Northern Suburbs Transit Corridor

Transit Corridor Options – Technical Report

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1 Introduction

1.1 Project Understanding

The Northern Suburbs Transit Corridor (the Corridor) represents the decommissioned railway tracks running from Macquarie Point in the south, through Hobart's Northern Suburbs, to the Glenorchy municipal boundary at the Derwent River in the north. The railway tracks were historically used by the Hobart to Brighton Passenger Train Line and rail freight, which operated between 1875 to 1978 – closing due to declining passenger numbers. Since 1978, the Corridor operated as a freight route only until 2014 when it was decommissioned. Since 2010, the Corridor has been subject to multiple studies exploring the feasibility of conversion into a transit route.

In 2019, The Hobart City Deal, a 10-year vision aimed at elevating Hobart to a global city, was signed. In it, the Corridor was highlighted as a priority area for both the development of a key public transport network and key location of urban renewal. Thus, it is necessary to re-examine the potential options along the corridor, this time with a broader scope to include the potential for activation of the public transit corridor as a catalyst for urban regeneration; or engage with the private sector regarding investment interest; or look at implementation of planning and regulatory changes to support more complimentary land uses adjacent to the Corridor.

1.2 Scope of Works

The scope of works and approach adopted for the development of the options assessment and cost estimation is outlined below.

Phase 1 – Inception Desktop Review

A desktop analysis was conducted in relation to the previous investigations into the Transit Corridor and the Hobart City Deal, with the primary focus being:

- Project justification, including the potential impact of not doing the project; and
- Options and solutions previously assessed (alignments, transit modes and cost estimates).

Phase 2 – Options Assessment: Long List and Refined List of Three Options

A qualitative assessment of the long list of potential options for the corridor was undertaken. The initial qualitative Strategic Assessment was used to support the overarching process in identifying the shortlisted options and ultimately a preferred option.

The high-level qualitative assessment focussed on the merits (in terms of the project objectives for the corridor), costs and risks for all long list options. The initial long list options proposed, which were based on our understanding of the project, included: Heavy Rail, Light Rail, Trackless Trams, Bus Rapid Transit and increased bus service on the highway. Previous project experience was utilised during this stage of the assessment, as well as best practice guidance.

The Strategic Assessment identified options in the long list which weren't suitable for further investigation due to the option's ability to meet the objectives outlined for the project. The outcome of the Strategic Assessment was the determination of a shortlist which contained three preferred options (alignment and transit mode) to be assessed further.

Phase 2 – Options Assessment: High Level Costings

Utilising ArcGIS an initial review of the alignment for each shortlisted option was conducted based on the typical infrastructure and spatial requirements associated with each option/mode. Based on the infrastructure requirements, cost estimates were developed for each option, including:

- Trackwork/pavements;
- Stations and canopies;
- Catenary and/or wire-free power and associated infrastructure (e.g. poles and traction power substations);
- High-level civils works (such as retaining structures, culverts, minor bridge widening, etc.); and
- Signals and ITS allowance.

Phase 2 – Options Assessment – MCA and Preferred Option

Following the development of the high-level strategic concept designs and cost estimates for the three shortlisted options, a Multi Criteria Analysis (MCA) was undertaken to compare and identify the preferred solution.

Phase 3 – Appraisal of Preferred Mass Transit Solution

Based the selection of the preferred solution and identified improvements proposed during an external workshop with stakeholders a final round of refinements and minor changes have been incorporated into the preferred solution.

1.3 Report Structure

This report comprises of the following:

- Section 2: Methodology;
- Section 3: Transit Corridor Options;
- Section 4: Concept Design Options Assessment; and
- Section 5: Preferred Option Appraisal.

2 Methodology

2.1 Literature Review

Aurecon conducted a literature review of studies previously undertaken along the corridor. Most notable of the reviewed studies included:

- Tasman Light Rail Business Case (ACIL, 2011 and ACIL, 2013);
- Multiple economic and strategic assessments (PWC, 2014);
- Review of Proposed Light Rail System (Infrastructure Tasmania, 2016); and
- Glenorchy to Hobart Transport Corridor Study (GHD, 2016).

Based on the literature review, a long list of options has been drawn up, consisting of capital, operational policy options focussing on the easing of Hobart congestion and urban activation of the Corridor.

2.2 Long List Assessment Methodology

Options outlined in the Long List were assessed at a high level, purely qualitative, based on experienced professional judgement, and criteria were not given a weighting. The assessment was undertaken using a 5-point scale (Table 2-1), and scored against the following four criteria:

- Transport service (potential to achieve mode shift towards public transport, reduce congestion and improve access). Compared to the 'do minimum' scenario (refer next section; base case).
- City shaping (potential to catalyse urban renewal, by increasing access and unlocking opportunities to invest in improving public realm). Compared to the 'do minimum' scenario.
- Cost (capital and operational), relative to other options.
- Ease and risk of implementation (feasibility, potential technical and planning risks), relative to other options.

Table 2-1 Long List Options Assessment Framework

	+ +	+	0	–	– –
Transport service	- High Mode shift potential - High improvement of access - High reduction congestion in network	- Mode shift potential - Improvement of access - Reduction congestion in network	No significant impact	- Potential mode shift towards car - Reduction of access - Increase congestion in network	- High potential mode shift towards car - High reduction of access - High increase congestion in network
City shaping	High potential catalyst for urban renewal	Potential catalyst for urban renewal	No significant impact	Potential deterrent for urban renewal	High potential deterrent for urban renewal
Cost (capital + operational)	Lowest expected costs	Relative to other options			Highest expected costs
Ease and risk of Implementation	Lowest expected risk / hardest to implement	Relative to other options			Highest expected risk / easiest to implement

The three most beneficial options following this assessment form the shortlist options and will be explored in greater depth in this study. Successful short list options must fulfil two criteria:

- The options must have a positive impact on the ‘transport service’ and ‘city shaping’ objectives of the project. Options that do not score positive on either of these criteria are discarded.
- Options which fulfil the previous criteria are ranked by their scores on the ‘cost (capital + operational)’ and ‘ease of risk and implementation’ criteria. The three options which score the most positive on these criteria will be selected for the short list.

2.3 Concept Designs and High-level Costings

Following the outcomes of the long list options assessment high-level concept designs for the three short-listed transit mode alternatives were developed. The development of the concept designs included:

- Corridor alignment layouts (in ArcGIS) along the length of the demarcated section;
- Typical cross sections and infrastructure requirements for the various transit modes;
- High level operational assessment; and
- Capital and operational cost estimates for each of the options.

Refer to Section 4 for further details relating to the concept designs for each of the options.

2.4 Multi Criteria Analysis

In order to compare the short-listed options against one another a set of criteria and key performance indicators (KPI’s) were derived to assess the ‘Deliverability and Affordability’ of the options. The overarching criteria considered when comparing the infrastructure and technical aspects of each of the options were:

1. Indicative whole of life cost estimates;
2. Ease and risk of delivery; and
3. Ongoing operation.

Due to the nature of the study and assessment the metrics and scoring of each of the options was primarily qualitative, apart from the determined ‘whole of life cost estimates’. Refer to Section 4.6 for the MCA assessment and outcomes.

3 Transit Corridor Options

3.1 Long List Options Assessment

A long list of options has been developed based on previous transport studies of the corridor. They have been divided into Infrastructure Australia's categories, namely Capital Investment, Better Asset Use Reform and Regulatory Reform. The options within the long list were individually assessed against the framework outlined in Table 2-1. Assessments were undertaken at a high level, and was purely qualitative, based on expert opinion. Criteria were not given a weighting. A summary of the long list options and their scores is provided in Table 3-1.

Table 3-1 Long List Options Assessment Summary

	Transport service	City shaping	Cost	Ease and risk of implementation
Capital Investment				
1. Heavy Rail	+ +	+ +	– –	– –
2. Light Rail (on corridor)	+ +	+ +	–	–
3. Light Rail (off corridor)	0	+	– –	– –
4. Bus Rapid Transit (on corridor)	+ +	+	–	–
5. Bus Rapid Transit (off corridor)	0	0	– –	– –
6. Trackless Tram (on corridor)	+ +	+	–	–
7. Trackless Tram (off corridor)	0	0	– –	– –
8. Dedicated bus lane on Main Road (off corridor)	–	0	+	+
9. Dedicated bus lane on Brooker Hwy (off corridor)	–	0	+	+
10. Expand existing road capacity	–	– –	–	–
11. Expand active transport / micro-mobility network	+	0	+ +	+ +
Better Asset Use Reform				
12. Improve existing bus services (off-corridor)	0	0	+ +	+
Regulatory Reform				
13. Road (congestion) pricing	+	–	–	– –
14. Legislative solutions	0	0	0	0

For further details and the technical memorandum on the long list options refer to Annexure A.

3.1.1 Heavy Rail

The Heavy Rail option entails the construction and operation of heavy rail services in the existing rail corridor, connecting the northern suburbs to Hobart CBD, including construction of new stations.

It is likely that this solution will need to be supported by a high frequency feeder bus service and active transport connectivity, essential in generating demand for heavy rail from the wider network. This option will necessitate the reopening and operation of multiple heavy rail level crossings with consequential operational and safety issues.

Table 3-2: Heavy rail qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+ +	+ +	– –	– –

3.1.2 Light Rail (on corridor)

The Light Rail on corridor option entails the construction and operation of light rail services in the existing rail corridor, connecting the northern suburbs to Hobart CBD, including construction of new stops. It is likely that this solution will need to be supported by a high frequency feeder bus service and active transport connectivity, essential in generating demand for light rail from the wider network. This option will necessitate the construction and operation of multiple intersections or crossings with the existing road network.

Table 3-3: Light rail (on corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+ +	+ +	–	–

3.1.3 Light Rail (off corridor)

The (partially) off corridor light rail option is similar to the previous option (light rail on corridor), however diverts from the separated rail corridor to the existing road network, south of New Town, following New Town Road and Elisabeth Street. This option will necessitate the construction and operation of multiple intersections and crossings with the existing road network on the northern section and would likely operate at slower speeds. On the southern section the light rail needs to be integrated in existing roads (on street).

Table 3-4: Light rail (off corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
0	+	– –	– –

3.1.4 Bus Rapid Transit (on corridor)

The bus rapid transit (BRT) on corridor option entails the construction and operation of bus rapid transit services in the existing rail corridor, connecting the northern suburbs to Hobart CBD, including construction of new stops. It is likely that this solution will need to be supported by a high frequency feeder bus service and active transport connectivity, essential in generating demand for light rail from the wider network.

Table 3-5: BRT (on corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+ +	+	–	–

3.1.5 Bus Rapid Transit (off corridor)

The (partially) off corridor Bus Rapid Transit option is similar to the previous option (Bus Rapid Transit on corridor), however diverts from the separated rail corridor to the existing road network, south of New Town, following New Town Road and Elisabeth Street. This option will necessitate the construction of multiple intersections with the existing road network on the northern section. The option would be subject to friction from traffic and other road users. On the southern section, the Bus Rapid Transit infrastructure needs to be integrated on existing roads, requiring the construction of separated bus lanes and new stops.

Table 3-6: BRT (off corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
0	0	– –	– –

3.1.6 Trackless Tram (on corridor)

Trackless trams (tram buses) are a new mode of transport that perform like a hybrid of light rail and bus systems. It combines the benefits of rail systems such as ride quality and lower dwell times, with the lower implementation and operational costs associated with bus systems. Trackless trams and tram buses have been implemented in certain parts of China and Europe.

This option entails the construction and operation of a road corridor in the existing rail corridor. It is likely that this solution will need to be supported by a high frequency feeder bus service and active transport connectivity, essential in generating demand for light rail from the wider network.

Table 3-7: Trackless tram (on corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+ +	+	–	–

3.1.7 Trackless Tram (off corridor)

The (partially) off corridor Trackless Tram option is similar to the previous option (Trackless Tram on corridor), however diverts from the separated rail corridor to the existing road network, south of New Town, following New Town Road and Elisabeth Street. This option aims to leverage existing infrastructure on the road network to save on capital costs and bring greater access to existing suburbs with a built-up population to use the network.

This option will necessitate the construction of multiple intersections with the existing road network on the northern section. The option would be subject to friction from traffic and other road users. On the southern section, the Trackless Tram infrastructure needs to be integrated with existing roads, requiring the construction of separated lanes and new stops.

Table 3-8: Trackless tram (off corridor) qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
0	0	– –	– –

3.1.8 Dedicated Bus Lane on Main Road

This option entails the construction of two dedicated bus lanes on Main Road[1]. This will require the construction of a new lane on either side of the carriageway, and intersection upgrades.

[1] Potentially this could be a one way bus lane, operating in peak direction, with buses in off peak direction using the existing road network.

Table 3-9: Dedicated bus lane on Main Road qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
–	0	+	+

3.1.9 Dedicated Bus Lane on Brooker Highway

Brooker Highway is a dual carriageway four-lane road. To provide a dedicated bus lane along its length, it will require a new lane to be constructed on both carriageways, or the repurposing of an existing lane for bus priority.

Table 3-10: Dedicated bus lane on Brooker Highway qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
–	0	+	+

3.1.10 Expanded Existing Road Capacity

One approach which is often used to improve traffic flow in road networks is to widen roads, or to remove bottlenecks which can exacerbate congestion. The two main candidates for widening are Brooker Highway and Main Road, the latter more closely following the existing railway corridor. Both roads were not designed with expansion in mind.

Another approach is de-bottlenecking, a more targeted approach focusing on particular points on the corridor where bottlenecking occurs. Depending on the nature and scale of bottlenecks, this solution can range in cost and complexity from adding an extra turning lane, to removal of on-street parking, to provision of grade separation.

Table 3-11: Expanded existing road capacity qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
–	– –	–	–

3.1.11 Expand Active Transport (micro-mobility) Network

Expansion of Hobart's active-transport network will be based on providing feeder routes onto the existing bicycle route along the rail corridor. The infrastructure ideally exists of a connected network of separated cycleways and wide footpaths, to increase walkability of the area. This will provide greater connectivity from suburbs to the main cycle network and encourage a modal shift from motorised vehicles to active travel modes.

Table 3-12: Expand active transport network qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+	0	+ +	+ +

3.1.12 Improve Existing Bus Services (off corridor)

ACIL (2011) notes that a major reason for low bus demand within Hobart is that their frequency of service does not match the needs of passengers, and that increasing frequency of existing bus services can have a significant effect on patronage.

Locations of bus frequency improvements can be tailored to the needs of the network. For example, if network capacity constraints are the issue, then more services can be put on the busier parts of the network.

On the other hand, if activating passenger demand is the issue, then more services can be put in areas where demand is low, services are infrequent, and potential demand is high.

Table 3-13: Improve existing bus services qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
0	0	+ +	+

3.1.13 Road (congestion) Pricing

Introduction of road congestion pricing aims to disincentivise the use of private transport in and out of the CBD during peak hours. Its ultimate goal is to reduce congestion by encouraging a modal shift from motorised vehicles to public or active travel modes, shift demand to off-peak periods, shift traffic to preferred routes. Road congestion pricing will be introduced not specifically along the corridor, but in the wider network.

Table 3-14: Road pricing qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
+	–	–	– –

3.1.14 Legislative Solutions

A number of legislative solutions could be implemented by themselves or in combination with any capital works solutions. A few which have been raised as part of this memo are listed below:

- Encouragement of infill development, particularly along the corridor;
- Intensify provision of services (health and education) in the corridor;
- Encourage intensification of employment hubs;
- Public housing policies; and
- Maximum parking requirements / parking levies.

Table 3-15: Legislative solutions qualitative assessment

Transport service	City shaping	Cost	Ease and risk of implementation
0	0	0	0

3.2 Short List Options

Based on the assessment of the Long List options, three Short List options are selected. These options have the highest potential to impact the main objectives (both Transport service and City shaping), and score acceptable on feasibility (cost, ease and risk of implementation).

Table 3-16: Proposed shortlist options

Option	Transport service	City shaping
2. Light Rail (on corridor)	+ +	+ +
4. Bus Rapid Transit (on corridor)	+ +	+
6. Trackless Tram (on corridor)	+ +	+

The three most beneficial options following the assessment formed the Short List Options and will be explored in greater depth in this study. As mentioned previously, the selection of short list options followed a staged approach.

- First, the options were selected with expected positive impact (+ + or +) on the objectives of the project, both 'Transport service' and 'City shaping'. Options that did not score positive on either of these criteria were discarded.
- Second step was to discard options that score very negative (– –) on the feasibility criteria (cost, ease and risk of implementation).

Table 3-17: Justification for discarding options from the long list

	Effect (Transport service and City shaping potential)	Feasibility (cost, ease and risk of implementation
Capital Investment		
1. Heavy Rail		Very low score on feasibility (cost, ease and risk of implementation)
3. Light Rail (off corridor)	Low score on effect (Transport service)	Very low score on feasibility (cost, ease and risk of implementation)
5. Bus Rapid Transit (off corridor	Low score on effect ('Transport service' and 'City shaping')	Very low score on feasibility (cost, ease and risk of implementation)
7. Trackless Tram (off corridor	Low score on effect ('Transport service' and 'City shaping')	Very low score on feasibility (cost, ease and risk of implementation)
8. Dedicated bus lane on Main Road (off corridor)	Low score on effect (both 'Transport service' and 'City shaping')	
9. Dedicated bus lane on Brooker Hwy (off corridor)	Low score on effect ('Transport service' and 'City shaping')	
10. Expand existing road capacity	Low score on effect ('Transport service' and 'City shaping')	
11. Expand active transport / micro-mobility network	Low score on effect ('City shaping')	
Better Asset Use Reform		
12. Improve existing bus services (off-corridor)	Low score on effect ('Transport service' and 'City shaping')	

Regulatory Reform		
13. Road (congestion) pricing	Low score on effect ('City shaping')	Very low score on feasibility (ease and risk of implementation)
14. Legislative solutions	Low score on effect ('Transport service' and 'City shaping')	

4 Concept Design Options Assessment

4.1 Introduction

The three shortlisted options have been further developed into high-level concept designs, to inform the Multi Criteria Analysis (MCA), with high-level cost estimates. This section captures the main assumptions made to prepare the high-level concept designs, distinguishing between general assumptions valid for all three options (Section 4.2) and transit mode specific assumptions relevant to that particular option (Sections 4.3). Based on these concept design assumptions the high-level cost estimates have been captured in Section 4.5. The comparison of the three shortlisted options and MCA results are presented in Section 0.

4.2 General Assumptions

It has been assumed that all shortlisted options will follow the same general alignment and station locations. The general assumptions adopted are outlined below.

- Corridor alignment
  - The precise corridor alignment, between Macquarie Point and Hobart CBD, shall be investigated and refined in subsequent studies.
  - Stage 1 Northern end: MONA, Berriedale Bay (current Stop 34, Main Road).
  - Stage 2 Northern end: Granton Bridge[2], near Black Snake Road.
- Station locations
  - The proposed location of stops/station along the proposed alignment for each option are derived from the report 'Glenorchy to Hobart Public Transport Corridor Study' (GHD, 2016):

Stage 1 Stations

- Hobart CBD
- Macquarie Point
- Botanical Gardens
- New Town
- Albert Road
- Derwent Park Road
- Hobart Showgrounds[4]
- Glenorchy Central
- Brooker Interchange
- Berriedale / MONA

Stage 2 Stations

- Claremont
- Austins Ferry
- Granton Bridge / Interchange[3]

- The options will be developed as single carriageway / lane for the majority of the corridor for all options. Provision shall be made at stations for dual carriageway / lanes to allow for passing of vehicles, i.e. function as passing loops.

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[2] It is noted that shorter stages, terminating at Claremont or Glenorchy, were considered but rejected due to low expected demand and low potential for multi-modal interchange.

[3] Granton Bridge Station has been moved southwards to an improved operational and functional location.

[4] The Hobart Showgrounds Stations has been included as a new station in this study.

- Locations with expected constraints in terms of limited corridor width will be assumed to be single lane / carriageway. Examples of such constraints included: property boundaries and structures on either side of the corridor, natural / topographical constraints, civil structures (bridges and underpasses) [5].
- Preferably no land acquisitions, the new infrastructure must stay within the current rail corridor, except for the section between Macquarie Point and Hobart CBD, which will be built on-road within crown land up to building shopfronts.
- Additional lighting to be added for security and safety at crossings, intersections, stations, and transitions between single and dual carriageways/lanes. Within the corridor itself, no additional lighting will be provided, additional to the existing street lighting of the Inner-City Cycleway.
- The existing Inner-City Cycleway must remain functional and safe but can be reinstated/relocated within the existing rail corridor. A width of 4.0m is provided for the cycleway / shared path which also includes 1.0m reservation for safety measures.
- All current level crossings of the rail line with crossing roads stay functional. At all level crossings, traffic signals are installed (or adjusted at level crossings that are already signalised).
- The designs provide for a safety zone on either side of the transit lanes / carriageway which includes a 1.2m high fence/barrier to prevent ease of access into the transit pathway and reduce potential conflicts.

Refer to Annexure B for concept layout plans for the corridor based on the above assumptions.

4.3 Transit Mode Options Development

The following sections outline the options development and assumptions relating to the infrastructure requirements for each of the shortlisted transit modes.

4.3.1 Option 1 – Light Rail Transit (LRT)

Proposed Infrastructure

- It is assumed that the section north of Macquarie Point, using the existing rail corridor, will be constructed as ballasted track. The on-road section between Macquarie Point and Hobart CBD will be designed as an embedded rail in concrete trackform.
- It is assumed that the existing ballast and rails will be replaced[6].
- Typical stations shall be side platforms. This is the most conservative, as side platforms require more width than island platforms.
- Standard gauge of 1,435 mm.
- It is assumed that the rolling stock has capacity to operate wire free running under an on-board energy storage system (supercapacitors/batteries). Therefore, no overhead wiring will be required. The corridor width is conservative and would allow for sufficient width in case overhead poles would be required.
- Substations are assumed every 3 km.
- The cost estimate includes the infrastructure required for a depot (stabling and maintenance). It is assumed that the depot will be on crown land and therefore land acquisition costs are excluded.
- Total width for the dual LRT corridor configuration shall be approximately 14.0m.
- Total width for the single LRT corridor configuration shall be approximately 10.0m.
- Station platform widths to be a minimum 3.0m and platform lengths to be 35m.

[5] In a later stage, designs could be optimised to minimise costs (while maintaining an acceptable level of service).
[6] No research has been undertaken into the current state of the existing rails and earthworks, as part of this study.

Indicative Cross Sections

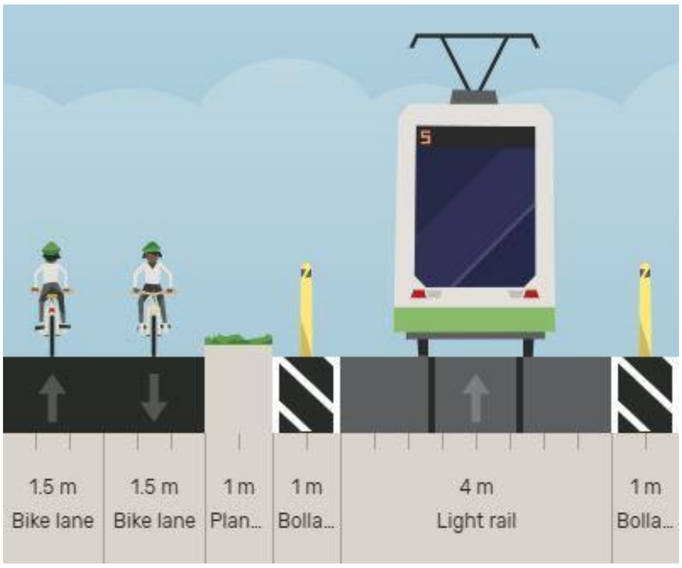

Figure 4-1: Indicative cross section light rail (10m single carriageway)

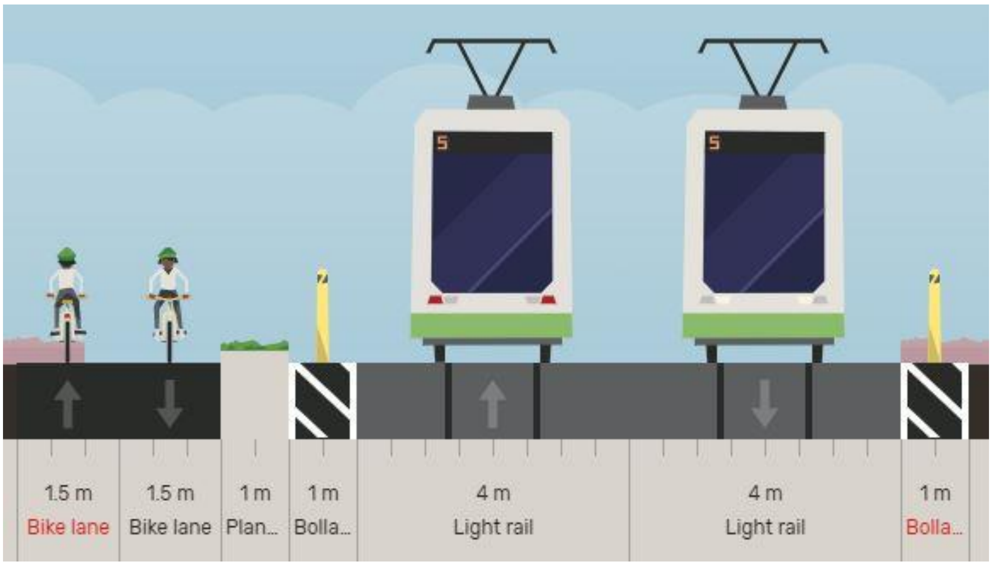

Figure 4-2: Indicative cross section light rail (14m dual carriageway)

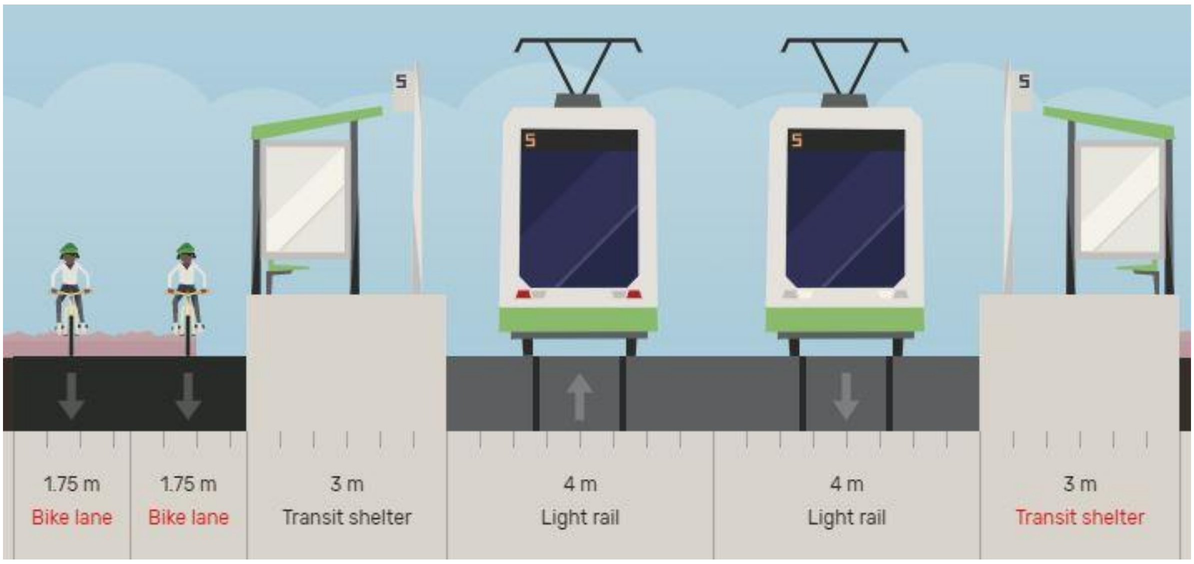

Figure 4-3: Indicative station cross section for light rail

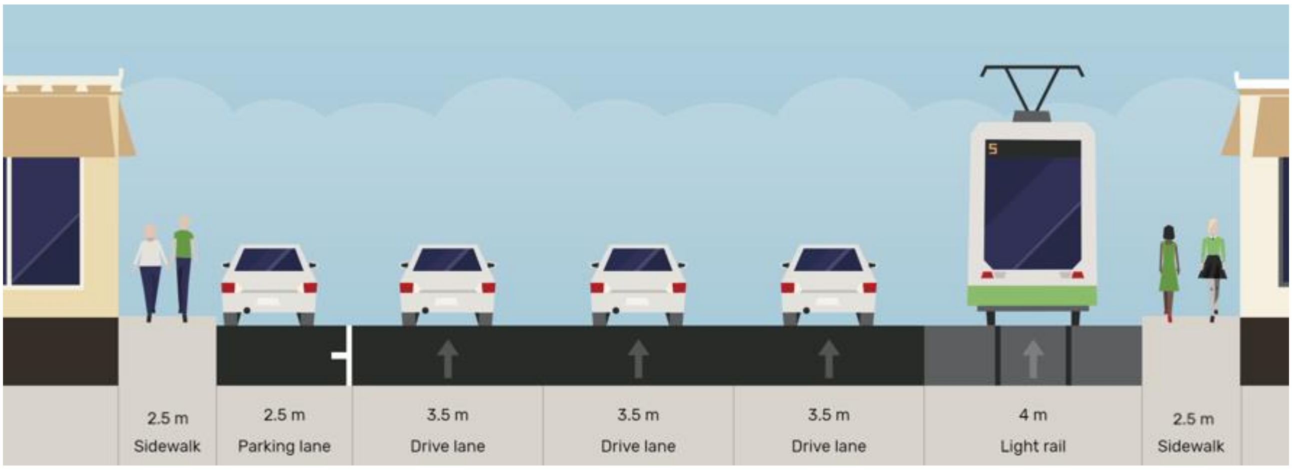

Figure 4-4: Indicative cross section light rail (on-road, single direction)

Typical Vehicle Configuration

Table 4-1: Light Rail Vehicle specification

	Light Rail Vehicle
Configuration	5 module light rail
Example Model	Bombardier Flexity 2
Length	33m
Door Configuration	Two double and two single doors on each side
Total Capacity	266
Max service speed	80km/h

Figure 4-5: Light Rail (example: Bombardier Flexity 2)

4.3.2 Option 2 – Bus Rapid Transit (BRT)

The proposed bus rapid transit (BRT) alternative makes use of the existing corridor extents and alignment adopting both single and dual lane configurations where applicable. The below outlines the key infrastructure and operational components of the BRT.

Proposed Infrastructure

The following key transport infrastructure components are proposed for the BRT network:

- It is assumed that the section north of Macquarie Point, using the existing rail corridor, will be delivered with the use of a suitable pavement design for the bus lanes. The on-road section between Macquarie Point and Hobart CBD will be designed as on-road sections. Important to note that at turning locations and at the stations concrete pavements shall be provided due to vehicle stopping and turning actions.

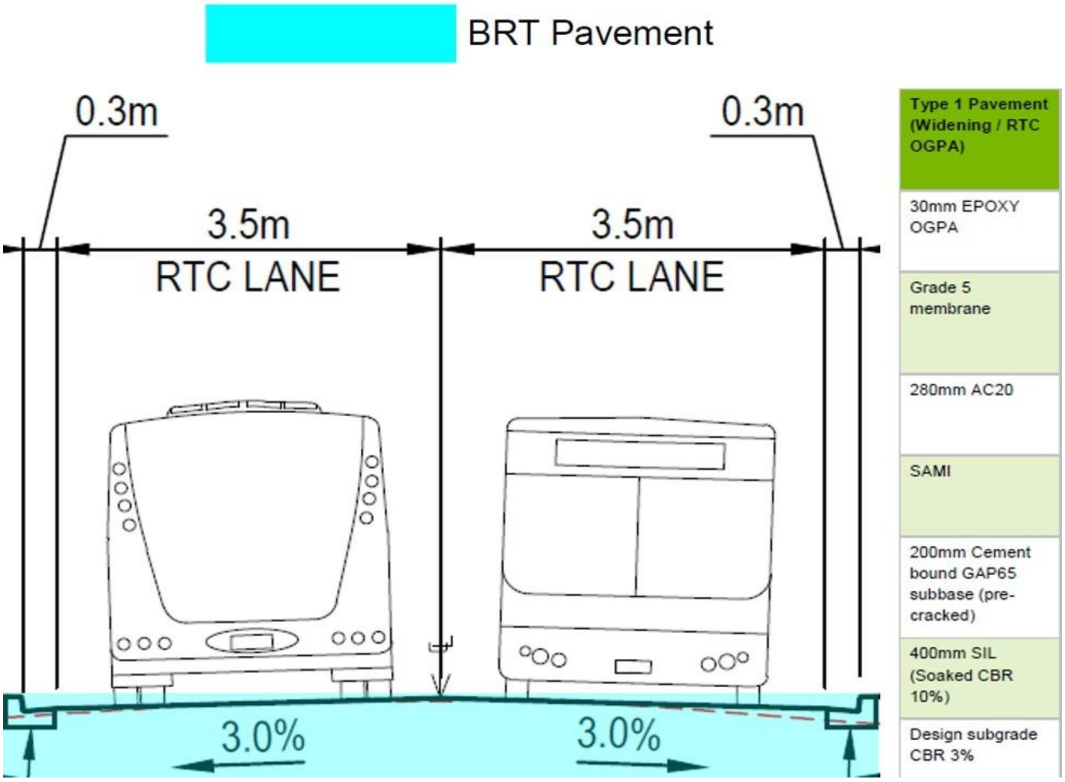

Figure 4-6: Proposed pavement along the BRT corridor

- Total width for the dual BRT corridor configuration shall be approximately 13.0m.
- Total width for the single BRT corridor configuration shall be approximately 9.5m.
- BRT Stations:
  - Station platform widths to be a minimum 3.0m.
  - Station platform lengths to be 20.0m.

Indicative Cross Sections

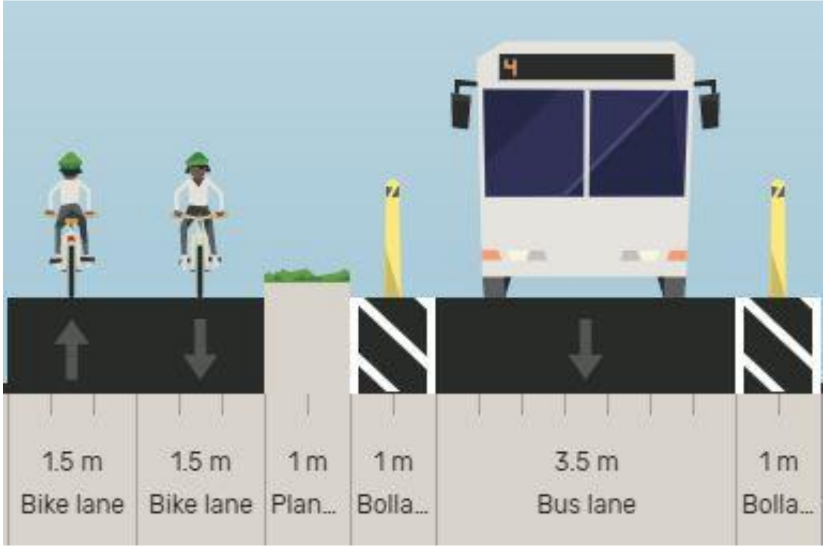

Figure 4-7: Indicative cross section BRT (9.5m single carriageway)

Figure 4-8: Indicative cross section BRT (13m dual lane)

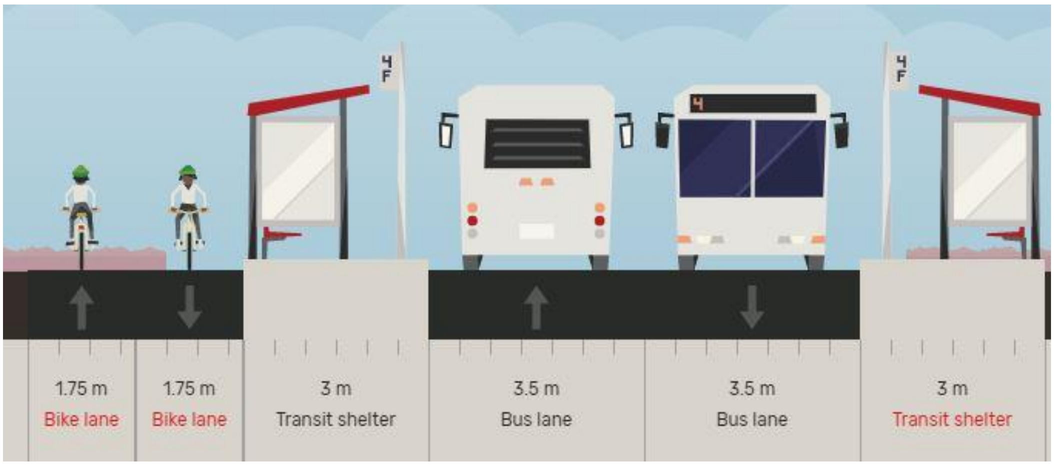

Figure 4-9: Indicative station cross section for BRT

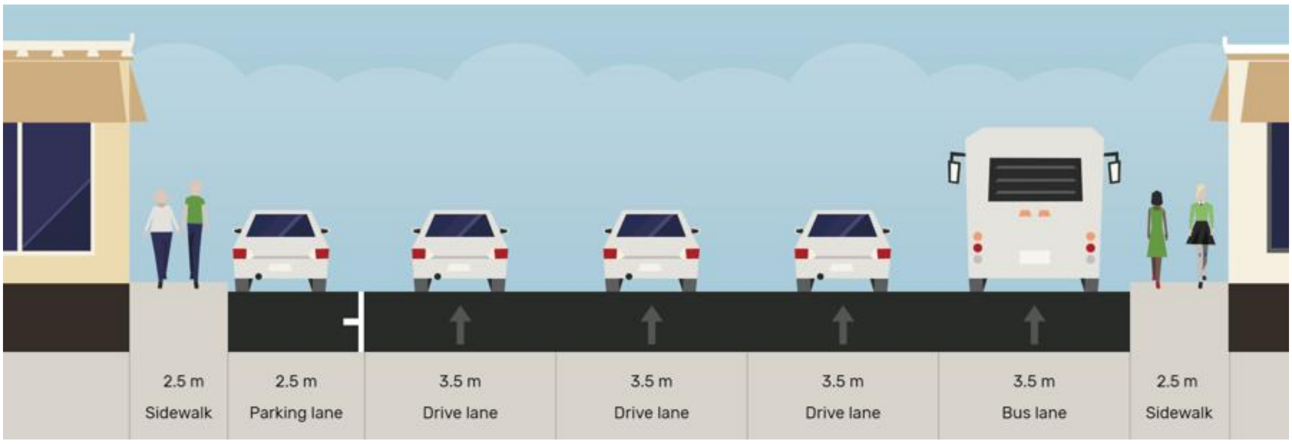

Figure 4-10: Indicative cross section BRT (on-road, single direction)

Typical Vehicle Configuration

Table 4-2: Single articulated bus specification

	Single articulated bus
Configuration	Single articulated bus
Example Model	Van Hool Exquicity 18
Length	18.6m
Door Configuration	Three double doors, kerbside only
Seating Capacity	44
Standing Capacity	69
Total Capacity	113
Max service speed	80km/h

Figure 4-11: Single articulated bus (example: Van Hool Exquicity 18m)

4.3.3 Option 3 – Trackless Trams

As with Options 1 and 2, the trackless tram alternative makes use of the existing corridor extents and alignment adopting both single and dual lane configurations where applicable. The below outlines the key infrastructure and operational components for the trackless tram option.

Proposed Infrastructure

Due to the similarity in the infrastructure requirements between a BRT and Trackless Tram, the proposed corridor infrastructure is the same for Options 2 and 3 apart from a longer platform length at the station to accommodate the longer vehicle.

Typical Vehicle Configuration

Two vehicles are proposed for the implementation of a trackless tram solution. A double articulated bus and an emerging trackless tram technology. The specifications of a typical model for each of the two solutions is provided below:

Table 4-3: Trackless tram specification

	ART 'trackless tram'
Configuration	Three section double-ended road vehicle
Example Model	CRRC ART
Length	31.6m
Door Configuration	Six double doors on each side
Seating Capacity	44
Standing Capacity	116
Total Capacity	160
Max service speed	70km/h

Table 4-4: ART trackless tram (example: CRRC ART 31m)

Figure 4-12: Trackless Tram (example: CRRC ART 31m)

4.4 Operational Assessment

A high-level operational assessment has been performed to investigate the travel durations, potential operational frequencies and headway, number of vehicles to service the corridor and as input to a high-level operational cost estimate. No detailed modelling has been undertaken, this is recommended for the next stage or in case further improvements of frequency are considered. The assessment considered the following corridor characteristics and operational assumptions.

- Station distances from Hobart Central

Table 4-5: Distances between stations

Station No.	Station Description	Distance (km) (from Hobart Central)
1	**Hobart Central**	0.0
2	**Macquarie Point**	0.8
3	**Botanical Gardens**	3.2
4	**New Town**	5.2
5	**Albert Road**	6.6
6	**Derwent Park Road**	7.7
7	**Hobart Showground**	8.5
8	**Glenorchy Central**	9.3
9	**Brooker Interchange**	10.7
10	**Berriedale/MONA**	12.3
11	**Claremont (Stage 2)**	14.6
12	**Austins Ferry (Stage 2)**	18.2
13	**Granton Bridge/Interchange (Stage 2)**	20.1

- The proposed corridor is predominantly single carriageway/lane with passing loops at all stations, to allow for passing of the north and south bound vehicles.
- Assumed average transit speeds are the same across the three options with operational speeds adopted being:
  - 30km/h in urban areas, namely Hobart CBD (i.e. along Davey and Macquarie Streets).
  - 50km/h along the dedicated corridor, from Macquarie Point to Granton Bridge.
- Assumed dwell time of 30s at each station, this excludes allowances for deceleration, acceleration and waiting at the station passing loops.
- Assumed that there is a 3 to 5-minute change over at the end of each south to north trip (Stage 1 – Berriedale/Mona Station or Stage 2 – Granton Station) for driver relief and vehicle turnaround.
- The public transit mode and corridor shall receive full prioritisation at level crossings and within the CBD area, along Davey, Elisabeth and Macquarie Streets and associated intersections.

Based on the above assumptions, the high-level operational assessment outcomes are:

- The travel duration for Stage 1, i.e. Hobart Central to Berriedale/Mona station (one-way), is estimated to take approximately 20 minutes whilst the complete Stage 2 trip (one-way), to Granton Bridge, will take roughly 30 minutes.

- The resulting 'round trip' for Stage 1, i.e. Hobart Central to Berriedale/Mona Station and back to Hobart Central, is estimated to take approximately 40 to 45 minutes. The estimated 'round trip' for Stage 2 is estimated to take approximately 60 to 70 minutes.
- Undertaking a high-level frequency assessment, it is estimated that an operational frequency/headway of 10 minutes could be achieved with the number of passing loops currently proposed. Operating passing loops will result in a high level of interdependency between services operating in both directions. This, combined with the on-street section in the CBD means that the risk to reliability of the service is higher than in a dual-track or dual-carriageway operation. The assessment does not take into consideration the impact of lower travel time reliability as a result of corridor configuration, potential delays and breakdowns. It is recommended that a more detailed modelling study be undertaking during the next planning stage to further investigate and accurately detail the achievable operational headways of the current corridor configuration.
- It is estimated that 8 vehicles will be required to ensure a satisfactory level of service whilst accounting for scheduled maintenance services and flexibility in the system in the event of increased demand, unforeseen breakdowns, etc. The following staged vehicle configuration is:
  - <u>Stage 1:</u>
    - 4 vehicles in operation along the network at all times.
    - 1 vehicle out of service for maintenance.
    - 1 vehicle for redundancy for standby in case of a breakdown or to improve efficiencies.
  - <u>Stage 2:</u>
    - 6 vehicles in operation along the network at all times.
    - 1 vehicle out of service for maintenance.
    - 1 vehicle for redundancy for standby in case of a breakdown or to improve efficiencies.

4.5 High-Level Cost Estimates

High-level cost estimates have been developed for each of the short-listed options based on the typical concept design cross sections for each transit mode and extrapolated along the length of the corridor dependent on where single or dual carriageways/lanes have been proposed. Allowances for civil infrastructure items, i.e. culverts, have been incorporated as required based on a desktop visual assessment along the length of the corridor.

It is important to note that the high-level cost estimates have been developed on the premise that new infrastructure shall be provided for all options, including the light rail alternative, as assuming the re-use of the existing rail and ballast without a detailed condition assessment carries too great a risk at present.

Excluded from the cost estimates are the upgrades to bridges and underpasses as the proposed approach does not deem this necessary, at this present time.

4.5.1 Capital Expenditure Estimates

The Capital Expenditure (capex) cost estimates for the three short-listed options are:

Table 4-6: Concept options capex estimates (in $ AUD million)

	Option 1 – LRT		Option 2 - BRT		Option 3 – Trackless Tram	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
Capex Estimate	$520	$680	$380	$510	$440	$590

*Note – the above capex estimates have been rounded up or down to the nearest $10 million. The actual cost estimate amounts are contained in Annexure C.

For the detailed breakdown and assumptions relating to the capex estimates refer to the report contained in Annexure C.

4.5.2 Operational Expenditure Estimates

The annual Operational Expenditure (opex) cost estimates for the three short-listed options are:

Table 4-7: Concept options opex estimates (in $ AUD million)

	Option 1 - LRT	Option 2 - BRT	Option 3 – Trackless Tram
	Stage 2	Stage 2	Stage 2
Opex Estimate	$8.3	$6.6	$7.3

The operational cost estimates for each of the options are based on the following assumptions:

- Number of drivers = 15;
- Number of support staff = 3.75 fte;
- Rolling stock / vehicle maintenance = 3% of capital investment; and
- Infrastructure maintenance = 1% of capital investment.

4.6 Multi-Criteria Assessment

This section presents the Multi-Criteria Assessment (MCA) of the three shortlisted options, for the criteria focussed on 'Deliverability and Affordability'. The overarching themes for the criteria were:

1. Indicative whole of life cost estimates;
2. Ease and risk of delivery; and
3. Ongoing operation.

Based on the above overarching themes the three transit options were assessed in relation to specific key performance indicators (KPI's) which would allow for the comparison between the modes. The KPI's proposed included:

Indicative whole of life cost estimates

1. Estimate of the whole of life capital cost including estimate of contingency ($).
2. Estimate of the yearly operational cost ($)

Ease and risk of delivery

1. Qualitative indicator on the ease and risk of delivery considering scope of works, reuse of materials (e.g. ballast, tracks), impact on structures, etc.
2. Qualitative indicator representing the disruption during construction.
3. Qualitative indicator representing planning procedure risks, e.g. remaining within existing corridor, potential rezoning of land, land and property acquisitions.
4. Qualitative indicator representing international and local implementation experience of required technology.

Ongoing operation

1. Qualitative indicator representing the ability to safely continue the existing active transport corridor.
2. Qualitative indicator representing the requirement for supporting transport services e.g. feeder bus operations, active transport network (walking and cycling).
3. Qualitative indicator representing ease of maintenance, e.g. the likelihood of maintenance required and availability of vehicles and spare parts.

The assessment of the three options is outlined below.

Table 4-8: Multi-criteria qualitative assessment of the shortlisted options

Overarching criteria for the MCA	Specific quantifiable / qualitative metrics	Option 1 – Light Rail	Option 2 – Bus Rapid Transit	Option 3 – Trackless Tram
Indicative whole of life cost estimates	Estimate of the whole of life capital cost including estimate of contingency ($).	The capital cost estimate for the provision of the Light Rail Transit corridor is AUD 680 million.	The capital cost estimate for the provision of the Bus Rapid Transit corridor is AUD 510 million.	The capital cost estimate for the provision of the Trackless Tram transit corridor is AUD 590 million.
	Estimate of the whole of life operational cost ($).	The operational cost estimate for the provision of the Light Rail Transit corridor is AUD 8.3 million per annum.	The operational cost estimate for the provision of the Bus Rapid Transit corridor is AUD 6.6 million per annum.	The operational cost estimate for the provision of the Trackless Tram transit corridor is AUD 7.3 million per annum.
Ease and risk of delivery	Qualitative indicator on the ease and risk of delivery considering scope of works, remaining within existing corridor, reuse of ballast, impact on structures, etc.	It is assumed that none of the existing rail corridor infrastructure, including ballast and rails, can be reused at this stage. However, the adopted design does stay within the existing corridor boundary and does not significantly impact major transport infrastructure or underpasses.	The BRT infrastructure will be completely new. The adopted design stays within the existing corridor boundary and does not significantly impact major transport infrastructure or underpasses.	The Trackless Tram infrastructure will be completely new. The adopted design stays within the existing corridor boundary and does not significantly impact major transport infrastructure or underpasses.
	Qualitative indicator representing the disruption during construction.	The construction of the Light Rail Transit infrastructure, particularly at level crossings and along Davey and Macquarie Streets (in the CBD), will take longer to be constructed and cause significant disruption to the existing local/immediate transport network and commuters.	The construction of the BRT infrastructure won't be as disruptive as the light rail option however, it will disrupt the existing local/immediate transport network and commuters at certain locations, in particular along Davey and Macquarie Streets (in the CBD).	The construction of the Trackless Tram infrastructure won't be as disruptive as the light rail option however, it will disrupt the existing local/immediate transport network and commuters at certain locations, in particular along Davey and Macquarie Streets (in the CBD).
	Qualitative indicator representing planning procedure risks.	Assume that no land and property acquisition required along the transit corridor. And within the CBD it is assumed	Assume that no land and property acquisition required along the transit corridor. And within the CBD it is assumed	Assume that no land and property acquisition required along the transit corridor. And within the CBD it is assumed

		that the corridor stays within the existing road reserve.	that the corridor stays within the existing road reserve.	that the corridor stays within the existing road reserve.
	Qualitative indicator representing international and local implementation experience of required technology.	The application and implementation of Light Rail Transit systems as a public transport offering is well practiced international and locally within Australia. Subsequently there are a number of Light Rail examples from which to gain insight in practical applications and manufacturers from which a number of LRT vehicle alternatives can be procured.	The application and implementation of BRT systems as a public transport offering is well practiced international and locally within Australia. Subsequently there are a number of BRT examples from which to gain insight in practical applications and manufacturers from which a number of BRT vehicle alternatives can be procured.	The application and implementation of Trackless Tram systems as a public transport offering is not extensively practiced international, apart from in China, and has never been implemented in Australia. There are very few manufacturers which will make procuring the vehicles more costly.
Ongoing operation	Qualitative indicator representing the ability to safely continue active transport corridor.	The integration of the Light Rail Transit infrastructure with the active transport corridor can be achieved relatively easily. To improve the operational safety and usage of both corridors concurrently a safety zone along with a separation barrier have been included.	The integration of the BRT infrastructure with the active transport corridor can be achieved relatively easily. To improve the operational safety and usage of both corridors concurrently a safety zone along with a separation barrier have been included.	The integration of the Trackless Tram infrastructure with the active transport corridor can be achieved relatively easily. To improve the operational safety and usage of both corridors concurrently a safety zone along with a separation barrier have been included.
	Qualitative indicator representing the requirement for supporting transport services eg. feeder bus operations, active transport, etc.	The Light Rail Transit network will require supporting transport services to ensure sufficient accessibility of the network to the surrounding catchments and potential commuters.	The BRT network will require supporting transport services to ensure sufficient accessibility of the network to the surrounding catchments and potential commuters.	The Trackless Tram network will require supporting transport services to ensure sufficient accessibility of the network to the surrounding catchments and potential commuters.
	Qualitative indicator representing ease of maintenance eg. the availability of vehicles and spare parts.	There are a number of Light Rail manufacturers from which vehicles and parts can be procured from for general maintenance and emergency repairs. This will assist with ongoing operations,	There are a number of BRT manufacturers from which vehicles and parts can be procured from for general maintenance and emergency repairs. This will assist with ongoing operations,	As Trackless Tram is not widely adopted and implemented globally the number of manufacturers are limited. Therefore, the procuring of specialist parts for maintenance and emergency repairs will

		reduction in downtime and improved OPEX expenditure/budgeting.	reduction in downtime and improved OPEX expenditure/budgeting.	be costlier resulting in higher OPEX expenditure and potentially long procurement durations.

Table 4-9: Multi-criteria assessment scoring of the shortlisted options

Overarching criteria for the MCA	Specific quantifiable / qualitative metrics	Option 1 – Light Rail	Option 2 – Bus Rapid Transit	Option 3 – Trackless Tram
Indicative whole of life cost estimates	Estimate of the whole of life capital cost including estimate of contingency ($).	4	8	6
	Estimate of the whole of life operational cost ($).	4	8	6
Ease and risk of delivery	Qualitative indicator on the ease and risk of delivery considering scope of works, remaining within existing corridor, reuse of ballast, impact on structures, etc.	6	6	6
	Qualitative indicator representing the disruption during construction.	4	6	6
	Qualitative indicator representing planning procedure risks.	6	6	6
	Qualitative indicator representing international and local implementation experience of required technology.	8	8	2
Ongoing operation	Qualitative indicator representing the ability to safely continue active transport corridor.	8	8	8
	Qualitative indicator representing the requirement for supporting transport services eg. feeder bus operations, active transport, etc.	4	4	4
	Qualitative indicator representing ease of maintenance eg. the availability of vehicles and spare parts.	8	8	4
	Total Score (out of 90) (unweighted)	**52**	**62**	**48**

5 Recommendations

In order to obtain greater technical insight and assist in the further development of the options/opportunities along the Northern Suburbs Transit Corridor the following next steps are recommended:

- Undertake a detailed condition assessment of the existing rail and corridor infrastructure;
- Conduct a topographical survey along the length of the corridor;
- Perform a geotechnical investigation at strategic locations along the length of the corridor; and
- Undertake a detail engineering optioneering and concept design study which is informed by the above studies.

The above recommendations will significantly improve the determination of the preferred and applicable technical solution and reduce the associated risks, both technically and financially (i.e contingencies).

Annexure A - Technical Memo NSTC Long List Options Assessment

Annexure B – Transit Corridor Concept Layout

Annexure C – Fission Cost Estimation Report

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