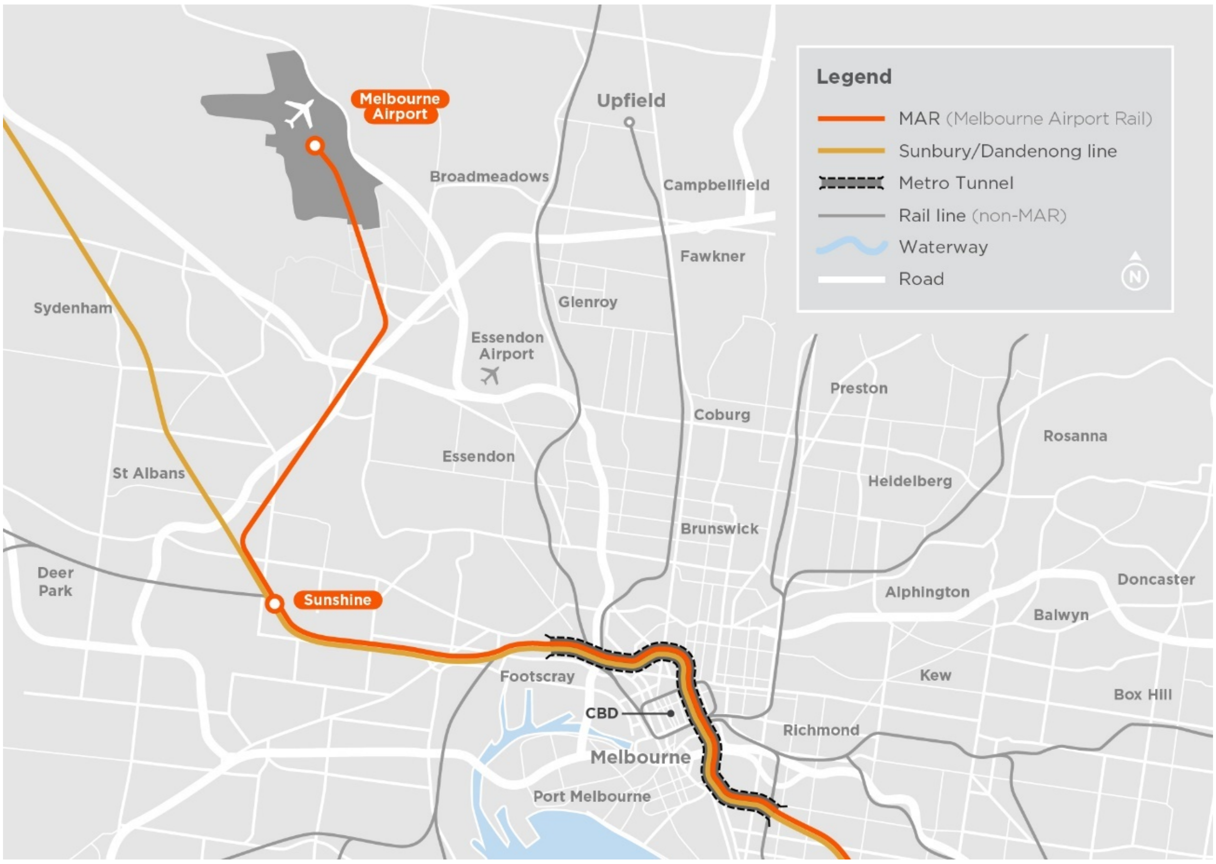
Executive Summary

This report details the methodology and results of the economic appraisal undertaken for the Melbourne Airport Rail (**MAR**) project.

The project provides a rail connection between Melbourne Airport and the CBD via Sunshine. The integration of MAR with the Metro Tunnel (**MTP**) will directly connect airport services with the rest of the metropolitan rail network, providing multiple entry and exit points within the Melbourne CBD via the five new stations along the MTP corridor, and link to the City Loop via Melbourne Central and Flinders Street stations. The improved service provision along the Metro Tunnel corridor, particularly in non-peak periods, will also result in better connectivity to Melbourne's south-east and the National Employment and Innovation Clusters (**NEICs**) along this corridor. The route via Sunshine and Footscray also provides connectivity to the regional Victorian lines of Bendigo, Ballarat and Geelong, as well as the Wyndham and Melton growth areas.

Figure 1 illustrates the MAR alignment in the context of the Melbourne transport network.

Figure 1: MAR alignment in the context of the Melbourne transport network



The economic appraisal has been undertaken in accordance with accepted transport evaluation techniques, including conventional cost benefit analysis (**CBA**), wider economic benefits (**WEBs**) analysis and macro economy-wide impact assessment (using computable general equilibrium (**CGE**) modelling).

The following economic performance measures were calculated to determine the economic viability of MAR:

- the Net Present Value (**NPV**), which gives an indication of the magnitude of net benefit to society, where positive NPVs indicate the investment is desirable to society as a whole.
- the Benefit Cost Ratio (**BCR**), which is a measure of value for money for public expenditure, and is of principal value when a government is considering spending scarce funds.

Both Melbourne Airport Rail and Suburban Rail Loop (**SRL**) East (from Cheltenham to Box Hill) are currently expected to commence construction in 2022, with SRL North (from Box Hill to Melbourne Airport) to be delivered later. In consideration of this, the economic appraisal has been undertaken with and without the SRL North connection to Melbourne Airport in 2051 in the Base Case.

The NPV, BCR and underlying economic benefits set out in this appraisal are shown as a range between the P10 and P90 values. The incorporation of uncertainty within the economic appraisal reflects best practice and responds to broader recommendations within Victoria and Australia regarding the appraisal of projects with long lead times.[1]

Figure 2 and Figure 3 summarise the probabilistic economic analysis results for MAR excluding the SRL North connection to Melbourne Airport in 2051 in the Base Case (**MAR exc. SRL**) and MAR including the SRL North connection to Melbourne Airport in 2051 in the Base Case (**MAR inc. SRL**) respectively at a discount rate of 4 per cent. In summary:

- MAR exc. SRL in the Base Case has an NPV ranging from $7.5bn to $10.8bn and a BCR ranging from 1.8 to 2.1
- MAR inc. SRL in the Base Case has an NPV ranging from $0.9bn to $2.8bn and a BCR ranging from 1.1 to 1.3.

[1] Victorian Auditor-General's Office (2019, pg.11). *Melbourne Metro Tunnel Project - Phase 1: Early Works*

Figure 2: Economic evaluation result considering a 4 per cent discount rate (MAR exc. SRL in the Base Case)

Figure 3: Economic evaluation result considering a 4 per cent discount rate (MAR inc. SRL in the Base Case)

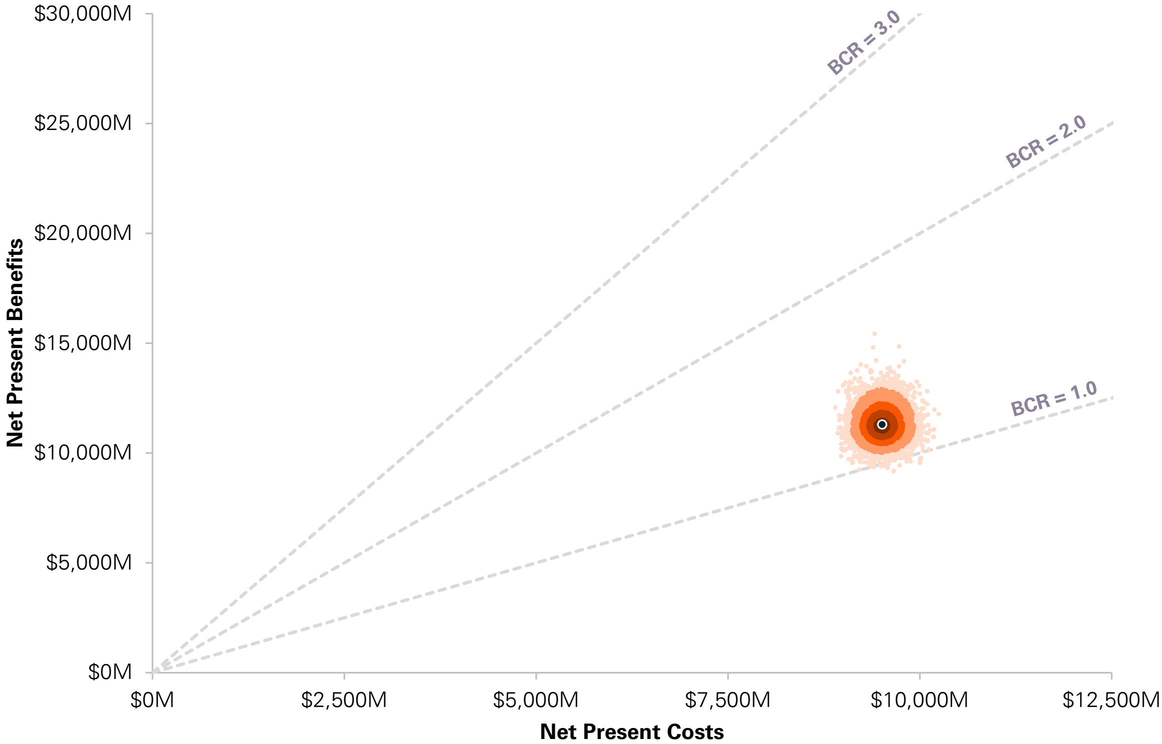


Table 1 provides a breakdown of the economic evaluation results for MAR exc. SRL and MAR inc. SRL considering a 4 per cent discount rate. The economic analysis is based on demand modelling undertaken using the Victorian Integrated Transport Model (**VITM**). Capital costs have been distributed across the construction period, and economic benefits and operating costs are calculated over a 50-year period from project opening.

Table 1: Economic evaluation results for MAR (4 per cent discount rate)[2]

Category	MAR exc. SRL in the Base Case (P10 to P90)	MAR inc. SRL In the Base Case (P10 to P90)
COSTS		
Capital costs	$8.1bn - $8.5bn	$8.1bn - $8.5bn
Operating, maintenance & renewal costs	$1.1bn - $1.3bn	$1.1bn - $1.3bn
TOTAL COSTS	**$9.2bn - $9.8bn**	**$9.2bn - $9.8bn**
BENEFITS		
Conventional economic benefits		
Public transport user benefits	$6.4bn - $8.5bn	$3.1bn - $4.0bn
Road user benefits	$5.0bn - $5.8bn	$3.0bn - $3.4bn
Externalities (non-user benefits)	$0.9bn - $0.9bn	$0.7bn - $0.7bn
Option and non-use value	$0.6bn - $1.6bn	$0.6bn - $1.6bn
Residual value of assets	$1.0bn - $1.1bn	$1.0bn - $1.1bn
Total conventional economic benefits	**$14.3bn - $17.4bn**	**$8.8bn - $10.5bn**
Wider Economic Benefits (WEBs)		
WEB1 – Agglomeration economies	$2.2bn - $2.8bn	$1.3bn - $1.7bn
WEB2 – Labour market deepening	$0.0bn - $0.0bn	$0.0bn - $0.0bn
WEB3 - Output increase in imperfectly competitive markets	$0.3bn - $0.4bn	$0.1bn - $0.2bn
Total Wider Economic Benefits	**$2.4bn - $3.2bn**	**$1.5bn - $1.9bn**
TOTAL BENEFITS	**$17.1bn - $20.3bn**	**$10.4bn - $12.3bn**
ECONOMIC INDICATORS		
Net Present Value (total benefits)	$7.5bn - $10.8bn	$0.9bn - $2.8bn
Benefit cost ratio (total benefits)	**1.8 - 2.1**	**1.1 - 1.3**

The delivery of MAR will support up to 8,000 direct and indirect jobs during construction. These jobs will range from engineers and subject matter experts planning behind the scenes, to construction workers and local suppliers who will help to deliver the project on site.[3] This level of investment will increase the size of the economy and job market, creating 1,880 net additional jobs across Victoria at the peak of MAR's construction. Across Australia, approximately 2,100 net additional jobs are expected to be generated at the peak of construction.

At a 4 per cent discount rate, the construction and operation of MAR exc. SRL in the Base Case is expected to increase Victoria's Gross State Product (**GSP**) approximately $17.9bn in present value

[2] Note that the probabilistic ranges set out in this appendix are not necessarily additive. This is because the underlying input distributions to the probabilistic analysis vary for each line item. More detail on the underlying input distributions is provided in Section 8.1.
[3] RPV analysis on behalf of DoT.

terms. For MAR inc. SRL in the Base Case, the project is expected to increase Victoria's GSP approximately $16.2bn in present value terms.

An alternative approach to assessing the economic contribution of the investment is to assess the return on investment against the funding cost of the investment. The analysis shows that the Victorian economy as measured by change in GSP will be better off by between 5.9 and 5.0 times the cost of investment (after allowing for borrowing costs) for MAR exc. SRL in the Base Case and for MAR inc. SRL in the Base Case respectively.[4] Similarly, the Australian economy as measured by the change in Gross Domestic Product (**GDP**) will be better off by between 2.9 and 2.4 times the cost of investment for MAR exc. SRL in the Base Case and for MAR inc. SRL in the Base Case respectively.

[4] The analysis assumes that 100 per cent of the investment cost is borrowed and is split evenly between the Victorian and Australian governments. Interest payments are based on the 10-year TCV bond rate and 30-year Commonwealth bond rate for the Victorian and Australian governments respectively. The KPIs were calculated using total cost (capital expenditure and benchmark borrowing cost) and the real increase in GSP / GDP.

1 Introduction

This report details the methodology adopted and the results of the economic appraisal undertaken for MAR to be included in the business case being prepared by the Victorian Department of Transport (**DoT**).

The economic appraisal considers MAR, an asset investment initiative designed to enhance travel choice and outcomes for users travelling to and from Melbourne Airport, while also contributing to enhanced productivity and competitiveness for Victoria.

1.1 Background

Despite the recent widening of the CityLink-Tullamarine Freeway corridor, the forecast sustained increase in airport patronage and freight demand will continue to impact travel times on this key airport access route. The ongoing concentration of employment in Melbourne's CBD and population growth in areas along the Melbourne Airport-CBD corridor will also put further pressure on Melbourne's arterial network.

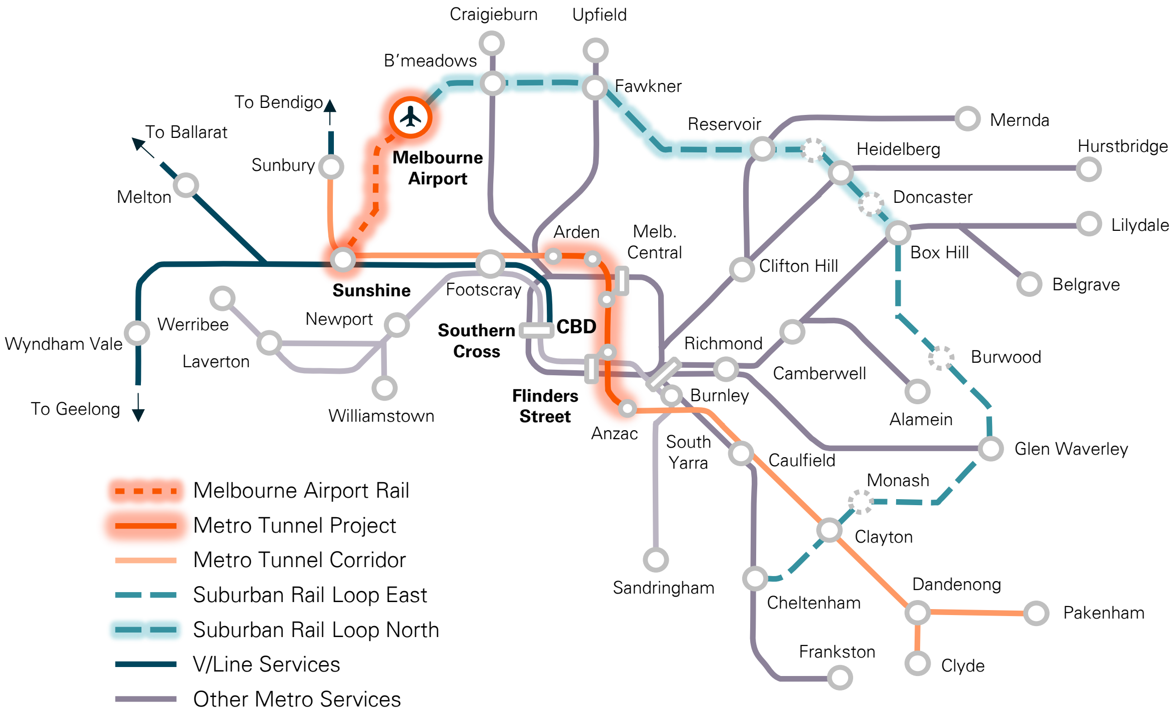
MAR addresses the project objectives specified in Section 1.3, including improving travel choice and reliability of ground access options to the airport, and reducing the impact of congestion on the CityLink-Tullamarine Freeway corridor. The project has been listed as a national priority by Infrastructure Australia (**IA**) and the Australian and Victorian governments have committed to the business case development for MAR.

MAR will run via Sunshine and connect to the Metro Tunnel. The integration of MAR with the Metro Tunnel will directly connect airport services with the rest of the metropolitan rail network, providing multiple entry and exit points within the Melbourne CBD via the five new stations along the MTP corridor, and link to the City Loop via Melbourne Central and Flinders Street stations. The improved service provision along the Metro Tunnel corridor, particularly in non-peak periods, will also result in better connectivity to Melbourne's south-east and the NEICs along this corridor. The route via Sunshine and Footscray also provides connectivity to the regional Victorian lines of Bendigo, Ballarat and Geelong, as well as the Wyndham and Melton growth areas.

MAR is expected to deliver benefits to airport passengers and also generate and enhance economic, social and environmental value for road users along key access routes across the network.

Figure 4 provides an overview of MAR in the context of the Melbourne passenger rail network. It also highlights how MAR interacts with the future SRL East and SRL North project.

Figure 4: Schematic of the proposed MAR project



The MAR scope of works are detailed in Chapter 6 of the Business Case and include:

- an elevated station at Melbourne Airport
- a track pair starting at the Airport Station and transitioning into an elevated viaduct at Mercer Drive that continues across Sharps Road and over the Western Ring Road (M80) – the track continues on an embankment toward and through the Albion-Jacana freight corridor from Steele Creek, including a new bridge crossing over the Maribyrnong River, and a double track flyover past Albion Station after which the track merges into the Sunbury line just before entering Sunshine Station
- future proofing for an intermediate station (proposed at Keilor East)
- works at Sunshine Station to enable delivery of MAR
- line-wide rolling stock, traction power, train control and signalling solutions.

1.2 MAR objectives

The agreed objectives of the Australian and Victorian governments for MAR are to:

- address growth pressures in and around Melbourne, including population growth and increasing congestion
- increase public transport services, options and accessibility to and between Melbourne Airport and the CBD
- ensure financial and economic sustainability with consideration given to patronage and precinct development
- maximise service offerings to passengers with frequent and reliable services, and improved passenger amenity

- support Victoria's and Australia's economic growth by improving access to international and interstate markets
- integrate the Project into the urban and regional transport network to facilitate broader economic and social development goals for Victoria
- catalyse viable urban and economic development opportunities
- maximise other government policy outcomes with options for corridors including with respect to housing affordability, transport mode connections and access to employment.

1.3 Outcomes

The anticipated MAR project outcomes are underpinned by the Investment Logic Map (**ILM**) benefits. The outcomes reflect the economic and social benefits of addressing the overarching problems identified in the MAR Business Case.

- **Enhanced travel choice and outcomes for airport users travelling to and from Melbourne Airport** – The project provides a foundation for enhanced accessibility and connectivity to and from Melbourne Airport by offering a faster and more reliable alternative to road-based travel, particularly in peak periods. This higher quality service will promote increased public transport usage and release capacity across the road network, particularly on the key access routes to the airport.
- **Improved productivity and competitiveness for Victoria** – Beyond improved access to and from the airport, the mode shift to public transport due to MAR reduces congestion on key arterial roads across Melbourne. As Melbourne's arterial network is a key carrier of the city's freight task, the travel time savings will reduce input costs and help boost productivity for local exporters and businesses importing goods.

1.4 Scope of economic appraisal

The economic appraisal has been undertaken by KPMG with inputs from a range of stakeholders, including DoT and Rail Projects Victoria (**RPV**). The appraisal draws upon the relevant economic evaluation and transport appraisal guidelines and assumptions agreed with key stakeholders.

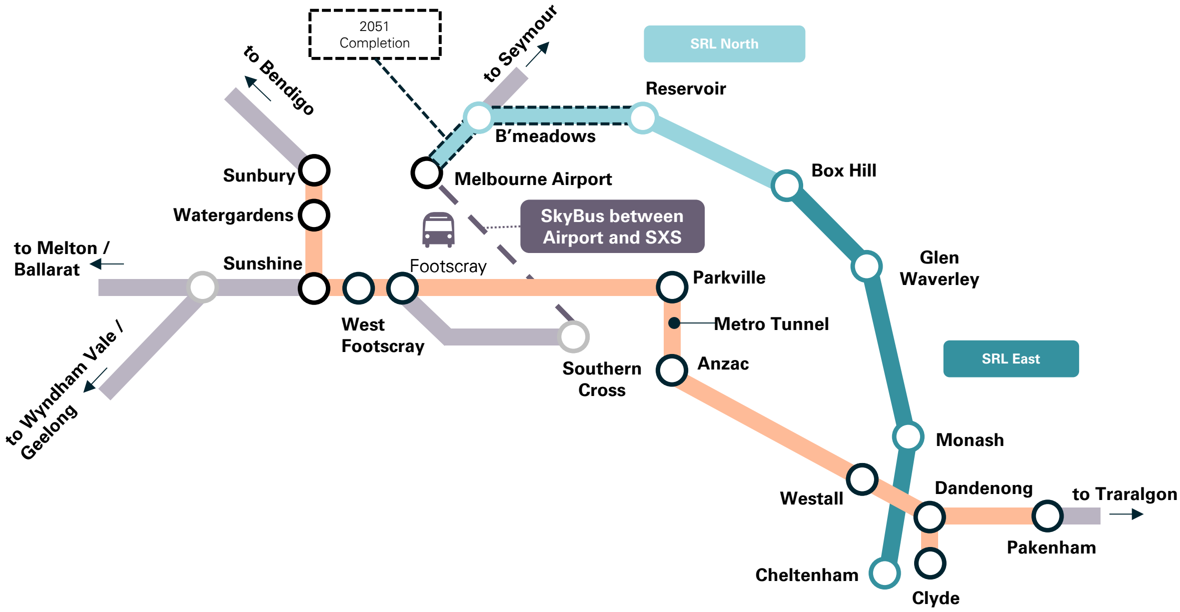
The framework adopted for economic appraisal is summarised in Figure 5.

Figure 5: Economic evaluation framework

This economic appraisal has assessed and compared the incremental costs and benefits of the Project Case relative to the Base Case, as described below:

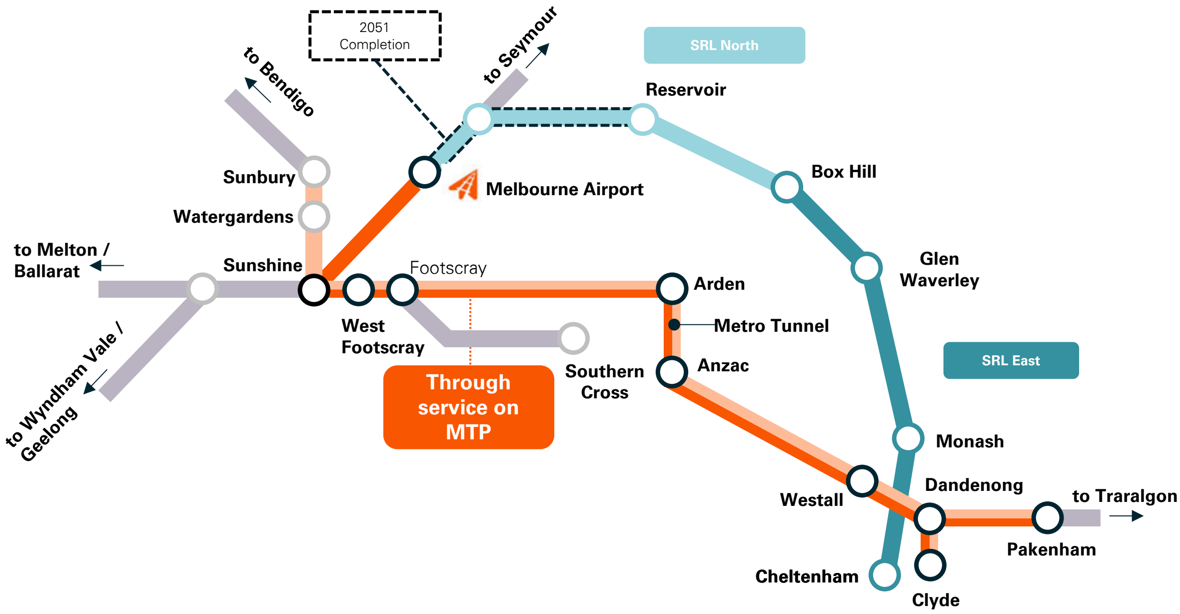
- **Base Case** – The Base Case is the reference point for the economic analysis and considers future transport network assumptions and land use projections consistent with the DoT Reference Case, but excludes MAR. The Base Case network configuration is presented in Figure 6. Under the Base Case, the SkyBus between Southern Cross and Melbourne Airport (**Melbourne City Express**) is the primary means of public transport connecting Melbourne CBD to Melbourne Airport.

Figure 6: Base Case network configuration



- **Project Case** – The Project Case considers the Base Case described above, plus the changes to the transport network required to deliver the proposed service plan for MAR. The network configuration associated with the Project Case is presented in Figure 7. Under the Project Case, the Melbourne City Express SkyBus does not operate during MAR hours of operation.

Figure 7: Project Case network configuration



1.5 Purpose

The purpose of this report is to document the economic appraisal undertaken for MAR – in accordance with the relevant guidelines – for inclusion in the MAR Business Case.

This report details the economic appraisal result and assesses the economic viability of the proposed MAR investment.

This report also describes the methodology used for the economic appraisal; it sets out the framework and details relevant elements of the economic methodology used to undertake a whole of life appraisal of MAR.

1.6 Report structure

The remainder of this report is structured as set out below:

- **Section 2** presents the economic appraisal framework and discusses the modelling approach considered for the economic appraisal
- **Section 3** outlines the scenarios assessed in the appraisal
- **Section 4** outlines the economic costs included in the appraisal
- **Section 5** outlines the conventional benefits assessed in the appraisal
- **Section 6** outlines the Wider Economic Benefits assessed in the appraisal
- **Section 7** outlines the macro-economic impact of MAR
- **Section 8** discusses the approach to considering uncertainty within the appraisal
- **Section 9** outlines the economic evaluation results
- **Section 10** provides an overview of the qualitative benefits considered
- **Section 11** summarises the key findings from the economic appraisal
- **Appendix A** details the appraisal approach for the conventional economic benefits
- **Appendix B** details the appraisal approach for wider economic benefits
- **Appendix C** details the appraisal approach for the macro-economic impact.

2 Economic appraisal framework

2.1 Overview

Conventional CBA is the most commonly used approach to economic appraisal for transport investments in Australia. Under a conventional approach, a CBA is undertaken to understand the economic benefits and costs of a project or program to broader society. A key output of a conventional CBA is the BCR, a measure calculated based on the present value of the quantifiable benefits and the estimated present value of the cost of a Project Case scenario, relative to a Base Case. It is common for long-term projections and complex analysis to be distilled into a 'headline' BCR which becomes the focus in determining whether a project is worthwhile, even though this was not the sole intention of the use of a CBA for economic appraisal.

Given the nature of the MAR project and its potential to deliver economy-wide productivity benefits, a conventional approach to economic appraisal will not reflect the project's full merit and will likely underestimate its value. As such, a sole focus on the conventional approach to economic appraisal would be inappropriate for the MAR project.

Moreover, the NPV, BCR and underlying economic benefits set out in this appraisal are shown as a range between the P10 and P90 values. The need to incorporate uncertainty within the economic appraisal builds on the feedback provided by a range of reviewers on appraising projects with long lead times.[5] See Section 8.1 for details.

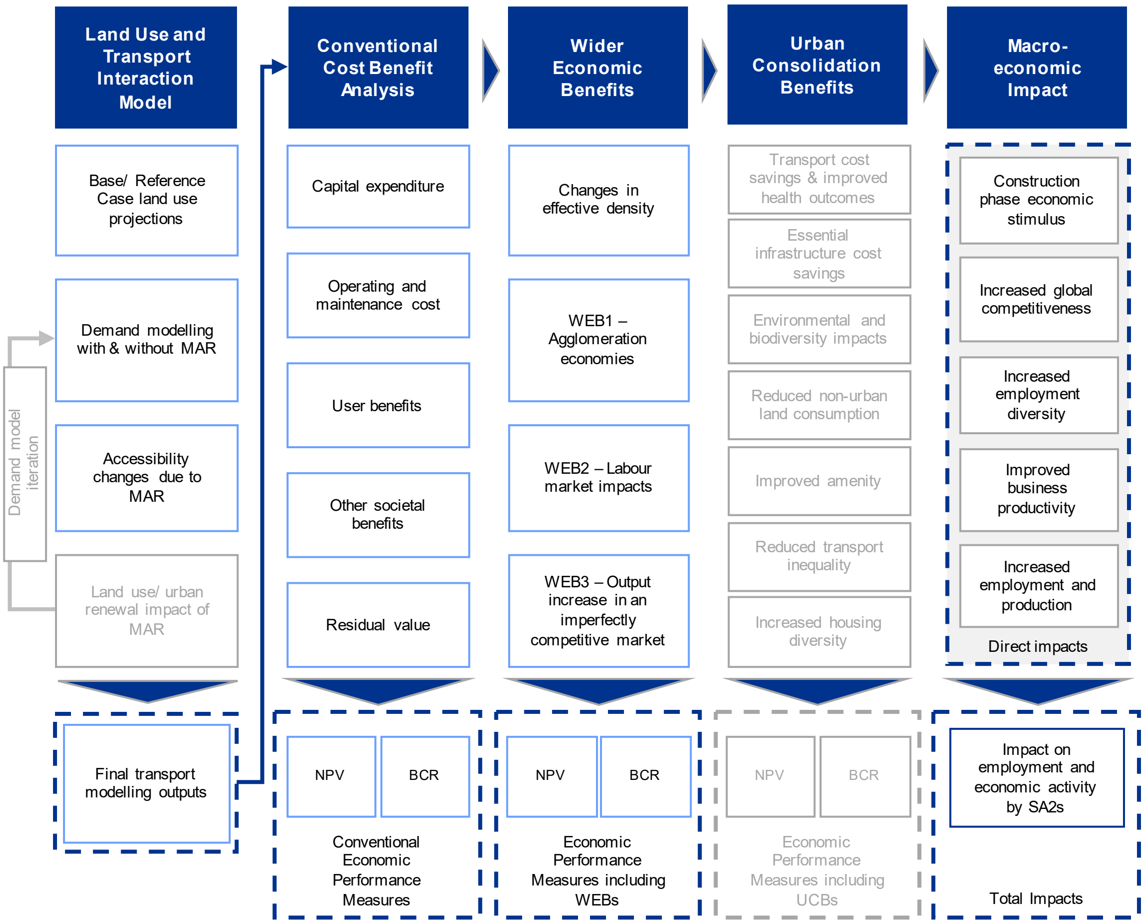
2.1.1 A holistic approach adopted for MAR

The economic appraisal framework considers a full spectrum of impacts attributable to MAR. The appraisal framework is summarised in Figure 8. Not all of the economic benefits considered are quantified, given data availability and applicability to MAR. This is discussed in further detail below.

The economic evaluation will utilise Land Use Transport Interaction (**LUTI**) model outputs to inform quantification of benefits derived from any changes in land use generated by MAR. The economic appraisal draws upon relevant guidelines and agreed assumptions / inputs from a range of stakeholders, including DoT, RPV and DTF.

[5] Victorian Auditor-General's Office (2019, pg.11). *Melbourne Metro Tunnel Project - Phase 1: Early Works*

Figure 8: MAR economic appraisal framework



The figure sets out the benefits considered in the economic appraisal framework:

- **Conventional economic benefits** including travel time savings, improved road travel time reliability, reduced crowding, externalities and option and non-use value. These benefits have been quantified using CBA, drawing on relevant Victorian and Australian economic evaluation guidelines.
- **WEBs** including agglomeration, labour market deepening through increased labour supply and output increase in an imperfectly competitive market, which result from improved accessibility and connectivity.
- **Macro-economic impacts** such as increased global competitiveness, labour productivity, economic output and employment, which have been quantified using CGE modelling.

Urban consolidation benefits (UCBs) arise due to a more consolidated land use form, and resulting changes to the socio-economic fabric creating a more socially equitable and inclusive community. The land use impacts of MAR, as assessed within the CityPlan model, are not substantive so neither the land use impact nor the UCBs were incorporated into the economic appraisal of MAR.

2.1.2 Key analysis steps

The analytical framework shown above in Figure 8 is implemented in practice through six key steps which are summarised in Figure 9. The remainder of this document follows these appraisal steps.

Figure 9: Key steps in the economic appraisal

Step	Description
1	**Definition of scenarios** – Including the Project Cases (with the proposed transport infrastructure investment) and Base Cases (without the proposed transport infrastructure investment).
2	**Transport and land use modelling** – Modelling of Base Cases and Project Cases to determine impact of changes to service plans etc.
3	**Economic costs** – Identification and quantification of economic costs.
4	**Economic benefits** – Identification and quantification of economic benefits.
5	**Economic evaluation** – Evaluation of the economic viability of the Project Cases by comparing the incremental costs and benefits against the corresponding Base Cases and calculating economic performance measures such as NPV and BCR. The benefits include conventional benefits and WEBs.
6	**Uncertainty analysis** – Analysis of the uncertainty of the economic performance measures to changes in key input variables and assumptions.

2.1.3 Relevant guidelines

This economic appraisal draws upon the relevant guidelines and agreed assumptions from RPV and DoT. The relevant guidelines used in the economic evaluation include:

- Department of Treasury and Finance (2013). *Economic Evaluation for Business Cases - Technical Guidelines*
- DoT (2019). *The Standard Approach to Transport Modelling and Economic Evaluation in Victoria, 2019-20 v 4.0*
- Austroads (2012). *Guide to Project Evaluation Part 4: Project Evaluation Data*
- Transport and Infrastructure Council (2016a). *Australian Transport Assessment and Planning (ATAP) Guidelines: Road Parameter Values [PV2]*
- Transport and Infrastructure Council (2016b). *Australian Transport Assessment and Planning Guidelines (ATAP): Active Travel [M4]*
- Transport and Infrastructure Council (2020). *Australian Transport Assessment and Planning Guidelines (ATAP): Wider Economic Benefits [T3] – Draft*
- Transport and Infrastructure Council (2018a). *Australian Transport Assessment and Planning (ATAP) Guidelines: Cost Benefit Analysis [T2]*

- Transport and Infrastructure Council (2018b). *Australian Transport Assessment and Planning Guidelines (ATAP): Public Transport [M1]*
- Infrastructure Australia (2018). *Assessment Framework – For initiatives and projects to be included in the Infrastructure Priority List*
- DoT (2020). *April 2020 Reference Case*

2.2 Governance

The MAR Business Case is being developed by DoT. The demand and economics work stream has been undertaken as follows:

- VITM is owned and managed by the Victorian Government and key inputs are provided by RPV, DoT or its advisors to inform the demand model runs. Demand forecasting for the economic analysis has been undertaken by KPMG and independently reviewed by WSP, while demand forecasting for design purposes has been undertaken by the Aurecon Jacobs Mott McDonald Joint Venture (**AJM**).
- Land use modelling has been undertaken by KPMG, and independently reviewed by WSP.
- Project capital costs have been estimated by RPV's cost advisor Turner and Townsend (T&T). Project operating, maintenance and renewal costs have been estimated independently by Firecone.
- The economic analysis and modelling have been undertaken by KPMG and independently peer reviewed by the Centre of International Economics (**CIE**).
- An independent peer review of the draft report has been undertaken by DoT and CIE, with resulting updates to the analysis and report to address reviewer comments.

2.3 Transport and land use modelling

VITM was the primary model used to inform the transport demand forecasts and subsequent economic appraisal for MAR and is described in Table 2. More detail about model application and development is provided in Appendix 5: Demand modelling.

Table 2: VITM description

Model type	Model	Role	Benefits calculated
Transport demand model	VITM	A primary, four-step model which forecasts travel demand by road and public transport from a given set of demographic, road network and public transport service plan inputs.	Outputs for the majority of benefits were sourced from VITM, including conventional benefits and WEBs.

The transport impacts of MAR are discussed in detail in Appendix 5: Demand modelling. These impacts include:

- growth in public transport trips
- reduced travel time for public transport users
- improved public transport accessibility
- reduced congestion and journey time reliability on the road network.

The land use impacts of MAR were also assessed using CityPlan, a 4th Generation Land Use and Transport Interaction Model (when combined with VITM) that helps assess the changes in land use facilitated by transport accessibility changes. Due to the nature of the project, the land use impacts of MAR, as assessed within the CityPlan model, are not substantive. CityPlan outputs were therefore not incorporated back into VITM and a 'fixed' land use was considered appropriate for appraising MAR. A detailed explanation of land use impact estimation for MAR is provided in Appendix 5: Demand modelling.

2.3.1 Model uncertainty

VITM is used to estimate levels of transport demand for future transport corridors or for major transport infrastructure projects. The model estimates the demand response to changes in land use and transport supply. In doing so, the model uses mathematical equations and assumptions that simplify real life behaviour, which in part are determined by data availability and computing constraints, to achieve a practical and workable model.

The demand forecasts for MAR necessarily involve risk and uncertainty because they are dependent on events and circumstances that will occur in the future. As such, the VITM outputs and subsequent calculation of economic benefits, need to be interpreted with an understanding of the above. Further information about model uncertainty is provided in Appendix 5: Demand modelling.

2.4 Key inputs and assumptions

Key inputs and assumptions used in the economic appraisal include:

- **Capital costs** – All non-recurrent capital costs that are expected to be incurred to deliver MAR after the economic evaluation commences. The capital cost estimates were developed in real (2020 dollar) prices. More details are provided in Appendix 7: Capital cost estimate report.
- **Operating and maintenance costs** – All necessary recurrent costs to operate, maintain and renew the MAR asset and rolling stock over the evaluation period. It also considers the operational and maintenance cost savings associated with the cessation of the Melbourne City Express SkyBus service in the Project Case. The operating, maintenance and renewal costs were estimated in real (2020 dollar) prices. More details are provided in Appendix 8: Operational cost estimate report.
- **Demand forecasts** – Outputs from VITM for the Base Case and the Project Case for the model years 2026, 2031, 2036, 2041, 2051 and 2056. For each of the model years, outputs are provided for four time periods across an average weekday from which benefits (including travel time savings, vehicle operating cost savings, crash cost savings and environmental externality savings) are calculated.
- **Land use impact analysis** – Outputs from the LUTI model for the Base Case and the Project Case for the model years 2026, 2031, 2036, 2041, 2051 and 2056. CityPlan was the dedicated LUTI model used to estimate the land use impact of MAR. For each of the model years, outputs are generated in the format of demographic information such as employment and population across the Melbourne travel zones. Where the land use impact is substantive, this demographic information is then fed back into VITM to produce the transport demand metrics needed for economic benefit calculation, which accounts for the land use impact.
- **Unit rates** – For each of the benefits calculated from the modelling outputs, primarily derived from ATAP guidelines.
- **Applicable evaluation parameters** – Key input parameters are summarised in Table 3.

Table 3: Key input parameters

Parameter	Value	Supporting information
Discount rate, real	4 per cent (real)	The economic assessment was undertaken using a discount rate of 4 per cent. See Section 2.5 for details.
Costs	The economic cost distribution used within the probabilistic analysis has been derived from the financial cost distribution	The financial costs presented in Chapter 10 of the Business Case (and detailed in Appendix 7: Capital cost estimate report and Appendix 8: Operational cost estimate report) have been adjusted to yield the real economic costs as discussed in Section 4. This real economic cost distribution is included within the probabilistic analysis discussed further in Section 8.1.
Evaluation period	50 years	From the first year of operation of the Project Case, 50 years is used in line with the ATAP T2 guideline for rail infrastructure. As per IA and DTF guidance, the residual value of assets is included in the last year of evaluation to incorporate the benefits that will continue to be delivered by the main asset.
Base year for discounting	2022	To align with the first year of major capital expenditure as per the ATAP T2 guideline.
Price base	2020 (Q1)	To align with the price base used for capital costs as outlined in Chapter 10 of the Business Case.
Capital spend period	***Redacted***	To align with the capital spend period outlined in Chapter 10 of the Business Case.
Operational commencement (MAR day-1)	***Redacted***	As per the P90 close-out date in line with the construction schedule. See Chapter 15 of the Business Case for details.
Fare structure (airport access)	***Redacted***	***Redacted*** The actual fare premium for MAR will be subject to a separate analysis and determined at a later point in time.
Public transport expansion factors	Peak to annual: 241.2 Off peak to annual: 354.5	Based on travel patterns informed by Myki data for work days, public / school holidays and weekends. For the economic appraisal, a probability distribution for public transport expansion factors has been considered around this central value. More details are provided in Section 8.1.
Road expansion factors	Daily to annual: 330	This is consistent with the economic appraisal of major road transport infrastructure projects such as North East Link.[6]

[6] Ernst & Young (2018). *Appendix Q1 Economic Appraisal* [PDF File]. Retrieved from: https://northeastlink.vic.gov.au/__data/assets/pdf_file/0003/417954/NEL-Business-Case-Appendix-Q1.pdf

Parameter	Value	Supporting information
Value of travel time savings:	Value of travel time (in 2020 dollar terms): • business to business trips: $55.32 • other trips: $17.05	In line with the ATAP PV2 guideline and indexed as described below. More details are provided in Section A.1.1. For the economic appraisal, a probability distribution for the airport user value of travel time has been considered. More details are provided in Section 8.1.
Indexation	Value of Travel Time (**VOT**) has been indexed at 1.5 per cent per year for work related travel. For non-work related travel, VOT has been indexed at 0.75 per cent (calculated as the estimated real long-term average growth in real income in Victoria multiplied by an elasticity of 0.5).	Analysis of Average Weekly Earnings (**AWE**) and Consumer Price Index (**CPI**) data from the Australian Bureau of Statistics (**ABS**) for Victoria. This is consistent with the 2015 Intergenerational Report[7] which recommends the value of time being indexed using long-term average growth in real income.
Demand modelling years	2026, 2031, 2036, 2041, 2051 and 2056	As agreed with DoT.
Interpolation and extrapolation	Benefits have been linearly interpolated between modelled years using the annual average growth rates of the modelled economic benefit between model years. The modelled benefit between 2051 and 2056 has been used to determine the magnitude of benefits beyond the final demand modelling year (until the end of the economic appraisal period).	More details are provided in Section A.1.4.

2.5 Economic discount rate

For some time, there has been growing local and global support for fit-for-purpose discount rates for multi-generational projects. For example, research from the Grattan Institute noted that longer-term projects should require lower discount rates that vary to reflect the current risk-free rate and the sensitivity of the project's expected returns to the economy.[8]

In recent years, fit-for-purpose discount rates have been applied on a number of major infrastructure project appraisals, such as:

[7] Commonwealth of Australia (2015). *2015 Intergenerational Report - Australia in 2055*
[8] Terrill, M. and Batrouney, H. (2018). *Unfreezing discount rates: transport infrastructure for tomorrow* [PDF File]. Retrieved from: https://grattan.edu.au/wp-content/uploads/2018/02/900-unfreezing-discount-rates.pdf

- In the UK, London's Crossrail project[9], High Speed Rail 1[10] and High Speed Rail 2[11] - these projects were assessed over a 60 year period utilising a discount rate of 3.5 per cent for the first 30 years and 3 per cent thereafter to reflect the impacts on future generations
- Grand Paris Express, a large scale automated metropolitan orbital transport and urban regeneration project under construction in Paris and greater Ile-de-France – this was assessed using a discount rate of 4 per cent to demonstrate the rate of return required for public projects in France.[12]
- Inland Rail, an expansive multigenerational rail infrastructure initiative – the Australian Government and Australian Rail Track Corporation applied and reported against a discount rate of 4 per cent as part of the project's economic appraisal.[13]

Using a discount rate for multi-generational projects – such as MAR – in line with standard investment guidance results in latter year benefits (and equally costs) being discounted to near zero. For example, the equivalent of $1 (real) in undiscounted economic benefit in 2029 (the first full year of operation) would be valued at 62 cents in present value terms and in 2053 (halfway through the appraisal period), would be valued at just 12 cents in present value terms if a discount rate of 7 per cent (real) was applied.

Accordingly, the economic assessment of MAR has considered a discount rate of 4 per cent (real) that:

- better reflects the intended outcomes of the multi-generational MAR investment
- is more in-line with the low risk-free rate over the last decade and longer, as well as the current global economic environment
- is consistent with global and local practice for appraising long term, large scale infrastructure investments.

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[9] Transport for London (2010). *Crossrail business case – Summary report* [PDF File]. Retrieved from: https://2577f60fe192df40d16a-ab656259048fb93837ecc0ecbcf0c557.ssl.cf3.rackcdn.com/assets/library/document/c/original/crossrailbusinesscasefinal300710.pdf
[10] London & Continental Railways (2019). *Economic Impact of High Speed 1* [PDF File]. Retrieved from: https://volterra.co.uk/wp-content/uploads/2013/02/Economic-Impact-of-High-Speed-1.pdf
[11] UK Department for Transport (2020). *High Speed 2 Phase One – Full Business Case* [PDF File]. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879445/full-business-case-hs2-phase-one.pdf
[12] International Transport Forum (2018). *Strategic Investment Packages – Case-Specific Policy Analysis* [PDF File]. Retrieved from: https://www.itf-oecd.org/sites/default/files/docs/strategic-investment-packages.pdf
[13] Australian Rail Track Corporation (2015). *Inland Rail Programme Business Case* [PDF File]. Retrieved from: https://1worpv3xudfc4dl40l1hi7fz-wpengine.netdna-ssl.com/wp-content/uploads/2020/07/business-case-2015.pdf

3 Scenarios assessed

This economic evaluation assesses and compares the incremental costs and benefits of the Project Case relative to the Base Case:

- **Base Case** – Considers the future transport network assumptions and land use projections consistent with the DoT Reference Case but excluding the introduction of MAR. Under the Base Case, the Melbourne City Express SkyBus is the primary means of public transport connecting Melbourne CBD to the airport.
- **Project Case** – Considers the future transport network assumptions and land use projections consistent with the DoT Reference Case assuming the completion and operationalisation of MAR. Under the Project Case, the Melbourne City Express SkyBus does not operate during MAR hours of operation.

3.1 Scenario definitions

3.1.1 DoT Reference Case

KPMG have adopted the Reference Case approach in line with relevant DoT guidelines.[14] The Reference Case transport network includes committed projects in addition to an agreed set of projects, including arterial road upgrades, rail service upgrades, motorway improvements, tram and bus upgrades and service level augmentations to supply a reasonable capacity that is supportive of the future demand associated with the Reference Case land use.

Inclusion of projects in the Reference Case does not imply there is any commitment from the Victorian Government to undertake these projects. It merely indicates that DoT has determined that it is reasonable to represent the project, or a similar investment, in the future network for the purposes of modelling demand in the transport system.

The Reference Case is managed, coordinated and produced by DoT. This is generally produced on an annual basis, or as required to suit major updates or releases of key inputs such as:

- new government policies or strategies
- population and employment forecasts
- updated travel survey data
- significant changes to transport networks.

The responsibilities for the various inputs to the Reference Case are shown in Table 4.

Table 4: Responsibilities for inputs to Reference Case

Reference Case Inputs	Responsibility
Population forecasts	DoT, Department of Environment, Land, Water and Planning (**DELWP**)
Employment forecasts	DoT, Department of Jobs, Precincts and Regions (**DJPR**)

[14] DoT (2019). *The standard approach to transport modelling and economic evaluation in Victoria, 2019-20 v4.0.*

Reference Case Inputs	Responsibility
Road network	DoT (Network Planning)
Public transport network and service plans	DoT (Network Planning)
Freight network and forecasts	DoT (Freight Victoria)
Airport patronage forecasts	DoT
Transport modelling parameters	DoT (Transport Analysis and Assessment Branch, Economic Reform Branch)

***Source**: DoT (2019, pg. 9). The standard approach to transport modelling and economic evaluation in Victoria, 2019-20 v4.0.*

Key Reference Case projects which are included within the MAR Base Case and Project Case are as follows (as advised by DoT):

- Suburban Rail Loop East
- Metro Tunnel incl. Sunbury line upgrade
- Regional Rail Revival (**RRR**)
- Level crossing removals
- West Gate Tunnel (**WGT**)
- North East Link (**NEL**)
- M80 upgrades
- Mordialloc bypass
- Hurstbridge Line upgrade
- Monash Freeway Upgrade
- Outer Metropolitan Ring Road (**OMR**)
- Western Rail Tunnel
- Western Rail Plan (**WRP**)
- Geelong Fast Rail (**GFR**).

Note that MAR is also included within the DoT Reference Case. However, for the purpose assessing MAR, it is removed to develop the Base Case transport network which is subsequently used as the reference point for the economic analysis. This is discussed in Section 3.1.2.

For further detail regarding the Reference Case, including land use assumptions, airport patronage and both the timing and inclusion of specific transport network projects, see Appendix 5: Demand modelling.

3.1.2 Base Case

The Base Case is the reference point for the economic analysis and considers future transport network assumptions and land use projections consistent with the DoT Reference Case, but excludes MAR. The Base Case for this appraisal therefore:

- reflects the scenario without costs or benefits associated with MAR
- includes land use assumptions as per the Reference Case, but without the MAR investment.

Under the Base Case, the Melbourne City Express SkyBus service is the primary public transport connection between the CBD and Melbourne Airport. Currently, the Melbourne City Express service operates 24/7 at frequencies of approximately nine to ten minutes during the day to and from Southern Cross Station. According to the SkyBus website, travel times between Southern Cross Station and the airport can be 35 minutes, but passengers are advised to allow extra travel time during peak periods. An average journey time of 22 minutes is published.

The modelled SkyBus fare for the Melbourne City Express is ***Redacted*** and the modelled headway for the service is five minutes, as agreed with DoT and RPV.[15]

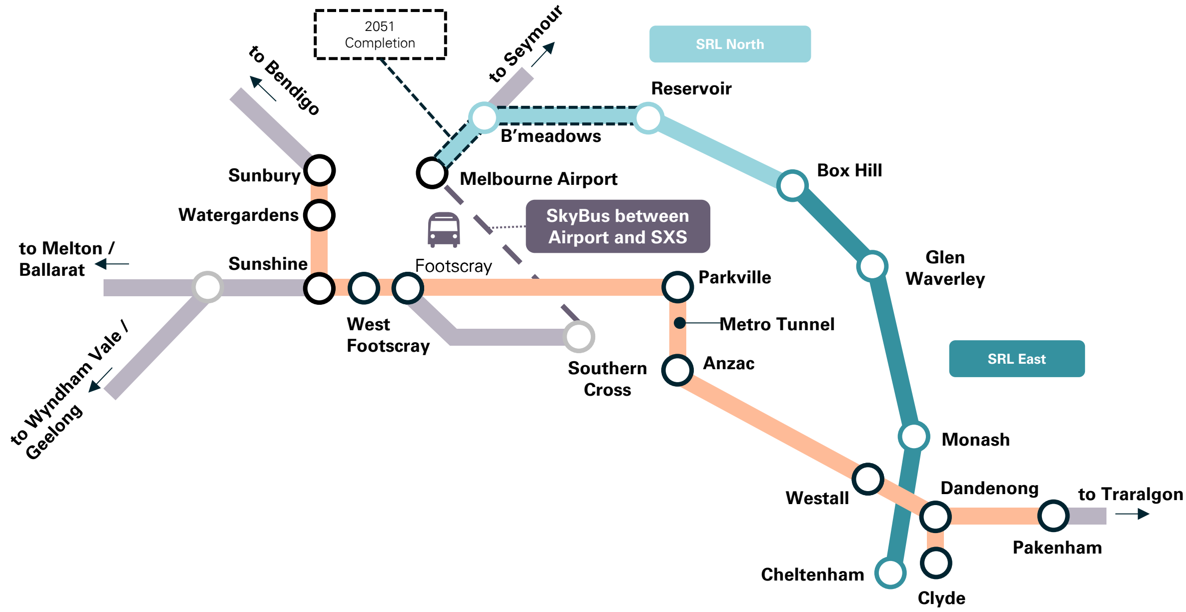
In addition to the Melbourne City Express, SkyBus provides connectivity across Melbourne via an additional five services that operate to:

- Southbank (Southbank Docklands Express)
- St Kilda (St Kilda Express)
- Frankston (Peninsula Express)
- Croydon (Eastern Express). Note that this service is not included within the DoT Reference Case and is not modelled within the Base Case
- Werribee (Western Express).

In 2051, the DoT Reference Case incorporates the SRL North connection to Melbourne Airport (see Figure 10), providing an additional means of accessing the airport via public transport. Both Melbourne Airport Rail and SRL East (from Cheltenham to Box Hill) are currently expected to commence construction in 2022, with SRL North (from Box Hill to Melbourne Airport) to be delivered later. In consideration of this, the economic appraisal has been undertaken with and without the SRL North connection to Melbourne Airport (from Reservoir to Melbourne Airport) in 2051 in the Base Case.

The Base Case network configuration is provided in Figure 10 with the MTP corridor also highlighted.

Figure 10: Base Case network configuration



3.1.3 Project Case

The Project Case considers the Base Case described above, plus the changes to the transport network required to deliver the proposed service plan for MAR. This involves the extension of short starters at Sunshine and West Footscray to Melbourne Airport via a new track between Sunshine and the airport. In the Project Case, the Melbourne City Express SkyBus service does not operate during MAR hours of operation.

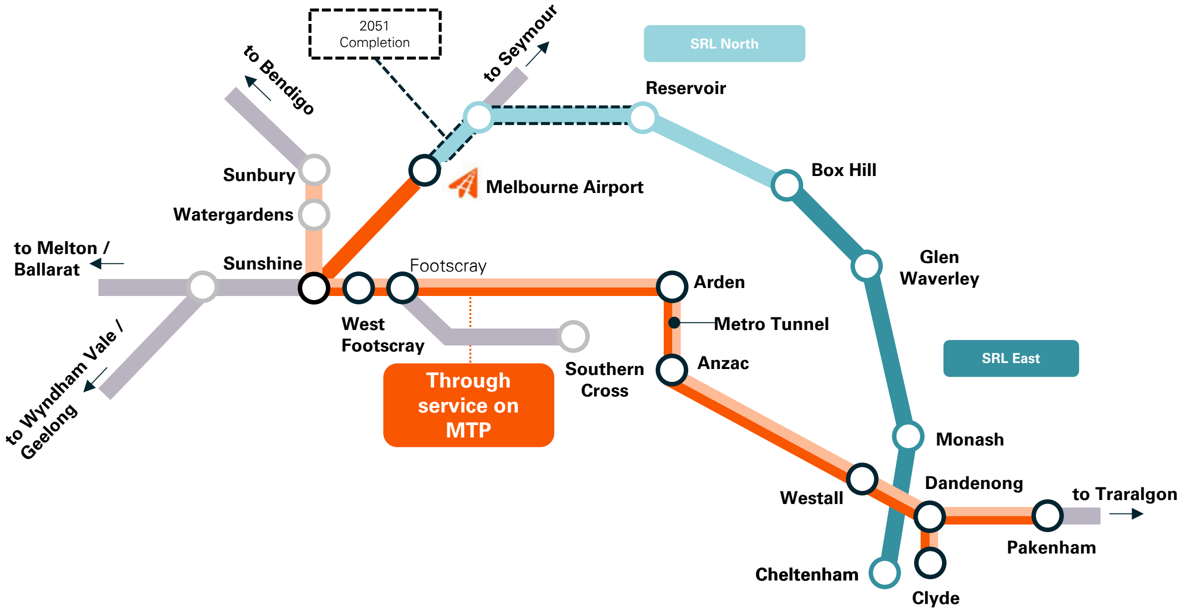
15 ***Redacted***

MAR offers a heavy rail link from the airport to the CBD via Sunshine with a service frequency of six trains per hour. The travel time between Melbourne Airport and the CBD is approximately 30 minutes. The MAR fare premium modelled for demand modelling purposes is the same as the Melbourne City Express SkyBus service, at *Redacted* .[16] The modelled rolling stock for the MAR service is the 7-car High Capacity Metro Train (**HCMT-7**) on day one of operations.

The network configuration associated with the Project Case is shown in Figure 11. This figure also highlights that infrastructure associated with MAR forms an integral part of SRL by providing a link to the western network between Broadmeadows and Sunshine.

As described in Section 3.1.2, the economic analysis was undertaken with as well as without the SRL North connection to Melbourne Airport in 2051 in the Base Case.

Figure 11: MAR network configuration



Further detail on the Base Case and Project Case network assumptions (e.g. key rail and arterial road projects) is provided in Appendix 5: Demand modelling.

3.2 Service planning

This section presents the modelled service plans for the Base Case and Project Case.

3.2.1 Base Case

The Melbourne City Express SkyBus service frequency and load standard capacity under the Base Case are provided in Table 5.

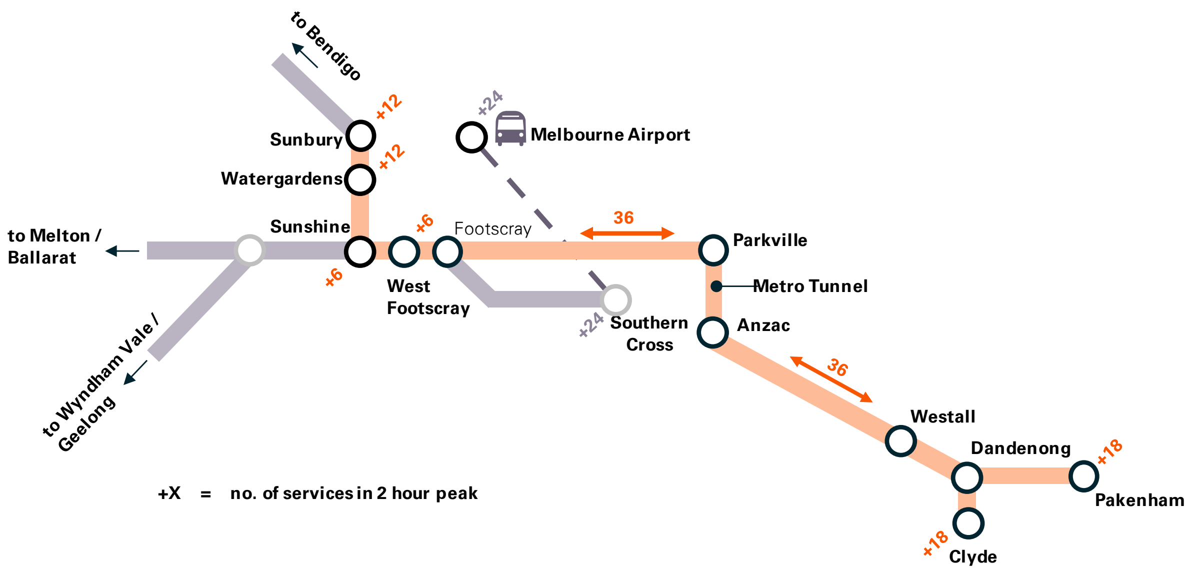
16 *Redacted*

Table 5: Base Case Melbourne City Express SkyBus service frequency and service capacity[17]

Bus type	Load standard	Service frequency (headway)
Standard bus	67.5	5 minutes

The network configuration of the Base Case with associated service levels for the MTP corridor and the Melbourne City Express SkyBus service in the 2-hour AM peak for MAR day-1 is illustrated in Figure 12.

Figure 12: Base case network configuration and 2-hour AM peak service levels (MAR day-1)



3.2.2 Project Case

The seated capacity, crush capacity and load standard for the MAR rolling stock is summarised in Table 6. HCMT-7s are assumed to service MAR from 2028, with the introduction of the 10-car High Capacity Metro Train (**HCMT-10**) along the MTP corridor from 2041 onwards.

Table 6: Capacity of HCMT-7 and HCMT-10 rolling stock

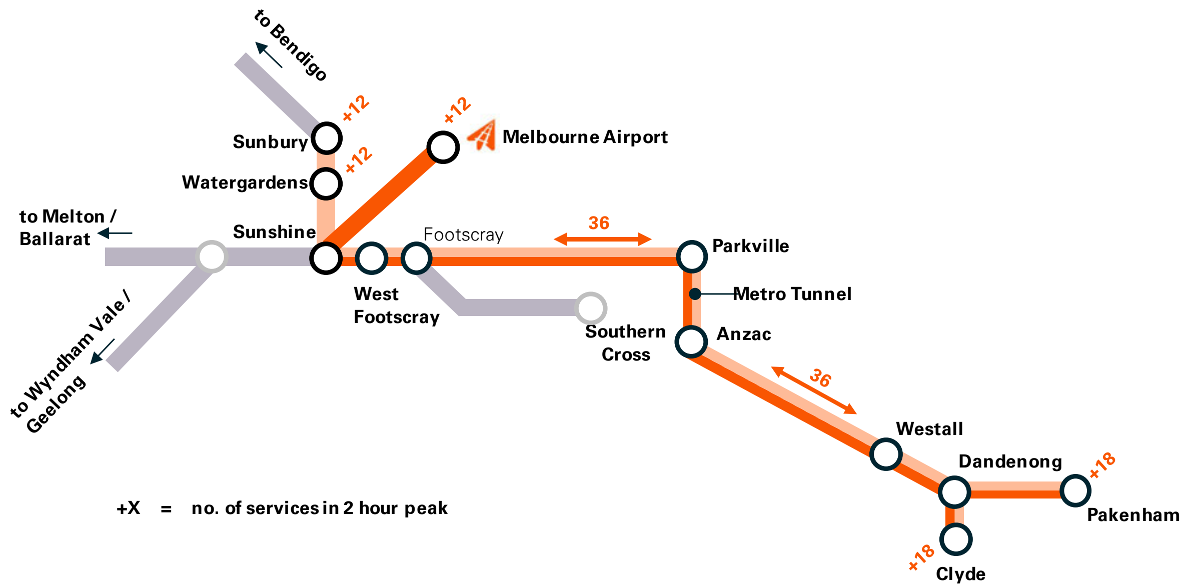
Rolling stock type	Expected commencement	Seated capacity	Crush capacity	Load standard
HCMT-7	2028	510	1,433	1,100
HCMT-10	2041	744	2,039	1,570

Source: DoT MAR Reference Case, 2020.

The MTP network configuration and 2-hour AM peak service plan for MAR day-1 is provided in Figure 13.

[17] This is as agreed with DoT and RPV.

Figure 13: MTP network configuration and 2-hour AM peak service levels (MAR day-1)



Considering both the vehicle capacities and service frequency, Table 7 presents the following:

- service capacity to Melbourne Airport from the CBD in both the Base Case and Project Case
- service capacity on the MTP corridor in both the Base Case and Project Case.

It should be noted that a direct comparison of service capacity between MAR and the Melbourne City Express SkyBus service cannot be made. This is because in the Base Case, the Melbourne City Express SkyBus is a dedicated service for passengers travelling to and from Melbourne Airport whereby in contrast, in the Project Case, MAR provides service to all passengers travelling along the MTP corridor which includes both airport and non-airport passengers.

Table 7: Load capacity under the Base Case and Project Case during the 2-hour AM peak

	2028 to 2036	2036 to 2041	2041+	2028 to 2036	2036 to 2041	2041+
	2 hr peak			Interpeak / offpeak		
CBD to / from airport						
Base Case (Melbourne City Express SkyBus)	1,620	1,620	1,620	1,620	1,620	1,620
Project Case (MAR)	6,600	6,600	9,420	6,600	6,600	9,420
Difference (Project Case – Base Case)	**+4,980**	**+4,980**	**+7,800**	**+4,980**	**+4,980**	**+7,800**
MTP corridor (West Footscray to Westall)						
Base Case	39,600	50,600	72,220	6,600	9,900	14,130
Project Case	39,600	50,600	72,220	13,200	16,500	23,550
Difference (Project Case – Base Case)	-	-	-	**+6,600**	**+6,600**	**+9,420**

4 Economic costs

4.1 Overview

This section outlines the economic costs to be used in the CBA of MAR.

The economic appraisal requires that only economic costs are included in the analysis. Economic costs include incremental changes relative to the Base Case necessary to deliver the benefits of the project and consider the capital costs and operating, maintenance and renewal costs but exclude DoT recharge costs and profit margins. Costs that have already been incurred prior to the investment decision being made are considered sunk costs and have been excluded from the analysis.

The economic costs for the Project Case include the capital cost of track works, stations, civil works, bridge works, signalling, traction power and rolling stock, as well as the associated delivery, operating and maintenance costs. The costs associated with the discontinuation of the Melbourne City Express SkyBus service during MAR hours of operation – including avoided costs as a result of the cessation of the Melbourne City Express SkyBus service, and one-off contractual close-out cost – have also been estimated and included.

These costs are incremental to the Base Case and are detailed in Table 8.

Table 8: Economic costs of MAR (real, undiscounted, $2020)

Cost type	Value (P50)	Value (P90)
Capital costs	$9.3bn	$9.5bn
Recurrent costs[1]	Averaging $80m per annum	Averaging $85m per annum

1. *Operating, maintenance and renewal costs include savings from the cessation of the Melbourne City Express SkyBus service.*

Sources: *Appendix 7: Capital cost estimate report and Appendix 8: Operational cost estimate report*

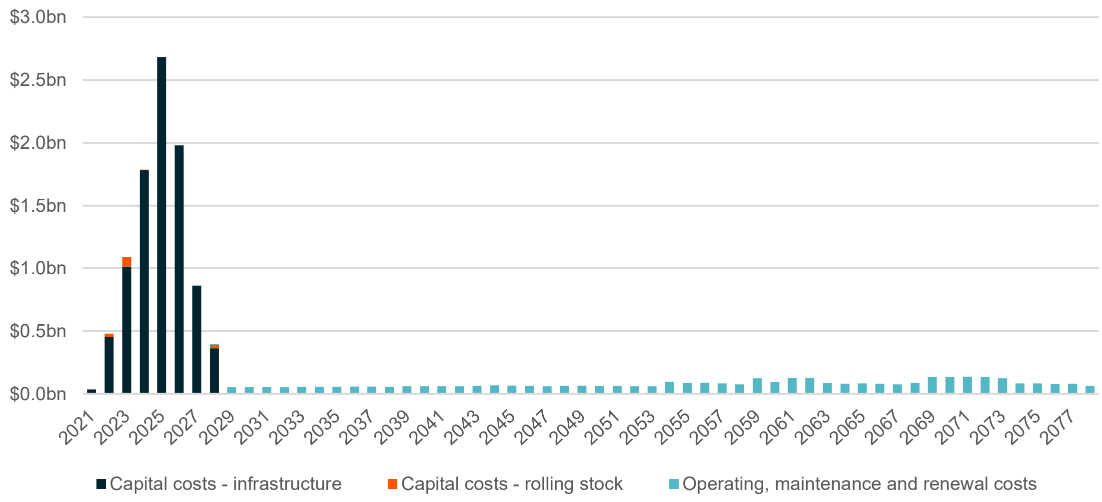
For the purposes of the economic evaluation, costs are expressed as real values (using a 2020 Q1 price base). A real value is a value that has been adjusted from a nominal value to remove the effects of general price level changes over time (e.g. inflation).

It is important to note that the financial assessment uses nominal values which retain the effects of inflation. Costs originally provided by the cost advisors were in the format of nominal values and, as a result, were required to undergo an adjustment to derive economic costs. This includes the following:

- Removal of CPI.
- Inclusion of cost savings due to the cessation of the Melbourne City Express SkyBus service. The cost savings partially offset the project costs attributable to MAR. This reflects the incremental (to the Base Case) nature of the economic costs.
- Real incomes used in the analysis have been assumed to increase by 1.5 per cent per annum over the economic evaluation period. Accordingly, the labour component of costs used in the analysis have been adjusted to account for increases in labour costs.

Figure 14 shows the P50 cost profile for the Project Case over the economic appraisal period.

Figure 14: Cost profile for MAR (P50, real, undiscounted, $2020)



1. *The rolling stock costs include the one-off SkyBus contractual close-out cost.*
2. *Operating, maintenance and renewal costs include savings from the cessation of the Melbourne City Express SkyBus service.*

Sources*: Appendix 7: Capital cost estimate report and Appendix 8: Operational cost estimate report*

4.2 Capital costs

Capital costs include all costs incurred when delivering and commissioning the infrastructure and rolling stock required for the Project Case. The economic cost excludes recharge costs as they are not a resource cost to the project.

Table 9 summarises the capital cost of the Project Case incremental to the Base Case.

Table 9: Summary capital costs (real, undiscounted, $2020)

Item	Capital cost (P50)	Capital cost (P90)
Rolling stock[1]	$0.1bn	$0.1bn
Infrastructure	$9.2bn	$9.4bn
TOTAL COST	**$9.3bn**	**$9.5bn**

1. *The rolling stock costs include the one-off SkyBus contractual close-out cost.*

Source*: Appendix 7: Capital cost estimate report*

4.3 Recurrent costs

Recurrent costs include all necessary incremental costs to the Base Case for running train services, and comprise operating, maintaining and periodical renewal to support the operation of infrastructure, rolling stock, rail track and stations. Similar to capital costs, all levies are excluded from the analysis. The key assumptions include:

- all infrastructure works associated with MAR, including track and bridge works between Sunshine and the airport and a new station at Melbourne Airport, are completed by MAR day-1

- an increase in service kilometres through the extension of Sunshine and West Footscray starters to Melbourne Airport in peak periods, as well as from additional interpeak and off-peak services to the airport, with no other changes in service to the Melbourne train or tram networks
- alignment between the MAR hours of operation and the broader network operating hours
- sixty-five HCMT-7s already operating on the Sunbury to Pakenham / Clyde corridor before MAR is operational, with an additional four HCMT-7s required for the MAR service plan
- cost savings arising from the cessation of the Melbourne City Express SkyBus service during the hours within which MAR is operational.

Table 10 summarises the operating, maintenance and renewal costs of the Project Case incremental to the Base Case.

Table 10: Summary of incremental operating, maintenance and renewal costs (real, undiscounted, $2020)

Item	Average annual cost (P50)	Average annual cost (P90)
Operating costs	$70m	$74m
Maintenance and renewal costs	$33m	$35m
Cessation of Melbourne City Express service	$23m (saving)	$25m (saving)
TOTAL COST	**$80m**	**$85m**

***Sources**: Appendix 8: Operational cost estimate report*

4.4 Escalation rates

The escalation rates considered are summarised in Table 11. To ensure consistency within the economic analysis, only real escalation is used as per the ATAP T2 guideline.

Table 11: Escalation rates - nominal rate (real rate)

Redacted

Commercial-in-confidence

As detailed in Section 4.1, real incomes used in the analysis are assumed to increase by 1.5 per cent per annum over the economic evaluation period. Accordingly, the labour component of costs used in the analysis have been adjusted at this same rate to account for increases in labour costs.

5 Conventional economic benefits

5.1 Overview

Conventional economic benefits primarily include transport-related benefits quantified in accordance with the relevant ATAP, DoT and DTF guidelines. Conventional economic benefits fall into three main categories:

- **User benefits (public transport and road users)** – Benefits to public transport and remaining road users as a result of the Project Case. User benefits include, for example, reduced crowding and waiting times on public transport, or travel time savings and vehicle operating cost savings for commercial vehicles resulting from people switching from car to public transport. The majority of benefits are calculated using the consumer surplus approach. Certain benefits are not perceived by users but result in a change in consumption of resources. Resource cost corrections therefore need to be applied.
- **Other societal benefits** – Benefits accruing to Victorians as a whole from changes to travel behaviour following the introduction of the Project Case. For example, this includes reduced crashes, greenhouse gas emissions and improved health (due to increased walking) resulting from people switching from car to public transport. Other societal benefits also include the value Victorians place on having an airport rail link, including benefits associated with option and non-use value.
- **Infrastructure residual value** – The infrastructure constructed for the Project Case will have an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

The user and non-user benefits are calculated from the outputs of the transport models and are valued using unit costs sourced from primarily from ATAP guidelines and Austroads (2012).

5.2 Public transport user benefits

Public transport user benefits accrue from changes to the public transport service levels, resulting in improvements to capacity, quality and convenience.

Benefits to customers comprise changes to generalised journey time (a weighted measure of the door-to-door travel time, including time spent walking and waiting for a service as well as time spent on board); reduced crowding on trains and in stations; improved reliability and resilience of the network; and improvements to the journey experience. Table 12 shows the public transport user benefits to be quantified in the analysis.

Benefits to public transport users has been calculated using outputs of VITM, and these have been monetised using parameters primarily from the ATAP guidelines.

Public transport user benefits have been calculated using the consumer surplus approach described in Section A.2.1. New public transport users (who use a car in the Base Case but switch to public transport in the Project Case) receive half of the benefit accrued by existing users in accordance with the 'rule of half' convention. The exception is farebox revenue which is subject to a resource cost correction.

Table 12: Public transport benefits

Benefit type	Description
Generalised travel time savings	The change in door-to-door travel times includes time spent walking (or driving) to and from stops / stations (and interchanging between services); waiting for a train, tram or bus; and time spent on-board the vehicle. Various components of time have been weighted to reflect how passengers perceive their time in accordance with weightings provided in the ATAP M1 guideline: passengers generally perceive time spent waiting for a service to be longer than time spent on board a moving vehicle. Consequently, passengers tend to value improvements in frequency (leading to reduced wait times) more than they do improvements in in-vehicle time (IVT).
Reduced crowding on trains and trams	Crowding, or crowded IVT reflects the discomfort customers feel from travelling in varying levels of crowded conditions. As crowding levels increase to crush capacity, the valuation of crowding in IVT minutes also increases. Where customers are unable to board a service due to it being at capacity, they will also incur additional wait time or costs associated with changing mode.
Farebox resource cost correction	A resource cost correction to offset the perceived disbenefit of fares in the public transport user benefits.

5.3 Road user benefits

Road user benefits principally accrue due to some road users switching from car in the Base Case to public transport in the Project Case. Consequently, there is less congestion on the road, and other road users, including freight vehicles, benefit from the reduced traffic on the road.

Benefits to road users consist of travel time savings, improvements in journey time reliability, and monetary items such as vehicle operating cost savings, parking cost savings and toll savings. Road user benefits to be captured in the analysis are shown in Table 13.

Benefits to road users have been calculated using outputs of VITM, and these have been monetised using parameters primarily from the ATAP guidelines.

Road user benefits will also be calculated using the consumer surplus approach as used for public transport users. In some cases, road conditions may improve such that some public transport users divert to road in the Project Case (induced demand). Benefits to these users will also be calculated according to the 'rule of half' convention.

Some benefits are not directly perceived by road users (and so do not constitute part of their willingness-to-pay) but do result in a change in consumption of resources. These benefits have been accounted for through resource cost corrections.

Table 13: Road user benefits

Benefit type	Description
Travel time savings	The change in door-to-door travel times resulting from reduced levels of traffic on the road network due to some car users switching to public transport.
Vehicle operating cost savings	Operating costs of vehicles, such as fuel and maintenance, are a function of distance and speed travelled across the network. In general, fuel consumption is higher at low speeds in interrupted flow / stop-start conditions than it is on free-flowing conditions. As a result of some drivers switching from car to public transport, road network speeds can increase leading to fuel savings for other road users. For vehicles which operate in fleets (such as commercial vehicles), if travel times decrease as a result of network speeds increasing, then operators will be able to undertake either the same freight task with a smaller number of fleet vehicles or undertake more trips with the same vehicle. This leads to savings related to vehicle capital costs, including time-related depreciation, registration and insurance. A resource cost correction is applied to the unperceived (non-fuel) component of vehicle operating costs.
Road journey time reliability	Road journey time reliability is a function of congestion in the road network – when links are at or near capacity, any unplanned incident, such as a crash or breakdown, is more likely to result in major delays to other vehicles than if the crash or breakdown occurred on a more lightly trafficked route. Consequently, drivers must allow more buffer time before making trips to ensure that they arrive on time. Some road links will become less congested and trips by road for remaining road users will become more reliable, allowing them to reduce the buffer time and use the time saved more productively.
Travel time in congested conditions	Research shows that the value of time increases with the level of congestion, reflecting the increased stress and effort associated with driving in more congested conditions. As the Project Case results in some mode shift from road to public transport, some road links will become less congested and remaining road users will benefit from travelling in less congested conditions.
Savings in parking and toll charges	Savings due to road users switching from car to public transport, or from remaining road users changing routes due to reduced road congestion as a result of some users switching to public transport. A resource cost correction has been applied to the unperceived component of tolls and parking charges.

5.4 Other societal benefits

Other societal benefits include externalities, which are benefits that accrue to society as a whole, resulting from people changing their travel behaviour. They are not factored into the decision making of the transport user but are a benefit to all Victorians. As externalities are unperceived by transport users, they are not subject to the consumer surplus calculation approach. Instead, they have been calculated from the total change in consumption of resources.

These non-user benefits include reductions in road crashes and environmental externalities (resulting from drivers switching from road to public transport), and improvements in public health due to an increase in public transport use enabling ancillary physical activity (as public transport users walk to or from a public transport stop as part of their journey). Other societal benefits also include the value Victorians place on having an airport rail link, including benefits associated with option and non-use value. Table 14 shows the other societal benefits to be included in the analysis.

Table 14: Other societal benefits

Benefit type	Description
Crash cost savings	Crash costs are a function of the number of vehicle kilometres travelled on a particular road type. In general, limited access roads, such as freeways, have lower crash rates per vehicle kilometre travelled than roads in residential areas. As a result of some road users switching from car to public transport, there will be fewer vehicle-kilometres travelled on the network. Consequently, fewer crashes will occur.
Environmental externality cost savings	Environmental externalities quantified include greenhouse gas emissions, air pollution, noise pollution, water pollution, nature and landscape impacts, urban separation effects and upstream and downstream impacts. Benefits have been calculated using network-wide changes in vehicle kilometres travelled or net tonne kilometres travelled by road and public transport vehicles and the application of valuation parameters.
Improved health due to increased walking	Public transport users walk or cycle an average of 41 minutes per day compared to eight minutes per day for car users. As a result of car drivers switching to public transport, these individuals' levels of physical activity increases, and may lead to some improved health outcomes. Walking undertaken by new public transport commuters (i.e. those who mode shift from car) incurs a benefit in line with the ATAP M4 guideline.
Option and non-use value	Option and non-use value should be included in the economic appraisal if the project being appraised includes measures that will change the availability of transport services within the study area (e.g. the opening of a rail service). Option and non-use value is considered relevant for this economic appraisal as MAR provides a new rail service for travellers to Melbourne Airport. An option value is the willingness to pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. Non-use values are the values that are placed on the continued existence of a service, regardless of any possibility of future use by the individual in question. The motivation for the desire for a transport service to continue to exist may vary from one circumstance to another. Whilst a full analysis of user benefits will include the expected value of any such occasional use, theory suggests that, in circumstances where the lack of the transport facility would cause inconvenience, people may be willing to pay a premium over and above their expected use value to ensure that the service exists for unplanned trips, as a type of insurance.

5.5 Residual value

Benefits have been assessed over a 50-year period from project opening. However, the infrastructure will have an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

The residual value was calculated based on the economic life as per the ATAP M1 guideline. A number of these assets, in particular rail infrastructure and bridge structures, are estimated to have an economic life that extends beyond the 50-year evaluation period. It is therefore prudent to accurately reflect the residual value of the assets beyond the end of the evaluation period.

A weighted average asset life for the project as a whole was developed based on information provided by the cost advisor. Based on the method described above, the estimated weighted asset life of MAR is 69 years, which is used in the residual value calculation for this appraisal.

The residual value method applied within the economic appraisal considers the lower of the present value of the replacement cost at the end of the evaluation period, or the present value of the future stream of net benefits from the end of the evaluation period to the end of the economic life of the asset in line with DTF guidelines.

5.6 Key findings

5.6.1 Overview

The following sections discuss the conventional benefits attributable to MAR. The results are summarised in Table 15.

Table 15: Conventional benefits of MAR (4 per cent discount rate)

Category	MAR exc. SRL in the Base Case[1] (P10 to P90)	MAR inc. SRL in the Base Case[1] (P10 to P90)
Public transport user benefits[2]	$6.4bn - $8.5bn	$3.1bn - $4.0bn
Road user benefits[3]	$5.0bn - $5.8bn	$3.0bn - $3.4bn
Externalities (non-user benefits)	$0.9bn - $0.9bn	$0.7bn - $0.7bn
Option and non-use value	$0.6bn - $1.6bn	$0.6bn - $1.6bn
Residual value of assets	$1.0bn - $1.1bn	$1.0bn - $1.1bn
Total conventional economic benefits	**$14.3bn - $17.4bn**	**$8.8bn - $10.5bn**

1. *Monetary values presented in Q1 2020. Costs and benefits discounted to 2022.*
2. *Farebox resource cost corrections account for approximately 29 per cent and 40 per cent of public transport user benefits for MAR exc. SRL and MAR inc. SRL respectively. This proportion is higher than typical for public transport projects, driven by the considerable number of new users (due to mode shift) and* ***Redacted*** *. For further details on farebox resource cost correction, see Appendix A.2.2.*
3. *Perceived congestion benefits are included and comprise less than 0.1 per cent of road user benefits.*

5.6.2 Public transport user benefits

Public transport benefits make up the largest component of conventional benefits, accounting for approximately 47 per cent and 37 per cent for MAR exc. SRL and MAR inc. SRL respectively.

The present value of public transport benefits ranges from $6.4bn to $8.5bn for MAR exc. SRL, whilst the present value of public transport benefits ranges from $3.1bn to $4.0bn for MAR inc. SRL.

Figure 15, Figure 16 and Figure 17 show the trip-weighted distribution of public transport user benefits (by origin) as modelled for the AM peak in 2031 and 2056 for both MAR without and with the SRL North connection to Melbourne Airport respectively.

Figure 15: Distribution of trip-weighted perceived public transport user benefits by trip origin (AM peak, 2031)

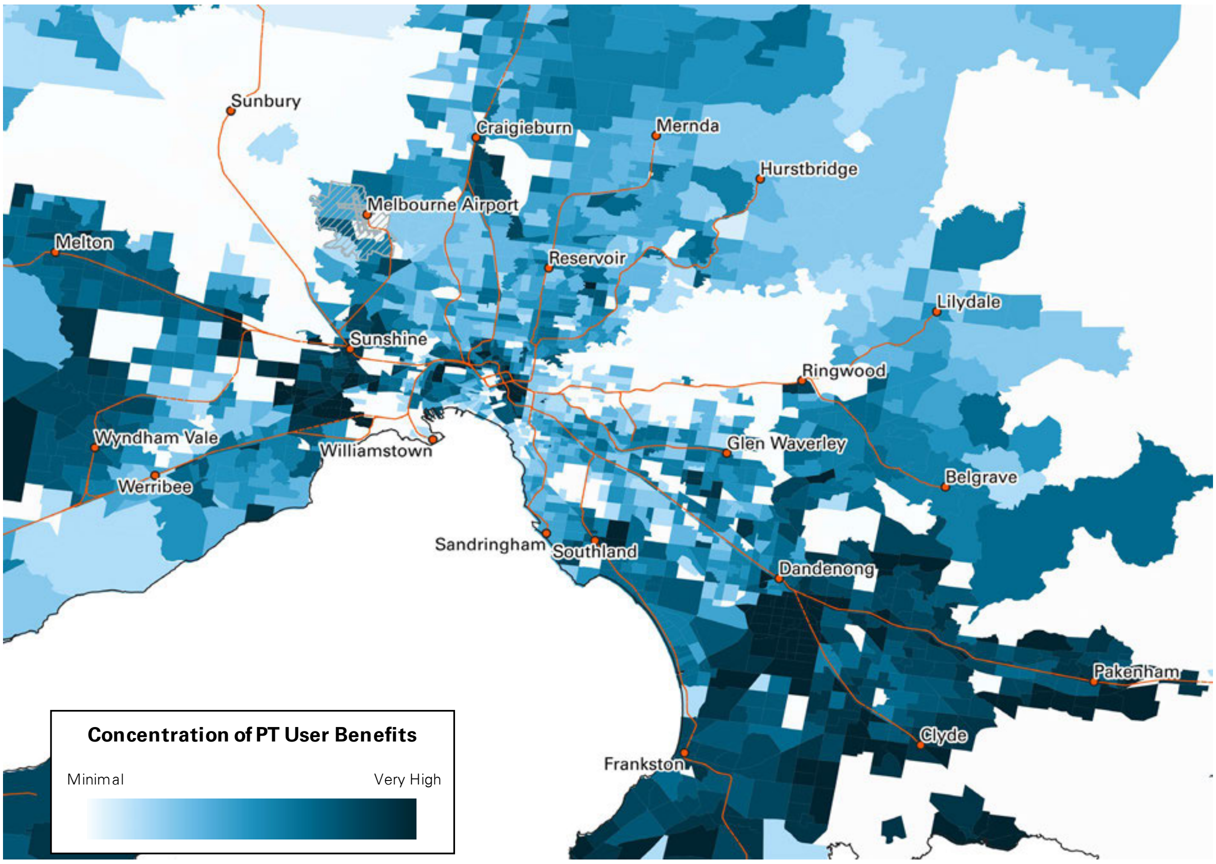
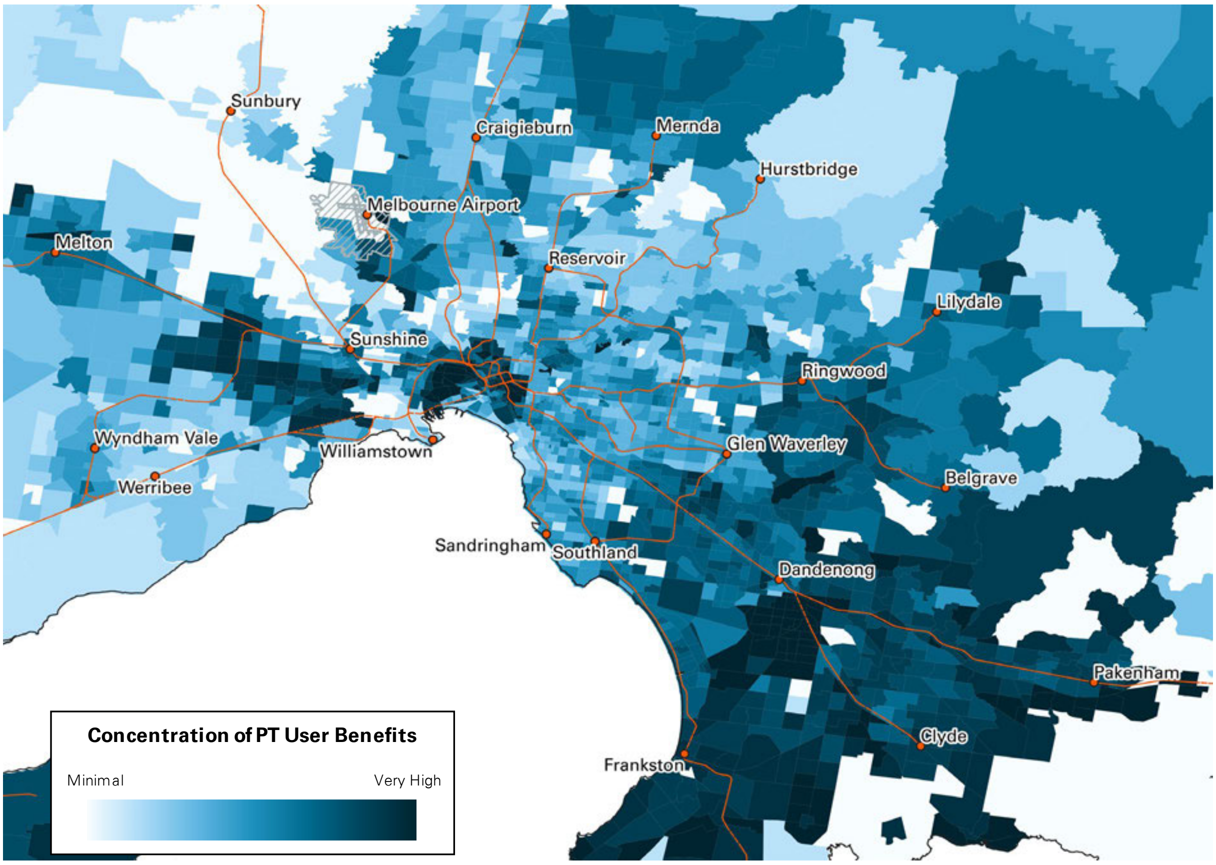


Figure 15 demonstrates that MAR delivers public transport benefits across the majority of metropolitan Melbourne in 2031, driven primarily by overall travel time savings and reduced crowding for air passengers in the AM peak. This is particularly concentrated along the MTP corridor in the south-east and in the CBD around the new MTP stations, where airport passengers now have a one-seat journey to Melbourne Airport. Public transport users to the west of Melbourne are also key beneficiaries of the project, primarily due to the interchange opportunity at Sunshine for airport passengers. This includes passengers originating from Melton and Wyndham, as well as those in the vicinity of Sunshine Station.

Figure 16: Distribution of trip-weighted perceived public transport user benefits by trip origin for MAR exc. SRL in the Base Case (AM peak, 2056)



By 2056, the significant improvement in travel times and alleviation of crowded conditions for airport passengers offered by MAR – relative to the Melbourne City Express SkyBus service – results in a superior public transport option to access Melbourne Airport. In turn, public transport user benefits intensify across all of metropolitan Melbourne, and the footprint of the project influence grows to encompass areas such as the east of Melbourne and in the vicinity of Southern Cross which did not accrue benefits in 2031. As illustrated in Figure 16, the key beneficiaries are public transport users along the MTP corridor, as well as on the Frankston corridor (due to the interchange opportunity at Caulfield) and in the west (due to the interchange opportunity at Sunshine).

Figure 17: Distribution of trip-weighted perceived public transport user benefits by trip origin for MAR inc. SRL in the Base Case (AM peak, 2056)

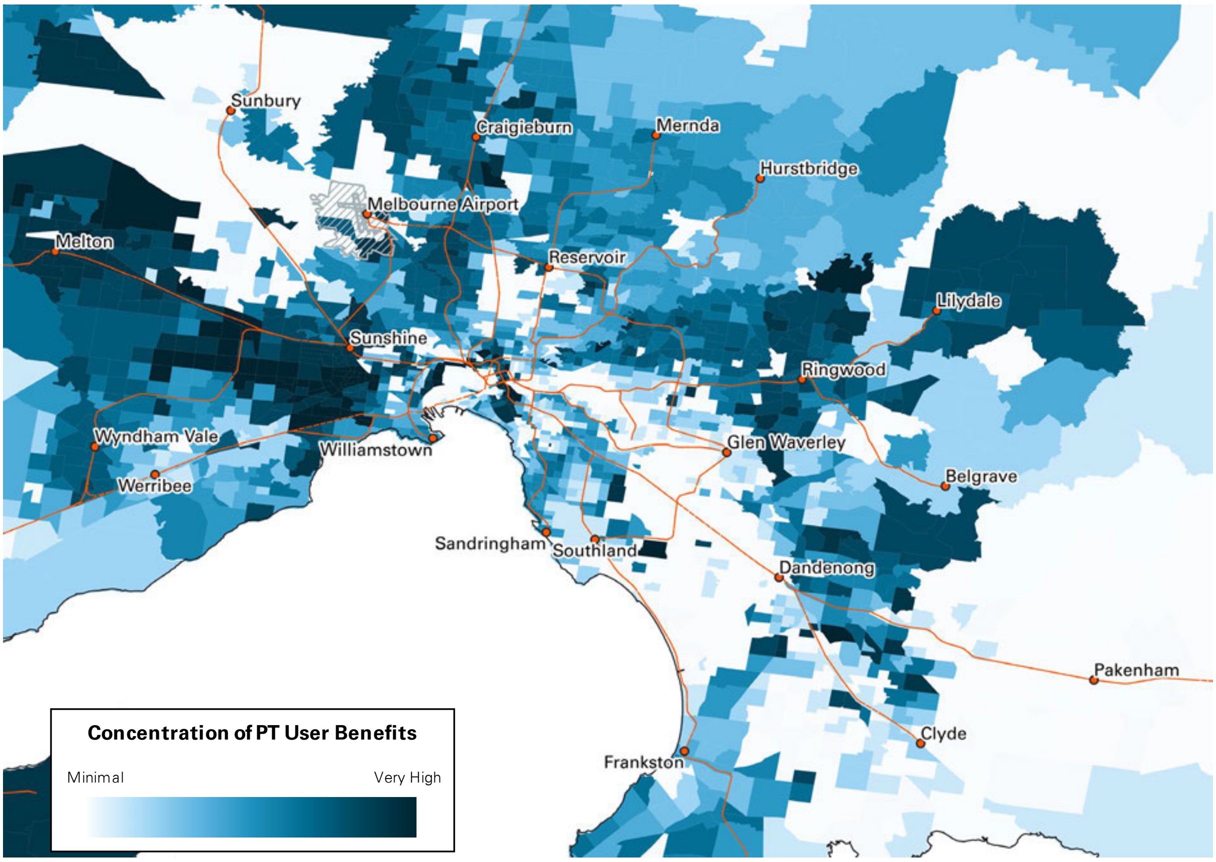


Figure 17 demonstrates that, if the SRL North connection to Melbourne Airport is operational in 2056, the influence of the project on public transport user benefits is muted and concomitantly, less areas across Greater Melbourne accrue benefits. This is because the incremental impact of MAR under this scenario, relative to the Base Case, is diminished, particularly for airport passengers adjacent the SRL East and SRL North corridor, who already have the option of taking SRL to Melbourne Airport in the Base Case. In contrast, the impact of the SRL North connection to Melbourne Airport is less influential in the west of Melbourne, where public transport users remain a key beneficiary of the project.

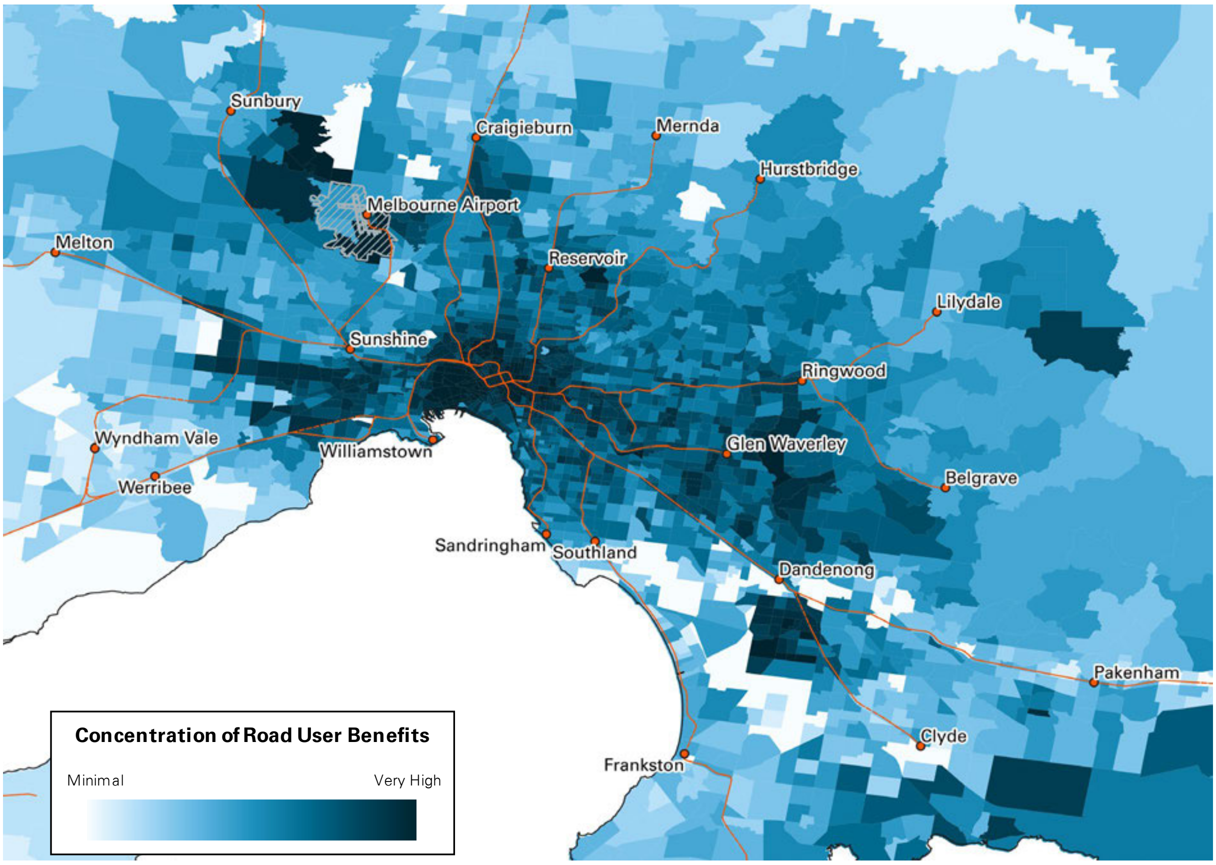
5.6.3 Road user benefits

Road user benefits are a significant component of the conventional benefits, with a similar magnitude to the public transport benefits described above. They account for approximately 34 per cent of both MAR exc. SRL and MAR inc. SRL conventional benefits.

The present value of road user benefits ranges from $5.0bn to $5.8bn for MAR exc. SRL, whilst the present value of road user benefits ranges from $3.0bn to $3.4bn for MAR inc. SRL.

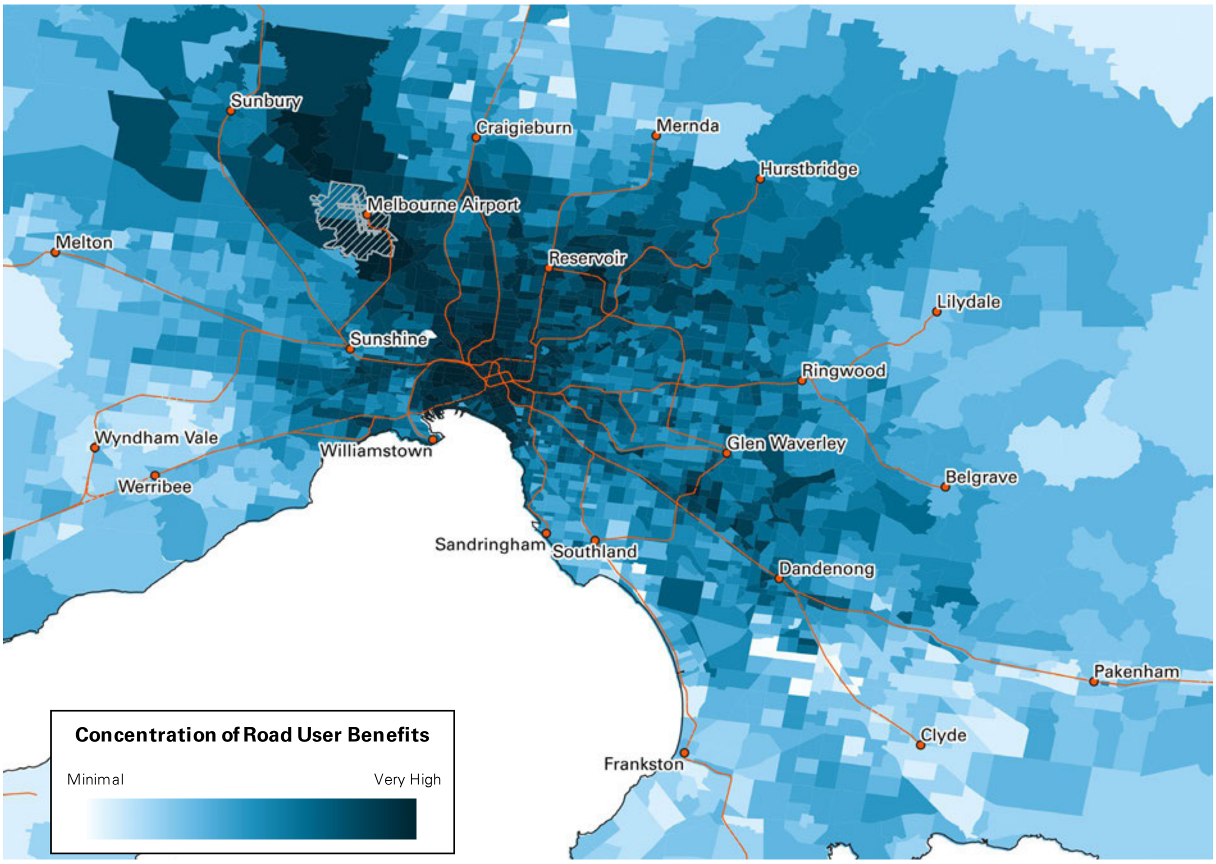
Figure 18, Figure 19 and Figure 20 show the distribution of trip-weighted road user benefits (by origin) as modelled for the AM peak in 2031 and 2056 for both MAR without and with the SRL North connection to Melbourne Airport respectively.

Figure 18: Distribution of trip-weighted perceived road user benefits by trip origin (AM peak, 2031)



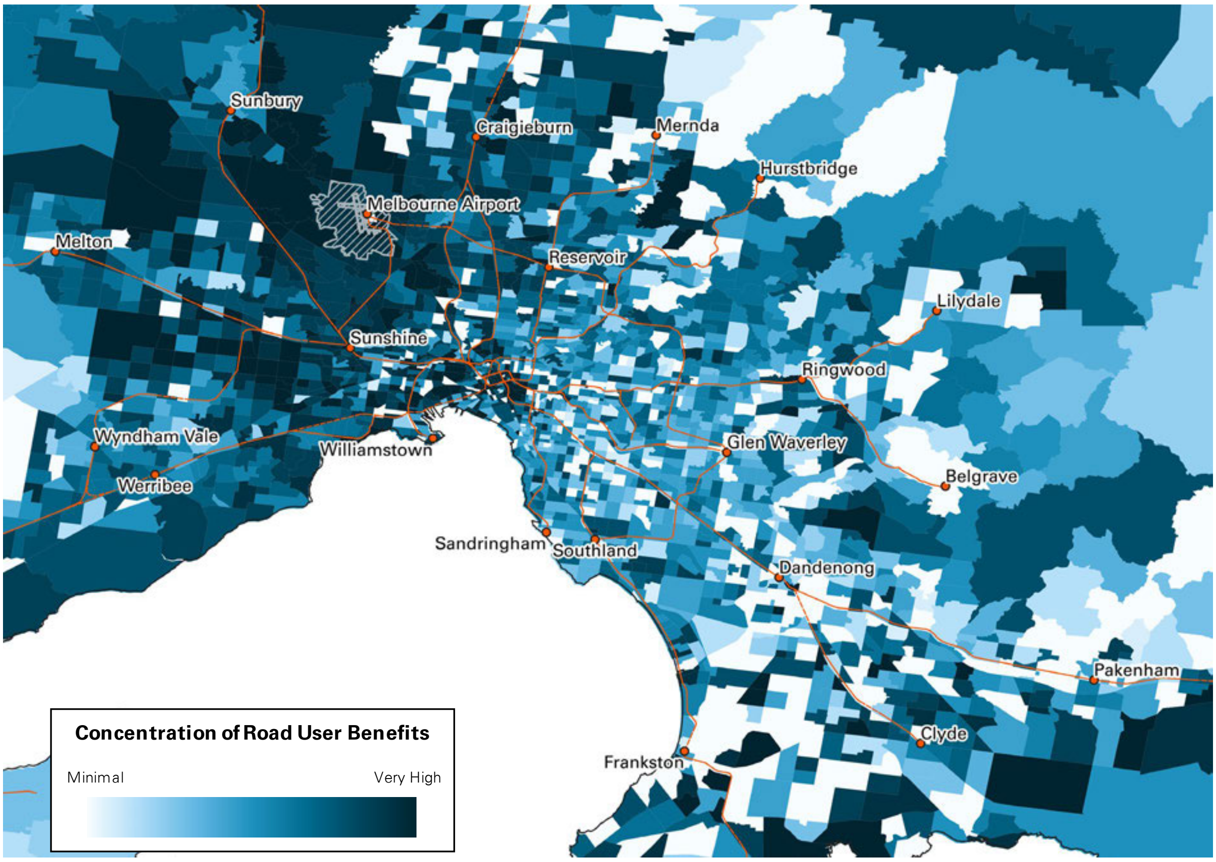
As highlighted in the discussion on public transport user benefits, the introduction of MAR provides a superior public transport option for accessing Melbourne Airport for the majority of people in Melbourne. This promotes considerable mode shift from private vehicle to public transport for trips to and from Melbourne Airport, relieving road congestion and providing travel time savings across Melbourne as illustrated in Figure 18. The road user benefits are particularly concentrated in the north adjacent to Melbourne Airport, in the east and south-east along the MTP corridor as well as in the CBD and inner Melbourne.

Figure 19: Distribution of trip-weighted perceived road user benefits by trip origin for MAR exc. SRL in the Base Case (AM peak, 2056)



Worsening road congestion in 2056 amplifies the road user benefits generated by the introduction of MAR. This is because the incremental impact of promoting mode shift and removing private vehicle users from a heavily congested road network is considerably more pronounced than in 2031, where road network congestion is not as acute. The distribution of road benefits is highlighted in Figure 19, which again highlights, as in 2031, that the benefits are most concentrated in the north adjacent to Melbourne Airport, where a significant number of private vehicle users in the Base Case who ultimately use the CityLink-Tullamarine Freeway corridor to access Melbourne Airport opt for MAR in the Project Case. The connectivity through the south-east also results in roads users along the Monash Freeway diagonal being key beneficiaries of the project.

Figure 20: Distribution of trip-weighted perceived road user benefits by trip origin for MAR inc. SRL in the Base Case (AM peak, 2056)



As discussed above, the SRL North connection to Melbourne Airport impacts the spatial distribution of benefits across Melbourne. This is exemplified in Figure 20, particularly in the south-east and east of Melbourne, where the SRL North connection to Melbourne Airport relieves a similar area of the road network as MAR, resulting in a lower concentration of benefits in this region. In contrast, the impact of the SRL North connection to Melbourne Airport is less influential in the west, north-west and north of Melbourne, who see the largest improvement in road user benefits on a per trip basis.

5.6.4 Other societal benefits

The quantifiable non-user benefits included in the analysis make up approximately 13 per cent and approximately 19 per cent of conventional benefits for MAR exc. SRL and MAR inc. SRL respectively.

5.6.4.1 Externalities

The present value of externalities ranges from $925m to $935m for MAR exc. SRL, whilst the present value of externalities ranges from $715m to $725m for MAR inc. SRL.

Externality benefits are driven primarily by improvements to road conditions. As such, they are distributed in a similar pattern to the road user benefits shown in Figure 19.

5.6.4.2 Option and non-use value

The present value of option and non-use value ranges from $0.6bn to $1.6bn. The option and non-use value is the same across the MAR exc. SRL and MAR inc. SRL scenarios, as the project impacts the same proportion of Victorian households irrespective of the SRL North connection to Melbourne Airport.

5.6.5 Residual value

As discussed in Section 5.5, the residual value method applied within the economic appraisal considers the lower of the present value of the replacement cost at the end of the evaluation period, or the present value of the future stream of net benefits from the end of the evaluation period to the end of the economic life of the asset in line with DTF guidelines.

The lower of the above two approaches is the replacement cost method. Under this approach, the present value of residual asset value is between $1.0bn to $1.1bn, making up approximately 7 per cent and 11 per cent of the conventional benefits for MAR exc. SRL and MAR inc. SRL respectively.

6 Wider Economic Benefits

6.1 Overview

The conventional CBA is based on the assumption of perfect competition and lack of market imperfections. The presence of additional market imperfections (beyond those externalities typically identified in a conventional CBA) means that not all the impacts of changes in the marginal costs of travel are assessed in a conventional CBA. In addition, the cost of travel does not equate to the marginal social cost of transport supply. This divergence between price and marginal social cost gives rise to potential for additional impacts (benefits or costs) that are not captured in the conventional CBA.

These impacts, which have been traditionally excluded from 'conventional' CBA, are now commonly referred to as WEBs. Over the last decade, WEBs have entered the project evaluation framework for significant transport projects.

6.2 MAR WEBs

MAR will deliver transport network improvements that facilitate an increase in accessibility to Melbourne Airport, as well as enhance connectivity between the airport and key activity and economic centres such as Sunshine, Parkville, Monash and Dandenong. These improvements to transport network performance act to reduce the generalised cost of travel, particularly between employment centres, but also between where people reside and their place of work. In turn, this will result in the realisation of a range of WEBs, including:

- **Agglomeration (WEB1)** – MAR will support improved accessibility to Melbourne Airport and also improve connectivity between Melbourne Airport and key activity and economic centres by promoting mode shift and reducing the generalised cost of travel across the network.
- **Labour market deepening (WEB2)** – The reduction in the generalised cost of travel catalysed by MAR may encourage workers to take on additional hours or encourage the under-engaged and disengaged workforce into active employment. This increased labour supply, in turn, will create welfare benefits though additional tax revenue from income and payroll tax as well as through tax on the additional output created by businesses.
- **Output increase in imperfectly competitive markets (WEB3)** – In an imperfectly competitive market, prices may exceed production costs and output may be less than optimal. WEB3 arises from a reduction in transport costs due to MAR, allowing for an increase in production or output of goods or services that use transport.
- **Improved competition (WEB4)** – This is considered minimal in countries with a highly competitive market like Australia. Therefore, this benefit is not included in this economic appraisal.

The evaluation of WEBs for the Project Case has been undertaken in accordance with guidance provided in the ATAP T3 guideline.

The WEBs descriptions are shown in Table 16.

Table 16: Wider economic benefit descriptions

Benefit type	Description
WEB1 – Agglomeration economies	'Agglomeration economies' refers to benefits which flow to firms and workers located in close proximity (or agglomerating). Agglomeration economies arise from economies of scale and scope. The three principal sources of agglomeration economies include input sharing (including labour market pooling), knowledge / technological spillovers and output sharing. By lowering travel costs and enabling land use densification, transport projects can have a significant impact on agglomeration / density (e.g. effective density). Lower generalised costs or greater physical density of employment results in enhanced accessibility / connectivity which facilitates increased formal and informal interaction. This in turn enables increased input and output sharing and, more importantly, knowledge spillovers, the principal source of agglomeration economies in the modern economy. Agglomeration economies can be facilitated by either improving connectivity between employment dense areas (proximity effects) or enabling land use changes which lead to more jobs locating in areas that are already employment dense (cluster effects) or both.
WEB2 – Labour market deepening	Labour market deepening refers to two distinct impacts: • WEB2a – Increased labour supply • WEB2b – Move to more or less productive jobs. **WEB2a – Increased labour supply** In deciding whether to work, a worker weighs, among other factors, travel costs associated with the job against the wage received from the job. Lowering of transport cost may encourage workers to work longer hours or encourage the under-engaged and disengaged workforce into active employment. This may result in an increase in overall labour supply in the economy. This increased labour supply, in turn, will result in increased value added or gross domestic or state product (GDP / GSP). The marginal change in tax receipts from changes in labour supply (e.g. WEB2a) is then estimated for inclusion in the economic evaluation. **WEB2b – Move to more (or less) productive jobs** 'Move to more (or less) productive jobs' refers to how increased employment opportunities within a worker's travel budget may provide employers with access to a broader range of employees (to recruit the most suitable skills), and employees with access to a wider range of jobs better suited to their skills. Better skills matching / alignment, in turn, results in workers being more productive. Ultimately, this will lead to an increase in GSP and GDP and associated marginal change in tax receipts. Note that WEB2b can only be estimated where land use impacts of the transport intervention are available. This is because the benefit is fundamentally driven by land use changes (i.e. jobs moving from lower to higher productivity areas). As highlighted in Section 2.3, the land use impacts of MAR are not substantive and therefore, WEB2b is excluded from the economic analysis. A detailed explanation of land use impact estimation for MAR is provided in Appendix 5: Demand modelling.
WEB3 – Output increase in imperfectly competitive markets	In an imperfectly competitive market, prices may exceed production costs and output may be less than optimal. 'Output change in imperfectly competitive markets' arises from a reduction in transport costs allowing for an increase in production or output of goods or services that use transport. The existence of price-cost mark-up under imperfect competition implies that consumers are willing to pay more than the marginal social cost of producing the additional output such that there is a net gain, or welfare benefit, that accrues to the firm as additional profit. This impact is not captured in conventional CBA as it assumes that markets are perfectly competitive.

Benefit type	Description
WEB4 – Increased competition	Any transport project which makes an area significantly more accessible has the potential to increase market competition in that area. Significant enhancement in accessibility, and therefore reduction in transport cost, allows new firms to enter the market and effectively compete with incumbent firms. The theory behind WEB4 is that reducing transport costs opens up areas to increased competition, driving production efficiencies, which in turn results in lower prices for consumers. Any transport projects in developed countries, which are characterised by reasonable transport access, are unlikely to generate sufficiently significant travel cost savings to have any material impact on competition. Consequently, WEB4 is not discussed in this economic appraisal.

6.3 Key findings

6.3.1 Overview

As highlighted in Table 16, the following sections discuss the benefits associated with WEB1, WEB2a and WEB3 attributable to MAR.

The results are summarised in Table 17.

Table 17: Wider economic benefits of MAR (4 per cent discount rate)

Category	MAR exc. SRL in the Base Case[1] (P10 to P90)	MAR inc. SRL in the Base Case[1] (P10 to P90)
WEB1 – Agglomeration economies	$2.2bn - $2.8bn	$1.3bn - $1.7bn
WEB2 – Labour market deepening	$0.0bn - $0.0bn	$0.0bn - $0.0bn
WEB3 – Output increase in imperfectly competitive markets	$0.3bn - $0.4bn	$0.1bn - $0.2bn
Total Wider Economic Benefits	**$2.4bn - $3.2bn**	**$1.5bn - $1.9bn**

1. *Monetary values presented in Q1 2020. Costs and benefits discounted to 2022.*

6.3.2 WEB1 – Agglomeration economies

Agglomeration economies make up the largest component of WEBs attributable to MAR. The present value of agglomeration economies ranges from $2.2bn to $2.8bn for MAR exc. SRL and from $1.3bn to $1.7bn for MAR inc. SRL.

Quantification of agglomeration economies relies on the concept of ‘effective density’. This describes the (weighted) number of jobs accessible within a given travel impedance. The calculation of effective density uses a decay function to assign high weights to ‘near’ jobs and low weights to ‘far’ jobs, and is influenced by:

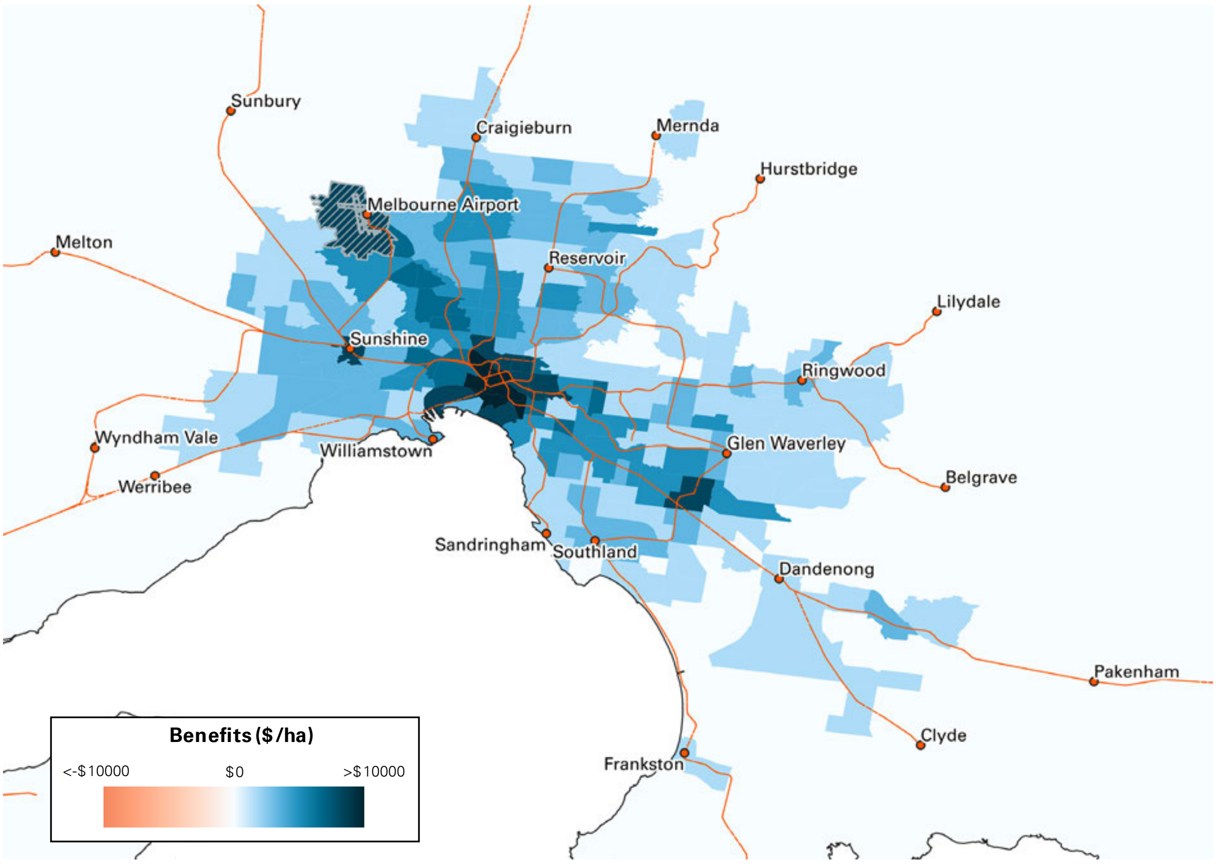
- proximity effects, which refer to increases in effective density enabled by reductions in travel impedance
- cluster effects, which refer to increases in effective density enabled by increases in physical density - the number of jobs within a given unit of area (e.g. jobs per square kilometre).

The introduction of MAR leads to improvements in effective density across metropolitan Melbourne, with the impact most pronounced in the south-east of Melbourne along the MTP corridor, in proximity of Sunshine and to the north-west of Melbourne near the airport. This is driven by mode shift from road to rail, acting to reduce road congestion and improving the performance of the entire transport network.

Whilst increases to effective density are apparent across Melbourne, the agglomeration benefits are most pronounced around the CBD and inner Melbourne, as well as at Melbourne Airport and Sunshine, due to the high concentration of employment in these areas. Considerable agglomeration benefits are also observed in the south-east of Melbourne, mirroring the improvements in effective density. These impacts are most pronounced in later years, at which point increasing congestion on the network results in more pronounced travel time savings for more road users, yielding higher agglomeration benefits.

Figure 21 shows the estimated concentration of agglomeration benefits (dollars per hectare) attributable to MAR in the year 2056 for MAR exc. SRL.

Figure 21: Concentration of agglomeration benefits in 2056 (MAR exc. SRL in the Base Case)[18]



When the SRL North connection to Melbourne Airport is considered, there is a considerable reduction in effective density improvement along the SRL East and SRL North corridor, as well as in the outer east, north-west and south-east of Melbourne. Overall, the magnitude of effective density improvements is significantly less across Melbourne, driven by the relatively muted incremental impact on road travel times delivered by MAR in this scenario.

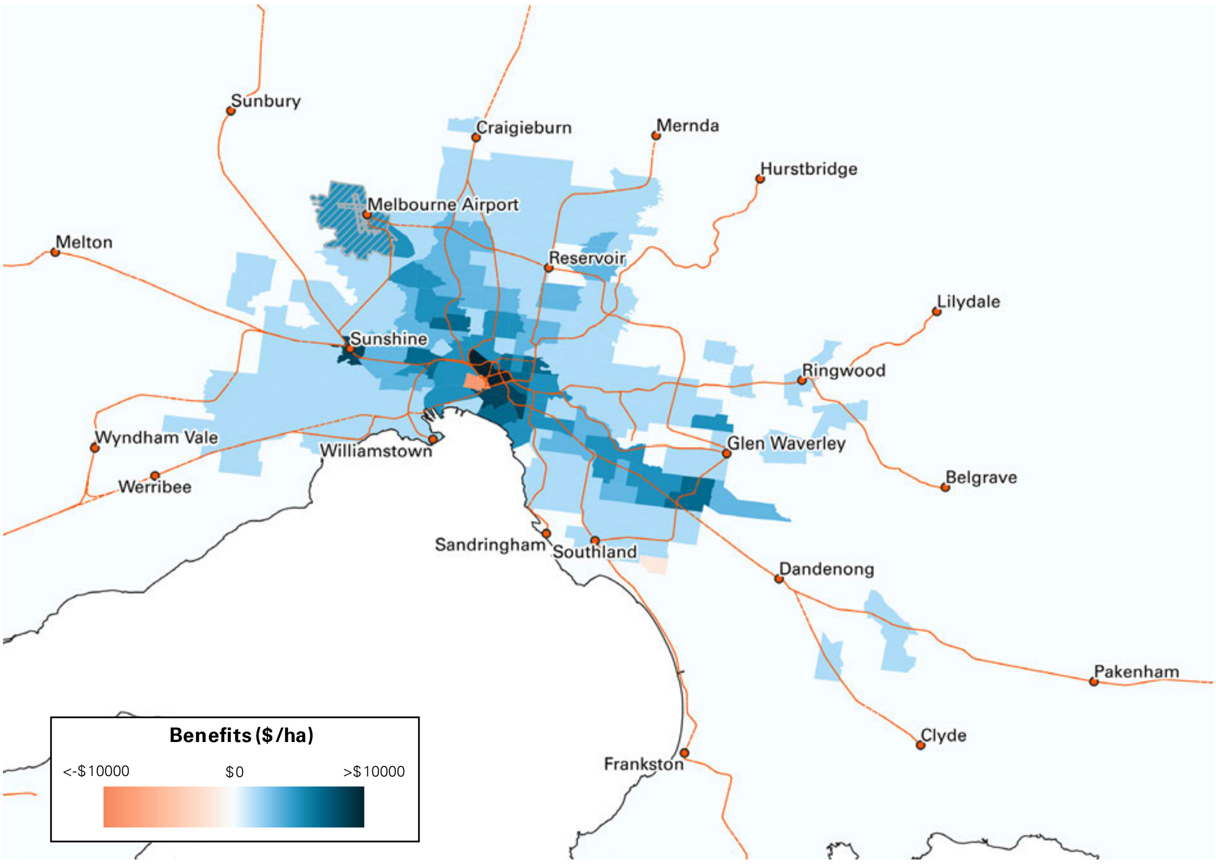
As a result, the agglomeration benefits are significantly less pronounced, particularly adjacent to the SRL East and SRL North corridor and further south-east along the MTP corridor. The CBD and Sunshine

[18] While the estimation of WEBS is undertaken at a TZN level, the result is presented as Statistical Areas Level 2 (**SA2s**) level to smooth out localised model noise.

remain the most concentrated area for agglomeration benefits due to the density of employment in these areas.

Figure 22 shows the estimated concentration of agglomeration benefits (dollars per hectare) attributable to MAR in the year 2056 for MAR inc. SRL.

Figure 22: Concentration of agglomeration benefits in 2056 (MAR inc. SRL in the Base Case)[19]



6.3.3 WEB2 – Labour market deepening

Labour market deepening benefits were quantified in line with the ATAP T3 guideline. As highlighted in Table 16, only WEB2a (increased labour supply) has been quantified.

Benefits from an increased labour supply are derived from improvements in the logsum generalised cost of travel of commuting trips, which approximates the lowest travel time of the car and public transport between an origin and destination zone. In peak periods – during which most commuting trips are made – the lowest travel time, particularly to areas of increasingly concentrated employment such as the CBD and key National Employment and Industry Clusters (NEICs), is via train. Whilst MAR links a number of these precincts, including Dandenong, Monash, Parkville and Sunshine, to Melbourne Airport, it does not materially increase peak commuting capacity or improve travel times relative to the Base Case. As a result, the benefits that accrue from an increased labour supply are negligible.

The present value of benefits from increased labour supply ranges from $13m to $17m for MAR exc. SRL and from -$5m to -$4m for MAR inc. SRL.

[19] Ibid.

6.3.4 WEB3 – Output increase in imperfectly competitive markets

The reduction in transport costs catalysed by MAR results in the increased production of goods and services. The net gain to firms this generates ranges from $300m to $400m for MAR exc. SRL and from $100m to $200m for MAR inc. SRL.

7 Macro-economic impact

7.1 Overview

Conventional economic appraisal does not consider the economy-wide impact of an investment on productivity, the labour market and other economic variables, such as employment, Gross Domestic Product (**GDP**) and Gross State Product (**GSP**). While these impacts are not intended to contribute to the calculation of a project's NPV or BCR, these provide an alternative perspective on the total economic contribution of MAR on the Victorian and national economies.

7.2 Macroeconomic impact of MAR

MAR represents a significant investment that will have a material impact on the capital stock of Victoria as well as overall employment. MAR will enable employment and economic growth opportunities at a regional, state and national level. It is therefore relevant to assess the project's total economic contribution to obtain an understanding of how MAR will affect the broader economy.

The economy-wide impact of MAR was assessed using KPMG-SD, a regional CGE model of the Australian economy. This approach assesses the total impact of MAR on the labour market, including flow-on effects and other key markets. As such, the analysis estimates the economy-wide impacts of the proposed infrastructure investment and the operational phase at the state and national levels.

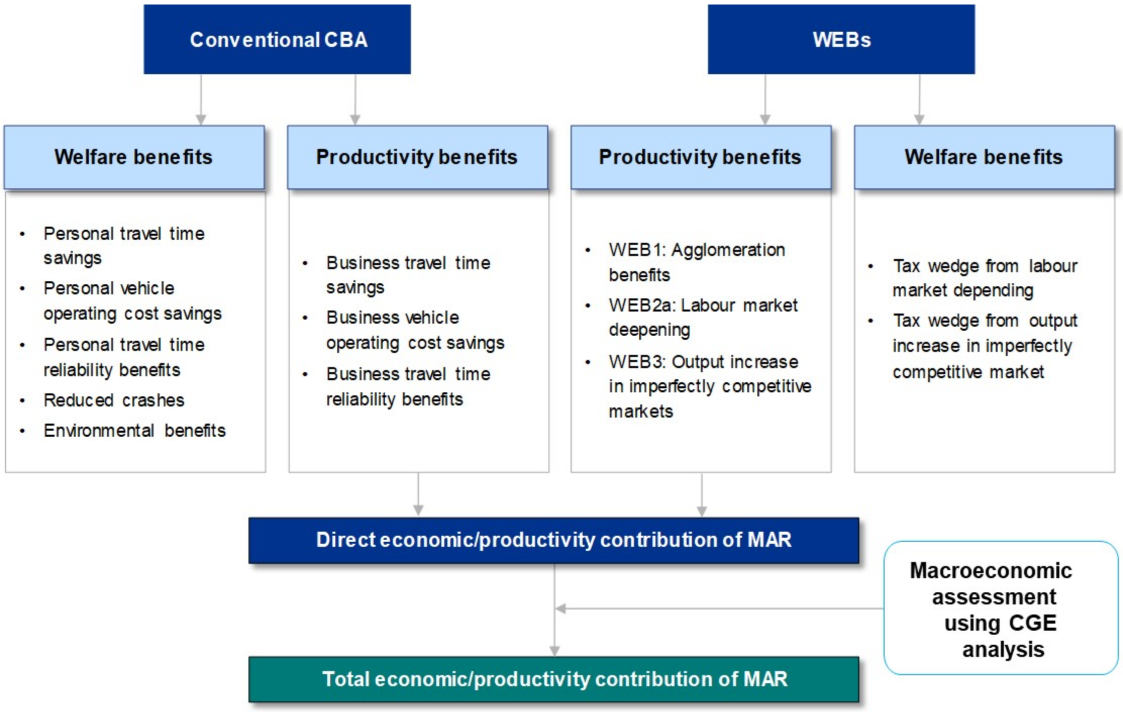
The framework, inputs and processes for assessing the macroeconomic impact of MAR is illustrated in Figure 23. Further detail regarding the methodology and the KPMG-SD model is provided in Appendix C.

The economy-wide analysis is divided into two distinct project phases and these apply various metrics as inputs when simulating the macroeconomic impact:

- **Construction phase** – This assesses the impact of the construction of MAR by applying the planned capital expenditure in rail transport infrastructure in Melbourne. These effects are largely transient as the construction activity is temporary.
- **Operational phase** – This assesses the ongoing effects of MAR once operations commence. These effects are simulated by applying the planned operational expenditure, changes in demand for rail transport by firms and households, changes in demand for road transport and related road vehicle expenditure, time savings for road and rail users, and WEBs.

The inputs applied in the two phases can be considered the direct effects of MAR. These inputs are taken from the MAR financial analysis, CBA and WEBs. The effects on other parts of the economy due to MAR are considered the indirect effects. The total effects are summarised by variables such as production (e.g. GDP, GSP etc.), employment, household income and consumption, and government tax revenue.

Figure 23: Framework for assessing the macroeconomic impact of MAR



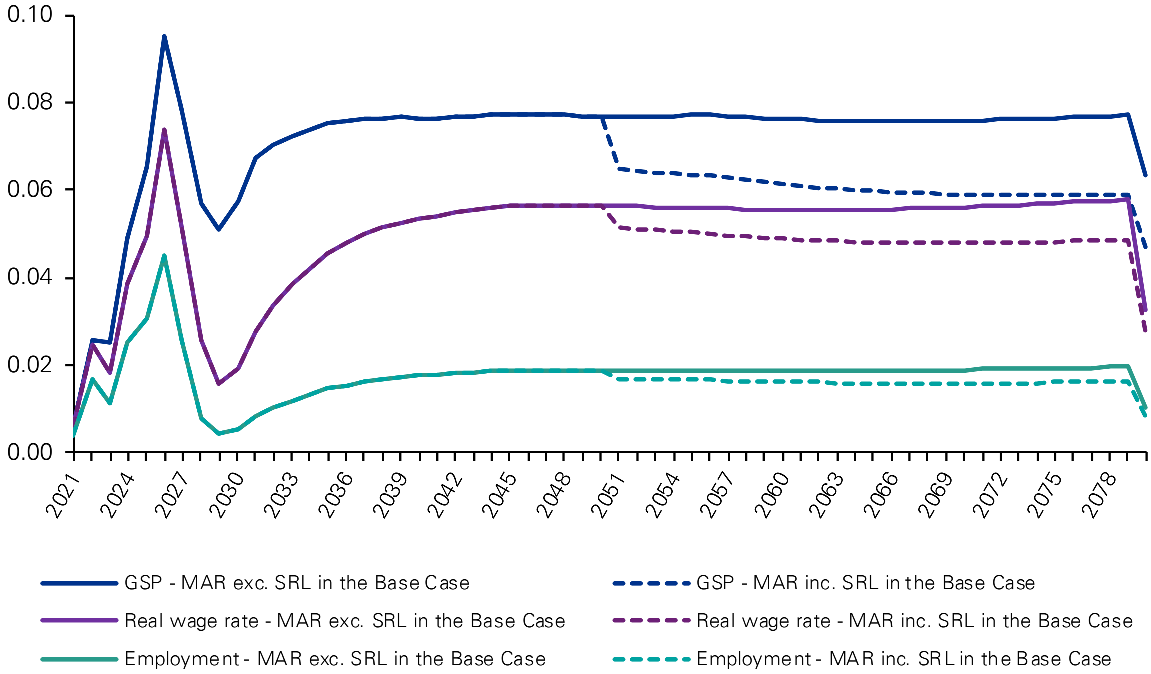
7.3 Key findings

7.3.1 Economic output and employment impacts

Figure 24 shows the economy-wide effects of MAR on GSP, the average real wage rate and employment for Victoria. The key observations include:

- During the construction phase, the investment stimulus increases labour demand and decreases the unemployment rate, which in turn puts upward pressure on real wage rates. The increase in employment causes real GSP to increase with the peak observed in 2026. This coincides with the average real wage rate peak in 2026.
- As construction activity winds down, the average real wage rate starts to fall from 2027. The fall in construction activity causes the unemployment rate to rise, reflecting the fall in aggregate employment, but remains slightly above baseline in the long-run due to the expansion in economic activity in Victoria.
- In the long-run, the main benefits of MAR are in the form of higher GSP and real wage rates with smaller benefits in employment. Note that the tax imposed in Victoria in the final year (to pay for the Victorian Government's share of the debt associated with the cost of MAR) causes consumption and therefore GSP to fall noticeably.
- Real GSP and employment are lower under the scenario where the SRL North connection to the Melbourne Airport is included in 2051.

Figure 24: Effect of MAR on Victorian GSP, real wage rate and employment, % deviation from baseline



***Source**: KPMG-SD simulations*

Table 18 show the impacts of the project on economic output and employment during the main construction phase and the operational phase considering a 4 per cent discount rate.

In net present value terms, MAR exc. SRL generates an additional $17.9bn in GSP while MAR inc. SRL generates an additional $16.2bn in GSP. At the peak of construction, real GSP for Victoria is $0.6bn above baseline and real GDP is $0.6bn above baseline. The GDP gain is slightly lower than the GSP gain reflecting the relocation of some jobs to Victoria from the rest of Australia in response to higher demand and productivity generated by the MAR project.

On an annual basis, the peak employment impact of MAR occurs during the construction phase. The large jump in investment generates an increase in both real wage rates and aggregate employment. The delivery of MAR will support up to 8,000 direct and indirect jobs during construction. These jobs will range from engineers and subject matter experts planning behind the scenes, to construction workers and local suppliers who will help to deliver the project on site.[20] This level of investment will increase the size of the economy and job market. Across the state, net employment in Victoria increases by an average of 730 full-time equivalent (**FTE**) workers per annum during the construction phase with a peak of 1,880 FTE workers. An additional 1,210 FTE jobs are generated within Victoria at the peak of the operational phase of MAR exc. SRL compared with an additional 980 FTE jobs for MAR inc. SRL. The corresponding employment effects are higher for Australia during the construction phase and lower during the operational phase.

During the construction phase there is an increase in employment (and fall in unemployment rates) in all regions as the labour market responds with a lag to the strong increase in investment due to the project. At the national level, the increase in employment during the construction phase is higher than Victoria despite generating a smaller GDP gain. The employment increase and GSP reduction in the rest of Australia reflects the lagged response of wage rates to changes in labour demand. Thus, the reduction in rest of Australia GSP mainly reflects a smaller capital stock. Once wage rates have fully

[20] RPV analysis on behalf of DoT.

responded to the changes in labour demand during the operational phase, the GSP and employment responses are both negative outside of Victoria.

During the operational phase the national unemployment rate returns to baseline, which is mainly accommodated by the unemployment rate in the rest of Australia returning to baseline as MAR leads to increased long-run economic activity in Melbourne and Victoria. As a result, unemployment rates in Melbourne and Victoria remain above baseline.

Table 18: Economy wide impact (4 per cent discount rate)

		Construction phase	Operational phase	Total
MAR exc. SRL in the Base Case				
Gross Regional / State / Domestic Product (present value)	Greater Melbourne	$2.5bn	$14.5bn	$17.1bn
	Victoria	$2.7bn	$15.2bn	$17.9bn
	Australia	$2.5bn	$13.2bn	$15.7bn
Jobs number in peak year	Victoria	1,880	1,210	n/a
	Australia	2,100	470	n/a
MAR inc. SRL in the Base Case				
Gross Regional / State / Domestic Product (present value)	Greater Melbourne	$2.5bn	$12.9bn	$15.4bn
	Victoria	$2.7bn	$13.6bn	$16.2bn
	Australia	$2.5bn	$11.7bn	$14.1bn
Jobs number in peak year	Victoria	1,880	980	n/a
	Australia	2,100	380	n/a

Appendix C provides a detailed description of the economy-wide effects of the MAR project.

7.3.2 Economic return on investment

An alternative approach to assessing the economic contribution of the investment in MAR is to assess the return on investment against the funding cost of the investment. Two separate KPIs have been developed at both the state and national level to assess the value of investing in MAR to bolster and catalyse growth in the Victorian and Australian economy. This is particularly relevant given the current economic uncertainty:

- **KPI 1** – compares the total cost (capital expenditure and benchmark borrowing cost) against the real increase in GSP / GDP
- **KPI 2** – compares the financing cost (benchmark borrowing cost) against the marginal increase in tax receipts (as a result of increases to GSP / GDP).

The KPIs are summarised in Table 19.

Table 19: CGE KPIs[21]

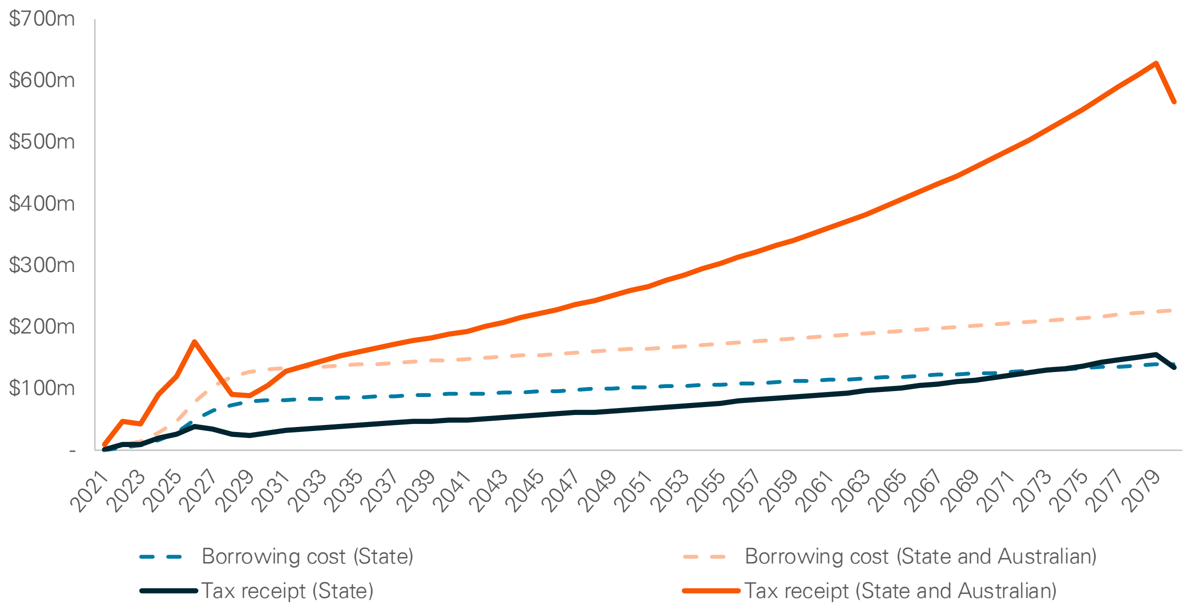
KPI	MAR exc. SRL in the Base Case	MAR inc. SRL in the Base Case
KPI 1		
Victoria (Δ GSP / State total cost)	5.9	5.0
Australia (Δ GDP / State + Australian total cost)	2.9	2.4
KPI 2		
Victoria (Δ State tax receipts / State interest)	0.8	0.7
Australia (Δ State + Australian tax receipts / State + Australian interest)	1.9	1.6

The KPI 1 results in Table 19 highlight the economic return on investment compared with the funding cost. This analysis shows that the Victorian economy will be better off by 5.9 and 5.0 times the cost of investment (after allowing for borrowing costs) for MAR exc. SRL and for MAR inc. SRL respectively. Similarly, the national economy will be better off by 2.9 and 2.4 times the cost of investment for MAR exc. SRL and for MAR inc. SRL respectively.

This increase in economic activity will boost Victorian and Australian government tax receipts. The KPI 2 results in Table 19 show the increase in tax receipts is sufficient to cover the combined Australian and Victorian government borrowing costs, with a minor shortfall when only considering the Victorian Government borrowing costs.

The relationship between borrowing costs and tax receipts over time for the Victorian and Australian governments is highlighted in Figure 25 for MAR exc. SRL.

Figure 25: Borrowing costs against tax receipts (MAR exc. SRL in the Base Case)



[21] The analysis assumes that 100 per cent of the investment cost is borrowed and is split evenly between the Victorian and Australian governments. Interest payments are based on the 10-year TCV bond rate and 30-year Commonwealth bond rate for the Victorian and Australian governments respectively. The KPIs were calculated using total cost (capital expenditure and benchmark borrowing cost) and the real increase in GSP / GDP.

8 Economic analysis considering uncertainty

The economic analysis undertaken for major transport infrastructure business cases is typically reflected through the reporting of a single 'headline' BCR. However, due to the range of intrinsic uncertainties associated with cost planning, transport modelling and a range of other assumptions (including long-term projections of land use and the future transport network configuration), the presentation of a single economic result fails to adequately capture the possibility of a range of possible scenarios and economic outcomes.

The impact of changes in key inputs and assumptions was tested through an uncertainty analysis, comprising both probabilistic analysis and scenario testing.

8.1 Probabilistic analysis

Monte Carlo simulation was undertaken to analyse the impact of key uncertainties on the NPV and BCR. The need for this approach is driven by uncertainties associated with key inputs, assumptions and the nature of air passenger travel. To account for this, an input distribution was considered for the following economic parameters:

- **Air passenger value of time**: The underpinning economic metrics associated with air passenger value of time (**AVOT**) differ from other transport users. Research indicates that the standard value of travel time (**SVOT**) may underestimate the AVOT, such that air passengers are less sensitive to the transport fare associated with travelling to and from the airport.[22]
- **Public transport expansion factors**: The outcome of the economic appraisal is critically dependent on the expansion factors considered within the appraisal. The central public transport expansion factors considered are derived based on 2018 Myki data provided by DoT as detailed in Section A.1.3.
  - **Upside potential**: More passengers use Melbourne Airport during school holiday weekday peak periods and off-peak demand is more concentrated on weekends and public holidays for air passengers, relative to standard public transport travel.[23] Given that VITM models the standard working weekday, air passengers require higher expansion factors and therefore accrue more economic benefits across the year relative to standard public transport travel.
  - **Downside potential**: There is an increasing shift to remote working, particularly in professional industries, which has been catalysed by the impacts of COVID-19 (see Section 8.2.3). The potential outcome of this is that the current travel patterns and volumes coded in VITM for a standard working weekday, which is calibrated against observed data, does not reflect travel patterns and volumes moving forward. Given the potential for larger proportions of the population choosing to work remotely, VITM may currently overstate benefits. A lower

[22] KPMG (2019). *Value of time for airport travel.*
[23] KPMG (2019). Analysis based on traffic arrival and departure data collected at the terminals between July 2016 and June 2017.

expansion factor can be used as a proxy to test for this in the interim, prior to VITM being calibrated against future travel data.

- **Willingness to pay for option and non-use:** The central value used for willingness to pay per household (**WTP per household**) for option and non-use is derived by taking the WTP per household for a train service (in this case MAR) less the WTP per household for a bus service (the cessation of the Melbourne City Express SkyBus). In practice, whilst this may approximate the WTP per household for people living near Southern Cross, households further in the south-east and out towards the north-west along the MTP corridor may not ascribe option or non-use value to the Melbourne City Express SkyBus, due to the lack of proximity from these areas. Therefore, their WTP per household would approximate that for a new train service only.

The uncertainty in WEBs was also considered as part of the probabilistic analysis. Furthermore, costs are reported in ranges for this appraisal, taking into consideration the risk-adjusted cost distribution derived from the financial analysis outlined in Chapter 10 of the Business Case. In particular, for capital costs, this captures the upside risk and thus provides a more robust estimate of the NPV and BCR.

The key uncertainties and their corresponding distribution parameters used for the Monte Carlo simulation are provided in Table 20.

Table 20: Uncertainties and assumptions used in the Monte Carlo simulation

Uncertainties	Distribution parameters[3, 4]	Distribution	Truncation points (if applicable)
Peak to annual factor (PT) – all	μ = 241 P5 = 217 (0.9μ) – pre-truncation P95 = 265 (1.1μ) – pre-truncation	Normal	± 10 per cent of μ
Non-peak to annual factor (PT) – all	μ = 354 P5 = 319 (0.9μ) – pre-truncation P95 = 390 (1.1μ) – pre-truncation	Normal	± 10 per cent of μ
Non-business VOT – airpax[1]	P2.5 = $17.05 (SVOT) P95 = $30.23 (AVOT)	Log-normal	
Business VOT – airpax[1]	P2.5 = $55.32 (SVOT) P95 = $71.03 (AVOT)	Log-normal	
Option and non-use willingness to pay	μ = $202 (willingness to pay for option and non-use of train service less bus service)[5] P97.5 = $407 (willingness to pay for option and non-use of train service)[5]	Log--normal	
WEBs	P5 = 0.8μ – pre-truncation P50 = μ P95 = 1.2μ – pre-truncation	Normal	± 20 per cent of μ
Discount rate	4 per cent (real)	Discrete	
Capital cost[2]	Aligned to financial cost distribution using the P10, P50 and P90 risk-adjusted outputs	Aligned to financial cost distribution	
Operating, maintenance and renewals cost[2]	Aligned to financial cost distribution using the P10, P50 and P90 risk-adjusted outputs	Aligned to financial cost distribution	
Avoided Melbourne City Express SkyBus costs[2]	Aligned to financial cost distribution using the P10, P50 and P90 risk-adjusted outputs	Aligned to financial cost distribution	

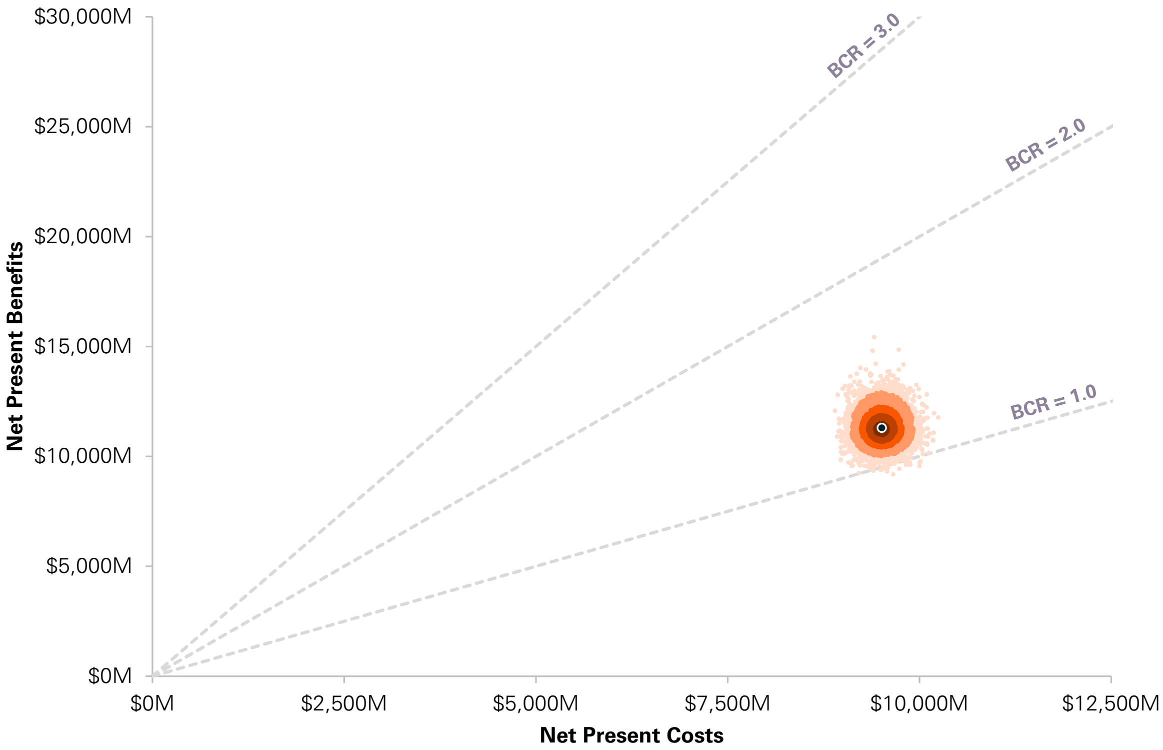
1. *A correlation coefficient of 0.9 has been considered for non-business and business value of time to reflect the propensity of these variables to move together in direction and magnitude.*

2. *A correlation coefficient of 0.9 has been considered for the cost distributions to reflect the propensity of these variables to move together in direction and magnitude.*
3. *The symbol 'μ' denotes the mean / expected value of the distribution. P'X' denotes a percentile and reflects that there is an X per cent chance that the variable being tested will fall below this value.*
4. *All monetary values are presented in 2020 dollars.*
5. *Currency conversion has been undertaken to convert the original British pound sterling (GBP) parameters (presented in the UK Department for Transport – Transport Analysis Guidance (TAG) documentation) into Australian dollars (AUD).*

An overview of the probabilistic results for MAR exc. SRL and MAR inc. SRL is presented in Figure 26 and Figure 27. A detailed breakdown of economic results from the probabilistic analysis is presented in Section 9.

Figure 26: Monte Carlo simulation results considering a 4 per cent discount rate (MAR exc. SRL in the Base Case)

Figure 27: Monte Carlo simulation results considering a 4 per cent discount rate (MAR inc. SRL in the Base Case)



8.2 Uncertainty regarding COVID-19

The MAR Business Case and associated economic appraisal were developed in 2020 and 2021. During this time, the COVID-19 pandemic and necessary measures implemented to slow its spread have led to unprecedented economic challenges. At the time of writing, these measures included:

- restrictions on domestic and international travel for Australian citizens
- all inbound travellers, except those from New Zealand, subject to mandatory 14-day quarantine
- 'last step' restrictions in Victoria which include caps on people densities indoors, and restrictions regarding social gatherings, religious gatherings, hospitality, community facilities and recreation, as well as ongoing limitations to on-site and office working.

By the end of 2021, most of these restrictions have been lifted in line with *Victoria's Roadmap: Delivering the National Plan*. In particular, international travel restrictions have been lifted primarily for fully-vaccinated travellers. Remaining gathering, capacity and density limits in social, work, retail, hospitality and entertainment contexts as well as at major events were lifted at the end of November 2021.

Despite these relaxing of restrictions, the full length and severity of the economic contraction remains uncertain. The observed impacts of COVID-19 on the economy, the ensuing effects on work and travel patterns around Melbourne and the potential implications for MAR are discussed below.

8.2.1 Population impact

Migration is a key driver of population growth in Australia and is expected to decline significantly as a result of the travel restrictions and border closures induced by COVID-19.

Ongoing constraints to work, study and visitor conditions will have a considerable impact on migration to Australia. The Commonwealth Treasury predicts that net overseas migration will fall from 194,000 in FY2019 to the lowest rate in more than a century, as travel restrictions prevent people coming to Australia and temporary migrants leave the country. Overall, more people are expected to migrate out of Australia in FY2020 and FY2021, with net outflows of 97,000 and 77,000 respectively.[24] However, net overseas migration is expected to lift to pre-COVID-19 levels over the next four years.[25] International students are also expected to gradually return to Victoria in late 2021 and early 2022 under the International Student Arrivals Plan.

The weaker economic outlook is also expected to contribute to a decline in the fertility rate. The combined impact of a lower fertility rate and migration level is anticipated to slow the rate of population growth to 1.2 per cent for 2019-20 (compared to 1.5 per cent in 2018-19[26]), and then further to 0.2 percent in 2020-21 – the lowest annual rate of growth since 1916-17.[27]

8.2.2 Economic impact

COVID-19 has dramatically impacted the livelihoods of Victorians. The most visible impacts during the lockdowns have included the shutdown of non-essential retail trade, the hospitality industry and arts and recreational venues.

Historically, immigration has been a strong driver of recovery following economic shocks, with immigrants accounting for over 80 per cent of employment growth between July 2011 and July 2016 post the Global Financial Crisis (GFC).[28] However as highlighted above, the nature of the crisis is likely to result in an extended period of subdued migration, which will have considerable impacts on consumer spending and the housing sector, as well as the supply of skilled labour.

While the longer-term implications of the crisis have yet to be fully realised, current data suggests that the unemployment rate in Australia has declined to 5.2 per cent as of October 2021, an improvement from a high of 6.9 per cent in October 2020.[29] This reflects some of the positive impact of loosened restrictions on hard-hit sectors such retail and hospitality. The labour force participation rate also recovered slightly to 64.7 per cent by October 2021 after falling to a low of 64.1 per cent in May 2020.

Overall, the globally synchronised slowdown is expected to dampen economic activity, rates of population growth and consumer spending in the short-term, but there are signs of recovery as vaccination rates increase internationally. Domestically, stimulus packages and targeted support from governments have also helped to restore demand as restrictions are lifted and accelerate economic recovery. The Commonwealth Treasury projects GDP to grow 2.5 per cent in 2022, signalling a return to levels of growth observed pre-COVID-19, after a fall of 3.75 per cent in 2020.30

[24] Australian Bureau of Statistics, Labour Force, Australia, October 2020, (2020).
[25] Ibid.
[26] Australian Bureau of Statistics (2019). *Australian Demographic Statistics, Jun 2019.*
[27] Commonwealth of Australia (2020). *Budget 2020-21: Budget Strategy and Outlook, Budget Paper 1 – October 2020.*
[28] McDonald, P. (2017). International migration and employment growth in Australia, 2011–2016. *Australian Population Studies*, *1*(1), 3-12.
[29] Australian Bureau of Statistics, *Labour Force, Australia, October 2020,* (2020).
[30] Commonwealth of Australia , *Budget 2021-22: Budget Strategy and Outlook, Budget Paper 1 – May 2021,* (2021).

8.2.3 Possible changes to mobility patterns

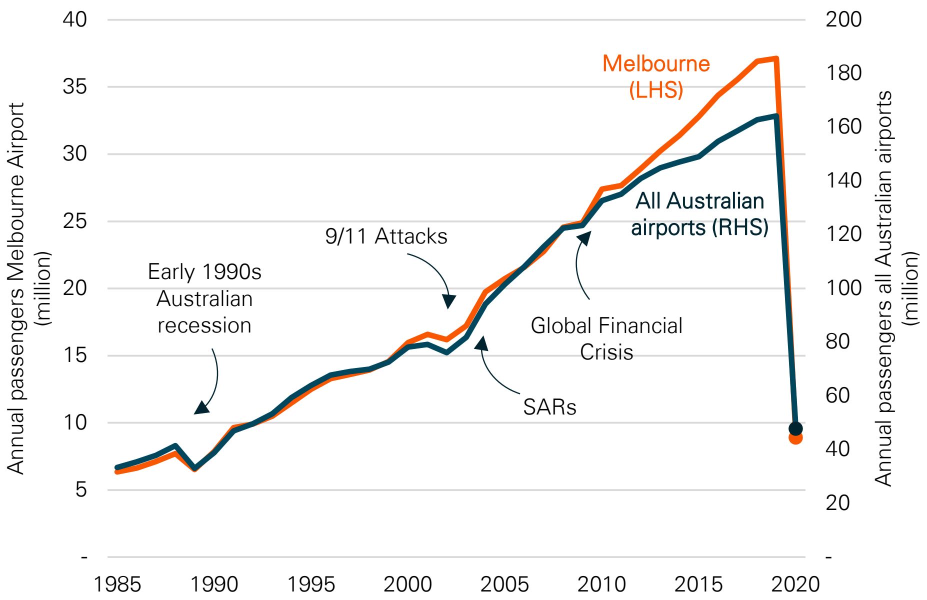
There is also uncertainty around how COVID-19 will impact mobility patterns over the longer term. As people shift to working from home or remote schooling where possible during the lockdown period, the share of active and private transport, and shorter local trips has increased.

How, and if, this period fundamentally affects the amount and way people travel and conduct business will only be made apparent in the years to come. It is possible that COVID-19 may lead to a changing of mindsets around remote working and grow the role technology can play in how we work. On the other hand, concerns around supply chain resiliency and minimising operational disruptions may catalyse a shift towards logistics networks with a larger local footprint.

8.2.4 Airport patronage impact

The nature and extent of longer-term implications that the current health crisis will have on the aviation industry remains unknown. Historically, air passenger traffic has recovered relatively quickly from short-term upheavals, with typical returns to pre-shock trend levels occurring within four years.[31] Global patterns indicating the resilience of the aviation industry are also reflected in airport traffic data from Melbourne Airport and Australian airport totals, which similarly show that, following recovery from major shocks, air passenger traffic continues to grow more or less in line with long-term trends (see Figure 28).

Figure 28: Air passenger traffic at Melbourne and all Australian airports, 1985–2020[32]



However, each shock is different, and the sharp decline in aviation activity caused by COVID-19 is significantly worse than those observed after the 9/11 attacks and the GFC. Specifically, Melbourne Airport experienced a 98.3 per cent drop in international passenger numbers and a 93.7 per cent drop in domestic passenger numbers in June 2020 compared to the same period a year earlier. Overall

[31] International Air Transport Association (2015). *Global Air Passenger Markets: Riding Out Periods of Turbulence.*
[32] BITRE (2020). *Airport Traffic Data 1985-86 to 2020-21*

traveller numbers were down 27 per cent from 37 million in 2018-19 to 27 million in 2019-20.33 This has declined to just over 6 million in FY2021.[34]

While the industry has historically been able to adapt its business model to new challenges and disruptions, it should not be assumed this will easily occur, as the regulatory environment and local market dynamics retain significant power on the industry's ability to weather shocks. Looking forward, the lifting of travel restrictions and federal support for the aviation and tourism industry is likely to restore some demand, however a weakened global economic outlook and continued uncertainty will likely soften airport patronage for several years.

8.2.5 Implications for MAR

While the length and magnitude of these headwinds is uncertain, many of these impacts will likely continue to be felt for some time. Despite these unknowns, it is possible that both airport patronage and road and public transport travel demand may be lower over the next few years, as international travel restrictions and the economic contraction may contribute to slowing employment and population growth in the years to come.

The combined impact of this is that land use (employment and population) may be delayed relative to the business as usual projections. Working from home rates may also increase with almost one third of jobs in Victoria remote workable. Airport patronage growth will also be impacted in the short term but based on the historical recovery of air travel to external shocks, it may return to pre-COVID trend within ten years. To test for this uncertainty and better understand the potential implications of the COVID-19 on the project, an additional COVID-19 sensitivity scenario has been considered as discussed in Section 8.3.

8.3 Scenario tests and economic sensitivities

The MAR economic appraisal horizon spans over five decades. Within this period, it is reasonable to expect changes in the supply of transport infrastructure and people's behaviour towards transport costs and accessibility. These uncertainties, which may materially impact the economic viability of the project, include future network supply changes, changes in travel behaviour, alternative fare structures, and potential variations in project scope.

Given the inherent uncertainties associated with the long-term projections underpinning the MAR economic appraisal, it is appropriate to consider the economic outcomes of a range of future scenarios via alternative Base Case and / or Project Case combinations. The following were considered as part of the scenario testing:

- COVID-19 sensitivity which considers the following assumptions[35]:
  - based on analysis undertaken by DELWP, population and employment are expected to be delayed by two years in early model years, increasing to a delay of four years by 2056 (for example, the growth originally forecast for 2020 is now expected to be realised by 2022, while 2052 growth levels are expected to be realised by 2056)

[33] Melbourne Airport (2020). *Melbourne Airport passenger performance FY19/20.* Retrieved from: https://www.melbourneairport.com.au/Corporate/News/Melbourne-Airport-passenger-performance-FY19-20
[34] Melbourne Airport, *Melbourne Airport passenger performance FY20/21.* (2021).
[35] Department of Transport (2020). *COVID-19 impacts on demand forecasts – sensitivity and scenario testing project analysis.* Note that air passenger assumptions are based on IATA and Qantas announcements and were agreed with RPV / DoT.

  - based on analysis undertaken by DoT and DJPR, 29 per cent of Victorian jobs are suited for remote work and those employed in these jobs are assumed to work from home for two to three days a week
  - air passenger numbers fall in the short term – with travel returning to 2019 levels by 2023 for domestic and short haul travel, and by 2024 for all travel – but by 2031, air travel forecasts are assumed to revert to pre-COVID levels.
- alternative fare structure of ***Redacted***
- including an intermediate station at Keilor East, which reflects the priced option discussed in Chapter 6 of the Business Case
- different alternative specific constant (**ASC**) in VITM airport module to test different user response assumptions to MAR – this test provides a 10 minute preference to rail as a mode choice for air passengers[37]
- prevalence of autonomous vehicles (**AVs**)[38]:
  - in a high automation, high private use (**PAV**) scenario which considers 35 per cent conventionally driven vehicles (**CDVs**) and 65 per cent privately owned AVs
  - in a high automation, high shared use (**SAV**) scenario which considers 21 per cent CDVs, 39 per cent privately owned AVs and 40 per cent shared, on-demand AVs.
- transport network pricing (**TNP**) options based on time of day, mode of transport and location – specifically, the TNP scenario tested considers an alternative pricing strategy for both road and public transport travel:
  - road pricing: $0.165/km
  - public transport (peak): $1.70 flag fall and $0.09/km
  - public transport (off-peak): $1.50 flag fall and $0.07/km.

More details on the modelled scenarios and the associated demand findings are provided in Appendix 5: Demand modelling.

A number of additional economic sensitivities were also considered which include:

- no growth in benefits beyond the final model year
- a 20 per cent decrease in public transport benefits
- a 20 per cent increase in public transport benefits
- a 20 per cent decrease in road benefits
- a 20 per cent increase in road benefits.

Economic results for the scenario tests and economic sensitivities are presented in Section 9.

36 ***Redacted***

37 The ASCs in the Airport Module account for the unobserved attributes not captured by the time and cost incurred by a user which impact air passenger mode choice. The use of alternative ASCs aims to test the variability of the unobserved user attributes on modelled results (e.g. sensitivity of mode share).

38 Note that all CDVs and AVs in these scenarios are electric vehicles.

9 Economic evaluation

9.1 Key evaluation metrics

This section provides a summary of the key economic performance measures that have been reported as part of the economic evaluation.

The following economic performance measures have been calculated to compare the economic viability of the Project Case against the Base Case as part of the CBA:

- **NPV** – The NPV gives an indication of the magnitude of net benefit to society, calculated by taking the difference between the present value of the total incremental benefits and the present value of the total incremental costs. Positive NPVs indicate an investment is desirable to society as a whole.
- **BCR** – The BCR is a measure of value for money for government expenditure, calculated by dividing the present value of total incremental benefits by the present value of the investment and recurrent operating and maintenance costs. It is of principal value when a government is considering spending scarce funds.

The benefits and operating costs are calculated over a 50 year evaluation period from project opening and have been discounted at a rate of 4 per cent (real). Capital costs are distributed across the construction and commissioning period and are discounted at 4 per cent (real).

9.2 Monetised costs and benefits

9.2.1 Key findings – Core

The economic evaluation results for MAR, considering a 4 per cent discount rate, are summarised in Table 21.

Under a holistic assessment including conventional benefits and WEBs, the BCR:

- ranges from 1.8 (P10) to 2.1 (P90) for MAR exc. SRL in the Base Case
- ranges from 1.1 (P10) to 1.3 (P90) for MAR inc. SRL in the Base Case.

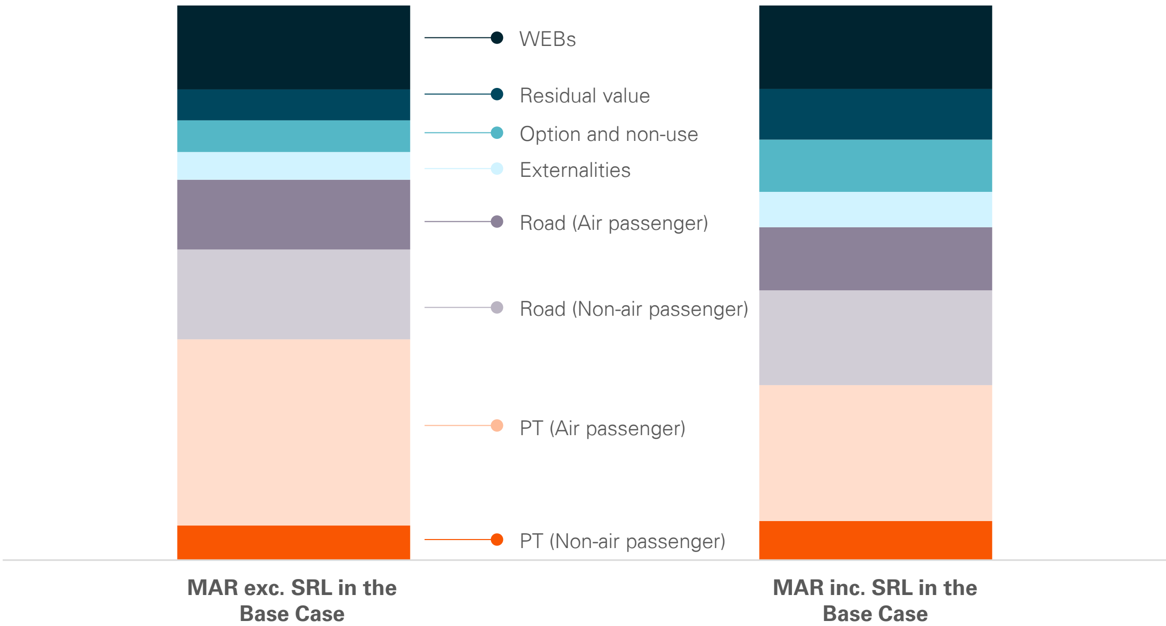
Table 21: Economic evaluation results for MAR (4 per cent discount rate)

Category	MAR exc. SRL in the Base Case (P10 to P90)	MAR inc. SRL in the Base Case (P10 to P90)
COSTS		
Capital costs	$8.1bn - $8.5bn	$8.1bn - $8.5bn
Operating, maintenance & renewal costs	$1.1bn - $1.3bn	$1.1bn - $1.3bn
TOTAL COSTS	**$9.2bn - $9.8bn**	**$9.2bn - $9.8bn**
BENEFITS		
Conventional economic benefits		
Public transport user benefits	$6.4bn - $8.5bn	$3.1bn - $4.0bn
Road user benefits	$5.0bn - $5.8bn	$3.0bn - $3.4bn
Externalities (non-user benefits)	$0.9bn - $0.9bn	$0.7bn - $0.7bn
Option and non-use value	$0.6bn - $1.6bn	$0.6bn - $1.6bn
Residual value of assets	$1.0bn - $1.1bn	$1.0bn - $1.1bn
Total conventional economic benefits	**$14.3bn - $17.4bn**	**$8.8bn - $10.5bn**
Wider Economic Benefits (WEBs)		
WEB1 – Agglomeration economies	$2.2bn - $2.8bn	$1.3bn - $1.7bn
WEB2 – Labour market deepening	$0.0bn - $0.0bn	$0.0bn - $0.0bn
WEB3 - Output increase in imperfectly competitive markets	$0.3bn - $0.4bn	$0.1bn - $0.2bn
Total Wider Economic Benefits	**$2.4bn - $3.2bn**	**$1.5bn - $1.9bn**
TOTAL BENEFITS	**$17.1bn - $20.3bn**	**$10.4bn - $12.3bn**
ECONOMIC INDICATORS		
Net Present Value (total benefits)	$7.5bn - $10.8bn	$0.9bn - $2.8bn
Benefit cost ratio (total benefits)	**1.8 - 2.1**	**1.1 - 1.3**

1. *All labour costs have been uplifted at the business productivity growth rate of 1.5 per cent within the economic appraisal*
2. *Operating, maintenance and renewal costs include savings from the cessation of the Southern Cross to Melbourne Airport SkyBus service*
3. *Monetary values presented in Q1 2020. Costs and benefits discounted at 4 per cent to 2022.*

The approximate composition of benefits is shown in Figure 29.

Figure 29: Benefit composition (4 per cent discount rate)



The largest component of benefits are public transport user benefits, accounting for approximately 40 per cent and 32 per cent of total benefits for MAR exc. SRL and for MAR inc. SRL respectively. The primary beneficiary of public transport benefits are air passengers, who comprise approximately 84 per cent of public transport benefits for MAR exc. SRL and approximately 78 per cent of public transport benefits for MAR inc. SRL.

Road user benefits arising from decongestion comprise the second largest component of the benefit stream, accounting for approximately 29 per cent of total benefits for MAR exc. SRL and approximate 28 per cent of total benefits for MAR inc. SRL. The primary beneficiary of road user benefits are non-air passengers, who comprise approximately 56 per cent of road user benefits for MAR exc. SRL and approximately 60 per cent of road user benefits for MAR inc. SRL.

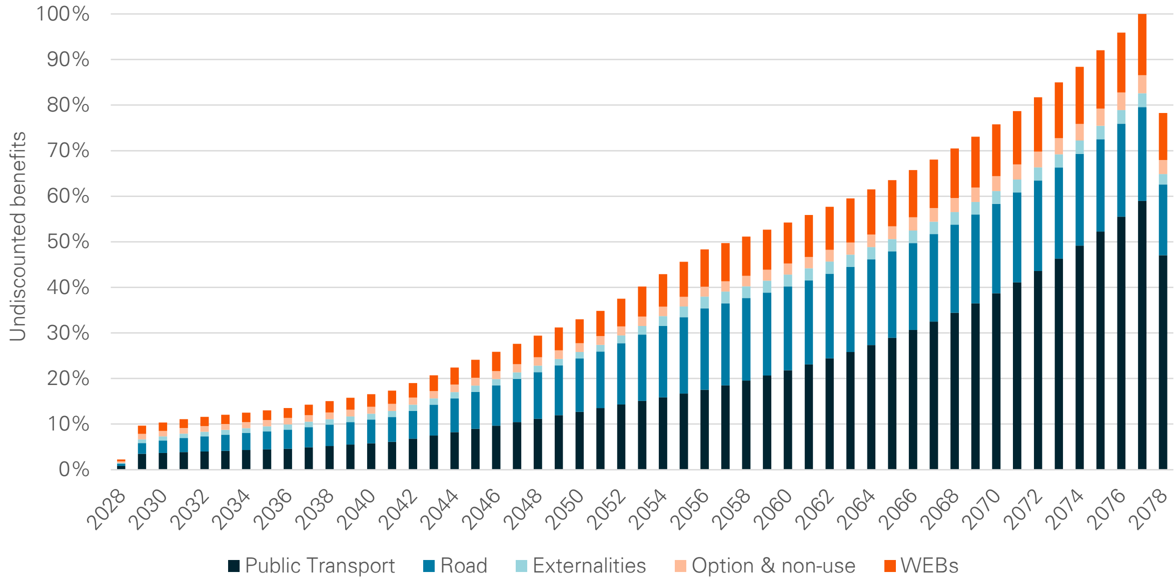
Other conventional benefit streams, including externalities, option and non-use value and the residual value of assets, account for approximately 16 per cent and 25 per cent of total benefits for MAR exc. SRL and for MAR inc. SRL respectively.

WEBs make up 15 per cent of total benefits for MAR exc. SRL and for MAR inc. SRL.

9.2.2 Benefit profile over time

Figure 30 shows the profile of undiscounted economic benefits (conventional benefits as well as WEBs) for MAR exc. SRL over the 50-year evaluation period.

Figure 30: Undiscounted expected benefit profile over time (MAR exc. SRL in the Base Case)[39]



Conventional benefits account for the majority of benefits attributable to MAR. This is driven by public transport and road user benefits, with the former becoming the primary source of economic benefits in later years.

9.2.3 Key findings – scenario tests and economic sensitivities

To assess the impact of changes in key inputs and assumptions, a number of alternative scenarios were modelled in VITM and a number of economic sensitivities were considered as highlighted in Section 8.3. The economic evaluation results for these are summarised in Table 22. Note that the following analysis considers conventional benefits only and excludes the SRL North connection to Melbourne Airport in 2051.

[39] The benefits observed in 2028 and 2078 are less than that observed in adjacent years. This is because the appraisal period considered is from late 2028 to late 2078 and the economics therefore captures a portion of the full calendar year of benefits in these two years.

Table 22: Economic results for MAR scenario tests and economic sensitivities, excluding the SRL North connection to Melbourne Airport in 2051 in the Base Case (4 per cent discount rate)

Scenario[1]	Economic benefits	Total costs	Net present value	Benefit cost ratio
Core	\$17.1bn - \$20.3bn	\$9.2bn - \$9.8bn	\$7.5bn - \$10.8bn	**1.8 - 2.1**
Core (excluding WEBs)	\$14.3bn - \$17.4bn	\$9.2bn - \$9.8bn	\$4.8bn - \$7.9bn	**1.5 - 1.8**
Scenario tests (excluding WEBs)				
COVID-19	\$12.9bn - \$15.8bn	\$9.2bn - \$9.8bn	\$3.3bn - \$6.3bn	**1.3 - 1.7**
Alternative fare structure	\$15.2bn - \$18.5bn	\$9.2bn - \$9.8bn	\$5.6bn - \$9.0bn	**1.6 - 2.0**
Keilor East	\$14.8bn - \$17.8bn	\$9.4bn - \$10.0bn	\$5.0bn - \$8.1bn	**1.5 - 1.8**
Modified ASCs	\$16.5bn - \$20.1bn	\$9.2bn - \$9.8bn	\$6.9bn - \$10.5bn	**1.7 - 2.1**
PAV	\$10.6bn - \$13.0bn	\$9.2bn - \$9.8bn	\$1.1bn - \$3.5bn	**1.1 - 1.4**
SAV	\$9.1bn - \$11.1bn	\$9.2bn - \$9.8bn	-\$0.5bn - \$1.6bn	**1.0 - 1.2**
TNP	\$13.9bn - \$17.1bn	\$9.2bn - \$9.8bn	\$4.3bn - \$7.6bn	**1.5 - 1.8**
Economic sensitivities (excluding WEBs)				
No growth in benefits post 2056	\$12.7bn - \$15.3bn	\$9.2bn - \$9.8bn	\$3.1bn - \$5.8bn	**1.3 - 1.6**
- 20% PT benefits	\$13.0bn - \$15.7bn	\$9.2bn - \$9.8bn	\$3.5bn - \$6.2bn	**1.4 - 1.7**
+ 20% PT benefits	\$15.6bn - \$19.1bn	\$9.2bn - \$9.8bn	\$6.1bn - \$9.6bn	**1.6 - 2.0**
- 20% road benefits	\$13.3bn - \$16.3bn	\$9.2bn - \$9.8bn	\$3.8bn - \$6.7bn	**1.4 - 1.7**
+ 20% road benefits	\$15.3bn - \$18.6bn	\$9.2bn - \$9.8bn	\$5.8bn - \$9.0bn	**1.6 - 2.0**

The economic evaluation results are discussed below, noting that the demand related impacts are addressed in detail in Section 7 of Appendix 5: Demand modelling:

- The modelled impacts of COVID-19 act to reduce benefits relative to the Core scenario. This is primarily driven by the delayed land use growth and increased working from home rates considered as part of this test, which reduce road network congestion and result in road-based access to Melbourne Airport remaining a viable alternative for a longer duration within the appraisal period.
- The alternative fare structure yields higher benefits than the Core scenario due to the increased patronage the lower fare attracts relative to the Core scenario.
- The inclusion of Keilor East Station results in a small increase to the economic benefits delivered by MAR. However, this is offset by the additional cost associated with the provision of the intermediate station, which means the BCR is unchanged relative to the Core scenario.
- The modified ASCs test yields materially higher benefits than the Core scenario. This scenario provides a 10 minute preference to rail as a mode choice for air passengers, and highlights the upside potential if airport users view rail preferentially to other modes as a means to access the airport (over and above the generalised cost considered when making a mode choice within VITM, such as the reliability of a rail service compared with road-based travel).
- The AV sensitivities result in a considerable reduction in economic benefits relative to the Core scenario. This is largely driven by the ability of AVs to use the road network more efficiently through platooning, which generates a 20 – 25 per cent increase in road network capacity without any corresponding infrastructure enhancements. In turn, this results in a measurable improvement in the performance of the road network, leading to reduced congestion in the Base Case and Project Case, and a concomitant reduction in the attractiveness of public transport. Together, these factors yield an overall drop in MAR patronage, driving down public transport user and road user benefits.

- The impact on economic benefits for the SAV scenario is more pronounced than the PAV scenario. This is driven by two factors:
  - the SAV scenario has a larger share of total AVs relative to the PAV scenario, resulting in a larger increase in road network capacity
  - the inclusion of shared, on-demand AVs as part of the SAV scenario provides an alternative cost-effective means of access to Melbourne Airport.
- The TNP scenario results in a slight reduction in economic benefits relative to the Core scenario, primarily driven by lower road user benefits. As highlighted in Section 8.3, the road pricing considered as part of this test applies a per km fare to road travel. This lowers highway demand relative to the Core scenario improving the Base Case and Project Case road networks, which in turn, reduces the incremental benefit delivered by MAR.

10 Qualitative benefits considered

A range of other economic effects have been identified which may be included in the economic analysis. These benefits will not be quantifiable but are discussed qualitatively in Table 23.

Table 23: Other economic impacts of MAR

Cost or Benefit	Impact on benefits	Rating
Improved public transport travel time reliability	In the context of an improved public transport service, people not only value travel time savings but also consistency in travel times. Where there is significant variability in journey times, travellers may be required to allow more time for their journey to reduce the probability of arriving late at their destination. MAR provides improved travel time reliability compared with road-based access to Melbourne Airport via SkyBus services. This is likely to benefit airport users by reducing the additional time added to a journey to reduce the probability of arriving late and potentially incurring a large cost in the form of a missed flight. Unlike travel time, approaches to measure and quantify travel time reliability are less well-established. Due to the lack of reliable data and approach to quantification / monetisation, this benefit has not been included within the appraisal.	Moderate impact on result
Improved amenity at Sunshine Station	The Sunshine Station works to be delivered as part of MAR include: • a new pedestrian overpass at the opposite end of the station to the existing concourse to accommodate passenger interchange • works to existing station facilities • upgrades to active transport facilities within the Sunshine Station precinct • construction of additional car parking at Sunshine Station western car park. It is expected that customers will benefit from the increased amenity at Sunshine Station as a result of the works. However, due to the lack of reliable data, this benefit is not quantified.	Moderate impact on result
Reduced roadway costs	This includes road maintenance, construction and land. These are affected by vehicle weight, size and speed. In urban areas with significant congestion problems and high land values, even a modest reduction in volumes can provide large savings. As highlighted in Section 5.6.3, MAR reduces car use across Greater Melbourne. However, due to the lack of reliable data, this benefit is not quantified.	Slight impact on result

Cost or Benefit	Impact on benefits	Rating
Construction disruption	While a range of construction related impacts are captured in the economic costs (including business disruption and costs to mitigate impacts), some have not had an economic value placed on them. Construction disruption is typically captured in the project risk analysis and included in the cost estimate to some extent. It is not a standard practice to be quantified as part of the economic appraisal.	Slight impact on result
Improved social inclusion and equality (UCB)	This benefit accrues from removing transport related barriers for people such that their ability to fully participate in the economy, society and community improves. The lack of connectivity to public transport infrastructure can act to entrench social exclusion as access to major employment and other services becomes increasingly more difficult. This benefit is expected to be significant for infrastructure initiatives that connect activity centres (e.g. jobs) with suburbs over-represented by residents with lower socio-economic status. Whilst MAR improves accessibility and connectivity to Melbourne Airport which previously had no passenger rail transport access, its ability to improve social inclusion by strengthening people's ability to participate in social and economic activities is considered minimal and hence this benefit is not quantified.	Slight impact on result

11 Conclusions

The economic appraisal for MAR assesses the economic viability of the MAR project, as well as the key risks associated with its economic benefit and cost.

The economic appraisal has been undertaken in accordance with accepted transport evaluation techniques, and takes a holistic evaluation approach that quantifies the conventional transport economic benefits and WEBs, in addition to the macro economy-wide impact (assessed using CGE modelling).

The economic appraisal for MAR demonstrates that at a 4 per cent discount rate:

- for MAR exc. SRL in the Base Case, the BCR ranges from 1.8 to 2.1, with a corresponding NPV range from $7.5bn to $10.8bn
- for MAR inc. SRL in the Base Case, the BCR ranges from 1.1 to 1.3, with a corresponding NPV range from $0.9bn to $2.8bn.

The delivery of MAR will support up to 8,000 direct and indirect jobs during construction. These jobs will range from engineers and subject matter experts planning behind the scenes, to construction workers and local suppliers who will help to deliver the project on site.[40] This level of investment will increase the size of the economy and job market, creating 1,880 net additional jobs across Victoria at the peak of construction. Across Australia, 2,100 net additional jobs are created at the peak of construction.

The construction and operation of MAR exc. SRL in the Base Case is expected to increase Victoria's GSP approximately $17.9bn in present value terms using a discount rate of 4 per cent. For MAR inc. SRL in the Base Case, the project is expected to increase Victoria's GSP approximately $16.2bn in present value terms using a discount rate of 4 per cent.

The economic contribution of the investment was also assessed by analysing the return on investment against the MAR funding cost. The analysis shows that the Victorian economy as measured by change in GSP will be better off by between 5.9 and 5.0 times the cost of investment (after allowing for borrowing costs) for MAR exc. SRL in the Base Case and for MAR inc. SRL in the Base Case respectively. Similarly, the Australian economy as measured by the change in GDP will be better off by between 2.9 and 2.4 times the cost of investment for MAR exc. SRL in the Base Case and for MAR inc. SRL in the Base Case respectively.

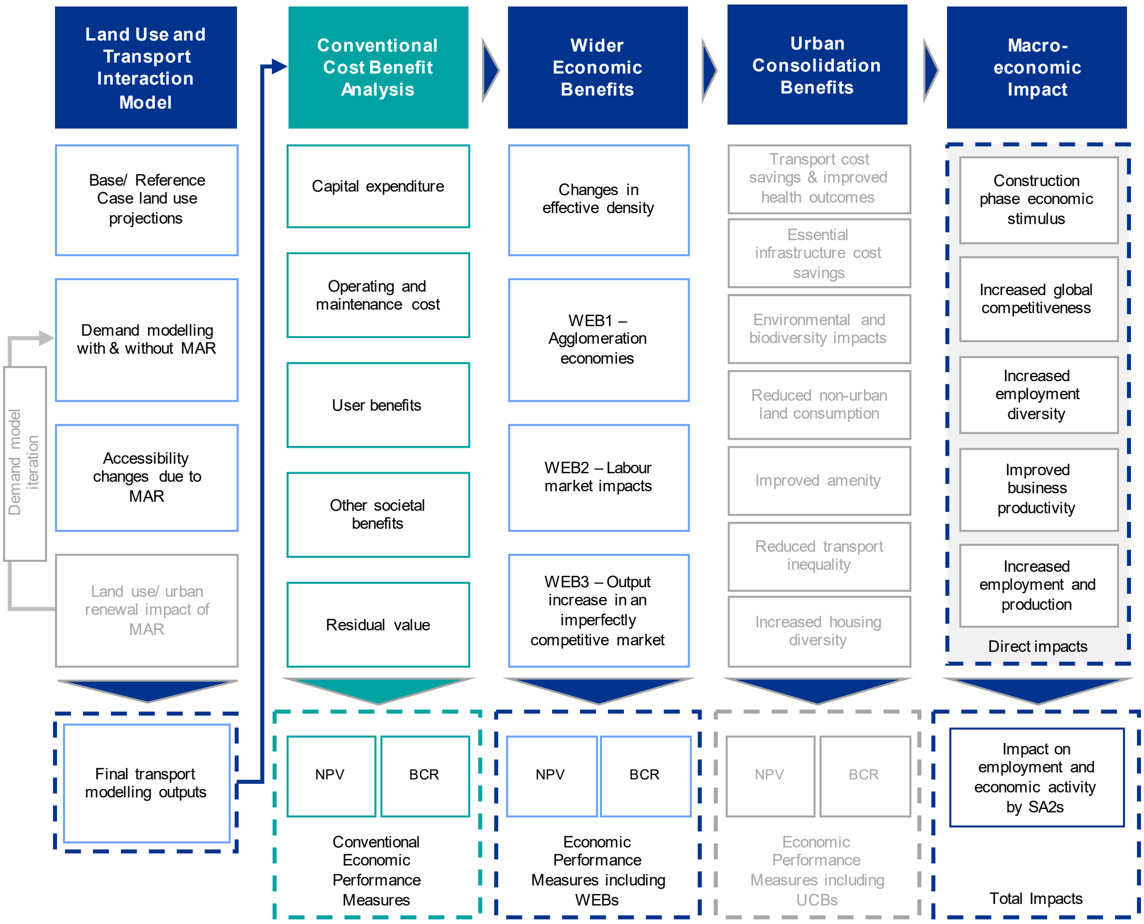
The increase in economic activity will boost tax receipts for the Victorian and Australian governments. These tax receipts will be sufficient to cover the combined Australian and Victorian government borrowing costs, with a minor shortfall when only considering the Victorian Government borrowing costs.

[40] RPV analysis on behalf of DoT.

Appendix A: Conventional cost benefit appraisal approach

This appendix provides the detailed approach and relevant economic theory underpinning the calculation of the conventional benefit streams. Figure 31 highlights the components of the conventional benefits which were quantified for MAR.

Figure 31: Conventional benefits within the overarching economic appraisal framework



A.1 Parameter values

A.1.1 Values of time

Time-related savings used in the analysis were valued using a value of time (**VOT**), which differs by trip purpose:

- **Business-to-business trips** reflect trips made during the course of the working day. The VOT reflects the cost to the employer in lost productivity from time spent travelling.
- **Non-business trips** reflect trips made in an individual's own time. The VOT reflects the individual's 'willingness-to-pay' to avoid time spent travelling. People implicitly put a value on their own time in that they will trade a slow, cheaper journey against a fast, more expensive one.

Based on productivity growth forecasts in the 2015 Intergenerational Report[41], the value of time has been indexed using long-term average growth in real income.

Analysis of AWE and CPI data from ABS for Victoria demonstrates that real average weekly earnings in Victoria grew at a rate of 1.55 per cent per annum over the last 20 years to 2015.

The Intergenerational Report states that during the 1990s, Australia's productivity grew at an average of 2.2 per cent per year. This declined to 1.5 per cent per year during the 2000s. The Intergenerational Report assumes that over the next 40 years, Australia's productivity will increase by 1.5 per cent per year.

To be consistent with the Intergenerational Report, and given the marginal difference between that assumed by the Intergenerational Report and the observed real growth in AWE in Victoria, the VOT was indexed at 1.5 per cent per year. For non-work related benefits, the estimated real long-term average growth in real income in Victoria is multiplied by an elasticity of 0.5.[42] In other words, the non-work benefit streams were indexed at half the rate of growth in real income. The VOTs used in the analysis are shown in Table 24 and Table 25 for public transport and road users.

Table 24: Values of time – public transport and car users ($ per person-hour)

	2020	2026	2031	2036	2041	2051
Non-business trips	$17.05	$17.83	$18.51	$19.22	$19.95	$21.50
Business-to-business trips	$55.32	$60.49	$65.16	$70.20	$75.62	$87.77

Source: ATAP PV2 (2016a, pg. 16). 2020 values have been inflated from June 2013 to December 2019 using ABS average weekly earnings data (ABS Catalogue 6302). Future year values have been indexed at 1.5 per cent p.a. for business-to-business related benefits, and 0.75 per cent p.a. for non-business related benefits.

Table 25: Values of time – freight (per vehicle-hour)

	2020	2026	2031	2036	2041	2051
Heavy rigid trucks	$45.84	$47.95	$49.77	$51.67	$53.63	$57.79
Artic 6-axle trucks	$78.04	$81.62	$84.73	$87.95	$91.30	$98.38

Source: ATAP PV2 (2016a, pg. 16). 2020 values have been inflated from June 2013 to December 2019 using ABS average weekly earnings data (ABS Catalogue 6302). Future year values have been indexed at 0.75 per cent p.a.

The airport user values of time for non-business and business-to-business trips are modelled as a distribution, as highlighted in Section 8.1. The P95 value for this distribution is summarised in Table 26.

[41] Commonwealth of Australia (2015). *2015 Intergenerational Report - Australia in 2055*
[42] The elasticity of 0.5 is based on Hensher & Goodwin (2003) and is also consistent with the elasticity recommended by TfNSW (2013).

Table 26: Values of time – traveller to the airport ($ per person-hour)

	2020	2026	2031	2036	2041	2051
Non-business trips	$30.23	$31.62	$32.82	$34.07	$35.37	$38.11
Business-to-business trips	$71.03	$77.67	$83.67	$90.14	$97.10	$112.69

Source: KPMG (2019) Review of values of travel time savings and value of reliable service. 2020 values have been inflated from July 2019 to December 2019 using ABS average weekly earnings data (ABS Catalogue 6302). Future year values have been indexed at 1.5 per cent p.a. for business-to-business related benefits, and 0.75 per cent p.a. for non-business related benefits.

A.1.2 Other societal benefits

Table 27: Crash cost savings

	2020
Crash cost benefits ($/veh-km)	$0.16

Source: Based on crash rates provided in Austroads (2012, p. 23) and crash costs provided in ATAP PV2 (2016a, pg. 25 and pg. 30). Further details provided in Section A.5.1. Values have been inflated from June 2013 to December 2019 using ABS CPI medical (ABS Catalogue 6401).

Table 28: Environmental externality

	Car (cents/veh-km)	Truck ($/1000 tonne-km)
Greenhouse gas emissions		
Greenhouse gas emissions (CO_2)	2.66	6.25
Other environmental externalities		
Air Pollution	3.37	28.08
Noise Pollution	1.10	4.68
Water Pollution	0.51	4.21
Nature & Landscape	0.06	0.46
Urban Separation	0.78	3.13
Upstream & Downstream Costs	4.54	25.00
Total	**10.36**	**65.56**

Source: Austroads (2012, pg. 30 and pg. 33). Further details provided in Section A.5.2. Values have been inflated from June 2010 to December 2019 using ABS CPI all groups data (ABS Catalogue 6401).

Table 29: Health benefits due to increased walking

	Health benefit per kilometre[2]
Weighted health benefit average per km walked	**$1.29**

Source: ATAP M4 (2016b, pg. 37). Value has been factored down to reflect the proportion of health system costs over total health costs in line with ATAP M4 (2016b, pg. 36). Values have been inflated from June 2013 to December 2019 using ABS CPI medical data (ABS Catalogue 6401). Further details are provided in Section A.5.3.

A.1.3 Expansion factors

Economic benefits have been calculated in VITM for an average weekday excluding school holidays for the AM peak (7-9am), interpeak (9am-3pm), PM peak (3pm-6pm) and off-peak (6pm-7am). Expansion factors are used to calculate annual totals.

Public transport expansion factors have been derived from analysis of 2018 Myki data provided by DoT. The Myki data provided covers boarding and alighting by hour of day for all weekdays, weekdays excluding school holidays and any day (i.e. across all 365 days in the year). This is then used to calculate boarding and alighting for school holiday weekdays, weekends and public holidays.

Table 30 and Table 31 demonstrate the approach for calculating train interpeak / off-peak and AM peak / PM peak to annual expansion factors.

Table 30: Interpeak and off-peak to annual expansion factors – public transport

Time period	Total train boardings	Weighting (relative to boardings on average weekday exc. school holidays)	Equivalent number of days per year
Interpeak and off-peak on average weekdays excluding school holidays (9am-3pm, 6pm-7am)	350,477	1.00	199
Interpeak and off-peak on average school holiday weekday (9am-3pm, 6pm-7am)	321,050	0.92	53
Weekends and public holidays (all day)	331,682	0.95	113
Interpeak / off-peak to annual expansion factor		**Weighted average**	**354.5**

Source: KPMG based on 2018 Myki data provided by DoT.

Table 31: AM and PM peak to annual expansion factors – public transport

Time period	Total train boardings	Weighting (relative to boardings on average weekday exc. school holidays)	Equivalent number of days per year
AM peak and PM peak on average weekdays excluding school holidays (7am-9am, 3pm-6pm)	450,170	1.00	199
AM peak and PM peak on average school holiday weekday (7am-9am, 3pm-6pm)	358,661	0.8	53
AM peak / PM peak to annual expansion factor		**Weighted average**	**241.2**

Source: KPMG based on 2018 Myki data provided by DoT.

A.1.4 Interpolation and extrapolation methodology

Economic benefits were modelled for the years 2026, 2031, 2036, 2041, 2051 and 2056. Linear interpolation was used to determine the magnitude of benefits for intermediate years. For benefit streams with a time component, the indexed value of time as detailed in Section A.1.1 was then applied to calculate the value of the economic benefit in that year.

Beyond the final demand modelling year (2056) until the end of the economic appraisal period (2078), the compound annual growth rates of benefits between 2051 and 2056 have been used to determine the magnitude of benefits. A number of benefit stream specific extrapolation rates were used as follows:

- **air passenger public transport user benefits**: perceived air passenger public transport benefits growth rate
- **other public transport user benefits**: perceived non-air passenger public transport benefits growth rate
- **road benefits (including corrections)**: no growth
- **emissions and accident savings**: no growth
- **health benefits***:* perceived public transport benefits growth rate

- **farebox resource cost correction**: MAR patronage growth rate
- **option and non-use value**: option and non-use value benefits growth rate
- **other benefits (WEBs etc)**: benefit-weighted average of other growth rates.

A.2 Relevant economic theory

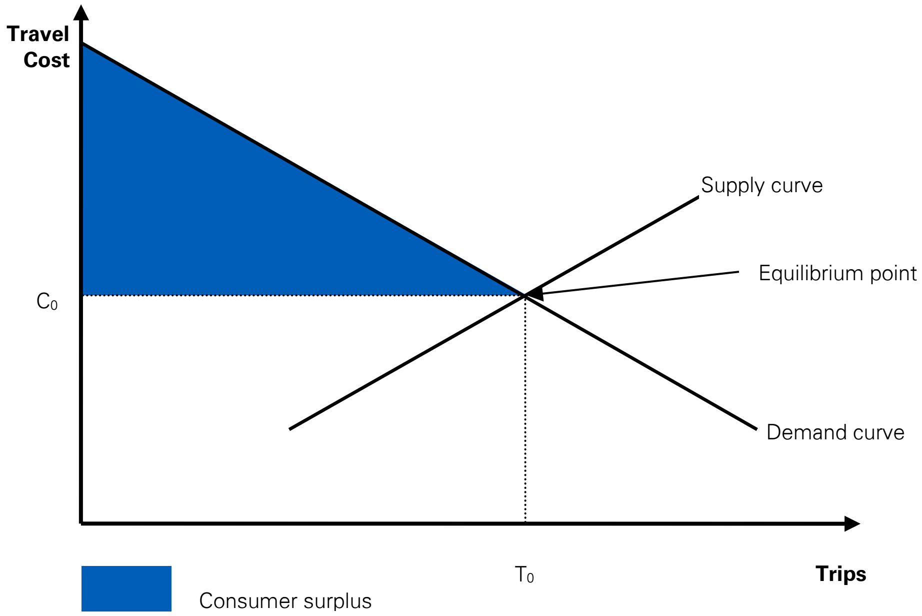
A.2.1 Consumer surplus

The calculation of transport user benefits have been based on the conventional consumer surplus theory as discussed in the ATAP T2 guideline.[43] 'Consumer surplus' is defined as the benefit which a consumer enjoys, in excess of the costs which he or she perceives. For example, if a journey would be undertaken by a traveller provided it takes no more than 20 minutes, but not if it takes more than 20 minutes, then the total value of the journey is equivalent to the cost to that traveller of 20 minutes of travel time. If actual travel time for the journey is only 15 minutes, then the traveller enjoys a surplus of five minutes. If a new proposal reduces travel time further, to 12 minutes, then the increase in consumer surplus from the proposal is three minutes.

The evaluation of economic benefits to transport users relies on the transport system equilibrium being correctly assessed by the transport model. At the equilibrium point, the numbers of trips T_0 (demand) and system performance (supply) are in balance producing an average trip cost of C_0.

At this equilibrium point, there are benefits to the consumer over and above the actual trip costs; that is, there is a difference between what they would be willing to pay and what they actually pay. This difference is the consumer surplus. This is shown diagrammatically in Figure 32.

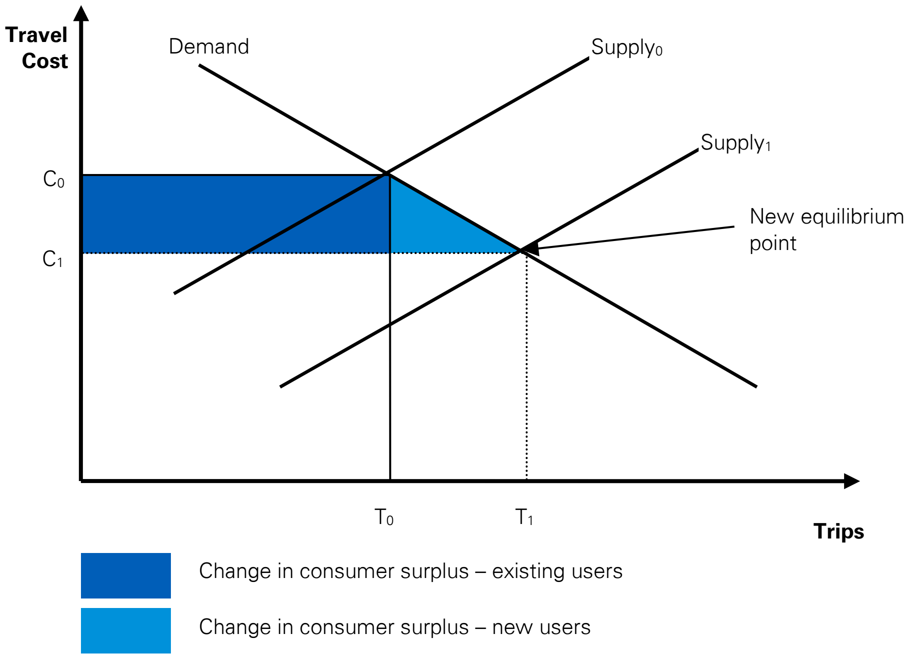
Figure 32: Supply / demand equilibrium showing consumer surplus



A new public transport scheme will reduce travel costs. This shifts the supply curve down as shown in Figure 33. A new market equilibrium point is found where the demand is T_1 and the supply cost is C_1. The benefit to transport users is therefore the change in the consumer surplus, which is shown by the shaded area of the chart.

[43] Transport and Infrastructure Council (2018a, pg. 29). *Australian Transport Assessment and Planning (ATAP) Guidelines: Cost Benefit Analysis [T2]*

Figure 33: Change in consumer surplus



For small changes in costs, the demand curve can be considered to be linear.

In the case of *existing public transport users*, a change in door-to-door travel time from 20 minutes to 15 minutes will equate to a full five minutes in consumer surplus benefit. Therefore, the change in consumer surplus for existing travellers who were already making trips in the Base Case is given by the area of the shaded rectangle:

$$CS_{existing} = T_0(C_0 - C_1)$$

In contrast, *new public transport users* (who switch from car in the Base Case to public transport in Project Case) receive half the benefit of existing users in accordance with the 'rule of half' convention as described in the ATAP T2 guideline.[44]

For some journeys on the transport network, there may be cases where existing public transport users cease to use public transport, and instead switch to road based modes in the Project Case. The benefits to these new road users are also calculated in accordance with the 'rule of half' convention.

The change in consumer surplus for new trips (those who switch from car to public transport or vice versa) is given by the area of the shaded triangle:

$$CS_{new} = \frac{1}{2}(T_1 - T_0)(C_0 - C_1)$$

The total change in change in consumer surplus is calculated by summing the areas of the rectangle and triangle, which simplifies to:

$$CS_{total} = \frac{1}{2}(T_0 + T_1)(C_0 - C_1)$$

[44] Transport and Infrastructure Council (2018a, pg. 32-33). *Australian Transport Assessment and Planning (ATAP) Guidelines: Cost Benefit Analysis [T2]*

A.2.2 Resource cost corrections

Cost-benefit analysis of transport projects within Australia is undertaken using resource costs.[45] These costs reflect the opportunity cost to society of the resources used in a project and therefore include costs such as time spent waiting for or travelling on public transport, fuel costs and maintenance costs. Resource costs do not include financial transfers such as taxes, subsidies or payments for services (e.g. public transport fares) when costs relating to those services are incorporated within the analysis.

Strategic demand modelling is undertaken based on perceived costs to represent the travel behaviour exhibited by users of the transport system. In the context of travel, transport users fully perceive time, comfort aspects and out of pocket costs such as fuel, train / bus fares and car parking. VITM takes these aspects into account in the computation of generalised costs and the subsequent mode choice decision for a trip. As a result, transport user benefits which are obtained from the change in consumer surplus (VITM outputs) reflect perceived costs, not resource costs.

Where a perceived cost component is the same as a resource cost component, changes in costs are fully perceived by users and the consumer surplus theory outlined in Section A.2.1 is applicable. However, there are several components where resource costs differ from perceived costs. For example, transport users do not perceive that fares, tolls or parking costs are transferred to the rest of the economy. In economic terms, this exchange should be considered a financial transfer rather than an economic cost. For these components, the change in consumer surplus will not accurately reflect the change in resource costs, and therefore a resource cost correction is needed within the analysis.

The following general form of calculation is used for calculating resource cost corrections.

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

where:

RCC = resource cost correction

T = number of trips

PC = perceived cost

RC = resource cost

Subscripts 0, 1 refer to the Base Case and Project Case

Public transport fares

A resource cost correction is needed for public transport fares as the resource cost is zero, but the perceived cost is the actual fare amount paid or faced by users. Based on this, the general resource cost correction formula can be simplified for fares as follows:

$$RCC = T_1PC_1 - T_0PC_0$$

The equation above demonstrates that the public transport fare RCC is driven by mode shift to public transport and / or changes in fare. A project that does not contemplate a change to fares or generate new users on public transport will hence have a low public transport fare RCC. Conversely, a project that experiences significant mode shift or alters a fare structure will result in a larger public transport fare RCC. The magnitude of the RCC is amplified if the mode shift occurs on services with a large fare, as is the case with MAR.

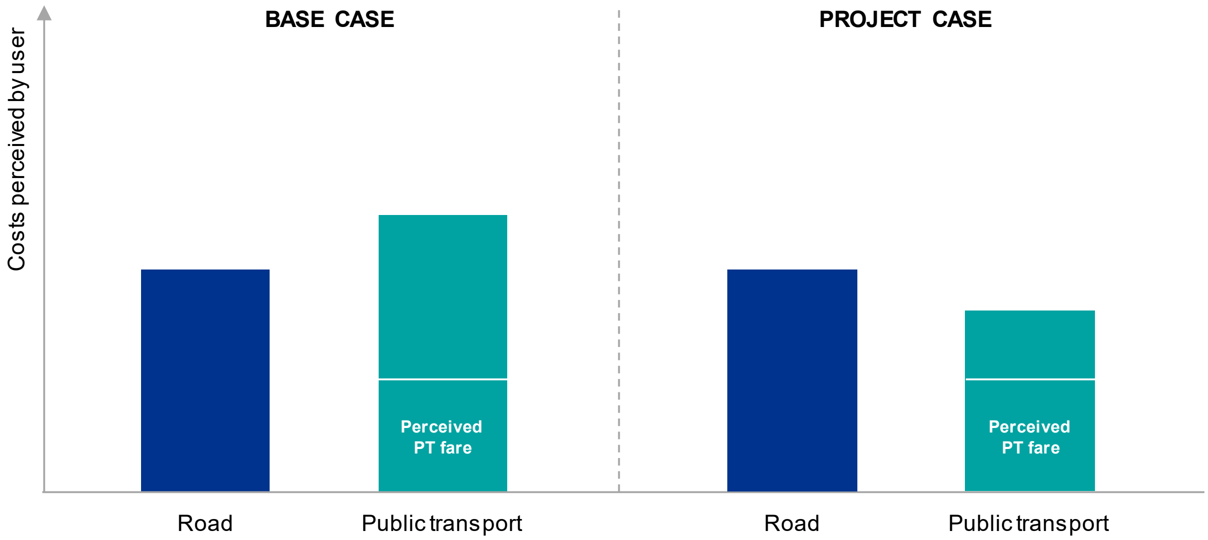
Figure 34 illustrates a simplified example of user costs (road and public transport) for a trip to the airport in the Base Case and Project Case. In the Base Case, the user opts to travel via car as the perceived costs of road travel are lower than the perceived costs of public transport. Even though the user does not travel by public transport, the perceived fare component makes up a significant proportion of the

[45] Transport and Infrastructure Council (2018a, pg. 14, 33-34). *Australian Transport Assessment and Planning (ATAP) Guidelines: Cost Benefit Analysis [T2]*

perceived public transport cost and hence the decision not to take public transport. In the Project Case, improvements delivered by MAR reduce the perceived public transport cost (e.g. through reduced travel time) and the user switches from road to public transport.

As the change in consumer surplus outputs (reported by VITM) reflect perceived costs, the RCC is required to accurately reflect the resource cost of the fare paid by the new public transport user within the economic analysis.[46] Not including the correction would unfairly represent the resource cost to society of the public transport trip compared with the road trip. The RCC therefore effectively subtracts the value of the fare from the total cost perceived by the user. At an aggregate level, this increases the difference between road and public transport generalised costs, thereby increasing the total benefits of public transport trips for society. As the perceived PT fare for MAR is large relative to a standard Myki fare, and the MAR project results in significant mode shift to public transport, this component comprises a larger share of benefits than for most other transport projects.

Figure 34: Perceived costs under the Base Case and Project Case



Further detail regarding the calculation of road based RCCs is provided in Section A.4.2 for VOC, Section A.4.5 for tolls and Section A.4.6 for car parking.

A.2.3 Computation of benefits

VITM generates outputs for the generalised travel time savings (in minutes) for each origin-destination pair in the Base Case and Project Case for existing, new and lost users using the formulae provided in Sections A.2.1 and A.2.2. A number of network wide statistics were also sourced from VITM to quantify externality benefits.

The benefits were then aggregated for all origin-destination pairs. These aggregated outputs were monetised within a bespoke Microsoft Excel CBA model built specifically for the MAR economic appraisal, considering the economic parameters discussed in Section A.1. The Monte Carlo simulation was performed within the Microsoft Excel CBA model using the software @RISK.

[46] Transport and Infrastructure Council (2018b, pg. 30). *Australian Transport Assessment and Planning (ATAP) Guidelines: Public Transport [M1]*

A.3 Public transport user benefits

This section sets out the approach and key outputs resulting from calculation of public transport user benefits relating to MAR. These include calculations for:

- generalised travel time savings
- reduced crowding on trains
- resource cost corrections for public transport fares.

A.3.1 Generalised travel time savings

Total journey travel time savings comprise discrete parts of the overall public transport journey which include both time and monetary components. For certain trip components, passengers value their time more relative to time spent in vehicle. As such, travel time multipliers are considered in line with the VITM economic module.

The components of generalised travel time savings which were measured from the outputs of the transport models include:

- **Walk access and egress time savings** – Reflect the aggregate change in walk access and egress times. The change in access / egress times were calculated within the patronage model and multiplied by the applicable value of time VOT. For non-business trips, a weighting of 1.4 times was applied to the value of in-vehicle time (**IVT**) as passengers value out-of-vehicle time higher than that of time spent in vehicle.
- **Park and ride drive access and egress time savings** – Reflect the aggregate change in car access and egress times. The change in access / egress times was calculated within the patronage model and multiplied by the applicable VOT.
- **Wait time savings** – Reflects the reduction in wait time due to greater service frequency. The change in wait time was calculated within the patronage model and multiplied by the applicable VOT. For non-business trips, a weighting of 1.4 was applied to the value of IVT as passengers value out-of-vehicle time higher than that of time spent in vehicle.
- **In-vehicle travel time savings** – Reflect changes in in-vehicle travel time due to service pattern changes. The change in IVT was calculated within the patronage model and multiplied by the applicable VOT.
- **Walk transfer time savings** – Reflects the change in transfer time (within or between modes) due to service changes. The change in transfer times were calculated within the patronage model and multiplied by the applicable VOT. For non-business trips, a weighting of 2.0 times the value of IVT was applied as a passenger's value time spent transferring between services at twice that of time spent in vehicle.
- **Transfer penalty savings** – Transfer penalties represent user preferences which are not explicitly measured by variables in the patronage model. Transfer penalties were included to reflect the disutility that most users associate with interchanging, over and above the measured travel time. The transfer and access penalties were calculated within the patronage model and multiplied by the applicable VOT.
- **Fare** – Fares paid by transport users form part of their generalised journey time that they perceive. In VITM, fares were converted into generalised time using the applicable VOT.

VITM measures the time spent by passengers on different parts of their trip between each origin-destination pair, with some parts weighted as described above. The consumer surplus of generalised public transport user travel time savings was calculated by applying the general approach provided in Section A.2.1, using the travel times (weighted as described above) and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0 + T_1)(PC_0 - PC_1)$$

where:

CS = consumer surplus

T = number of trips

PC = generalised travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Project Case

The time savings were then monetised using the values of time provided in Section A.1.1.

A.3.2 Reduced crowding on trains

Crowding disbenefits reflect the discomfort that passengers feel from travelling in varying levels of crowded conditions. As crowding levels increase towards crush capacity, the valuation of passengers' in-vehicle time also increases, e.g. if a train is at crush capacity, standing passengers will perceive their journey to take twice as long. A reduction in crowding occurs when additional services are provided; consequently existing public transport users experience a reduction in their perceived value of time.

VITM has the ability to assign public transport trips with the application of crowding constraints. The Public Transport program within VITM supports two types of crowd models:

- in-vehicle travel time adjustment
- wait time adjustment.

In-vehicle travel time adjustment

In-vehicle travel time adjustment models a passenger's perception that travel time is more onerous when standing (rather than sitting) or when on crowded vehicles. This adjustment is specified with a crowding factor. The program multiplies the crowding factor by in-vehicle time to determine the perceived 'crowded in-vehicle time'.

For example, suppose a vehicle has a seated capacity of 40, crush capacity of 50, and load distribution factor of 0.85 (standing occurs when more than 85 per cent of 40 – that is, 36 seats – are occupied). Once standing starts, the crowding factor might increase slowly from 1.0 for the first few standing passengers, then more steeply once vehicle loading exceeds 40.

The Public Transport program within VITM uses crowding curves, which set the relationship between the crowding factor and the vehicle utilisation. The utilisation is the percentage of standing places occupied and can vary between 0 and 100. Crowding factors are 1.0 in uncrowded conditions, and typically rise to values in the ranges 1.0 to 1.5 for seated passengers and 1.5 to 3.0 for standing passengers when the vehicle is fully loaded with standing occurring.

For example, for a HCMT7, when all seats are occupied, the VITM crowding curve suggests that seated time should be valued at 110 per cent of IVT, increasing linearly to 130 per cent of IVT at crush capacity. For standing passengers, it is recommended that standing time is valued at 140 per cent of IVT when all seats are occupied, increasing linearly to 200 per cent of IVT at crush capacity. These factors are shown in Table 32.

Table 32: Crowded in-vehicle time weighting factors for a HCMT7

Load factor (passengers : seats)	Seated passenger IVT weighting factor	Standing passenger IVT weighting factor
70%	1.0	n/a
100%	1.1	1.4
Crush capacity (6 passengers per square metre)	1.3	2.0

Source: VITM

Wait time adjustment

The wait time adjustment reflects the ability to board a service. In simple models (without crowding modelling), travellers typically board the first service that arrives at a stop and travel to the required alighting point. As loadings on services increase, this becomes less realistic, as travellers will choose the first appropriate service that has available capacity. Using measures of demand and available capacity, the wait-time adjustment computes the probability of being able to board a service. With heavily loaded services, some travellers will wait for the next service, incurring additional wait time at the boarding node.

The wait time adjustment module redistributes public transport line loadings whenever any line does not have the available capacity to take its assigned demand. The program reassigns this excess demand to other lines with spare unused capacity; those travellers incur additional wait time.

The additional wait time might make this route less attractive, resulting in diversion of demand to other public transport routes.

If demand exceeds capacity and no alternative routes are available, a 'bottleneck' occurs and not all of the travel demand is able to use the service during the modelled period. The demand remaining at the end of the modelled period would discharge once peak travel volumes subside; those travellers experience additional delays, which form a second component to the wait-time adjustment.

'Flow metering' handles the bottleneck effect and the inability of demand to pass through that point. Flow metering removes the excess demand from later stages in the trip; thus, demand at any downstream point reflects the number of travellers who can reach that point. For any origin-destination pair, the program can calculate the proportion of flow-metered demand (that is, demand unable to reach its destination due to network bottlenecks), and the number of trips affected.

Calculation

VITM measures the crowded in-vehicle time and crowded wait time between each origin-destination pair. The consumer surplus of crowded travel time savings was calculated by applying the general approach provided in Section A.2.1, using the travel times (weighted as described above) and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

where:

CS = consumer surplus

T = number of trips

PC = crowded travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Project Case

The crowded travel time savings were then monetised using the values of time provided in Section A.1.1.

A.4 Road user benefits

This section sets out the approach, inputs, parameters and flow of detailed calculations undertaken for road user benefits relating to MAR. These include calculations for:

- travel time savings for road users
- vehicle operating cost savings
- road journey time reliability
- travel time in congested conditions
- relevant resource cost corrections (refer section A.2.2).

A.4.1 Travel time savings

The change in door-to-door travel times result from reduced levels of traffic on the road network due to some car users switching to public transport.

VITM measures the travel time spent by road users between each origin-destination pair. The consumer surplus of road user travel time savings was calculated by applying the general approach provided in Section A.2.1, using the travel times and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

where:

CS = consumer surplus

T = number of trips

PC = travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Project Case

The time savings were valued using the values of time.

A.4.2 Vehicle operating cost savings

Vehicle operating costs (**VOCs**), such as fuel and maintenance, are a function of distance and speed travelled across the network. In general, fuel consumption is higher at low speeds in interrupted flow / stop-start conditions than it is on free-flowing conditions.

As a result of some drivers switching from car to public transport, road network speeds can increase leading to fuel savings for other road users.

For vehicles which operate in fleets (such as commercial vehicles), if travel times decrease as a result of network speeds increasing, then operators will be able to undertake either the same freight task with a smaller number of fleet vehicles or undertake more trips with the same vehicle. This leads to savings related to vehicle capital costs, including time-related depreciation, registration and insurance.

Road users only perceive the fuel cost of VOC. Non-fuel costs are unperceived and hence are accounted for as a resource cost correction.

The consumer surplus component of VOC savings was calculated by applying the general approach provided in Section A.2.1, using the perceived component of VOC and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

The resource cost correction were calculated by applying the general approach provided in Section A.2.2, using the resource component of VOC and trip numbers as output from VITM as follows:

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

where:

CS = consumer surplus

RCC = resource cost correction

T = number of trips

PC = vehicle operating cost (perceived cost)

RC = vehicle operating cost (resource cost)

Subscripts 0,1 refer to the Base Case and Project Case

The perceived and resource cost components of VOC were calculated in VITM using the VOC model provided in the ATAP guidelines[47]:

$$c_{stop-start} = A + \frac{B}{V}$$

$$c_{freeflow} = C_0 + C_1V + C_2V^2$$

where:

A, B, C_0, C_1, C_2 = model coefficients provided in Table 33 and Table 34

c = vehicle operating cost (c/km) or fuel consumption (litres/km)

V = average travel speed in km/h

Table 33: Fuel consumption model coefficients for stop-start and free-flow models (litres per 100km)

	Stop-start (urban)		Free-flow (rural)		
	A	B	C_0	C_1	C_2
Medium car	8.8017	179.6890	9.8014	-0.0785	0.0008
Heavy rigid truck	45.5089	535.1584	32.0378	-0.2949	0.0040
Articulated 6 axle truck	75.4028	547.8857	45.8457	-0.3168	0.0049

Source: ATAP 2016a (PV2, pg. 53)

Table 34: VOC model coefficients for stop-start and free-flow models (cents per km, $2013)

	Stop-start (urban)		Free-flow (rural)		
	A	B	C_0	C_1	C_2
Medium car	12.6514	1315.518	35.0470	-0.1751	0.0012
Heavy rigid truck	57.1600	2556.077	82.2900	-0.5525	0.0053
Articulated 6 axle truck	98.6903	3991.276	128.6879	-0.6878	0.0066

Source: ATAP 2016a (PV2, pg. 52-53)

[47] Transport and Infrastructure Council (2016a) *Australian Transport Assessment and Planning (ATAP) Guidelines: Road Parameter Values [PV2]*, pg. 52

Perceived costs (fuel costs)

Perceived VOC was calculated using the VOC model set out above and applying the coefficients provided in Table 33 to calculate total fuel consumption for different vehicle types. The fuel consumption model used depends upon the classification of the road as either urban or rural. Multiplying the fuel consumption by the market price of fuel and dividing by 100 gives the perceived VOC per km for non-work trips.

Table 35 shows an example calculation of weighted average perceived VOC for non-work trips.

Table 35: Example calculation of perceived VOC

	Free-flow	Stop-start
Proportion of total VKT (assumption)	30%	70%
V (km/h) (assumption)	80	50
A		8.8017
B		179.689
C_0	9.8014	
C_1	-0.0785	
C_2	0.0008	
Fuel consumption (litres/100km)	8.6	12.4
Weighted average fuel consumption	11.3 litres/100km	
Average retail price	144.8 cents/litre	
Weighted average perceived VOC perceived cost per vehicle-km for non-work trips	**16.3 cents/km**	

Source: KPMG analysis based on Table 33. Average retail fuel price based on ATAP 2016a (PV2, pg. 9)

Resource costs

The resource component of VOC was calculated using the VOC model set out above and applying the coefficients provided in Table 34 for different vehicle types. The VOC model used depends on the classification of the road as either urban or rural.

Table 36 shows an example calculation of weighted average VOC in resource costs.

Table 36: Example calculation of resource component of VOC

	Free-flow	Stop-start
Proportion of total VKT (assumption)	30%	70%
V (km/h) (assumption)	80	50
A		12.6514
B		1315.5178
C_0	35.047	
C_1	-0.1751	
C_2	0.0012	
VOC (cents/km)	28.7	39.0
Weighted average VOC resource cost per vehicle-km	**35.9 cents/km**	

Source: KPMG analysis based on Table 34

A.4.3 Improved journey time reliability

Road journey time reliability is a function of congestion on the road network – when links are at or near capacity then any unplanned incident, such as a crash or breakdown, is more likely to result in major delays to other vehicles than if the crash or breakdown occurred on a more lightly trafficked route. Consequently, drivers must allow more buffer time before making trips to ensure that they arrive on time.

As the Project Case results in some mode shift from road to public transport, then some road links will become less congested and trips by road for remaining road users will become more reliable, allowing them to reduce the buffer time and use the time saved more productively.

Travel time reliability benefits were estimated by applying the approach presented in the UK Transport Analysis Guidance (**TAG**).[48] The approach considers reliability benefits as the change in monetised journey time variability, between the Base Case and the Project Case, using the following formula, to forecast changes in the standard deviation of travel time from changes in journey time and distance:

When travel time reliability is expressed in terms of changes in standard deviation, a typical approach is to convert changes in travel time variability into in-vehicle time equivalents. In line with the ATAP guidelines, a conversion factor of one in-vehicle time minute for a minute change in the standard deviation for all vehicle types has been assumed.

The UK approach links reliability to a 'congestion index' (CI): the ratio between modelled average (or equilibrium) travel time and free flow travel time.

$$CI = \frac{t_{modelled}}{t_{freeflow}}$$

where

$t_{modelled}$ = modelled travel time between an origin-destination pair

$t_{freeflow}$ = freeflow travel time between an origin-destination pair

Reliability is then measured by the coefficient of variation (CV): the standard deviation of travel time to the average travel time. The relationship links the CV as a function of distance and the CI:

$$CV = \alpha \cdot CI^{\beta} \cdot d^{\delta}$$

where

d = distance between the origin-destination pair

α = scaling factor (estimated at 0.16)

β = coefficient (estimated to be 1.02)

δ = coefficient (estimated to be -0.39)

Multiplying CV by the average travel time between each origin-destination pair gives an estimate of the standard deviation of travel time reliability. The standard deviation of travel time in the Base Case and Project Case is therefore given by:

$$\begin{aligned} \sigma &= t_{modelled} \cdot CV \\ &= t_{modelled} \cdot 0.16 \left(\frac{t_{modelled}}{t_{freeflow}}\right)^{1.02} d^{-0.39} \end{aligned}$$

[48] Department for Transport UK (2017). *Transport Analysis Guidance Unit A1.3 – User and Provider Impacts*

The reliability benefits were calculated using the consumer surplus approach provided in Section A.2.1, using the standard deviation of travel time and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(\sigma_0-\sigma_1) \cdot VOR$$

where:

CS = consumer surplus

T = number of trips

σ = standard deviation of travel time (perceived cost)

VOR = value of reliability

Subscripts 0,1 refer to the Base Case and the Project Case

With respect to the VOR relative to VOT, that travel time reliability for:

- cars is equivalent to 0.4 units of in-vehicle travel time[49]
- commercial vehicles is equivalent to 1.2 units of in-vehicle travel time.[50]

A.4.4 Travel time in congested conditions

Standard travel time benefits capture changes in the opportunity cost of time spent travelling, measured as either willingness to pay for additional leisure time or the resource costs of labour.

However, this does not capture the full benefits to road users who also perceive a reduction in utility as a result of discomfort and lack of amenity from travelling in congested conditions. Research from overseas shows that the value of time increases with the level of congestion, reflecting the increased stress and effort associated with driving in more congested conditions.[51]

As the Project Case results in some mode shift from road to public transport, some road links will become less congested and remaining road users will benefit from travelling in less congested conditions.

Travel time benefits from improved congestion were valued by applying estimates of the value of time in congested conditions compared with uncongested conditions. These were estimated in VITM by calculating whether weighted travel time hours in congested conditions reduce relative to the Base Case.

The benefit is incremental to road user travel time savings (described in Section A.4.1) and is related to reduced discomfort from travelling in congested conditions (deemed to be roads with volume-capacity (V/C) ratios greater than 0.7), similar to the way that weightings were applied to crowded in-vehicle time on public transport (as described in Section A.3.2).

The congested time saving benefit is calculated by:

$$\sum Congested\ time\ saving * Value\ of\ congested\ travel\ t\ ime$$

where the perceived change in travel time caused by congestion on the road is given by:

$$\Delta T_1^C = \min\left(0.0, \max\left(1.0 \frac{V_l - 0.7C_l}{0.3C_l}\right)\right) \cdot T_l$$

[49] Department for Transport UK (2017). *Transport Analysis Guidance Unit A1.3 – User and Provider Impacts*
[50] NZ Transport Agency (2018). *Economic evaluation manual (First edition, Amendment 2)*
[51] See for example Wardman & Ibanez, (2012).

where:

ΔT_1^C = perceived incremental travel time caused by congestion

T_l = congested travel time on link

V_l = traffic volume on link

C_l = capacity on link

VITM measures the travel time spent by road users in congested conditions between each origin-destination pair. The congested travel time savings were then monetised using values of time set out in Table 37.

Table 37: Value of time in congested conditions (V/C ratio equal to 1.0 or higher) ($ per person-hour, $2015)

	Value of time in congested conditions
Car	$5.30
Rigid truck	$4.04
Articulated truck	$4.04

Source: Department of Treasury and Finance (2015, p. 62)

The values of time provided in Table 37 increase linearly in proportion to the V/C ratio whereby travel time costs on links with V/C ratios of 0.7 or below are valued at zero, and those on links with V/C ratios of 1.0 or above are valued at the full rate.

VITM measures the amount of time spent by road users travelling on roads with V/C ratios greater than 0.7 between each origin-destination pair. The consumer surplus of travel time savings in congested conditions were calculated by applying the general approach set out in Section A.2.1, using the travel time in congested conditions and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

where:

CS = consumer surplus

T = number of trips

PC = travel time in congested conditions (perceived cost)

Subscripts 0,1 refer to the Base Case and the Project Case

A.5 Other societal benefits

A.5.1 Crash cost savings

Crash cost savings relate to a reduction in the number of road crashes which is a function of the change in the number of vehicle kilometres travelled as a result of some car drivers switching from car to public transport use.

The unit rates per vehicle-kilometre for crash costs were derived from crash rates provided in Austroads (2012) and crash costs provided in the ATAP PV2 guideline. A crash cost unit rate was derived for freeways and undivided roads and a weighted average was taken, as shown in Table 38, Table 39 and Table 40.

The crash cost savings were obtained by multiplying the unit rates provided in Table 40 to the change in the number of vehicle-kilometres travelled between the Base Case and Project Case as output by VITM.

Table 38: Crash rate for undivided roads

	Crash rate (Crashes per 100m vehicle-kilometres)[1]	Crash cost ($ per crash, $2013)[2]
Fatal	1.28	$8,409,584
Injury	24.33	$178,552
Property damage only	41.87	$9,257
Weighted average crash cost per vehicle-kilometre		**$0.16/veh-km**

1. *Austroads (2012, p. 23)*
2. *ATAP PV2 (2016a, pg. 25 and pg. 30).*

Table 39: Crash rate for freeways

	Crash rate (Crashes per 100m vehicle-kilometres)[1]	Crash cost ($ per crash, $2013)[2]
Fatal	0.4	$8,409,584
Injury	5.35	$178,552
Property damage only	14.25	$9,257
Weighted average crash cost per vehicle-kilometre		**$0.04/veh-km**

1. *Austroads (2012, p. 23)*
2. *ATAP PV2 (2016a, pg. 25 and pg. 30).*

Table 40: Weighted average crash costs

	Assumed proportion of vehicle-km	Crash cost per vehicle-km[2]
Undivided roads	70%	$0.16
Freeway	30%	$0.04
Weighted average crash cost per vehicle-kilometre ($2013)		$0.12
Weighted average crash cost per vehicle-kilometre ($2020)[2]		**$0.16**

1. *From Table 38 and Table 39*
2. *Indexed from June 2013 to December 2019 using ABS CPI component of medical, dental and hospital services data (ABS Catalogue 6401)*

A.5.2 Environmental externalities

Environmental externality cost savings were calculated as a function of the change in the number of vehicle kilometres travelled as a result of some car drivers switching from car to public transport use.

The greenhouse gas emission savings based on CO_2 equivalent was estimated separately in line with IA guidelines.

The unit rates per vehicle-kilometre were taken from Austroads (2012) and are shown in Table 41. For trucks, the rate provided in Austroads are per tonne-km. A rate per vehicle-km was derived using estimates of average load per trip taken from Austroads. Table 42 shows the approach used to derive the unit rate per vehicle-kilometre for greenhouse gas emissions.

The environmental externality cost savings were obtained by multiplying the unit rates provided in Table 41 to the change in the number of vehicle-kilometres travelled between the Base and Project Case as output by VITM.

Table 41: Environmental externality parameters

	Car ($/veh-km)[1]	Truck ($/1000 tonne-km)[1]	Truck ($/veh-km)[2]
Greenhouse gas emissions			
Greenhouse gas emissions (CO_2)	0.03	6.25	0.07
Other environmental externalities			
Air pollution	0.03	28.08	0.29
Noise pollution	0.01	4.68	0.05
Water pollution	0.00	4.21	0.04
Nature & landscape	0.00	0.46	0.00
Urban separation	0.01	3.13	0.03
Upstream & downstream costs	0.04	25.00	0.26
Total	**0.10**	**65.56**	**0.69**

1. *Austroads (2012, pg. 30 and pg. 33). Values have been inflated from June 2010 to December 2019 using ABS CPI all groups data (ABS Catalogue 6401).*
2. *See Table 42 for approach used to convert tonne-km into vehicle-km*

Table 42: Conversion of truck rate per tonne-km to rate per vehicle-km

Conversion of truck rate per tonne-km to rate per vehicle-km	
Truck cost for CO_2 ($/1000 tonne-km)[1]	$6.25
Average load – Rigid (tonne / trip)[2]	5.39
Average load – Artic (tonne / trip)[2]	25.35
%kms – Rigid (%)[3]	51.34%
%kms – Artic (%)[3]	45.66%
Weighted Average Truck Cost ($/veh-km)	**$0.07**

1. *From Table 41*
2. *Austroads (2012, p. 34)*
3. *ABS Survey of Motor Vehicle Use, 12 months ended 30 June 2018, Victoria (ABS Catalogue 9208).*

A.5.3 Improved health due to increased walking and cycling

Transport systems and urban form are also increasingly recognised as a factor influencing public health outcomes and, in particular, it is considered that car-dependency has led to the creation of obesogenic environments (an environment which promotes gaining weight and is not conducive to losing weight).

By increasing the attractiveness of rail travel as an alternative to car travel, people are more likely to engage in incidental exercise when travelling to stations. This is likely to produce a reduction in the frequency and intensity of associated health care costs.

The value of health benefits associated with walking have been derived from the ATAP M4 guidelines. This provides a unit rate per kilometre for walking based upon the avoidable annual mortality and morbidity costs and health sector costs associated with inactivity and the number of additional kilometres required to be walked or cycled to achieve the required level of activity for people who fall into three categories: inactive, insufficiently active and sufficiently active.

The guidelines also provide the value of health benefits associated with cycling. However, VITM does not model changes in cycling activity between the Base Case and Project Case as the percentage of people cycling to access public transport is considered minimum in Melbourne. As a result, the health benefit of MAR associated with active transport considers walking only.

The ATAP rates per kilometre are based upon the proportion of inactive, insufficiently active and sufficiently active people for the whole Australian population (20.5 per cent, 36 per cent and 43.5 per cent respectively). Table 43 shows the derived unit rate for the health benefit per additional kilometres walked to access public transport.

To calculate the total health benefits from improved health due to increased walking, the derived rate was multiplied by the change in the number of kilometres walked by public transport users (as output from VITM).

The total health benefits include both benefits to health system (e.g. reduced hospital costs and sick days) and benefits to individuals (e.g. better health outcomes and life expectancy). The benefits to individuals are captured by the travel related benefits (e.g. reflected through mode shift). Therefore, only the benefits to the health system should be captured as the health benefits of MAR to avoid double counting. The benefit to the health system as a percentage of total health benefit due to active transport is 35 per cent according to the ATAP M4 guidelines. As such, the total health benefits calculated was multiplied by 35 per cent to determine the benefits accruing to the health system as a result MAR.

Table 43: Per-kilometre weighted health benefits from walking

Health system benefits of walking	
Weighted average rate per kilometre walked[1]	$2.77
Proportion of total health costs attributable to health system[2]	35%
Health system weighted average rate per kilometre walked ($2013)	$0.97
Health system weighted average rate per kilometre walked ($2020)[3]	**$1.29**

1. *ATAP M4 (2016b, pg. 37).*
2. *ATAP M4 (2016b, pg. 36).*
3. *Indexed from June 2013 to December 2019 using ABS CPI component of medical, dental and hospital services data (ABS Catalogue 6401).*

A.5.4 Option and non-use values

Option and non-use value should be included in the economic appraisal if the program / project being appraised includes measures that will change the availability of transport services within the study area (e.g. the opening of a rail service), according to the TAG of the UK Government.[52] Option and non-use value is considered relevant for this economic appraisal as MAR provides a new rail service for travellers to Melbourne Airport.

An **option value** is the willingness-to-pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. Important features for option values include:

- they are associated with uncertainty about use of the transport facility
- they may exist even if the option of using the transport service is never taken up
- they are related to the individual's attitude to uncertainty.

[52] Department for Transport UK (2017). *Transport Analysis Guidance Unit A4.1 – Social Impact Appraisal*

Non-use values are the values that are placed on the continued existence of a service, regardless of any possibility of future use by the individual in question. The motivation for the desire for a transport service to continue to exist may vary from one circumstance to another. For example, individuals may value a transport facility for altruistic reasons, reasons of indirect use or because it has some existence, bequest or intrinsic value. For example, consider a project that introduces a railway line, linking a series of towns and villages to a major town or city that already has a highway connection. Even if a particular individual living in one of the villages along the route does not intend to use the rail service, they may still value having the option to use the service. A car owner may value the ability to use the service when, for whatever reason, they cannot drive or their car is unavailable. A non-car-owning resident who generally does not travel beyond the village may value the knowledge that, should they need to reach the town or city, the facilities exist for them to do so, at reasonable cost and with a reasonable level of convenience. Whilst a full analysis of user benefits will include the expected value of any such occasional use, theory suggests that, in circumstances where the lack of the transport facility would cause inconvenience, people may be willing to pay a premium over and above their expected use value to ensure that the service exists for unplanned trips, as a sort of insurance.

Whilst option and non-use value is recognised within the ATAP guidelines, it does not provide detailed quantification parameters. More literature and quantification guides are available by the UK Government and are provided within its TAG.

According to the TAG, when quantifying option and non-use value, it is necessary to calculate the number of households that will be affected by the project, then apply the willingness to pay to have the new mode of service of interest.

Table 44 provides the willingness to pay for the option and non-use value of a new train service and new bus service. As highlighted in Section 8.1, the willingness to pay is expressed as a distribution. The mean value of this distribution is given by the difference between the willingness to pay for the option and non-use value of a new train service and a new bus service. This reflects that the introduction of MAR results in the cessation of the Melbourne City Express SkyBus service.

Table 44: Option and non-use value for rail and bus

	Willingness to pay per household per year
Train service	£122
Bus service	£242
New train service in lieu of existing bus service	£120
New train service in lieu of existing bus service ($2010)	$202
New train service in lieu of existing bus service ($2020)	**$259**

Source: Department for Transport UK (2020). TAG Data Book, Tab A4.1.8.

1. *British pounds are converted to Australian dollars based on the average 2010 exchange rate published by Reserve Bank of Australia.*
2. *Indexed from July 2019 to December 2019 using ABS average weekly earnings data (ABS Catalogue 6302)*

This willingness to pay per household value was then multiplied by the number of households that are within the zone of influence of MAR to determine the economic benefit of option and non-use value for MAR.

As recommended by TAG (2017), the households applicable are those living in the project catchment area; in the context of MAR, this catchment has been defined as an 800m radius from every MTP corridor station servicing Melbourne Airport.

The above can be summarised in mathematic forms as follows:

$$O = (HH_{PC} - HH_{BC}) \times WTP$$

where:

O = option and non-use value

HH = number of households in the MAR catchment

WTP = willingness to pay for option and non-use value per household

Subscripts $_{BC}$ refers to the Base Case and $_{PC}$ refers to the Project Case.

A.6 Infrastructure residual value

Benefits have been assessed over a 50-year period from project opening. However, the infrastructure will have an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

Table 45 includes economic life estimates for assets as per the ATAP M1 guidelines. A number of these assets, in particular rail infrastructure, are estimated to have an economic life that extends beyond the 50-year evaluation period. It is therefore prudent to accurately reflect the residual value of the assets beyond the end of the evaluation period. Note that where a range is provided in Table 45, the midpoint value was used.

A weighted average asset life for the project as a whole was developed based on information provided by the cost advisor.

Table 45: Typical economic lives for infrastructure assets

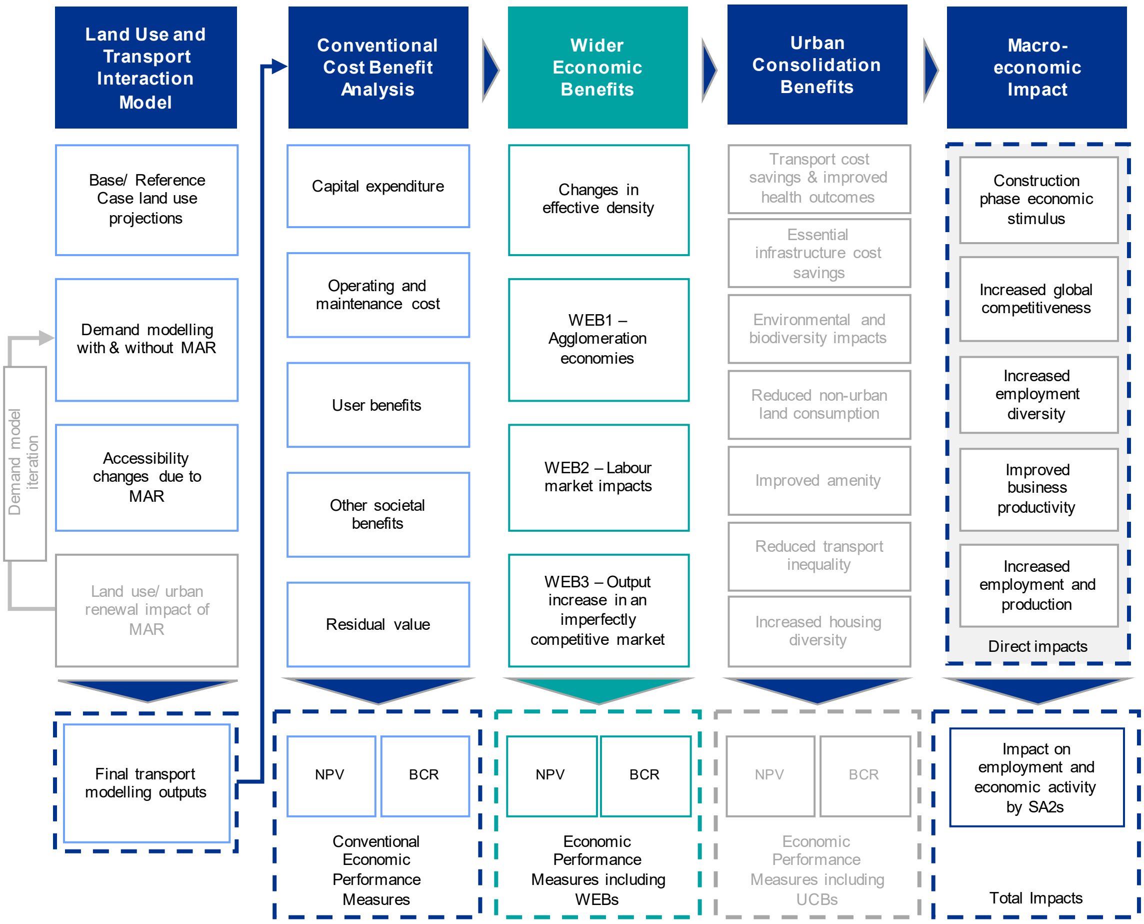
Asset class	Estimated economic life (years)
Network infrastructure	
Rail extensions	70
Earthworks	50 – 150
Bridges – concrete	120
Bridges – timber	40
Tunnels	100
Culverts	100 –120
Rail track	50 – 100
Turnouts	15 – 50
Ballast	60
Sleepers – concrete	50
Sleepers – timber	20
Road pavements - concrete	60 – 80
Road pavements - asphalt	20
Nodal infrastructure	
Stations – rail / light rail	50
System and miscellaneous infrastructure	
Depots, buildings (miscellaneous)	40 – 50
Plant and equipment (miscellaneous)	12
Control centres (IT systems, excl. buildings)	5
Rail signals and communications	20

Source: ATAP M1 (2018b, pg. 77).

Appendix B: WEBs appraisal approach

This appendix presents the detailed approach and assumptions regarding the calculation of WEBs for MAR. Figure 35 highlights the components of the WEBs analysis which have been considered within the economic evaluation.

Figure 35: WEBs within the overarching economic appraisal framework



B.1 Approach for assessing WEBs

The methodologies used to quantify the WEBs for MAR comply with the relevant draft ATAP T3 guideline.[53]

As detailed within the guidelines, WEBs for an infrastructure project can be quantified at either the static or dynamic level, depending on the impact a project has on land use. Due to the nature of the project, the land use impacts of MAR, as assessed within the CityPlan model, are not substantive. As such, the WEBs benefits for MAR are driven by transport network improvements which act to reduce

[53] Transport and Infrastructure Council (2020). *Australian Transport Assessment and Planning Guidelines (ATAP): Wider Economic Benefits [T3] – Draft.*

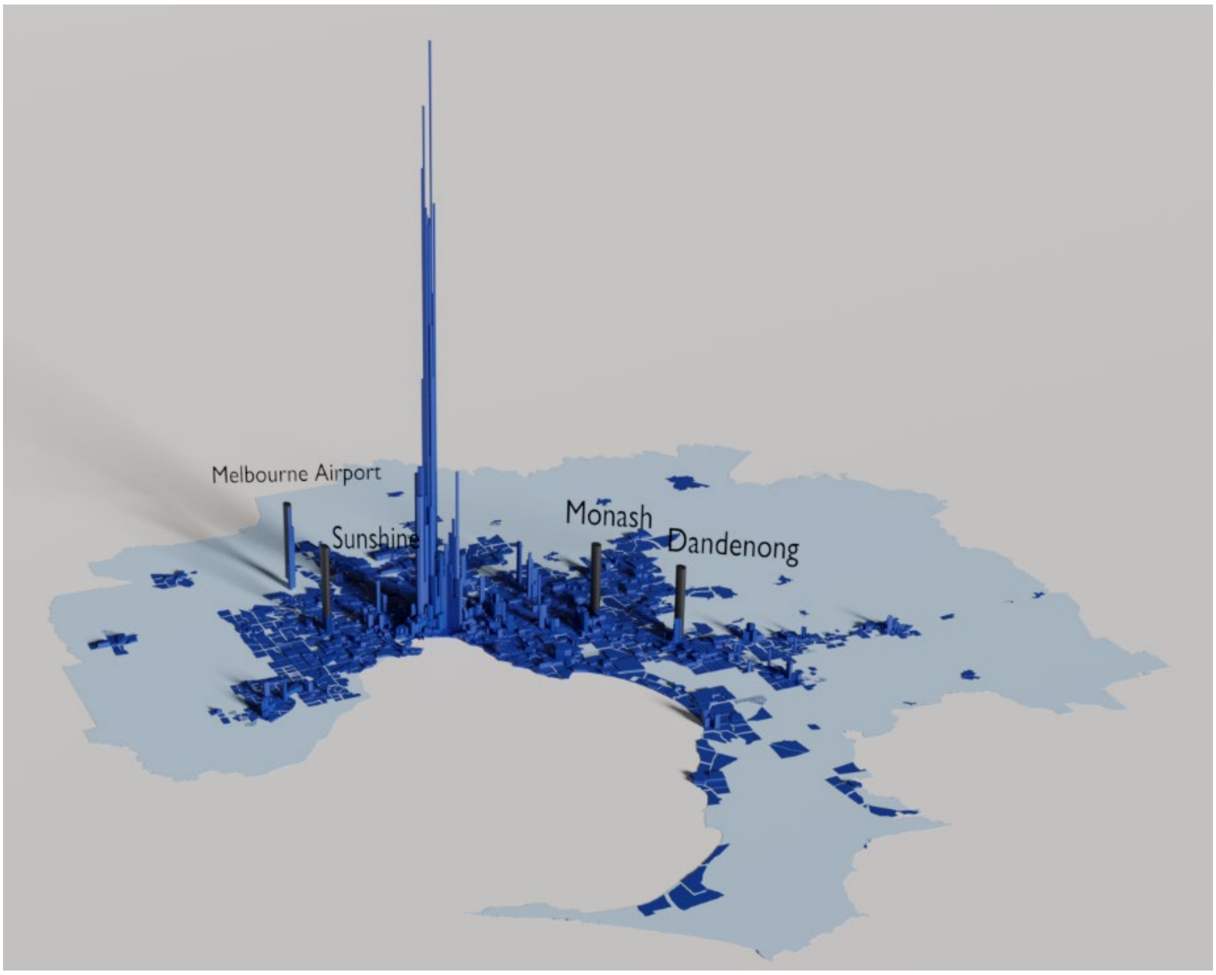
the generalised cost of travel. A detailed explanation of land use impact estimation for MAR is provided in Appendix 5: Demand modelling.

B.2 WEB1: Agglomeration economies

Agglomeration economies are positive externalities which arise from increases in the density of economic activity. The existence of agglomeration economies is one of the reasons that cities exist, as inner-city offices continue to attract tenants despite increasing rents and congested transport networks. Firms benefit from access to greater numbers of other firms, workers and customers. These benefits arise from sharing of inputs and outputs, better matching of workers to employers, and suppliers or customers to firms, and employees learning from one another.

Figure 36 demonstrates the extremely high concentration of employment in Melbourne's CBD, with a peak employment density of 110,000 jobs per square kilometre in the Hoddle Street Grid. This concentration has increased over time, as agglomeration economies have created a positive feedback loop, encouraging more firms to locate centrally. This same dynamic is apparent in other major cities. In New York and London, peak employment density have reached around 150,000 jobs per square kilometre.[54] High employment density leads to increased economic interactions between firms, and also between firms and customers. This leads to benefits as firms are able to enhance their productivity through input sharing, knowledge / technological spillovers and output sharing.

Figure 36: Employment density in Melbourne, 2021



[54] Smith, Duncan (2012). *World City Living and Working Densities: Poles Apart?*.

The method used for estimating the MAR agglomeration economies is consistent with the methodology and parameters specified in the ATAP T3 guideline.

In particular, agglomeration impacts are determined by the changes in Gross Value Added (**GVA**) for all industries and all origins (at the travel zone level). The change in GVA by industry for each origin is mainly driven by the percentage change in productivity between Base Case and Project Case which reflects the rate of change in effective density. Change in effective density is the mechanism through which agglomeration impacts are transmitted (either through changes in transport network performance, changes in land use or both). Effective density is a quantitative measure of access to opportunities, for instance typical jobs, which is quantified using a measure of travel impedance (e.g. generalised cost, time or distance of travel).

The impact of MAR on Melbourne's agglomeration economy is through its potential to improve transport network performance and subsequently increase the productivity in these centres (and Melbourne collectively). Given that the land use impact of MAR is minimal (see Appendix 5: Demand modelling), the economic appraisal for MAR only considers static agglomeration, driven by improved transport network performance.

Algebraically, agglomeration economies can be estimated as:

$$WEB1 = \textit{Change in GVA for all industries across all origins}$$

The mathematical form is shown in Equation 1.

Equation 1

$$WEB1 = \sum_{ind} \sum_{i} D\ GVA_{ind,i} \qquad (1)$$

where:

$D\ GVA_{ind,i}$ = the change in GVA of all industries in origin i

The change in GVA ($) by industry for each origin i ($D\ GVA_{ind,i}$) can be estimated as set out below.

Equation 2

$$\Delta GVA_i = \frac{\Delta Productivity_i}{Productivity_i} \cdot GVApw_i^B \cdot M_i^B \qquad (2)$$

where:

$\frac{\Delta Productivity_i}{Productivity_i}$ = percentage change in productivity at origin i

$GVApw_i^B$ = GVA per worker by industry at origin i, Base Case ($)

M_i^B = employment by industry at origin i, Base Case ($)

The percentage change in productivity by industry for each origin i can be estimated as set out below.

Equation 3

$$\frac{\Delta Productivity_i}{Productivity_i} = \left(\frac{ED_i^P}{ED_i^B}\right)^{\rho} - 1 \qquad (3)$$

where:

ED_i^B = the effective density at origin i in the Base Case

ED_i^P = the effective density at origin i in the Project Case

ρ = productivity elasticity for a given industry group

The ATAP T3 guideline suggests the use of GVA per worker by industry for each small area or travel zone. This appraisal has thus adopted these values; when applying these values to estimate productivity impacts in future years, the GVA per worker was adjusted for changes in labour productivity over time for the appraisal period. The annual productivity growth is assumed to be 1.5 per cent based on Commonwealth Government projections of long-term labour productivity growth published in the 2015 Intergenerational Report.[55]

Effective density

The quantification of agglomeration economies relies on the concept of effective density and the estimation of productivity elasticity parameters.

Effective density describes the (weighted) number of jobs accessible within a given travel impedance. The calculation of effective density uses a decay function to assign high weights to 'near' jobs and low weights to 'far' jobs, and is influenced by the following:

- proximity effects, which refer to increases in effective density enabled by reductions in travel impedance
- cluster effects, which refer to increases in effective density enabled by increases in physical density - the number of jobs within a given unit of area (e.g. jobs per square kilometre).

MAR reduces travel time between Melbourne Airport and key destinations across Melbourne including the CBD and NEICs. It therefore has the potential to increase the number of people working in these employment centres (previously working elsewhere due to longer travel time) and improve skills matching. This will increase the effective density in these centres.

The overall effective density for a particular zone is the sum of the effective density within all other zones (including itself). The equation for estimating effective density (noted as ED below) is shown in Equation 4.

Equation 4

$$ED_i = \sum_j \frac{M_j}{(ACG_{ij})^{\alpha}} \tag{4}$$

where:

M_j = the total employment at destination j

ACG_{ij} = factor representing accessibility of destination j from origin i

α = decay curve parameter

The above specification for effective density can take into account both the proximity (due to transport network impacts) and the scale (due to land use impacts) of economic activity at the destination, ensuring that those destinations that have low travel impedance but also low employment are weighted lower when compared to destinations that have low travel impedance and high employment. As previously noted, given that the land use impact of MAR is minimal, the analysis only considers proximity effects resulting from transport network improvements.

Measure of travel impedance

The purpose of the decay factor is to assign high weights to 'near' jobs and low weights to 'far' jobs. As per the ATAP T3 guideline, the appropriate measure to use as the travel impedance between travel zones is travel time.

Average generalised cost (AGC)

In order to measure effective density, a single measure of travel impedance that considers all modes, trip purposes and time periods is necessary. As per the ATAP T3 guideline, the sum of Base Case and Project Case trip numbers are used as weights to produce a weighted average as shown in Equation 5

[55] Commonwealth of Australia (2015). *2015 Intergenerational Report - Australia in 2055*

and 6. This equation is applied separately to each origin-destination pair in the Base Case and Project Case.

Equation 5

$$AGC_{ij}^{B} = \frac{\sum_{m,p,t}\left(T_{ij}^{B,m,p,t} + T_{ij}^{P,m,p,t}\right) g_{ij}^{B,m,p,t}}{\sum_{m,p,t} T_{ij}^{B,m,p,t} + \sum_{m,p,t} T_{ij}^{P,m,p,t}} \tag{5}$$

Equation 6

$$AGC_{ij}^{P} = \frac{\sum_{m,p,t}\left(T_{ij}^{B,m,p,t} + T_{ij}^{P,m,p,t}\right) g_{ij}^{P,m,p,t}}{\sum_{m,p,t} T_{ij}^{B,m,p,t} + \sum_{m,p,t} T_{ij}^{P,m,p,t}} \tag{6}$$

where:

AGC_{ij} = average generalised cost of travel between origin i and destination j

T_{ij} = number of trips

g_{ij} = generalised cost of travel between zones

m = transport mode (e.g. car, public transport)

p = trip purpose (e.g. business, commuting, freight)

t = time period (e.g. AM peak, inter-peak, PM peak, off-peak)

The average generalised cost of travel (**AGC**) can be calculated using inputs from VITM.

Decay factors

The decay factor represents how the propensity to travel declines as travel time increases. As per the ATAP T3 guideline, decay factors are specified with per industry group as with production elasticities as shown in Table 46.

Table 46: Estimated elasticities of productivity with respect to effective density by industry[56]

ANZSIC	Industry	Group	Productivity elasticity	Decay curve parameter
A	Agriculture Forestry and Fishing	1. low productivity elasticity, low distance decay rate	0.025	**1.1**
B	Mining			
C	Manufacturing			
D	Electricity Gas Water and Waste Services			
E	Construction	2. low productivity elasticity, high distance decay rate	0.025	**1.8**
F	Wholesale Trade			
G	Retail Trade			
H	Accommodation and Food Services			
I	Transport Postal and Warehousing			
P	Education and Training			
Q	Health Care and Social Assistance			
R	Arts and Recreation Services			
S	Other Service			

[56] Commonwealth Department of Infrastructure, Transport, Regional Development and Communications (2020). *Australian Transport Assessment and Planning Guidelines, T3 Wider Economic Benefits, 11 November 2020 draft.*

<table>
<tr><th>ANZSIC</th><th>Industry</th><th>Group</th><th>Productivity elasticity</th><th>Decay curve parameter</th></tr>
<tr><td>J</td><td>Information Media and Telecommunications</td><td rowspan="6">3. high productivity elasticity, high distance decay rate</td><td rowspan="6">0.08</td><td rowspan="6">1.8</td></tr>
<tr><td>K</td><td>Financial and Insurance Services</td></tr>
<tr><td>L</td><td>Rental Hiring and Real Estate Services</td></tr>
<tr><td>M</td><td>Professional Scientific and Technical Services</td></tr>
<tr><td>N</td><td>Administrative and Support Services</td></tr>
<tr><td>O</td><td>Public Administration and Safety</td></tr>
</table>

B.3 WEB2: Labour market deepening

Transport projects can enable labour market benefits by reducing the generalised cost of commuting. Lower generalised costs of commuting reduce barriers to people taking up work / working longer hours or switching to jobs that better match their skills and areas of interest, e.g. moving to more productive jobs. Conventional economic analysis captures the benefits of transport infrastructure to new users through time and operating cost savings, but does not capture the benefits of additional tax revenue due to increased labour force participation or increased productivity of workers. Therefore, labour market deepening benefits arise from the market imperfection created by taxation, in which government realises a proportion of the benefits of increased economic activity.

Labour market deepening benefits arise from increased participation in the labour market (*WEB2a: increased labour supply*) and from existing workers switching to more productive jobs (*WEB2b: move to more productive jobs*). WEB2b is purely driven by land use changes and is therefore not considered within the MAR economic appraisal.

MAR improves overall transport network performance by improving accessibility and connectivity between Melbourne Airport and the rest of the metropolitan network. In turn, this results in reductions to the generalised cost of travel, which in turn encourages job participation (e.g. less burdensome to get to and from work, especially for people with caring responsibilities).

B.3.1 WEB2a: Increased labour supply

Increased labour supply benefits (WEB2a) are based on the theory that in choosing whether to take up work, individuals trade off the perceived benefit of the potential wages with the perceived disbenefit of commuting. A reduction in commuting costs can impact the supply of labour, either by increasing the number of people who choose to work (e.g. an increased participation rate) or by increasing the number of hours worked by those already working. This can be alternatively described as an increase in the labour supply at the extensive and intensive margin respectively.

In either case, there is no additional benefit to the individual. An individual who is encouraged to work by a change in transport cost previously assessed the utility of leisure time as greater than the utility of working net of transport costs. If that individual enters the labour force, the benefit to them cannot be greater than the user benefit counted as part of the conventional travel time savings.

The welfare benefit then is the additional tax revenue received by government, which is a combination of taxes on labour (income and payroll tax) as well as tax on the additional output created by businesses.

Increased labour supply benefits are quantified by estimating the change in the average daily generalised cost of commuting due to the transport improvement for travel zones in Melbourne. The perceived benefit of working (measured in dollars) for each area is defined as the average daily wage minus the average daily generalised cost of commuting. A reduction in the generalised cost of commuting translates to an increase in the perceived benefit of working.

Algebraically, increased labour supply can be estimated as:

$$WEB2a = Change\ in\ Tax\ revenue\ between\ the\ Base\ and\ Project\ Case$$

The mathematical form is shown in Equation 7.

Equation 7

$$WEB2a = \sum_i (\tau_{LS} \cdot D\ GW_i) \quad (7)$$

where:

$D\ GW_i$ = additional gross wages earned by workers resident at each origin i

τ_{LS} = the effective tax take resulting from changes in labour supply (0.17)

The total change in gross wages $(D\ GW_i)$ earned by workers resident at each origin i attributable to the transport intervention can be estimated as set out in Equation 8.

Equation 8

$$D\ GW_i \approx \eta_h \cdot \eta_w \cdot (LFP_{i,PC} - LFP_{i,BC}) \cdot WAP_i \cdot AGW_i \quad (8)$$

where:

$LFP_{i,PC}$ = labour force participation rate for the Project Case for each origin i

$LFP_{i,BC}$ = labour force participation rate for the Base Case for each origin i

WAP_i = working age population usually resident at origin i

AGW_i = average gross wage per worker at origin i

η_h = a reduction factor for the reduced working hours of a marginal worker relative to an average worker (0.7)

η_w = a reduction factor for the reduced hourly wage of a marginal worker relative to an average worker (0.8)

The labour force participation rate for the Project Case $LFP_{i,PC}$ for each origin i can be estimated as set out in Equation 9.

Equation 9

$$LFP_{i,PC} = LFP_{i,BC} + \varepsilon \cdot \%D\ PNRW_i \quad (9)$$

where:

$LFP_{i,BC}$ = labour force participation rate for the Base Case for each origin i

$\%D\ PNRW_i$ = percentage change in the perceived net return from working for a marginal worker

ε = the semi-elasticity of labour force participation with respect to the perceived net return from working (0.18)

The labour force participation rate can be defined as set out in Equation 10.

Equation 10

$$LFP_i = \frac{W_i}{WAP_i} \quad (10)$$

where:

W_i = number of workers usually resident at origin i

WAP_i = working age population usually resident at origin i

The percentage change in the perceived net return from working for a marginal worker between the Base Case and Project Case $\Delta\ PNRW_i$ for each origin i may be estimated as set out in Equation 11.

Equation 11

$$\%D\ PNRW_i = \left(\frac{PNRW_{i,PC}}{PNRW_{i,BC}}\right) - 1 \qquad (11)$$

where:

$PNRW_{i,PC}$ = perceived net return from working at origin i in the Project Case

$PNRW_{i,BC}$ = perceived net return from working at origin i in the Base Case

The perceived (weekly) net return from working $PNRW_i$ for a marginal worker at origin i may be conceptualised as the net wage after taxes and generalised commuting.[57] It is assumed that a full time worker makes five return commuting trips per week (10 trips in total) and a marginal worker takes fewer trips in proportion to fewer hours worked. $PNRW_i$ may be estimated as set out in Equation 12.

Equation 12

$$PNRW_i = \eta_h \cdot \eta_w \cdot (1 - \tau_w) \cdot AGW_i - 10 \cdot \eta_h \cdot AGCC_i \qquad (12)$$

where:

$PNRW_i$= perceived (weekly) net return from working for a marginal worker at origin i

AGW_i = average gross weekly wage per worker at origin i

η_h = a reduction factor for the reduced working hours of a marginal worker relative to an average worker (0.7)

η_w = a reduction factor for the reduced hourly wage of a marginal worker relative to an average worker (0.8)

τ_w = tax wedge for a marginal worker (0.093)

$AGCC_i$ = average generalised cost of one-way commuting trip at origin i

Average gross wages per worker (by usual residence) was sourced from ABS Census data at an SA1 level. Gross wages may be escalated by 1.5 per cent per annum from the evaluation year to forecast years. This aligns with the Commonwealth Government's current assumption from the Intergenerational Report that labour productivity will grow by 1.5 per cent per annum over the next 40 years.

The average, one-way generalised cost of commuting $AGCC_i$ at origin i for a typical weekday AM peak (e.g. 7am – 9am) can be estimated using Equation 13.

Equation 13

$$AGCC_i = \frac{\sum_j((V_{ij,car} + V_{ij,pt}) \cdot GC_{ij})}{\sum_j(V_{ij,car} + V_{ij,pt})} \qquad (13)$$

where:

$V_{ij,car}$ = volume of commuting trips between origin i and destination j by car

$V_{ij,pt}$ = volume of commuting trips between origin i and destination j by public transportation

GC_{ij} = logsum generalised cost ($) of commuting between origin i and destination j

Commuting trip volume inputs can be sourced from a strategic transport model. The logsum generalised cost for each origin-destination pair GC_{ij} can be estimated using Equation 14.

[57] 'Marginal worker' refers to the worker who is at the margins of decision making and weighs the benefit from working (wages after tax and transport cost) equally to the utility from other activities including leisure.

Equation 14

$$GC_{ij} = \frac{\ln \sum_m e^{(\lambda \cdot GC_{ij,m})}}{\lambda} \quad (14)$$

where:

λ = a scaling parameter (-0.3)

m = a transport mode (car or public transport)

$GC_{ij,m}$ = generalised travel cost ($) between origin i and destination j for mode m

B.3.2 WEB2b: Move to more productive jobs

Increased employment opportunities within a worker's travel budget means that a worker can search through a larger range of jobs and better match their skills to the jobs on offer. There is literature that supports the theory that, at the aggregate level, urban residents tend to have an approximate pre-determined daily travel time budget of between 1 to 1.5 hours.[58] It is within this travel budget that workers search for suitable employment. A transport initiative that lowers the generalised cost of travel could bring more jobs within the travel time budgets of individual workers. Some of them might be able to find higher paying, and therefore, more productive jobs.

Note that WEB2b can only be estimated where land use impacts of the transport intervention are available. This is because the benefit is fundamentally driven by land use changes (i.e. jobs moving from lower to higher productivity areas).

Due to the nature of the project, the land use impacts of MAR, as assessed within the CityPlan model, are not substantive and, as such, no WEB2b benefits are claimed. Furthermore, the ATAP T3 guideline does not provide an algebraical method for quantifying WEB2b due to limited data in Australia to estimate the necessary parameters.

B.4 WEB3: Output increase in imperfectly competitive markets

Transport costs act as a barrier to competition and therefore help to maintain imperfect competition. Imperfectly competitive markets mean firms are incentivised to sell less output at higher prices than they would in a perfectly competitive market. Projects that reduce transport costs can enhance the ability for the firms to produce goods at a lower cost, therefore generating additional consumer surplus due to the existence of the price-cost mark-up which is not captured in the conventional economic analysis.

The welfare impact of transport improvement depends on the increase in output attributable to the transport improvement and the price-cost margin applicable to the industry sector. The welfare gain is the product of the two.

Algebraically, output change in imperfectly competitive markets benefit can be estimated as:

*WEB3 = Price-cost margin * Output change*

The mathematical form is shown in Equation 15.

Equation 15

$$WB3 = (BTTS + BRB) \cdot V \quad (15)$$

where:

[58] Stropher, Peter and Zhang, Yun (2011). *Travel time expenditures and travel time budgets - Preliminary findings.* Mokhtarian, Patricia and Chen, Cynthia (2004). *TTB or not TTB, that is the question: a review and analysis of the empirical literature on travel time (and money) budgets.*

$BTTS$ = business travel time savings due to MAR

BRB = business reliability benefits due to MAR

V = uprate factor

The uprate factor used is 0.10, which is provided in the ATAP T3 guideline. The use of the uprate factors presented here implicitly assumes that the uprate factors will remain stable over the course of the project appraisal period.

B.5 WEB4: Increased competition

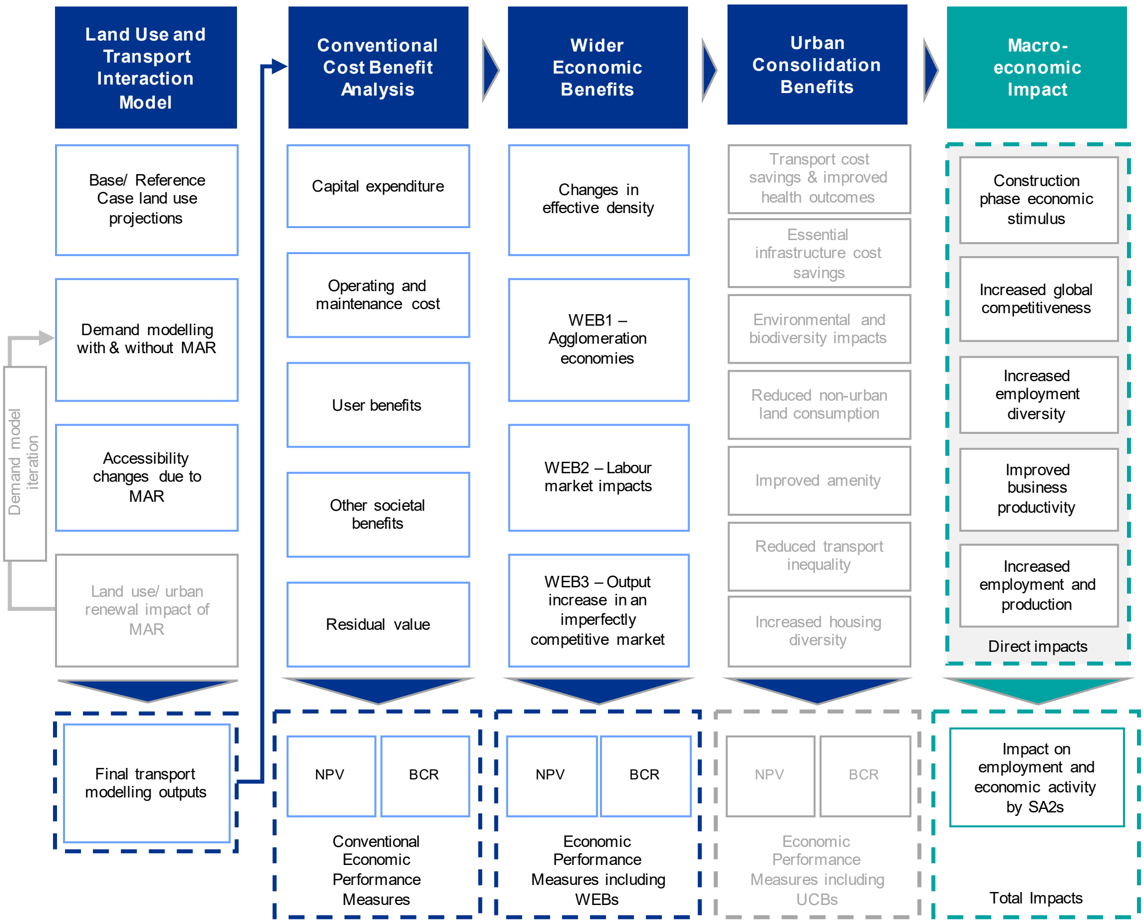
Any transport project which makes an area significantly more accessible has the potential to increase market competition (WEB4) in that area. Significant enhancement in accessibility, and therefore reduction in transport cost, allows new firms to enter the market and effectively compete with incumbent firms. The theory behind WEB4 is that reducing transport costs opens up areas to increased competition, driving production efficiencies, which in turn results in lower prices for consumers.

Any transport projects in developed countries, which are characterised by reasonable transport access, are unlikely to generate significant enough travel cost savings to have a material impact on competition, as is the case for MAR. Consequently, the approach to estimating benefits from increased competition is not discussed in this economic appraisal.

Appendix C: Macroeconomic impacts

This appendix presents the detailed approach and assumptions regarding the quantification and modelling of the macroeconomic impacts associated with MAR. Figure 37 highlights the specific elements of the macroeconomic impact that has been quantified within the economic evaluation.

Figure 37: Macroeconomic impacts within the overarching economic appraisal framework



The macroeconomic wide impact of MAR can be attributable to (and reflected in) its ability to improve the attractiveness of Victoria and Melbourne as a place for investment and in which to live, among other international cities. This is known as the economic benefit of improved global competitiveness and 'Brand Victoria'.

C.1 Improved Global Competitiveness and 'Brand Victoria'

C.1.1 Transport infrastructure provision and a State's global competitiveness

The concept of global competitiveness stems from the competitiveness of businesses and industries, with its application in comparing countries, states and cities first appearing in the 1990s during the rise of globalisation.[59, 60, 61] Rather than the primary focus being on profit maximisation (as it is for many businesses), states compete for much more complex, long-term goals such as:

- attracting population and workforce talent
- gaining private sector investment
- increasing tourism
- receiving funding for public infrastructure
- holding major cultural or sporting events.

These more complex goals set the foundation for the state's long-term growth, liveability, sustainability and prosperity, going beyond short-sighted financial returns alone. In many cases, the global competitiveness of a state is related to the mix of attributes it has which improves the environment in which businesses operate.[62] This can be manifested in the state's economic success in the global market, displayed in 'outcomes' such as gross state product (GSP), employment and income which are driven by 'determinants' including productivity, innovation and the provision of infrastructure.[63]

As part of the above measures, the provision of transport infrastructure plays an important role in contributing to competitiveness. The enabling qualities of having good transport infrastructure on a state's competitiveness is well understood and documented in the literature. Transport infrastructure investments spur business interaction and knowledge exchange, allowing communities to leverage combined resources and assets and has the potential to influence productivity through accessibility and travel time improvements. Transport infrastructure is also considered a 'key service' in modern societies that affects people's daily lives, including life satisfaction and perceived wellbeing. It promotes the progression of modern society by supporting people's interaction, cooperation and mutual understanding.[64] All of these are key for developing productivity, business and growing employment and population in Victoria.

Figure 38 shows an example of the factors in a state competitiveness model to compare cities on a global scale, with 'Metro Access' (i.e. the connectivity of the passenger rail network) identified as one of the headline criteria.

[59] State Competitiveness can also be referred to as 'urban competitiveness' or 'social competitiveness.'
[60] Porter, M. (1990). The Competitive Advantage of Nations. *Harvard Business Review* (March – April 1990)
[61] Porter, M. (1995). The Competitive Advantage of the Inner City. *Harvard Business Review* (May – June 1995)
[62] Begg, I. (1999). Cities and Competitiveness. *Urban Studies*, *36* (5-6), 795-809.
[63] Greene, F., Tracey, P., & Cowling, M. (2007). Recasting the City into City-Regions: Place Promotion, Competitiveness Benchmarking and the Quest for Urban Supremacy. *Growth and Change, 38* (1), 1-22.
[64] Kiel, J., Smith, R., & Ubbels, B. (2014). The Impact of Transport Investments on Competitiveness. *Transportation Research Procedia, 1* (1), 77-88.

Figure 38: Example model of urban competitiveness[65]

This importance of transport infrastructure provision has also been recognised by a number of international growth promoting bodies and publications, notably the World Economic Forum *Global Competitiveness Report* which includes two public transport metrics in railroad density (measured via length of railway per km^2) and efficiency of train services (measured via qualitative survey).[66] In another urban competitiveness model (used to compare cities within the same country), infrastructure was identified as the carrier of economic and social development, with public transport provision being a key metric of this (measured by the number of public transport vehicles per 10,000 population).[67]

C.1.2 Competitiveness of Melbourne and Victoria

Victoria and Melbourne are generally seen as being broadly competitive on a global scale, owing to the good mix of institutions and services provided within the state. Victoria already has the second largest GSP[68] and highest population growth rate[69] in Australia, with the Economist Intelligence Unit's Global Liveability Index ranking Melbourne as the second most liveable city in the world.[70]

However, other measures show significant room for improvement. In a report benchmarking Melbourne against 10 other 'global cities' (such as New York, London and Hong Kong), Melbourne ranks at the bottom in terms of 'Connectivity' and 'Metro Access', and is behind cities such as Sydney, San Francisco and Shanghai.[71]

For example, Melbourne does not have an airport rail service, compared with other major international cities or Sydney more locally. Introducing an airport rail link will help move Victoria in line with other comparable major cities and can increase the 'perceived' value of doing business in Victoria for global investors and skilled migrants who consider living in Victoria. Key infrastructure such as an airport rail can also improve the competitiveness of Victoria in attracting talent and investment.

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[65] Hu, R., Blakely, E., & Zhou, Y. (2013). Benchmarking the Competitiveness of Australian Global Cities: Sydney and Melbourne in the Global Context. *Urban Policy and Research, 31* (4), 435-452.
[66] Schwab, K. (2017). *The Global Competitiveness Report 2017–2018*. World Economic Forum
[67] Liu, X., Guo, H., Li, Y., Li, Y., & Pan, W. (2016). Measuring the urban competitiveness of Chinese cities based on multi-attribute decision making approach. *International Journal of Sustainable Development, 19* (4), 315-341
[68] Australian Bureau of Statistics (2019). *Australian National Accounts: State Accounts, 2018-19.* Cat. No 5220.0
[69] Australian Bureau of Statistics (2019). *Australian Demographic Statistics, Jun 2019.* Cat. No 3101.0
[70] The Economist Intelligence Unit (2018). *The Global Liveability Index 2018*
[71] Hu, R., Blakely, E., & Zhou, Y. (2013). Benchmarking the Competitiveness of Australian Global Cities: Sydney and Melbourne in the Global Context. Urban Policy and Research, 31 (4), 435-452.

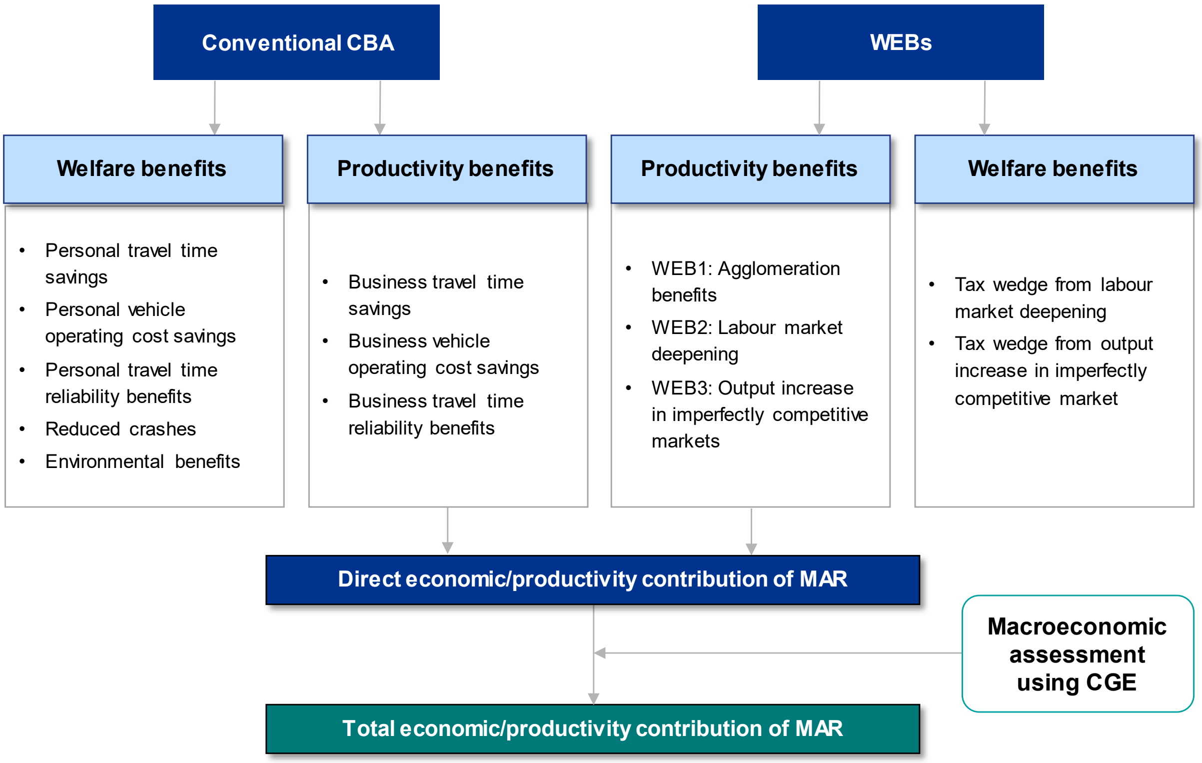
C.2 Approach to quantification of macroeconomic benefits

MAR represents a significant investment that will have a material impact on the capital stock and employment within Victoria. MAR will enable employment and economic growth opportunities at a regional, state and national level. As such, it is pertinent that the project's total economic contribution is assessed to obtain an understanding of how MAR will affect the broader economy. Major rail infrastructure investments, such as Crossrail 2 and HS2, have adopted this approach and made significant findings associated with the total economic contribution of these projects.

The economy-wide impact of MAR has been assessed using KPMG-SD, a regional Computable General Equilibrium (CGE) model of the Australian economy. This approach assesses the total impact that MAR has on the labour market, including flow-on effects, and other key markets. As such, the analysis estimates the economy-wide impacts of the proposed infrastructure investment and the operational phase at the state and national levels.

The framework, inputs and process for assessing the macroeconomic impact of MAR is illustrated in Figure 39.

Figure 39: Framework for assessing the macroeconomic impact of MAR



The macroeconomic indicators assessed using CGE modelling will draw on the following (Table 47) productivity metrics associated with MAR.

Table 47: Productivity metrics of MAR simulated by CGE analysis

Direct investment (financial) related productivity metrics	CBA related productivity metrics	WEBs related productivity metrics
The productivity metrics associated with the direct investment in MAR include: • construction phase capital investment • operational phase operating expenses.	The productivity metrics associated with MAR's CBA include: • direct estimated changes in business travel time, reliability and vehicle operating costs.	The productivity metrics associated with MAR's WEBs include: • increased productivity by increasing economies of agglomeration • increased labour supply by reducing commuting costs

That is, the CGE analysis has used the above productivity metrics as inputs when simulating the macroeconomic impacts. The macroeconomic impacts (indicators) of MAR simulated by CGE analysis include the following:

- construction phase stimulus (e.g. on the labour market and consumption)
- operational phase impact - improved global competitiveness and 'Brand Victoria', that will be reflected in:
  - increased immigration
  - increased productivity by industries (including improved transport efficiency)
  - increased production (e.g. GDP, GSP) and employment
  - increased household income and consumption
  - increased tax revenue collected by the government.

C.3 KPMG-SD model

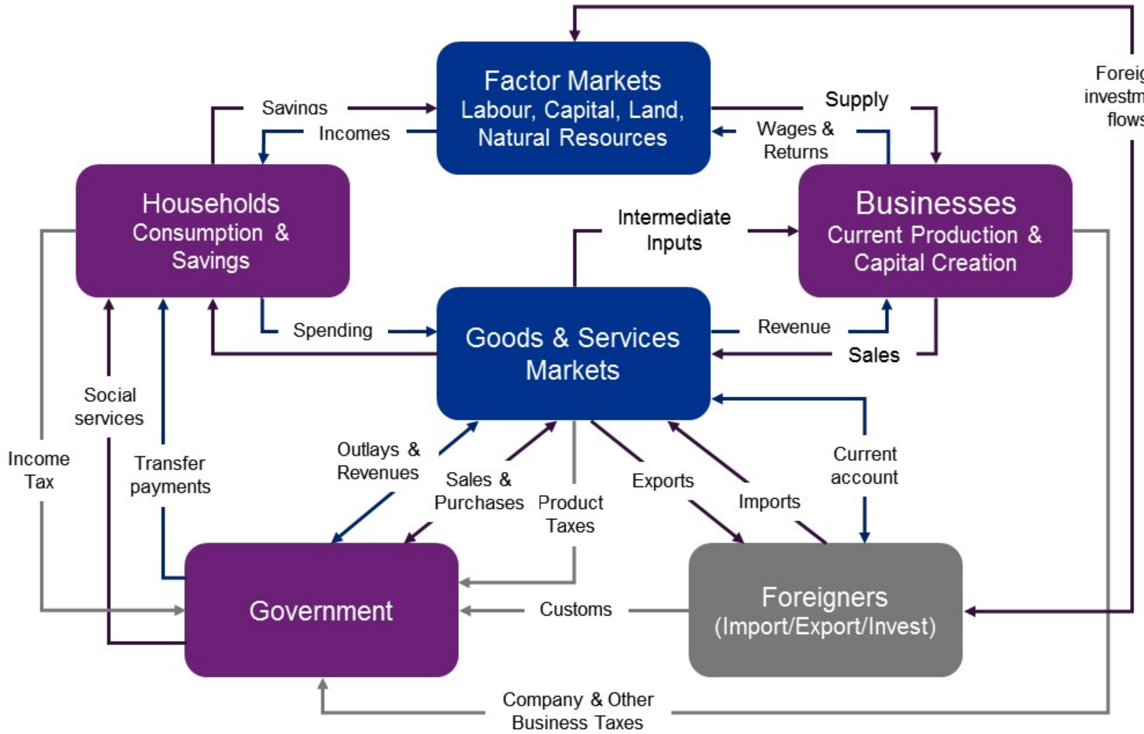
C.3.1 Model overview

The approach to estimating the economy-wide effects of the Melbourne Airport Rail (MAR) project is based on a detailed, policy-focussed model of the Australian economy: the KPMG-SD model. This is KPMG's proprietary computable general equilibrium model of the Australian statistical divisions (hereafter referred to as regions). KPMG-SD has been specifically designed for the analysis of regional policies as it explicitly captures:

- linkages between industries within and between regions;
- flows of income stemming from jobs and profits supported by industry activity within each region
- relationships between the government sector and the rest of the economy.

The KPMG-SD model represents the economy as a system of interdependent economic agents and thus is capable of tracing and quantifying the impact of the MAR project from one sector to another. Figure 40 shows a stylised representation of the transmission channels through which the impact of MAR affects the whole economy.

Figure 40: System of interdependent economic agents



Economic theory is used to specify the behaviour and market interactions of economic agents in KPMG-SD. Defining features of the theoretical structure of KPMG-SD include:

- optimising behaviour by households and businesses in the context of competitive markets with explicit resource constraints and budget constraints
- the price mechanism operates to clear markets for goods and factors, such as labour and capital i.e. prices adjust so that supply and demand are equal
- marginal costs are equal to marginal revenues in all economic activities.

The model combines data from input-output tables, labour force surveys and other sources with the model theory to quantify sophisticated behavioural responses such as:

- price and wage adjustments driven by resource constraints
- household spending and government spending, and taxing adjustments driven by budget constraints
- allowance for input substitution possibilities in production (e.g. allowing the combination of labour, capital, and other inputs required for production to vary in response to relative price changes).

KPMG-SD takes a 'bottom-up' approach to multiregional modelling. In each region, economic agents decide the allocation of labour, capital and land to different productive activities. The cost structure of firms in each sector, the composition of investment goods, the endowments and preferences of households and the level and composition of public expenditures are all region-specific. Regions are interdependent via bilateral flows of goods and services between regions and with the rest of the world. Bilateral trade flows are facilitated in the model via a detailed specification of transport margins for goods.

The dynamic features of KPMG-SD are built on the premise that economic adjustment to economic shocks takes place over a period of years with the economy demonstrating much greater flexibility in the long-run than in the short-run. A core dynamic feature is the accumulation of capital. Investment behaviour is industry-specific and is positively related to the expected rates of return, which depend on the growth rates of the capital stock. The capital growth rate in any industry is determined by investment in the previous year less capital depreciation. Another dynamic feature of KPMG-SD is the lagged adjustment process in the labour market. The real wage rate adjusts gradually over time until employment reaches its long-run equilibrium level; this relationship is calibrated using coefficients estimated by the NIGEM macroeconomic model. Workers are somewhat mobile between regions in response to changes in real wage rate relativities.

C.3.2 Model implementation

The KPMG-SD database typically represents regional economies aligned to SA4s. For this study, a regional aggregation has been used that explicitly captures the areas through which the new rail line will run, as well as other surrounding areas of Melbourne. The regional aggregation includes eight SA4 regions representing the Greater Capital City area of Melbourne, and composite rest of Victoria and rest of Australia regions. The areas directly impacted by MAR include Melbourne Airport, Keilor and Sunshine, as shown in Figure 41. These SA2 regions are represented by the Melbourne - North West and Melbourne - West regions in the KPMG-SD model (Table 51). The regional economies represented in KPMG-SD are integrated through interregional flows of goods and services, factors of production and the explicit representation of population and labour supply.

Figure 41: Area coverage of the Melbourne Airport Rail project

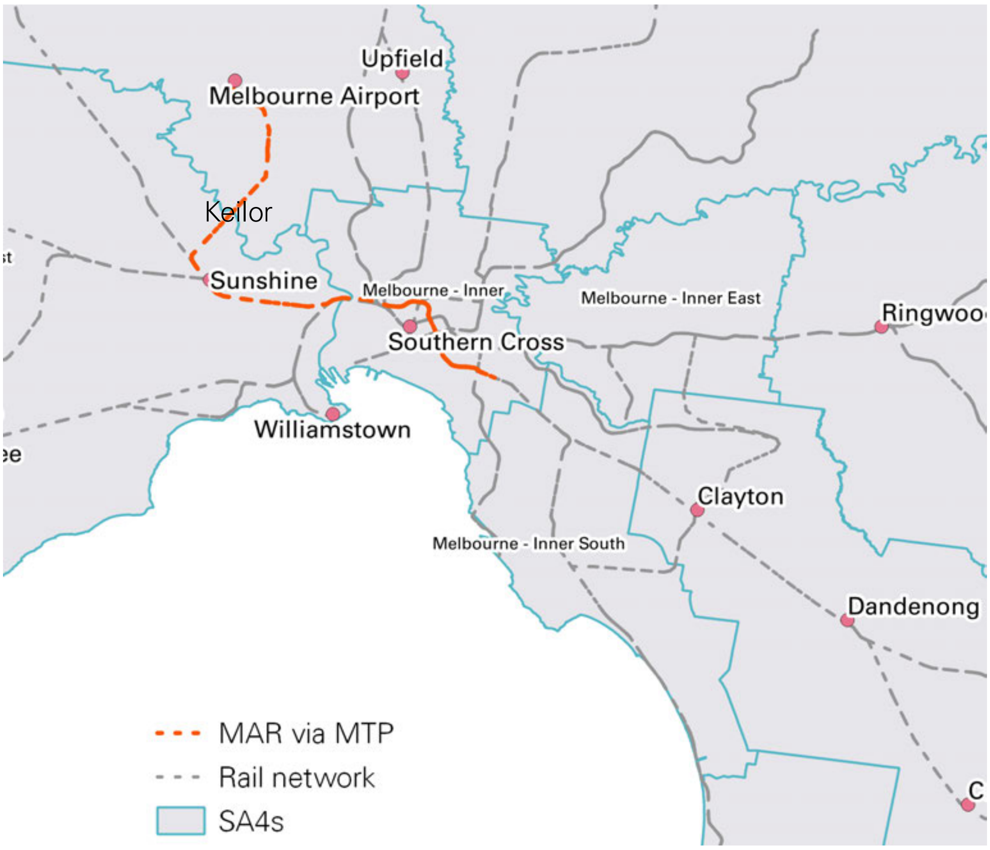


Table 48: Regional aggregation in KPMG-SD

KMPG-SD regions	MAR line key areas
Melbourne – Inner	
Melbourne - Inner East	
Melbourne - Inner South	
Melbourne - North East	
Melbourne - North West	Keilor (SA2)
	Melbourne Airport (SA2)
	Rest of Melbourne - North West
Melbourne - West	Sunshine (SA2)
	Rest of Melbourne - West
Melbourne - Outer East	
Melbourne South East	
Rest of Victoria	
All other SA4 regions	

The KPMG-SD model also represents the economy at a high level of industry detail. In standard form, the model has 117 sectors, but these are aggregated to a more manageable number to focus on sectors of particular interest to the analysis. Table 49 presents the final industry aggregation. The aggregated sectors correspond to the broad sectors defined in National Accounts except for the transport sector and industries servicing the transport sector. The analysis has identified 28 sectors for each of the 11 regional economies with each sector producing one good or service. Note that the terms ‘sectors’ and ‘industries’ are used interchangeably throughout this report.

Table 49: Industry aggregation in KPMG-SD

Industry	
1. Agriculture, Forestry & Fishing	15. Air Passenger
2. Mining	16. Air Freight
3. Petroleum products	17. Other Transport, Support Services and Storage sector
4. Motor vehicle, Parts and Auto Repair	18. Information Media & Telecommunications
5. Other manufacturing	19. Financial & Insurance Services
4. Electricity, Gas, Water & Waste Services	20. Rental, Hiring & Real Estate Services
5. Construction	21. Professional, Scientific & Technical Services
6. Wholesale trade	22. Administrative & Support Services
7. Retail trade	23. Public Administration and Defence
8. Accommodation & Food Services	24. Education
9. Road Passenger	25. Healthcare & Social Assistance
10. Road Freight	26. Arts & Recreation Services
11. Rail Passenger	27. Other Services
12. Rail Freight	28. Dwellings

C.4 Simulations / scenarios tested

The economic effects of MAR are assessed against a Base Case (or baseline) scenario. Note that the terms 'Base Case' and 'baseline' are used interchangeably. The Base and Project Cases are generally described as:

- **Base Case** – ground access to Melbourne Airport remains reliant on road transport in Victoria, with ongoing capital expansion in road operations consistent with assumed growth in population and passenger volumes.
- **Project Case** – this is a counterfactual scenario where MAR is constructed and then comes into operation. It considers the investment spending to construct the airport rail infrastructure, the operational expenditure, and the direct benefits arising from the project such as time savings by public and private transport users.

As the model is dynamic, it is run twice over a 60-year horizon to implement the construction and operational phases of the project. In dynamic mode, a simulation of the effects of MAR involves running the model once to create the baseline (or business-as-usual) scenario and once to create the Project Case scenario. In running these two simulations, a valid closure must be implemented – i.e. a sub-set of variables must be selected that the model will be allowed to determine (endogenous variables) with the remainder set outside the model (exogenous variables). The set of exogenous variables will include the variables that will be shocked. In the baseline scenario, the paths of most macroeconomic variables are exogenous over the simulation period and set in accordance with forecasts made by KPMG-MACRO (KPMG's macroeconomic model) and other macroeconomic forecasting groups (e.g. population forecasts from DELWP and ABS). In the Project Case scenario, most macroeconomic variables are endogenous. Other than the specific project variables of interest (e.g. additional investment or output from the MAR project), all exogenous variables in the Project Case scenario are assigned the values they have in the baseline scenario. The differences in values between the Project Case and baseline scenarios quantify the economic contribution of MAR.

C.5 Simulation inputs and assumptions

The project inputs capture the direct economic impacts of MAR during the construction and operational phases. By applying these inputs to the KPMG-SD model, the direct and indirect annual effects on the economy of the rail link can be estimated. The construction and operational phases of the MAR project are simulated over a 60-year period.

C.5.1 Rail infrastructure and operation

The projected capital expenditure for MAR over the construction period is derived from the financial analysis. The capital expenditure is implemented in the model as annual investment shocks to the Rail transport sector in Greater Melbourne.

During the operational phase, the annual operating and maintenance (**O&M**) expenses are applied as derived from the financial analysis. The O&M costs are also applied as annual investment shocks in the Rail transport sector in Greater Melbourne. As the rail system operates as a network, the project will increase capacity and productivity along the entire rail corridor. This is captured in KPMG-SD by having the benefits of the rail corridor applied to all 12 Melbourne regions.

C.5.2 Project financing

The base assumption is that all investment is initially financed by the government through borrowings such that government debt is increased by the total investment cost per year. As a result, government debt rises above baseline levels during the construction phase reflecting the cost of implementing the rail link. Once the construction phase ends the government budget (as a ratio of GDP) is slowly reduced to baseline levels during the operational phase. This is achieved through higher income taxes raised by the Australian Government and paid to Victoria via higher intergovernmental grants. In the last year of the forecast period the Victorian Government pays back all borrowings used to finance their share of the investment cost (50 per cent). This is achieved via a broad-based consumption tax raised in Victoria. This means that the project build cost is equally shared by the Commonwealth and Victorian governments reflecting the financing arrangements of the project.

C.5.3 Changes in transport use

Following the introduction of MAR, the mode shift from private vehicles to public transport will generate economic benefits. The changes in transport use and associated benefits have been estimated in VITM. These estimates are summarised in Table 50 and have been applied to KPMG-SD as inputs. In particular, VITM provides estimates of changes in public transport use, farebox revenues and travel time savings for new and existing public transport users due to the project.

Table 50: KPMG-SD inputs during operational phase, $m

		MAR exc. SRL in the Base Case	MAR inc. SRL in the Base Case
	PUBLIC TRANSPORT	**27.10**	**9.67**
1	Farebox revenue - business	1.52	0.79
2	Farebox revenue - non-business	7.40	3.75
3	Value of PT travel time savings - business	5.61	1.60
4	Value of PT travel time savings - non-business	12.58	3.53
	ROAD BENEFITS	**16.40**	**8.48**
5	Value of car travel time savings - business	2.26	1.03
6	Value of car travel time savings - non-business	4.90	2.54

		MAR exc. SRL in the Base Case	MAR inc. SRL in the Base Case
7	Value of truck travel time savings	0.74	0.42
8	Reduction in vehicle operating costs, parking fees and tolls - business	1.41	0.71
9	Reduction in vehicle operating costs, parking fees and tolls - non-business	6.84	3.56
10	Reduction in vehicle operating costs, and tolls - trucks	0.25	0.22
11	**WIDER ECONOMIC BENEFITS (WEBs)**	**10.81**	**5.08**

Public transport

VITM provides the network-wide change in farebox revenues for the modelled years. The underlying assumption is that all changes in farebox revenues are associated with rail use. The farebox revenues are used to estimate the change in demand for public transport by households and firms (rows 1 and 2 of Table 50). To model the public transport impacts of MAR, these aggregate impacts are allocated across the model regions based on changes in the number of public transport trips in each region as estimated in VITM.

Private transport

Car trips (business and non-business travel)

Switching to public transport is associated with savings in travel times for users engaged in both business-to-business (**B2B**) travel and non-business travel. B2B travel time savings are assumed to be devoted to work (Table 50, rows 3 and 5). In the model, these savings are translated into labour-saving productivity improvements for firms in the following sectors: Health and Education, Public Services and Other Services. These sectors predominantly use cars and other light vehicles whereas sectors such as Manufacturing and Trade predominantly use trucks or other heavy vehicles. While B2B travel time savings are assumed to be devoted to work, non-business travel time savings are assumed to be devoted to leisure and are implemented in KPMG-SD as an exogenous increase in welfare due to increased leisure time for households (Table 50, rows 4 and 6).

Switching from private cars to public transport for business purposes results in savings to firms in terms of VOCs, and tolls and parking fees. These are shown in Table 50, row 8. In KPMG-SD, reductions in VOC are modelled as reductions in consumption of Petrol Products and Motor Vehicles and Repairs. Reductions in tolls and parking fees are modelled as reductions in demand for Other Services. Changes to non-business car trips are associated with the same types of benefits as changes to B2B car trips but these benefits are assumed to accrue to households rather than firms. The household benefits associated with car trips are shown in Table 50, row 9.

Truck trips

Estimated savings in VOC, tolls and time for truck trips are assumed to accrue to firms in the road freight industry and those in other sectors that operate heavy vehicles on their own account. While savings associated with B2B car and public transport travel were assumed to accrue to firms in service industries, savings associated with truck trips are assumed to accrue to firms in non-service industries. The methodology for applying the impacts on truck trips is identical to that for B2B car trips except that parking fees are not applicable. Estimated truck cost savings are shown in Table 50, rows 7 and 10.

Wider Economic Benefits

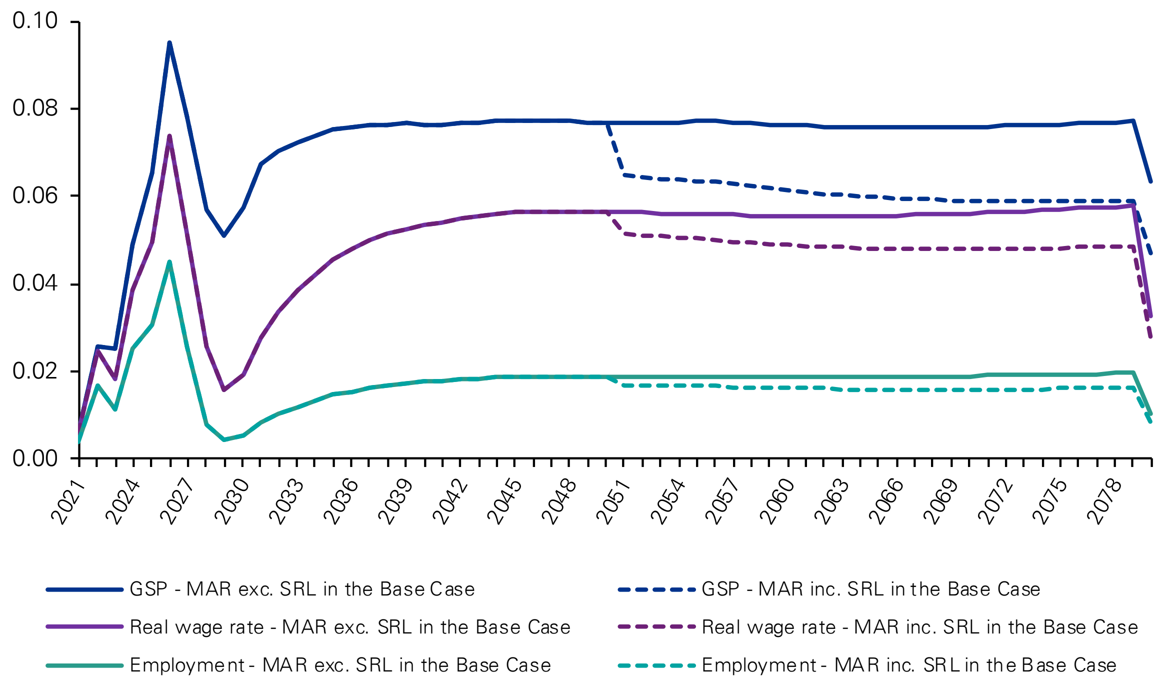
WEBs are presented in Table 50, row 11. As highlighted in Section 6, WEB1 (agglomeration) contributes the most to benefits while WEB2 (labour market deepening) has a much smaller impact. WEB3 benefits were also calculated but have not been implemented within the macroeconomic modelling. This is because these benefits arise from imperfect competition in product markets and this is not consistent with the assumption of perfectly competitive markets in KPMG-SD. The WEB1 and WEB2 inputs are represented in KPMG-SD as additional productivity improvements.

C.6 Simulation results

Figure 44 shows the economy-wide effects of MAR on GSP, the average real wage rate and employment for Victoria. The key observations include:

- During the construction phase, the investment stimulus increases labour demand and decreases the unemployment rate, which in turn puts upward pressure on real wage rates. The increase in employment causes real GSP to increase with the peak observed in 2026. This coincides with the average real wage rate peak in 2026.
- As construction activity winds down, the average real wage rate starts to fall from 2027. This causes the unemployment rate to rise reflecting the fall in aggregate employment. As a result, employment is slightly below baseline at the end of the construction period but gradually moves above baseline in the long-run due to the expansion in economic activity in Victoria.
- In the long-run the main benefits of MAR are in the form of higher GSP and real wage rates with smaller benefits in employment. Note that the tax imposed in Victoria in the final year to pay for the Victorian Government's share of the debt associated with the cost of MAR causes consumption and therefore GSP to fall noticeably.
- Real GSP and employment are lower under the scenario where the SRL North connection to the Melbourne Airport is included in 2051.

Figure 42: Effect of MAR on Victorian GSP, real wage rate and employment



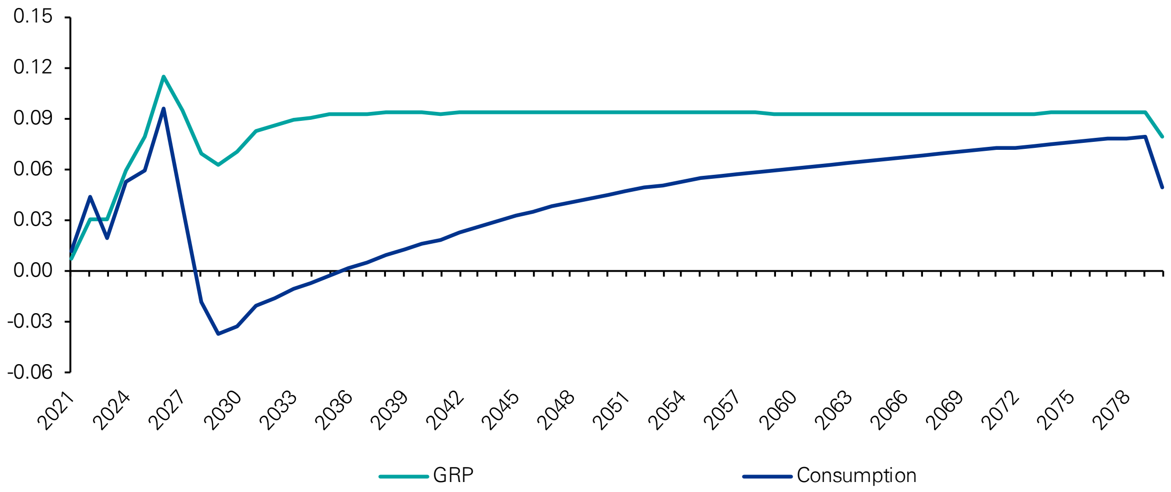
The remainder of this section presents the economic impacts of MAR exc. SRL in the Base Case. As shown in Figure 44, the effects of MAR inc. SRL are similar to MAR exc. SRL albeit it with a smaller magnitude. The results presented below are discussed in a bottom-up approach starting with the impacts on the Greater Melbourne region, followed by the impacts on the Victorian and Australian economies.

C.6.1 Impacts on Greater Melbourne

An overall measure of economic gain in a particular region or state is the Gross Regional Product (GRP) or Gross State Product (GSP). Figure 45 shows a positive impact on the GRP of Greater Melbourne. The peak of the GRP gain (0.12 per cent) occurs when construction activity is at its peak. GRP is 0.08 per cent higher relative to baseline at the end of the forecast period. This increase in GRP is equal to the sum of the changes in household consumption, aggregate investment, government spending and net exports (i.e. exports minus imports). The effects of MAR on these GRP components is described below.

The MAR project increases household consumption as illustrated in Figure 45. This is driven by higher household disposable income and wealth due to the increase in employment (Figure 47) and profits driven by the switching of economic activity to higher value-added sectors at the margin. The rise in consumption also peaks in 2026 when employment is highest over the construction period. Note that the imposition of a consumption tax in Victoria in the final year to pay for the Victorian Government's share of the debt associated with the cost of MAR causes consumption and therefore GRP to fall noticeably. Notwithstanding, real household consumption is 0.5 per cent higher relative to baseline at the end of the forecast period.

Figure 43: Real consumption and GRP results, % change from baseline, Greater Melbourne



Investment and exports are strongly affected by the project's construction phase as shown in Figure 46. The large investment response reflects mainly the direct capital expenditure of the project with the peak occurring in 2026. The initial investment spike increases the real cost of capital, which in turn raises domestic production costs relative to the rest of Australia and the rest of the world. This manifests as a rise in the international terms of trade: international export prices increase relative to international import prices. The terms of trade effect initially causes exports to become less competitive in international markets and imports to become more competitive relative to domestically-produced goods. As indicated in Figure 46, this means international exports fall and international imports rise during the construction phase. This leads to a decline in the current account balance that is matched by increased foreign borrowing, which is required to finance the project.

During the operational phase investment moves towards baseline levels in the long-run and this allows production costs and therefore the terms of trade to fall leading to a recovery in net international exports.

Figure 44: Real investment, exports and import results, % change from baseline, Greater Melbourne

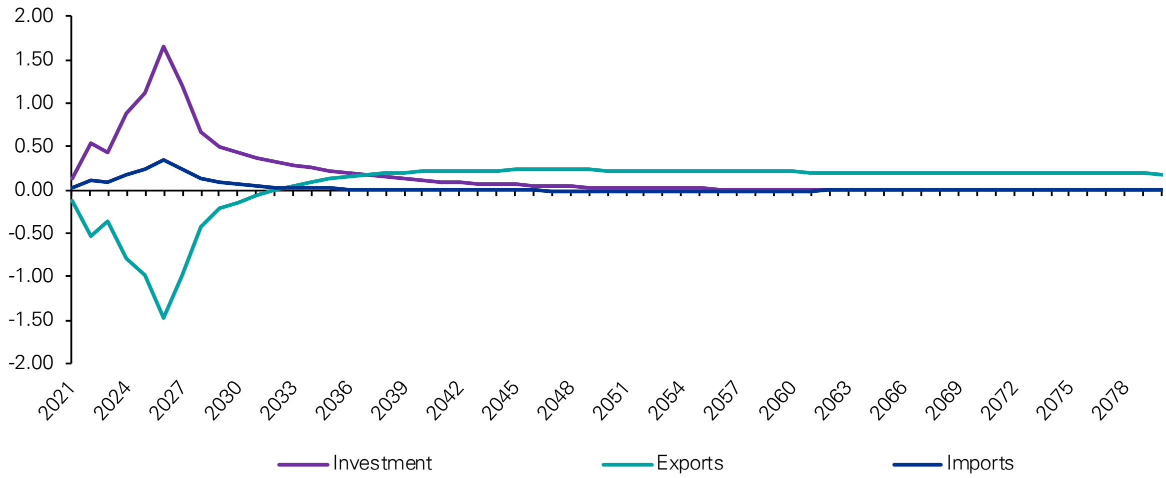
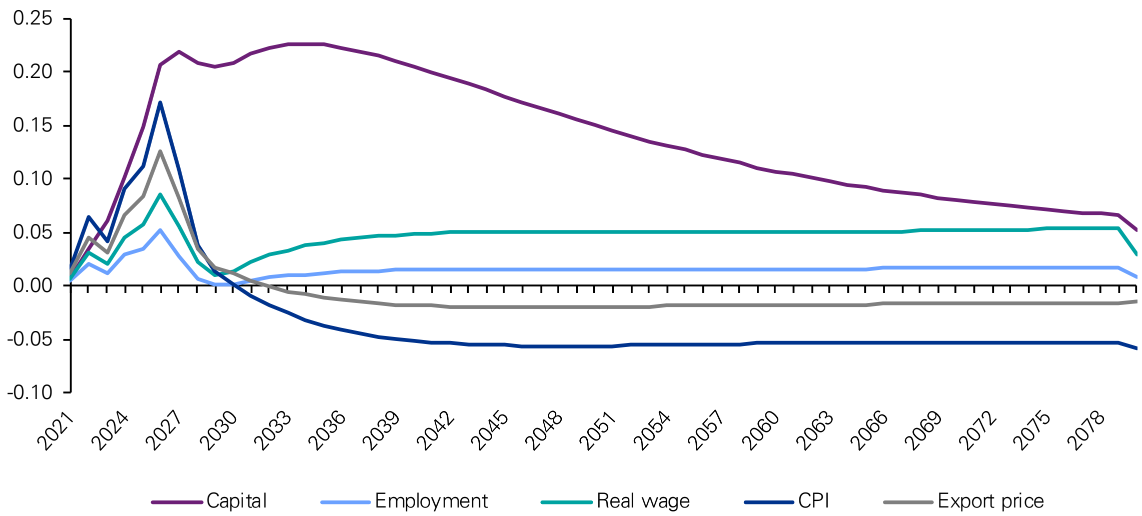


Figure 47 presents the effects on capital, labour and various price indices. With the additional investment in the early years of the project there is a large increase in the capital stock during the construction phase. The construction activity increases labour demand and decreases the unemployment rate. Figure 47 shows that employment peaks in 2026 when investment spending is highest. Consistent with this, real wage rates rise strongly over this period in response to the increased demand for labour required by the higher investment expenditure. Higher capital and labour income results in higher household income and thus higher consumption (Figure 45). After the construction phase, employment winds down relative to capital. This lower employment reduces household income leading to a temporary fall in household consumption in the medium-run (Figure 45). Employment then rises again during the operational phase and remains above baseline in the long-run due to the expansion of economic activity in Greater Melbourne. This increases household income relative to baseline, leading to higher consumption in the long-run.

Figure 45: Real GRP income components and price indices, % change from baseline, Greater Melbourne



C.6.2 Impacts on Victoria

Figure 48 to Figure 50 show the economic effects for Victoria. The patterns are consistent with those already discussed for Greater Melbourne but the effects are smaller in magnitude. This implies that the impact of MAR is concentrated in the Greater Melbourne region with movements of resources from other regions as both labour and capital are drawn into the project.

Figure 46: Real consumption and GSP results, % change from baseline, Victoria

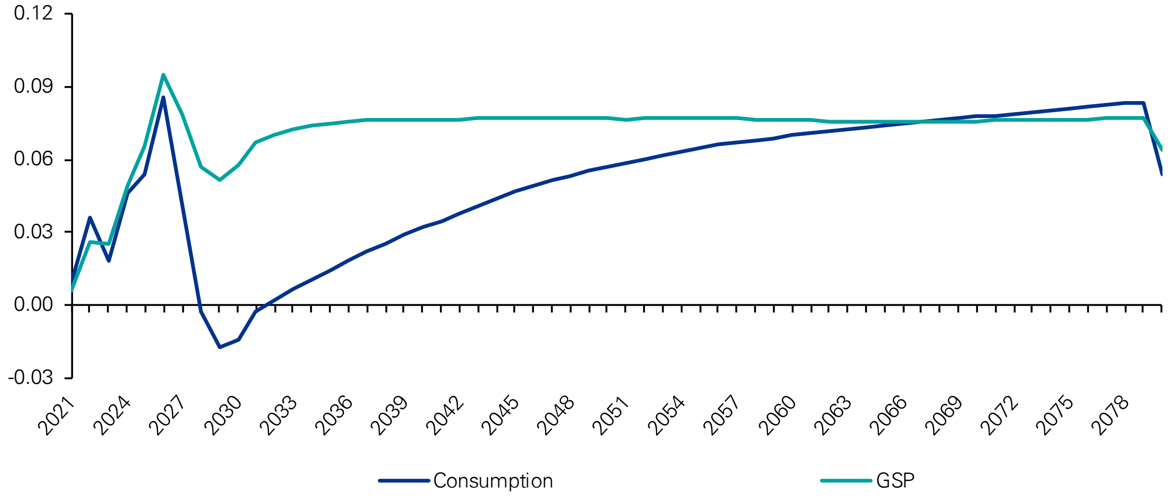


Figure 47: Real investment, exports and import results, % change from baseline, Victoria

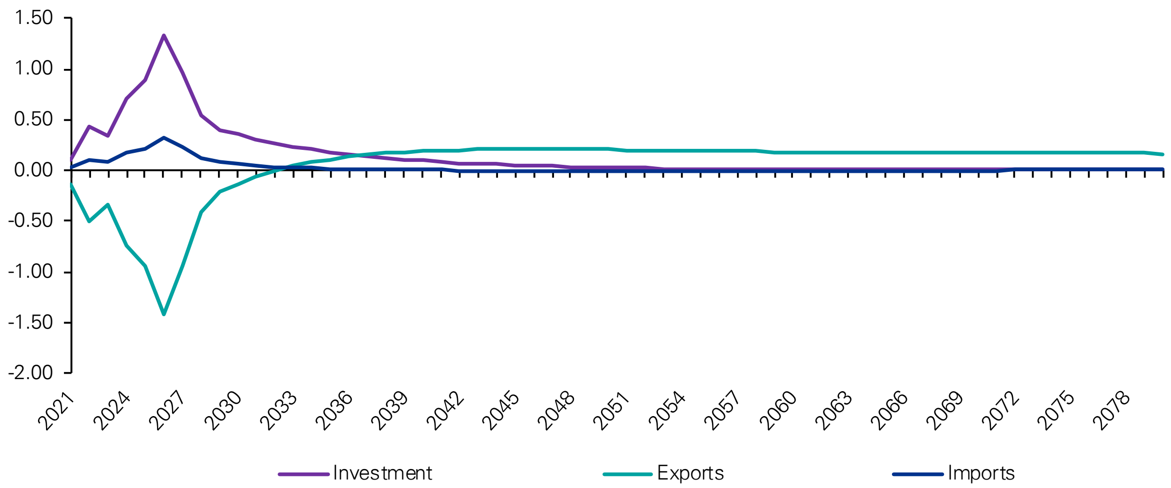
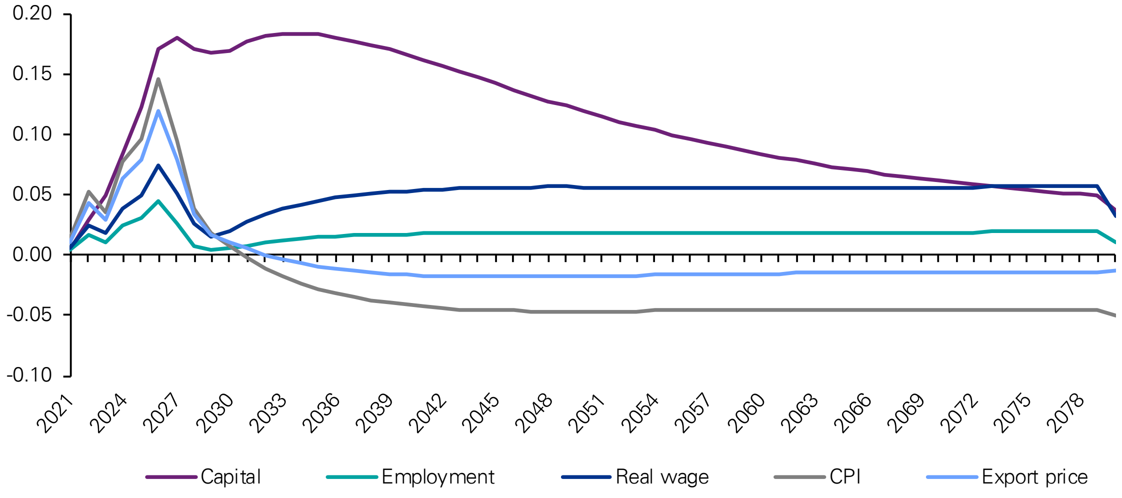


Figure 48: Real GSP income components and price indices, % change from baseline, Victoria



C.6.3 Impacts on the Australian economy

Figure 51 to Figure 53 show the results for Australia. The patterns are similar to the Victorian results but are of much smaller magnitude.

Figure 49: Real consumption and GDP results, % change from baseline, Australia

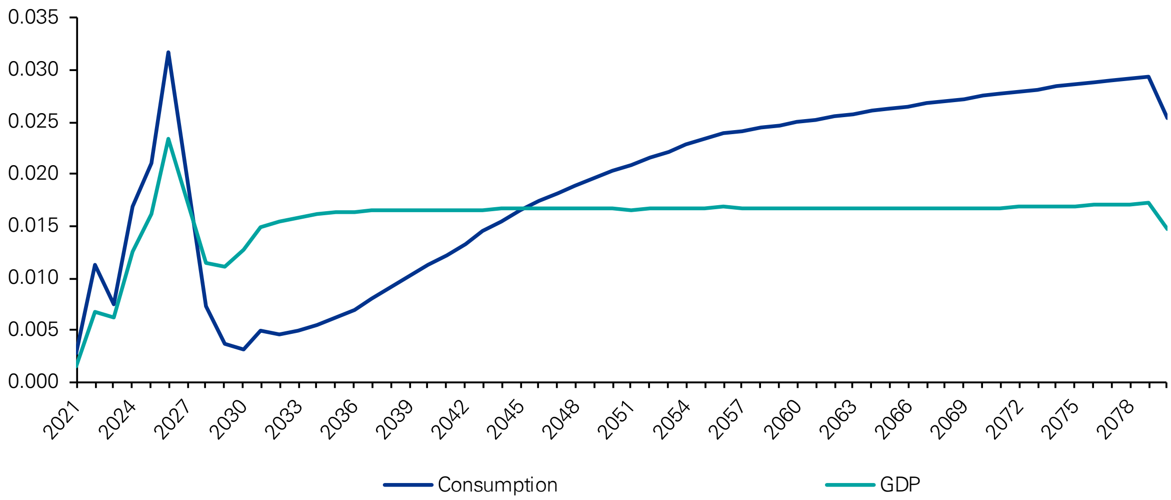


Figure 50: Real investment, exports and import results, % change from baseline, Australia

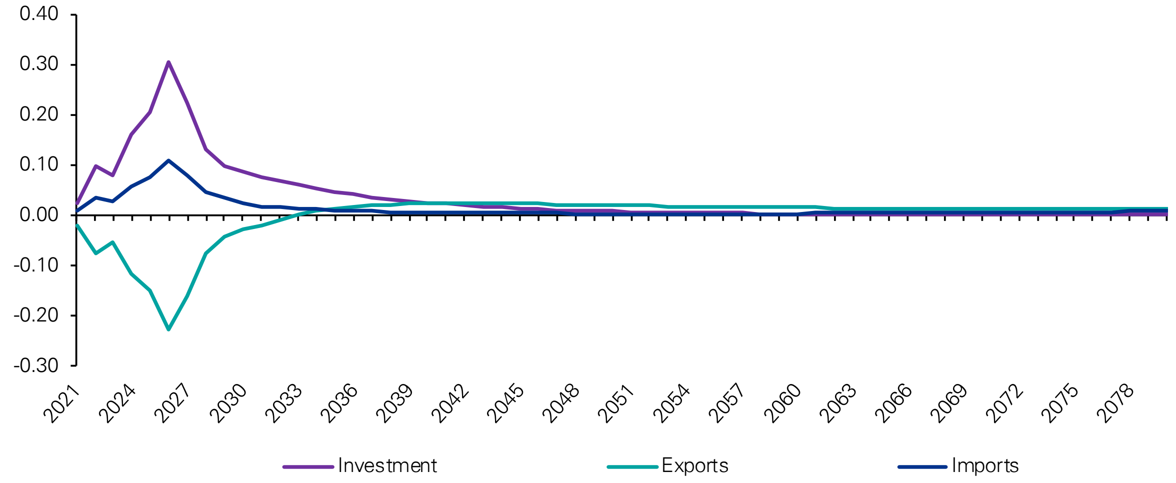
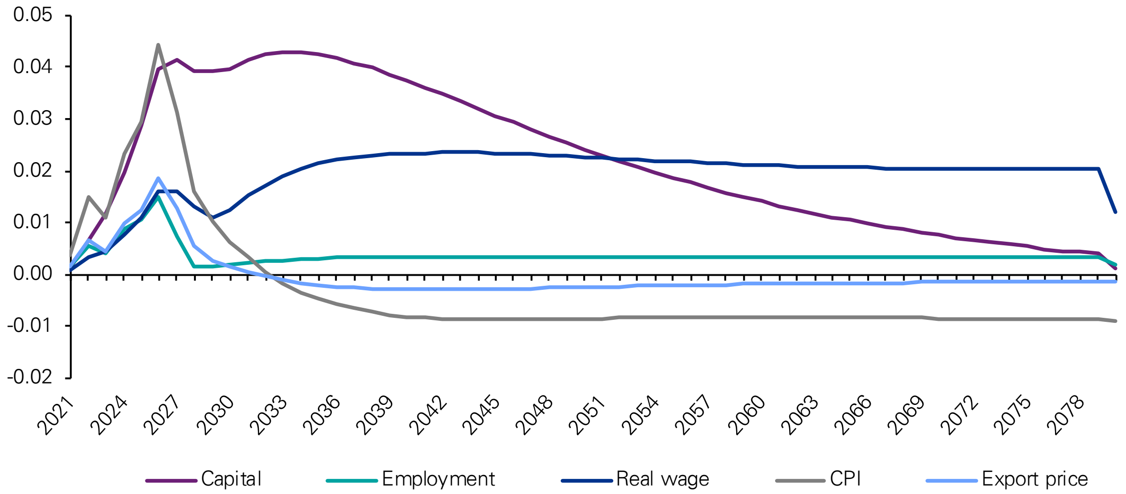


Figure 51: Real GDP income components and price indices, % change from baseline, Australia



C.6.4 Industry impacts

Regional industry results are presented in Table 51. Output of the Construction sector increases significantly during the construction phase as this sector is an important input to investment. The additional construction activity in the region also increases economic activity in other industries, particularly upstream industries that supply inputs to the Construction sector. For example, the Wholesale and Retail Trade sector facilitates the sale of material inputs used by the Construction sector. The construction activity also requires more inputs from Rental, Hire & Real Estate Services, Electricity, Gas, Water & Waste Services, and Other Services.

In contrast, the Road Passenger sector contracts as commuters substitute passenger rail services for private cars and public vehicles. The Motor Vehicle Repairs and Petroleum Products sectors also contract due to the reduction in vehicle operating expenses when households and firms shift from private to public transport. The increase in demand for resources required to complete the construction of MAR increases costs for other industries, particularly wage rates. This has negative impacts on other sectors such as the Manufacturing, Accommodation & Food Services, and other labour-intensive sectors, e.g., Information, Media & Telecommunications, and Professional, Scientific & Technical Services. These sectors contract and release resources to other sectors. Moreover, the investment shock causes export prices to rise as already noted above. This price effect causes demand to fall leading to the output of export-oriented industries like Mining and Agriculture to contract.

In the long-run, most industries expand by the end of the forecast period. This is driven by the long-run increase in household income that stimulates household consumption. As expected, the Rail Passenger sector experiences a significant increase in output as it directly benefits from the operation of MAR.

Table 51: Percentage change in industry output

	Peak of construction			End of forecast period		
Industry	Gtr. Melb.	Vic	Aus	Gtr. Melb.	Vic	Aus
Agriculture, Forestry & Fishing	-0.111	-0.058	-0.018	0.025	-0.006	-0.006
Mining	-0.108	-0.079	0.002	0.039	0.020	-0.001
Petroleum products	-0.012	-0.009	-0.006	0.019	0.010	0.002
Motor vehicle repairs	-0.559	-0.466	-0.148	0.095	0.070	0.012
Manufacturing	-0.147	-0.124	-0.047	0.075	0.052	-0.001
Electricity, Gas, Water & Waste Services	0.050	0.040	0.013	0.024	0.024	0.007
Construction	1.492	1.205	0.286	0.085	0.074	0.022
Wholesale trade	0.098	0.082	0.014	0.055	0.048	0.007
Retail trade	0.198	0.157	0.033	0.040	0.038	0.005
Accommodation & Food Services	-0.209	-0.145	0.021	0.072	0.082	0.064
Road Passenger	-0.089	-0.064	0.005	0.095	0.086	0.044
Road Freight	-0.038	-0.035	-0.013	-0.010	-0.021	-0.017
Rail Passenger	2.980	2.538	0.520	3.197	2.592	0.435
Rail Freight	-0.028	-0.025	0.000	0.008	0.006	-0.003
Air Passenger	-0.325	-0.312	-0.039	0.039	0.041	0.054
Air Freight	0.009	0.009	0.004	0.029	0.029	0.007
Transport Support Services and Storage sector	-0.072	-0.061	-0.015	0.075	0.059	0.012
Information Media & Telecommunications	-0.088	-0.079	-0.029	-0.002	0.000	-0.006
Financial & Insurance Services	0.000	0.000	0.000	-0.019	-0.015	-0.008
Rental, Hiring & Real Estate Services	0.056	0.050	0.012	0.064	0.054	0.012
Professional, Scientific & Technical Services	0.046	-0.018	-0.009	0.073	0.063	0.009
Administrative & Support Services	-0.045	-0.036	-0.010	0.132	0.107	0.026
Public Administration	0.019	0.014	0.003	0.018	0.013	0.001
Education	-0.165	-0.133	-0.040	0.103	0.077	0.014
Healthcare & Social Assistance	0.022	0.019	0.007	0.016	0.019	0.006
Arts & Recreation Services	-0.110	-0.076	-0.002	0.046	0.051	0.030
Other Services	0.033	0.029	0.008	0.036	0.032	0.002
Dwellings	-0.013	-0.011	-0.002	-0.058	-0.048	-0.012

C.7 Summary

Table 52 summarises the absolute changes in GSP / GDP and employment numbers for both MAR exc. SRL and MAR inc. SRL for Victoria and Australia. On average, for MAR exc. SRL, real GSP for Victoria is higher on average by $340 million per year. during the construction phase with a peak of $630 million. Net employment in Victoria increases on average by 730 FTE jobs per year during the construction phase with a peak of 1,880 FTE jobs (or a 0.05 per cent increase), while the real wage rate increase peaks at 0.07 per cent over this period. During the operational phase of MAR exc. SRL the Victorian economy gains an additional $1.20 billion of GSP and 855 FTE jobs per year on average.

For the whole of Australia, the GDP gain is lower on average over the forecast period. This reflects the relocation of resources to Victoria from the rest of Australia in response to higher demand and productivity resulting from the MAR project. Both labour and capital are drawn into the project from Victorian regions outside of Melbourne and from other Australian states. This redistribution of capital and workers to Melbourne causes a contraction in the economic activity of industries in the rest of Australia.

The operational effects on GSP / GDP and employment are lower when MAR operates concurrently with the SRL North connection to Melbourne Airport.

Table 52: Summary of impacts on output, jobs and real wage rates

	Construction phase	Operational phase	
		MAR exc. SRL in the Base Case	MAR inc. SRL in the Base Case
Victoria			
Increase in GSP ($m)	340 / 630 (average / peak)	1,195 / 2,195 (average / peak)	1,005 / 1,670 (average / peak)
Net jobs created (FTE)	730 / 1,880 (average / peak)	855 / 1,210 (average / peak)	760 / 980 (average / peak)
Net jobs created (%)	0.045% (peak)	0.020% (peak)	0.019% (peak)
Average real wage increase (%)	0.074% (peak)	0.058% (peak)	0.057% (peak)
Australia			
Increase in GDP ($m)	315 / 620 (average / peak)	1,030 / 1,910 (average / peak)	850 / 1,430 (average / peak)
Net jobs created (FTE)	770 / 2,100 (average / peak)	365 / 470 (average / peak)	325 / 380 (average / peak)
Net jobs created (%)	0.015% (peak)	0.003% (peak)	0.003% (peak)
Average real wage increase (%)	0.016% (peak)	0.024% (peak)	0.024% (peak)

Table 53 shows the net present value of the real GSP and real GDP gains. Using a 4 per cent discount rate the MAR exc. SRL generates an additional $17.9 billion of Victorian GSP in present value terms and an additional $15.7 billion of Australian GDP in present value terms. The present values of GSP and GDP are lower for MAR inc. SRL - $16.2 billion and $14.1 billion respectively.

Table 53: Summary of impacts on real GSP and GSP in present value terms (4 per cent discount rate)

	Construction phase	Operational phase	Total
MAR exc. SRL in the Base Case			
Victoria	$2.7bn	$15.2bn	$17.9bn
Australia	$2.5bn	$13.2bn	$15.7bn
MAR inc. SRL in the Base Case			
Victoria	$2.7bn	$13.6bn	$16.2bn
Australia	$2.5bn	$11.7bn	$14.1bn

Table 54 shows the welfare effects of MAR, which comprises increased household consumption, increased leisure due to household travel time savings, and welfare due to health and the quality of the environment (**LH&E**) benefits. In present value terms, MAR exc. SRL generates an additional $15.7 billion in welfare benefits for Victoria and MAR inc. SRL generates an additional $12.3 billion in welfare benefits.

Table 54: Summary of impacts on welfare due to consumption gains and LH&E benefits for households in present value terms (4 per cent discount rate)

	Construction phase	Operational phase	Total
MAR exc. SRL in the Base Case			
Real consumption			
Victoria	$0.7bn	$5.8bn	$6.5bn
Australia	$1.3bn	$7.3bn	$8.6bn
LH&E benefits			
Victoria	$0.6bn	$8.6bn	$9.2bn
Australia	$0.4bn	$11.0bn	$11.4bn
MAR inc. SRL in the Base Case			
Real consumption			
Victoria	$0.7bn	$4.6bn	$5.4bn
Australia	$1.3bn	$5.9bn	$7.2bn
LH&E benefits			
Victoria	$0.6bn	$6.3bn	$7.0bn
Australia	$0.4bn	$8.7bn	$9.1bn

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Appendix 10
Packaging and Procurement Strategy

Contents

1
Introduction

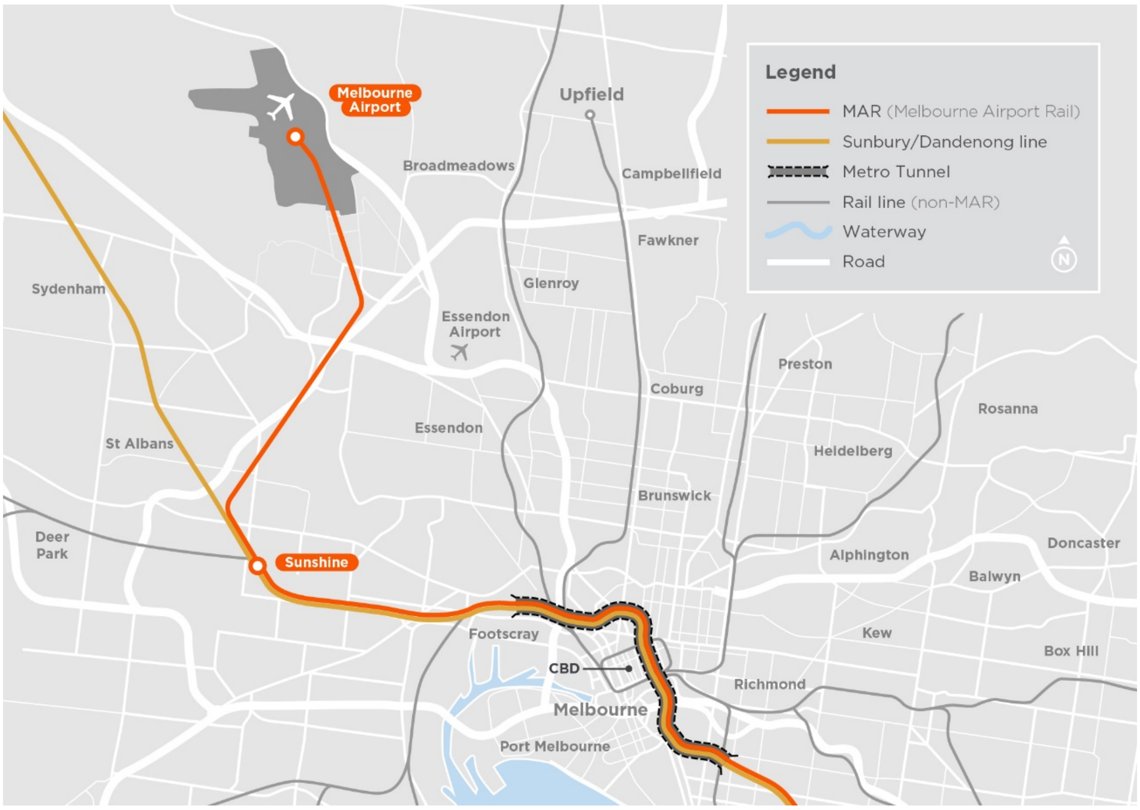
1. Introduction

1.1. Background

Melbourne Airport Rail (MAR or the Project) will connect Melbourne Airport with a rail service for the first time, running from a new Airport Station located at Melbourne Airport in Tullamarine to the Central Business District (CBD). MAR will maximise airport access for all Victorians, providing easy access from all metropolitan and regional train lines. Rail Projects Victoria (RPV) is working closely with the Department of Transport (DoT) in relation to the development of the Project.

The Project was announced by the Victorian Government in July 2018. An alignment via Sunshine Station then through the Metro Tunnel has been confirmed as the preferred route between Melbourne Airport and the CBD. The Victorian Government completed the Business Case for the Project in 2021 and has announced that construction will commence in 2022.

Figure 1: Airport Rail Link alignment via Sunshine



1.2. Market conditions

A key consideration in evaluating packaging and procurement strategies is the impact of current and future Australian projects on market conditions. There are currently 165 major road and rail transport projects being delivered across Victoria involving around A$80 billion in capital expenditure [1], including projects like Suburban Rail Loop and North East Link.

A large number of major transport projects are also being planned and delivered elsewhere across Australia, for example Sydney Metro (NSW), NorthConnex (NSW), WestConnex (NSW), Western Harbour Tunnel & Beaches Link (NSW), Western Sydney Airport (NSW), North-South Rail Link (NSW), Cross River Rail (Qld), Inland Rail Project (Vic, NSW, Qld), Forrestfield Airport Link (WA) and

[1] Major Transport Infrastructure Authority, *Victoria's Big Build*, (2020). Available at: https://bigbuild.vic.gov.au/projects

Metronet (WA). The wide-spread and ongoing government commitment to major projects is translating into a 'new normal' level of public sector investment in infrastructure projects.

More broadly, market dynamics are shifting as the current wave of projects move into delivery and delivery risks begin to materialise. Market capacity has already evolved to be a significant issue in recent years, with Victoria competing with interstate and international projects for contractors and resources.

1.3. Purpose of this Appendix

Consistent with State's broader project and policy objectives, the purpose of this Appendix is to detail the development of packaging and procurement options and risk allocation structures through which all elements of the MAR scope could ultimately be delivered.

1.4. Stakeholder engagement

RPV has been working closely with key stakeholders including DoT and the Department of Treasury and Finance (DTF) to develop this packaging and procurement strategy. RPV has also commenced, and will continue to have, engagement with a range of other key government and Project stakeholders including, but not limited to, Melbourne Airport's owner and operator Australia Pacific Airports (Melbourne) Pty Ltd (APAM), Department of Premier and Cabinet (DPC), the Australian Government's Department of Infrastructure, Transport, Regional Development and Communications (DITRDC), Metro Trains Melbourne (MTM), V/Line and the Australian Rail Track Corporation (ARTC).

2
Packaging and procurement assessment

2. Packaging and procurement assessment

2.1. Methodology

2.1.1. Procurement objectives

To support the delivery of the MAR Project Objectives, the following procurement objectives were developed with a focus on achieving commercial and delivery related outcomes that will help drive value for money for the State:

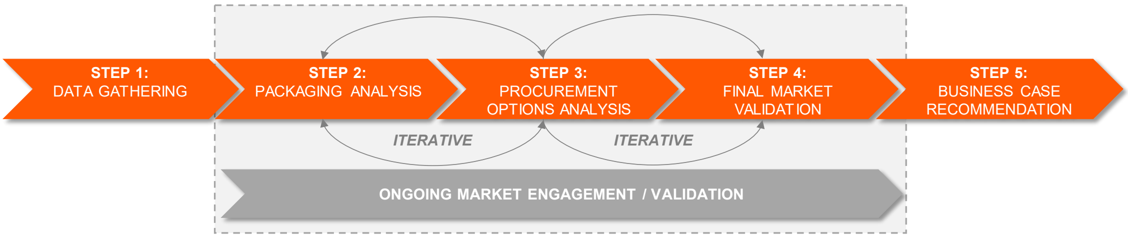
- optimise market participation and competition
- deliver the Project within the State's time requirements
- provide appropriate budget, capital and recurrent cost certainty to the State
- allocate risks to the party best placed to manage and price them
- incentivise contactor innovation where applicable
- enable the State to retain appropriate control and flexibility to accommodate future changes.

These objectives have been used to guide the overall development of the packaging and procurement strategy for the Project.

2.1.2. Evaluation methodology

The evaluation methodology adopted is consistent with DTF and Infrastructure Australia (IA) guidelines for identifying and assessing packaging and procurement options. Figure 2 below presents the methodology.

Figure 2: Process for developing packaging and procurement recommendation



- **Step 1: Data gathering** – Key data about the Project that is relevant to procurement is gathered. Experiences and lessons learnt from procurement precedents in comparable projects from Australia and internationally are drawn on to inform and benchmark the analysis.
- **Step 2: Packaging analysis** – The key project scope elements are assessed against key considerations to test whether there are components of the Project that would be optimally delivered individually or bundled together.
- **Step 3: Procurement options analysis** – Procurement models are shortlisted (from a long list of potential delivery models) and the Project packages (developed in Step 2) assessed against the shortlist of procurement models.
- **Step 4: Market validation** – Testing and validation with the market through a market sounding process occurs.
- **Step 5: Recommendation** – The recommended procurement strategy is determined based on the assessment undertaken in Steps 1 to 4.

2.2. Key assumptions

The analysis documented in this Appendix is predicated on a number of key assumptions, as outlined in the following subsections.

2.2.1. Integration into Metro Tunnel

The alignment option adopted for MAR is a key Project decision that has a significant impact on the Project's packaging. RPV has undertaken an assessment of options for connecting MAR between Sunshine and the CBD. Based on that analysis, the preferred alignment option is connecting MAR services to the CBD via Sunbury tracks and the Metro Tunnel.

As such, it is assumed that Metro Tunnel will be delivered on time and will be able to accommodate Day 1 of operations for MAR services.

2.2.2. Rolling stock

Work undertaken by DoT to date has identified that four additional High Capacity Metro Trains (HCMT) are required to accommodate the Day 1 service plan for MAR (in addition to those HCMTs already on order by the State).

2.2.3. Signalling and systems

MAR will utilise High Capacity Signalling (HCS) train control and signalling. The specific delineation of the systems and signalling scope between packages has been developed to minimise interfaces. While this remains subject to change through further design and assessment, the outcome of any changes is not expected to materially impact the recommendations or outcome of this analysis.

2.2.4. Rail service operation and maintenance

As a result of integrating MAR services into the existing network via the Metro Tunnel Project (MTP) and using HCMT rolling stock, it is assumed that MAR services will be operated and maintained by the metropolitan network franchisee. The contractual arrangement to support this outcome is not contemplated for the purposes of this analysis.

2.3. Key project risks

A key consideration in the selection of a packaging and procurement strategy is its ability to promote efficient and effective management of project risks. Risks should be allocated to the party most capable of managing and/or pricing the risk. The key project risks identified through the risk assessment process at a whole-of-project level are outlined in Chapter 9, together with identification of potential risk mitigation strategies for these risks.

An outline of key package-specific risks and how the proposed delivery model for each works package will mitigate these risks is provided in section 5.1.4.

3
Step 1: Data gathering

3. Step 1: Data gathering

3.1. Overview

As part of this initial phase of development, RPV gathered and considered key data relevant to the packaging and procurement assessment, including:

- desktop reviews of various other airport rail links and other precedent projects from Australia and overseas
- project objectives
- base assumptions
- detailed scope elements
- unique project characteristics
- key project risks and interfaces
- scale of works
- market capacity, capability, trends and preferences
- performance of other projects
- informal market sounding feedback
- indicative cost of works.

The data gathered in relation to the above has informed RPV's packaging and procurement position.

3.1.1. Procurement workshops

A series of packaging and procurement workshops were held with technical, legal and commercial teams to inform the development of the recommended packaging and procurement strategy.

3.1.2. Market engagement process

RPV is conducting a multi-phase market engagement process to understand the extent of interest in MAR, the market's views and preference, potential issues, risks and opportunities. This process builds on the initial Registration of Interest (ROI) process undertaken in late 2018, which resulted in over 100 industry participants registering their interest in the Project. The most recent aspects of the process have involved three key stages:

- **Stage 1: Written questionnaire** (December 2020 – January 2021) – As part of this stage, an Information Brief was issued to all ROI respondents providing background on the Project and reference packaging and procurement strategy, and seeking written responses to a series of questions regarding the Project. Responses were received from 27 participants.
- **Stage 2: Initial market soundings** (February 2021) – Following receipt of written submissions in Stage 1, one-on-one meetings were conducted with 14 participants, focused on local and international construction companies of various sizes.
- **Stage 3: Further market soundings** (September 2021) – RPV undertook further market soundings with the same constructor group that participated in Stage 2, with one additional participant. The purpose of Stage 3 was to provide an update on the packaging and procurement strategy, confirm market interest and appetite in each MAR package, and obtain feedback from participants on a range of specific commercial and delivery issues.

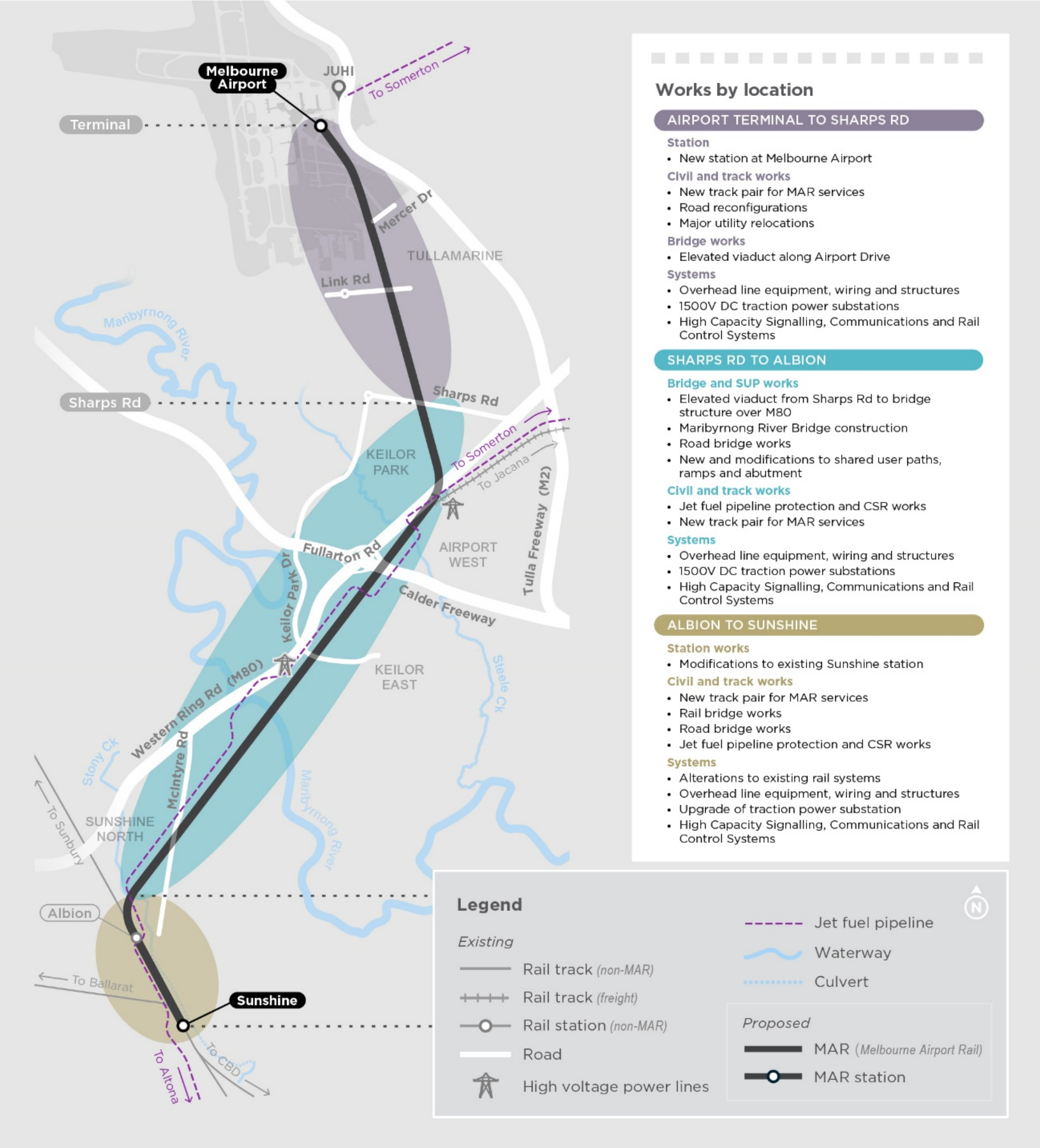
Refer section 7 for a summary of the key findings from the market engagement process to date.

3.2. Project scope

3.2.1. Scope summary

The overall scope summary of MAR is presented in Figure 3, showing the geographical location and potential nature of the works along the route.

Figure 3: Scope summary

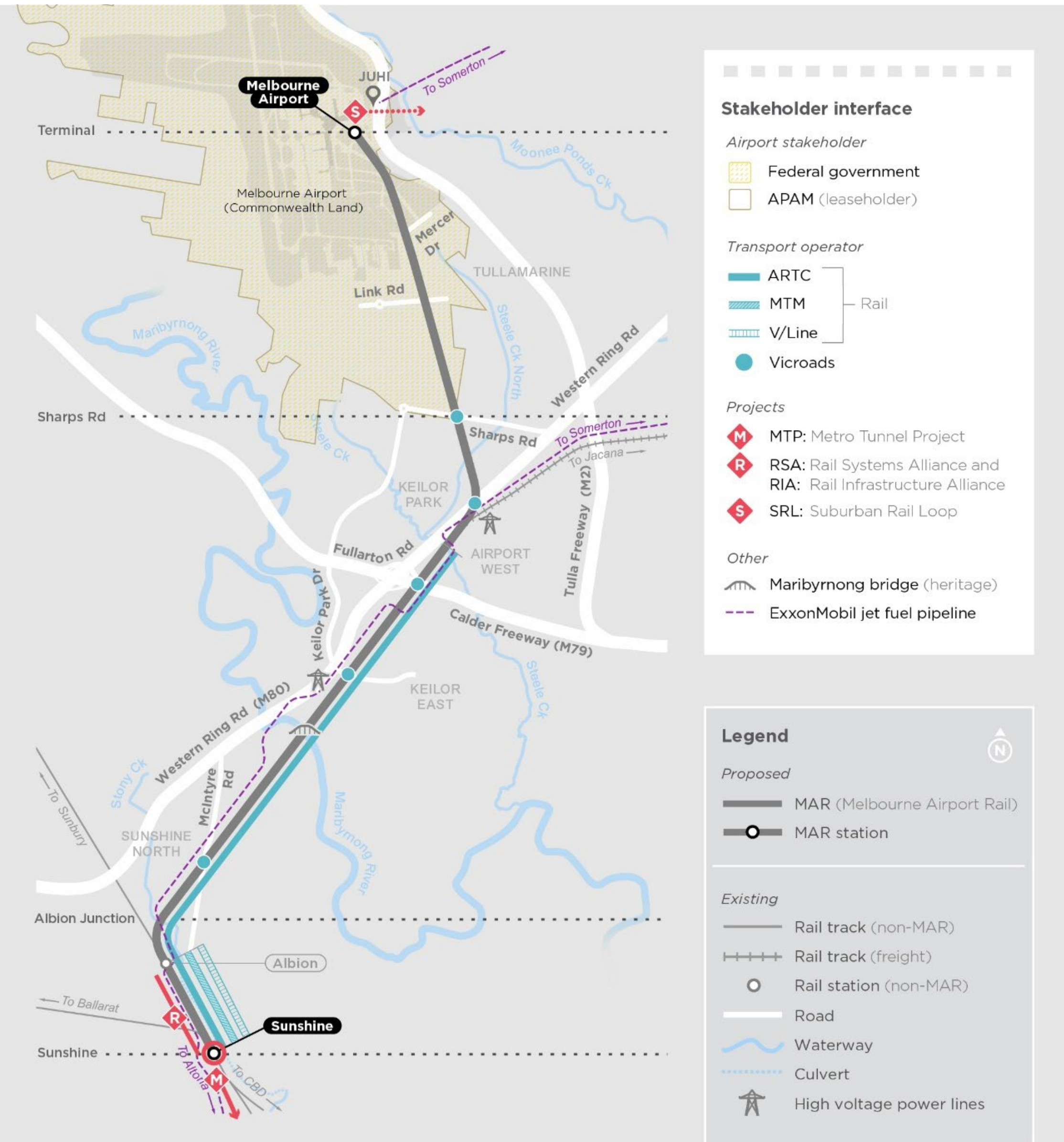


3.2.2. Key scope interfaces and interdependencies

Based on the scope set out and as highlighted in Chapter 6 of the Business Case, there are a range of interfaces with land owners, transport operators and other projects currently being delivered on the network that have been considered as part of the development of the packaging and procurement strategy for MAR.

Figure 4 depicts a number of the key scope interfaces and a range of interfacing and interdependent projects are also detailed in section 6.8 of the Business Case.

Figure 4: Key scope interfaces (land owners, transport operators and other rail projects)



4
Step 2: Packaging analysis

4. Step 2: Packaging analysis

4.1. Packaging approach

To establish the most appropriate procurement strategy for MAR, it is necessary to determine if works should be delivered as a single, integrated package or split into a number of smaller packages.

After consideration of the Project's characteristics, inputs from technical advisers and analysis of approaches adopted or proposed to be adopted on comparable projects, the packaging considerations outlined in Table 1 were developed to support the development, assessment and comparison of packaging options. These drivers helped identify and inform the key differentiating factors between potential packaging options as part of this assessment.

Table 1: Packaging considerations

Packaging considerations	Description
Geography	• Does the approach maximise efficiencies / synergies by bundling / separating works by geography?
Technical requirements / discipline	• Does the approach maximise efficiencies / synergies by bundling / separating works by discipline / technical requirements (i.e. like with like according to contractor capability)? • Does the approach minimise complicated technical interfaces?
Program	• Does the approach minimise risk of program overruns? • Does the approach support the ability to deliver the Project in line with the State's sequencing and time constraints and minimising the risk of program overrun?
Risk profile	• Can works be grouped / separated by risk profile?
Cost efficiency	• Does bundling the works provide for a more efficient use of resources and minimise the risk of cost overrun?
Market capacity, appetite and capability	• Does the market have capacity, appetite and capability to deliver the works (with reference to size, scale & complexity)? • Does the approach encourage an appropriate number of bidders?
Interfaces	• Does the approach minimise and / or create natural and manageable, points of interface with other packages (and/or existing network / ongoing projects)? • Does the approach minimise stakeholder interfaces / approval processes (e.g. Accredited Rail Transport Operator (ARTO) access / approvals)?
Disruption	• Does the approach minimise disruption in relation to other packages, projects and/or the existing transport network?
Innovation	• Does the packaging approach support / enable innovation in design, construction and/or whole-of-life focus?

The approach used to develop and evaluate packaging options comprised of three key steps:

- consideration of an extensive list of potential packaging options on factors such as geography and technical discipline
- identification of a shortlist of potential packaging options by undertaking a qualitative analysis to determine the most realistic, practical options, which considered factors such as the potential

benefits of delivering elements with specific characteristics separately, the ability of the packaging option to assist in achieving Project objectives and reduce interface risks

- assessed shortlisted packaging options against the packaging considerations to determine the most suitable option.

4.2. Packaging options assessment

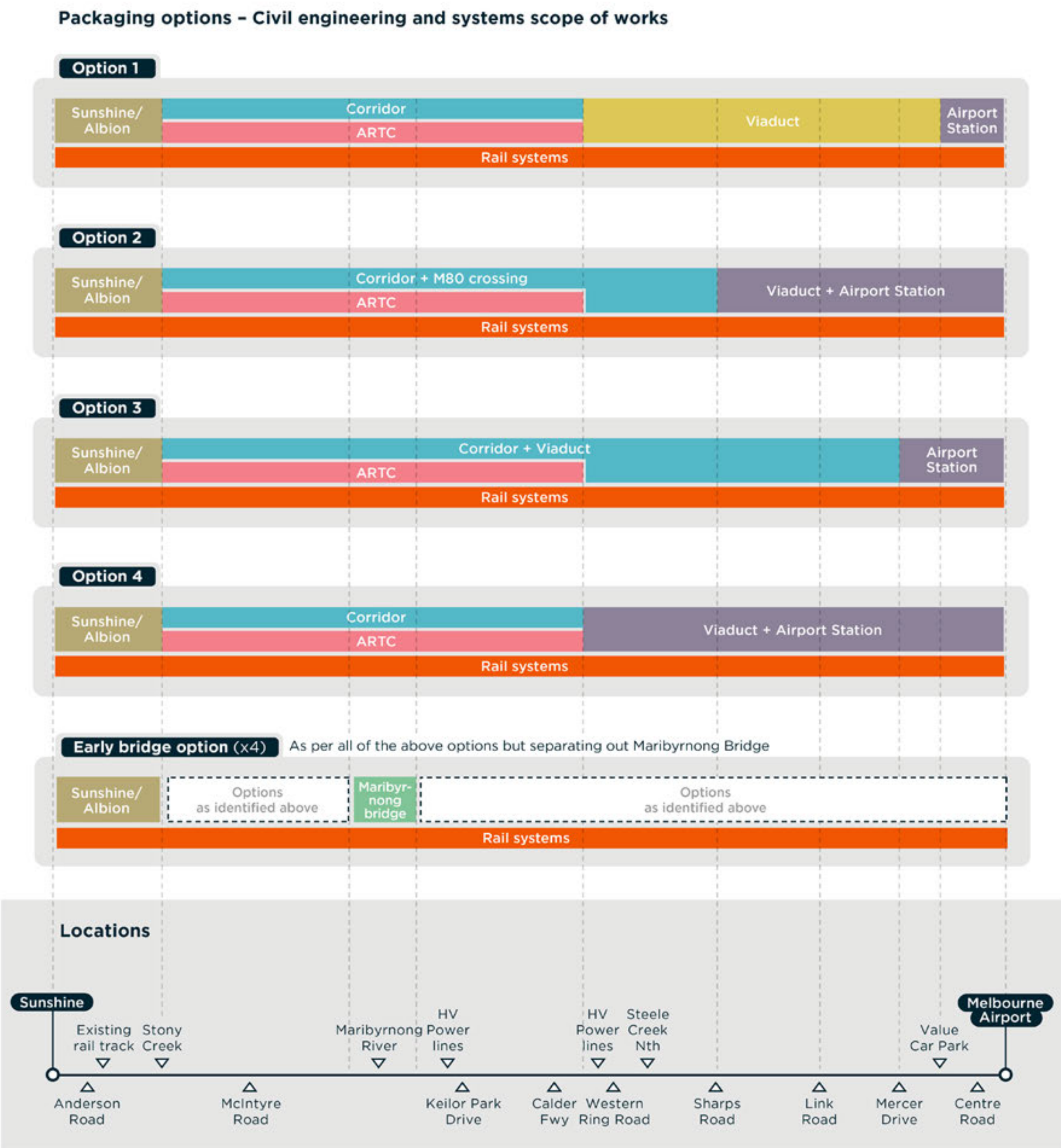
4.2.1. Packaging options identification and preliminary observations

RPV initially considered the following packaging options at a high level:

- single package
- geographic split within corridors (i.e. multiple packages with works split at logical construction staging points)
- split by discipline (i.e. track duplications and passing loops, station works and signalling works).

Building on the packaging concepts set out above, a mixture of packaging options was developed in order to determine which scope elements should be bundled together in order to maximise geographical and/or technical synergies. The packaging considerations set out in Table 1 above were used to test whether each scope element would deliver material benefits or create complexities by being bundled with other elements, in order to deliver a value for money packaging solution. RPV shortlisted a range of packaging options, shown in Figure 5, before ultimately identifying Option 1 with a separate Maribyrnong River Bridge package as the preferred packaging solution for this Appendix, shown in Figure 6.

Figure 5: Packaging options



4.2.2. Packaging assessment (core scope) and recommended approach

The proposed packaging approach is summarised in Figure 6. The rationale provided in Table 2 highlights the key packaging considerations that drove the outcome for each package.

Figure 6: Packaging Solution

RPV has investigated opportunities for, and the risks of, the Rail Systems package scope being delivered as part of Sunshine / Albion package. This was recently tested with the market as part of the MAR procurement process and it has been determined that the Rail Systems package scope will be incorporated into the Sunshine / Albion package.

Table 2: Packaging assessment

Packaging approach	Detailed scope of works	Analysis / Rationale
Airport package: Bundled geographically	**Airport Station** • 350m long elevated station • 160m active platform (7-car HCMT) • 230m future-proofed (10-car HCMT) • PIDS, ticketing and CCTV • Terminal connections • Station Services building **Value Car Park to Airport Station** • New track pair and civil works for MAR services between the Value Car Park and Airport Station • Civil works associated with road re-alignment and intersection works along Terminal Drive, Arrivals and Departures Drive, Centre Road and within the Value Car Park • Civil works for new traction power substation **OHW and systems** • Overhead line equipment (OHLE), structures between the Value Car Park and Airport Station	**Key rationale:** • **Interface** –The works in this area are relatively high risk due to the number of physical and operational interfaces with the existing airport infrastructure (including a number of access roads and APAM capital works projects as well as the terminals itself) and a complex and heavily congested operational airport environment for delivery of the works. Separating these works from the remaining works on Airport-leased land "ring-fences" the direct, technically complex interface with the Melbourne Airport terminals and elevated road program within a single, smaller value package of works (and as a result, mitigates some interface and program risk from the remaining works on Airport-leased land). • **Risk profile and program** –The complexity of constructing the Airport Station, and in particular how these works interface with the Airport terminals and APAM's elevated road network, (which remains under development) has been identified as a key project risk, with the potential to cause significant delays if not completed according to program timelines. An Airport package enables the critical, complex works associated with the station to be managed by a single contractor and isolated from the remaining works on Airport-leased land (mitigating risk to the overall program in the event of delays to the agreement of the Airport Station design with Melbourne Airport). • **Market capacity, appetite and capability** – Bundling the technical disciplines required for the works on Airport-leased land should maximise market interest by creating a package of a more manageable size from a contractor perspective that is largely focussed on specialist skillsets required for the Airport Station.
Viaduct package: Bundled geographically and	**Viaduct works** • Construction of approximately 6km of twin track viaduct commencing at the interface with the Airport package in the Melbourne Airport	**Key rationale:** • **Risk profile** – Delineating between the Viaduct works and the Airport package scope "ring-fences" the critical, complex works associated

by technical discipline	Value Car Park, continuing along Airport Drive and above the median strip of Airport Drive towards Steele Creek North and across the Western Ring Road toward Fullarton Road **Civil works** • All civil works associated with the viaduct construction, including temporary/permanent road, demolition, drainage, access works and temporary civil works • Utility service protection works, in particular with interfaces with Greater Western Water, Melbourne Water, ExxonMobil, Viva pipeline (yet to be constructed), Telcos, AusNet and APAM utilities • Civil works for new traction power substation and new intake substation at Fullarton Road • New SUP connection from Steele Creek North to Airport Drive • Civil works associated with road re-alignment and intersection works along Airport Drive. **OHW and systems** • OHLE, wiring, structures from the interface with the Airport package in the Melbourne Airport Value Car Park, continuing along Airport Drive and above the median strip of Airport Drive towards Steele Creek North and across the Western Ring Road toward Fullarton Road	with constructing adjacent to the Airport terminals and APAM's elevated road network and potentially means the Viaduct package has a more manageable risk profile for contractors. • **Technical discipline** – The technical requirements for delivering the viaduct is different when compared to other works along the alignment (i.e. this package focusses largely on delivery of elevated infrastructure in a greenfield rail environment, whereas other packages are delivering infrastructure in complex operating environments with significant interfaces). Bundling this major civil structure into one package will allow the viaduct contractor to focus on the specific technical discipline required. • **Market capacity, appetite and capability** – This package provides the opportunity to attract contractors (including international contractors) with a specialist structures skillset and experience. The package also maximises the length of the same structural form up to the Airport package interface, which maximises economies of scale.
Corridor package: Bundled geographically	**Bridge and SUP works** • Bridge modification and strengthening works at Calder Freeway bridges. Fullarton Road bridge, the M80 crossing, Keilor Park Drive and McIntyre Road bridge • Upgrades to existing SUP connections along M80 on-ramp and Fullarton Road bridge • Decommissioning and backfilling of the existing underpass at Barwon Avenue and construction of a new pedestrian overbridge **Civil and track works** • New track pair (at-grade) and civil works for MAR services between Stony Creek and Calder Freeway bridges • Protection of ExxonMobil fuel pipeline at various locations between Stony Creek and Calder Freeway Bridges • Civil works for new traction power substation at McIntyre Sidings. **OHW and systems**	**Key rationale:** • **Market capacity, appetite and capability** – Bundling the technical disciplines required for the works along this section of the alignment (i.e. track and civil works, road bridge works) maximises the potential number of bidders for this package of works, given the largely common civil nature of the works which many contractors are capable of completing. • **Program** – Bundling works in this section of the corridor by geography offers the State and contractor the ability to better coordinate occupations and create the potential for program savings. Further, scheduling occupations is complex along this section of the alignment due to the limited opportunities for access in and alongside the Albion-Jacana freight corridor, and would be best managed by a single point of contact. • **Interface** – This package enables the isolation of specific works with stakeholders along this section of the alignment, specifically interfaces with ARTC (operator of the Albion-Jacana freight corridor) and VicRoads. It is noted that the interface with ARTC will need careful management and coordination, as their operational rail presence in the

	• OHLE, wiring, structures, between Stony Creek and Calder Freeway bridges	corridor makes for a more difficult and constrained delivery environment and this presence extends beyond the boundary of this package (into the Sunshine/Albion package).
ARTC package: Bundled geographically and by discipline	**Works** • Works primarily comprise modifications to ARTC rail infrastructure and associated civil infrastructure along the eastern side of the existing Albion-Jacana freight corridor. **Civil and track works** • Track and formation works associated with slewing existing ARTC standard gauge and broad/dual gauge tracks for approximately 2km to accommodate the MAR track between Keilor Park Drive and the Calder Freeway • Relocation of existing ARTC CSR on the eastern side of the existing Albion-Jacana freight corridor • Upgrades to Keilor Park Drive overbridge substructure • Provision of soil retaining structures and provision of noise walls • Identification, protection, replacement and relocation of all utilities affected by the works, including protection over the Somerton Jet Fuel Pipeline **Systems** • Signalling and rail control system works on the ARTC line associated with the track slew and the introduction of MAR • Relocation of existing ARTC signalling assets (and decommissioning as required) **Other transport mode infrastructure and urban design** • Reinstatement and repair of road infrastructure affected by the works • Adjustments and reinstatement of existing public areas affected by the works (including urban design and landscaping)	• **Program** – The majority of participants in the MAR market engagement process confirmed that utility works, general site preparatory and investigatory works, should be delivered as early works. Delivering the ARTC works as a separate package allows early delivery of key scope items (including utilities relocation and other important preparatory works such as the freight track slew) which will de-risk the Sunshine / Albion works, Corridor works, Maribyrnong River Bridge works and overall MAR Program. • **Risk profile** – The ARTC package has a distinct risk profile when compared to other works in the geographical area, given the works are being delivered on predominantly ARTC assets within an operational freight environment. An ARTC package enables these works to be managed by a single contractor and distinct from the remaining works associated with the Albion-Jacana freight corridor. • **Market capacity, appetite and capability** – Separating the ARTC scope from the remaining packages allows for a smaller, discrete package of works and maximises the opportunity for smaller contractors to participate in the Project.
Maribyrnong River Bridge Package: Bundled geographically	**Bridge works** • Maribyrnong River Bridge construction	• **Program** – Delivering the Maribyrnong River Bridge as a separate package allows early delivery of the Maribyrnong River Bridge to de-risk the overall MAR Program. • **Risk profile** – The Maribyrnong River Bridge package has a distinct risk profile when compared to other works in the geographical area, given the heritage overlay of the existing Maribyrnong River Bridge and construction occurring over a waterway. A Maribyrnong River Bridge package enables any resulting heritage requirements associated with the works (including conditions of a heritage permit) to

		be managed by a single contractor and isolated from the remaining works in the Albion-Jacana freight corridor. • **Market capacity, appetite and capability** – The largely common civil nature of the works and the size of the package should maximise the potential number of bidders for this package of works and provide smaller contractors with an opportunity to participate in the Project
Sunshine / Albion package: Bundled geographically	**Station works** • Modifications to existing Sunshine station **Civil and track works** • Construction of a new 1.5 km long twin track viaduct structure between Sunshine Station and the Albion-Jacana corridor (crossing Ballarat Road, the Sunbury rail corridor, St Albans Road and Stony Creek) • New track pair and civil works for MAR services between Sunshine Station and Stony Creek • New rail bridges at Anderson Road • Protection of ExxonMobil fuel pipeline at various locations between Sunshine Station and Stony Creek • Conventional signalling works to facilitate signalling staging in the Sunshine / Albion area **OHW and systems** • OHLE, wiring, structures, between Sunshine Station and Stony Creek • Upgrade and modifications to two existing traction power substations	**Key rationale:** • **Interfaces** – Given the multiple rail operators in this area (including MTM, V/Line and ARTC), in addition to multiple project to project interfaces (including the Rail Systems Alliance (RSA) and Rail Infrastructure Alliance (RIA) from MTP) access and approvals would be best managed by a single point of contact. One delivery entity should be responsible for the operational interfaces in this busy, live, brownfield rail environment that has a number of interstate, regional and metropolitan passenger services as well as freight services passing through on a daily basis. • **Program** – The delivery timeframe and staging of works will be largely interdependent and interface with the rest of the works in the geographic area. Bundling this package geographically will minimise the risk of program delays. • **Disruption** – Due to the complexity required for staging the works in this section of the alignment at a critical junction on the network, disruption to the existing rail and road networks will be a primary consideration that will need to be managed efficiently to avoid additional costs and program delays. This can be more effectively managed if there is one delivery entity responsible for safety and disruption management, the scheduling of occupations and shut downs. • **Geography** – Geographical synergies can be leveraged in order to minimise cost, delays and disruption given the heavy brownfield, operational rail environment in the Albion and Sunshine sections of the alignment. Vertically packaging these works on a geographical basis will enable an efficient outcome despite the complexities associated with delivering works in this area.
Rail Systems package: Bundled by technical discipline[2]	**Traction power** • 1500V DC traction power substations and intake substation **Signalling**	**Key rationale:** • **Technical discipline** and risk profile – Rail systems are complex and will have significant interfaces with the new HCMT rolling stock, existing signalling infrastructure, rail operations and the broader

[2] Rail Systems package scope to be delivered as part of the Sunshine / Albion package.

	• HCS (West Footscray to Ginifer and Airport) • Conventional signalling upgrades and changes in the Sunshine / Albion area to support HCS **Other systems** • Train control and signalling design integration • Technical change management • Operational control centre fitout and OCS back end modification • End to end / system level testing • Commissioning Management • Final driver and staff training • Traction power scheme design • Earthing/Bonding/protection coordination design and testing • HV & LV hauling and commissioning • SCADA • Fibre Optic Cable hauling and commissioning • Train Radio (assuming DTRS or DTRS replacement by others)	network. Separating these works from other works packages facilitates efficient and effective management of systems related risks. • **Interface** – While the systems package will have overarching interfaces with each of the main works packages referred to above, bundling the systems by technical discipline will be a more manageable interface than bundling systems by geography (which would create multiple complex systems interfaces that would be significantly more difficult to manage). • **Market capacity, appetite and capability** – Procuring the rail systems separately from other works packages enables specialist systems technologies and requirements (such as High Capacity Signalling (HCS)) to be isolated to a single package and procured on a value for money basis.
Early Works Package: Bundled by technical discipline	**Utilities works** • Relocation and/or protection of utilities at various locations along the MAR alignment, including electrical cables, water mains, gas mains, sewer mains, water pressure reducing station and telecommunications cables	• **Program** – By undertaking these works in advance of the main works packages, it is possible to reduce the overall MAR Program and support the delivery of the Project in line with the State's sequencing and time constraints. • **Risk profile and interface** – Delivery of utilities protection and relocation, particularly those that are complex and have long lead times, ahead of the main works reduces the number of direct interfaces with Utility Service Providers (USPs) and other third party asset owners/operators during delivery of the main works. Quarantining works associated with USPs from the rest of the main works enables these works to be managed more effectively and allow the main works to be 'de-risked' and delivered at a lower cost. • **Technical discipline** – Bundling this package by technical discipline will maximise efficiencies / synergies associated with utility services and USP interfaces.

5 Step 3: Procurement options analysis

5. Step 3: Procurement options analysis

5.1. Procurement assessment approach

MAR is being delivered as part of Victoria's Big Build and is one of the most significant investments in infrastructure in Victoria's history. MAR will eventually form part of SRL. It will also complement the longer-term pipeline of investment through the Western Rail Plan which will increase the capacity of the rail transport network to support the growing western region of Melbourne. The procurement of MAR will be undertaken in the context of this investment pipeline, and the State is continually evaluating infrastructure priorities and the most efficient way to procure and deliver these important projects, including considering innovative methods of procurement to provide value for money to the state and provide industry with a consistent and reliable pipeline of work to support the Big Build.

Consistent with the DTF *Procurement Strategy Guidelines*, Step 3 builds on the recommended packaging approach to consider suitable delivery models for the Project scope by undertaking analysis of procurement options for delivery for each package of works. For this process, a four-phase methodology was used to determine the procurement recommendation for each of the Sunshine / Albion, Corridor, ARTC, Maribyrnong River Bridge, Viaduct, Airport and Rail Systems packages:

- **Phase 1** – Identify procurement evaluation criteria.
- **Phase 2** – Evaluation framework.
- **Phase 3** – Procurement considerations.
- **Phase 4** – Procurement options assessment for each package.

The procurement options assessment of these packages of works (Sunshine / Albion package, Corridor package, Maribyrnong River Bridge package, ARTC, Viaduct package, Airport package and Rail Systems package) are explained in the following subsections 5.1.4.1 to 5.1.4.7. Due to the unique tenure arrangements and significant stakeholder interface complexities associated with the delivery of works on Melbourne Airport-leased land (which is owned by the Australian Government, and leased to APAM under a long term lease arrangement), there are additional considerations which apply to the Airport and Viaduct packages. Further details in relation to these packages are provided in section 5.2.

5.1.1. Phase 1: Evaluation criteria

Having regard for the factors outlined in Step 1 and considering approaches adopted on comparable projects, the following evaluation criteria were developed to support the value for money assessment of delivery models for the identified works packages.

Table 3: Procurement options assessment evaluation criteria

Evaluation criterion	Description	Relative Priority
Market interest and appetite	The extent to which the delivery model assists in maximising market interest amongst the appropriate market participants with the relevant skills, expertise and capacity.	High
Time	The extent to which the delivery model is able to deliver the Project within the State's time constraints and provides time certainty.	High

Evaluation criterion	Description	Relative Priority
Price and budget certainty	The extent to which the delivery model supports cost certainty and competitive pricing for capital costs.	High
Risk management	The extent to which the delivery model allocates risk (including technical, approvals, interface) to the party best placed to manage it.	High
Flexibility and control	The extent to which the delivery model enables the State to retain flexibility to change specifications, access, occupations and provide operational flexibility over time.	Moderate
Innovation and incentive	The extent to which the delivery model incentivises the contractor to innovate to meet the required performance outputs and other requirements.	Moderate
Stakeholder management	The extent to which each procurement option assists the Victorian Government in managing stakeholders through the delivery of the Project.	Moderate

These criteria have not been numerically weighted, however, some provide inherently greater differentiation between alternative procurement models than others and therefore an indicative 'priority' (e.g. high / moderate / low rating) has been attached to each criterion as set out above. The 'Relative Priority' listed relates to a whole-of-project focus, however the weightings may vary between packages to reflect the key drivers for the relevant package.

5.1.2. Phase 2: Evaluation framework

The following ratings were used to assess the suitability and value for money proposition of each shortlisted procurement model against the evaluation criteria.

Table 4: Procurement options assessment evaluation framework

Scoring	Description
✓✓✓	Procurement option is extremely effective in satisfying the requirements of the criterion
✓✓	Procurement option is effective in satisfying the requirements of the criterion
✓	Procurement option satisfies or partially satisfies the requirements of the criterion
✗	Procurement option is ineffective in satisfying the requirements of the criterion
n/a	Not applicable

5.1.3. Phase 3: Procurement considerations

5.1.3.1. Procurement options identified

Procurement models across Australia have evolved over the past decade, primarily driven by the increasingly constrained construction market and evolving market appetite for risk. This has seen the rigid definition and labels of traditional procurement models become more fluid with elements of collaboration and fixed price co-existing in any given procurement model.

Based on RPV's preliminary consideration of the issues and relevant package risks, fixed price / lump sum Design and Construct (D&C) and Alliance delivery models are seen as the opposing ends in a spectrum of viable procurement models for the seven main works packages under consideration (Sunshine / Albion package, Corridor package, ARTC package, Maribyrnong River Bridge package, Viaduct package, Airport package, and Rail Systems package), as shown in Figure 7. Note that the recommended delivery model(s) for the Airport and Viaduct packages have been informed by the unique issues associated with delivering works on Melbourne Airport-leased land (see section 5.2).

Figure 7: Collaborative contracting spectrum

A high level summary of the alternative procurement models that were not considered appropriate for these packages of works is provided in Table 5 below.

Table 5: Delivery models not assessed

Procurement model	Why not considered relevant
Managing contractor (MC)	A MC model is generally suited to projects where there are benefits associated with a contractor managing the development of design and construction works on the State's behalf through separate subcontracts. While this model could be viable for some elements of MAR (including potential early works, refer section 12.1.1), it was considered not suitable as a 'core option' because a pure MC is unlikely to provide the requisite level of price certainty in relation to the delivery of MAR and there was limited, if any, opportunity or benefit associated with further disaggregating the works into smaller sub-packages. For completeness, it is noted that there is no recent precedent in the Victorian rail sector for delivery of major rail works under a managing contractor model (other than in the case of the early works package for MTP).
Engineering, Procurement, Construction Management (EPCM)	Similar to the MC model outlined above, the EPCM contractor is generally appointed early in the project development process to assist manage the design and construction works on the State's behalf. The key departure from the MC model relates to the allocation of risk; an EPCM contractor does not take on liability for the quality of the works, whereas an MC generally accepts responsibility for ensuring the works are fit for purpose and free of defects (similar to a D&C contractor). Similar to the MC model above, this model is unlikely to provide the necessary price certainty for the delivery of main works, and results in greater risk exposure for the State in comparison with MC and D&C models.
Delivery Partner	The delivery partner model enables a client to supplement its internal project management capabilities by engaging one or more delivery partners to assist the client with project planning, programming, design management and construction management services. Design and construction services are competitively tendered, and the owner has a direct relationship with each subcontractor or supplier, with direct liability for contractual breaches. Delivery partners participate in a form of gainshare / painshare under this model, which also serves to limit the delivery partner's overall liability for poor performance. Similar to the EPCM model above, this model is unlikely to provide the necessary price certainty for the delivery of main works, and results in greater risk exposure for the State in comparison with MC and D&C models.
Early Contractor Involvement (ECI)	The Early Contractor Involvement (ECI) model is a collaborative procurement contract to develop a tender for the construction phase of a project. The ECI model is comprised of two phases: 1. The early engagement of a contractor(s) to provide input into the design process. 2. The construction phase, which involves the selected contractor delivering the project under a more traditional D&C style contract.

Procurement model	Why not considered relevant
	While this model could be viable for some elements of MAR, it was considered not suitable as a 'core option' because a pure ECI is unlikely to provide the requisite level of price certainty in relation to the delivery of MAR and there was limited, if any, opportunity or benefit associated with further increasing the level of contractor input in the design and development and design and construction phases. This model would also require additional State resources to ensure a successful outcome and lead to a more complex tender process.
Construct only	A construct only contract is generally suited to projects where the scope is well-defined and there is little likelihood of scope creep or changes to requirements. Given the uncertainty in relation to MAR's scope and design, this option was considered to offer the least certainty with regard to time and cost.
Public Private Partnership (PPP)	A PPP model is considered best suited for projects with opportunities for genuine risk transfer and private sector innovation/synergy in whole-of-life design, costing, innovation, and operations and maintenance (O&M). Given the nature and risk profile of the packages, together with limited opportunities for sector innovation / synergy in whole-of-life design and/or O&M services, a PPP was not considered appropriate for the packages under consideration in this analysis.

RPV has therefore assessed two delivery model options in detail for each of the Sunshine / Albion package, ARTC package, Corridor package, Maribyrnong River Bridge package, Viaduct package, Airport package and Rail Systems package, as set out in the following table.

Table 6: Delivery models assessed

Procurement option	Description
Alliance	An alliance comprising the State as owner, the franchisee and other non-owner participants (NOPs) – e.g. Contractor NOP, Designer NOP and potentially a Rail Systems NOP, if required. Key elements of a traditional alliance include: • participation in performance-based remuneration arrangements, under which NOPs and the project owner share the financial benefits or disbenefits of project performance through a painshare / gainshare regime • open book transaction process, with full transparency in relation to reimbursable costs • no blame, no disputes clause, which limits the liability of each party for mistakes, breach or negligence (except in very limited circumstances) • contractual commitments to co-operate and act in 'good faith' • governance arrangements that facilitate collective problem-solving and project-based decision-making.
Design & Construct (D&C)	A fixed-price, fixed-time contract for the delivery of the works (potentially with provisional sum items if required).

5.1.3.2. Approach to managing interfaces

RPV proposes to take a proactive approach to understanding and managing both external project / network interfaces to the Project (e.g. the systems package interface with the rest of the metropolitan rail network), as well as interfaces between packages within the Project.

This Appendix focusses on the identification and management of package interfaces within the Project, and detailed analysis is currently ongoing to identify, assess and respond to key package interface risks. For example, the scope delineation between the line-wide Systems package and the geographical packages (i.e. Airport, Viaduct, Maribyrnong River Bridge, Corridor and Sunshine / Albion packages) has been determined in order to minimise the magnitude and extent of interfaces between packages, where interfaces can be defined precisely and managed appropriately.

Detailed analysis is also being undertaken to ensure current and future external project and network interfaces are also considered as the Project develops. The proposed approach to managing these risks is a key consideration in the development and refinement of the packaging and procurement strategy for the Project.

A review of both local and interstate interface and integration governance arrangements will be undertaken to ensure key findings from precedent projects are incorporated into the delivery arrangements for MAR. RPV will draw on lessons learnt from the Metro Tunnel Project (MTP), including through the Integrated Program Management Framework and related governance processes as well as the detailed specification/delineation of scope between packages.

5.1.4. Phase 4: Procurement options assessment

The tables in the following subsections present detailed analysis for each of the Sunshine / Albion, Corridor, ARTC, Maribyrnong River Bridge, Viaduct, Airport and Rail Systems packages. The proposed procurement strategy for the Early Works package and other potential early works scope items is also outlined.

5.1.4.1. Sunshine / Albion package

Table 7 below presents a summary of the analysis against each evaluation criterion.

Table 7: Sunshine / Albion package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Based on feedback received through the MAR market engagement process, participants are generally supportive of collaborative contracting and a shared approach to risk. Participants generally agreed with the approach of using an alliance to deliver the Sunshine / Albion works, given the heavy brownfield nature of this package. • Based on experience, the market may prefer an alliance delivery method for packages involving significant interface with the ARTOs and therefore support using an alliance model for the Sunshine / Albion package. • This model is arguably the 'market standard' approach for high value, complex, brownfield works in a live rail environment and has been proved for similar works on Regional Rail Link and the MTP.	• Based on feedback received through the MAR market engagement process, there is likely to be less market appetite for the Sunshine / Albion works to be delivered as a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation). This is due to the complexity of the works, the significant interface with the live network and the need for multiple / extensive occupations.
Scoring: **(Priority: High)**	✓✓✓	✓
Time	• The alliance model provides an opportunity to develop construction approaches that provide an optimal balance between time required for construction, access and occupations which should increase confidence that timeframes can be met. • Pain/gain sharing mechanisms can be built into the alliance to provide incentives for the parties to complete the works within the required timeframes. • The metropolitan rail franchisee will likely be party to the alliance (given this is the biggest ARTO interface for this package) and will be the accredited rail infrastructure manager and also able to assist in defining requirements, assisting with a 'best for project' and best for	• Financial incentives can be built into D&C contracts to encourage timely completion. For example, the payment arrangements could be structured on a milestone completion basis and/or a portion of any milestone/progress payments could be retained until final completion. In addition, D&C contracts typically include liquidated damages to cover the owner's genuine pre-estimated loss arising from any delay to completion. • However, given the significant design and construction complexity and extensive and uncertainty of interfaces with the ARTOs, the level of detail required to clearly define scope and understand all risks to an acceptable level for bidders to bid back a fixed price proposal will be substantial. Further, the ability to develop a deliverable construction program within a predefined access regime is unlikely for these works, with flexibility required in relation to occupations and the complexities in relation to constructability (meaning that the State would likely be exposed to extension of time claims

Evaluation criterion	Alliance	D&C
	network balanced approach to occupations and access, and providing continued engagement and flexibility during construction. • The alliance model also provides an opportunity to commence the delivery phase early and for the alliance participants to develop collaborative approaches to construction that balance access / occupation regimes which may support shorter construction timeframes (rather than relying on predefined occupations and access regimes).	from a D&C contractor for these works, thereby eroding some of the time-based risk transfer).
Scoring: (Priority: High)	✓✓	✓✓
Price and budget certainty	• Although an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on a value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the State, contractors and ARTOs. This collaborative process should provide confidence that the TOC is achievable (with the alliance non-owner participants bearing a degree of cost risk if the TOC is not achieved). • The earlier involvement of the contractor(s) with the project team and with input from the ARTOs (and incentivised participation by the ARTOs) should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	• A D&C model will result in a fixed price contract, however given the significant design and construction complexity, extensive and uncertain interfaces it will be difficult for contractors to provide an achievable and accurate fixed price. As such, bidders will likely include a price premium in order to try to account for these uncertainties and the cost of variations during delivery will be high. • Under a D&C model the metropolitan rail franchisee is not contractually incentivised to collaboratively work with the State to minimise design and construction costs.
Scoring: (Priority: High)	✓✓	✓
Risk management	• Given the level of construction complexity in the Sunshine / Albion package, which is driven by the brownfield, operational rail environment (with numerous ARTOs operating through Sunshine Station and interfaces with other projects), the alliance structure provides the opportunity for the State, ARTOs and contractors to work collaboratively to ensure risks are identified and managed collectively.	• The design and construction complexity of the Sunshine / Albion package is such that it may be difficult to effectively transfer these risks under a fixed time, fixed cost contract on a value for money basis (i.e. without a significant risk premium). For example, it will be difficult to pre-agree a fixed occupations regime for the entire delivery phase when entering into the contractual arrangements because the need for occupations is likely to

Evaluation criterion	Alliance	D&C
	This provides continued ability of the State and contractors to deal with the complexities and develop approaches to manage risks as they arise, be they constructability issues, scope change risks or risks in relation to ARTO access and occupations. • Early involvement of the contractor with the State and the ARTOs during the design phase increases the opportunity to understand the technical complexities and to better identify, mitigate and manage risks. An alliance model is expected to provide the optimal forum through which these risks can be managed, with the State, the contractor(s) and the ARTOs all working together on a 'best for project' basis.	evolve and change as design is further developed and as the works are delivered. It is therefore likely that the contractor would need to include a significant risk premium to manage these risks and/or that the State may be exposed to material claims and variations. • Previous experience with comparable D&C contracts has indicated that this is not the optimal approach for managing interface risks. Separate interface arrangements would be required to manage key interfaces.
Scoring: (Priority: High)	✓✓✓	✓
Flexibility and control	• The alliance model provides significant flexibility to change the scope, design or construction approach post contract award. Given the brownfield nature and significant number of interfaces of this package, these features would be valuable. • The alliance model also has the flexibility to amend occupations and access regimes with the ARTO(s) as they are part of the alliance.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree. In particular and as previously discussed, as the metropolitan rail franchisee would not be party to the works contract there may be a lack of flexibility (or appropriate incentives) for the metropolitan rail franchisee to manage any required changes to the access and occupations regime. Given the uncertainty in relation to occupations, a flexible framework will be particularly important for this package.
Scoring: (Priority: Moderate)	✓✓✓	✓
Innovation and incentive	• Early involvement of the contractor with the State and ARTOs increases the opportunity to identify innovation and optimise the access regimes. • The State will also share in the benefit of further innovations identified (post development of the TOC) during design and construction. • The collaborative alliance environment allows all parties to modify the design and construction approach on an on-going basis, on a best for	• Given the nature of these works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process or during delivery of the works because any changes to scope or the occupations regime would require a variation. • In addition, under a D&C model, the State potentially would not share in any innovation benefits realised during design and construction.

Evaluation criterion	Alliance	D&C
	project basis. This can create incentive for all parties to be 'innovative' when dealing with risks and issues as they arise (whereas, for example, under a D&C there would be little or no incentive for the metropolitan rail franchisee to contribute to innovative 'workaround' solutions such as different occupations regimes).	
Scoring: **(Priority: Moderate)**	✓✓✓	✓
Stakeholder management	• An alliance model enables the metropolitan rail franchisee to be 'brought inside the tent' and actively involved in the design development process and the delivery of the works. This will help to reduce the risk of scope changes and creates a forum through which the State, the metropolitan rail franchisee and the contractors can collaborate to agree occupations and access arrangements. It also enables works to be delivered by the ARTOs where they are best placed to do so without complex contractual interfaces. • Provides a commercial framework through which stakeholder issues can be better managed, with the State, the contractor(s) and the metropolitan rail franchisee aligned and therefore all working together to identify, mitigate and manage stakeholder risks.	• Previous experience with comparable D&C contracts has indicated that this is not the optimal approach for managing complex stakeholder relationships.
Scoring: **(Priority: Moderate)**	✓✓✓	✓✓

Table 8: Sunshine / Albion – summary of assessment

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓	**Alliance**
Time	High	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓	
Risk management	High	✓✓✓	✓	
Flexibility and control	Moderate	✓✓✓	✓	
Innovation and incentive	Moderate	✓✓✓	✓	
Stakeholder management	Moderate	✓✓✓	✓✓	

An Alliance approach was assessed as the recommended procurement model for the Sunshine / Albion package, as it performs stronger than a D&C against all of the evaluation criteria. This reflects, amongst other things, the level of construction complexity associated with the Sunshine / Albion works and brownfield, operational rail environment through Sunshine into the Albion-Jacana corridor, which involves numerous ARTOs operating through Sunshine Station and multiple interfaces with other projects currently in delivery.

Table 9 summarises the key risks specific to the Sunshine / Albion package and how the recommended Alliance would mitigate these risks.

Table 9: Mitigation of key Sunshine / Albion package risks

Key risks	Mitigation under delivery model
• Stakeholder interface with ARTOs (e.g. MTM, V/Line and ARTC) is less effective and efficient than expected, resulting in delay. • Complex staging requirements of works in operational road and rail environments is more difficult than anticipated, leading to program delays.	• An alliance model is expected to provide the best commercial framework through which these risks can be managed, with the State, the contractor(s) and the ARTOs commercially aligned and therefore all working together to identify, mitigate and manage these risks. • Complex works to be delivered in a live operational environment results in a risk profile that would be better managed collaboratively between relevant parties to minimise delays and manage these risks effectively, with the contractor incentivised via painshare / gainshare regime.

5.1.4.2. Corridor package

Table 10 below summarises the procurement options assessment for the Corridor package against each evaluation criterion.

Table 10: Corridor package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Based on feedback received through the MAR market engagement process, participants are generally supportive of collaborative contracting and a shared approach to risk. Contractor market appetite for the Corridor package is expected to be stronger using a collaborative procurement model given the brownfield nature of the works. There is also a significant operational interface with ARTOs such as ARTC, and design interfaces with MTM. • This model is arguably the 'market standard' approach for high value, complex, brownfield works in a live rail environment and has been proved for similar works on Regional Rail Link and the MTP.	• Based on feedback received through the MAR market engagement process, there is likely to be less market appetite for the Corridor works to be delivered as a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation). This is due to the significant interface with the live freight network and the likely need for multiple occupations with limited opportunities for access without interrupting the operation of the freight corridor.
Scoring (Priority: High)	✓✓✓	✓✓
Time	• The alliance model provides incentives for timely completion through pain / gain share arrangement and time key performance indicators (KPIs). • Where there are interfaces or constraints with the existing rail corridor, the alliance model provides potential benefits with regard to innovative staging, occupations regime (i.e. limited rail occupations) that could create opportunities and an incentive for earlier completion. • An alliance also provides for more flexibility to adapt to scope changes, risks and opportunities which can provide program efficiencies. • The complexities regarding limited opportunities for access in this operational freight corridor may lead to delays, meaning this package may be suited to an alliance model for improved program outcomes. • An alliance model provides the opportunity for ARTC to participate in the alliance. ARTC has established relationships with freight operators, which is critical to the success of the program delivery, and these relationships have more influence in an alliance model.	• As the D&C model is a fixed time contract, program risk is transferred to the private sector (subject to nominated extension events). • Typically, the contractor will be required to pay Liquidated Damages if it does not achieve practical completion by the specified date. The Liquidated Damages regime will strongly incentivise timely completion. • However, given the extent and uncertainty of interfaces with ARTC (as ARTO of the Albion-Jacana corridor), the level of detail required to clearly define scope and risks such that bidders are able to bid back a fixed price proposal will be substantial. Further, the ability to develop a deliverable construction program within a predefined access regime is unlikely for these works, with flexibility required in relation to occupations and the complexities in relation to constructability (meaning that the State would likely be exposed to extension of time claims from a D&C contractor for these works, thereby eroding some of the time-based risk transfer).

Evaluation criterion	Alliance	D&C
Scoring (Priority: Moderate)	✓✓	✓✓
Price and budget certainty	• Under an alliance model, the risk of cost overruns is shared by the parties (up to a point, after which overruns are a State risk). • While an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a Target Outturn Cost (TOC), with consultation between the State, contractors and ARTOs. This collaborative process should provide confidence that the TOC is achievable. For a work package susceptible to scope changes or other changes which would traditionally be retained as State risks under a D&C model, an alliance may provide more flexibility, comparatively, for the parties to explore collaboratively the best for project solution to the change, including if there are material scope variations post contract award. Under this model, the pricing of works is done on an open book basis so that the State has visibility over the contractor's actual costs and payment is based on the actual reimbursable costs plus a pre-agreed margin. Under a traditional D&C model by comparison, variations are by agreement or valued on a unit rates (plus profit) basis which may not provide the State with the same value for money outcome for the State. The earlier involvement of the contractor(s) with the project team and input from the ARTO(s) (and potentially incentivised participation by the Franchisee) should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model. • An alliance model may enable the Franchisee to embed specialist operational and signalling resources from the initial formation of an alliance (assuming participation as a NOP), which are critical to the success of the Corridor package. This would not be possible in a D&C arrangement.	• A fixed price contract may provide greater price and budget certainty (assuming a well-defined scope and minimal variations post contract award). Where the scope of works and risks are expected to be definable and well understood, fixed price models and competitive tension should deliver better value; that is, the State will not be paying a premium for passing on undefined risks. • The contractor also accepts the risk of construction and as such has a strong incentive to ensure the design is constructible and delivers on the functional requirements. The contractor is heavily incentivised to manage changes efficiently post contract award, in comparison to the pain/gain share regime of an alliance model (which, due to the payment structure, dilutes the incentive to manage change with the same level of efficiency as a D&C).
Scoring (Priority: High)	✓✓	✓✓
Risk management	• Other than in the case of specific Adjustment Events, the risk sharing approach under an alliance may not specifically 'allocate' risks to the	• The level of risk transfer is agreed prior to contact close and, in general, overall design and construction risk lies with the contractor. While this is a benefit of the D&C model, it is noted that the current construction

Evaluation criterion	Alliance	D&C
	parties best able to manage them. All risks are shared, including cost overruns arising from them. • An alliance model is preferable where the cost of transferring risks is prohibitive in the prevailing market conditions. The extent of these risks, particularly those relating to safety, approvals, supervisions, occupations and program within the Albion-Jacana corridor are still under consideration. However, an alliance model is expected to provide the optimal forum through which these risks can be managed, with the State, the contractor(s) and the ARTO(s) all working together on a 'best for project' basis. • The Corridor package has interfaces with almost all other packages, with the exception of the Airport Station package, creating a high level construction interface and interdependency. The alliance structure provides the opportunity for the State, ARTO(s) and contractors to work collaboratively and deal with the complexities and develop approaches to manage risks as they arise (whether in the Corridor package or the neighbouring packages), be they constructability issues, scope change risks or risks in relation to ARTO access and occupations.	market has become increasingly constrained and the market appetite for risk has evolved concurrently. This has seen the market reject rigid risk allocations of traditional procurement models, with elements of collaboration and fixed price co-existing in any given procurement model as a result. • It may be difficult to pre-agree a fixed occupations regime for the entire delivery phase when entering into the contractual arrangements because the need for occupations in the corridor is likely to evolve and change as design is further developed and as the works are delivered. The contractor may need to include a significant risk premium to manage these risks and/or that the State may be exposed to material claims and variations.
Scoring (Priority: High)	✓✓✓	✓✓
Flexibility and control	• There is flexibility to adapt to scope changes, risks and opportunities as they arise during delivery of the works. • An alliance model is preferable where the owner has superior knowledge, skills, preference and capacity to influence or participate in the development and delivery of the package of works. • An alliance model also has the flexibility to amend occupations and access regimes with the ARTO(s) if they are part of the alliance. This would be helpful for this package of works which is at a critical juncture in the network where the freight, regional and metropolitan networks meet. • As previously mentioned, the Corridor package has interfaces with every single other package, creating a high level of construction interface and interdependency thereby reiterating the need for the Corridor package to be flexible and adaptable given the environment.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree. In particular, as ARTC would not be party to the works contract there may be a lack of flexibility (or appropriate incentives) for the ARTO to manage any required changes to the access and occupations regime. In addition to this operator interface, the Corridor package has interfaces with every single other package which should also be considered. Given the uncertainty in relation to opportunities, ability and extent of occupations, a flexible framework will be particularly important for this package.

Evaluation criterion	Alliance	D&C
Scoring (Priority: Moderate)	✓✓✓	✓✓
Innovation and incentive	• Early involvement of the contractor with the State and ARTO(s) increases the opportunity to identify innovation and optimise the access regimes and influence signalling technology. • The State will also share in the benefit of further innovations identified (post development of the TOC) during design and construction, albeit the opportunities for innovation are limited in this package of works.	• Given the nature of these works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process or during delivery of the works because any changes to scope or the occupations regime would require a variation. • In addition, under a D&C model, the State potentially would not share in any innovation benefits realised during design and construction.
Scoring (Priority: Moderate)	✓✓	✓
Stakeholder management	• Painshare / gainshare and collaborative elements of the alliancing model encourages good relationships between parties (especially if key stakeholders are 'in the tent' of the alliance participating as NOPs).	• While stakeholder management is expected to be more manageable than the Corridor package's neighbouring packages, extensive stakeholder management will be required with ARTC and VicRoads (in particular). Previous experience with comparable D&C contracts has indicated that this is not the optimal approach for managing complex stakeholder relationships.
Scoring (Priority: Moderate)	✓✓	✓✓

Table 11: Procurement options assessment summary – Corridor package

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓✓	**Alliance**
Time	Moderate	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓✓	
Risk management	High	✓✓✓	✓✓	
Flexibility and control	Moderate	✓✓✓	✓✓	
Innovation and incentive	Moderate	✓✓	✓	
Stakeholder management	Moderate	✓✓	✓✓	

An Alliance approach has been assessed as the recommended procurement model for the Corridor package as, on balance, it performs equal to or stronger than a D&C in relation to each of the evaluation criteria. This reflects, amongst other things, the highly brownfield nature of the Corridor package and construction, staging and interface complexity and the need to work closely with ARTOs such as ARTC.

Table 12 summarises the key risks specific to the Corridor package and how the recommended Alliance model would mitigate these risks.

Table 12: Mitigation of key Corridor package risks

Key risks	Mitigation under delivery model
• Stakeholder interface with ARTOs (e.g. ARTC) and VicRoads is less effective and efficient than expected, resulting in delay. • Restrictive site access arrangements due to freight timetabling, leading to an impact on the occupations schedule and thereby program delays.	• An alliance model is expected to provide the best commercial framework through which these risks can be managed, with the State, the contractor(s) and the Franchisee commercially aligned and therefore all working together to identify, mitigate and manage these risks.

5.1.4.3. ARTC package

The table below summarises the procurement options assessment for the ARTC package against each evaluation criterion.

Table 13: ARTC package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Based on feedback received through the MAR market engagement process, participants are generally supportive of collaborative contracting and a shared approach to risk. Market participants have suggested that key risks (including in relation to interfaces and utilities, which are relevant for the ARTC package) should be shared or retained by the State, which supports the Alliance model.	• Based on feedback received through the MAR market engagement process, there is likely to be less market appetite for the ARTC works to be delivered as a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation). This is due to the significant interface with the live freight network and the likely need for multiple occupations with limited opportunities for access without interrupting the operation of the freight corridor.
Scoring (Priority: High)	✓✓✓	✓✓
Time	• The alliance model provides an opportunity to develop construction approaches that provide an optimal balance between time required for construction and access which should increase confidence that timeframes can be met. • Pain/gain sharing mechanisms can be built into the alliance to provide incentives for the parties to complete the works within the required timeframes. • There may be some program benefits to be achieved from the flexibility of an Alliance structure due to the material operational freight interface.	• The D&C model transfers program risk to the private sector and provides incentives for timely completion through mechanisms such as the Liquidated Damages regime. • However, given the extent and uncertainty of interfaces with ARTC (as ARTO of the Albion-Jacana corridor), the level of detail required to clearly define scope and risks such that bidders are able to bid back a fixed price proposal will be substantial. Further, the ability to develop a deliverable construction program within a predefined access regime is unlikely for these works, with flexibility required in relation to occupations and the complexities in relation to constructability (meaning that the State would likely be exposed to extension of time claims from a D&C contractor for these works, thereby eroding some of the time-based risk transfer).
Scoring (Priority: High)	✓✓	✓✓
Price and budget certainty	• Although an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on a value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the alliance participants. This collaborative process should provide confidence	• A fixed price contract may provide greater price and budget certainty (assuming a well-defined scope and minimal variations post contract award). However, given the complexity of the ARTC works, the State may pay a premium for passing on undefined risks to the contractor.

Evaluation criterion	Alliance	D&C
	that the TOC is achievable (with the alliance non-owner participants bearing a degree of cost risk if the TOC is not achieved). • The earlier involvement of the contractor(s) with the project team should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	
Scoring (Priority: High)	✓✓	✓✓
Risk management	• The risk sharing approach under an alliance may not ‘allocate’ risks to the parties best able to manage them. The ARTC package has a range of complexities associated with delivering works in a brownfield environment, narrow rail corridor, and operational freight environment. These risks may be better managed under a collaborative alliance model. • An Alliance model may also support better management of interfaces with the other MAR packages which are being delivered as alliances, enabling integrated governance, design development and risk management.	• The ARTC package has an overall lower risk profile than other MAR packages, making it relatively more suitable for a fixed price approach. However, there are significant risks associated with the brownfield nature of the works, operational freight environment and other key interfaces, meaning contractor appetite to accept these risks (without a substantial risk premium) may be limited. • It is critical that the ARTC works are delivered to ARTC’s specifications given its rail safety accreditation requirements. Under a D&C approach, an independent certifier could be engaged to certify completion and confirm that the works have been delivered in accordance with the specification, helping manage a key risk for ARTC and the State.
Scoring (Priority: High)	✓✓	✓✓
Flexibility and control	• Under an alliance model there is flexibility to adapt to scope changes, risks and opportunities as they arise during delivery of the works.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree.
Scoring (Priority: Moderate)	✓✓✓	✓✓
Innovation and incentive	• An alliance should drive / facilitate innovation by bringing all stakeholders together with aligned incentives and a focus on ‘best for project’ outcomes. However, there are relatively limited opportunities to identify innovation in design as part of the ARTC package (beyond optimisation of the access regimes and occupation schedules) due to the nature of the works.	• Compared to an alliance model, it would be more difficult for a D&C contractor to deliver design innovation from an access and occupations perspective due to the lack of direct involvement from ARTC. • Given the nature of these works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process because any changes to scope or the occupations regime would require a variation.

Evaluation criterion	Alliance	D&C
Scoring (Priority: Moderate)	✓✓	✓
Stakeholder management	• Painshare / gainshare and collaborative elements of the alliancing model encourages good relationships between parties. A collaborative approach would provide benefits in terms of engagement with key stakeholders and early identification and appropriate management of key interfaces.	• Relative to other MAR packages, there are fewer complex stakeholder relationships and package interfaces to manage as part of the ARTC package. The ARTC works are intended to be delivered early, before the other MAR package contractors commence on-site. However, there are key interfaces with the operational freight corridor, USPs and other MAR packages expected during design development and delivery.
Scoring (Priority: Moderate)	✓✓	✓✓

Table 14: Procurement options assessment summary – ARTC package

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓✓	**Incentivised Target Cost (ITC)**
Time	High	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓✓	
Risk management	High	✓✓	✓✓	
Flexibility and control	Moderate	✓✓✓	✓✓	
Innovation and incentive	Moderate	✓✓	✓	
Stakeholder management	Moderate	✓✓	✓✓	

As outlined in section 205.1.3.1, fixed price / lump sum D&C and Alliance delivery models are seen as the opposing ends in a spectrum of viable procurement models. Therefore, while the procurement options assessment conducted above was based on these two delivery models, the assessment highlighted this package may be best suited to a procurement model that has both elements of collaboration and greater risk transfer to the contractor. As a result, an Incentivised Target Cost (ITC) approach (which sits on the collaborative contracting spectrum) was assessed as the recommended procurement model for the ARTC package.

RPV has also assessed options for the ITC contracting structure and determined that ARTC is the most appropriate entity to enter into the agreement as counterparty and manage the works on behalf of the State. This is due to the following key factors:

- ARTC, as ARTO of the Albion-Jacana corridor, is best placed to manage the constrained delivery environment and difficult operational interface for delivery of these works (which will require careful management and coordination).
- A key benefit of the ARTC package is that certain key ARTC works can be completed early, which de-risks the Sunshine / Albion, Corridor and Maribyrnong River Bridge packages. As the package involves planning and delivery of works on ARTC-controlled assets, having ARTC directly manage procurement and delivery of the works simplifies the process and allows for faster mobilisation.
- ARTC's direct involvement and control over the works will help to reduce rail accreditation and safety interface risks along the corridor, as well as minimise disruption to ARTC's business generally.
- ARTC has significant experience in procuring and managing capital works on its assets, with an established project delivery arm to its business.

Table 15 summarises the key risks specific to the ARTC package and how the recommended ITC model would mitigate these risks.

Table 15: Mitigation of key ARTC package risks

Key risks	Mitigation under delivery model
• Operational and safety interface risks due to the live freight network	• The ITC model promotes a collaborative approach between ARTC and the contractor, with the target cost providing a more flexible and transparent

Key risks	Mitigation under delivery model
• Risk that the works fail to meet ARTC's rail safety accreditation standards	mechanism for managing unforeseen events during delivery • Under an ITC, an independent certifier may be engaged to certify that the works have been completed in accordance with the specification

5.1.4.4. Maribyrnong River Bridge package

The table below summarises the procurement options assessment for the Maribyrnong River Bridge package against each evaluation criterion.

Table 16: Maribyrnong River Bridge package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Based on feedback received through the MAR market engagement process, participants are generally supportive of collaborative contracting and a shared approach to risk. Market participants have suggested that key risks (including in relation to interfaces, utilities and geotechnical, which are all relevant for the Maribyrnong River Bridge works) should be shared or retained by the State, which supports the Alliance model.	• As part of the recent MAR market sounding, market participants expressed interest in delivering the Maribyrnong River Bridge works via a fixed price contract due to the smaller size, and discrete greenfield nature of the scope. This view is supported by other recent market soundings undertaken by RPV for works of similar scale and complexity on other projects, to be delivered by D&C contract.
Scoring (Priority: High)	✓✓✓	✓✓✓
Time	• The alliance model provides an opportunity to develop construction approaches that provide an optimal balance between time required for construction and access which should increase confidence that timeframes can be met. • Pain/gain sharing mechanisms can be built into the alliance to provide incentives for the parties to complete the works within the required timeframes. • There may be some program benefits to be achieved from the flexibility of an Alliance structure due to the material stakeholder involvement required in the delivery of these works (e.g. interface with ARTC and Heritage Victoria).	• The D&C model transfers program risk to the private sector and provides incentives for timely completion through mechanisms such as the Liquidated Damages regime. • As the scope of works (and associated risks) is expected to be well understood and have relatively manageable interfaces with other work packages, the private sector is more likely to accept the risk of timely completion on a value for money basis.
Scoring (Priority: Moderate)	✓✓	✓✓
Price and budget certainty	• Although an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on a value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the State, contractors and ARTOs. This collaborative process should provide	• A fixed price contract may provide greater price and budget certainty (assuming a well-defined scope and minimal variations post contract award). Where the scope of works and risks are expected to be definable and well understood, fixed price models and competitive tension should deliver better value; that is, the State will not be paying a premium for passing on undefined risks.

Evaluation criterion	Alliance	D&C
	confidence that the TOC is achievable (with the alliance non-owner participants bearing a degree of cost risk if the TOC is not achieved). • The earlier involvement of the contractor(s) with the project team and with input from the ARTOs (and incentivised participation by the ARTOs) should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	• Under a D&C model the metropolitan rail franchisee is not contractually incentivised to collaboratively work with the State to minimise design and construction costs.
Scoring (Priority: High)	✓✓	✓✓
Risk management	• The risk sharing approach under an alliance does not 'allocate' risks to the parties best able to manage them. Although the Maribyrnong River Bridge works involve a largely greenfield construction, there are complexities associated with significant ARTO interfaces during delivery which may be better managed under a collaborative alliance model. • An Alliance model may also support better management of interfaces with the other MAR packages which are being delivered as alliances, enabling integrated governance, design development and risk management.	• Risks, including constructability risks, are expected to be relatively well understood, and as such can be effectively allocated (and priced) through the D&C. • Although the Maribyrnong River Bridge package has an overall lower risk profile than other MAR packages, making it more suitable for a fixed price approach, the scope predominantly comprises structural works. Under a D&C approach, there would be a clear distinction that the contractor is responsible for quality and fitness for purpose of the works. This may drive a stronger level of compliance in the design and delivery of the works, helping the State manage a key risk. • The largest risk of this package relates to the heritage, land, planning and environment risks associated with the bridge. Primary approvals risks are generally retained by the State during the planning and development phase of the project and can be mitigated by ensuring primary approvals are received prior to contract award. However, it is noted that secondary approvals would usually be transferred to the contractor which are not insignificant in terms of cost and time.
Scoring (Priority: High)	✓✓	✓✓
Flexibility and control	• Under an alliance model there is flexibility to adapt to scope changes, risks and opportunities as they arise during delivery of the works.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree.

Evaluation criterion	Alliance	D&C
Scoring (Priority: Moderate)	✓✓✓	✓✓
Innovation and incentive	• Early involvement of the contractor with the State and ARTOs should optimise the access regimes and occupation schedules and increase the opportunity to identify innovation in design. For the Maribyrnong River Bridge package works, innovative solutions may be developed in response to the specific topography, ecology, heritage and cultural heritage considerations of the site. • In addition, an alliance should drive / facilitate innovation by bringing all stakeholders together with aligned incentives and a focus on 'best for project' outcomes.	• Compared to an alliance model, it would be more difficult for a D&C contractor to deliver design innovation from an access and occupations perspective due to the lack of direct ARTO involvement. • Given the nature of these works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process because any changes to scope or the occupations regime would require a variation.
Scoring (Priority: Moderate)	✓✓	✓
Stakeholder management	• Painshare / gainshare and collaborative elements of the alliancing model encourages good relationships between parties (especially if key stakeholders are 'in the tent' of the alliance participating as NOPs). A collaborative approach would provide benefits in terms of engagement with ARTC and early identification and appropriate management of key interfaces.	• Relative to other MAR packages, there are fewer complex stakeholder relationships to manage as part of the Maribyrnong River Bridge package. While key interfaces with ARTC are expected during design development phase, these are expected to be manageable as they are relatively well understood and definable.
Scoring (Priority: Moderate)	✓✓✓	✓✓

Table 17: Procurement options assessment summary – Maribyrnong River Bridge package

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓✓✓	**Incentivised Target Cost (ITC)**
Time	Moderate	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓✓	
Risk management	High	✓✓	✓✓	
Flexibility and control	Moderate	✓✓✓	✓✓	
Innovation and incentive	Moderate	✓✓	✓	
Stakeholder management	Moderate	✓✓✓	✓✓	

As with the ARTC package discussed in 5.1.4.3, the procurement options assessment for the Maribyrnong River Bridge package suggests that this package may be best suited to a procurement model which has both elements of collaboration and greater risk transfer to the contractor. As a result, an ITC model was assessed as the recommended procurement model for the Maribyrnong River Bridge package.

Table 18 summarises the key risks specific to the Maribyrnong River Bridge package and how the recommended ITC model would mitigate these risks.

Table 18: Mitigation of key Maribyrnong River Bridge package risks

Key risks	Mitigation under delivery model
• Requirements of Heritage Victoria are more onerous or time consuming than expected, leading to program delays. • Adverse ecological impacts arise as a result of the location of the works which may lead to changes in requirements during the design and construction of the works.	• The collaborative and flexible aspects of the ITC model should allow for innovation in the design solution of the new Maribyrnong River Bridge while remaining cognisant of the site's complexities, due to the topography, ecology, heritage and cultural heritage.

5.1.4.5. Viaduct package

The table below summarises the procurement options assessment for the Viaduct package against each evaluation criterion.

Table 19: Viaduct package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Based on feedback received through the MAR market engagement process, participants are generally supportive of collaborative contracting and a shared approach to risk. Some participants noted the Viaduct should be delivered as an alliance, which is expected given the brownfield nature of the works and the significant complexity associated with delivering works on Airport-leased land, within a live operational airport environment. There are also key design and/or delivery interfaces with the Department of Transport, the metropolitan rail franchisee, ARTC and APAM. • This model is arguably the 'market standard' approach for high value, complex, brownfield works and has been proved for similar works on Regional Rail Link and the MTP noting the Viaduct works will be in a brownfield airport environment as opposed to a brownfield rail environment.	• Some participants in the MAR market engagement process suggested that the Viaduct package could be delivered under a more traditional delivery model. However, there is likely to be less market appetite for a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation) given the significant interface with the live road network and operational airport environment.
Scoring (Priority: High)	✓✓✓	✓
Time	• The alliance model provides incentives for timely completion through pain / gain share arrangement and time KPIs. • The alliance model provides potential benefits in managing the various interfaces or constraints with the live road network and operational airport environment that could create opportunities and an incentive for earlier completion. • An alliance also provides for more flexibility to adapt to scope changes, risks and opportunities which can provide program efficiencies. • The complexities regarding site access in the operational airport environment may lead to delays, meaning this package may be suited to an alliance model for improved program outcomes, (particularly if APAM were a party to the alliance compared to if they were a stakeholder under a D&C).	• As the D&C model is a fixed time contract, program risk is transferred to the private sector (subject to nominated extension events). • Typically, the contractor will be required to pay Liquidated Damages if it does not achieve practical completion by the specified date. The Liquidated Damages regime will strongly incentivise timely completion. • However, given the extensive interfaces, including with APAM, and complexities in relation to constructability, the level of detail required to clearly define scope and risks such that bidders are able to bid back a fixed price proposal will be substantial. Further, the ability to develop a deliverable construction program within a predefined access regime is unlikely for these works, with flexibility required in relation to road occupations and the operational airport environment (meaning that the State would likely be exposed to extension of time claims from a D&C contractor for these works, thereby eroding some of the time-based risk transfer).

Evaluation criterion	Alliance	D&C
	• An alliance model provides the opportunity for APAM to participate as a NOP in the alliance. APAM's involvement would support timely delivery given its significant influence over the works and because it would have a vested interest in the outcome of the Project under an alliance model.	
Scoring (Priority: High)	✓✓	✓✓
Price and budget certainty	• Under an alliance model, the risk of cost overruns is shared by the parties (up to a point, after which overruns are a State risk). • While an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the State, contractors and ARTOs. This collaborative process should provide confidence that the TOC is achievable. For a work package susceptible to scope changes or other changes which would traditionally be retained as State risks under a D&C model, an alliance may provide more flexibility, comparatively, for the parties to explore collaboratively the best for project solution to the change, including if there are material scope variations post contract award. Under this model, the pricing of works is done on an open book basis so that the State has visibility over the contractor's actual costs and payment is based on the actual reimbursable costs plus a pre-agreed margin. Under a traditional D&C model by comparison, variations are by agreement or valued on a unit rates (plus profit) basis which may not provide the State with the same value for money outcome for the State. The earlier involvement of the contractor(s) with the project team and input from the metropolitan rail franchisee and potentially APAM should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	• A fixed price contract may provide greater price and budget certainty (assuming a well-defined scope, access regime and minimal variations post contract award). Where the scope of works and risks are expected to be definable and well understood, fixed price models and competitive tension should deliver better value; that is, the State will not be paying a premium for passing on undefined risks. • The contractor also accepts the risk of construction and as such has a strong incentive to ensure the design is constructible and delivers on the functional requirements. The contractor is heavily incentivised to manage changes efficiently post contract award, in comparison to the pain/gain share regime of an alliance model (which, due to the payment structure, dilutes the incentive to manage change with the same level of efficiency as a D&C). • Under a D&C model, there is less opportunity to contractually incentivise key stakeholders like the metropolitan rail franchisee and APAM to collaboratively work with the State to minimise design and construction costs.
Scoring (Priority: High)	✓✓	✓✓
Risk management	• Other than in the case of specific Adjustment Events, the risk sharing approach under an alliance may not specifically 'allocate' risks to the parties best able to manage them. All risks are shared, including cost overruns arising from them.	• The level of risk transfer is agreed prior to contact close and, in general, overall design and construction risk lies with the contractor. While this is a benefit of the D&C model, it is noted that the current construction market has become increasingly constrained and the market appetite for

Evaluation criterion	Alliance	D&C
	• An alliance model is preferable where the cost of transferring risks is prohibitive in the prevailing market conditions. The extent of these risks, particularly those relating to safety, approvals and regulatory requirements (e.g. Civil Aviation Safety Authority, Airservices, Airport Building Controller) on Airport land are still under consideration. However, an alliance model is expected to provide the optimal forum through which these risks can be managed, with the State, the contractor(s), the metropolitan rail franchisee and potentially APAM all working together on a 'best for project' basis. • The Viaduct package has interfaces with the Corridor, Airport, Rail Systems and Early Works packages, creating significant construction interfaces and interdependencies. The alliance structure provides the opportunity for the State, the metropolitan rail franchisee, contractors (and potentially APAM) to work collaboratively. Together, these parties can deal with the complexities and develop approaches to manage risks as they arise (whether in the Viaduct package or the neighbouring packages), including in relation to constructability, scope change or access to Airport land.	risk has evolved concurrently. This has seen the market reject rigid risk allocations of traditional procurement models, with elements of collaboration and fixed price co-existing in any given procurement model as a result. • It will be difficult to pre-agree the road occupations regime and access arrangements with APAM for works on Airport land for the entire delivery phase when entering into the contractual arrangements. This is because occupations and access requirements are likely to evolve and change as design is further developed and as the works are delivered. The contractor may need to include a significant risk premium to manage these risks and/or that the State may be exposed to material claims and variations.
Scoring (Priority: High)	✓✓✓	✓✓
Flexibility and control	• There is flexibility to adapt to scope changes, risks and opportunities as they arise during delivery of the works. • An alliance model is preferable where the owner has superior knowledge, skills, preference and capacity to influence or participate in the development and delivery of the package of works. • An alliance model also has the flexibility to amend land access regimes with APAM (if it is part of the alliance), which would be particularly helpful given the complexity of the works being undertaken in an operational airport environment. • The Viaduct package has interfaces with the Corridor, Airport, Rail Systems and Early Works packages, creating significant construction interfaces and interdependencies. This supports the need for the Viaduct package to be flexible and adaptable given the environment.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree. • The Viaduct package has interfaces with APAM, which should also be considered. Given the uncertainty in relation to opportunities, ability and extent of land access arrangements, a flexible framework will be particularly important for this package.
Scoring (Priority: Moderate)	✓✓✓	✓✓

Evaluation criterion	Alliance	D&C
Innovation and incentive	• Early involvement of the contractor with the State, the metropolitan rail franchisee and APAM increases the opportunity to identify innovation and optimise the land access regimes and influence signalling technology. • The State will also share in the benefit of further innovations identified (post development of the TOC) during design and construction.	• Given the nature of the Viaduct works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process or during delivery of the works because any changes to scope, the road occupations regime or land access regime would require a variation. • In addition, under a D&C model, the State potentially would not share in any innovation benefits realised during design and construction.
Scoring (Priority: Moderate)	✓✓	✓
Stakeholder management	• Painshare / gainshare and collaborative elements of the alliancing model encourages good relationships between parties (especially if key stakeholders are ‘in the tent’ of the alliance participating as NOPs).	• Extensive stakeholder management will be required on the Viaduct package, including with APAM, the metropolitan rail franchisee, ARTC and the Department of Transport. Previous experience with comparable D&C contracts has indicated that a D&C model is not the optimal approach for managing complex stakeholder relationships.
Scoring (Priority: Moderate)	✓✓✓	✓✓

Table 20: Procurement options assessment summary – Viaduct package

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓	**Alliance**
Time	High	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓✓	
Risk management	High	✓✓✓	✓✓	
Flexibility and control	Moderate	✓✓✓	✓✓	
Innovation and incentive	Moderate	✓✓	✓	
Stakeholder management	Moderate	✓✓✓	✓✓	

An Alliance approach was assessed as the recommended procurement model for the Viaduct package as, on balance, it performs equal to or stronger than a D&C in relation to each of the evaluation criteria. This reflects the nuances associated with the Viaduct package straddling Airport and State land. Construction, staging and interface complexity will be associated with the operational road environment on the State land portion of the package, in addition to the need to work closely with APAM in relation to the Airport land portion of the package.

Table 18 summarises the key risks specific to the Viaduct package and how the recommended Alliance would mitigate these risks.

Table 21: Mitigation of key Viaduct package risks

Key risks	Mitigation under delivery model
• Stakeholder interface with APAM is less effective and efficient than expected, resulting in delay. • Restrictive site access arrangements and complex staging requirements due to operational airport and road environment lead to program delays.	• An alliance model, with a risk allocation tested and informed by the market and APAM, is expected to provide the best commercial framework through which these risks can be managed, with the State, the contractor(s) and Franchisee commercially aligned and therefore all working together to identify, mitigate and manage these risks.

5.1.4.6. Airport package

The table below summarises the procurement options assessment for the Airport package against each evaluation criterion.

Table 22: Systems package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• Participants in the MAR market engagement process were generally supportive of an alliance model for the Airport package. This is expected, given the brownfield nature of this package and the significant complexity associated with delivering works in a live operational airport environment. There are also key interfaces with APAM and the metropolitan rail franchisee. • This model is arguably the 'market standard' approach for high value, complex, brownfield works and has been proved for similar works on Regional Rail Link and the MTP noting these works will be in a brownfield Airport environment as opposed to a brownfield rail environment.	• There is likely to be less market appetite for a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation) given the significant interface with APAM and the operational airport environment.
Scoring (Priority: High)	✓✓✓	✓
Time	• The alliance model provides incentives for timely completion through pain / gain share arrangement and time KPIs. • The alliance model provides potential benefits in managing the various interfaces or constraints with the operational airport environment that could create opportunities and an incentive for earlier completion. • An alliance also provides for more flexibility to adapt to scope changes, risks and opportunities which can provide program efficiencies. • The complexities regarding site access in the operational airport environment may lead to delays, meaning this package may be suited to an alliance model for improved program outcomes, (particularly if APAM were a party to the alliance compared to if they were a stakeholder under a D&C). • An alliance model provides the opportunity for APAM to participate as a NOP in the alliance. APAM's involvement would support timely delivery given its significant influence over the works and because it	• As the D&C model is a fixed time contract, program risk is transferred to the private sector (subject to nominated extension events). • Typically, the contractor will be required to pay Liquidated Damages if it does not achieve practical completion by the specified date. The Liquidated Damages regime will strongly incentivise timely completion. • However, given the extensive interfaces, including with APAM, and complexities in relation to constructability, the level of detail required to clearly define scope and risks such that bidders are able to bid back a fixed price proposal will be substantial. Further, the ability to develop a deliverable construction program within a predefined access regime is unlikely for these works, with flexibility required in relation to the operational airport environment (meaning that the State would likely be exposed to extension of time claims from a D&C contractor for these works, thereby eroding some of the time-based risk transfer).

Evaluation criterion	Alliance	D&C
	would have a vested interest in the outcome of the Project under an alliance model.	
Scoring (Priority: High)	✓✓	✓✓
Price and budget certainty	• Under an alliance model, the risk of cost overruns is shared by the parties (up to a point, after which overruns are a State risk). • While an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on value for money basis – i.e. without a significant risk premium), the alliance model provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the State, contractors and the metropolitan rail franchisee. This collaborative process should provide confidence that the TOC is achievable. For a work package susceptible to scope changes or other changes which would traditionally be retained as State risks under a D&C model, an alliance may provide more flexibility, comparatively, for the parties to explore collaboratively the best for project solution to the change, including if there are material scope variations post contract award. Under this model, the pricing of works is done on an open book basis so that the State has visibility over the contractor's actual costs and payment is based on the actual reimbursable costs plus a pre-agreed margin. Under a traditional D&C model by comparison, variations are by agreement or valued on a unit rates (plus profit) basis which may not provide the State with the same value for money outcome for the State. The earlier involvement of the contractor(s) with the project team and input from the metropolitan rail franchisee and potentially APAM should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	• A fixed price contract may provide greater price and budget certainty (assuming a well-defined scope, access regime and minimal variations post contract award). Where the scope of works and risks are expected to be definable and well understood, fixed price models and competitive tension should deliver better value; that is, the State will not be paying a premium for passing on undefined risks. • The contractor also accepts the risk of construction and as such has a strong incentive to ensure the design is constructible and delivers on the functional requirements. The contractor is heavily incentivised to manage changes efficiently post contract award, in comparison to the pain/gain share regime of an alliance model (which, due to the payment structure, dilutes the incentive to manage change with the same level of efficiency as a D&C). • Under a D&C model, there is less opportunity to contractually incentivise key stakeholders like the metropolitan rail franchisee and APAM to collaboratively work with the State to minimise design and construction costs.
Scoring (Priority: High)	✓✓	✓✓
Risk management	• Other than in the case of specific Adjustment Events, the risk sharing approach under an alliance may not specifically 'allocate' risks to the parties best able to manage them. All risks are shared, including cost overruns arising from them. • An alliance model is preferable where the cost of transferring risks is prohibitive in the prevailing market conditions. The extent of these	• The level of risk transfer is agreed prior to contact close and, in general, overall design and construction risk lies with the contractor. While this is a benefit of the D&C model, it is noted that the current construction market has become increasingly constrained and the market appetite for risk has evolved concurrently. This has seen the market reject rigid risk allocations of traditional procurement models, with elements of

Evaluation criterion	Alliance	D&C
	risks, particularly those relating to safety, approvals and regulatory requirements (e.g. Civil Aviation Safety Authority, Airservices, Airport Building Controller) on Airport land are still under consideration. However, an alliance model is expected to provide the optimal forum through which these risks can be managed, with the State, the contractor(s), the metropolitan rail franchisee and potentially APAM all working together on a 'best for project' basis. • The Airport package has interfaces with the Viaduct and Rail Systems packages, APAM's Stage 2 Elevated Roads Project and potential utilities relocations by APAM, creating significant construction interfaces and interdependencies. The alliance structure provides the opportunity for the State, the metropolitan rail franchisee, contractors (and potentially APAM) to work collaboratively. Together, these parties can deal with the complexities and develop approaches to manage risks as they arise (whether in the Airport package or the neighbouring packages), including in relation to constructability, scope change or access to Airport land.	collaboration and fixed price co-existing in any given procurement model as a result. • It will be difficult to pre-agree the road occupations regime and access arrangements with APAM for works on Airport land for the entire delivery phase when entering into the contractual arrangements. This is because occupations and access requirements are likely to evolve and change as design is further developed and as the works are delivered. The contractor may need to include a significant risk premium to manage these risks and/or that the State may be exposed to material claims and variations.
Scoring (Priority: High)	✓✓✓	✓✓
Flexibility and control	• There is flexibility to adapt to scope changes, risks and opportunities as they arise during delivery of the works. • An alliance model is preferable where the owner has superior knowledge, skills, preference and capacity to influence or participate in the development and delivery of the package of works. • An alliance model also has the flexibility to amend land access regimes with APAM (if it is part of the alliance), which would be particularly helpful given the complexity of the works being undertaken in an operational airport environment. • The Airport package has interfaces with the Viaduct and Rail Systems packages, creating significant construction interfaces and interdependencies. This supports the need for the Viaduct package to be flexible and adaptable given the environment.	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree. • The Airport package has interfaces with APAM, which should also be considered. Given the uncertainty in relation to opportunities, ability and extent of land access arrangements, a flexible framework will be particularly important for this package.
Scoring (Priority: Moderate)	✓✓✓	✓✓
Innovation and incentive	• Early involvement of the contractor with the State, the metropolitan rail franchisee and APAM increases the opportunity to identify	• Given the nature of the Airport package works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process or during delivery of the

Evaluation criterion	Alliance	D&C
	innovation and optimise the access regimes and influence signalling technology. • The State will also share in the benefit of further innovations identified (post development of the TOC) during design and construction.	works because any changes to scope, the road occupations regime or land access regime would require a variation. • In addition, under a D&C model, the State potentially would not share in any innovation benefits realised during design and construction.
Scoring (Priority: Moderate)	✓✓	✓
Stakeholder management	• Painshare / gainshare and collaborative elements of the alliancing model encourages good relationships between parties (especially if key stakeholders are ‘in the tent’ of the alliance participating as NOPs).	• Extensive stakeholder management will be required on the Airport Package, particularly with APAM and the metropolitan rail franchisee. Previous experience with comparable D&C contracts has indicated that a D&C model is not the optimal approach for managing complex stakeholder relationships.
Scoring (Priority: Moderate)	✓✓✓	✓✓

Table 23: Procurement options assessment summary – Airport package

Package / Evaluation criterion	Relative priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓	**Alliance**
Time	High	✓✓	✓✓	
Price and budget certainty	High	✓✓	✓✓	
Risk management	High	✓✓✓	✓✓	
Flexibility and control	Moderate	✓✓✓	✓✓	
Innovation and incentive	Moderate	✓✓	✓	
Stakeholder management	Moderate	✓✓✓	✓✓	

An Alliance approach was assessed as the recommended procurement model for the Airport package as, on balance, it performs equal to or stronger than a D&C in relation to each of the evaluation criteria. This reflects the live brownfield operational environment of the Airport package which will present construction, staging and interface complexity and the need to work closely with APAM.

Table 21 summarises the key risks specific to the Airport package and how the recommended Alliance would mitigate these risks.

Table 24: Mitigation of key Airport package risks

Key risks	Mitigation under delivery model
• Stakeholder interface with APAM is less effective and efficient than expected, resulting in delay of this critical path scope element. • Restrictive site access arrangements and complex staging requirements due to operational airport environment lead to program delays of this critical path scope element.	• An alliance model, with a risk allocation tested and informed by the market and APAM, is expected to provide the best commercial framework through which these risks can be managed, with the State, the contractor(s) and Franchisee commercially aligned and therefore all working together to identify, mitigate and manage these risks.

5.1.4.7. Rail Systems package

The table below summarises the procurement options assessment for the Rail Systems package against each evaluation criterion.

Table 25: Rail Systems package procurement options assessment

Evaluation criterion	Alliance	D&C
Market interest and appetite	• A key market risk is the potential capacity constraints of suitably qualified railway signalling technicians and engineers with in-depth knowledge of Melbourne's metropolitan rail network. In the event that there are resource constraints, this will be an issue under any procurement model (i.e. this is not only relevant to the alliance model). This is also impacted by the signalling solution proposed for MAR. • Notwithstanding the above, contractor market appetite is expected to be strong under any procurement model with a number of major signalling providers actively seeking opportunities in the Australian market. • Participants in the MAR market engagement process generally indicated a preference for the Rail Systems package to be delivered as an alliance, given the significant ARTO interfaces.	• As per the alliance, there is a potential capacity constraint of suitably qualified railway signalling technicians and engineers. • Based on market feedback as part of the MAR market engagement process, there is likely to be less market appetite for the Rail Systems package to be delivered as a D&C than an alliance (and/or strong market push-back in relation to a 'typical' D&C risk allocation). This is due to the complexity of the works, the significant interface with the live network and the interface with other packages.
Scoring (Priority: High)	✓✓✓	✓
Time	• The ARTO stakeholders have a particular interest in the rail systems design and operations and can delay commissioning if rail systems do not meet their requirements. As such, an approach to enable coordination of these key stakeholders and involvement in the rail systems design and installation is preferred. An alliance model is expected to provide the best forum through which this can be achieved. • The alliance model also provides an opportunity to commence the development phase early to ensure that the works meet the operational requirements within the required timeframes.	• Financial incentives can be built into D&C contracts to encourage timely completion, including milestone/progress payments and/or liquidated damages. However, under a D&C model the metropolitan rail franchisee is not contractually incentivised to collaboratively work with the State to minimise delays relating to design and commissioning.
Scoring (Priority: High)	✓✓	✓
Price and budget certainty	• Although an alliance does not result in a fixed price contract (on the basis that fixed pricing cannot be obtained on a value for money basis – i.e. without a significant risk premium), the alliance model	• Under a D&C model the metropolitan rail franchisee is not contractually incentivised to collaboratively work with the State to minimise design and installation costs and to achieve successful commissioning of the

Evaluation criterion	Alliance	D&C
	provides an opportunity to develop a full understanding of risks and scope to develop a TOC, with consultation between the State, contractors and ARTOs. This collaborative process should provide confidence that the TOC is achievable (with the alliance non-owner participants bearing a degree of cost risk if the TOC is not achieved). • The earlier involvement of the contractor(s) with the project team and with input from the ARTOs (and incentivised participation by the ARTOs) should also ensure a more clearly defined scope and specifications and better understanding of the access and occupations regimes, resulting in more effective risk pricing than achievable under the D&C model.	rail systems. For example, the complexity of the systems integration and commissioning required for this Project will also be difficult to price on a fixed time, fixed cost basis – particularly prior to undertaking detailed design (which would be undertaken post signing a contract under a D&C model), without significant franchisee input (noting that franchisee acceptance of the rail systems will be critical to the success of the Project) and without certainty as to the access regime for integration and commissioning activities.
Scoring (Priority: High)	✓✓	✓
Risk management	• Early involvement of the contractor(s) with the project team and the ARTOs during the design phase increases the opportunity to understand the technical complexities of the rail systems scope and to better identify, mitigate and manage risks. An alliance model is expected to provide the optimal forum through which these risks can be managed, with the State, the rail systems provider(s) and the ARTOs all working together on a 'best for project' basis. • An alliance model including the rail systems contractor(s) and the rail franchisee enables the rail systems provider(s) to develop a rail systems solution in an environment that includes appropriate incentives for all parties (including the rail franchisee) to work together to achieve the requirements.	• The design, installation, integration and commissioning complexity of the rail systems package is such that it may be difficult to effectively transfer these risks under a fixed time, fixed cost contract on a value for money basis (i.e. without a material risk premium). • Previous experience with D&C contracts has indicated that this is not the optimal approach for managing significant interface risks.
Scoring (Priority: High)	✓✓✓	✓
Flexibility and control	• The alliance model provides significant flexibility to change the scope, design or installation approach post contract award. • The alliance model also has the flexibility to develop the systems design, amend occupations and access regimes with the ARTO (as they are part of the alliance) or adjust the approach to systems	• Although a D&C contract would include a variations regime to enable changes post contract award, the fixed time, fixed price nature of the contract limits flexibility to some degree. In particular and as previously discussed, as the metropolitan rail franchisee would not be party to the contract there may be a lack of flexibility (or appropriate incentives for the franchisee) to manage any required changes to the access and occupations regime.

Evaluation criterion	Alliance	D&C
	integration and commissioning to align with the other civil works package.	
Scoring (Priority: High)	✓✓✓	✓
Innovation and incentive	• Early involvement of the contractor with the State and ARTOs increases the opportunity to identify innovation in design and optimise the access regimes and occupation schedules. • In addition, an alliance should drive / facilitate innovation by bringing all stakeholders together with aligned incentives and a focus on 'best for project' outcomes.	• It would be difficult for a D&C contractor to innovate in design to the extent possible under an alliance due to the lack of direct franchisee involvement (noting that franchisee acceptance of the rail systems will be critical to the success of the Project). • Given the nature of these works, the relatively fixed nature of a D&C contract may make it difficult for the contractor to innovate during the detailed design development process because any changes to scope or the occupations regime would require a variation.
Scoring (Priority: Moderate)	✓✓✓	✓
Stakeholder management	• An alliance model enables the metropolitan rail franchisee to be 'brought inside the tent' and actively involved in the design development process and the delivery of the works. This will help to reduce the risk of scope changes and creates a forum through which the State, the metropolitan rail franchisee and the contractors can collaborate to agree occupations and access arrangements. It also enables works to be delivered by the ARTOs where they are best placed to do so without complex contractual interfaces. • An alliance model provides a commercial framework through which stakeholder issues can be better managed, with the State, the contractor(s) and the metropolitan rail franchisee are aligned, and therefore all working together to identify, mitigate and manage stakeholder risks.	• Previous experience with comparable D&C contracts has indicated that this is not the optimal approach for managing complex stakeholder relationships.
Scoring (Priority: Moderate)	✓✓✓	✓✓

Table 26: Procurement options assessment summary – Rail Systems package

Package / Evaluation criterion	Relative Priority	Alliance	D&C	Recommended model
Market interest and appetite	High	✓✓✓	✓	**Alliance**
Time	High	✓✓	✓	
Price and budget certainty	High	✓✓	✓	
Risk management	High	✓✓✓	✓	
Flexibility and control	High	✓✓✓	✓	
Innovation and incentive	Moderate	✓✓✓	✓	
Stakeholder management	Moderate	✓✓✓	✓✓	

An Alliance approach was assessed as the recommended procurement model for the Rail Systems package, as it performs stronger than a D&C against all of the evaluation criteria. This reflects, among other things, the technical complexity of the rail systems scope and its interface with the other packages and other rail network projects. The procurement model must facilitate the early and sustained identification, mitigation and management of these risks, on a collaborative basis, with the State, contractors, ARTOs, systems providers and other key stakeholders.

RPV has investigated opportunities for, and risks of, the Rail Systems package scope being delivered as part of the Sunshine / Albion package. This was recently tested with the market as part of the MAR procurement process and it has been determined that the Rail Systems package scope will be incorporated into the Sunshine / Albion package.

Table 24 summarises the key risks specific to the Rail Systems package and how the recommended Alliance would mitigate these risks.

Table 27: Mitigation of key Rail Systems risks

Key risks	Mitigation under delivery model
• Risk of delay due to complex staging of works and interfaces with multiple packages (and projects, including the MTP) and varying operational rail, road and airport environments. • Risks associated with integration of new systems into the Victorian network, including delays and technical interface issues.	• An alliance model, with a risk allocation tested and informed by the market and ARTOs, is expected to provide the best commercial framework through which these risks can be managed, with the State, the contractor(s) and ARTOs commercially aligned and therefore all working together to identify, mitigate and manage these risks.

5.1.4.8. Early Works package

RPV has identified discrete scope items (primarily related to utility relocations) that would benefit MAR overall through separate procurement and delivery before, or in parallel to, the main works. These scope items will be delivered under a Managing Contractor arrangement, with the Managing Contractor managing the interface with the relevant Utility Service Providers.

The rationale for using a Managing Contractor model for the Early Works package is that:

- risk allocation can be agreed during competitive proposal process (prior to appointment) which should enable appropriate risk transfer
- Time (and other) KPIs can be built into the Managing Contractor contract to provide incentives
- there is sufficient flexibility for the State to adjust scope if required as the Project's design is further developed and unforeseen risks materialise
- the benefits of coordinating and managing a diverse range of works and utility owner/operator interfaces are realised
- margins, preliminaries, overheads and management fees will be set in an environment of competitive tension
- although the State does not have direct control over the delivery of works, it does have transparency over the procurement processes for subcontractors.

5.1.4.9. Early Works (other scope items)

RPV is exploring other opportunities for early works (not within the scope of the Early Works package above) to be delivered as part of the Project.

For example, the relocation of AusNet HV Towers is recommended to be delivered by AusNet via a direct agreement between the State and AusNet, due to the following key factors:

- ensures an appropriate level of State control, helping to ensure that critical timelines are met
- AusNet is best placed to manage the delivery of these works given that, as the asset owner, it understands the unique technical requirements and has visibility over the limited access windows and industry embargo periods associated with these works
- avoids additional costs (such as contractor margins and overheads) which may provide limited benefit.

5.2. Context for works on Airport-leased land

5.2.1. Overview

The most appropriate delivery model(s) and framework for the works to be delivered on Airport-leased land (i.e. the Airport and Viaduct packages, the latter of which straddles both Airport and State land) were informed by the unique characteristics applicable to the scope of works, including:

- **APAM** – Melbourne Airport is owned and operated by APAM. The State will need to reach an agreement with APAM in relation to the design, approvals, delivery and operations phases of the Project, which involves the construction of the Airport package and associated infrastructure on Airport-leased land.
- **Land tenure and leasing arrangements** – Melbourne Airport is situated on land owned by the Australian Government, which is leased to APAM under a 50-year lease (with an option to extend for a further 49 years).Over 4 km of the MAR alignment will be located within the APAM leasehold. The boundary of the Airport-leased land commences where the MAR alignment intercepts Sharps Road. For the delivery of works on Airport-leased land, the State will need to agree a range of tenure and access agreements with APAM over the alignment from Sharps Road to the Airport terminals.
- **Major Development Plan (and other approvals)** – MAR Works on Melbourne Airport-leased land will need to be implemented within the parameters of the existing Melbourne Airport Master Plan, capital works projects and precinct guidelines, as well as the *Airports Act 1996* (Cth) and relevant approvals for major project development on Commonwealth land. This will require a range of approvals from APAM and the Australian Government, as well as the Airport Building Controller.
- **Melbourne Airport Internal Road Network Plan** – Under the current Airport Master Plan, expansion of the on-airport road network is proposed including the construction of an elevated entry to a newly reconfigured T123 by 2023. The proposed elevated road is geographically proximate to potential locations of the Airport Station and may impact construction methodologies. As a result, discussion and agreement with APAM is required to identify the most appropriate design for both the elevated road solution and the Airport Station.
- **Live airport environment** – Melbourne Airport is an operational airport environment, which attracts additional requirements that will need to be contemplated as part of the Airport Station design and delivery (e.g. security, safety, fire and police requirements).

Both the Airport package and the Viaduct package are subject to these unique characteristics. The Airport package relates to works located solely on Airport-leased land for delivery in a heavily congested Airport-leased landside environment. The Viaduct package scope requires the delivery of largely elevated infrastructure on both State and Commonwealth land (the viaduct extends beyond the Sharps Road boundary into State land (until Terror Street) for approximately 2 kilometres). Further details in relation to the approach to arrangements at Melbourne Airport are provided in the subsections below.

5.2.2. Arrangements with APAM

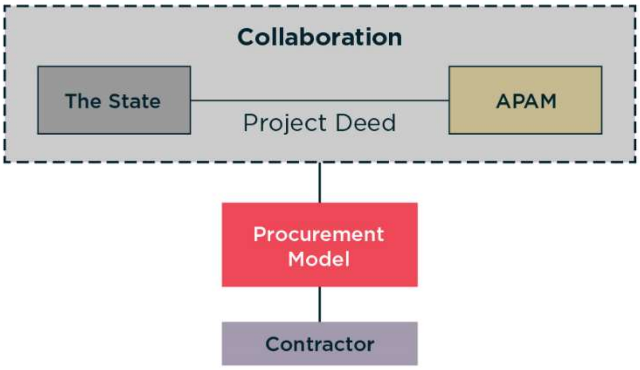
The proposed alliance delivery model(s) and framework for the Airport and Viaduct packages will need to deal appropriately with each of the elements above to ensure a successful outcome. As a result, the State will require a high degree of collaboration with APAM as the current leaseholder of the Airport-leased land and operator of Melbourne Airport.

5.2.2.1. Project Deed

Due to the unique characteristics applicable to the works to be delivered on land currently leased to APAM by the Australian Government, the proposed alliance delivery model(s) is only one part of the Project's procurement strategy. In addition to the delivery of the physical scope of works on Airport-leased land, overarching governance and commercial arrangements for delivery and operation of MAR will need to be agreed between the State (and Australian Government) and APAM. These arrangements will be reflected in a Project Deed (Project Deed), the terms of which are intended to be negotiated with APAM.

A summary of these procurement and delivery arrangements is illustrated in the diagram below.

Figure 8: Airport works – procurement and delivery framework



The terms of the Project Deed are under development and will be discussed and agreed with APAM. RPV intends to agree and document the high level position in relation to the following topics (not exhaustive) in the Project Deed:

- input and approval over the design, and design standards, for works delivered on Airport-leased land
- input and approval over construction methodology (traffic management, site access, site conditions, hours of operation) for works delivered on Airport-leased land
- land tenure arrangements on Airport-leased land
- procurement process for works on Airport-leased land
- governance, including arrangements to address scope change, disputes, delays.

6
Packaging and procurement solution

6. Packaging and procurement solution

Table 28 provides a summary of the recommended Packaging and Procurement Solution as developed in Step 2 and Step 3.

Table 28: Packaging and Procurement Solution

Works package	Description	Procurement model
Airport Package	**Airport Station works** • New elevated station at Melbourne Airport **Civil and track works** • New track pair for MAR services • Civil works for traction power substation and rail systems **Overhead wiring (OHW)** • Overhead line equipment (OHLE), wiring and structures	Alliance
Viaduct Package	**Viaduct works** • Bridge structure across Western Ring Road (M80) • Elevated viaduct along Airport Drive **Civil and track works** • New track pair for MAR services • Civil works for traction power substation and rail systems **OHW** • OHLE, wiring and structures	Alliance
Corridor Package	**Bridge and SUP works** • Road bridge modifications **Civil and track works** • New track pair for MAR services • Shared user paths and bridge works • Civil works for traction power substations **OHW** • OHLE, wiring and structures	Alliance
ARTC Package	**Civil and track works** • ARTC track slew to accommodate the MAR • Civil works and relocation of existing ARTC CSR • Utilities identification, protection, replacement and relocation **Systems** • Signalling and rail control system works on the ARTC line • Relocation/decommissioning of ARTC signalling assets **Other transport mode infrastructure and urban design** • Reinstatement and repair of road infrastructure • Adjustments and reinstatement of existing public areas	ITC
Maribyrnong River Bridge Package	**Bridge works** • New Maribyrnong River Bridge construction	ITC
Sunshine / Albion Package	**Station works** • Modifications to existing Sunshine station • Conventional signalling works to facilitate staging works required	Alliance

Works package	Description	Procurement model
	Civil and track works • New track pair for MAR services • Rail bridges • Double track flyover **OHW and structures** • OHLE, wiring and structures • Upgrade of existing traction power substations	
Rail Systems Package[3]	**Train Control and Signalling** • Rail systems design (including CBTC) • Equipment / cable supply, install and testing • System level testing and commissioning **Traction Power** • New DC and Intake Substations • 22kv reticulation **Communications** • Fibre Optic network • Train Radio Systems	Alliance
Early Works Package	Utilities protection and relocation along the MAR alignment	Managing Contractor

In addition to the above, it is also noted that:

- the metropolitan rail franchisee will operate the MAR services
- HCMTs will be used to operate the MAR services and will be procured separately to the Project on a network-wide basis.[4]

[3] Scope to be incorporated into the Sunshine / Albion package.
[4] Work undertaken by the Department of Transport (DoT) to date has identified that 5 additional HCMTs are required to accommodate the Day 1 service plan for MAR (in addition to those HCMTs already on order by the State).

7
Step 4: Market validation

7. Step 4: Market validation

As outlined in section 3.1.23.1.2, multiple stages of market engagement have been undertaken by RPV, comprising both written questionnaires and one-on-one market sounding interviews. A number of packaging and procurement options were validated with the market in accordance with DTF Guidelines, including key elements of the packaging and procurement solution outlined above.

Key themes from the market sounding processes relevant to establishing the overarching procurement strategy may include but are not limited to:

- market appetite and capacity
- packaging and procurement, including risk allocation and viability of early works
- interface, integration and commissioning
- procurement process and timelines.

The packaging and procurement solution was revisited following this market validation exercise to confirm that the proposed delivery strategy for the Project ensures an optimal result for Victorians as well as ensuring value for money is obtained for the State.

At a high level, notable key messages from the market engagement process were as follows:

- Most participants were **generally supportive of the proposed packaging strategy** and noted support for the Maribyrnong River Bridge as its own package.
- Most participants **confirmed that utility works, general site preparatory and investigatory works, should be delivered as early works**, specifically mentioning that the utilities and services at Melbourne Airport should be done early.
- Participants generally agreed with the proposed strategy that the **Sunshine / Albion package and Systems package** should be **alliances**.
- Participants also generally recommended that the **Corridor and Airport packages** should also be delivered as **alliances**.
- Some participants noted that the **Viaduct package** should also be an **alliance or collaborative contract however** others suggested that the Viaduct **could be delivered under a more traditional delivery model**.
- A number of participants identified the **Maribyrnong River Bridge** as a simpler scope element for MAR that may be suited to **a greater level of risk transfer to the contractor.**
- All participants generally **supported collaborative contracting and a shared approach to risk**. Key risks related to interfaces, utilities, geotechnical and contamination risks were repeatedly referenced as risks that needed to be shared or retained by the State.
- The market indicated that the **preferred contractor should be engaged in a one-on-one collaborative process quicker**, so that more value and certainty can be unlocked and risks effectively identified, quantified and mitigated.
- Engaging in **deep collaboration** during procurement processes, utilising **collaborative procurement models**, leveraging existing **benchmarking data** and getting the **right team** on the job early were suggested as the **best ways to achieve value for money**.

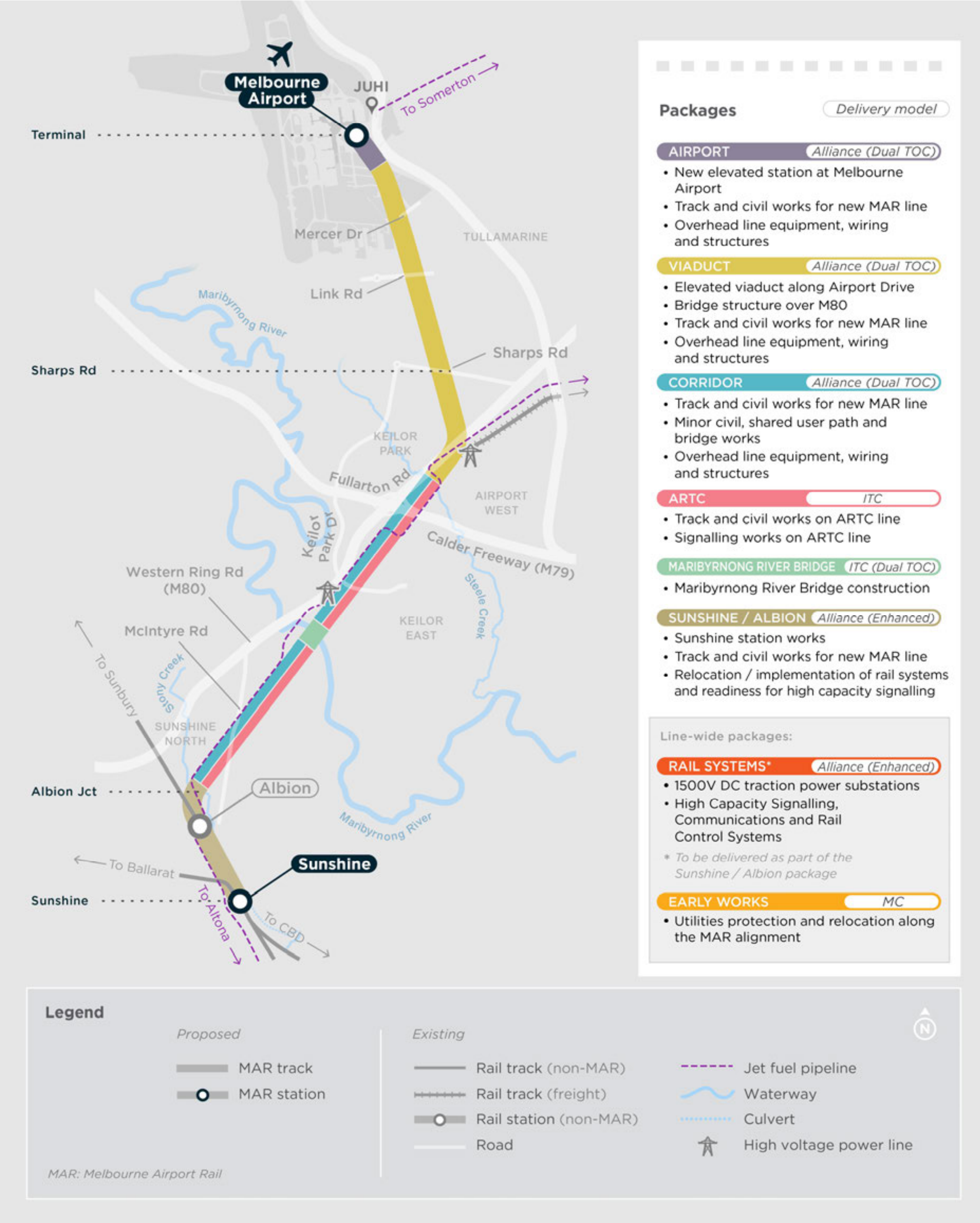
8
Step 5: Business Case recommendation

8. Step 5: Business Case recommendation

MAR is being delivered as part of Victoria's Big Build and is one of the most significant investments in infrastructure in Victoria's history. MAR will eventually form part of SRL. It will also complement the longer-term pipeline of investment through the Western Rail Plan which will increase the capacity of the rail transport network to support the growing western region of Melbourne. The procurement of MAR will be undertaken in the context of this investment pipeline, and the State is continually evaluating infrastructure priorities and the most efficient way to procure and deliver these important projects, including considering innovative methods of procurement to provide value for money to the state and provide industry with a consistent and reliable pipeline of work to support the Big Build.

The recommended Packaging and Procurement Solution for MAR is summarised in Figure 9, noting that the final position is subject to further technical work on the design solution, discussion with key stakeholders and market engagement feedback.

Figure 9: Packaging and Procurement Solution



Appendix 11
Public Interest Test

Contents

1. Introduction

All Victorian projects that are the subject of a full business case under the Department of Treasury and Finance (DTF) *Investment Lifecycle High Value High Risk (HVHR) Guidelines* must complete a public interest test for approval.

Melbourne Airport Rail (MAR or the Project) has been assessed against the public interest test to determine whether suitable measures can be established to adequately protect the interests of the community. The eight elements of the test are as follows:

- effectiveness
- accountability and transparency
- affected individuals and communities
- equity
- consumer rights
- public access
- security
- privacy.

The test has been undertaken in line with the Partnerships Victoria template, with three columns as outlined in Table 1 below.

Table 1: Structure of public interest test

Public interest element	Standard	Assessment
This lists each of the eight elements of the public interest test.	This lists the government standard to apply for each public interest element. These standards may derive from government policy, legislation or regulation, current practice, or may be developed specifically for the project.	For each identified public interest issue, an assessment is made of whether appropriate mechanisms are available to provide an adequate level of protection. The mechanisms to be used need to be identified.

The on-balance determination of whether the public interest can be adequately protected for a project requires a judgement of whether the failure to adequately protect any individual public interest element is a significant concern and whether it outweighs (on its own, or together with other failures) the benefits to the public interest arising from the potential project being delivered.

The public interest test may be updated throughout procurement, and must be assessed and updated when seeking government approval at contract execution stage.

2. Findings

From the preliminary assessment below, MAR adequately satisfies the public interest test. Throughout the stages of MAR, the eight elements will be taken into account to ensure that any individual public interest element will be adequately protected.

3. Assessment

The assessment of MAR against the public interest test is summarised below.

Table 2: Public interest test assessment for MAR

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
Effectiveness Is the project effective in meeting government objectives?	MAR aligns with a range of key government policy initiatives, strategic directions and investment priorities. In particular, the following: **Plan Melbourne 2017-2050** *Plan Melbourne* is the Victorian Government's premier metropolitan planning strategy that will guide the city's growth to 2050. *Plan Melbourne* establishes Melbourne Airport as a transport gateway of State significance for passenger and freight movements. It highlights the importance of supporting future employment and economic development opportunities at the airport. **Victorian Infrastructure Plan (2017)** The *Victorian Infrastructure Plan* is the State's first long-term, state-wide infrastructure plan which specifically sets out the State's infrastructure priorities for the next five years. The Plan recognises the importance of building integrated transport infrastructure for the future to address changing demographics and population growth in Victoria. In line with this, it supports Infrastructure Victoria's recommendation for the Melbourne Airport rail link. **National Rail Program** As part of the 2017-18 Budget, the Australian Government established the $10 billion National Rail Program, a major, long-term commitment to invest in passenger rail networks. The National Rail Program promotes the benefits of providing a higher reliability and higher frequency public transport service to Melbourne Airport. It also emphasises the importance of a rail connection to Melbourne Airport in alleviating congestion on the Tullamarine Freeway.	MAR is closely aligned with a range of the Victorian and Australian government policies and objectives. In particular the objectives which relate to public transport and those that promote economic and sustainable population growth. In this context, the Project is expected to generate benefits and delivery will be consistent with government policies and objectives. MAR will ease congestion on the surrounding road network, improve road travel times and reliability and enhance accessibility and connectivity. Moreover, a rail connection between Melbourne Airport and the CBD will enhance Melbourne Airport's role as the largest employment hub in the west, and provide connectivity between the airport and other economic centres of State significance. These improvements in accessibility and connectivity will support Victoria's knowledge economy and deliver improved productivity and competitiveness for Victoria. MAR is of strategic importance to the Victorian economy and therefore under the National Rail Program the Australian Government has contributed funding towards a Melbourne Airport Rail Link. In addition, MAR will achieve a number of the *Transport Integration Act 2010* objectives, including: • social and economic inclusion through improved public transport accessibility and associated connectivity to jobs and services • greater accessibility to and connectivity between key economic centres and improved freight efficiency leading to economic prosperity

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Public interest element	**Standard**	**Assessment**
	Transport Integration Act 2010 (Vic) The *Transport Integration Act 2010* (Vic) (the Act) requires that all decisions affecting the transport system be made within the same integrated, decision-making framework to support the same objectives. The Act's six transport system objectives are: • social and economic inclusion • economic prosperity • environmental sustainability • integration of transport and land use • efficiency, coordination and reliability • safety and health and wellbeing.	• encouraging mode shift to public transport and in turn promoting environmental sustainability • provision of a more efficient and reliable public transport service.
Accountability and transparency Do the partnership arrangements ensure that: • the community can be well-informed about the obligations of government and the private sector partner; and • they can be overseen by the Auditor-General?	MAR is to comply with all Victorian Government accountability and transparency policies and obligations including under the: • *Freedom of Information Act 1982* (Vic) • Victorian Government Purchasing Board Policies • Supplier Code of Conduct • *Audit Act 1994* (Vic).	The community will be well informed about the obligations of both the Government and private sector partners through several mechanisms, including the following: • the Business Case is anticipated to be released to the public, acknowledging some redactions will be required (for commercially sensitive information) • information on MAR's performance will be available in the Department of Transport's (DoT) annual report • the *Freedom of Information Act 1982* (Vic) will apply to MAR • the Auditor-General will have access to project information in accordance with the *Audit Act 1994* (Vic) • the Victorian Government Purchasing Board Policies will apply to the tender process • an independent probity adviser will oversee the procurement process to ensure the process is fair and transparent and conducted in accordance with the Project's Probity Plan. The probity adviser will provide sign-off to government following the conclusion of the negotiation process with the preferred proponent • an independent probity auditor will validate the evaluation process to check and sign off compliance with Government procurement guidelines, State probity and procurement procedures and the request for proposal and any associated documentation. At the

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
		completion of the tender process, the probity auditor will determine whether the tender process had been conducted in a manner consistent with the probity principles.
Affected individuals and communities Have those affected been able to contribute effectively at the planning stages, and are their rights protected through fair appeals processes and other conflict resolution mechanisms?	MAR must conduct, or be compliant with: • an appropriate public consultation process with those individuals/groups identified as being affected by MAR • environmental, Occupation Health and Safety (OH&S) and other assessments of the project area and relevant conditions and requirements set for MAR • local government planning requirements.	Stakeholder engagement and community consultation for MAR commenced in 2018. Rail Projects Victoria (RPV) has undertaken high-level engagement with local councils, community groups and industry stakeholders regarding the planning of MAR. A phased approach to communications and stakeholder engagement has been developed which proactively identifies and manages risks and opportunities. The following individuals/groups have been identified as being affected by MAR: • government stakeholders including Victorian Government, Australian Government and local government • landowners and operators such as tenants, landowners, traditional owners and indigenous groups, Australia Pacific Airports Melbourne Pty Ltd (APAM), freight and transport operators, utility owners and operations • users including road, public transport and airport users • community groups including culturally and linguistically diverse communities, advocacy groups, local community, cyclists and pedestrians, institutions, environmental interest groups, disability and accessibility groups and businesses • industry stakeholders including project construction partners and peak bodies and industry groups • media. The key planning, environment and heritage approvals potentially required for MAR are separated into those required for land under Commonwealth jurisdiction and land under State jurisdiction. While the approvals processes for these two jurisdictions are independent, an integrated approach will be adopted with the view to provide a seamless approvals process for the Project. From preliminary

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
		investigations have indicated that the following primary approvals will be required: • development of a Major Development Plan (MDP) under the *Airports Act 1996* (Cth) • approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), if the potential for significant impacts on matters of national environmental significance is identified • application for a planning scheme amendment (PSA) for the Hume, Brimbank, Moonee Valley and Maribyrnong planning schemes under the *Planning and Environment Act 1978* (Vic) to introduce a project-specific Incorporated Document to facilitate the Project • preparation of a Cultural Heritage Management Plan (CHMP) for the Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation and a CHMP for Aboriginal Victoria • referral under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), as a result of the presence of, and proximity of works to, Matters of National Environmental Significance • land acquisition and project delivery powers under the *Major Transport Projects Facilitation Act 2009* (Vic) • heritage permits or permit exemptions will be required for impacts to any of the places or objects on the Victorian Heritage Register, or consents to damage any Victorian Heritage Inventory sites under the *Heritage Act 2017* (Vic) • approval under the *Pipelines Act 2005* (Vic) for protection and potential relocation works on the existing fuel pipeline which connects through to Melbourne Airport. RPV will continue to work closely with the Department of Environment, Land, Water and Planning (DELWP) and other agencies as necessary to maximise the performance of MAR through avoiding, mitigating and managing planning, environment and heritage risks.

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
Equity Are there adequate arrangements to ensure that disadvantaged groups can effectively use the infrastructure or access the related service?	The key disadvantaged groups expected to use the infrastructure and access the services are those with physical impairment, the aged and frail and people of culturally and linguistically diverse backgrounds. MAR must comply with all relevant government laws and policies including: • *Disability Act 2006* (Vic) and *Disability Discrimination Act 1992* (Cth) (DDA) • *Disability Standards for Accessible Public Transport 2002* (Cth) (DSAPT) • *Racial Discrimination Act 1975* (Cth) • *Sex Discrimination Act 1974* (Cth) • *Equal Opportunities Act 1995* (Vic).	Throughout the planning, development and delivery phases of MAR, RPV will ensure that there are adequate safeguards in place to ensure MAR will comply with all relevant legislation, codes and standards. In particular MAR will: • provide DDA compliant design and operations • provide information on services and facilities for users from culturally and linguistically diverse backgrounds • be compliant with the DSAPT • be served with a hearing augmentation system at stations • customers will be able to hear announcements at any place throughout the station, with alternatives provided for those with a hearing impairment • seek to improve walking and cycling facilities along the rail corridor. Many passengers may be eligible for concession Myki fares. This includes eligible cardholders, children, asylum seekers and students. An Assistance Animal Pass will remain available to passengers needing an assistance animal to help manage a disability while using public transport.
Consumer rights Does the project provide sufficient safeguards for service recipients, particularly those for whom government has a high level of duty of care, and/or the most vulnerable?	Service recipients to whom government owes a high level of duty of care including children, seniors, low income earners, physically/mentally disabled, non-English speaking, overseas tourists, and those not familiar with the transport system.	MAR will meet all of the special needs and rights through adequate design, construction and maintenance, noting that the metropolitan rail network Franchisee will play a key role in protecting consumer rights from an operational perspective. As set out under the heading of “equity” the technical specifications require that contractors design and construct MAR to maximise accessibility to commuters with special needs. Travellers Aid will remain at Southern Cross and Flinders Street stations, where services available include: • emergency relief for travellers • the Pathways to Education program, providing travel passes for disadvantaged secondary school students • a Companion Service to help passengers to get to and from appointment

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
		• personal care and meals assistance for people with disabilities • a Buggy Service to help get around Southern Cross station • mobility equipment hire • accessible toilets with ceiling hoists, adult change tables and qualified carers to help. The Try Before You Ride program will remain in place. This program helps passengers become more familiar with public transport. They can practise getting on and off an accessible train and have a chat to public transport experts who will be there to assist. The passenger is given the opportunity to explore the inside of the train while it is stationary to become more familiar with the environment. This program aims to help people of all abilities to feel more confident when using the public transport system.
Public access Are there safeguards that ensure ongoing public access to essential infrastructure?	DoT must make MAR available for ongoing public access (as appropriate) to the infrastructure. All required and statutory public access will be provided, where it is safe to do so. All relevant public transport access requirements will be implemented. Appropriate contractual arrangements will be in place.	During construction, the State will impose controls to ensure impacts on the surrounding transport infrastructure and network are minimised. Both the technical and contractual arrangements will require delivery contractors to provide the required public access including adequate safeguards to ensure the continued supply of service to the public. The contract will include step-in rights for the State to take over the assets in the event of a contract breach or major incident. MAR infrastructure will be made available to operate for use and access by the public, except during overnight closure periods and times when essential maintenance may be required.
Security Does the project provide assurance that community health and safety will be secured?	MAR needs to ensure: • all relevant occupational health and safety standards are met in design, construction and operation /maintenance stages • government can meet its duty of care obligations to the public • all accreditation requirements are met. MAR must comply with all relevant government laws and policies including: • *Rail Safety National Law Application Act 2013* (Vic) • *Occupational Health and Safety Act 2004* (Vic)	Safety is a key consideration throughout all stages of the Project. All tender and contractual documents will require compliance (by all contractors involved) with the *Occupational Health and Safety Act 2004* (OH&S Act) and all relevant codes of practice that establish health and safety guidelines supporting the OH&S Act. Contract specifications require MAR to be designed, built and maintained in order to meet relevant occupational health, safety, physical security, emergency risk management, data protection and ICT security requirements in full. As with all rail projects, MAR has an obligation to satisfy the requirements of the Rail Safety National Law (RSNL). MAR will satisfy

Protecting the public interest		
Public interest element	**Standard**	**Assessment**
	• *AS 45001:2018 Occupational Health & Safety Australian Standards* • The Rail Transport Operator's (RTO) and Rail Infrastructure Manager's (RIM) standards and policies that are part of their Safety Management Systems for their accreditations.	the RSNL obligations and endure that safety risk is managed do far as is reasonably practicable. MAR will work closely with the RIM and RTO whose accreditation will be impacted by the changes introduced by MAR.
Privacy Does the project provide adequate protection of users' rights to privacy?	Applicable privacy standards with which MAR is required to comply are set out in: • *Freedom of Information Act 1982* (Cth) • *Privacy Act 1988* (Cth) • *Health Records Act 2001* (Vic) • *Privacy and Data Protection Act 2014* (Vic) • *Surveillance Devices Act 1999* (Vic).	MAR will ensure the protection of rights to privacy through adherence to a set of 'Privacy Principles' which includes the 'Health Privacy Principles' as contained in the *Health Records Act 2001* (Vic) and the 'Information Privacy Principles' as contained in the *Privacy and Data Protection Act 2014* (Vic). Broader compliance with the *Freedom of Information Act 1982* (Cth)*, Privacy Act 1988* (Cth) and *Surveillance Devices Act 1999* (Vic) provides an additional layer of privacy protection. Additionally, the Public Transport Victoria (PTV) Information Privacy Policy will remain applicable to any collection, use, storage or disclosure of personal information and health information. Similarly, the Myki Privacy Policy will remain applicable to the management of Myki information collected.