

Melbourne Metro Two Alignment Options Assessment

Cabinet in Confidence
Commercial in Confidence

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Table of Contents

1	Introduction	5
1.1	Purpose.....	5
1.2	Background.....	5
2	Project Need, Benefits and Costs	7
2.1	Demand and Capacity.....	7
2.2	Overarching Benefits.....	7
2.3	Costs Common to All Options	11
3	Alignment Options	13
3.1	Assessment Criteria	13
4	Alignment Options Preliminary Assessment	14
4.1	Strategic Land Use Opportunities	14
4.2	Additional Public Transport Trips	14
4.3	Engineering Feasibility and Capital Cost.....	15
4.4	Initial Assessment Summary	17
4.5	Preliminary Options Assessment Recommendation	17
5	Station Options Assessment	18
5.1	Domain Metro (Both Alignments)	18
5.2	Dandenong Road Alignment	19
5.3	Toorak Road Alignment	22
5.4	Preliminary Station Demand Forecasts.....	25
5.5	Station Cost Considerations on the Toorak Rd Alignment	27
5.6	Station Assessment Recommendation	28
6	Alignment Options Multi Criteria Analysis	29
6.2	Overall Assessment	38
6.3	MCA Recommendation	38
7	Staging Options Assessment	40
8	Recommendations	43

Executive Summary

The Melbourne Metro (MM) project was first proposed in the 2008 East West Link Needs Assessment (EWLNA) report, to assess and respond to the growing demand for personal, business and freight travel across Melbourne. This report was prepared by an independent study team led by Sir Rod Eddington. The 2008 Victorian Transport Plan (VTP) proposed that the project be delivered in stages, with Stage One of MM (MM1) providing new tracks between South Kensington through the CBD to Domain, and Stage Two (MM2) providing a connection from Domain to the Dandenong Rail Corridor (DRC). An MM2 alignment along St Kilda Rd and Dandenong Rd, as recommended by the EWLNA, is implied as the default VTP scheme.

Further studies have been completed on MM2 alignment options to better inform the interface with MM1 and planning to meet the future requirements of the Caulfield Rail Group.

Growing demand for passenger services on the Dandenong Rail Corridor means that the corridor is anticipated to reach rail operational capacity by around 2018, when 18 metropolitan trains per hour will be operating in the peak one hour. Short term initiatives will be undertaken to achieve this throughput.

Longer trains in conjunction with upgraded signalling are then proposed to operate on the Dandenong Rail Corridor to provide capacity beyond 2018. The MM2 is a critical project as it will allow longer trains to operate through the city via the metro tunnel, reducing major congestion on Caulfield and Burnley Group loop services and relieving overcrowding at Richmond, Flinders Street and Parliament Stations, thus mitigating service reliability impacts caused by the increased likelihood of prolonged dwell times. MM2 will also provide significant network connectivity benefits associated with providing a direct cross-town rail connection between Melbourne's west and the south east.

In addition to the default alignment along Dandenong Road included in the VTP, three other alignment options that connect the proposed MM1 Domain Station to the Dandenong Rail Corridor via Toorak, Commercial and Balaclava Roads have been assessed.

All alignment options provided a similar level of benefits and no option causes any significant change to urban redevelopment potential. Commercial and Balaclava Roads were ruled out due to higher costs, engineering complexity of a narrow road reserve and property acquisition requirements for very marginal benefits.

The lower cost Toorak Road option rated stronger than Dandenong Road in a further assessment that considered a wider range of criteria. The Toorak Road option involves a "short tunnel" connection between Domain and existing DRC tracks at South Yarra, and does not augment track capacity between South Yarra and Caulfield. The study found that, with the introduction of longer High Capacity Metro Trains (HMCT), additional tracks between South Yarra and Caulfield would not be required until beyond 2046. It is estimated that the cost of the Toorak Road option would be at least 30(1) less than the Dandenong Road option. Hence, the Dandenong Road alignment option will involve the delivery of expensive infrastructure in advance of when it is required.

Further refinement of the Toorak Road alignment concept design has been undertaken over the past year, including an evaluation of the alignment both with and without a South Yarra Metro station. This work has found that a metro station at South Yarra would add 30(1) to the cost of the Toorak Rd option, and require significant property impacts in the South Yarra area. Due to the physical constraints on the tunnel alignment, achieving an effective interchange with the existing South Yarra Station would also be infeasible.

For these reasons, the investigation concluded that the inclusion of a metro station at South Yarra is very unlikely to be justified given the relatively high costs, social impacts, and low patronage benefits.

An evaluation of staging options for the MM1 project has found that major cost savings and other project development and construction efficiencies could be realised by delivering the preferred MM2 Toorak Road alignment concurrently with the MM1 Project. It is estimated that delivering the MM2 Toorak Road tunnel concurrently with MM1 would add an additional 30(1) (2011 Real) to the cost of the MM1 project.

If a decision regarding the preferred MM2 alignment is deferred, the design of the Domain station (MM1 project) could be modified to enable flexibility with respect to both the Dandenong Road and Toorak Road MM2 alignment options. This would be achieved by constructing an underground bifurcation box at an additional cost of 30(1) to the MM1 project. As this is a significant cost it is recommended that a decision on MM2 alignment be taken in advance of the formal planning for the project commencing.

To date, no stakeholder consultation has been undertaken on MM2 alignment options. This needs to occur to complete the options assessment.

The key recommendations arising from this MM2 Alignment Options Assessment are:

- That the MM2 Toorak Rd alignment option from Domain to South Yarra, without a metro station, be adopted as the preferred MM2 tunnel option.
- Progress the design of the preferred MM2 alignment between Domain and South Yarra along Toorak Road and enabling works as part of the continued development of the Melbourne Metro Project
- That the option to deliver MM1 and MM2 as a single project be considered in the further development of the Melbourne Metro project. Concurrent delivery of MM1 and the preferred MM2 Toorak Road alignment would provide major cost savings and project development and delivery efficiencies, and enable the full benefits of the Melbourne Metro tunnel to be realised on opening.
- Undertake planning approvals for the Melbourne Metro Project, including community and stakeholder consultation, proceed on the basis of the preferred MM2 Toorak Road alignment, enabling a decision to reserve this corridor.
- Continue to develop incremental improvements for the Dandenong Corridor through the Metropolitan Rail Upgrade Program and South East Corridor Strategy prior to MM2.

1 Introduction

1.1 Purpose

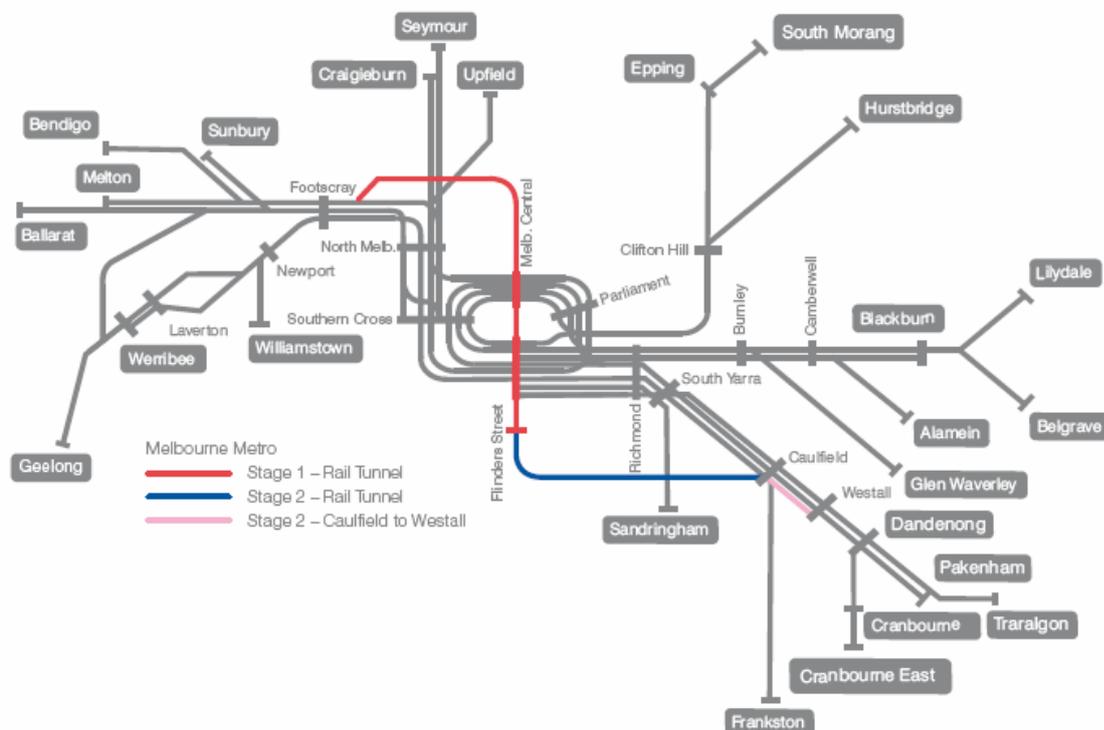
The purpose of this report is to identify the Melbourne Metro 2 (MM2) preferred alignment and station locations, and to discuss the staging options with respect to MM1. The report will inform the Melbourne Metro 1 (MM1) planning approvals strategy.

1.2 Background

MM2 is an important part of the Metropolitan Rail Upgrade Program and forms the second stage of the Melbourne Metro project from Domain to Caulfield,

The default alignment at the commencement of this study was via St. Kilda Road and Dandenong Road. This alignment was put forward in the East West Link Needs Assessment (EWLNA) and included in the Victorian Transport Plan (VTP). It was chosen largely on the basis that it would capitalise on redevelopment opportunities along St Kilda Rd and Dandenong Rd, and also relieve tram congestion on St Kilda Rd by diverting passengers to the Metro.

Figure 1: MM2 as Presented in the VTP



Further studies have since been completed on MM2 alignment options to better inform the interface with MM1 and planning to meet the future requirements of the Caulfield Rail Group. This report presents results of the alignment options assessment between Domain and the Dandenong Rail Corridor north of Caulfield, in addition to an assessment of station locations, staging options and recommended next steps.

It should be noted that the Caulfield Group consists of the Sandringham, Frankston, Cranbourne and Pakenham Rail Lines. In this report, the Dandenong Corridor is the trunk corridor for the Caulfield Group.

2 Project Need, Benefits and Costs

2.1 Demand and Capacity

Patronage demand on the Dandenong Rail Corridor is approaching capacity, as average AM peak capacity utilisation on the Caulfield Group exceeds 80%, and with 18% of AM peak train loads exceeding the load standard of 800 passengers per train in 2010, despite the introduction of five new morning services¹.

Although rail patronage growth has slowed in recent years, coinciding with the Global Financial Crisis, the Dandenong Rail Corridor has still recorded a 5% pa AM peak growth in train loads arriving at the city cordon over the last five years². The corridor is anticipated to reach rail operational capacity by around 2018, when 18 metropolitan trains per hour will be operating in the AM peak one hour. The following network constraints will restrict the ability to cater for future growth:

- access to city loop stations, including platform-side capacity at Richmond, Flinders Street and Parliament
- rolling stock passenger carrying capacity (i.e. limited to six car trains);
- congestion at level crossings; and
- signalling headways.

2.2 Overarching Benefits

Constraints on the Dandenong Rail Corridor are addressed incrementally through the Metropolitan Rail Upgrade Program, which includes New Generation Signalling (NGS), High Capacity Metro Trains (HCMT) and MM2, which links the Dandenong Rail Corridor (DRC) to the MM1 project at Domain. The benefits for the Dandenong Rail Corridor (irrespective of the MM2 alignment option selected) are:

- Enabling an 75% increase in capacity along the Dandenong Rail Corridor, through the introduction of 200m High Capacity Metro Trains (HCMT) and New Generation Signalling (NGS) along the entire corridor, consistent with MM operations.
- Reducing inner core station congestion at Flinders Street, Richmond and Parliament Stations by enabling Dandenong trains to run into the CBD via the Melbourne Metro tunnel. This will reduce the level of interchange activity associated with accessing Burnley and Caulfield loop services at these stations.
- Improving access to the Central Business District (CBD) for Frankston and Sandringham services. Prior to MM2, it is proposed that an increasing number of Frankston trains will operate directly to Flinders Street to maintain capacity and operations (with Dandenong services running through the Caulfield loop). By diverting Dandenong services through the new Melbourne Metro tunnel, all Frankston services will be able to re-enter the city loop.

¹ DOT Passenger Counts on the Caulfield Group Lines, August 2010

² DOT Metropolitan Train Load Standard Surveys, April 2011, Compound growth rate from May 2006 to May 2010.

Sandringham trains, which currently terminate at Flinders Street, will also be able to run through to Southern Cross, Footscray and on to Werribee.

- Providing a direct cross-city rail connection. This rail connection will link strategically important destinations across Melbourne, including four major universities at Footscray (Victoria University), Parkville (Melbourne University), inner Melbourne (RMIT University), and Caulfield (Monash University). MM2 will also provide a link between the high population growth areas in Melbourne’s north and west, and the rapidly expanding employment precincts in the south east.

2.2.1 New Generation Signalling

New generation signalling will provide a further 30% increase in capacity throughput.

Current train throughput capacity is about 18-20 trains per hour as a result of the design of the existing signalling system. Current signalling is designed to enable a train to operate at between 2.5 and 3 minute headways between Richmond and Dandenong, and 5 minute headways from Dandenong to Pakenham or Cranbourne for all stopping services. Train throughput will increase by around 30% with the introduction of new generation signalling as this will enable trains to operate closer together.

Consistent with MM1 planning, MM2 will incorporate New Generation Signalling, irrespective of the alignment option selected. This technology can be incrementally rolled out to the corridor, before or after MM2, as the likely technology option involves minimal line-side infrastructure.

New generation Signalling will increase the throughput of existing and proposed rail infrastructure.

2.2.2 High Capacity Metro Trains

The ability to operate High Capacity Metro Trains (HCMT) and New Generation Signalling (NGS) will increase capacity throughput by about 75%.

Staging longer (200m) trains will provide about 50% more passenger carrying capacity per train than the current trains. MM will enable this through the construction of longer platforms at new metro stations. As 200m HCMTs cannot operate in the city loop, MM2 provides a link to MM1 stations which will be designed to accommodate longer trains through the city. The comparison between existing and HCMT car sets is reflected in Table 1.

Table 1: Comparison of the Number of Trains Required to Accommodate Demand in the Critical Peak One Hour (Preliminary Forecasts) on Dandenong Rail Corridor

Year	Estimated Critical One Hour Peak Demand	No. of existing trains in the peak direction (assumes 900 p/t)	No. of 160 m HCMT in the peak direction (assumes 1,100 p/t)	No. of 200m HCMT in the peak direction (assumes 1,400 p/t)
2010 (existing)	14,000	16	13	10
2021	20,000	22	18	14
2031	25,000	28	23	18
2046	28,000	31	26	20

Forecasts to 2046 presented in Table 1 indicate that demand can be met by operating 200m HCMTs with new generation signalling on one track pair dedicated for the Dandenong Rail Corridor and

another pair for the Frankston Rail Corridor. There are currently four tracks between Caulfield and Richmond. Based on these forecasts, no additional tracks would be required for the purpose of providing additional passenger rail capacity until beyond 2046.

2.2.3 New Generation Signalling

New generation signalling will provide a further 30% increase in capacity throughput.

Current train throughput is about 18 trains per hour as a result of the design of the existing signalling system. Current signalling is designed to enable a train to operate at between 2.5 and 3 minute headways between Richmond and Dandenong, and 5 minute headways from Dandenong to Pakenham or Cranbourne for all stopping services. Train throughput will increase by around 30% with the introduction of new generation signalling as this will enable trains to operate closer together.

Providing the MM2 link will enable the new signalling technology provided by MM1 through the city to be utilised. The technology can then be incrementally rolled out to the corridor as the likely technology option involves minimal line-side infrastructure.

2.2.4 Inner Core Congestion

MM2 will provide congestion relief at inner core stations by diverting Dandenong services into the Melbourne Metro tunnel, reducing interchanges activity associated with accessing Caulfield and Burnley loop services at Flinders Street, Richmond and Parliament.

Prior to MM2, Frankston trains are progressively being scheduled to operate directly to Flinders Street as the number of Dandenong services increases. Diverting Dandenong services through to Melbourne Metro will allow all Frankston trains to use the loop instead of running direct to Flinders St, taking up paths released by the diverted Dandenong services. Sandringham trains would also be able to run through to Southern Cross, Footscray and on to Werribee instead of the Frankston trains (refer Figure 2 which represents the base case).

Figure 2: Service Operating Plan with MM1 but without MM2

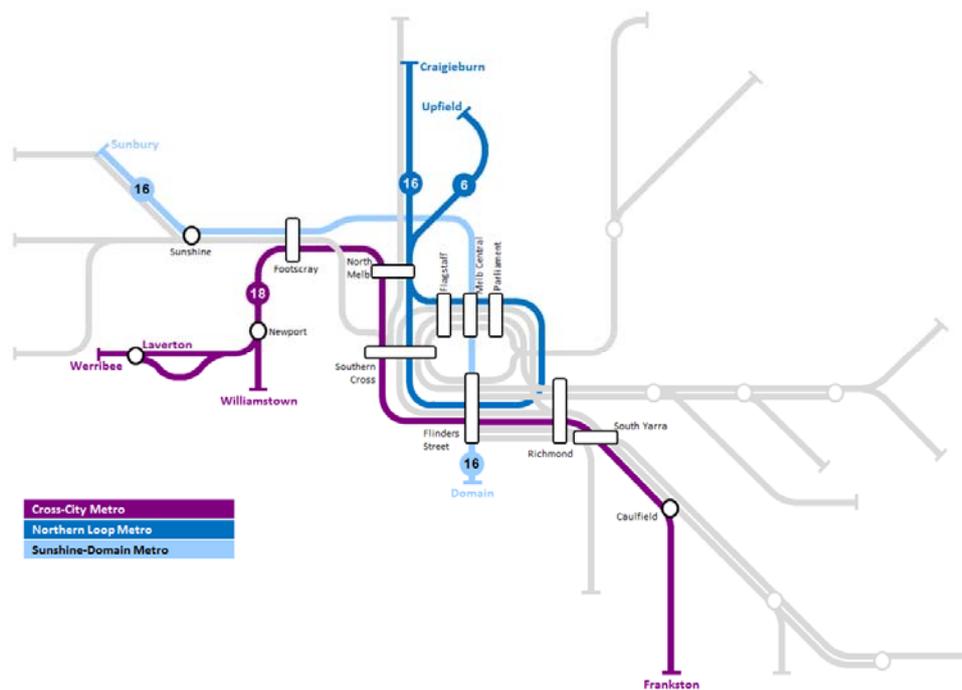
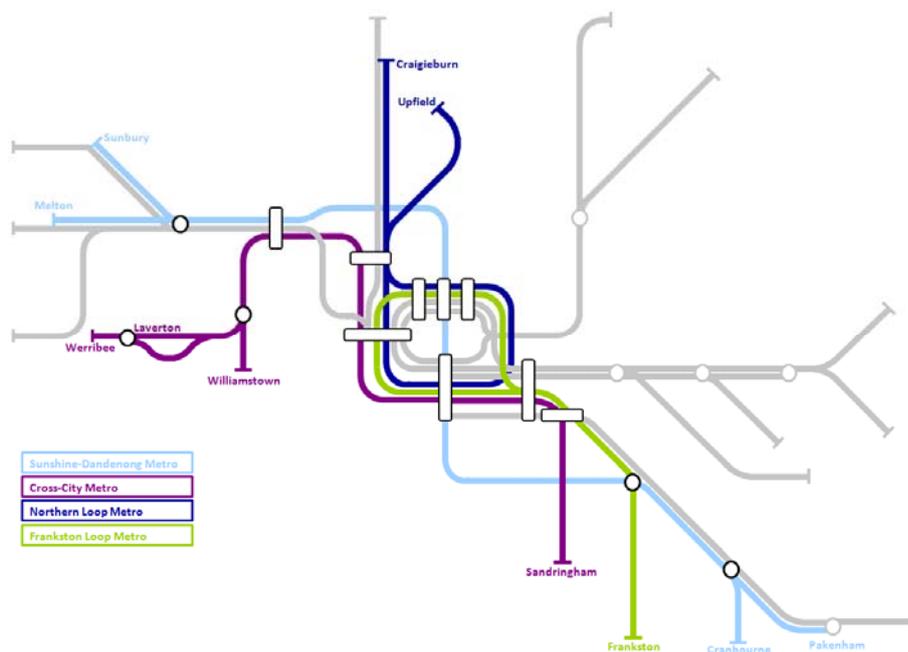


Figure 3 Operating Plan with MM1 and MM2



The diversion of Dandenong services through Melbourne Metro from Richmond will relieve platform overcrowding at Richmond, Parliament Flinders Street Stations. Platform crowding at Richmond is expected to reach critical levels by 2020. The number of transfers in the AM peak at Richmond station is estimated to fall by over 40% with MM2 as a result of Frankston services operating through the loop and Dandenong services operating through Melbourne Metro³. This will reduce the likelihood of prolonged dwell times and consequential delays on Dandenong and Ringwood loop services.

Dandenong services would also stop at the new CBD South Metro station that is interconnected with Flinders Street and not at the existing Flinders Street Station platforms. Relief would therefore also be provided at Flinders Street as the number of alightings is forecast to fall by over 20% in the AM peak due to Dandenong services using the CBD South Station. In particular, MM2 would enable the change of the through connection from Werribee - Frankston (two of the busiest lines on the network) to Werribee - Sandringham. This will provide substantial relief to Flinders Street platforms 8 and 9.

³ Melbourne Metro Business Case Patronage Modelling, Zenith Unconstrained 2031AM Peak Results

2.2.5 Improved Cross City Access

Melbourne Metro will provide an additional cross-city connection, which will link the south east to expanding employment opportunities in Parkville, North Melbourne, Footscray and St Kilda Road (Domain). These key employment centres are:

- Parkville is a world-class centre for education, research, and health care. The universities and research institutes which are co-located within this precinct are expected to continue to develop and expand around these existing nodes, continuing to draw users from across not only the wider metropolitan area but also across the state, the nation and internationally
- The Arden development in North Melbourne extends capital city functions towards Melbourne's west and take the first step in a long-term strategy to connect Footscray to Melbourne's CBD. There are significant development opportunities in the Arden precinct for the expansion of higher order employment core and for significant dwelling development. It is estimated that this urban renewal precinct could support up to 25,000 jobs, and 12,000 students in the Metro station catchment, as well as additional residential development within and beyond the immediate station catchment.
- St Kilda Road is a key employment locations for advanced business services and a number of public and private education institutions. Recently, there has been a significant increase in high end residential stock.

Greater accessibility to jobs and education opportunities will provide significant improvements to human capital. These benefits extend to the west as the Melbourne Metro will provide direct cross-city connection with expanding job opportunities in the south east and CBD.

Productivity and agglomeration benefits will also accrue to firms through improved levels of accessibility.

2.3 Costs Common to All Options

The costs in the following sections of this report are for scope elements that are peculiar to each alignment option. Costs that are common to all options include:

- Additional rolling stock, stabling and turnaround facilities;
- Implementation of new generation signalling for existing tracks throughout the corridor;
- Extensions to platforms and station modifications (unless otherwise specified) to accommodate longer High Capacity Metro Trains (HCMT);
- Potential enhancements at the existing stations, such as Caulfield Station, to accommodate additional passenger flow,
- Cranbourne to Dandenong duplication, and
- Any costs associated with urban redevelopment opportunities presented by any particular alignment option.

These costs are not included in the comparative assessment of the alignment options in this report.

Assessment of construction staging options, and the associated cost implications, is considered independently in Section 7.

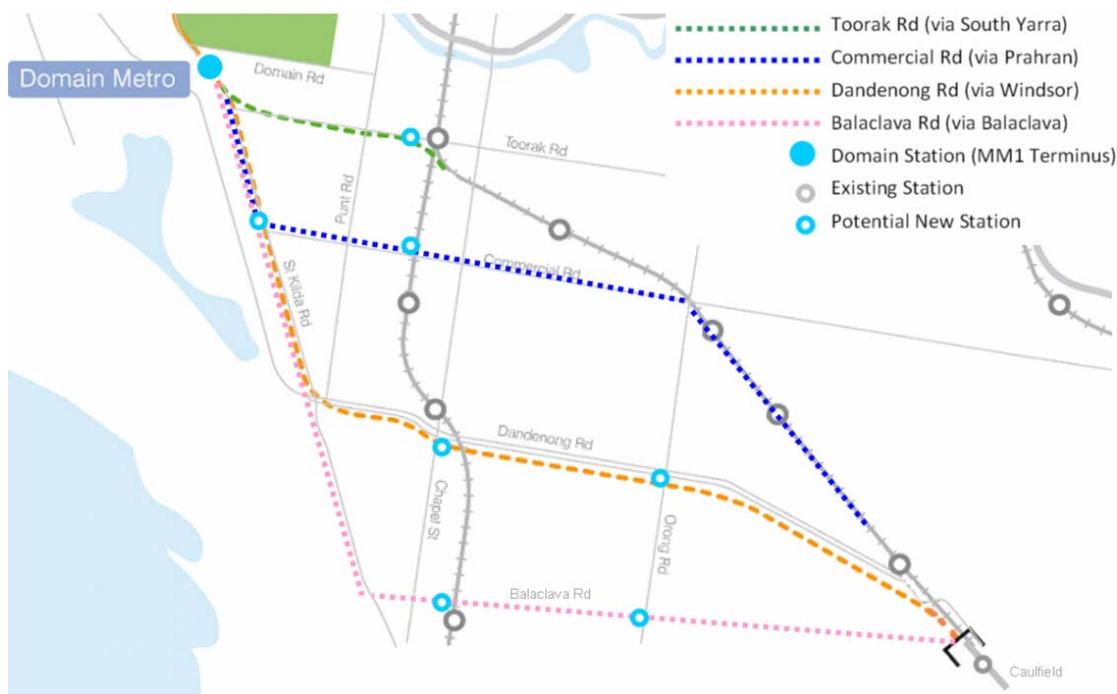
2.4 Assumptions

1. Consistent with MM1 planning, MM2 will incorporate New Generation Signalling, irrespective of the alignment option selected. This technology can be incrementally rolled out to the corridor, before or after MM2.
2. The envisaged rollout strategy for the trains will be to initially procure the standard HCMT (160 metres long) for the opening of MM and then extend them to 200 metres long in the future as demand grows. This defers the need to extend existing surface platforms, until the extended HCMT are in service
3. Assuming that the Melton Line electrification occurs after the MM2 opening means that more trains will operate to the south east than the west. Turnback facilities in the west are therefore required to handle surplus trains from the south east until Melton electrification..
4. Enhancements at existing stations, specifically Caulfield Station, to accommodate additional passenger flow have been excluded from alignment options assessment
5. Costs associated with urban redevelopment opportunities presented by any particular alignment option have been excluded from estimates.

3 Alignment Options

In addition to the EWLNA default alignment along St Kilda Rd and Dandenong Road, three other alignment options have been considered to connect Domain Station to the Dandenong Rail Corridor. These three additional options vary depending on the east-west connection between St Kilda Road and the existing Caulfield to South Yarra rail corridor. These options are presented in Figure 4.

Figure 4: MM2 Options between Domain and the Dandenong Rail Corridor



3.1 Assessment Criteria

A two stage assessment process has been developed to assess the four alignment options. The first stage involves undertaking a preliminary assessment to develop a short list of options. The second stage involves applying a multi criteria analysis (MCA) assessment to the short-listed options.

The preliminary options assessment criteria focussed on engineering (cost) and the two key benefit drivers which differentiate between alignment options. These drivers are the additional public transport trips resulting from those who divert from car which results in congestion relief, and land use opportunities.

The MCA considered tram impacts, engineering and constructability, risks, planning and environmental impacts, preliminary economic assessment and desktop assessment of stakeholder impacts. It should be noted that no stakeholder consultation has been undertaken to date. This needs to occur to complete the options assessment.

To support the MCA, a high level assessment of potential stations associated with each of the short listed alignments was undertaken to refine the options.

4 Alignment Options Preliminary Assessment

The preliminary assessment focuses on the key benefit and cost drivers of strategic land use redevelopment opportunities, additional public transport trips and engineering.

4.1 Strategic Land Use Opportunities

DPCD's planning studies concluded that there are no major land use redevelopment opportunities along any of the MM2 tunnel alignments of a scale that would influence the selection of the preferred alignment. There are significant constraints on redevelopment in the vicinity of proposed stations, including existing and dense residential development and heritage restrictions.

Infill opportunities which do exist are being actively developed or pursued by the property market regardless of a new station being provided in the area. The area in the vicinity of proposed alignments and stations sites is currently very well served by public transport including existing Dandenong, Frankston and Sandringham rail services and a grid network of tram and bus routes.

Providing an additional rail service is unlikely to spur further redevelopment of significance over and above that already being achieved by the market.

There are however two strategically important destinations, namely South Yarra-Prahran (Principal Activity Centre) and the Alfred Hospital (Specialised Activity Centre) which would benefit from improved accessibility depending on which alignment is chosen.

In addition to the strategic benefits associated with individual alignment options, all MM2 alignment options will provide a direct cross-city rail connection, linking high population growth areas in the north and west with strong service-based employment centres in the south east.

4.2 Additional Public Transport Trips

All options will result in a significant increase in the number of public transport trips as a result of improved service and coverage, and the overcoming of a major corridor capacity constraint. This section presents the relative difference in additional public transport trips between each of the options. These additional trips result from travellers diverting from other modes, particularly car, onto public transport. Those trips diverted from car provide road congestion relief, a major benefit and project driver.

The number of new trips public transport trips varies marginally across the four alignment options (Table 2), with the greatest variation being only 2,500 trips less (Toorak Road option) during the two hour AM weekday peak.

The Commercial Road option provides slightly fewer trips than the Dandenong Road option. A key reason is that the interchange with Prahran Station on the Sandringham line is less integrated than an interchange at Windsor because it is located more than 250 metres from Commercial Road. This reduces the attractiveness of making interchanges between Melbourne Metro and Sandringham services.

The Balaclava Road option generates a very marginal increase in public transport trips. Balaclava Road currently has a tram link between Caulfield and St Kilda and the area is served by the Malvern East tram (Route 3). Improving the quality of these tram services is more appropriate than a rail

service given the modest number of additional trips compared with the reference case. St Kilda is currently well served by public transport. The Sandringham line currently serves Balaclava Station and the area is served by five tram routes.

Table 2: Estimated Difference in New Public Transport Trips Relative to the Default Case (Dandenong Road)

Alignment	Difference in New Metropolitan Public Transport Trips (2 Hour AM Peak – 2031)
Dandenong Road (Default)	Reference Case
Toorak Road	-2,500
Commercial Road	- 500
Balaclava Road	+2,000

Source: Melbourne Metro 2 Transport Modelling Working Paper (Arup 2010), MITM Unconstrained 2031 AM Peak Results

4.3 Engineering Feasibility and Capital Cost

There is significant variation in the cost of the alignment options for MM2 as presented in Table 3. To make the connection between Domain and the Dandenong Rail Corridor, the Toorak Road option is the most cost effective with savings of around 30(1) (2010 real) compared to the Dandenong Road default option.

Table 3: Comparison of Preliminary Costs Relative to the Default Case (Dandenong Road) (\$ Real 2010)

Alignment	MM2 Relative Capital Cost (Real)
Dandenong Road (Default)	Reference Case
Toorak Road	30(1)
Commercial Road	30(1)
Balaclava Road	

Note:

- Source: Melbourne Metro 2 Options Study, Aurecon P90 Cost Estimates, DOT levies excluded
- Excludes costs common to all options as outlined in Chapter 2
- Toorak Road option includes South Yarra Metro Station only (not Jam Factory option)
- Commercial Road option costs vary depending on the number of stations. Table 3 costs assume metro stations at both Alfred and Prahran (without an interchange with existing Prahran Station) would be built.
- Dandenong Road option costs vary depending on the number of stations. . Table 3 costs assume both Alfred and Windsor Station would be built, with Orrong Station excluded from the cost estimate.

- *Balaclava Road option cost estimate assumes an additional 700m tunnelling length to Dandenong Rd alignment, and includes construction of Alfred and two additional stations. Potential additional costs incurred due to the narrow road reserve along Balaclava Rd, and the additional construction complexities at Caulfield Station have been excluded from above estimate.*

The **Dandenong Road** alignment offers the most straight forward engineering project tunnelling under the relatively wide road reservations of St Kilda Rd and Dandenong Rd.

The **Toorak Road** alignment is the shortest of the tunnel options considered, and involves constructing a new tunnel between Domain and South Yarra, following the alignment of Toorak Road and connecting with the existing Dandenong line local tracks between the Toorak Road and Chapel Street bridges.

The alignment is approximately 5km shorter than the Dandenong Rd alignment, and does not provide additional track capacity between South Yarra and Caulfield.

The Toorak option offers significant cost savings of around 30(1) compared to the EWLNA default scheme⁴. The study found that with the introduction of new generation signalling, and extended High Capacity Metro Trains, additional track capacity on the corridor would not be required until beyond 2046 (see Table 1).

A component of the cost is property acquisition, of which a proportion is anticipated to be able to be recouped following the completion of construction. Furthermore, there may be opportunities to enable air-rights development over the rail corridor as part of construction works.

Construction impacts of this alignment are anticipated to be more significant than the Dandenong Road option. Impacts include those on local amenity and access due to construction vehicle movements, temporary road closures and noise and vibration. Such impacts are not uncommon for this type of project, and similar issues will need to be addressed along Swanston Street as part of MM1.

Initial feasibility work has indicated that disruption to rail services during construction will be minimal and can be managed during the construction of the tunnel portal and connection to existing tracks.

Stakeholder impacts will also include property acquisition of commercial buildings and residential properties in the vicinity of South Yarra. This, along with potential opportunities to deck over the rail corridor during construction, could also provide the opportunity for urban redevelopment.

A significant proportion of the land acquisition associated with the Toorak Rd alignment is associated with the new station. Eliminating the station from the alignment would provide an opportunity for the tunnel alignment to be improved, and for land take to be reduced. Consideration of the merits of South Yarra station is addressed further in section 5.3.

The **Commercial Road** alignment has considerable engineering difficulties for relatively marginal benefit compared to the default option along Dandenong Road.

A central issue with the Commercial Rd alignment is that it is very difficult to achieve a connection with the existing Dandenong Corridor tracks. The tunnel would need to extend from Commercial Road, then under the existing rail corridor to the southern side of Armadale Station before it can merge with the existing tracks. This is because there is insufficient length of rail between Toorak and

⁴ This cost saving assumes that the Toorak Rd Option would include a new metro station at South Yarra, and that the default Dandenong Road alignment includes stations at Commercial Rd (Alfred Hospital) and Windsor.

Armadale stations for the metro tracks to merge with the corridor prior to Armadale. To avoid impacting on the existing stations, the tunnel would need to be extended towards a portal near Malvern. As such, the minimum length of Commercial Rd tunnel is only around 2km shorter than the default Dandenong Road option.

An alternative option for the Commercial Rd alignment was also considered, which provided a full tunnel link between Domain and Caulfield (i.e. the same track functionality as the default alignment). This option was discarded as it was estimated to be more expensive than the default Dandenong Rd alignment, and with none of the constructability advantages of tunnelling along the wide Dandenong Rd reservation. Commercial Road's narrow road width would cause significant risk to properties during tunnelling, and necessitate the acquisition of many properties over a considerable length to accommodate the width of two rail tunnels.

The **Balaclava Road** alignment involves considerably more tunnelling and therefore cost for marginal benefit compared to the default option along Dandenong Road. In particular, Balaclava Road will have a significantly higher cost than Dandenong Road. This is due to the tunnel being longer and more technically challenging. The narrow width of Balaclava Road means that it will be challenging to fit twin tunnels in the road reserve and the close proximity of the eastern end of Balaclava Road to the northern end of Caulfield Station complicates the connection into the existing rail corridor.

4.4 Initial Assessment Summary

Alongside Dandenong Road, Table 4 indicates that only the Toorak Road is worthy of short listing based on the potential cost savings. The other two options will not progress to the next stage of assessment as they do not present any material benefits compared to the Dandenong Road option, but incur additional cost or engineering issues.

Table 4: Strategic Assessment

Criteria	Land Use	New Metropolitan PT Trips	Cost
Dandenong Road	✓	✓✓✓	-
Toorak Road	✓	✓✓	✓✓✓
Commercial Road	-	✓✓✓	✓
Balaclava Road	-	✓✓✓	xx

Assessment Criteria:

✓ - Advantage; - Similar, x Disadvantage

4.5 Preliminary Options Assessment Recommendation

The recommendations from the preliminary assessment of the four alignment options were:

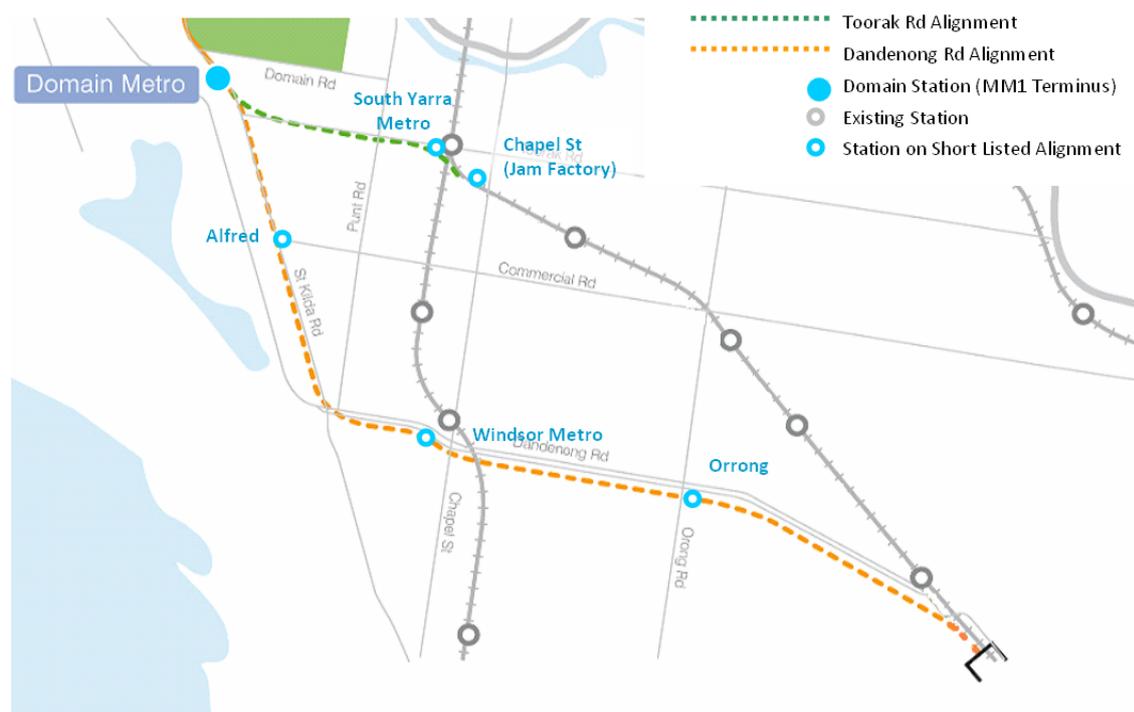
- the Dandenong Road and Toorak Road MM2 alignment options should undergo a more detailed multi-criteria- analysis to determined the preferred option; and
- the station options for the Dandenong and Toorak Road MM2 alignments should be investigated further.

5 Station Options Assessment

A preliminary assessment of land use and development potential has been undertaken for the various station locations on the two short-listed MM2 alignments, see Figure 5 below. The following sections provide an overview of the potential stations for:

- Dandenong Road alignment, including: Domain, Alfred, Windsor and Orrong stations
- Toorak Road alignment: Domain, South Yarra and Jam Factory stations.

Figure 5: Station Options on Dandenong and Toorak Road Alignments



5.1 Domain Metro (Both Alignments)

This station proposed is located on St Kilda Road between Domain Road and Park Street. The station's 800 metre walking catchment is made up of significant employment, schools and parkland.

Importantly, this station's role would be to provide a major interchange between the metro and tram services. In particular, selected St Kilda Road tram routes could be diverted to Kings Way and thus William Street to improve tram accessibility in South Melbourne and the western part of the CBD.

This site has no strong strategic or redevelopment reasons from a land use perspective as this area is constrained by overlays that protect vistas to the shrine and nearby parklands. Some land use change is occurring along St Kilda Road with commercial properties being redeveloped into high-end apartments.

Within a new station's 800 metre station catchment, there is:

- A large commercial precinct on St Kilda Road, part of which is used for apartments. A station may encourage additional commercial development, however trends suggest that apartments are a more likely outcome.
- Melbourne Grammar. This is an established school that may have some room to expand. A station is unlikely of itself to encourage growth in pupil numbers, however access would obviously be significantly improved particularly from the west. Mac.Robertson Girls' High School is also within the 800 meter catchment.
- Mixed use areas in South Melbourne that may increase in density over time. These would be accessible from Domain by tram.
- The Shrine of Remembrance and nearby parklands (Royal Botanic Gardens, Albert Park and Fawkner Park).

A station at Domain may make commercial development along other parts of St Kilda Road more desirable as accessibility by train improves. However, increased commercial development would be counter to current market trends (which is seeing a move toward residential development), and any such change is expected to be marginal.

5.2 Dandenong Road Alignment

5.2.1 St Kilda Road - Land Use Policies

Planning policies continue to encourage the role of St Kilda Road as a premier commercial precinct on the fringe of the Central Business District with ancillary residential development ensuring the area is vital and active at all times of the day. There is, however, a strong observable trend away from commercial development to apartments.

Developments at Southbank, Docklands and the inner east have increased CBD fringe options for commercial development. This has reduced the relative attractiveness and demand for St Kilda Road commercial office space.. The Alfred Hospital precinct is currently the only location where additional commercial property growth is occurring and this is in the absence of an existing station.

Queens Road continues to be a high quality residential area with development at higher densities than in the established residential areas of Port Phillip.

It is unlikely that future land use policies would radically change the current planning approach now applied along St Kilda Road. The existing high standards of landscaping, and the boulevard character of St Kilda Road are expected to be retained, including important views and vistas to the Shrine of Remembrance in particular.

5.2.2 Development Capacity Constraints

The trend toward residential development, as is currently occurring along St Kilda Rd, is generally a one way process. Once apartments are strata titled it is highly unlikely that they will return to commercial development. Therefore, the amount of available commercial land will reduce over time if current trends remain in place.

While there are no absolute height limits along St Kilda Road, the current guidelines and restrictions on set backs, heights, landscaping and design ensure that any radical changes that would encourage further increases in an already high dense development area are unlikely. The most probable changes are increases to building heights in locations which do not affect the Shrine Vistas. This

applies mainly to the land west of St Kilda Road, south of Albert Road. There is also significant parkland within the walking catchment that constraints further development.

5.2.3 Outlook

There is strong evidence that St Kilda Road is trending towards residential use rather than its traditional role as a commercial precinct second only to the Melbourne CBD, presumably related to the rise of Docklands and Southbank and other CBD fringe sites. As commercial activity stays static or potentially decreases in this area, travel demands to this area will also decrease as residential development generates fewer daily trips than commercial office development.

The one site that will remain busy and will potentially grow as a destination is the Alfred Hospital precinct, which will continue to consolidate its presence on St Kilda Road. The site is one of Victoria's key education and research precincts and some growth can be expected in clinical education and research.

5.2.4 Alfred Metro (Dandenong Road Alignment)

There is potential to locate a metro station on St Kilda Road in the vicinity of Commercial Road and the Alfred Hospital.

The Alfred Hospital's annual reports give an outline of staff numbers across its three campuses at Prahran, Sandringham and Caulfield. The total full-time equivalent staff has grown from 4,244 in 2005 to 4,869 in 2009 across the three campuses. Outpatients number around 708,000 (2008-2009) per year, or an average of 1,940 visits per day. In addition, there are visitors and persons accompanying patients.

The Alfred has undertaken a number of major building programs that have expanded and improved its facilities. The Alfred Medical Research and Education Precinct (AMREP) now includes the Burnet Institute, Monash University, La Trobe University, and the Baker International Diabetes Institute.

To get an understanding of how these workers use public transport, it is helpful to look at a TravelSmart survey undertaken in 2003, 2004 and 2005. Figures suggest that public transport use has grown slightly from 17% in 2003 to around 19.3% in 2005. Increased levels of access delivered by a metro station is likely to shift this travel mode profile towards public transport, however it is still a small number of trips in context of the overall corridor.

Advice from the Department of Health suggests that further rebuilding is likely to be aimed at improving facilities rather than increasing bed numbers. However, there is likely to be an increase in clinical training and allied health services, including on site research.

Hence, in the future the Alfred is likely to consolidate on site and provide further services to the public and grow its research and clinical training roles. Growth can therefore be expected in terms of staff, students, patients and visitors. Of itself, it is unlikely that a station would encourage further growth of the Alfred site. Additional key findings are:

- Long-term demand for residential development along St Kilda Road coupled with limited supply opportunities, mean there will be limited ability for any commercial growth into the future.
- Once residential development has occurred this should be viewed as an absolute constraint due to the significant problems associated with strata titling and the difficulty of converting back to commercial if this were considered desirable.

- There is no evidence that the Alfred would expand to a greater degree with a metro than without.
- The market is already constructing large scale residential projects without the metro and while metro would make the area more attractive, developments are already being built beyond existing guidelines. It is not considered there will be significant housing growth above the baseline.

A train station on St Kilda Road would improve accessibility, and provide a higher quality public transport link to major Medical Research institutes at Parkville and Clayton (Monash Medical Centre). This could enhance the possibilities for collaboration between the hospitals, research institutes and education facilities and thereby increase the strengths and productivity of these knowledge industries.

The Alfred Medical Research and Education Precinct is a major activity centre. A station located at or near the Alfred would underpin this role. However, the site is already well serviced by high frequency tram services along St Kilda Road and Commercial Road, with easy access to the CBD. Additionally, Prahran Station is located approximately 1 km away (door to door).

5.2.5 Windsor Metro Station

There is potential to locate a station on Dandenong Road near the intersection of Chapel Street and enable an interchange with Sandringham Services at Windsor Station. Windsor provides opportunities to connect with the Prahran Campus of Swinburne University, retail uses along Chapel Street, as well as two secondary schools and the Astor Cinema. The walking catchment is predominantly residential with some growth in the education sector, and limited employment growth.

Zoning controls north of Dandenong Road allow commercial development along part of Chapel Street, and that this is an area of moderate change. Land south of Dandenong Road, however, is zoned residential with extensive heritage controls. Heritage controls also exist along Chapel Street and around the station precinct.

Council policies, outlined in Chapel Vision, suggest that planning should be directed to low rise development. The majority of sites in and around each of the precincts are small and many sites are already occupied by dense unit development.

A Windsor metro station would provide an interchange with the existing Windsor station (Sandringham line), providing improved accessibility particularly for passengers on the Sandringham line. This may have the effect of making this area attractive for more intensive urban development. However this would require the assembly of small sites, many in residential use and therefore would be difficult to achieve given high site values and stakeholder response. It is conceivable that additional development could be encouraged at Windsor but this would be modest and generally low rise. Around Windsor Station, limited opportunities are presented by decking over the rail corridor and utilising the existing car park on the east side of Chapel Street.

5.2.6 Orrong Road Metro Station (Dandenong Road Alignment)

A potential station at Orrong Road serves no strategic land use purpose. The area is almost exclusively residential in land use and partly covered by heritage overlays. The residential and student population and employment within the station's walkable catchment are all expected to remain stable and comparatively low. Redevelopment opportunities are very limited.

5.3 Toorak Road Alignment

5.3.1 South Yarra Metro Station (Toorak Road Alignment)

This station involves implementing a new South Yarra metro station at Toorak Road that would enable an interchange with the existing South Yarra Station, as well as the Toorak Road tram. South Yarra and Prahran combined are recognised as a Principal Activity Centre. Chapel Street is the largest strip shopping centre in Australia and services regional and local needs.

The City of Stonington Planning Scheme supports this policy by encouraging regional retail, office and service activities. Council's Structure Plan Vision for this area is to see the following:

- Toorak Road west of the railway – moderate change along Toorak Road
- Residential Areas west of the railway – Limited/Minimal Change. The area has significant overlay controls, in particular the west of the Sandringham rail corridor subject to discretion an overlay restricts development heights to 12m to protect the surrounding parks.
- Areas north of Toorak Road and east of the railway – Substantial change including office and housing

Council has noted an economic downturn in Toorak Road because of the competition from other boutique strip centres. It is attempting to redress this by encouraging development in and around the South Yarra station, and the abutting Forest Hill precinct (the land parcel to the north-east of the existing South Yarra station, bordered by Yarra St, Toorak Rd, Chapel St, and Melbourne High School).

Currently, the main catchment for major new development is east of the rail corridor within the Forest Hill precinct, reported to be well into a \$1 billion rejuvenation of shops, offices and apartments. Two sites are earmarked for towers of over 30 levels and 3 more of 20 levels. Almost all buildings will flank the corner of Chapel and Toorak Road and will be mainly aimed at the apartment market but with some commercial and retail space.

The major changes noted north of Toorak Road have been bursts of activity relating to apartment building. This started with the Como Project and other developments near the Yarra and of more recent times with redevelopment along the Yarra Street frontage - a mix of apartments and commercial.

To achieve a favourable tunnel alignment (minimising tunnel length and property take), the South Yarra Metro Station would be located west of the existing Sandringham line and on the south side of Toorak Road, see Figure 6. This is a predominantly residential area and generally low rise in character, interspersed with attractive building stock. The station would require acquisition of residential properties along Toorak Rd between South Yarra Station and Punt Road. Some residential properties would also be impacted at the station site south of Toorak Rd.

Given the need to acquire properties for the station, there would be an opportunity to redevelop these sites to higher densities. However, the area directly impacted by the station is relatively small and would have only locally significant impacts. There would also be an opportunity develop over the rail corridor and to improve pedestrian access from the station to Chapel Street concurrent with construction of the metro, which may help to focus activity around the station. Given the confluence of existing lines at this location and the existing tram services on Toorak Road and Chapel Street, the addition of a South Yarra Metro Station is not in itself likely to encourage development beyond existing market trends.

South Yarra metro station would provide an opportunity to interchange with the existing South Yarra station, allowing those on the Sandringham Line and passengers boarding between Caulfield and South Yarra to interchange to the metro away from the inner core stations. These network connectivity benefits are countered by an additional stop for through metro passengers.

5.3.2 Jam Factory Metro Station

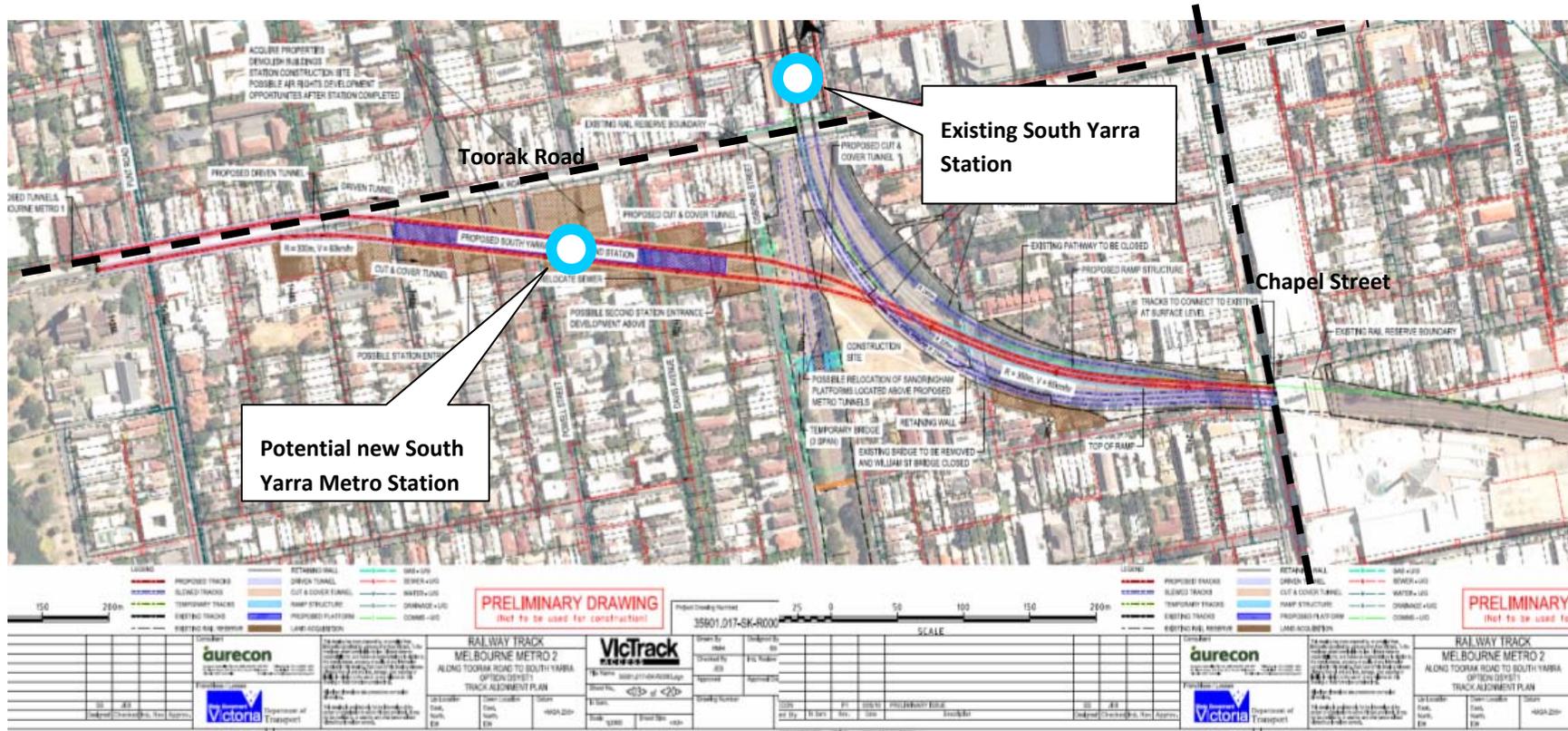
There is also potential to locate a station under the Jam Factory complex along the Toorak Road MM2 alignment.

A new station at this site may encourage or could be co-ordinated with a redevelopment of the Jam Factory and surrounding area. The Jam Factory station is also better located than South Yarra Metro in relation to the location of current activity within the South Yarra Principal Activity Centre.

Due to its location to the east of Chapel St, the Jam Factory Station Option precludes the opportunity to provide a metro interchange with the existing South Yarra Station.

In terms of the development opportunities associated with a Jam Factory station, the incremental opportunities associated with having a station at this site are likely to be limited. The South Yarra end of Chapel Street is already well developed, and Chapel Vision already supports substantial change south of the existing rail corridor. Decking over the rail corridor might also increase the redevelopment opportunity associated with the site, however this could occur regardless of a new station.

Figure 6 MM2 Preliminary Concept Design for Cost Estimate



5.4 Preliminary Station Demand Forecasts

The indicative patronage forecasts for each station during the 2 hour AM Peak in 2031 is presented in Table 5 and Table 6 below.

Table 5: Preliminary Station Demand Forecasts (2031 AM Peak) - Boarding & Alightings

Station	Dandenong Road		Toorak Road		Comment
	Boardings	Alightings	Boardings	Alightings	
Domain	30(1)				
Alfred					
Windsor Metro					Excludes existing Windsor Station
Orrong					
South Yarra Metro					Excludes existing South Yarra Station
Total					

Table 6: Preliminary Station Demand Forecasts (2031 AM Peak) – Interchange Activity

Station	Dandenong Road		Toorak Road		Comment
	Boardings	Alightings	Boardings	Alightings	
Windsor Metro - Transfer from/to Rail	30(1)				
South Yarra Metro - Transfer from/to Rail					

Notes:

1. Source: Melbourne Metro Options Assessment Patronage Modelling, Zenith Unconstrained 2031 AM Peak Results
2. Boardings and alightings include transfers within the station. A transfer would count as one boarding and one alighting.

Table 5 above show forecast patronage demand at each station on the two shortlisted MM2 alignments, and provide an indication of the relative merits of each station. Table 6 shows the forecast level of passenger transfer activity at the two metro stations where there is a potential interchange with an existing station (Windsor Metro on the Dandenong Rd alignment, and South Yarra Metro on the Toorak Rd alignment). These results indicate the level of demand for passengers to interchange between the existing rail network and the new metro tunnel at these two locations.

The forecast patronage demand at Domain and Alfred metro stations in Table 5 indicates the level of travel activity around St Kilda Road. There are two stations along St Kilda Road on the Dandenong Road alignment (Domain and Alfred), and one station on the Toorak Road option (Domain). Table 5 indicates that the total number of passengers alighting on St Kilda Rd in the Dandenong Road option 30(1) is higher than the number of alightings at Domain Station under the Toorak Road option

30(1) . A proportion of this difference is due to passengers diverting to or from the tram network⁵. Hence, the alightings results indicate that the Dandenong Rd alignment would provide more relief to the St Kilda Rd tram services than the Toorak Rd alignment, although this impact appears to be marginal as trams will be able to accommodate demand generated in both alignments. This issue is examined further in section 6.1.1 as part of the multi-criteria analysis, which provides a detailed analysis of the tram network impacts of the two shortlisted MM2 alignments.

The difference in patronage can also be attributable to the Dandenong Road alignment providing a direct connection from the Dandenong line to Dandenong Road and southern parts of St Kilda Road. A high quality direct tram service from Malvern Station along Dandenong Road to St Kilda Road south is currently under investigation, which would provide an alternative means of achieving a similar outcome. Dandenong corridor passengers would have the opportunity to interchange onto this tram as it is proposed that the service will stop at Malvern.

A further finding relating to the Dandenong Rd alignment is that activity at Orrong station is projected to be relatively low, such that it is would be unviable to build this station. This reflects the constrained urban character of that area which limits any redevelopment opportunity, and that the area is already well served by public transport.

Forecast patronage at Windsor Metro station is greater than Orrong, but is also relatively low at 30(1) boardings and 30(1) alightings in the AM peak. Table 6 indicates that Windsor Metro would provide some relief to existing inner core stations, with 1600 passengers forecast to interchange between the Sandringham line and the metro tunnel at Windsor, activity that would otherwise occur at Richmond or Flinders Street station.

Forecast patronage demand for South Yarra Metro station on the Toorak Rd alignment is comparable to that of Windsor Metro, with the forecast level of boardings, alightings, and interchange activity relatively low in the AM peak. This may reflect the fact that this precinct is already well serviced by public transport, and that Dandenong, Cranbourne and Frankston line passengers would also have the opportunity to interchange with metro services at Caulfield Station, prior to South Yarra. Hence, most passengers would have an opportunity to access South Yarra station, or to interchange at alternative location if South Yarra Metro Station was not constructed.

Table 7 presents the interchange opportunities for passengers in the absence of a South Yarra Metro Station. The passengers most disadvantaged are those wanting to transfer between the Sandringham and Dandenong lines when coming into the city and then heading out in a southbound direction. There are street based east-west public transport connections that could be used to make this movement, or alternatively these passengers could transfer at Flinders Street.

Table 7: Public Transport Options without South Yarra Metro Station

From	To	South Yarra	Domain	Dandenong Line (Metro line)	Notes
Dandenong Line		Change at Caulfield for a Frankston Service	Alight at Domain Metro Station	N/A	

⁵ The balance will have made their trip through another public transport route, such as using the nearby Prahran Station (1.0km walk), other tram or bus services or used car.

Frankston line south of Malvern	Alight at existing South Yarra Station	Change at Caulfield	Change at Caulfield	
Armadale, Toorak and Hawksburn	Catch Frankston Service	Use tram	Catch Frankston Service and change at Caulfield	
Sandringham line	Alight at existing South Yarra Station	Alight at existing South Yarra station and catch Toorak Rd tram	Catch east-west tram or bus service to Dandenong line or change at Flinders Street	Number of Sandringham line negatively impacted by no South Yarra Metro Station passengers is fewer than 30(1) 30(1) 30(1) in 2 hour AM peak in 2031.
Metro North West	Change at Melbourne Central Station or Flinders Street Station for a Frankston or Sandringham Service	Alight at Domain Metro Station	Metro service	

Comparing total station patronage for the two short-listed MM2 alignment options, there are more boardings and alightings on the Dandenong Road alignment metro stations, with 30(1) more boardings and 30(1) more alightings than the Toorak Rd alignment in the 2031 2hr AM peak.

5.5 Station Cost Considerations on the Toorak Rd Alignment

Although station construction on the Dandenong Road alignment is relatively straight-forward due to the wide road reservations along St Kilda and Dandenong Road, station construction for South Yarra Metro and Jam Factory Metro on the Toorak Road alignment would be considerably more complex.

Preliminary investigations found that the South Yarra Metro station would add at least 30(1) (\$Real) to the cost of the Toorak Rd alignment (See Table 8), and require the acquisition of about 10 houses and 25 flats and another 35 business along Toorak Road. The extent of property acquisition required for the MM2 Toorak Rd alignment could be significantly reduced if the alignment were built without a station.

Achieving a high quality interchange between South Yarra Metro station and the existing South Yarra station will also be challenging. The location of the station, south of Toorak Rd and to the west of the Sandringham line, is required to optimise the tunnel alignment in terms of cost and constructability. However, this will mean some passengers would be required to walk up to 250m to interchange with existing lines. Additional treatments could be considered to improve the quality of this interchange, such as bringing the Sandringham Line platform at the existing South Yarra Station to the southern side of Toorak Road, however such treatments would necessarily incur additional cost and disruption during construction.

Table 8: Toorak Road Alignment Estimated Station Costs

Toorak Road Alignment Option

Relative Capital Cost (Real)

No Station

Reference Case

South Yarra Metro Station

30(1)

Jam Factory Station

Note:

- Source for South Yarra options: MM1 Extension Study, Melbourne Metro Stage 1, , Aurecon et al, 2011
- Source for Jam Factory Station alignment: Melbourne Metro 2 Options Study, Aurecon, March 2011
- P90 risk allowance, DOT levies and land and property costs included
- South Yarra Metro Station estimate based on an underground station south of Toorak Road with no additional decking or overhead development. Interchange with existing station would be via Toorak Rd or Osborne St.

The tunnel alignment required to support the Jam Factory station option is longer and more complex to construct than for the South Yarra metro station. Under this alignment option, the metro tracks are not able to merge with existing Dandenong corridor tracks until nearly at Hawksburn Station, causing Chapel St and other local roads to be impacted during construction, and also require the permanent closure of Surrey Road. For these reasons, Jam Factory Station comes at a significant cost premium, estimated at 30(1) (2010 Real) above the cost of the Toorak Rd alignment option with a South Yarra Metro station (See Table 8). The longer alignment associated with this option would also have extensive additional impacts on residential properties east of Chapel Street.

5.6 Station Assessment Recommendation

It is recommended, pending stakeholder consultation outcomes, that:

- the Toorak Road alignment be assessed without the South Yarra Metro station. This station would add significant additional cost to the Toorak Rd alignment, and cause additional detrimental social impacts, particularly in terms of permanent residential property acquisition. The patronage and operational benefits of this station, and the limited development opportunities associated with it, are extremely unlikely to outweigh these issues.
- the Jam Factory (Toorak Road alignment) Stations be not considered for further investigation. This station does not provide an interchange with the existing South Yarra Station and incurs considerable additional costs, property acquisition and constructability challenges.
- the Orrong Road Station be no longer considered on the Dandenong Road alignment due to low demand not justifying the significant cost of an underground station.

6 Alignment Options Multi Criteria Analysis

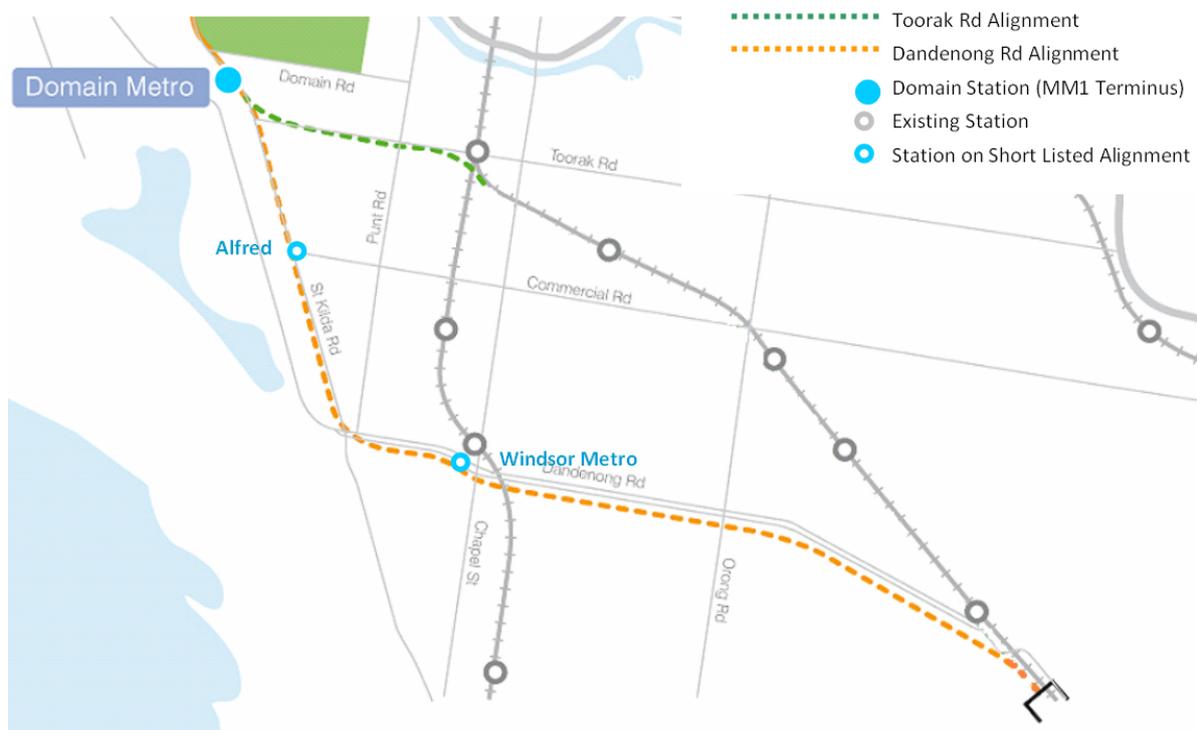
A more detailed multi-criteria analysis was undertaken to assess the Dandenong and Toorak Road options.

Table 9 presents the criteria used.

Table 9: MCA Criteria

Criteria	Description
Tram Impact	Impact on tram services, particularly along St Kilda Road
Planning and Environment	Cultural, heritage and local amenity impacts, localised urban redevelopment opportunities
Engineering and Constructability	Engineering and construction complexity, including impacts on day to day activities (eg rail operations)
Stakeholder Impacts	Property acquisition, community issues (desktop assessment only)
Preliminary Economic Assessment	Preliminary indication of cost benefit analysis outcome
Risk	Key risks that are peculiar to each option

Figure 7 MM2 Alignment Options for Multi-Criteria Analysis



6.1.1 Tram Impacts

Melbourne's inner south east is currently very well served by public transport including a network of tram and bus routes as well as the Dandenong, Frankston and Sandringham rail services. All of these services have already experienced significant growth which is expected to continue into the foreseeable future. Swanston Street/St Kilda Road is the world's busiest tram corridor and continuing to serve passengers reliably while meeting growing forecast demand represents a major challenge.

The tram network's capability to respond to demand in the long term is a key influence on the decision of the Metro route south of Domain Interchange. In assessing the alignment options, the key question is whether the tram network required to support the demand for trips under the two MM2 alignment options is significantly different. If there is sufficient impetus for different networks, then there is a need to consider the costs of augmenting the tram network in the overall evaluation of the costs and benefits of the two metro alignments.

In particular, the forecasts for tram patronage in the area south of Domain Interchange are important inputs for determining the route of MM2. If forecast passenger demand for tram services south of Domain Interchange exceeded the capacity of this tram corridor, then rail would be needed.

Given the complexity of travel choices in Inner Melbourne, two independent forecasting approaches were developed to undertake this assessment. The forecasting approaches involved using the Department's Melbourne Integrated Transport Model (MITM) and the Zenith model. Both models were refined in the vicinity of St Kilda Road and CBD to improve the modelling of travel behaviour. Forecasts for tram loadings were assessed in the north and southbound directions.

The modelled loads indicate that the 2031 worst case for tram services south of the Domain Interchange (i.e. the section of St Kilda Road where the two MM2 alignments do not provide the same functionality) is a load of 30(1) across the two hour peak for southbound travel at Domain Interchange (MITM Toorak Road tunnel option).

This load represents about half the theoretical carrying capacity of the corridor incorporating future tram service improvements such as larger trams and management treatments (e.g. light sequencing). Assuming an ongoing growth rate of 3 per cent per annum from 2031, which is higher than long term population and employment growth rates, the result suggests that the capacity of the system 30(1) people in two hours with new longer trams) would be sufficient beyond 2050. This result indicates that the tram network can manage future demand under either MM2 alignment option.

Table 10 suggests there is only minimal difference between tram network requirements for the Toorak Road and Dandenong Road alignments. MITM suggests a maximum difference of about 30(1) passengers in the peak two hours, or 6% of the ultimate capacity. Zenith has a smaller difference between the two alignment options.

Table 10: Comparison of Tram Demand at Critical Loading Points (2 Hour AM Peak – 2031) for MM2 alignment options

Tram Loading Cordon Point	MITM			Zenith		
	Toorak Rd MM2	Dandenong Rd MM2	Difference	Toorak Rd MM2	Dandenong Rd MM2	Difference
Princes Bridge						
St Kilda Rd – South of Southbank Blvd (Arts Centre)			30(1)			
St Kilda Rd – Domain Interchange						

The similar impact on Dandenong and Toorak Road alignments on St Kilda Road tram loadings (from the Zenith model) is presented Figure 8 and Figure 9. It illustrates the significant impact that both alignments have compared to the “Do Nothing” scenario. It also indicates that the magnitude of impact is also similar for both alignment options.

Figure 8: St Kilda Road Southbound Tram Loadings for MM2 Alignment Options (Zenith, 2031)

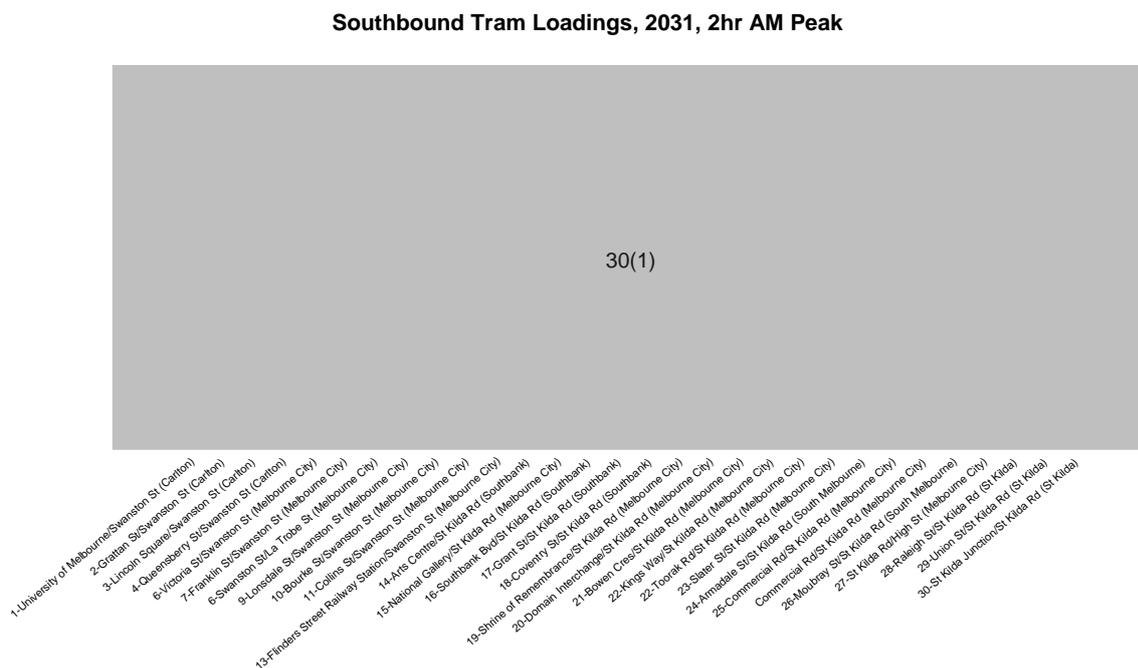
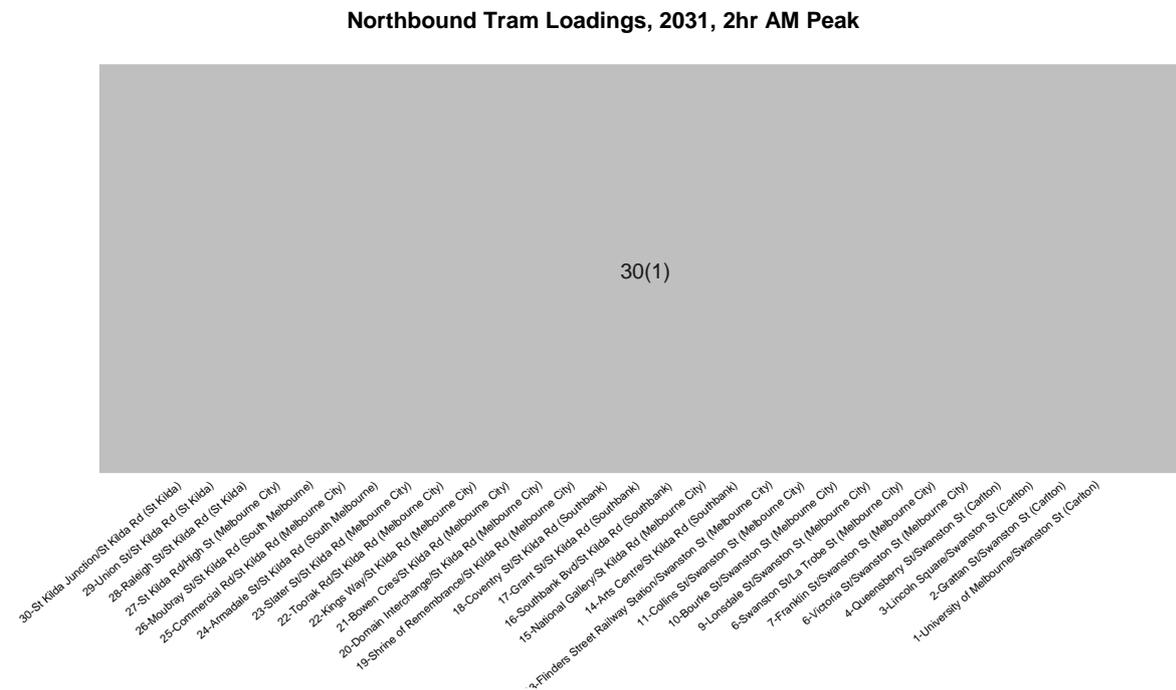


Figure 9: St Kilda Road Northbound Tram Loadings for MM2 Alignment Options (Zenith, 2031)



As a result, the same surface services are required in the inner south east regardless of which alignment is selected. Both options therefore rate equally with respect to their impact on the tram network (Table 11).

It is also proposed that a high quality tram service has been planned for the St Kilda Rd/Dandenong Rd tram corridor, with an interchange with the existing Malvern Station. This initiative is significant in terms of the MM2 alignment options assessment, as it would enable rail passengers from the Caulfield Group to access the southern end of St Kilda Rd/Dandenong Rd regardless of which MM2 alignment is taken as it is proposed that Dandenong rail services stop at Malvern Station.

Table 11: Tram Impact Assessment

Tram Loading Cordon Point	Dandenong Road	Toorak Road
Tram Impacts	✓	✓

Assessment Scoring:

✓ - Advantage; - Neutral, ✗ Disadvantage

6.1.2 Engineering and Constructability

The Dandenong Road alignment offers the most straight forward project from a tunnelling and engineering perspective with the relatively wide road reservations of St Kilda Rd and Dandenong Rd. The alignment veers to the north of Dandenong Road into Albert Street at Windsor to provide a higher quality interchange. The two metro tracks merge into existing tracks just north of Caulfield Station.

The Dandenong Road alignment option includes an underground station at Alfred (near the corner of St Kilda Rd and Commercial Rd) and Windsor. Both sites present some challenges in terms of

station construction due to the lack of worksite areas on the surface, and the desire to minimise the land take for structures.

The Dandenong Rd alignment is expected to require relatively little land take, most likely limited to the station sites. To achieve a high quality interchange with the existing Windsor Station will involve some commercial property acquisition in Albert St.

The Toorak Road option, although much shorter, is more complex than the Dandenong Road option. The narrow width of Toorak Road will require the tunnels to be located very close to property boundaries on each side. The design will need to carefully consider potential ground settlement effects on adjacent buildings. Such conditions are not unusual for this type of project, and a conservative tunnelling approach would minimise these risks.

To optimise the Toorak Rd alignment in terms of cost and operational functionality, and to minimise disruption during construction, the metro tracks would merge with the existing Dandenong line on the west side of Chapel St (i.e. there is no scope on the east side of the Chapel Street bridge). This alignment will have some localised impacts at South Yarra. Several commercial properties along Toorak Rd would be impacted in the vicinity of the tunnel portal. Additional rail reservation width would also be required where the ramps rise to merge with the existing tracks, requiring some residential property acquisitions in Osborne Street, William Street and Davis Avenue, as well as the closure of William St bridge. A pedestrian bridge would be feasible; however local traffic movements via William St would be impacted.

Traffic management during construction is likely to be more challenging for the Toorak Road Alignment option than for the Dandenong Rd option due to the more confined and residential nature of the road network around the South Yarra portal. Construction vehicle traffic is likely to be of a comparable level to that involved in the construction of the nearby Como Centre Development (Chapel St). Direct disruption to Toorak Road traffic and tram services is avoided by eliminating the South Yarra Metro station.

For both options, there are no major underground constraints that will conflict with the tunnel alignments without options for relocation or diversion. Services will need to be relocated particularly where the tunnels are transitioning back to surface level, at shafts, and at the station boxes where excavation from the surface is required. Driven tunnels will generally be located below the existing services.

For both options, the works to connect the MM2 tracks to the existing lines will require phasing of the excavations and structures, and slewing of the surface rail, but it is feasible to stage to works to keep the existing rail operations in place for peak hour operation.

The relative ratings for each option are presented in Table 12.

Table 12: Engineering and Constructability Assessment

Impacts	Dandenong Road	Toorak Road	Comment
Engineering and Constructability	✓✓	-	Dandenong Road is a wide road reserve. Toorak Road is a narrow corridor in a built up area (not unusual for this type of project).

Assessment Scoring:

✓ - Advantage; - Similar, ✗ Disadvantage

6.1.3 Planning and Environment

Key findings from a preliminary planning and environment desktop study for both of the short-listed options are presented in Table 13. There is a marginal difference between the two options and most impacts are of moderate consequence and can be managed. Managing disruption during construction will be more demanding for the Toorak Road option.

30(1)

Table 13: Preliminary Planning and Environment Strategic Assessment

Impacts	Dandenong Road	Toorak Road	Comment
Cultural/ Heritage	✗	-	Dandenong Road Tramway
Local Transport Access	-	✗	30(1) Other impacts can be mitigated
Road traffic disruption during construction	✗	✗✗	Toorak Road is a narrower road in a commercial area. Dandenong Rd is a major arterial. There is less construction traffic for Toorak Rd due to smaller scope
Soil treatment and ground water	✗	✗	Potential for elevated levels of naturally occurring metals may be present Ground water levels present at >10m depth, except in the Windsor area (> 5m)
Overall	✗	✗✗	

Assessment Scoring:

✓ - Advantage; - Neutral, ✗ Disadvantage

6.1.4 Stakeholder Impacts

The stakeholder consultation to date has only focused on Stage 1 of the Melbourne Metro Rail Tunnel.

The default MM2 scheme was subject to consultation and was part of *EWLNA* and *VTP*. The overall scheme enjoyed general community and stakeholder support. Adoption of the Toorak Road scheme can be expected to generate an adverse response from those in the community who would benefit more from the original St Kilda Road / Dandenong alignment. For example, the City of Port Philip has expressed positive support for the default scheme as it improves access to their municipality. In addition, the denser development and narrower road reserves along the Toorak Road alignment is

likely to have more significant construction and land acquisition impacts, and may therefore be less acceptable to those affected than those affected by the Default Scheme.

The Dandenong Road option will require the acquisition of a very small number of properties. As the Toorak Road option is in a more built up area, this option may involve the acquisition of around 10 residential properties in Davis Avenue and Osborne Street, and 18 businesses operating from commercial properties along Toorak Road, although it may be possible to reduce land take by optimising the design of the no-station Toorak Road alignment, and adopting less conservative rail design criteria. These considerations have not been pursued for this alignment evaluation. Following completion of construction, these property acquisitions also represents a potential opportunity for urban redevelopment.

A further consideration in favour of the Toorak Road alignment from a broader stakeholder perspective is that, by virtue of its hugely reduced cost relative to the Dandenong Road option, would improve the prospect of investment in additional capacity enhancements along the entire length of the Dandenong Rail Corridor, including those constraints south of Caulfield.

The relative ratings for each option from a stakeholder perspective are presented in Table 14.

Table 14: Stakeholder Impacts

Impacts	Dandenong Road	Toorak Road	Comment
Localised Impacts	-	✖✖	Toorak Road involves a higher number of property acquisition and potential construction disruption. Does not serve Alfred / St Kilda Rd South.
Corridor wide – improved prospects of additional capacity	-	✓✓	Lower cost Toorak Road option improves funding and project prospects
Overall	-	-	

Note: Subject to revision depending on outcomes of the stakeholder consultation stage

Assessment Criteria:

✓ - Advantage; - Neutral, ✖ Disadvantage

6.1.5 Economics

In light of there being very marginal changes in benefits and outcomes between the Dandenong and Toorak Road options, the Toorak Road option appears to be more favourable from an economic perspective due to the significantly lower cost.

Whilst there may be a strategic case to provide higher quality public transport to the Alfred Hospital that would connect it to medical precincts at Parkville and Clayton (Monash Medical Centre), it is unlikely that the value of these agglomeration benefits generated by this link would substantially offset the 30(1) additional cost of the Dandenong Road alignment. In particular, the Alfred precinct is already well served by tram and the Sandringham line, and would be close to the Domain metro station. Further discussion of an Alfred Station is presented in Chapter 4.

The ratings for each option from an economic perspective are presented in Table 14.

Table 15: Economics Assessment

Impacts	Dandenong Road	Toorak Road	Comment
Preliminary Economic Assessment	-	✓✓	Toorak Road provides a similar level of benefits for a significantly lower cost

Assessment Criteria:

✓ - Advantage; - Neutral, ✗ Disadvantage

6.1.6 Risk

Whilst there are overarching project risks, only the key technical risks peculiar to the Dandenong and Toorak Road options have been identified for the alignment options assessment. The Toorak Road option has more implementation and stakeholder risks due to the complexities associated with constructing in an area that is built up with commercial and residential activity. Notwithstanding this, many of these risks are not uncommon to projects of this nature and may also apply to other parts of the Melbourne Metro project, such as along Swanston Street. The next phase of development will involve developing plans to mitigate these risks.

A significant risk for the Dandenong Road option is that the economic case for this alignment is, based on this strategic assessment, not as strong as Toorak Road. The Dandenong Road option only provides small incremental benefits for significantly greater cost than the Toorak Road option. This will increase the risk of the project either not proceeding or being deferred for a long period, resulting in increased passenger crowding at inner city stations and inability to increase Dandenong rail corridor capacity.

The technical risks for Dandenong Road option is provided in Table 16, whilst the Toorak Road option is presented in Table 17.

Table 16: Key Technical Risks - Dandenong Road Alignment Option

Risk/ Hazard	Possible Causes	Possible Consequences
MM2 delivery delayed	Economic case of the stand alone project is not strong	Project not delivered resulting in increased passenger crowding at inner city stations and inability to increase Dandenong rail corridor capacity
Extent of rail development south side of Dandenong Road (Malvern/Caulfield)	Extensive retaining walls required on rail boundary (upside of Caulfield) Tree removal Increased rail activity, noise visual impact etc.	Public dissatisfaction resulting in delay and amended design leading to additional cost

Note: Risks common to all MM1 sectors are applicable to MM2

Table 17: Key Technical Risks – Toorak Road Alignment Option

Risk/ Hazard	Possible Causes	Possible Consequences
30(1)		

Note: Risks common to all MM1 sectors are applicable to MM2

Whilst Toorak Road option has more implementation risks, the Dandenong Road option has significant economic viability risks and therefore funding risks based on work completed to date (See Table 18).

Table 18: Risk Assessment

Impacts	Dandenong Road	Toorak Road	Comment
Delivery Risk	-	xx	Implementation in a built up area
Business Case Risk	xx	-	Economic viability and funding risks.
Overall Risk	xx	xx	

Assessment Criteria:

✓ - Advantage; - Similar, x Disadvantage

6.2 Overall Assessment

The overall MCA assessment indicates that Toorak Road rates strongly compared to the Dandenong Road option (Table 19) and has been identified as the preferred option at this stage, subject to public consultation and further detailed investigations. It is therefore recommended that this next stage of development progress to further inform and complete the options assessment.

Table 19: Overall MM2 Alignment Assessment

Impacts	Dandenong Road	Toorak Road with South Yarra	Toorak Road without South Yarra	Comment
New PT trips (metro?)	✓✓✓	✓✓		Both options provide a significant uplift in capacity for DRC
Land Use	✓	✓		Serves Alfred Hospital (SAC) and South Yarra PAC.
Cost	-	✓✓✓		Toorak Road cost is significantly lower
Tram Impacts	✓	✓		Both alignments provide similar of relief to tram
Engineering and Constructability	✓✓	-		Dandenong Road is a wide road reserve. Toorak Road is a narrow corridor in a built up area not unusual for this type of project.
Planning and Environment	×	×		Toorak Road impacting a built up area, but localised redevelopment opportunity
Stakeholder Impacts	-	-		Dandenong Rd serves Alfred and St Kilda South, but Toorak Road improves funding prospects
Economics	-	✓✓		Toorak Road provides a similar level of benefits for a significantly lower cost
Risk	××	××		Toorak Road has greater implementation risk, but Dandenong Road has greater business case/ funding risk
Overall	✓✓	✓✓✓		

✓ - Advantage; - Neutral, × Disadvantage

6.3 MCA Recommendation

Recommendation

The key recommendations from the Multi-Criteria Assessment are:

- That the MM2 Toorak Rd alignment option from Domain to South Yarra, without a metro station, be adopted as the preferred MM2 option.*
- Progress the design of the preferred MM2 alignment between Domain and South Yarra along Toorak Road and enabling works as part of the continued development of the Melbourne

Metro Project

- Progress community and stakeholder consultation on preferred MM2 alignment option as part of continued development of Melbourne Metro Project.

7 Staging Options Assessment

As the shorter Toorak Road MM2 alignment option involves only around 1km of additional tunnelling length to the MM1 project, a key consideration in adopting Toorak Rd as the preferred MM2 alignment concerns the level of construction synergies that would be associated with delivering both MM1 and MM2 as a single project. An investigation into staging options of the Melbourne Metro project has been undertaken to assess this issue. This review of staging options for Melbourne Metro has considered four staging scenarios:

- Termination of the MM1 project at Domain with provision of a bifurcation structure to keep both the “short” and long” MM2 tunnel options open;
- Construction of the short tunnel (without a South Yarra Metro station) as part of the MM1 project;
- Termination of the MM1 project at Domain and construction of the MM2 short tunnel (without a South Yarra Metro station) as a separate, later project; and,
- Termination of the MM1 project at Domain and construction of the MM2 long tunnel as a separate, later project (drawing on an update of the earlier cost estimates reflecting lessons learnt from the MM1 concept development).

The delivery of MM1 and MM2 short tunnel as a single project would allow the underground cross-over at Domain to be eliminated as well as construction efficiencies associated with continuous tunnelling. This produces an overall project cost saving of 30(1) compared to stand-alone delivery.

The capacity benefits associated with the MM2 Toorak Road alignment depend on other works to upgrade of the Dandenong corridor. The MM2 (providing increased inner city capacity) will enable the operation of longer trains on the DRC and through inner Melbourne, and together with a range of corridor upgrade works (including level crossing elimination and re-signalling) provides a significant uplift in capacity.

The design of the Domain station for the MM1 project could be modified to enable flexibility with respect to both the Dandenong Road and Toorak Road MM2 alignment options. The design of Domain would be reconfigured to incorporate a bifurcation box extending a further 140m south of the main station box, allowing the MM2 alignment decision to be deferred until after construction of MM1. This modification is estimated to increase the cost of the MM1 project by 30(1). As this is a significant cost it is recommended that a decision on MM2 alignment be taken in advance of the formal planning for the project commencing.

The incremental cost of these scenarios compared to the MM1 scheme identified in the business case is shown in the table below.

Scenario	Estimated Cost (\$b 2011)
MM1 includes bifurcated terminus Short tunnel delivered with MM1, no station	30(1)

Short tunnel delivered as separate project, no station	
Long tunnel delivered as separate project, no Alfred Station, excludes land/property costs	

Delivery the two projects concurrently would allow major synergies in project development and delivery activities. These include project and business case development, planning and environmental approvals, and procurement and construction synergies.

This option would enable the operation benefits of the full Melbourne Metro tunnel to be realised upon opening, providing a through connection to the Dandenong Corridor for metro services rather than a turn-back “dead-end” station at Domain.

Major overall cost savings can be made if the MM2 Toorak Rd alignment is delivered concurrently with MM2. The benefits of combining the delivery of MM1 and MM2 into a single project would allow the underground cross-over at Domain, part of the MM1 project scope, to be eliminated. This would also enable the opportunity to further optimise location and configuration of the Domain station, providing a project saving of up to 30(1) to the cost of MM1⁶. Concurrent delivery of MM1 and MM2 will provide major savings to the MM2 project, principally associated with design and construction costs.

The additional cost to the MM1 project of delivering the MM2 Toorak Road tunnel concurrently with MM1 is 30(1)⁷.

A preliminary assessment of the staging options is provided in Table 20.

⁶ MM1 Extension Study, Aurecon, March 2011 Rev 00

⁷ Aurecon, 2011. Cost based on underground works for Toorak Rd Tunnel alignment without a South Yarra Metro Station (tunnel and portal works to connect to the existing corridor). Surface works on the Dandenong corridor are excluded.

Table 20: Preliminary Staging Options Assessment

Impacts	MM1 and MM2 – Delivery as Stand Along Projects	MM1 and MM2 – Concurrent Delivery	Comment
Metro Tunnel Utilisation	✓	✓✓	Full benefits of MM tunnel will only be realised when MM2 comes on-line
Operational Functionality & Network Connectivity	✓	✓✓	Concurrent Delivery will allow through-running from the Northern Group to the Dandenong Corridor on tunnel opening. Avoids turn-back at Domain under MM1
Community disruption	xx	x	Community disruption will only occur during a single construction period
Cost Savings	-	✓	Major savings due to development and construction synergies
Risk	xx	x	Co-delivery will reduce overall construction risk. Co-delivery will increase funding requirement for MM1, possibly making it more difficult to secure investment
Overall	x	✓	

✓ - Advantage; - Neutral, x Disadvantage

Recommendation

- That the option to deliver MM1 and MM2 as a single project be considered in the further development of the Melbourne Metro project. Concurrent delivery of MM1 and the preferred MM2 Toorak Road alignment would provide major cost savings and project development and delivery efficiencies, and enable the full benefits of the Melbourne Metro tunnel to be realised on opening.

8 Recommendations

The key recommendations arising from this MM2 Alignment Options Assessment are:

- That the MM2 Toorak Rd alignment option from Domain to South Yarra, without a metro station, be adopted as the preferred MM2 tunnel option.
- Progress the design of the preferred MM2 alignment between Domain and South Yarra along Toorak Road and enabling works as part of the continued development of the Melbourne Metro Project
- Progress community and stakeholder consultation on preferred MM2 alignment option as part of continued development of Melbourne Metro Project.
- That the option to deliver MM1 and MM2 as a single project be considered in the further development of the Melbourne Metro project. Concurrent delivery of MM1 and the preferred MM2 Toorak Road alignment would provide major cost savings and project development and delivery efficiencies, and enable the full benefits of the Melbourne Metro tunnel to be realised on opening.
- Undertake planning approvals for the Melbourne Metro Project that includes the preferred MM2 alignment
- As part of the planning approvals process for Melbourne Metro, undertake stakeholder consultation for the preferred MM2 alignment
- Investigate staging options for the Melbourne Metro Project
- Continue to develop incremental improvements for the Dandenong Corridor through the Metropolitan Rail Upgrade Program and South East Corridor Strategy prior to MM2.