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PUBLIC TRANSPORT, ACTIVE MODE
LINK & CONNECTIVITY STUDY

FISHERMANS BEND

Project No. IS172500

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Improving Connectivity in Fishermans Bend – Phase 3

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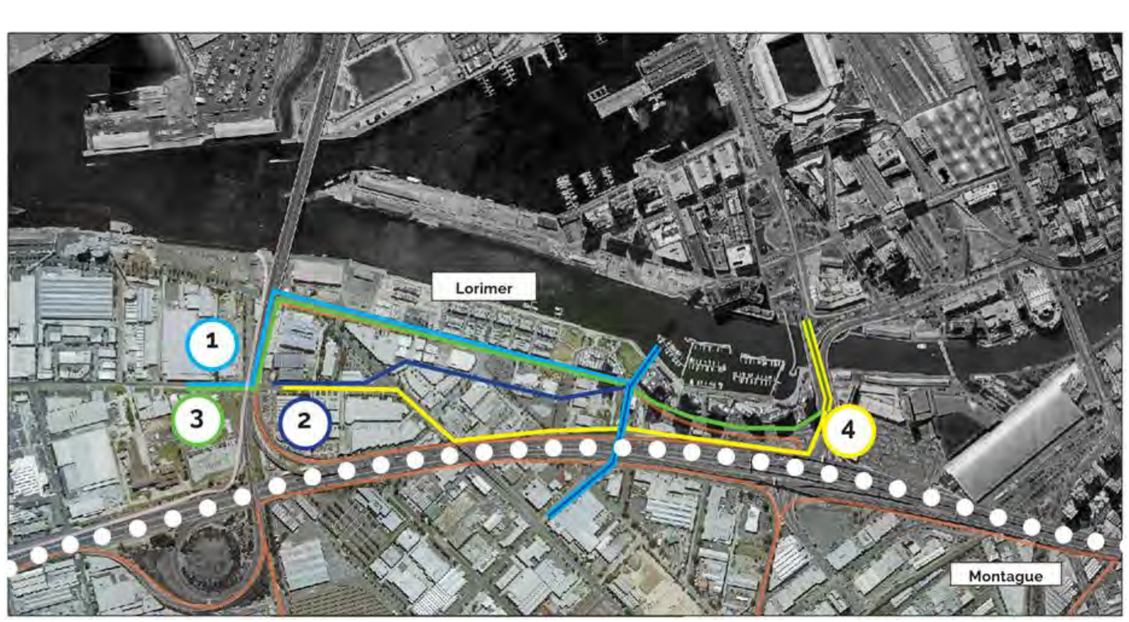
1. Executive Summary

The Fishermans Bend Taskforce is progressing development of a Framework Plan to guide development across Fishermans Bend. An ability for residents and workers to move efficiently within Fishermans Bend precincts will be just as important to the success of the development as being able to effectively move to and from Fishermans Bend. Effective planning to provide high quality, multi-model connections within Fishermans Bend, including across the M1 freeway corridor, will be a key factor in shaping how the precinct evolves over time.

Jacobs was engaged by the Department of Environment, Land, Water and Planning (DELWP) to investigate a range of options for enhancing connectivity for all modes of transport between the various precincts of the emerging Fishermans Bend renewal area. This engagement included three separate phases of work including:

- Assessment and design of feasible options for a number of new and enhanced crossings of the M1 freeway to enhance connectivity between the Fishermans Bend development precincts
- Assessment and design of a range of options for a new public transport route connecting two options for new Yarra River Crossing to both Turner St to the west and to Fennell St to the south.
- Assessment of a number of options for a full new public transport alignment from Collins St in Docklands connecting to both Turner St and Fennell St.

The options for connecting new public transport connections from the Yarra River into routes heading into the Employment and Sandridge/Wirrraway precincts that were designed and assessed during the second phase of work are shown on the map below. All the routes shown were found to be feasible, but were all found to have a range of costs and benefits.



In addition to completing concept designs and costing for the options identified, Jacobs also completed a Multi-Criteria Analysis (MCA) for each route. In summary, whilst the four routes shown above could all be built and would support efficient public transport operations, they each required large sections of elevated structure over roads (Lorimer St in particular) and park land that would have a significant impact on the amenity of the area. To respond to this finding, a new 'fifth alignment' was identified for assessment that would not require large sections of elevated structure over public areas whilst achieving the same connectivity. Jacobs was engaged to progress a 'third phase' designing and assessing this alternative route. The new fifth route is aligned slightly to the west of the earlier Yarra bridge design to support connection to a route over the M1 via Hartley St in the south. This report details the findings of the assessment of this new alignment option.

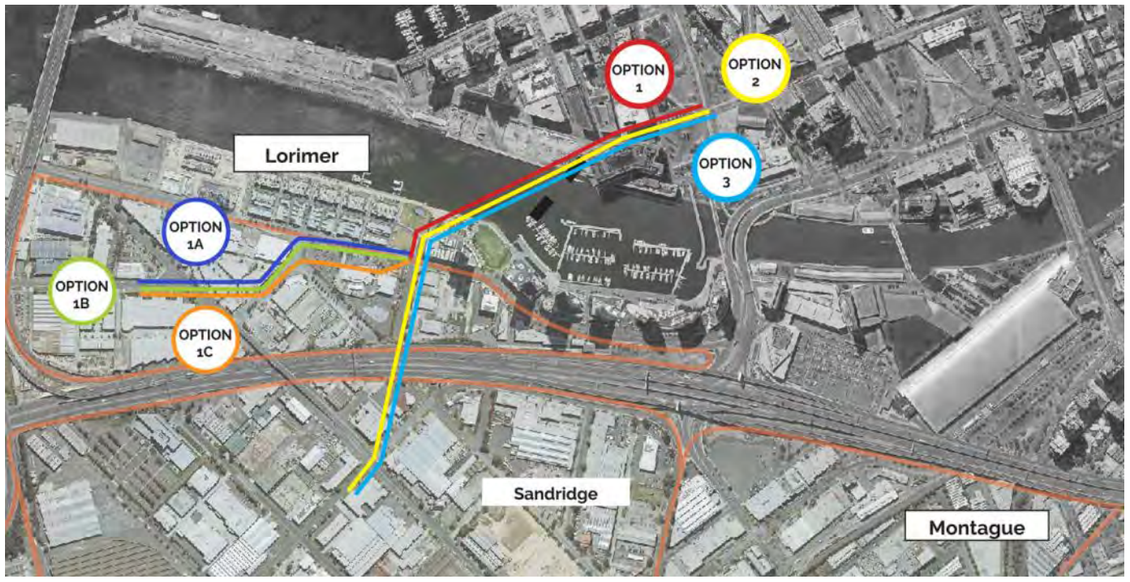
In summary, Jacobs were requested to design and assess the following three (3) new alignment options:

Option 1: Public transport route alignment over the Yarra towards Hartley St connecting with Turner St – three (3) sub options (1A, 1B and 1C) have been considered for the Option 1 route between Lorimer St and Turner St

Option 2: A public transport route alignment over the Yarra towards Hartley St connecting with Fennell St via a bridge over the M1.

Option 3: A public transport route alignment over the Yarra towards Hartley St connecting with Fennell St via a tunnel under the M1.

Jacobs have also assessed the route including a bridge providing either 6 metres or 9 metres clearance over the Yarra River. A map showing the alignment of the 3 'Phase 3' options is shown below.



The assessment of these options identified a range of issues and challenges including the likely impact on existing properties, where the route would need to be on structure and issues associated with accommodating a public transport stop before the route split towards Fennell St and Turner Streets. All options were found to be feasible and involve far less elevated structure. Significantly, unlike the earlier options, a Hartley St alignment can be built with the public transport crossing Lorimer St at grade before crossing the M1 whilst remaining within gradient limits for safe public transport operations. The key variations between the options were in the area of likely impact on property acquisition, impact on road space allocation on Lorimer St and other urban realm outcomes.

A multi criteria assessment process was used to consider the trade-offs between the options and to determine a preferred approach. This process identified that a choice is required across three 'route components' to establish a full preferred route. The choices are:

1. Yarra bridge height – 6m or 9m river clearance?
2. Preferred route alignment for connection from Lorimer St to Turner St?
3. M1 Crossing – bridge or tunnel?

In summary, the MCA found that:

Yarra River Bridge:

From a design perspective, a bridge providing either 9 metres of 6 metres clearance will reach grade on the south side of the Yarra so the height of the clearance has no impact to the south. The key difference between the two bridge heights considered were the level of marine access they provide and the location where the two options are able to reach grade on the north side of the river.

Whilst a bridge providing 9 metres Yarra clearance would be preferred from the perspective of retaining greater waterway access, in particular to the Yarra's Edge Marina development, this improved access was found to be a far smaller benefit than the costs associated with the impacts of alignment of the higher bridge. Specifically, a bridge providing 9 metre clearance of the Yarra, would involve a structure that would reach grade on Collins St, between Navigation Drive and Harbour Esplanade, until after it has crossed over the top of the street to reach the Collins St median. This would result in a large, elevated structure over the top of Collins St overshadowing all surrounding building and the Collins St streetscape. A bridge providing 6 metres clearance can reach grade before arriving at Collins St. Due primarily to far lower impact on the amenity of Collins, **the MCA determined that a bridge providing 6 metres clearance of the Yarra was preferred**.

As part of previous study *Fishermans Bend Public Transport and Active Mode Link: Options Assessment Report* (Jacobs October 2016) and opening bridge had been assessed but this is not part of this study.

Alignment Connecting Public Transport Route from Lorimer St to Turner St:

Three variations of 'Option 1' were considered to connect a public transport corridor from Lorimer St near Hartley St to Turner St to the west. The key difference between the three options considered was the degree of property acquisition required for the alignment compared to the impact on current allocation of space within the existing Lorimer St road reserve. In summary, Option 1A would have no property acquisition impact, however, with the public transport route placed on the south side of Lorimer St, traffic lanes would need to be reduced in width to only 3m wide and eastbound on-street bicycle lane and the existing median area will need to go. The loss of bicycle land would impact the operational functionality of the active transport bridge components by removing an approach route, whilst the removal of the median would result in the loss of all current trees and traffic currently turning right into Yarra's Edge from separated right turn lanes would have to turn right from the traffic lane.

Option 1B would involve some land acquisition (approx. 2m wide strip/400m2 from the front of properties consisting of car parking and vehicle dealership) along the south side of Lorimer St to slightly widen the road reserve. This acquisition would allow for retention of lane width and eastbound on-street bicycle lane and the median strip, but requires removal of one westbound lane. Whilst this option would allow for retention of the central median – a strong positive for the amenity of the area and safety of access to Yarra's Edge – loss of a traffic lane would be a concern due to Lorimer St being the preferred port freight route.

Option 1C would involve a larger acquisition (approx. 10.5m wide strip/2100m2 from the front of properties consisting of car parking and vehicle dealership), with the new public transport route built fully on land of the properties along the south side of Lorimer St, but would allow for retention of all current road space on Lorimer St.

A key factor that impacted the assessment of these options is the current, and continuing, use of Lorimer St as a key heavy freight route connecting Webb Dock to the south west of the project area, to Swanson Dock and the Dynon Rail Yards to the north. The Victorian Government has recently leased the port for 50 years to a private sector operator, which includes planning for further significant expansion of trade through Webb Dock. Without delivery of a substantial (costly) alternative route, the role of Lorimer St as a key connection within the port and rail freight precinct is likely to continue and grow.

Given the importance of the freight route and continued tree retention, maintenance of separate right turn into Foundry Way and retention of existing bike lane provision, **the MCA found that Option 1C, which provides for retention of the existing level of road space on Lorimer St, was on balance the preferred option**.

Crossing of the M1 Freeway:

Route Options 2 and 3 provided alternative approaches for connecting the public transport route from Lorimer St, via Hartley St, to Fennell St on the south side of the freeway. The key difference between the two options was that Option 2 would provide this link through a bridge structure over the M1 whilst Option 3 would involve a tunnel under the freeway. The horizontal alignments for both options are identical.

Jacobs prepared full, feasible concept designs for both options. Following confirmation of the geological conditions in the area and the resultant clearances below the freeway required to build a safe tunnel, it became clear that a tunnel arrangement would not be feasible from a tram operating perspective. Trams operate at maximum gradients around 6%. In order to have a tram at grade at Lorimer St and Fennell St, grades within the tunnel of 18 - 20% would be needed. A tram cannot operate at these grades.

In summary, before any consideration of the alterative amenity or connectivity outcomes offered by a tunnel relative to a bridge, **the MCA determined that a tunnel was not a feasible operational option for a new tram route between Hartley St and Fennell St. A bridge is clearly the preferred option.**

Summary MCA result for the Full Phase 3 Route:

Combining the outcomes of consideration across the three route components, the MCA process concluded that the preferred route for a public transport corridor from Collins St connecting to Turner St and to Fennell St was via a bridge providing 6 metres clearance over the Yarra, connecting to a route to Turner St via a new easement fully within land acquired from properties on the south side of Lorimer st and, thirdly, connecting from Lorimer St to Fennell St via Hartley St and a bridge over M1.

Contents

2. Introduction

2.1 Project Objectives and Outputs

The Objectives of Phase 3 are to:

1. Assess a range of options for a new public transport corridor connection from Collins St in Docklands over the Yarra River to connect to Turner St and to Fennell St via Hartley St.
2. Deliver high level costed, concept designs for all assessed, feasible options.
3. Identify a preferred approach.

Key outputs of Phase 3 included in this report are:

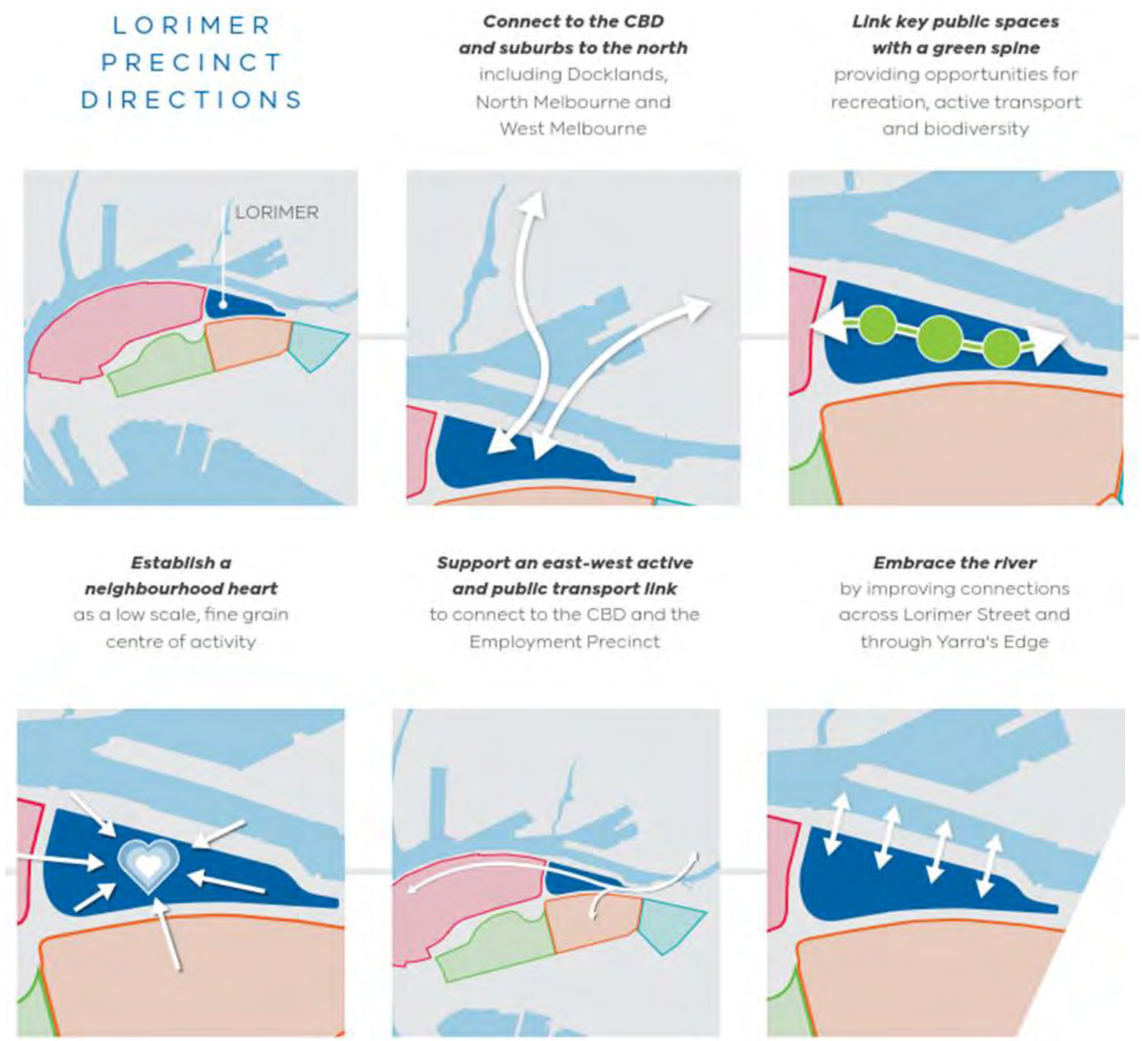
1. Consideration of options for improving connections within the development area across the Yarra River and West Gate Freeway corridor including:
   - High level concept and structural designs
   - Costing for feasible options
2. For the each option, advice is provided on:
   - Any factors limiting feasible design
   - Structural considerations
   - Clearances required and/or provided for
   - Necessary grade transitions to maintain reasonable grades for public transport, pedestrians and bike riders
   - Urban Design Considerations including impact on existing property boundaries and opportunities to support development
   - Indicative cost of feasible options
3. Multi Criteria Assessment of three options for connecting a potential light rail/rapid bus service from the Yarra to Turner Street and across/under the West Gate Freeway to connect to the Fennell St/Fennell St corridor.

2.2 Background and Context

During 2016 the Fishermans Bend Taskforce initiated a range of studies assessing transport options and requirements to support the future development across the five precincts of the Fishermans Bend renewal area. The recently released 'Vision September 2016' for the area sets out five distinct stories for each part of the renewal area. The vision also sets out some clear aspirations for the role Government sees transport playing to support and shape development. Fishermans Bend is expected to be home to as many as 80,000 people by 2050 in addition to more than 60,000 jobs. For this level of development to occur, Fishermans Bend will need to be an area that is accessible from across Melbourne – equally important, will be an ability to move seamlessly around Fishermans Bend itself. The vision also sets an 80% target for trips by walking, cycling and public transport.

Jacobs was engaged by the Department of Environment, Land, Water and Planning (DELWP) to investigate a range of options for enhancing connectivity for all modes of transport between the various precincts of Fishermans Bend. As a part of this work, Jacobs was also directed, as part of a second phase of work, to test a range of options for connecting new public transport connections from the Yarra River into routes heading into the Employment and Sandridge/Wirrraway precincts. During the second phase of work, a number of key challenges with the options being considered emerged including, most significantly, that any of the proposed routes would require extensive sections of route on structure above Lorimer St, significantly impacting the future amenity of the area.

This outcome would also be inconsistent with the directions identified for the Lorimer Precinct in the 2016 Final Vision for Fishermans Bend, which are shown below. Goals around 'linking public space' and 'establishing a community heart' in particular would be difficult to achieve with elevated structures dividing the precinct into separated zones.



In response to the findings of Phase 2, the Department engaged Jacobs to assess a further alignment across the river and towards the Sandridge precinct via Hartley St. This report details the findings of this work, including a range of concept designs for delivering a new public transport route via Hartley St and a Multi Criteria Assessment of all the options considered to identify a preferred approach. This further alignment across the river and via Hartley Street

should be considered alongside those assessed in the Jacobs report ‘Fishermans Bend Public Transport and Active Mode Link: Options Assessment Report’ September 2016.

3. Summary of Phase 3 – Alternate Public Transport Route Assessment

In September 2016, as part of a study assessing a range of options for new connection over the M1 within FIshermans Bend, DELWP engaged Jacobs to investigate four (4) options for connecting a new public transport corridor and shared path crossing of the Yarra River to a new bridge or tunnel crossing the M1 freeway into Fennell Street. Following conclusion of this work, the department requested that Jacobs consider an additional alignment, which would connect over the M1 via Hartley St, also requiring an alternate alignment for a new crossing over the Yarra.

In summary, Jacobs were requested to design and assess the following three (3) alignment options:

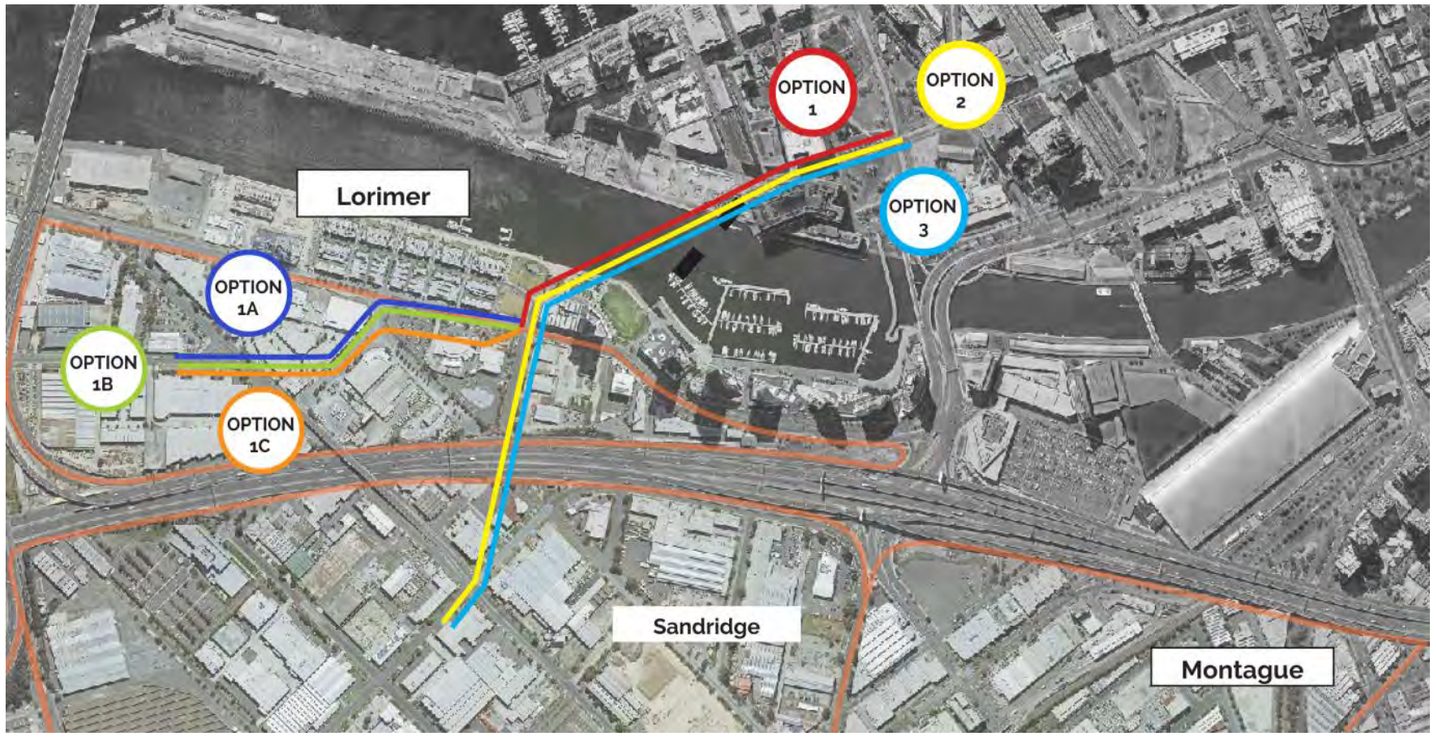
Option 1: public transport route alignment over the Yarra towards Hartley St connecting with Turner St – three (3) sub options (1A, 1B and 1C) have been considered for the Option 1 route between Lorimer St and Turner St

Option 2: A public transport route alignment over the Yarra towards Hartley St connecting with Fennell St via a bridge over the M1.

Option 3: A public transport route alignment over the Yarra towards Hartley St connecting with Fennell St via a tunnel under the M1.

A map showing the alignments of these 3 options is shown below at **Figure 4.1.** In addition to assessing these three route options, two options for the bridge over the Yarra were also considered – one providing nine (9) metres clearance over the Yarra and one providing six (6) metres clearance. Costings were also prepared for two structural variations of the 6 metre clearance bridge.

Figure 4.1: Options Assessed During Phase 3



For each option that was designed and assessed, commentary is provided on:

- Concept design for feasible designs – Detailed drawings for all concept designs can be found at **Appendix A** and **Appendix B**
- Factors limiting feasible design
- Structural considerations
- Clearances required and/or provided for
- Necessary grade transitions to maintain reasonable grades for public transport, pedestrians and bike riders
- Urban Design Considerations including impact on existing property boundaries and opportunities to support development – 3D Urban design imagery showing the alignment, and the new crossing of the Yarra in particular, can be found at **Appendix C**.
- Indicative cost of feasible options - A full table setting out the detailed costing for each option can be found at **Appendix D**.

Following the design work phase, Jacobs undertook a multi criteria assessment (MCA) of the options considered. The MCA was structured around considering the choices available for the three components needed for a complete route. Route components choices assessed through the MCA were:

- **Route Component 1** – Yarra River Bridge – 6m clearance or 9m clearance
- **Route Component 2** – Option 1A, B or C - preferred route Lorimer St to Turner St
- **Route Component 3** – Option 2 or 3 – Tunnel or bridge connecting Hartley St to Fennell St

Chapters 4, 5 and 6 describe the results of design work across the three route components. The outcomes of the MCA process are detailed in Chapter 8.

4. Assessment of Route Component 1 - Alternative Yarra Bridge Height Options

4.1 Bridge over the Yarra River providing 6 metre clearance

	Findings
Concept design for feasible designs	Yarra River Crossing – Elevated structure, public transport corridor, single bicycle lane and single footpath corridor (3m wide bi-direction facilities for bicycle and footpath user) Lorimer Street Crossing – at grade signalised intersection Small scale images of the concept designs for this option are shown below **Figure 4.1**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	The available width between the existing building at 833 Collins Street and proposed building at 839 Collins Street is a key limiting factor of the level of connectivity which could be provided via this route as it is considered impractical to fit access for public transport dual bicycle and footpath corridors. Future development of alignment would be required once exact extent of existing and proposed buildings are confirmed. Impact on DDA (Disability Discrimination Act) accessibility due to bridge gradients. Visual impacts on elevated public transport corridor in close proximity to existing and proposed buildings.
Structural considerations *Incl. constructability, maintenance, reasons for proposed structure etc.*	Two potential options were considered for the Yarra River Crossing between Collins Street and Hartley Street. The first option is a cable stayed bridge featuring a single-tower, unsymmetrical design with span lengths of 81.5m and 40m. The bridge deck is carried by a systems two planes of stays of a harp configuration and anchored in the upper half of the pylon. This option provides a minimum of 81.5m of horizontal clearance and 6m of vertical clearance for navigational traffic. Super T girder type bridge with 20m typical spans has been proposed for the approach viaducts on both sides. The second option is a multi-span super T structure spanning the entire Yarra River with a typical span in the range of 25m to 30m. Although this option would provide a 55m navigational clearance at least one pier will be located within this navigational zone. Whilst it would be relatively expensive to construct the Cable Stayed Bridge, it would offer the following advantages over the super T girder bridge: • Aesthetically pleasing design. • Increased clear horizontal clearance. • Hydrologic benefits within the river with the reduced number of bridge piers in the Yarra River Minimal disruption to navigational traffic during construction.
Clearances required	Yarra River = highest astronomical tide (0.524m AHD = 1.04m CD) + 0.5m freeboard + 0.2m sea level rise by 2040 + 6m clearance to underside of structure
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Maximum/actual vertical gradient of 6.67% for all tram corridors. Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Any matters to consider in connecting this bridge into the proposed future road network	The proposed structure supports delivery of the transport vision for Fishermans Bend. However, car traffic is unlikely to be feasible to accommodate.

Urban Design Considerations including impact on existing property boundaries and opportunities to support development	The 6m bridge urban impact to Collins Street on the north bank occurs in the restrictive open space between the two mixed used Lend Lease developments of 833 Collins Street (an ANZ building) and 839 Collins Street (currently under construction). A revised stepped landscape plaza could be designed to interface with the bridge slope to reduce impact but because of limited space the urban design quality of existing buildings ground level could be affected. A further more detailed urban study is required with stakeholders to confirm the bridges impact. North bank active access along riverbank under the proposed bridge will be maintained. The asymmetrical suspension bridge structural option for the Yarra crossing enables better visibility along the river corridor at eye height with a potential reduction in bridge deck depth and number of support columns required. A more conventional bridge structure will have an adverse effect of river view corridor increase structural members required. If this bridge option is considered viable it is suggested that the Government run an open architectural design competition run by the OVGA (Office of the Victorian Government Architect) and Architects Institute to maximise the bridge projects design outcome which will enhance to the urban amenity of the Yarra. The impact on the south bank of the Yarra River edge and the proposed bridge interface to the open space and proposed Mirvac developments is that space is potentially tight. Currently there is a-proposal of a Mirvac new apartment tower on the eastern side of the existing townhouses on Wharf Drive next to the river. A further urban study is required with stakeholders to confirm in detail the layout of the ground floor of the proposed tower and its interface and clearances with the proposed tram on the southern end of the Yarra River and active link corridor. 3D architectural designs of this option can be found at Appendix C
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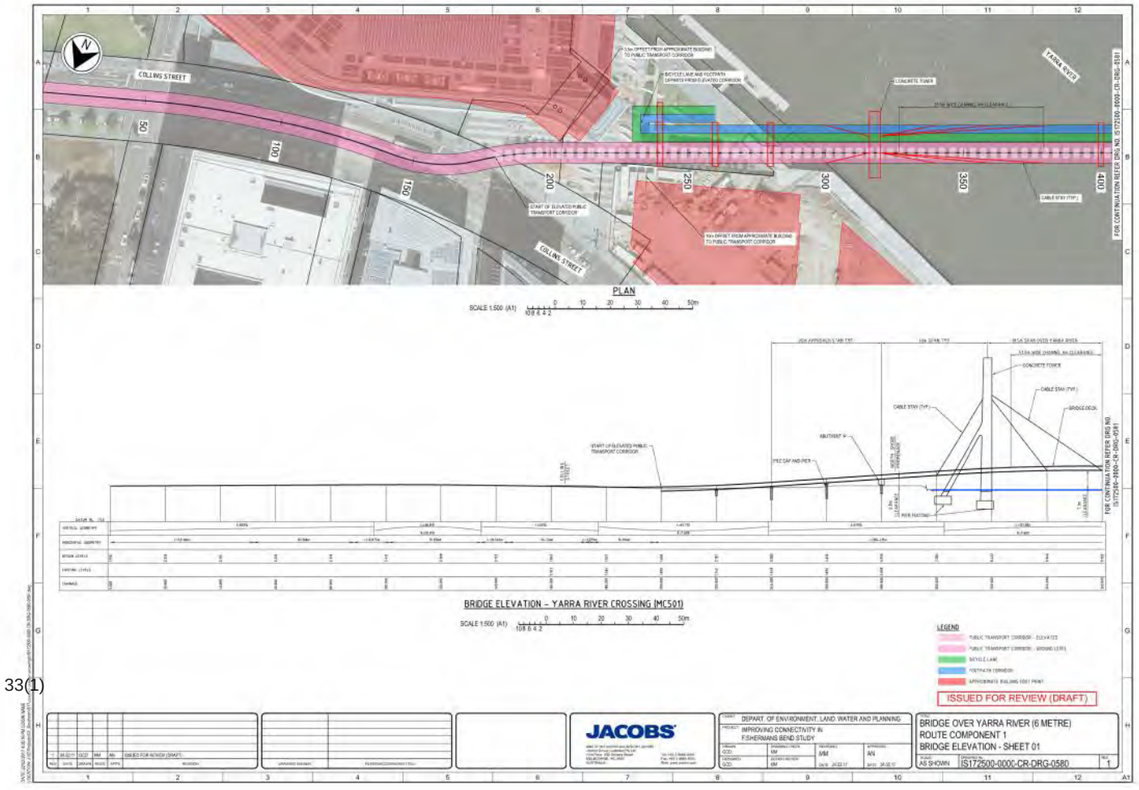
Figure 4.1: Indicative concept design of Yarra Bridge 6m clearance



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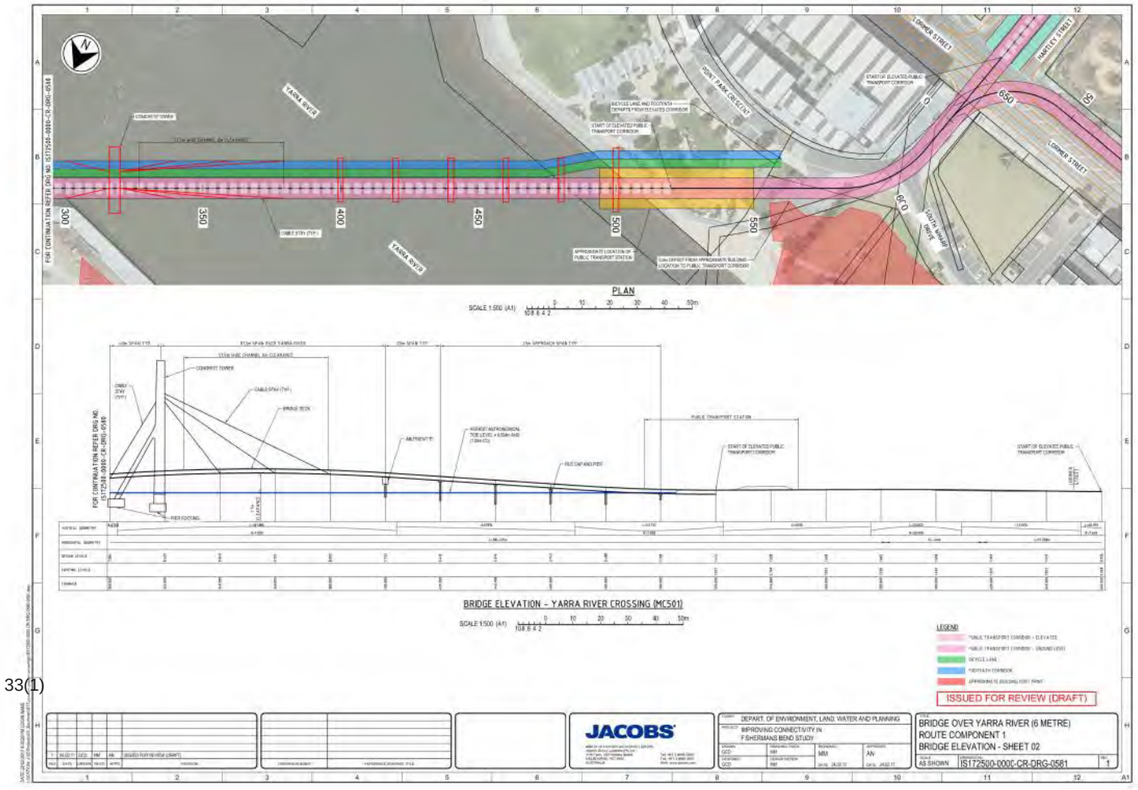

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4.2 Bridge over the Yarra River providing 9 metre clearance

	Findings
Concept design for feasible designs	Yarra River Crossing – Elevated structure, public transport corridor, single bicycle lane, single footpath corridor (3m wide bi-direction facilities for bicycle and footpath users) Lorimer Street Crossing – at grade signalised intersection Small scale images of the concept designs for this option are shown below **Figure 4.2**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	The available width between the existing building at 833 Collins Street and proposed building at 839 Collins Street is a key limiting factor of the level of connectivity which could be provided via this route as it is considered impractical to fit access for public transport dual bicycle and footpath corridors. Future development of alignment would be required once exact extent of existing and proposed buildings are confirmed. Impact on DDA (Disability Discrimination Act) accessibility due to bridge gradients Relocation of existing Collins Street tram stop to the east Realignment of existing Collins Street traffic lanes to accommodate through traffic and tram movements and tram ramp up to bridge over the Yarra River, possible removal of on street parking spaces. Visual impacts on elevated public transport corridor in close proximity to existing and proposed buildings
Structural considerations *Incl. constructability, maintenance, reasons for proposed structure etc.*	Two options were designed for a bridge providing 9m clearance over the Yarra in addition to the 6m clearance structures. However, whilst taller substructures and longer approach spans of elevated super T structures to reach 9 m clearance would be needed, the 9 metres clearance bridge is otherwise structurally identical to the designs for the 6 metre clearance bridge.
Clearances required	Yarra River = highest astronomical tide (0.524m AHD = 1.04m CD) + 0.5m freeboard + 0.2m sea level rise by 2040 + 9m clearance to underside of structure
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Maximum/actual vertical gradient of 6.67% for all tram corridors. Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Urban Design Considerations including impact on existing property boundaries and opportunities to support development	The 9m high bridge option has a significant urban impact to Collins street on the north bank with the elevated bridge slope negatively affecting the amenity of the streetscape between Merchant Street and Navigation Drive. The elevated bridge height also have a very large impact to the urban quality of the open landscaped space between the mixed used Lend Lease developments of 833 Collins Street (an ANZ building) and 839 Collins Street (currently under construction). North bank active access along riverbank under proposed bridge will be maintained. The asymmetrical suspension bridge structural option for the Yarra crossing enables better visibility along the river corridor at eye height with a potential reduction in bridge deck depth and the number of support columns required. A more conventional bridge structure will have an adverse effect of river view corridor with an increase in structural members required. The impact on the south bank of the Yarra River edge and the proposed bridge interface to the open space and proposed Mirvac developments is that space is potentially tight. The

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5. Assessment of Route Component 2 – Connection from Lorimer St to Turner St

5.1 Option 1A

	Findings
Design Description	Lorimer Street Crossing – at grade signalised intersection. Connection to Turner St via Rogers St and existing access way Public transport corridor along southern side of Lorimer Street Lorimer Street lane configuration maintained (4 traffic lanes, 2 lanes eastbound, 2 lanes westbound) Reduction in lane widths to 3m Removal of existing central median, protected right turn lane, on street parking and cycle lanes Rogers Street lane reconfigured, 2 lanes with central median removed and public transport corridor on eastern side Small scale images of the concept designs for this option are shown below **Figure 5.1**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	Reduction in lane widths of Lorimer Street, increase safety risk to travelling vehicles Increase in intersection timings due to public transport movements therefore increasing travel times along Lorimer Street Change in access to Yarra's Edge properties due to removal of central median (ie. Vehicles having to wait in the travel lane to turn right) into Foundry Way. Increased safety risk of waiting vehicles conflicting with through movement traffic along 60km/h road. Lorimer St is a preferred freight route connecting heavy vehicles to Webb Dock. Jacobs was advised this use is likely to remain for some years. Retention of current road capacity (incl. lane widths) is therefore preferred.
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Actual vertical gradient to follow existing levels which are quite flat Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
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5.2 Option 1B

	Findings
Concept design for feasible designs	Lorimer Street Crossing – at grade signalised intersection. Connection to Turner St via Rogers St and existing access way Public transport corridor along southern side of Lorimer Street with minor property acquisition (approx. 2m wide strip/400m2 from the front of properties consisting of car parking and vehicle dealership) Lorimer Street reconfigured (3 traffic lanes, 2 lanes eastbound, 1 lanes westbound) Lane widths, central median, on street parking and cycle lanes maintained Rogers Street lane reconfigured, 2 lanes with central median removed and public transport corridor on eastern side Small scale images of the concept designs for this option are shown below **Figure 5.2**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	Removal of one westbound traffic lane therefore reducing capacity Reduction in southern footpath widths (approx. 6m existing width to 3m) Increase in intersection timings due to public transport movements therefore increasing travel times along Lorimer Street Minor property acquisition along southern side of Lorimer Street Lorimer St is a preferred freight route connecting heavy vehicles to Webb Dock. Jacobs was advised this use is likely to remain for some years. Retention of current road capacity (incl. lane widths) is therefore preferred.
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Actual vertical gradient to follow existing levels which are quite flat Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Urban Design Considerations including impact on existing property boundaries and opportunities to support development	The Option 1B Lorimer street route with the addition of tram corridor requires some acquisition of land along the south side of Lorimer St, but does allow for retention of the existing medium strip with street trees which is a significant positive for urban amenity. Like for Option 1A, the location of the tram corridor to the southern edge of Lorimer Street will potentially affect vehicle driveway accessibility and pedestrian access thus reducing the precincts urban quality. Lorimer Street is an arterial and driveway access is not preferred along these routes.
	Exempt

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5.3 Option 1C

	Findings
Concept design for feasible designs	Lorimer Street Crossing – at grade signalised intersection. Connection to Turner St via Rogers St and existing access way Public transport corridor along southern side of Lorimer Street with major property acquisition (approx. 10.5m wide strip/2100m2 from the front of properties consisting of car parking and vehicle dealership) Lorimer Street lane configuration maintained (4 traffic lanes, 2 lanes eastbound, 2 lanes westbound) Lane widths, central median, on street parking and cycle lanes maintained Rogers Street lane reconfigured, 2 lanes with central median removed and public transport corridor on eastern side Small scale images of the concept designs for this option are shown below **Figure 5.3**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	Increase in intersection timings due to public transport movements therefore increasing travel times along Lorimer Street Major property acquisition along southern side of Lorimer Street Reduction in footpath widths (approx. 5m existing width to 4m) Lorimer St is a preferred freight route connecting heavy vehicles to Webb Dock. Jacobs was advised this use is likely to remain for some years. Retention of current road capacity (incl. lane widths) is therefore preferred.
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Actual vertical gradient to follow existing levels which are quite flat Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Urban Design Considerations including impact on existing property boundaries and opportunities to support development	The Option 1C Lorimer street route with the addition of tram corridor requires significant acquisition of land along the south side of Lorimer St, but does allow for retention of the existing medium strip with street trees which is a significant positive for urban amenity. This arrangement also retains all current road space which supports future allocation of additional space for active modes. Like for Option 1A and 1B, the location of the tram corridor to the southern edge of Lorimer Street will potentially affect vehicle driveway accessibility and pedestrian access thus reducing the precincts urban quality. It is noted, however, that indicative precinct plans for the area propose new open space in this location which would reduce the access problems that would arise under the existing property arrangements.

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6. Assessment of Route Component 3 – Options for Connecting from Lorimer St to Fennell St

6.1 Option 2 – Connection to Fennell St via a bridge over the M1

	Findings
Concept design for feasible designs	Lorimer Street Crossing – at grade signalised intersection Hartley Street - reduction to single lane one way loop (in the short term_- with options to widen bridge when future access arrangement are delivered). West Gate Freeway Crossing – Elevated structure, public transport corridor, shared user corridor (separate bicycle lanes and footpath corridor could be provided for additional cost) West Gate Freeway to Fennell Street - Elevated structure grading to ground level, public transport corridor, bicycle lanes, footpath corridor Small scale images of the concept designs for this option are shown below **Figure 6.1**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	Impact on DDA (Disability Discrimination Act) accessibility due to bridge gradients Visual impacts on elevated public transport corridor in close proximity to existing and proposed buildings. These impacts could be reduced in the future with the integration of new developments into the new bridge structure to remove the level difference at access points.
Structural considerations *Incl. constructability, maintenance, reasons for proposed structure etc.*	The proposed crossing over the M1 is a cable stayed bridge featuring a single-tower, unsymmetrical design with span lengths of 101.5m and 40m as depicted in drawing 0555. The bridge deck is carried by a systems two planes of stays of a harp configuration and anchored in the upper half of the pylon. This option provides a minimum of 5.9m of vertical clearance over the M1. Super T girder type bridge with 20m typical spans has been proposed for the approach viaducts on both sides. The main span of the bridge clears the entire M1 corridor and could be constructed with minimal disruption to M1 traffic.
Clearances required	West Gate Freeway = 5.9m minimum clearance to underside of structure
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Maximum/actual vertical gradient of 6.67% for all tram corridors. Desirable minimum vertical radius of 760 m. Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Any matters to consider in connecting this bridge into the proposed future road network	The proposed structure supports delivery of the transport vision for Fishermans Bend. However, car traffic is unlikely to be feasible to accommodate.
Urban Design Considerations including impact on existing property boundaries and opportunities to support development	The proposed M1 bridge slope on Hartley street will have a negative amenity impact on the existing buildings. There is an opportunity that the medium term re-development of these blocks (which are east and west of Hartley Street) have a potential to integrate the new development into this bridge approach slope like the current Collins Street extension past Spencer Street in Melbourne's CBD. The southern slope of the M1 will require land acquisitions in the block bounded by Fennell Street, Ingles Street and Anderson Street. The medium term re-development of the new blocks (which are east and west of the sloping M1 bridge) also have the potential to integrate the new development into this bridge approach slope. A new five way intersection is required at Fennell Street unless additional road closures are proposed. A suspension bridge over the Westgate Freeway (M1) is a more buildable option compared to a conventional bridge due to the reduced interference in the continual operation of this important road link. An asymmetrical tower suspension bridge will have less urban design impact to the surrounds streets than a more conventional twin towers to the north and south

	of the M1 freeway. If this bridge option is considered viable it is suggested that the Government run an open architectural design competition run by the OVGA (Office of the Victorian Government Architect) and Architects Institute to maximise the bridge projects design outcome which will enhance to the urban amenity of the precinct.

Exempt

Exempt

33(1)

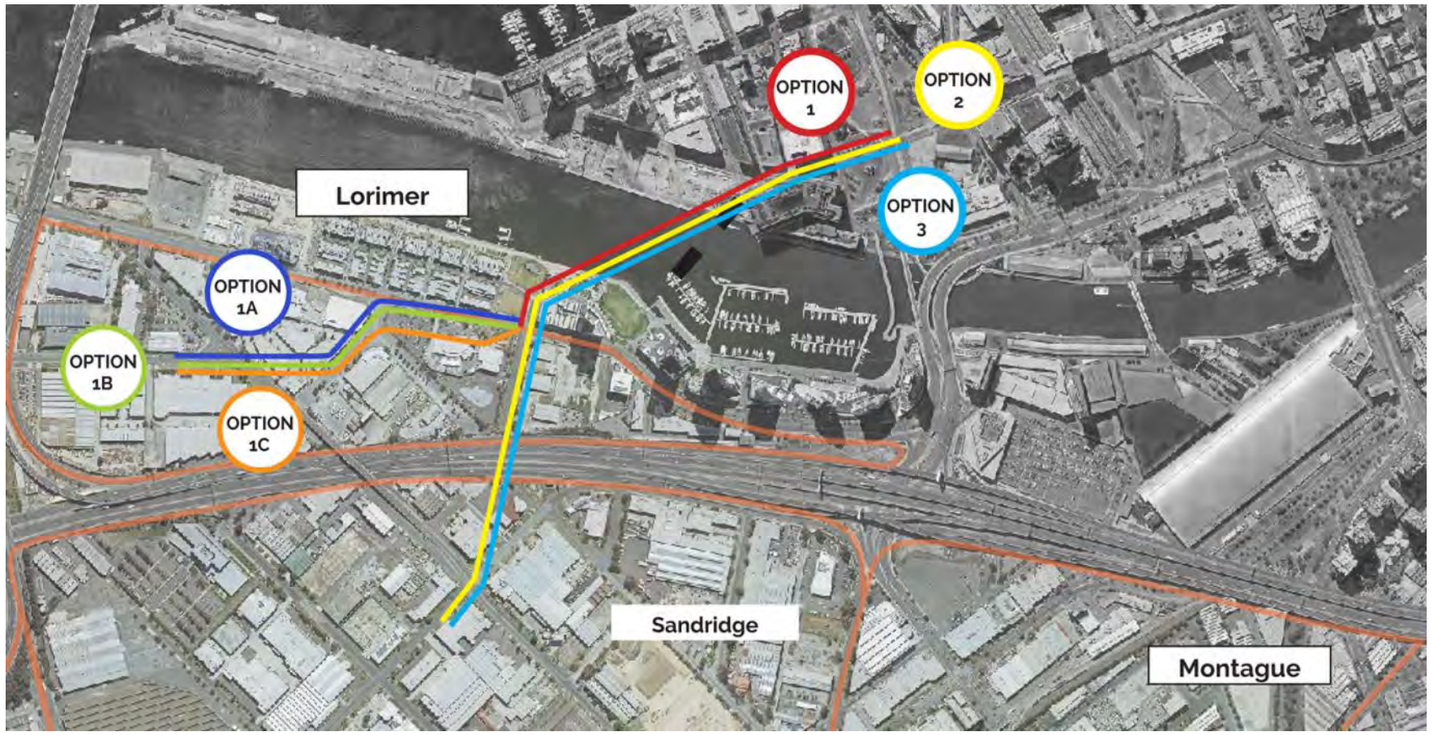
6.2 Option 3 – Connection to Fennell St via a Tunnel under the M1

Detailed notes detailing the work towards development of tunnel option concept designs can be found at **Appendix E**.

	Findings
Concept design for feasible designs	Lorimer Street Crossing – at grade signalised intersection Hartley Street - reduction to single lane one way loop West Gate Freeway Crossing – Tunnelled structure, public transport corridor, shared user corridor West Gate Freeway to Fennell Street - Tunnelled structure grading to ground level, public transport corridor, bicycle lanes, footpath corridor Small scale images of the concept designs for this option are shown below **Figure 6.2**. Large scale images of these designs can be found in **Appendix A**. Additional, more detailed drawings of particular route components are shown in **Appendix B**.
Factors limiting feasible design	Extreme gradients required to achieve the invert of tunnel (controlled by the structure cover, required structure, ventilation and fire services) Impact on DDA (Disability Discrimination Act) accessibility due to tunnel gradients Visual impacts on tunnelled public transport corridor in close proximity to existing and proposed buildings
Structural considerations *Incl. constructability, maintenance, reasons for proposed structure etc.*	Extensive notes detailing the work towards design of tunnel option concept designs can be found at **Appendix E.**
Clearances required	Tunnel Option 1(refer Figure 3) = 5m minimum clearance to obvert of tunnel box from West Gate Freeway, 8m minimum clearance within tunnel for public transport corridor Tunnel Option 2 (refer Figure 4) = 6m minimum clearance to obvert of tunnel box from West Gate Freeway, 8m minimum clearance within tunnel for public transport corridor Tunnel Option 3 (refer Figure 5) = 6m minimum clearance to obvert of tunnel box from West Gate Freeway, 8.962m minimum clearance within tunnel for public transport corridor
Necessary grade transitions to maintain reasonable grades for trams, pedestrians and bike riders	Maximum vertical gradient of 6.67% for all tram corridors. • Actual maximum vertical gradient of 20.35% (6m minimum clearance to obvert of tunnel box from West Gate Freeway) which exceeds Yarra Tram guidelines Desirable minimum vertical radius of 760 m. • Actual minimum vertical radius of 235m which exceeds Yarra Tram guidelines Minimum horizontal main line radius of 350 m. Minimum horizontal city street radius of 25 m.
Any matters to consider in connecting this tunnel into the proposed future road network	The proposed structure does not support delivery of the transport vision for Fishermans Bend. It's noted that bicycles, pedestrians and vehicle traffic is unlikely to be feasible to accommodate.

Urban Design Considerations including impact on existing property boundaries and opportunities to support development	A tunnel under the M1 for will be have a negative impact to the active connections (cyclists and pedestrians) due to the CPTED (Crime Prevention through Environmental Design) issues of the lack of passive urban supervision for the users compared to a bridge over option. Increased acoustic issues of a tram and active users sharing same tunnel would reduce user amenity and would potentially lead to creation of two separate tunnels. The open slope down into the tunnel at the north and south end will have a negative to existing streetscape and reduce the urban design outcomes of these areas through the longer term redevelopment of the precinct.

7. Summary Phase 3 Findings



Assessed Options for new public transport corridor	Summary Description and Assessment
Bridge over Yarra River (6 metre)	• Elevated structure (6 metre river clearance) across the Yarra River from Collins Street to Yarra's Edge consisting of a combination of public transport corridor, single bicycle lane and single footpath corridor (bi-directional) • Minimum structural width of 14.605m • At grade public transport corridor between Yarra River southbank and Lorimer Street • Allows at grade link connecting public transport corridor west along Lorimer Street and Rogers Street towards Turner Street • Over shadow amenities on towers and impact on open space on the north side of the river side around Collins St. • Cable Stay Bridge more costly, but provides superior waterway access and provides more aesthetic benefit relative to a super T bridge arrangement. Hydrologic benefits within the river with the reduced number of bridge piers in the Yarra River. Exempt • **Whilst a 6 metre clearance Yarra bridge would have some impact on amenity near the river banks to the north and south, this impact is considered to be within an acceptable range with use of effective design.**
Bridge over Yarra River (9 metre)	• Public transport corridor grading from ground level to sufficient elevation above Collins Street before turning south to cross the Yarra River • Minimum structural width of 14.605m

	• A bridge providing 9 metre clearance of the Yarra, would involve a structure that would reach grade on Collins St, between Navigation Drive and Harbour Esplanade • Elevated structure (9 metre river clearance) across the Yarra River from Collins Street to Yarra's Edge consisting of a combination of public transport corridor, single bicycle lane and single footpath corridor (bi-directional) • At grade public transport corridor between Point Park and Lorimer Street • Allows at grade link connecting public transport corridor west along Lorimer Street and Rogers Street towards Turner Street • Over shadow amenities on towers and impact on open space at the river side around Collins St and Lorimer St crossing. Exempt • **Similar design and alignment to the 6m clearance bridge which offers advantages in enhanced waterway access to the marina at Yarra's Edge. Critically, however, the higher structure results in a need to keep the route on structure crossing above Collins St before coming to grade within the Collins St median – this would have a significant impact and overshadowing of the streetscape in this location**.
Option 1 - Lorimer Street and Turner Street Option 1A	• At grade reconfigured intersection of Lorimer Street and Point Park Crescent • Realignment of Lorimer Street with removal of central median and reduction in lane widths • Reconfiguration of the intersection of Lorimer Street, Rogers Street and Foundry Way • Realignment of Rogers Street width reduction in carriageway, median and footpath widths, as per others in Option 1 • Maintain existing two lanes east bound and west bound. • Removal of existing on street parking on Lorimer Street • Removal of west bound on-street bicycle lane • No impact on existing property along Lorimer Street • Major property acquisition required for public transport corridor connection from Rogers Street to Turner Street, 30m wide corridor, approx. 3500m2 • Reduction in southern footpath widths (approx. 6m existing width to 3m) • Impact the urban realm in the area along Lorimer Street and Rogers Street Exempt • **Whilst avoiding the need for any property acquisition along Lorimer Street, would result in significant loss of road space including the loss of tree canopy in the median strip and a reduction in lane width to only 3m. Also reduces the safety of access to Yarra's Edge through removal of dedicated right turn space in median. Need to retain Lorimer St as a freight route through to Webb Dock makes any reduction in road space problematic.**
Option 1 - Lorimer Street and Turner Street Option 1B	• At grade reconfigured intersection of Lorimer Street and Point Park Crescent • Removal of single westbound lane of Lorimer Street while maintaining lane widths and central medians • Reconfiguration of the intersection of Lorimer Street and Rogers Street • Realignment of Rogers Street width reduction in carriageway, median and footpath widths, as per others in Option 1 • Maintain existing two lanes east bound of Lorimer Street

	• Removal of existing south side on street parking on Lorimer Street • Removal of west bound on-street bicycle lane • Minor property acquisitions required along southern side of Lorimer Street (approx. 2m wide strip/400m2 from the front of properties consisting of car parking and vehicle dealership) • Major property acquisition required for public transport corridor connection from Rogers Street to Turner Street, 30m wide corridor, approx. 3500m2 • Reduction in existing footpath widths along Lorimer Street (approx. 5m existing width to 4m) • Impact the urban realm in the area along Lorimer Street and Rogers Street Exempt • **Option would require some property acquisition, but would allow retention of the central median and existing lane widths. Need to retain Lorimer St as a freight route through to Webb Dock makes any reduction in road space problematic.**
Option 1 - Lorimer Street and Turner Street Option 1C	• At grade reconfigured intersection of Lorimer Street and Point Park Crescent • Lorimer Street to remain as current: retention of median, on-street bicycle lane, car parking and two traffic lanes in each direction. • Reconfiguration of the intersection of Rogers Street and Boundary Street • Realignment of Rogers Street width reduction in carriageway, median and footpath widths, as per others in Option 1 • Major property acquisition required for public transport corridor connection from Lorimer Street to Rogers Street (approx. 10.5m wide strip/2100m2 from the front of properties consisting of car parking and vehicle dealership) • Major property acquisition required for public transport corridor connection from Rogers Street to Turner Street, 30m wide corridor, approx. 3500m2 • Impact the urban realm in the area along Rogers Street Exempt • **Whilst avoiding the need for any property acquisition, would result in significant loss of road space including the loss of the green space in the median strip. Also reduces the safety of access to Yarra's Edge through removal of dedicated right turn space in median. Need to retain Lorimer St as a freight route through to Webb Dock makes any reduction in road space problematic.**
Option 2 – Lorimer St to Fennell St via Bridge over the M1	• At grade public transport corridor between Point Park and Lorimer Street • Hartley Street - reduction to single lane one way loop • Elevated structure across the West Gate Freeway from Lorimer Street to Fennell Street consisting of a combination of public transport corridor and shared user path widening to a public transport corridor, dual bicycle lane and dual footpath corridor. Current key constraints to separating bicycle and pedestrian pathways are the Hartley Street width and need to retain the access road. These could be removed in future post redevelopment of adjacent sites and widening of bridge. • Major property acquisition required for public transport corridor connection from Lorimer Street to Ingles Street, 21m wide corridor, approx. 3200m2 Exempt • **Whilst bridge alignment would impact existing access on Hartley St, this is considered to be workable. Clear property impact along this alignment on the south side of the M1 as route cuts through to Fennell St.**
Option 3 – Lorimer St to Fennell St via tunnel under the M1	• At grade public transport corridor between Point Park and Lorimer Street

	• Hartley Street - reduction to single lane one way loop • Tunnel structure under the West Gate Freeway from Lorimer Street to Fennell Street consisting of a combination of public transport corridor and shared user path widening to a public transport corridor, dual bicycle lane and dual footpath corridor • Tunnels generally deliver a poor outcome from an active transport perspective – they are rarely popular with users. • Major property acquisition required for public transport corridor connection from Lorimer Street to Ingles Street, 21m wide corridor, approx. 3200m2 Exempt • **Whilst unlikely to provide a strong outcome from an urban amenity or connectivity perspective, design work clearly found that the gradient in and out of the tunnel to allow connect at grade at Lorimer St or Fennell St would be well in excess of allowed guideline limits for either a tram or a bus route. Considered to be generally infeasible as a public transport route option based on this finding.**

8. Phase 3 – Multi Criteria Assessment of Options

The project team developed a Multi Criteria Assessment Framework to provide a basis for assessing each of the options and providing a recommendation for the preferred location and form for the public transport corridor. Details of the chosen criteria used for assessment and ranking approach are further detailed below.

8.1 Criteria

The project team developed assessment criteria that were relevant for this particular project including consideration of how each criterion should be rated. The assessment has been to equally weight each of the criteria. These are detailed in Table 8.1.

Table 8.1: Options Assessment Criteria

Criteria	Rating considerations
Improve transport efficiency	
Travel times along Lorimer Street - vehicles	Impact on travel times for users of Lorimer Street. This is mainly related to the additional delay in through traffic for the public transport corridor turning into the southern side of Lorimer Street or crossing Lorimer Street
Travel times across the Yarra River from FB to CBD - active transport / increased catchment	This considered likely reduction in travel time for active transport users but also the likely increased catchment for users to capture the benefits of additional facilities in new locations and benefits for different areas of Fishermans Bend (users of Lorimer Street versus Montague Street)
Impact on number of on street parking spaces	Impact on on-street parking for users of Lorimer Street
Minimise operating and maintenance costs	
Maintenance costs of the structures	Maintenance costs associated with each option – such as structure to maintain, public transport infrastructure, mechanical equipment associated with bridges and tunnel structures
Maximise accessibility and minimise negative social impacts	
Tram and active mode accessibility	Number and quality of active transport connections to Docklands, open space, Yarra's Edge, South Wharf
Pedestrian and bicycle accessibility	Impact on pedestrian and bicycle access across the Yarra River and West Gate Freeway
Footpath and walkway accessibility	Impact on DDA (Disability Discrimination Act) accessibility due to bridge and tunnel gradients
Marina access to harbour	Impact on access to the Yarra's Edge Marina for boats
Safety risks - conflict points	Number of conflict points with other modes of transport
Impact on open space	Extent of impact on existing public open space in the areas adjacent to the options
Minimise negative environmental impacts	
Visual amenity impacts	Extent of impact on existing views from residential properties adjacent to the Yarra River and along Lorimer Street
Visual amenity impacts	Extent of impact on existing views from properties adjacent along Collins Street
Hydrology impacts	Extent of potential impact on the Yarra River – new piers within the river etc
Noise impacts	Extent of expected impact on noise quality for existing residences adjacent to the route
Minimise constructability challenges	
Structural complexity	Complexity of extent of structural work required for each option
Disruption during construction	Extent of disruption to businesses and traffic during construction of the option
Minimise planning and property impacts	
Planning constraints / land acquisition	Difficult or lengthy planning processes, land acquisition required
Property access	Extent of impact on access to existing properties along the route

8.2 Ranking Approach

Due to the level of detail available for each of the options and to help facilitate a comparison between the options, five ranking levels were used for the assessment so a difference could be shown between two options with positive ratings. These were provided a score. Each of the criteria were rated and then the final scores for each option totalled to show the highest to lowest rated option. The capital costs were not rated as the relative level of capital cost is not the focus of the assessment. A separate high level cost estimate has been provided in Appendix A. Table 8.2 provides the ranking approach used for the assessment.

Table 8.2: Options Assessment Ranking Approach

Rating	What does the rating mean?	Score
High Positive	Strong positive impacts, operational performance, implementable e.g. gains for a large group of users of Fishermans Bend, strong gains for a small group of users of Fishermans Bend	5
Moderate Positive	Moderate positive impacts, operational performance, implementable e.g. moderate gains for some users of Fishermans Bend	4
No impact	relative to other options - not negative / not positive	3
Moderate Negative	Some difficulties, some negative impacts e.g. moderate costs to some users of Fishermans Bend; additional time/money is required to overcome specific issues	2
High Negative	Major constraints, major negative impacts e.g. substantial effort required to overcome issues, potential fatal flaws, costs to a large group of users of Fishermans Bend, high costs to a group of users of Fishermans Bend	1

8.3 Summary of Multi Criteria Assessment Outcome

A summary of the outcomes of the MCA assessment is provided below at **Table 8.3** which summarises the overall rating for each option/variation that was assessed. The MCA process had a core focus on considering the relative trade-offs between the options across the assessment criteria to determine a preferred approach. The MCA was structured around considering the choices available for the three components needed for a complete route. Route components choices assessed through the MCA were:

- **Route Component 1** – Yarra River Bridge – 6m clearance or 9m clearance
- **Route Component 2** – Option 1A, B or C - preferred route Lorimer St to Turner St
- **Route Component 3** – Option 2 or 3 – Tunnel or bridge connecting Hartley St to Fennell St

The outcomes of the assessment are set out below following this route component format to support consideration of options in terms of the decision points that need to be addressed to identify a full preferred alignment.

Table 6.3: Multi Criteria Assessment Table

Criteria	Criteria Rating considerations	Route Component 1 - Yarra River Bridge incl. connection from Collins St to Lorimer St		Route Component 2 - Connection Lorimer St to Turner St			Route Component 3 - Connection Lorimer St to Fennell St	
		Bridge over Yarra River 6 Metre clearance	Bridge over Yarra River 9 Metre clearance	Connection to Turner Street - Option 1A	Connection to Turner Street - Option 1B	Connection to Turner Street - Option 1C	Option 2 - Bridge Over the M1 at Hartley St	Option 3 - Tunnel under West Gate Freeway at Hartley Street
Improve transport efficiency								
Travel times along Lorimer Street - vehicles	Impact on travel times for users of Lorimer Street. This is mainly related to the additional delay in through traffic for the public transport corridor turning into the southern side of Lorimer Street or crossing Lorimer Street	NA	NA	3	2	3	NA	NA
Travel times across the Yarra River from FB to CBD - active transport / increased catchment	This considered likely reduction in travel time for active transport users but also the likely increased catchment for users to capture the benefits of additional facilities in new locations and benefits for different areas of Fishermans Bend (users of Lorimer Street versus Montague Street)	5	5	5	5	5	5	5
Impact on number of on street parking spaces	Impact on on street parking for users of Lorimer Street	NA	NA	2	2	4	NA	NA
Minimise operating and maintenance costs								
Maintenance costs of the structures	Maintenance costs associated with each option – such as structure to maintain, tram infrastructure, mechanical equipment associated with bridges and tunnel structures	3	3	NA	NA	NA	3	2
Maximise accessibility and minimise negative social impacts								
Tram and active mode accessibility	Number and quality of active transport connections to Docklands, open space, Yarra's Edge, South Wharf	4	4	4	4	4	4	4
Pedestrian and bicycle accessibility	Impact on pedestrian and bicycle access across the Yarra River and West Gate Freeway	4	4	NA	NA	NA	4	3
Footpath and walkway accessibility	Impact on DDA (Disability Discrimination Act) accessibility due to bridge and tunnel gradients	2	2	NA	NA	NA	2	1
Marina access to harbour	Impact on access to the Yarra's Edge Marina for boats	2	3	NA	NA	NA	NA	NA
Safety risks - conflict points	Number of conflict points with other modes of transport	2	3	1	2	2	2	2
Impact on open space	Extent of impact on existing public open space in the areas adjacent to the	2	2	NA	NA	NA	3	3

	options							
Minimise negative environmental impacts								
Visual amenity impacts	Extent of impact on existing views from residential properties adjacent to the Yarra River and along Lorimer Street	2	1	3	3	3	2	2
Visual amenity impacts	Extent of impact on existing views from properties adjacent along Collins Street	2	1	NA	NA	NA	2	2
Hydrology impacts	Extent of potential impact on the Yarra River – new piers within the river etc	2	2	NA	NA	NA	2	2
Noise impacts	Extent of expected impact on noise quality for existing residences adjacent to the route	2	2	2	2	2	2	1
Minimise constructability challenges								
Structural complexity	Complexity of extent of structural work required for each option	3	2	3	3	3	3	1
Disruption during construction	Extent of disruption to businesses and traffic during construction of the option	3	2	2	2	3	3	2
Minimise planning and property impacts								
Planning constraints / land acquisition	Difficult or lengthy planning processes, land acquisition required	3	2	3	2	1	3	2
Property access	Extent of impact on access to existing properties along the route	3	3	2	2	3	3	3
RATING		44	41	30	29	33	44	37

In summary, the MCA found that the preferred route includes a 6 metre bridge over the Yarra, Option 1C for the connection from Lorimer St to Turner St and, thirdly, a connection from Lorimer St to Fennell St via a bridge over the M1 Freeway. Key factors which drove this results are summarised below.

Yarra River Bridge:

From a design perspective, a bridge providing either 9 metres of 6 metres clearance will reach grade on the south side of the Yarra so the height of the clearance has no impact to the south. The key difference between the two bridge heights considered were the level of marine access they provide and the location where the two options are able to reach grade on the north side of the river.

Whilst a bridge providing 9 metres Yarra clearance would be preferred from the perspective of retaining greater waterway access, in particular to the Marina at the Yarra's Edge development, this improved access would found to be a far smaller benefit than the costs associated with the impacts of alignment of the higher bridge. Specifically, a bridge providing 9 metre clearance of the Yarra, would involve a structure that would not reach grade on Collins St until after it has crossed over the top of the street to reach the Collins St median. This would result in a large, elevated structure over the top of Collins St overshadowing all surrounding building and the Collins St streetscape. A bridge providing 6 metres clearance can reach grade before arriving at Collins St. Due primarily to far lower impact on the amenity of Collins, **the MCA determined that a bridge providing 6 metres clearance of the Yarra was preferred**.

Alignment Connecting Public Transport Route from Lorimer St to Turner St:

Three variations of 'Option 1' were considered to connect a public transport corridor from Lorimer St near Hartley St to Turner St to the west. The key difference between the three options considered was the degree of property acquisition required for the alignment compared to the impact on current allocation of space within the existing Lorimer St road reserve. In summary, Option 1A would have no property acquisition impact, however, with the public transport route placed on the south side of Lorimer St, traffic lanes would need to be reduced in width to only 3m wide and the existing median area would also need to go. The removal of the median would result in the loss of all current trees and traffic currently turning right into Yarra's Edge from separated right turn lanes would have turn right from the traffic lane. Option 1B would involve some land acquisition along the south side of Lorimer St to slightly widen the road reserve. This acquisition would allow for retention of lane width and the median strip, but requires removal of one westbound lane. Option 1B is also likely to be the most costly of the three option 1s given it would involve new works over the existing kerb area. Whilst this option would allow for retention of the central median – a strong positive for the amenity of the area and safety of access to Yarra's Edge – loss of a traffic lane would be a concern. Option 1C would involve a larger acquisition, with the new public transport route built fully on land of the properties along the south side of Lorimer St, but would allow for retention of all current road space on Lorimer St. Option 1C would also have the lowest construction cost as it could largely be built without great impact on the existing roadway. It is noted however, that the costing undertaken for this study has not considered costs associated with land acquisition, which may be significant for Option 1C.

A key factor that impacted the assessment of these options is the current, and continuing, use of Lorimer St as a key heavy freight route connecting Webb Dock to the south west of the project area, to Swanson Dock and the Dynon Rail Yards to the north. The Victorian Government has recently leased the port for 50 years to a private sector operator, which includes planning for further significant expansion of trade through Webb Dock. Within delivery of a substantial (costly) alternative route, the role of Lorimer St as a key connection within the port and rail freight precinct is likely to grow. Given this **the MCA found that Option 1C, which provides for retention of the existing level of road space on Lorimer St and would have the lowest construction cost, is on balance the preferred option**.

Crossing of the M1 Freeway:

Route Options 2 and 3 provided alternative approaches for connecting the public transport route from Lorimer St, via Hartley St, to Fennell St on the south side of the freeway. The key difference between the two options was that Option 2 would provide this link through a bridge structure over the M1 whilst Option 3 would involve a tunnel under the freeway. The horizontal alignments for both options are identical.

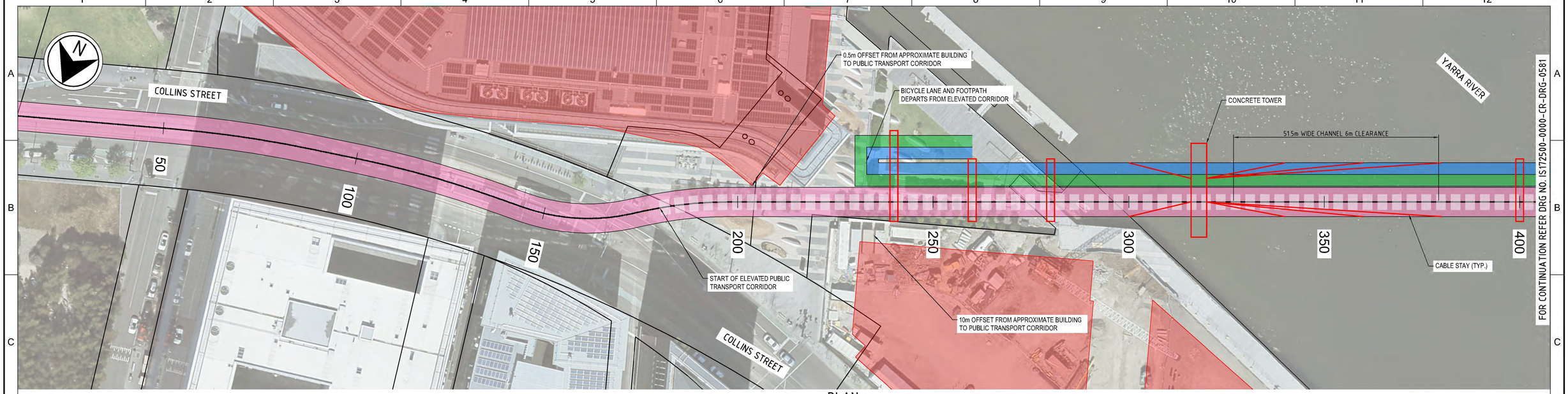
Jacobs prepared full, feasible concept designs for both options. Following confirmation of the geological conditions in the area and the resultant clearances below the freeway required to build a safe tunnel, it became clear that a tunnel arrangement would not be feasible from a tram operating perspective. Trams operate a maximum gradient of 6.67%. In order to have a tram at grade at Lorimer St and Fennell St, grades within the tunnel of 18 -20% would be needed. A tram cannot operate at these grades.

In summary, before any consideration of the alterative amenity or connectivity outcomes offered by a tunnel relative to a bridge, the MCA determined that a tunnel was not a feasible operational option for a new tram route between Hartley St and Fennell St. A bridge is clearly the preferred option.

Summary MCA result for Phase 3:

Combining the outcomes of consideration across the three route components, the MCA process concluded that the preferred route for a tram from Collins St connecting to Turner St and to Fennell St was via a bridge providing 6 metres clearance over the Yarra, connecting to a route to Turner St via a new easement fully within land acquired from properties on the south side of Lorimer st and, thirdly, connecting from Lorimer St to Fennell St via Hartley St and a bridge over M1.

Appendix A. Concept Design Drawings – Route Components



PLAN

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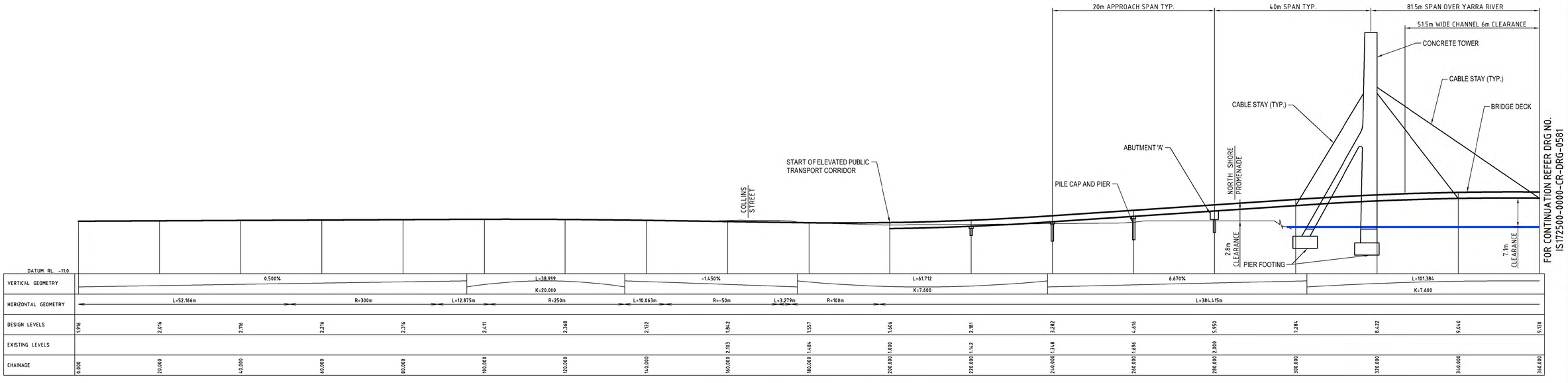


BRIDGE ELEVATION - YARRA RIVER CROSSING (MC501)

SCALE 1:500 (A1) 0 10 20 30 40 50m (10 8 6 4 2)

LEGEND

- PUBLIC TRANSPORT CORRIDOR - ELEVATED
- PUBLIC TRANSPORT CORRIDOR - GROUND LEVEL
- BICYCLE LANE
- FOOTPATH CORRIDOR
- APPROXIMATE BUILDING FOOT PRINT

ISSUED FOR REVIEW (DRAFT)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
1	24.02.17	GCD	MM	AN	ISSUED FOR REVIEW (DRAFT)

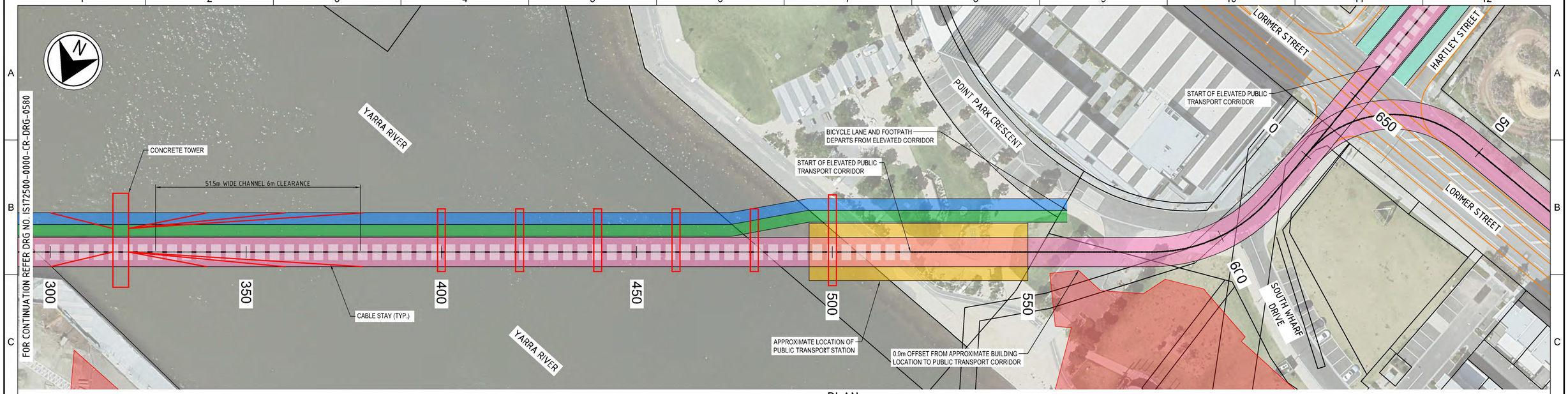
DRAWING NUMBER	REFERENCE DRAWING TITLE

JACOBS
ABN 37 001 024 095 and ACN 001 024 095
Jacobs Group (australia) Pty Ltd
11th Floor, 452 Flinders Street
MELBOURNE, VIC 3000
AUSTRALIA
Tel: +61 3 8668 3000
Fax: +61 3 8668 3001
Web: www.jacobs.com

CLIENT	DEPART. OF ENVIRONMENT, LAND, WATER AND PLANNING		
PROJECT	IMPROVING CONNECTIVITY IN FISHERMANS BEND STUDY		
DRAWN GCD	DRAWING CHECK MM	REVIEWED MM DATE 24.02.17	APPROVED AN DATE 24.02.17
DESIGNED GCD	DESIGN REVIEW MM		

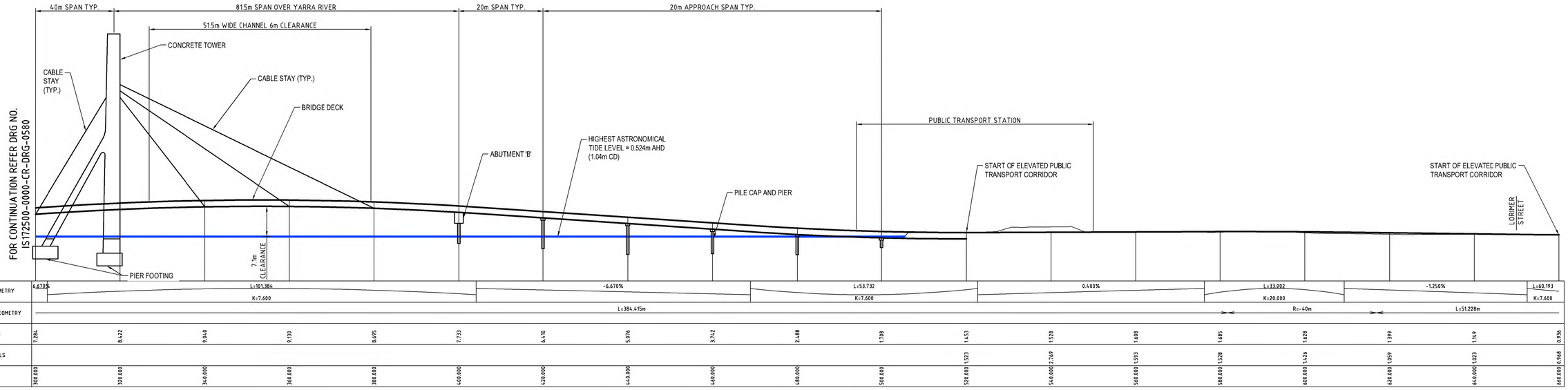
TITLE	BRIDGE OVER YARRA RIVER (6 METRE) ROUTE COMPONENT 1 BRIDGE ELEVATION - SHEET 01
SCALE	AS SHOWN
DRAWING No.	IS172500-0000-CR-DRG-0580
REV	1

DATE: 22/02/2017 4:00:16 PM LOGIN NAME
LOCATION: ...\IE\Projects\03_Southern\IS172500\01 Design\Drawings\IS172500-0000-CR-DRG-0580-0581.dwg
33(1)



PLAN

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)



BRIDGE ELEVATION - YARRA RIVER CROSSING (MC501)

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)

LEGEND

- PUBLIC TRANSPORT CORRIDOR - ELEVATED
- PUBLIC TRANSPORT CORRIDOR - GROUND LEVEL
- BICYCLE LANE
- FOOTPATH CORRIDOR
- APPROXIMATE BUILDING FOOT PRINT

ISSUED FOR REVIEW (DRAFT)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
1	24.02.17	GCD	MM	AN	ISSUED FOR REVIEW (DRAFT)

DRAWING NUMBER	REFERENCE DRAWING TITLE

JACOBS
ABN 37 001 024 095 and ACN 001 024 095
Jacobs Group (australia) Pty Ltd
11th Floor, 452 Flinders Street
MELBOURNE, VIC 3000
AUSTRALIA
Tel: +61 3 8668 3000
Fax: +61 3 8668 3001
Web: www.jacobs.com

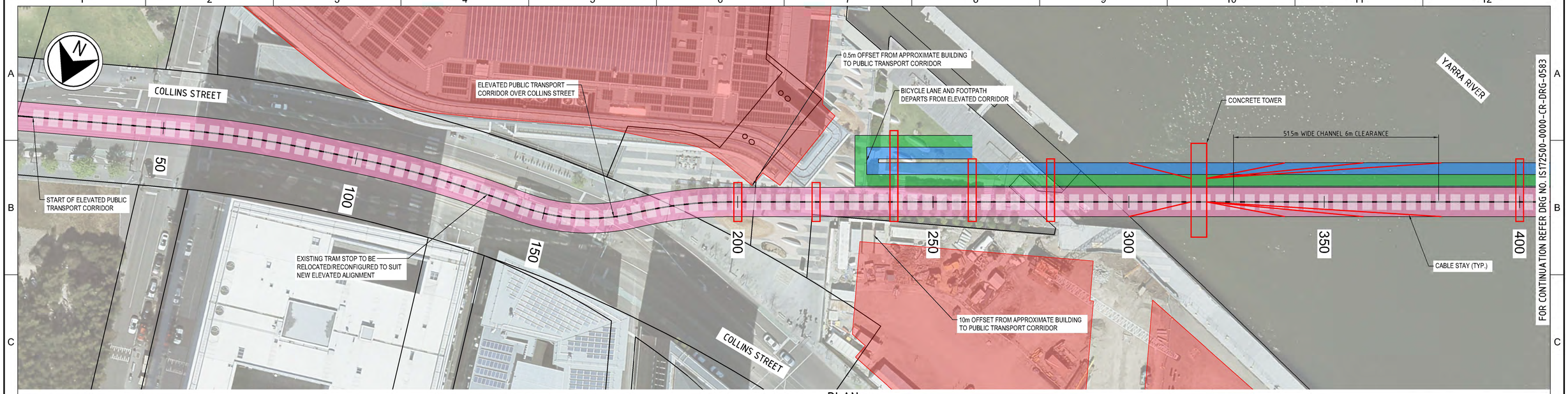
CLIENT: DEPART. OF ENVIRONMENT, LAND, WATER AND PLANNING

PROJECT: IMPROVING CONNECTIVITY IN FISHERMANS BEND STUDY

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
GCD	MM	MM	AN
DESIGNED	DESIGN REVIEW	DATE 24.02.17	DATE 24.02.17
GCD	MM		

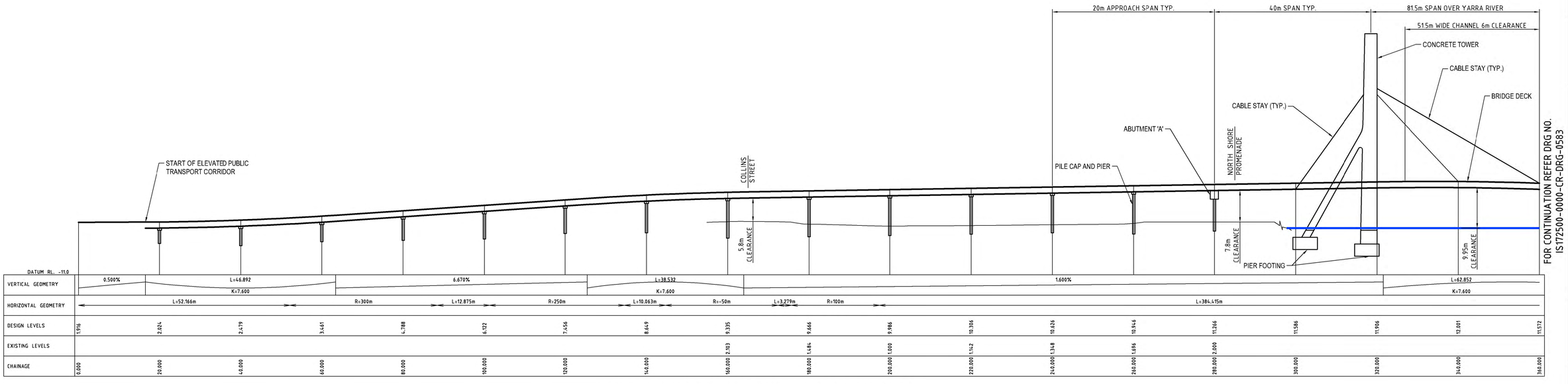
TITLE: BRIDGE OVER YARRA RIVER (6 METRE) ROUTE COMPONENT 1 BRIDGE ELEVATION - SHEET 02

SCALE	DRAWING No	REV
AS SHOWN	IS172500-0000-CR-DRG-0581	1



PLAN

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)



BRIDGE ELEVATION - YARRA RIVER CROSSING (MC502)

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)

LEGEND

- PUBLIC TRANSPORT CORRIDOR - ELEVATED
- PUBLIC TRANSPORT CORRIDOR - GROUND LEVEL
- BICYCLE LANE
- FOOTPATH CORRIDOR
- APPROXIMATE BUILDING FOOT PRINT

ISSUED FOR REVIEW (DRAFT)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
1	24.02.17	GCD	MM	AN	ISSUED FOR REVIEW (DRAFT)

DRAWING NUMBER	REFERENCE DRAWING TITLE

JACOBS
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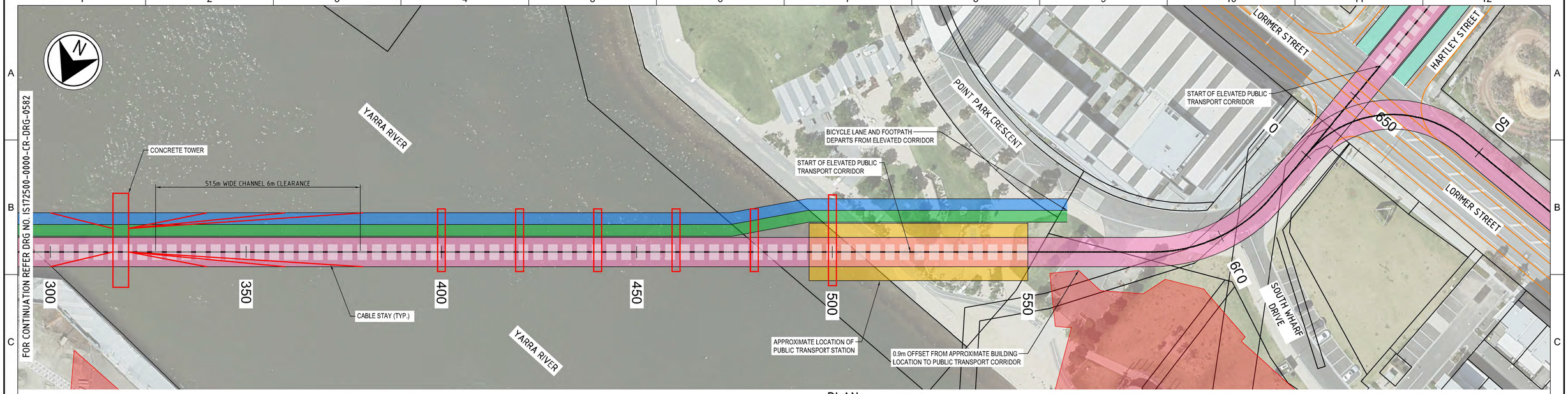
CLIENT	DEPART. OF ENVIRONMENT, LAND, WATER AND PLANNING		
PROJECT	IMPROVING CONNECTIVITY IN FISHERMANS BEND STUDY		
DRAWN GCD	DRAWING CHECK MM	REVIEWED MM DATE 24.02.17	APPROVED AN DATE 24.02.17
DESIGNED GCD	DESIGN REVIEW MM		

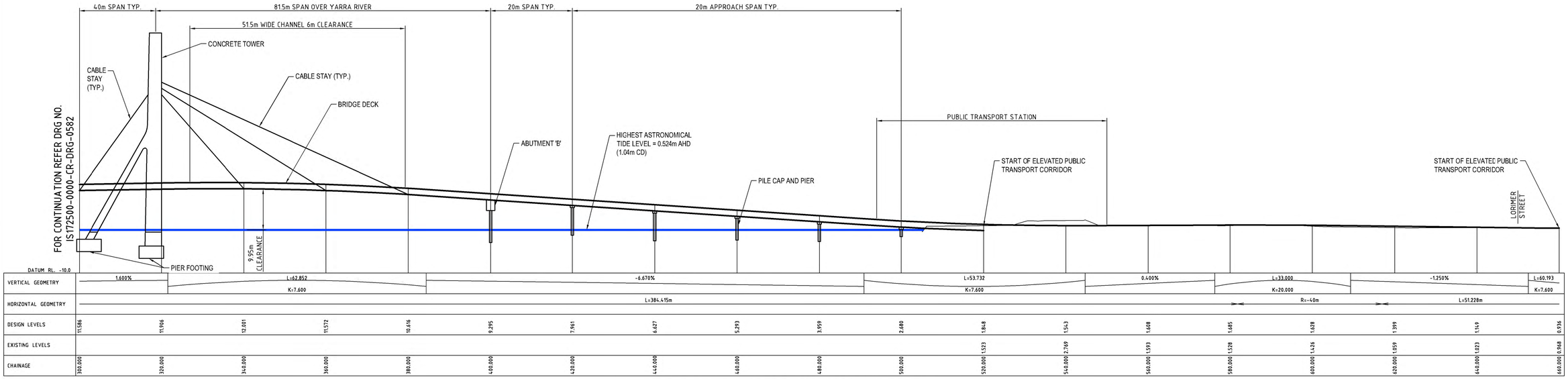
TITLE	BRIDGE OVER YARRA RIVER (9 METRE) ROUTE COMPONENT 1 BRIDGE ELEVATION - SHEET 01
SCALE	AS SHOWN
DRAWING No.	IS172500-0000-CR-DRG-0582
REV	1

DATE: 22/02/2017 4:01:25 PM LOGIN NAM
LOCATION: J:\IE\Projects\03_Southern\S1...\Engineering\IS172500-0000-CR-DRG-0582-0583.dwg
33(1)



PLAN

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)



BRIDGE ELEVATION - YARRA RIVER CROSSING (MC502)

SCALE 1:500 (A1) 0 10 20 30 40 50m (1 0 8 6 4 2)

LEGEND

- PUBLIC TRANSPORT CORRIDOR - ELEVATED
- PUBLIC TRANSPORT CORRIDOR - GROUND LEVEL
- BICYCLE LANE
- FOOTPATH CORRIDOR
- APPROXIMATE BUILDING FOOT PRINT

ISSUED FOR REVIEW (DRAFT)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
1	24.02.17	GCD	MM	AN	ISSUED FOR REVIEW (DRAFT)

DRAWING NUMBER	REFERENCE DRAWING TITLE

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CLIENT	DEPART. OF ENVIRONMENT, LAND, WATER AND PLANNING
PROJECT	IMPROVING CONNECTIVITY IN FISHERMANS BEND STUDY

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
GCD	MM	MM	AN
DESIGNED	DESIGN REVIEW	DATE 24.02.17	DATE 24.02.17
GCD	MM		

TITLE
BRIDGE OVER YARRA RIVER (9 METRE)
ROUTE COMPONENT 1
BRIDGE ELEVATION - SHEET 02

SCALE	DRAWING No	REV
AS SHOWN	IS172500-0000-CR-DRG-0583	1

DATE: 22/02/2017 4:01:38 PM LOGIN NAME
LOCATION: J:\IE\Projects\03_Southern\IS17...ing\IS172500-0000-CR-DRG-0582-0583.dwg
33(1)

Exempt

33(1)

Exempt

3(1)

Exempt