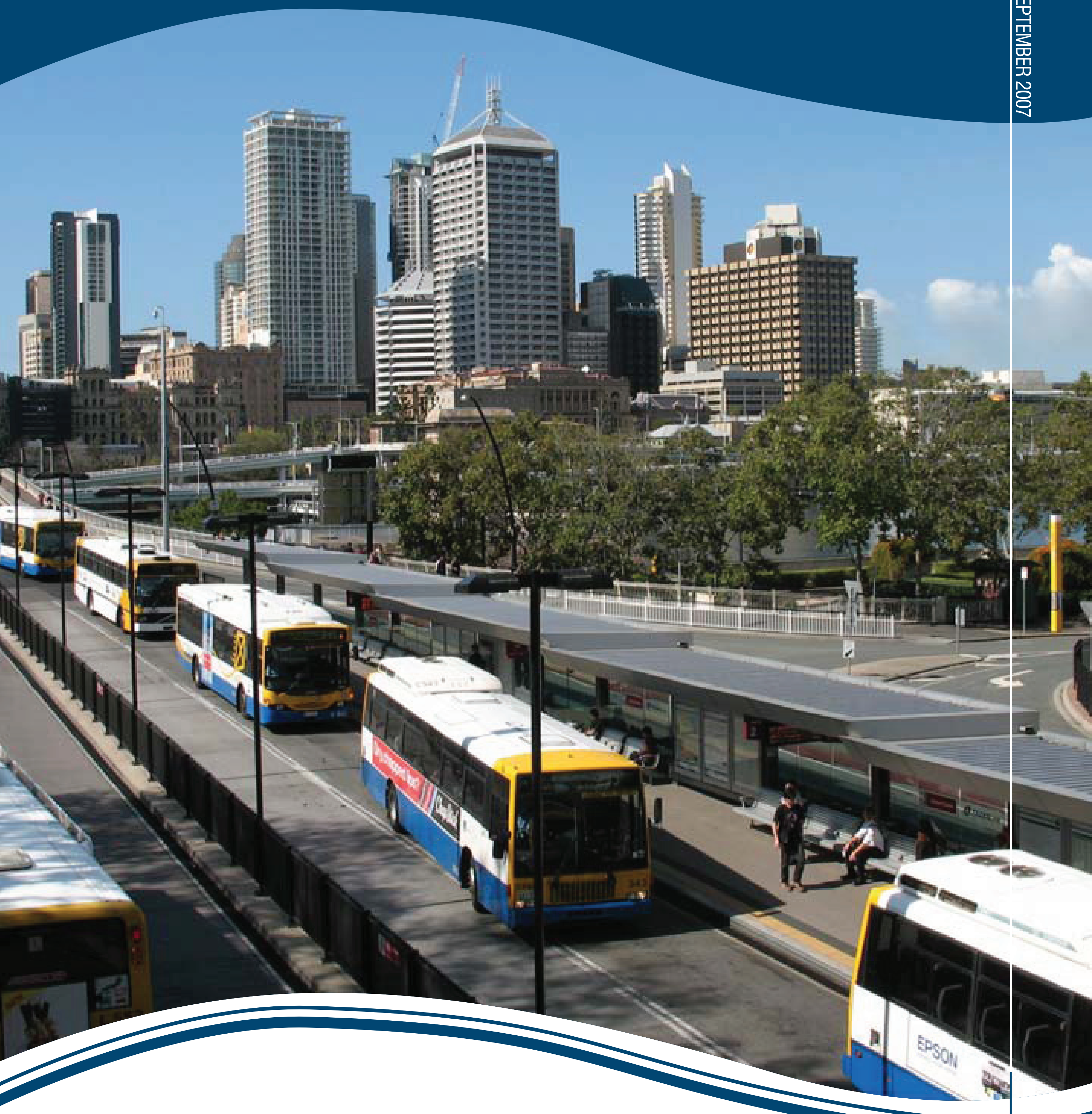
SEPTEMBER 2007



Lord Mayor's Taskforce Brisbane Mass Transit Investigation:

Options for consideration

BRISBANE CITY

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Glossary

Bus Rapid Transit	A non-rail based, distinctive, high passenger capacity vehicle which can operate in shared right-of-way with general road traffic or on its own right-of-way.
Busway	A dedicated right of way for buses
CBD	The zone of extensive commercial activity
Green bridge	A bridge used exclusively by public transport, pedestrians and cyclists
Integrated ticketing	One ticket that can be used on multiple public transport modes.
Light rail	A rail based service which can operate in shared right-of-way with general road traffic or on its own right-of-way.
Line haul services	Radial services to and from Brisbane's CBD
Mass Transit	Public transport with a high passenger carrying capacity and with the critical characteristics of efficient movement of large numbers of passengers, fast journey speeds and rapid boarding and alighting
Interchange	The act required by a public transport passenger to exchange between one public transport service and another to reach their final destination
Screen lines	Lines drawn along natural or human made boundaries where the number of transport crossings by road or rail are limited and the capacity and number of people travelling can be established
TransLink	Planning, coordination, service purchaser and marketing body developed to integrate public transport services, fares and ticketing throughout South East Queensland

This report responds to a request of the Lord Mayor of Brisbane, Campbell Newman, for an investigation into Brisbane's Mass Transit options to cater for future public transport demand, as identified in the City Centre Master Plan 2006, and the need to review available options to increase public transport capacity to cope with a significant increase in demand since 2004.

1. Executive summary and recommendations

1.1 A new Mass Transit system for Brisbane

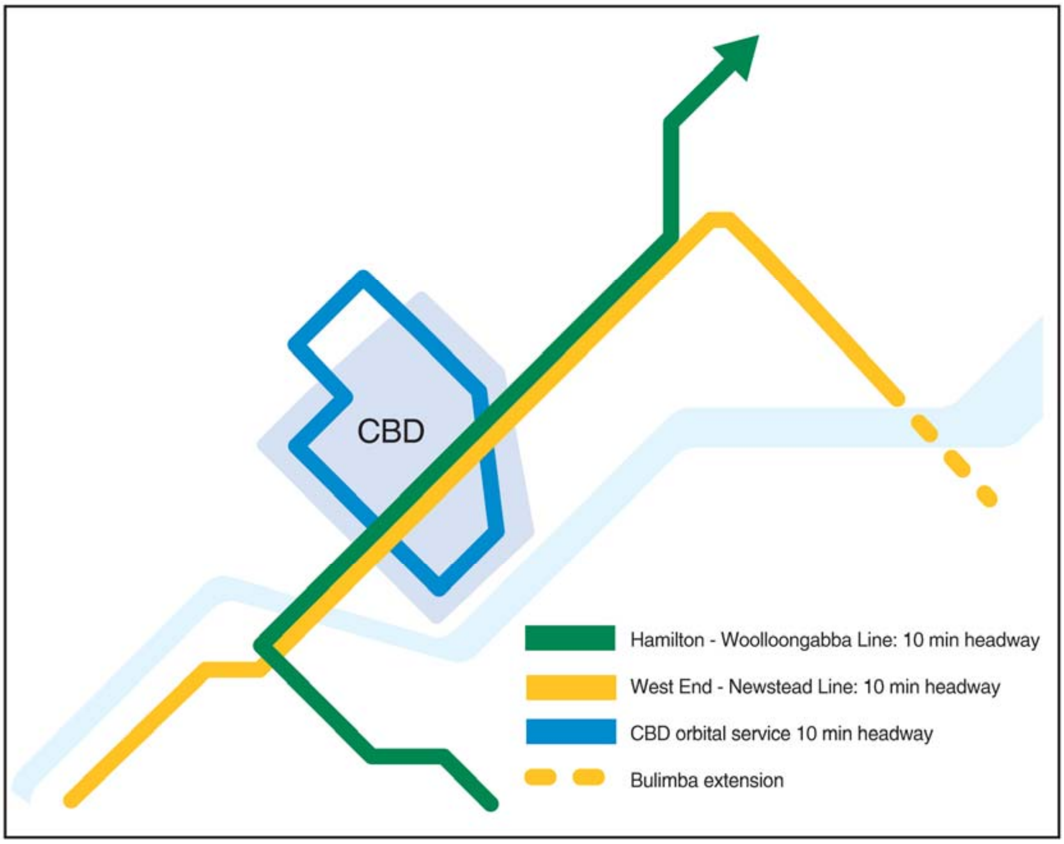
1.1.1 What is the need?

The City Centre Master Plan identified the need to provide a new Mass Transit service to connect many key destinations within the city centre and beyond, particularly in and around the CBD, West End, Newstead and Woolloongabba areas, with a highly visible, accessible, high-capacity public transport mode. This options paper is a response to that identified need and to projections such as those of the South East Queensland Regional Plan for population growth in Brisbane.

1.1.2 Proposed new Mass Transit service

Investment in new Mass Transit services will significantly improve the capacity, attractiveness and legibility of surface based public transport in the CBD and adjoining areas. A conceptual route network for the new Mass Transit service is shown in Figure 1-1:

Figure 1-1: Conceptual new Mass Transit network



- **West End–Newstead Line:** In the short term a north east/south west connector service between Newstead, Fortitude Valley, the CBD, South Brisbane and West End, to cater for high growth in residential development and employment there.

- **Hamilton-Woolloongabba line:** In the medium to long term, a new service from Hamilton/the Australia Trade Coast (north side of the River) to Woolloongabba with delivery timed to coincide with the staged development of the Australia Trade Coast, the Northshore Hamilton development and the urban renewal of Woolloongabba.
- **Bulimba extension:** In the medium to long term, the West End–Newstead line could be extended to Bulimba across a "green" bridge (public transport + cycling + walking), to improve linkages from the north-east to the south west through the CBD using the bridge announced by State Government and modified for public transport. The timing of the extension should be consistent with the growth in demand due to development within Bulimba.
- **Inner City Orbital Service:** An inner city orbital service is proposed to link Spring Hill, Roma Street Parklands, circling the CBD and linking to a proposed pedestrian bridge to Kangaroo Point.

1.1.3 Mode comparisons

The Taskforce identified that the proposed Mass Transit service could be provided by either an at-grade light rail or road based service. The road based service would be one equivalent to light rail in most aspects save that it would be rubber tyred and would not require an external power source. This mode was termed Bus Rapid Transit.

Several Bus Rapid Transit systems operate successfully around the world providing the Mass Transit service characteristics required by Brisbane. An example is the Bus Rapid Transit service in Eindhoven, Netherlands. The service is provided using single and bi-articulated hybrid diesel electric 'Phileas' buses produced by the VDL Groep. The bi-articulated vehicles have a maximum capacity of 185 passengers and are low floor vehicles. Irisbus, part of the Fiat-IVECO group, manufacture the Civis which is a single articulated stylised Bus Rapid Transit vehicle with a maximum capacity of 162 passengers.

Photo 1-1 Phileas Bus Rapid Transit vehicle

Source: www.apts-phileas.com

Photo 1-2: Civis articulated bus by Irisbus (IVECO)

Source: www.gobrt.org

Photo 1-3: Interior of Phileas

Source: www.apts-phileas.com

A Bus Rapid Transit system was identified by the Taskforce as providing significant advantages over a light rail system for this service. Brisbane's existing busways could be adapted rapidly and easily to accommodate a Bus Rapid Transit service. A comparison of the characteristics of both options is given is table 1-1.

Table 1-1: Comparison of modal characteristics

New Mass Transit system characteristics	light rail	Bus Rapid Transit
Route delineation	Very good	Markings required
Distinctive/attractive	Yes	Yes
Low floor	Yes	Mainly
Impact		
Traffic impact during construction	High	Low
Local air quality	Good	Moderate to good (if compressed natural gas or diesel–electric used)

Bus Rapid Transit was preferred because of its lower cost, significantly reduced infrastructure requirements, shorter time for implementation and lesser impact on road traffic operations, both during construction and in service. Apart from these advantages there were other issues associated with delivery of light rail including the following:

- Light rail systems require the laying of tracks and the installation of electrical systems (either overhead or inlaid in the pavement). The cost of construction and the disruption to traffic would be significant.
- Of particular concern is the ability of light rail to use the existing Victoria Bridge. It is unlikely the bridge could be modified to accommodate the load of light rail vehicles, tracks and overhead line equipment. A new bridge adjacent to the existing Victoria Bridge would need to be constructed and would add significant construction cost and delay the implementation.

A Bus Rapid Transit system was found to have the following advantages:

- The route would be delineated by distinctive road markings and priority measures where necessary to ensure high visibility, legibility, and service quality of the system but with relatively minimal disruption to traffic and adjacent businesses during the commissioning of the system.

- A Bus Rapid Transit system does not require the construction of an alternative to the Victoria Bridge.

Both light rail and Bus Rapid Transit would operate on shared right of way with general traffic but would require priority measures along parts of the route and at intersections to ensure a reliable and rapid service could be provided. Both modes would require the construction of appropriate stations which may involve the raising of footpaths.

Facilities to store and service vehicles for either operating system would need to be located as close as possible to the proposed routes, although there is greater flexibility in locating the depot for Bus Rapid Transit vehicles.

Although technically possible to implement – and hence not ruled out for consideration in the longer term – a Mass Transit system using light rail in the near term would come at a significantly higher cost and take longer to deliver. Given the limited funds available to government, the Taskforce believes that Bus Rapid Transit represents the most achievable option.

1.1.4 Costs

A high level estimate was made of the costs to construct and operate the Mass Transit service using light rail or Bus Rapid Transit. The Bulimba extension has not been costed due to uncertainty about the future development of the areas to be served.

Table 1-2: Comparison of Bus Rapid Transit and light rail on new Mass Transit lines

2007 Costs **($ million — capital costs include 30% contingency)**	**light rail**	**Bus Rapid Transit**
West End-Newstead		
Construction	$375	$33
Victoria Bridge upgrades/new bridge	New bridge = $94 m	not required
Vehicles (20 vehicles)*	$120	$60
Total capital cost *	$589	$93
Annual operating cost*	$7.8	$3.1
Hamilton-Woolloongabba line		
Construction (no viaduct)	$326	$32
Additional vehicles required (3 vehicles) **	$18	$9
Total capital cost	$344	$41
Future Kingsford Smith Drive viaduct	$220	$220
Additional annual operating cost **	$9.5	$3.8
Inner city orbital service		
Construction	$188	$11
Vehicles (9 vehicles)	$54	$27
Total capital cost	$242	$38
Annual operating cost	$3.1	$1.3

* - Peak service frequency of 5 minutes if Hamilton-Woolloongabba line is not commissioned

** - Additional costs required for services to be provided in conjunction with West End-Newstead service with 10 minute frequency on each line

1.1.5 Staging

The recommended timeframe for implementing the recommendations of the Taskforce in regard to a new Mass Transit services is set out in Table 1-3. The earliest operation of a Mass Transit system is only possible if Bus Rapid Transit is selected as the operating system.

Table 1-3: Staging of implementation

A detailed planning and design of the West End-Newstead Mass Transit corridor and the Inner City Orbital service should commence in the 2007/2008 financial year. This should be undertaken as a joint Brisbane City Council and State Government project to ensure that the development of the proposed Mass Transit system is integrated into the planning and operation of the public transport network.

It is proposed that the system be operational as soon as is practicable. It is important for the detailed planning and design to be completed early to allow vehicle procurement processes and construction procurement to commence in 2009/2010.

Detailed planning and design for the Hamilton-Woolloongabba Mass Transit corridor should continue on from the detailed planning and design undertaken for the West End-Newstead line. Commissioning of this line would depend on the delivery of planned development in Australia Trade Coast, Northshore Hamilton and Woolloongabba.

Planning for a Bulimba extension should only commence when there is greater certainty about the development of the suburbs that would be served by this extension.

1.2 System wide recommendations

1.2.1 Multi door access

Minimising embarking/disembarking times is critical in achieving faster journey times. This outcome needs to be facilitated with multiple door access to buses and Mass Transit vehicles. System-wide implementation of electronic ticketing as proposed by TransLink should provide the basis for enabling efficient and effective load and discharge of bus patrons.

1.2.2 Cross-town services

Cross town services linking major centres outside the CBD and surrounds, new employment nodes such as Australia Trade Coast, railway, busway and BUZ corridors are required to cater for increased diversity of travel. Cross-town routes should have adequate priority and services must be frequent to make them a viable travel choice.

1.2.3 Feeder services

High frequency feeder services, with adequate priority, are required to/from rail and busway line-haul corridors. Facilities for other feeder modes, including walking, cycling and taxis need to be improved. Wherever feasible new Park and Ride commuter parking facilities are required at rail and busway stations to take advantage of high frequency services on these networks.

1.2.4 Near-city orbital service

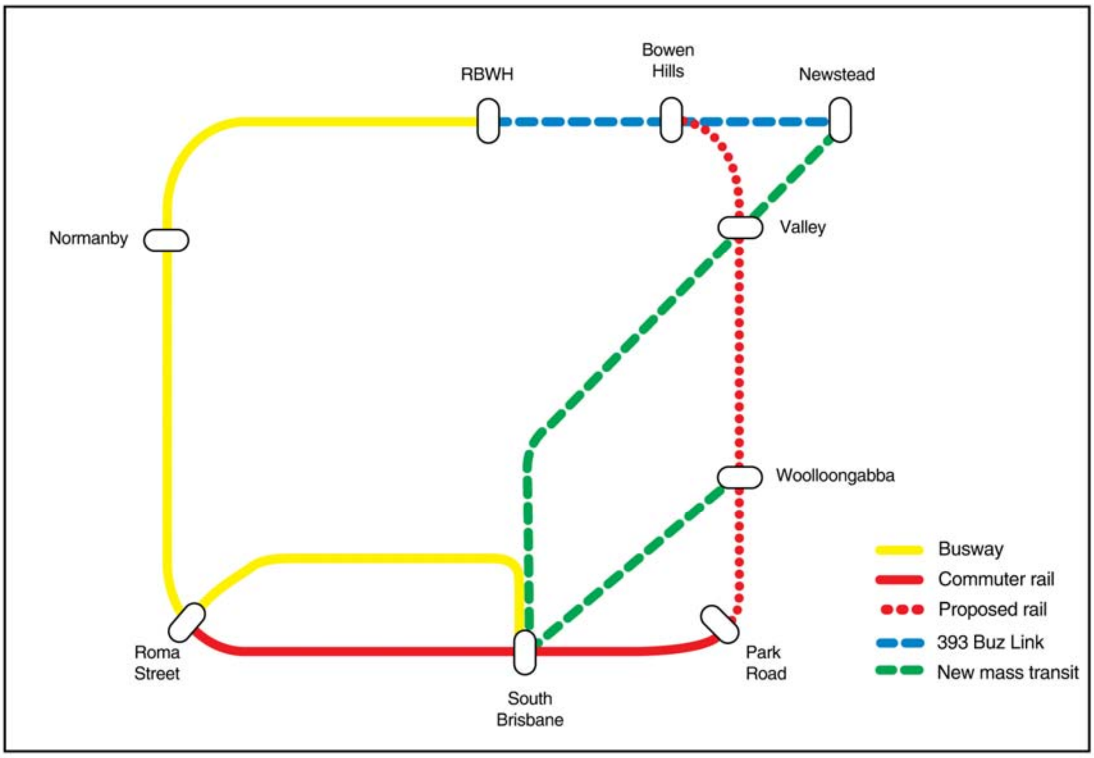
A near-city orbital service can be established using existing services on the South Coast rail line integrated with two new high frequency bus services, to improve connection of radial services to near-city destinations thus reducing the need for transfer in the central stations:

- Park Road Station-Bowen Hills Station via Woolloongabba, Kangaroo Point and Fortitude Valley; and
- Roma Street Station-Teneriffe Ferry via the Northern Busway, Royal Brisbane Hospital, Bowen Hills Station and the future West End-Newstead Mass Transit service. (similar to the current 393 bus route).

In the medium to long term, the State Government's new rail line from Park Road to Bowen Hills would replace the one high-frequency bus service.

There is a need for a stronger definition of this near-city orbital service, particularly on the bus segment linking Teneriffe Ferry, the proposed Newstead new Mass Transit, Bowen Hills Station and the Royal Brisbane Hospital to Roma Street Station.

Figure 1-2: Conceptual near City Orbital service



1.2.5 TransApex opportunities

The opportunities presented by TransApex will be available to benefit public transport and pedestrians, where TransApex projects reduce the capacity required for general traffic on existing roads. This capacity could be secured for public transport priority or pedestrian use.

1.3 Enhancement to existing public transport

The Taskforce supports the continued development by the State Government of the public transport network for the Greater Brisbane area, including the appropriate upgrading and extension of the heavy rail network, together with the expansion of the busway system.

To fulfil the vision of the City Centre Master Plan, the public transport network and service structure will need to be developed over time, to ensure that a fully integrated Mass Transit system services the CBD and adjacent inner urban areas.

In regard to current planning, investment and operation of the existing public transport network, the Taskforce makes the following comments on public transport developments that would aid and benefit the introduction of a Mass Transit system:

1.3.1 Commuter rail

Brisbane City Council should continue active engagement with Queensland Transport in support of the Inner City Rail Capacity Study. The concept of a commuter rail link from Bowen Hills to Park Road Stations, with connections at Centenary Place, Eagle St. Parliament/QUT and Woolloongabba, has significant network advantages.

1.3.2 Busways

Continued development of the busway program is strongly supported. In addition, the output of the Western Brisbane Transport Network Investigation will be important in defining the future busway needs in the South West, West and North West sectors of the City. Advantage should be taken in these areas of combined road and public transport infrastructure such as Northern Link.

The busway network needs to be operated with higher capacity buses in the short term. Articulated and/or bi-articulated Bus Rapid Transit vehicles, which could operate exclusively on the busways, need to be prioritised in fleet acquisition plans. In the long term, busways will need a larger capacity vehicle that may be readily adapted to light rail or a similar vehicle with comparable capacity and performance.

1.3.3 BUZ services

Increased capacity on existing BUZ services by using articulated buses and the introduction of new BUZ routes, will improve overall public transport service. Some of these new services should be structured to facilitate interchange with busway or heavy rail network where appropriate.

1.3.4 CityCat services

There is a need to expand the CityCat services to serve travel demands along the river corridor. New ferry terminals will be required in the West End, Milton, Northshore Hamilton and the CBD in support of development along the river.

1.4 Integrated Regional Transport Plan Update

Given work underway by the State Government on an update of the Integrated Regional Transport Plan (IRTP) for South East Queensland, the Taskforce recommends that a joint Brisbane City Council and State Government working group develop a specific Public Transport Plan for Brisbane as part of the IRTP.

This joint working group should commence upon completion of the State Government's Western Brisbane Transport Network Investigation, the Inner City Rail Capacity Study and the Bus Access Capacity – Inner City Study. If the Brisbane City Council adopts the Taskforce's recommendations as policy, these should be incorporated in the revision.

1.5 Consideration of a Metro system for Brisbane

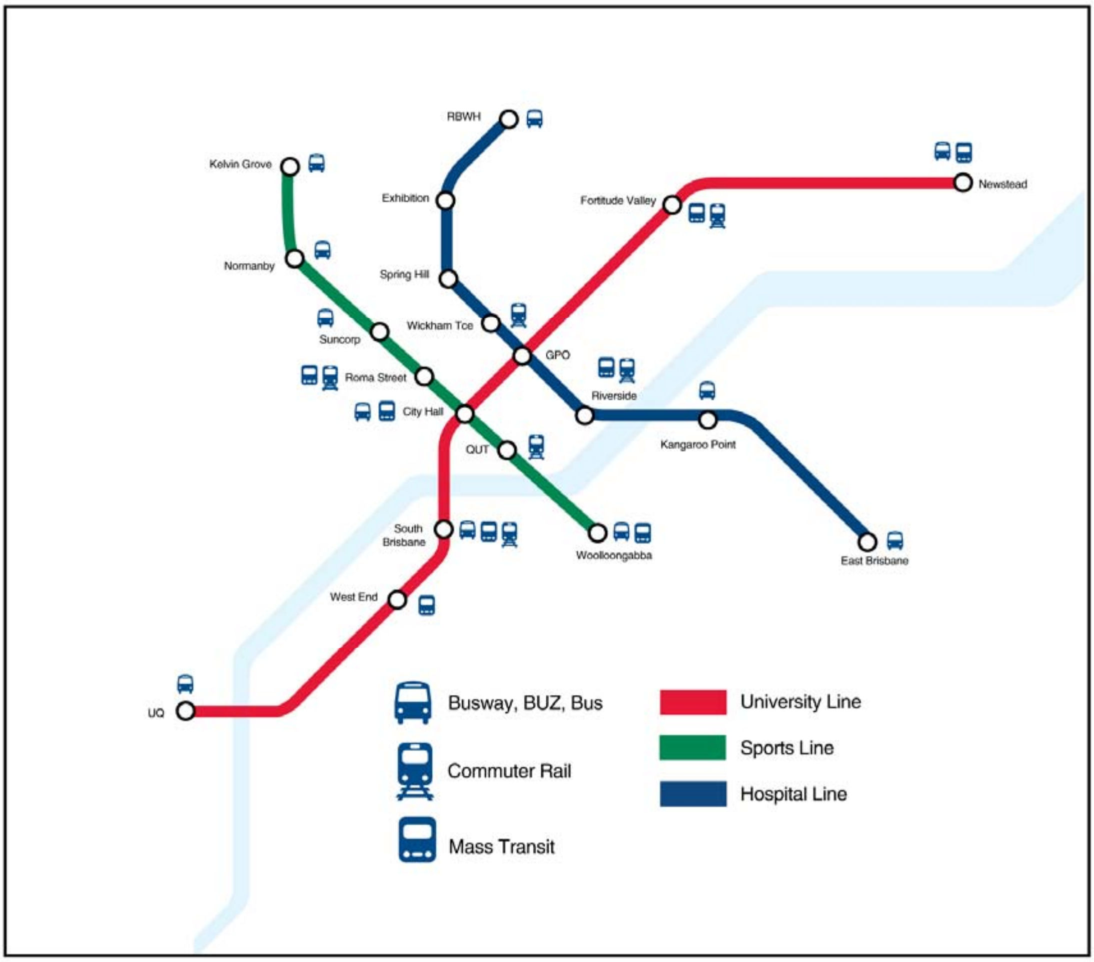
The feasibility of an underground Metro system, with a possible commencement date of 2026, is worthy of further investigation. An underground Metro system would reduce the impact of surface based public transport and improve pedestrian amenity in the CBD. The Metro system would distribute passengers across the CBD and surrounding areas and minimise the number of local buses needing to access the CBD.

Linking the key demand drivers of education centres, hospitals and sporting venues, the Metro would support adjacent commercial and residential centres. Three lines are proposed in concept for consideration.

Figure 1-3 illustrates a conceptual network for the Metro:

- **University line:** Linking University of Queensland, West End, South Bank. Queen Street Mall, Fortitude Valley and Newstead.
- **Hospital line:** Linking Royal Brisbane Hospital, Exhibition, Spring Hill, Queen Street Mall, Eagle Street, Kangaroo Point, and East Brisbane.
- **Sports line**: Linking Woolloongabba, Parliament/Queensland University of Technology, Queen Street Mall, Roma Street, Suncorp Stadium, Normanby and Kelvin Grove Village.

Figure 1-3: Conceptual route network for proposed Metro network



It is not considered that the capacity provided by a Metro system would be needed prior to 2026, but the concept should be included in planning being undertaken for inner city rail and bus capacity by a joint Brisbane City Council and State work group.

2. Introduction

South East Queensland has seen sustained population growth over the past 20 years. This growth is projected to continue and will impact on the capacity of existing transport systems.

Both the Brisbane City Council and State Government have in place planning frameworks to direct development to support more sustainable transport modes such as walking, cycling and public transport.

The City Centre Master Plan 2006 sets a 20-year vision for the future of Brisbane's city centre. The Master Plan has the following vision for Brisbane's public transport network:

> "An integrated public transport network capitalising on opportunities provided by TransApex. This integrated public transport network will include improvements to train, bus, ferry and taxi services and will prioritise investigation of new Mass Transit options."

In May 2007 the Lord Mayor of Brisbane, Campbell Newman, set up a Taskforce to investigate Mass Transit options to cater for existing and future public transport demand.

The Taskforce was asked to advise the Lord Mayor on an appropriate Mass Transit strategy for the inner city and the implications on the broader public transport network within the context of State Government's strategies and plans. The terms of reference for the investigation are set out in Appendix A, but can be summarised as follows:

> *An investigation into Brisbane's Mass Transit options to cater for future public transport demand, as identified in the City Centre Master Plan 2006, and the need to review available options to increase public transport capacity to cope with a significant increase in demand since 2004.*

Taskforce

The Taskforce consisted of Cr David McLachlan (Taskforce Chair), Mr John Gralton and Mr Stephen Lonie supported by a working group from the Brisbane City Council's Urban Transport Section of Transport and Traffic (City Policy and Strategy Division) performing project secretariat and coordination activities.

2.1 Scope

The Taskforce was asked to investigate Mass Transit options for Brisbane. The Taskforce used the term 'Mass Transit' to refer to public transport with a high passenger carrying capacity. Mass Transit is used to most efficiently move large numbers of people. Characteristics include fast journey speeds, and rapid boarding and alighting.

The Taskforce has concentrated its investigation on the CBD and the surrounding areas of South Brisbane, South Bank, West End, Kangaroo Point, Milton, Roma Street Gardens, Spring Hill, Bowen Hills, Fortitude Valley and New Farm – the area identified by the Brisbane City Master Plan 2006 as needing to be served by a future Mass Transit system. The geographical extent of this area is shown in Figure 2-1. This area is referred to in the report as the 'CBD and surrounds'. The Taskforce considered the implications of city-wide and regional public transport on the CBD and surrounds and vice versa.

Figure 2-1: Geographical extent of CBD and surrounds

2.2 Method

The Taskforce attempted to ensure that the investigation was informed by relevant policies and plans, transport demand projections and public and stakeholder consultation. It did not commence with a pre-determined view about the any particular mode of transport to be used to deliver a Mass Transit system.

In brief these steps were followed:

- **context** — review previous and existing plans
- **public transport demand** — estimate demand for public transport to 2026
- **public transport system** — identify the impact of planned system improvements
- **constraints and opportunities** — identify factors which either constrain or create opportunities for public transport
- **options to address demand** — develop options taking into account above
- **proposal** — recommend the preferred system and identify the impacts of the proposed system including traffic, infrastructure and cost.

2.3 Consultation

Community consultation

The community element of the consultation plan aimed to raise awareness of the project, provide information on Mass Transit modes and systems, receive ideas and gain an indication of the level of support for Mass Transit.

There were a number of means for people to hear about the project and have their say.

- **Website:** In the consultation period from 29 June to 20 July 2007 over 3,000 people visited the site.
- **Discussion forum:** A link from the Mass Transit website was provided for the community to connect directly to a discussion forum on Mass Transit where they could have their say. On the discussion forum, people were able to read each other's submissions, submit their own ideas, and engage in discussion with other users.
- **Email:** An email address was provided to which people could provide their comments if they were not comfortable submitting their comments using the discussion forum.
- **Press releases:** During the community consultation period, press releases were prepared and released to the media generating articles in local newspapers.
- **Informative emails:** Brisbane City Council employees were invited to have their say on Mass Transit via an administration email that went to all Brisbane City Council staff. Brisbane City Council also has an established contact group of residents involved in 'Your City Your Say'. This group is made up of high engagers, 5,000 with email contact and approximately a 20% response rate.
- **City Centre Master Plan:** The submissions relating to Mass Transit received during the public consultation of Brisbane's City Centre Master Plan were also considered as an input into the Mass Transit Investigation community consultation. These submissions were analysed with the submissions received from the online discussion forum.

Stakeholder consultation

The stakeholder consultation was predominantly arranged as one-on-one meetings with representatives from key peak bodies within Brisbane and relevant State Government departments. The purpose of this consultation was to understand the organisations' perspective, give the stakeholders the opportunity to raise issues, identify challenges, discuss parallel investigations, and exchange ideas and information. This consultation process ran in parallel with the community consultation.

Consultation occurred with stakeholders including:

- Queensland Transport
- TransLink
- Main Roads
- Queensland Rail — CityTrain
- Brisbane Transport
- Queensland Property Council
- Urban Futures Brisbane (Brisbane City Council)
- Northern and Southern Community Liaison Committees (Brisbane City Council)
- Chairs of Brisbane City Council's Urban Planning and Public Transport Committees.

2.3.1 Consultation outcomes

502 submissions were received from individuals through the online discussion forum, email and mail. Comment was invited on the future of public transport in Brisbane and submitters were not bound to a particular scope of discussion. At the end of the consultation period the submissions were collated according to the topics that came up frequently in submissions.

The consultation process for the City Centre Master Plan was of direct relevance to this investigation. The 27 community comments received on the proposed Mass Transit system were therefore combined with the comments received for this investigation.

Rail is a strongly supported public transport mode. The majority of comments received (82%) stated their support for the expansion of Brisbane's current public transport system to incorporate a Mass Transit system.

The proportion of comments received in support of light rail and bus were similar. This could indicate that the attractiveness of public transport is determined more by the service characteristics than the mode providing the service. The comments received on the preferred service characteristics are summarised in Table 2-1.

Some comment was received as to the preferred network structure. Thirteen per cent of comments received support a system which provides an orbital service in the city with some form of feeder service to this. Ten per cent of comments expressed the need for new routes to service more destinations.

Table 2-1: Service characteristics important to the public

Preferred characteristic	Comments
Frequent services	20%
Cheaper than other modes	13%
Interchange acceptable	11%
Must be environmentally friendly	10%
Increase park-and-ride	9%
Dedicated right-of-way	9%
Restrict car access to CBD	9%
Increased legibility of service	5%
Services on time	5%
Faster boarding	4%
Improve security and safety on PT	3%
Underground to improve CBD	1%
Free public transport	1%

Service frequency was seen as the most important characteristic. The relative cost of public transport against private car was an important factor affecting people's willingness to use the Mass Transit system. Despite this there was no real support for providing free public transport. A significant number of comments indicated that direct services were not always required and they accepted the need to transfer to reach their destination.

Most comments in support of commuter rail as a mode cited its ability to bypass congestion thanks to its dedicated right-of-way. Most comments in support of light rail and bus services indicated the need to prevent the service getting 'stuck in traffic'.

3. Context

This chapter provides an overview of the existing policy and planning context within South East Queensland. This involved the identification of policies and plans which impact directly on the development of a Mass Transit system for the Brisbane CBD and surrounds.

Although the work of the Taskforce is forward looking, it also acknowledges the importance of having a thorough knowledge and understanding of the historical context for Mass Transit systems in Brisbane. The task thus includes a historical overview of public transport in Brisbane and a review of previous Mass Transit proposals for Brisbane over the last 15 years.

3.1 Vision for Brisbane

The Brisbane City Council developed *Living in Brisbane 2026* as a vision for the future of the city. Some of the policies which impact on transport are:

- Brisbane will be kept moving by creating a strong, interwoven network of roads, public transport and pathways that link homes, workplaces, shops, schools and facilities.
- The 2026 target is that 41% of people travelling in the morning peak period will be walking, cycling or using public transport.
- Brisbane will be an accessible city for those who cannot afford private transport or who do not drive.

The Transport Plan for Brisbane 2002–2016 and the draft update of the plan (Brisbane Transport Plan Update 2006–2026) commit to the following six strategies to manage travel in Brisbane to achieve an accessible city:

1. quality public transport
2. managed travel demand
3. coordinated transport and land use
4. safe and efficient road network
5. delivering goods on time to the right place
6. more clean and green personal transport.

Brisbane City Council is committed to a quality public transport system for environmental and amenity reasons and for the strong contribution that public transport can make to reducing road congestion.

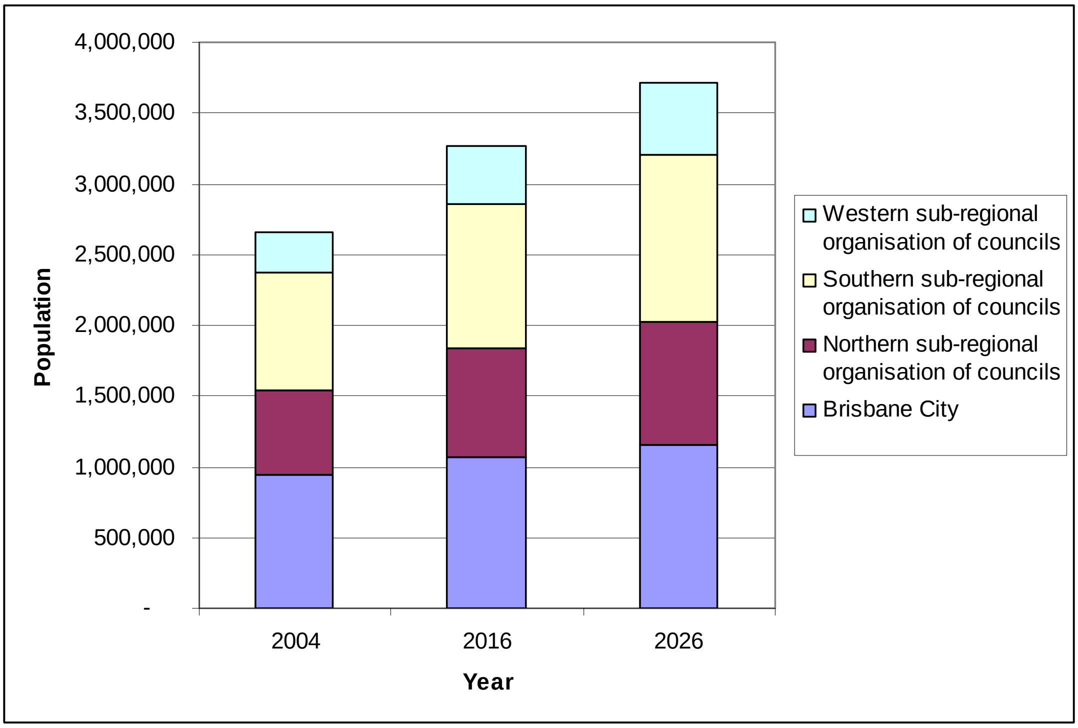
This context of strong promotion of sustainable transport solutions informed the Taskforce investigation of Mass Transit systems for the Brisbane CBD and surrounds.

3.2 Regional development

The South East Queensland region is the fastest growing region in Australia. This growth is projected to continue with an average growth of between 30,000 and 50,000 persons per year to 2026.

Although Brisbane is the economic and population hub for South East Queensland, its growth to 2026 is projected to be 22% compared to 42% growth in the southern sub-region, 47% growth in the northern sub-region and 79% growth in the western sub-region. The percentage of the population of South East Queensland residing in Brisbane will drop from 36% in 2004 to 31% in 2026. These figures indicate the approach of the regional plan to direct new development to the western corridor centred on Ipswich as well as in-fill development in existing areas. Figure 3-1 illustrates the projected change in population of sub-regions of the South East Queensland region. This regional growth will have a significant impact on the delivery of service and the provision of infrastructure for the City of Brisbane.

Figure 3-1: Indicative planning populations by sub-region



Source: SEQRP 2005–2026, Queensland Government Office of Urban Management

Currently the City of Brisbane accounts for over 75% of the jobs within greater Brisbane. More than 50% of employed residents in surrounding shires work in the Brisbane City area (Pine Rivers 61%, Logan City 51%, Ipswich 54% and Redland Shire 50%). As with population, the regional plan aims to generate employment outside Brisbane; however, the prominence of Brisbane as the regional employment hub will continue, and the demand for longer distance commuter trips will impact on the transport system in Brisbane.

3.3 Brisbane City future development

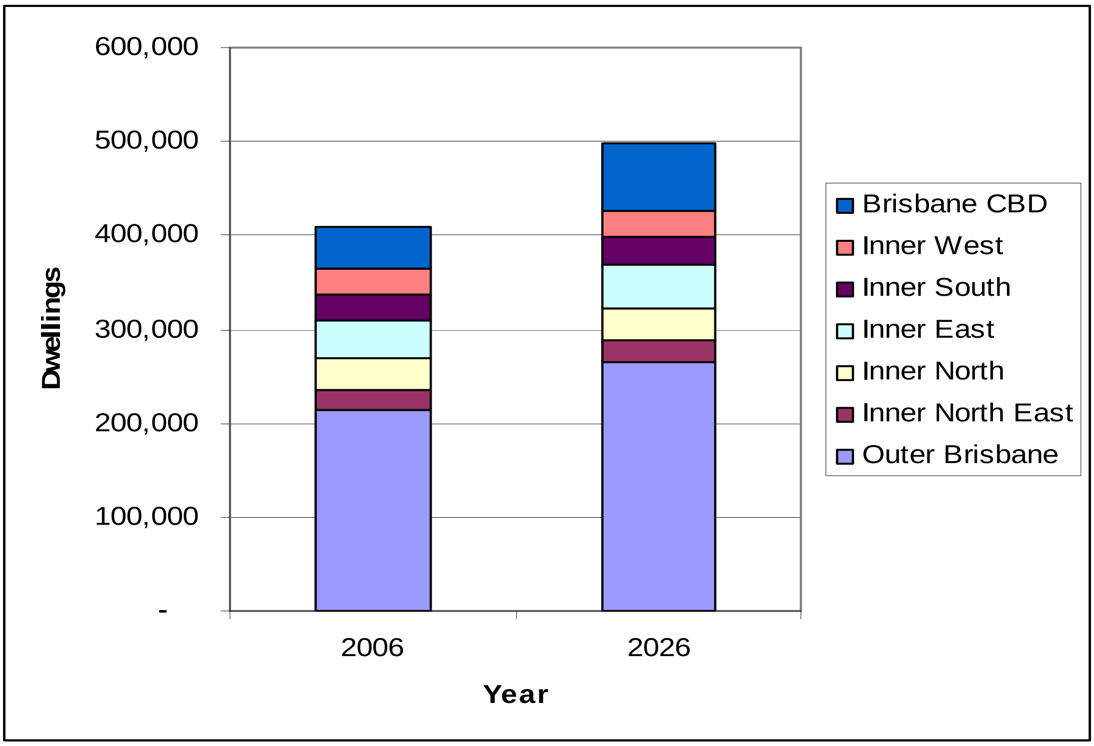
3.3.1 Population growth and residential development

Brisbane has changed rapidly over the past decade. Growth in population, demographic changes and economic growth and development have had a major effect on the nature of transport demand. This change will continue and is an important influence on the design of the city and its public transport systems.

From June 1995 to June 2005, Brisbane's population increased from 808,476 to 971,757. The population is predicted to be 1.15 million by 2026.[1] The majority of this growth will occur in the outer suburbs and by 2016 more than half of the population will reside in the outer suburbs. After 2016 green field land in outer areas of Brisbane will be largely developed and population growth will be accommodated by in-fill which will occur mainly in the inner area surrounding the CBD.

To limit urban sprawl and improve the sustainability of the city, the CityShape vision for the city is greater residential densities around major activity centres and along public transport corridors. CityShape is Brisbane City Council's response to the regional plan requirement for Brisbane City Council to develop a local growth management strategy. Figure 3-2 illustrates where growth will occur.

Figure 3-2: Projected growth in dwellings in Brisbane



Source: National Institute of Economic and industrial Research (2005)

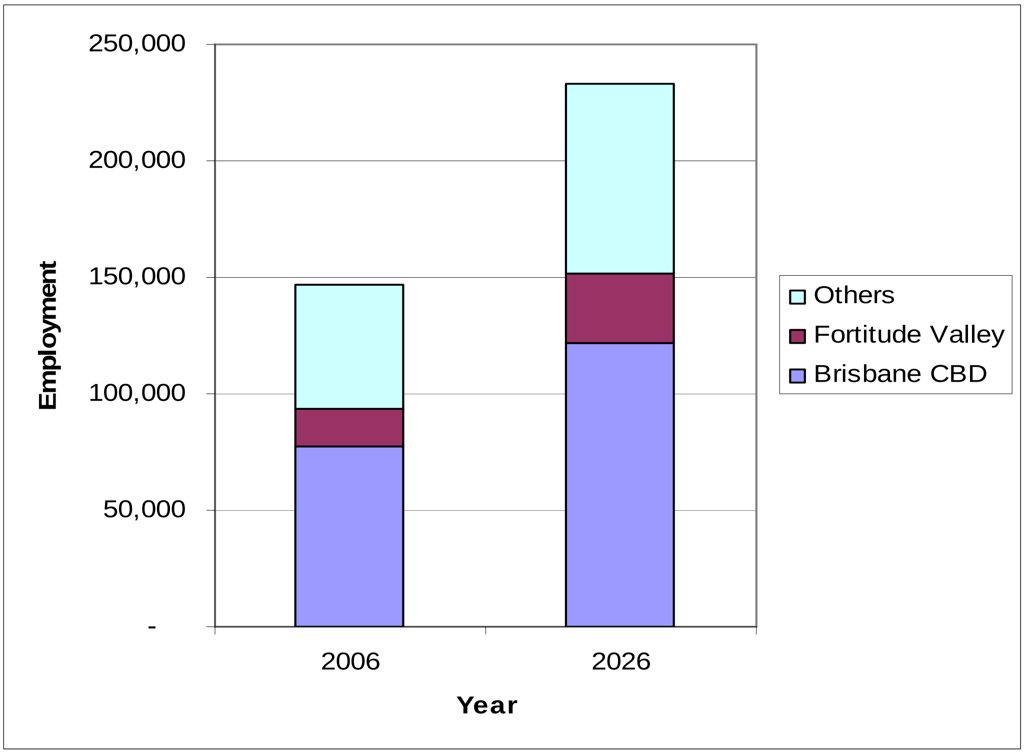
3.3.2 Economic activity

The growth of economic activity in Brisbane will be concentrated in the CBD and the areas surrounding the CBD, the Australia TradeCoast precinct, Indooroopilly, Carindale and Upper Mount Gravatt. Employment in Brisbane is expected to rise from 77,771 in 2006 to 122,000 in 2026. Although the percentage growth in employment in the CBD is lower than the percentage growth in other centres, the CBD will remain the main centre of employment in Brisbane for the foreseeable future.

[1] Population and Demographic Forecasts to 2031, Queensland Government's Planning Information Forecasting Unit (PIFU), 2005.

Figure 3-3 illustrates growth in employment in the CBD and Fortitude Valley and compares it to growth projected in the nodes of Chermside, Indooroopilly, Toowong, Upper Mount Gravatt, Carindale, Toombul, Mitchelton and Wynnum. Although the rate of growth of Fortitude Valley and other areas is higher than that projected in the CBD, the CBD remains the primary employment node in Brisbane.

Figure 3-3: Job growth in the CBD and activity centres



Source: National Institute of Economic and Industrial Research (2005)

The National Institute of Economic and Industrial Research's 'Brisbane Long Term Planning: Economic Indicators' published in October 2005 projected growth rates of over 80% in the Western Corridor and Australia TradeCoast which will result in significant growth in transport demand in these areas.

3.4 Brisbane public transport history

The history of public transport in Brisbane has shaped the network in existence. It also impacts on people's perceptions for future public transport options.

Table 3-1: Timeline of significant public transport events

Year	Milestone
1825	Convict settlement on Aboriginal land
1843	First cross-river ferry commences
1875	First Indooroopilly rail bridge connects Brisbane to Ipswich by rail
1882	Sandgate railway line opens
1885	First horse-drawn tram service starts
1885	Opening of first section of South Coast Line to Loganlea

Year	Milestone
1897	First electric tram commences
1901	Central Railway Station opens
1925	Brisbane City Council created
1925	First Brisbane City Council bus service starts
1927	Brisbane City Council buses cease due to financial loss
1940	Brisbane City Council recommences its bus services
1945	Trams carry 159 million customers
1947	Brisbane City Council takes over 20 private bus areas
1962	Fire destroys 65 trams at Paddington
1964	Railway from Brisbane to Gold Coast closes
1965	State Government's Wilbur Smith Plan says 'close tram network'
1969	Brisbane City Council ceases its tram and trolley bus services
1978	Merivale rail bridge opens
1982	*Cityxpress* radial bus routes commence
1988	Electrification of all Brisbane railway lines complete
1988	Queen Street Bus Station opens
1994	Brisbane City Council releases its busway plan
1996	Brisbane City Council introduces CityCats
1997	Rail line to the Gold Coast completed
2000	State Government's South East Busway opens to the Gabba
2000	Compressed natural gas buses introduced
2001	South East Busway opens to Eight Mile Plains
2002	Free downtown loop bus starts
2004	*BUZ* 'no timetable' services start
2004	State Government's Inner Northern Busway opens
2004	Integrated ticketing across South East Queensland begins
2006	Eleanor Schonell Bridge opens to UQ

Source: Brisbane City Council

Previous studies on light rail/trams in Brisbane

Brisbane discontinued its tram services in the 1960s and replaced them with bus services. Attempts to subsequently re-introduce light rail or trams have not been successful. The Taskforce examined these previous attempts. The lessons learnt are discussed in Appendix B of this options paper but can be summarised as follows:

- The primary purpose of a new public transport service must be to satisfy transport demand. Without this primary purpose the service cannot be viable.
- Due consideration must be given to the impact of a proposed new service on the existing road network, road users and adjoining properties.
- There is a need for a partnership between the Brisbane City Council, State Government and potentially the private sector in proposing to develop new or innovative public transport improvements.

4. Review of strategies, plans and studies

This chapter summarises the various public transport strategies, plans and planning studies of several agencies responsible for Brisbane's public transport network.

A review of these studies led to the conclusion that the future for the efficient and sustainable movement of the population of Brisbane lies with investment in public transport and the early planning of - and budgeting for - the services required alongside investments in road infrastructure.

Table 4-1: Agency responsibilities

Responsibility	Agency	Mode	Plans
Transport policy and planning	Queensland Transport	All modes	SEQ Integrated Regional Transport Plan
	Brisbane City Council	All modes	Transport Plan for Brisbane City Centre Master Plan Brisbane 2026 CityShape 2026
	Department of Local Government, Planning, Sport and Recreation	All modes	SEQ Regional Plan
Public transport infrastructure investment	Brisbane City Council	Bus, ferry	Brisbane 2026
	TransLink (Queensland Transport)	Bus, commuter rail	TransLink Public Transport Network Plan and program
	Main Roads	Road-based modes	Road Improvement Program
Public transport service planning	Brisbane City Council	Ferry Bus (advisory)	Transport Plan for Brisbane
	TransLink (Queensland Transport)	Bus, rail Ferry (advisory)	TransLink network Plan and program

4.1.1 South East Queensland Regional Plan

South East Queensland is the fastest growing metropolitan region in Australia. Although this growth brings opportunities, it also brings challenges. The State Government's South East Queensland Regional Plan (SEQRP) provides a growth management strategy for South East Queensland to the year 2026. The plan is a statutory and planning instrument which ensures alignment of local authority and State Government planning and policies.

The SEQRP has a vision of having a connected and accessible region based on an integrated transport system that supports more compact urban growth and efficient travel; connects people, places, goods and services; and promotes public transport use, walking and cycling.

The SEQRP sets a policy framework for transport in the region. It emphasises the need for integrating transport, land use and economic activity. Public transport infrastructure and service investment is required to lead and support the desired future urban form. The plan also gives strategic direction with regard to sustainability and environmental protection which impact on transport.

4.1.2 South East Queensland Infrastructure Plan and Program

The South East Queensland Integrated Plan and Program (SEQIPP) is a strategic long-term infrastructure plan that supports the South East Queensland Regional Plan. It provides certainty to State Government agencies, local government authorities, the private sector and communities on the priorities and timing for major infrastructure investment in South East Queensland.

The 2006–2026 SEQIPP identifies $3 billion of investment in increasing capacity on the passenger rail system and expanding the busway network up to 2026.

4.1.3 Transport Plan for Brisbane 2002–2016

The Brisbane City Council's Transport Plan for Brisbane 2002–2016 was published in 2002 and was a 15-year plan of coordinated actions and strategies to achieve balanced transport solutions for Brisbane.

The actions and strategies of the plan are grouped under six key objectives:

- **quality public transport** that everyone can use and encourages people to leave their cars at home
- **manage travel demand** so that traffic growth is kept below population growth
- **coordinated transport and land use** that makes it easy to travel across Brisbane using sustainable forms of travel
- **a safe and efficient road network** that minimises traffic impact on neighbourhoods and the environment
- **deliver goods on time to the right place** so that freight moves efficiently and safely throughout Brisbane while protecting residential areas
- **more clean and green transport** providing a safe and attractive alternative to driving.

The Transport Plan set a target for a 24-hour mode share for public transport of 14% and peak-hour public transport mode share of 68% of motorised trips to the CBD.

4.1.4 Brisbane Transport Plan Update 2006–2026

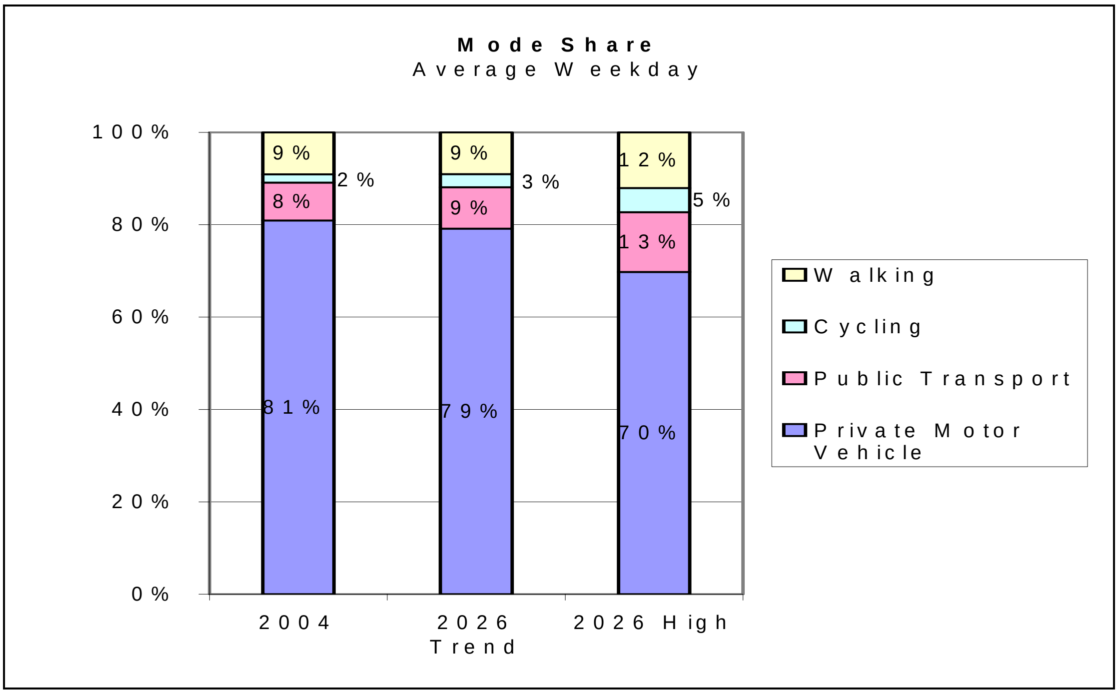
A draft updated transport plan for Brisbane was released in 2007. The update improved the accuracy in costing of road projects providing greater detail on the public transport resources required to achieve the mode-share targets. The update also has a longer-range focus with greater detail around the public transport services and infrastructure needed to provide for a sustainable future.

The Transport Plan Update considers three scenarios for public transport:

- Trend — a continuation of the long-term trend towards a greater proportion of trips being undertaken by car with excess demand over the capacity of the road network being addressed by further road widening mainly for private motoring.
- High public transport — trip demand over capacity of the road network out to 2026 is absorbed by expansion of public transport services. This does not prevent road widening and construction as planned in the South East Queensland Infrastructure Plan and Program (SEQIPP) and the Transport Plan for Brisbane 2002–2016. Further expansion of the road network beyond these projects would emphasise walking, cycling and public transport.
- Medium — a middle approach between trend and high public transport.

The draft Transport Plan Update recommends the high public transport approach, leading to the following overall mode-share targets for travel in the Brisbane City Council area as set out in Figure 4-1.

Figure 4-1: Mode-share percentage and total trips 2004 to 2026 (Brisbane City Council)



Source: Transport Plan for Brisbane Update (2007)

The plan sets targets for the peak public transport services by mode to achieve a daily public transport mode share of 13% for the city. This is contrasted with the mode split which would result from a continuation of current trends. The mode share for the CBD and an inner ring approximately 5 km from the centre are illustrated in Table 4.2.

Table 4-2: Mode-share targets for CBD and inner ring

Zone	Public transport mode share		
	2004	**2026 trend estimate**	**2026 high estimate**
CBD	45%	53%	75%
Inner ring	30%	35%	59%

Source: Transport Plan for Brisbane Update (2007)

4.1.5 City Centre Master Plan 2006

The Brisbane City Council's City Centre Master Plan 2006 sets a 20-year vision for the future of Brisbane's city centre. The focus of the Master Plan's proposal is the CBD and the transport, land use and the built-form relationship between the CBD and its immediate surroundings.

Transport strategies designed to service the busiest parts of the city centre are included in the Master Plan. The strategies link key generators and attractors in the city frame, and look at introducing new bus and train routes and stations, ferries and Mass Transit options.

The Master Plan identifies the need to improve public transport provision to and within the CDB and surrounding areas. It proposed some key transport elements that could make up such a system namely:

- an underground heavy rail link between Woolloongabba and Bowen Hills via Eagle Street and Parliament House to serve the eastern sector of the CBD and provide increased river crossing and city station capacity
- an accessible and recognisable Mass Transit service linking West End, South Brisbane, CBD, Valley, Teneriffe and New Farm to cater for the high growth and urban renewal.

The Master Plan does not specify the mode to provide the Mass Transit service but indicates that it should be a 'highly visible, extremely accessible high-capacity mode' which would be instantly recognisable and be integrated with other public transport services to provide a circulation system to enliven the city and connect key attractions. The Master Plan indicates a preference for light rail or similar services.

4.1.6 TransLink Public Transport Network Plan

In July 2007 the TransLink Network Plan was published. The plan provides a 10-year plan (2004–2014) for developing the public transport network and a 4-year program (2004/05–2007/08) of public transport services and infrastructure improvements.

The TransLink Network Plan sets out how TransLink will support the mode-share objectives of the Transport Plan for Brisbane. The plan sets out a program for increasing bus and rail capacity into the CBD on an expanded busways network and through increased rail capacity. It does not consider the possibility of the provision of an alternative Mass Transit solution for inner-city distribution as proposed in the City Centre Master Plan 2006 and therefore offers little guidance on the options to be considered in this investigation.

4.1.7 CityShape 2026

The Local Growth Management Strategy plan to manage growth in Brisbane over the next 20 years as required by the SEQRP is called CityShape 2026, currently in draft, and which sets the vision for the future development of Brisbane. The draft was developed by the Brisbane City Council in consultation with the community and will be finalised after further consultation.

The vision for the future Brisbane is for a multicentred city with growth encouraged along public transport corridors and around major centres located on public transport routes. CityShape proposes improving the public transport network to allow improved cross-city links and links between secondary centres. Achieving this vision will mean that between 2004 and 2026, 48% of new jobs will be created within 5 km of the CBD while 27% will be created in the CBD.

A key implication is that there is a need for public transport to better service travel to destinations other than the CBD.

4.1.8 Climate Change and Energy Taskforce Report

The Climate Change and Energy Taskforce Report was prepared in August 2006 to advise the Brisbane City Council on preparing the city for climate change and peak oil. Key recommendations relating to public transport are:

- to increase investment in public transport infrastructure and services, including the expansion of Mass Transit services to perform a distribution function within the CBD
- to lead the move to reduce greenhouse gas emissions by moving Brisbane City Council transport fleet to 'greener' fuels.

A key implication is that Mass Transit modes considered should preferably use 'green' fuels.

4.1.9 Inner City Rail Capacity Study

Queensland Transport is currently undertaking an Inner City Rail Capacity Study (ICRCS), supporting the development of the radial rail network in inner Brisbane. The purpose of this study is to develop an inner city rail master plan for the inner city.

The study is examining options to address the limited capacity that exists at the Merivale Bridge river crossing and at the inner-city tunnels and stations. This will include the possibilities of providing new underground rail links through the inner city.

The study will provide strategic direction for rail investment in the inner city to 2026 and beyond with initial advice due in the latter part of 2007.

4.1.10 The Bus Access Capacity — Inner City Study (BACICS)

This project is currently being undertaken by TransLink to assess future bus access and capacity needs in the inner city. The study will develop appropriate policy options and investment strategies to adequately provide for demands to 2016, 2026 and 2056. The study links with the Inner City Rail Capacity Study to ensure the same demand forecasts are used with a common understanding of the roles and long-term network strategy of rail. The study will provide strategic direction for bus investment in the inner city with initial advice due in the latter part of 2007. Final conclusions of the study will be made by mid-2008.

4.1.11 Western Brisbane Transport Network Investigation

The investigation is commissioned by Queensland Transport to produce a transport strategy that will guide the development of the transport system for western Brisbane for decades to come. It will investigate all transport options — public transport, roads, bikeways and pedestrian facilities — and how these modes will be integrated with other transport initiatives of the South East Queensland Regional Plan. By late 2007 stakeholder and community engagement on alternative network options will be undertaken. Final conclusions of the investigation will be published by mid-2008.

5. Public transport supply

This chapter provides an overview of the existing action plans of and initiatives taken by the City and State Governments with implications for the development of Mass Transit options.

5.1 Current public transport initiatives for the Brisbane local government area

5.1.1 Busways

Brisbane has a unique busway network constructed and being expanded by the State Government. The South East Busway and Inner Northern Busway have contributed to the increases in patronage on bus services. Figure 5.1 shows the planned busway network. Busways will fill the gaps between existing rail lines to enhance Brisbane's radial public transport network. The Western Brisbane Transport Network Investigation will consider the need for similar facilities in the western, north-western and south-western sectors of Brisbane.

5.1.2 BUZ services

The Bus Upgrade Zone (BUZ) concept was pioneered by the Brisbane City Council and has become an important component in TransLink’s planning. BUZ services are high-frequency services along corridors radiating from the CBD. Some of the services use the existing busway network or will use the planned extended busway routes. Figure 5.2 shows the existing BUZ service network. The concept has been extremely successful in attracting increased patronage. Services on the existing routes are being increased to cater for the increased demand. Brisbane City Council is discussing further BUZ routes with TransLink.

The majority of the BUZ services are targeted at suburban commuters. However the 199 service from West End to Newstead provides a service along a route similar to that proposed for a new Mass Transit service in the City Centre Master Plan.

5.1.3 Heavy commuter rail

This high-capacity network provides a suburban commuter service and inter-urban service radiating from the CBD. Figure 5.3 shows the existing rail network and supporting rail–bus services and the existing busways.

Additional track capacity and service frequencies are in the process of being provided or are planned to 2014 to cater for the rapid increase in patronage. Route extensions or new lines are planned to the west and south to cater for new development. Investigations are underway to increase rail capacity in inner Brisbane including the construction of new lines and stations serving the CBD.

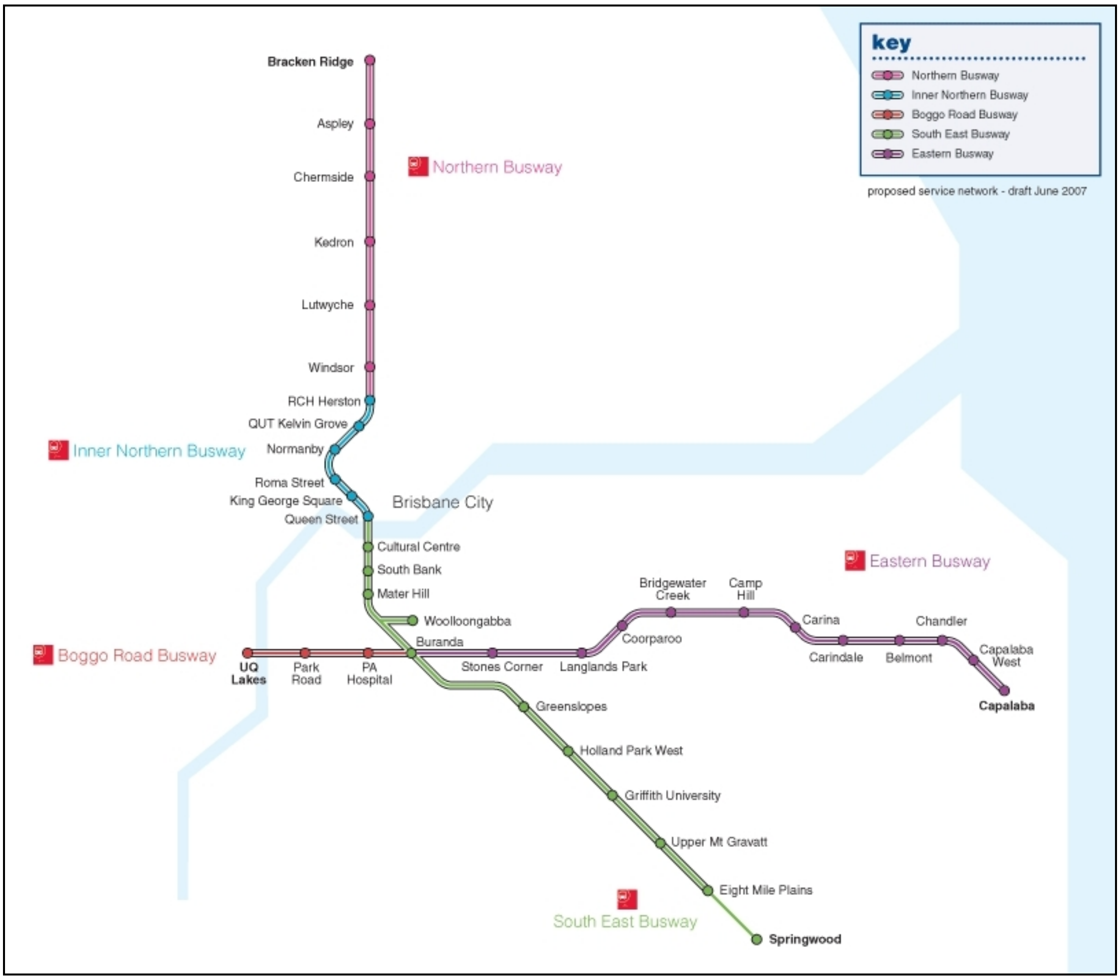
5.1.4 Integrated ticketing and smart card

Integrated ticketing was introduced in 2004 by the State Government with strong support from the Brisbane City Council on bus, rail and ferry services within the TransLink service area. The integrated ticketing system has standardised fares, concessions, ticket types and zones across the whole region.

Subsequent to the introduction of integrated ticketing there has been significant growth exceeding projections in public transport patronage. The rate of patronage growth since 2004 has exceeded the rate of population growth in the region by a factor of 5.[2] Although integrated ticketing has been an important factor in this growth, other significant factors have been, and continue to be, other public transport infrastructure investments and service improvements have also had a major impact.

TransLink is currently trialling an integrated ticketing system using smart-card technology. Originally announced for implementation in 2005, the TransLink Network Plan indicates that the pilot of the system will now be completed in 2007 and rolled out across the whole network by the end of 2007. The smart-card ticketing system is an essential element of improving boarding times on buses and is crucial to 'Mass Transit' services.

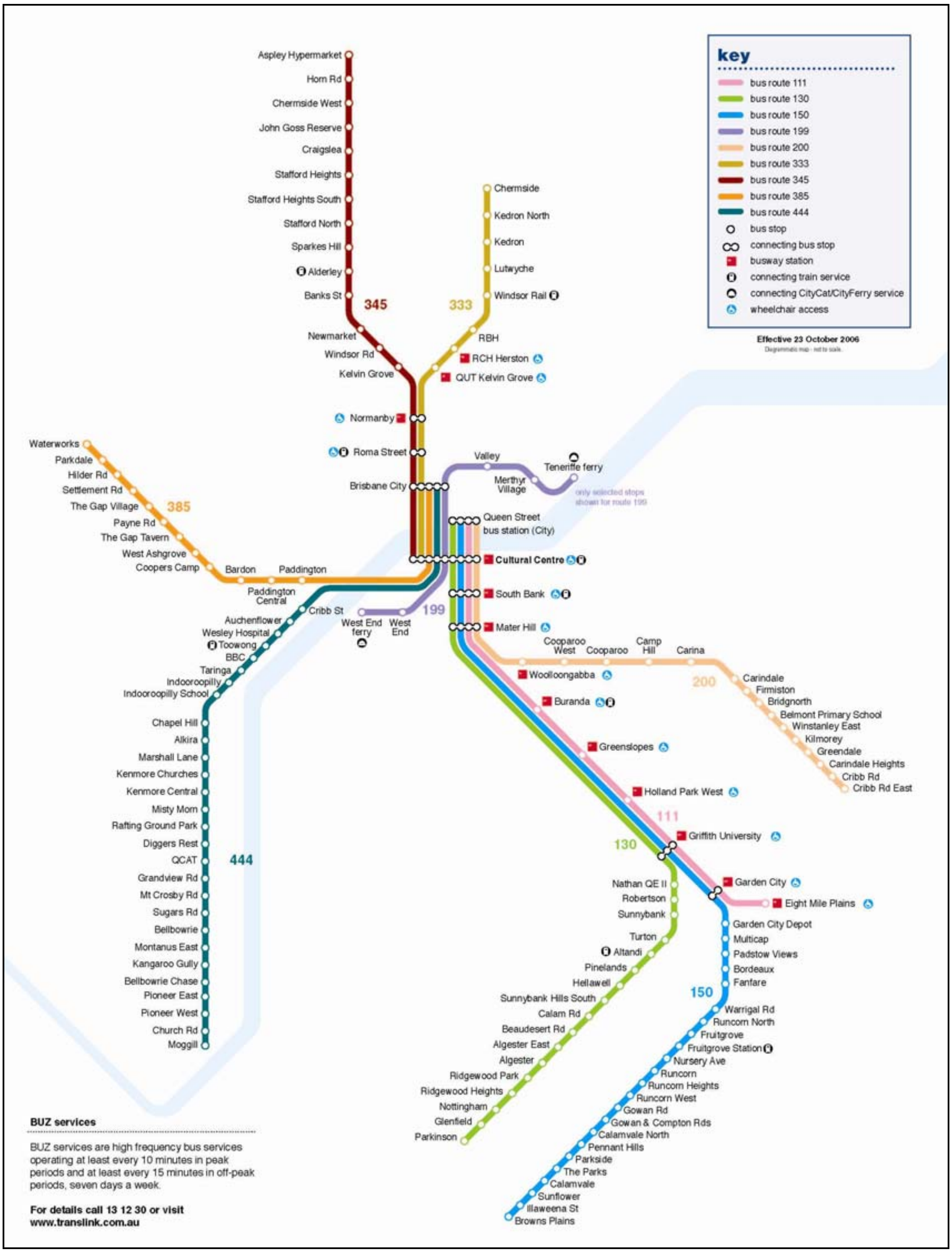
Figure 5-1: Planned busway network



Source: TransLink website

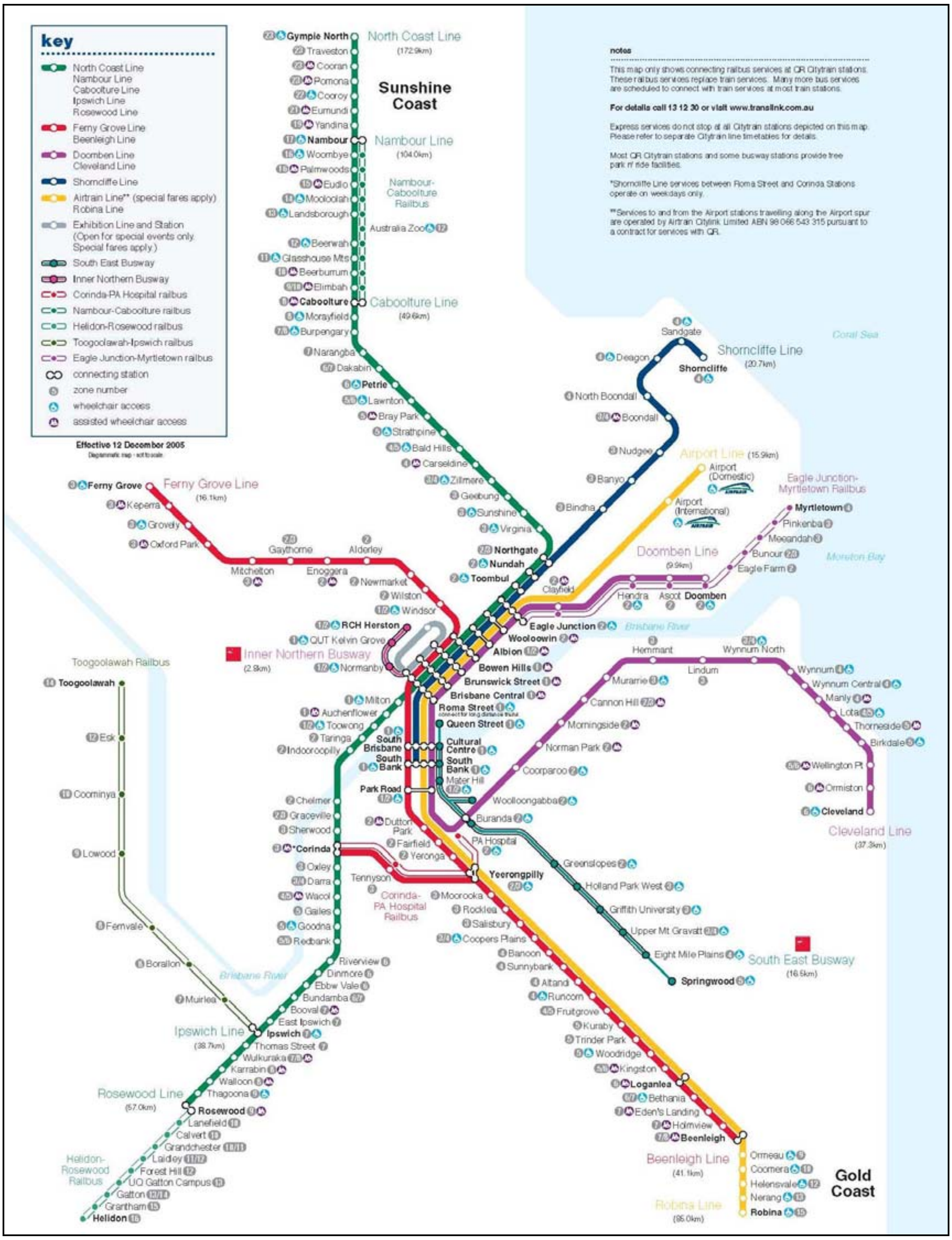
[2] TransLink Network Plan, July 2007

Figure 5-2: Existing BUZ service network



Source: TransLink website

Figure 5-3: Existing rail, rail–bus and busway network



Source: TransLink website

5.2 TransApex

Currently 43% of vehicles travelling through the CBD do not want or need to travel this route. TransApex is designed to free up the pressure on roads serving the CBD and divert traffic around the city centre. TransApex fills in some critical missing gaps in the arterial network and consists of a system of roads — primarily tunnels — allowing cross-city traffic to bypass the CBD.

Although TransApex is primarily focused on the provision of road capacity for car and freight transport, it is projected that it can have a significant impact on public transport within central Brisbane. This initiative will free up road space in the CBD and surrounding areas that could provide additional pedestrian areas in the CBD and improved right-of-way to public transport on roads through the CBD and surrounding areas.

TransApex also allows for the efficient delivery of express public transport services. For example, the proposed Northern Link tunnel could cut daily bus travel between Kenmore and the CBD by 26 minutes.

Figure 5-4: TransApex Plan

Source: Brisbane City Council website

The pre-feasibility study on the five legs of TransApex was undertaken in 2004 and three legs have advanced to construction or procurement phase — North–South Bypass Tunnel, Airport Link and Hale Street Link. A preliminary assessment of the fourth link, the Northern Link, has been completed. Brisbane City Council will again review the timing for East–West Link in 2011 when traffic demand will be re-examined.

Currently the North–South Bypass Tunnel is being constructed and is programmed to be completed in late 2010. A contractor has been selected for the Hale Street Bridge Project and tenderers have been short-listed for the Airport Link project. Construction of Hale Street is planned to start in late 2007 and finish in 2010. Construction of Airport Link is planned to start in 2008 and be completed in 2012. The impacts of these new links in encouraging traffic to divert around the CBD will be felt from 2010 onwards.

6. Public transport demand

This chapter examines the future demand for travel in the CBD and surrounds. The Taskforce set out to identify the demand for public transport into and within the CBD and surrounds. The demand across boundaries (screen lines) between sub-areas of the BCC area was identified in a 5 km radius around the CBD.

6.1 Existing public transport demand

6.1.1 City-wide demand

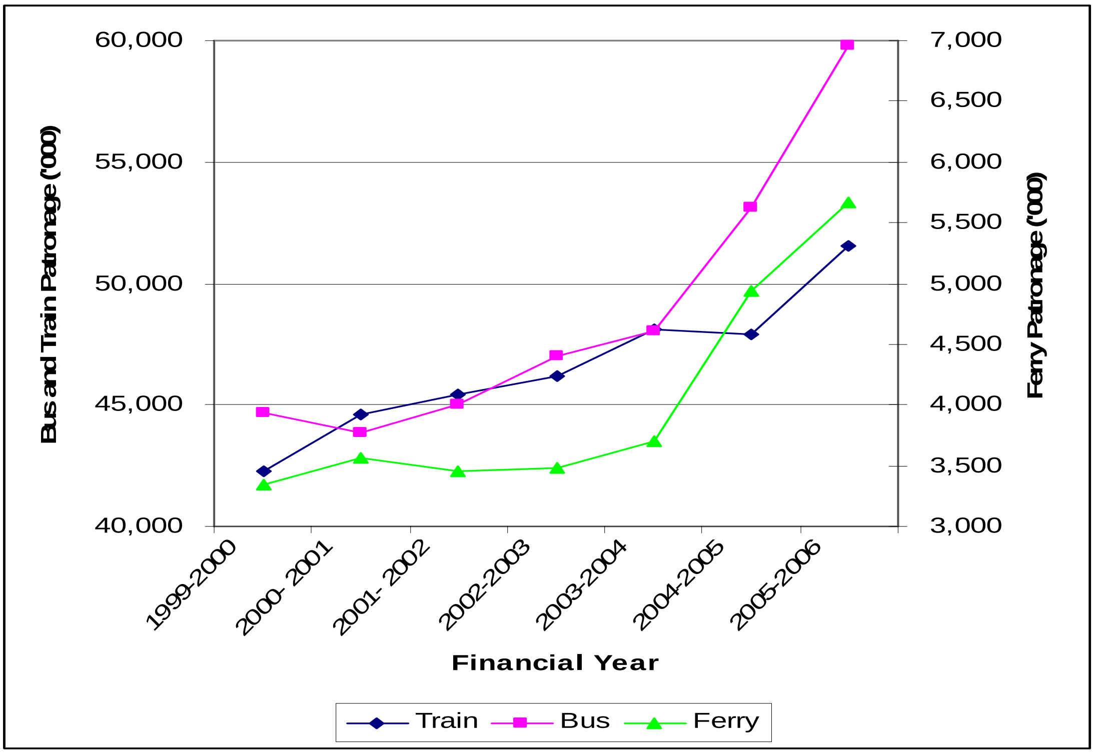
Public transport patronage in Brisbane (and the rest of South East Queensland) has been growing at unprecedented levels since 2004. Prior to 2004 the annual growth in patronage was less than 3% per annum and was less than the annual growth in trips (by all modes) within Brisbane. The public transport mode share decreased from 11% in 1976 to its current level of 8%. At the current growth rates the growth in public transport trips is ensuring that the public transport mode share at least remains constant. Table 6-1 and Figure 6-1 show the growth in patronage since 1999 for services terminating or originating in Brisbane.

Table 6-1: Public transport patronage in Brisbane 1999/2000 to 2005/2006

Passengers per annum ('000)	Train		Bus		Ferry		Total	
	Actual	Increase	Actual	Increase	Actual	Increase	Actual	Increase
1999–2000	42,288		44,673		3,347		90,307	
2000–2001	44,628	6%	43,880	-2%	3,563	6%	92,071	2%
2001–2002	45,414	2%	44,996	3%	3,460	-3%	93,870	2%
2002–2003	46,218	2%	47,020	4%	3,482	1%	96,719	3%
2003–2004	48,086	4%	48,062	2%	3,695	6%	99,843	3%
2004–2005	47,884	0%	53,101	10%	4,936	34%	105,921	6%
2005–2006	51,549	8%	59,793	13%	5,663	15%	117,005	10%

Source: Transport Plan for Brisbane Update (2007)

Figure 6-1: Patronage growth trends



Source: Transport Plan for Brisbane Update (2007)

The commissioning of the South East Busway in 2001, the Inner Northern Busway in 2003, the introduction of integrated ticketing in 2004, the introduction of high-frequency bus services (BUZ services), and the significant investment in the bus fleet (particularly in the number of airconditioned buses) have been the main reasons for the growth in bus patronage outperforming the growth in rail patronage.

6.2 Forecasting future public transport demand

The Taskforce used the Brisbane Strategic Transport Model (BSTM) estimates in the Transport Plan for Brisbane Update (2007) to identify the level of public transport patronage necessary along existing transport corridors to maintain minimal operational standards. In addition, demand was also assessed using a high-growth scenario based on a projection of growth in demand to 2026 at a rate equal to the average city-wide public transport growth rate over the last 3 years. This equates to a 5.83% annual growth rate from current patronage levels.

The current demand for public transport may well be constrained by existing peak public transport capacity. Previous investments in improving public transport have had a greater impact than expected on patronage. The Taskforce therefore concluded that it was advisable to consider the high growth public transport scenario share in the short to medium term would thus be used to ensure that proposals developed would adequately cater for this eventuality.

Looking beyond 2026, there are many uncertainties in regard to the development path of Brisbane and the impact changes in transport technology will have on the transport network. Transport demand has thus not been projected past 2026. Instead, assumptions as to the structure and operation of the land use and transport interaction in Brisbane and the CBD were used to inform the development of options for future Mass Transit systems in this period.

These demand projections were compared with an extrapolation to 2026 of an annual growth rate of 5.83%. Table 6-2 compares the Transport Plan for Brisbane Update (2007) and the extrapolation of the current growth in demand on major corridors crossing the southern and northern inner screen lines.

Table 6-2: Comparison of 2026 demand projections for the 2-hour peak period

Corridor	Mode	2006 demand	2026 demand (BSTM)	2026 high demand (5.83% constant growth)
Northern Screen Line				
Breakfast Creek Road	Bus	734	2,343	2,280
Coronation Drive	Bus	1,965	2,933	6,103
Ferny Grove Line	Rail	4,289	6,537	13,321
Ipswich Line	Rail	6,558	14,066	20,368
Kelvin Grove Road	Bus	1,878	2,413	5,833
Lutwyche Road	Bus	3,584	8,505	11,131
North Coast Rail	Rail	8,663	24,591	26,906
Other services	Bus	2,004	5,020	7,229
Total		**29,675**	**66,408**	**93,171**
Southern Screen Line				
Waterworks Road	Bus	1,220	1,671	3,789
Cleveland Rail	Rail	4,423	7,339	13,737
Ipswich Road	Bus	840	1,574	2,485
Old Cleveland Road	Bus	2,846	7,890	8,839
Other services	Bus	4,206	5,430	13,187
Pacific Motorway	Bus	1,465	2,700	4,550
South East Busway	Bus	6,821	18,527	21,185
South Coast Rail Line	Rail	4,501	10,227	13,979
Wynnum Road	Bus	1,631	3,845	5,066
Total		**27,953**	**59,203**	**86,817**

Source: Brisbane Strategic Transport Model (2007)

The Taskforce investigation used the more conservative projections developed in the Brisbane Strategic Transport Model (BSTM) to estimate the possible patronage expected on the various corridors entering the CBD and the implications for existing line-haul modes and the CBD. Appendix C contains the BSTM zones and 2026 forecast for trips originating or terminating in the inner city.

An analysis of the public transport demand throughout the day showed the peak-hour demand equates to 60.7% of the 2-hour peak demand.[3]

[3] 2003/04 South east Queensland Travel Survey version 1.6

6.3 Public transport demand in 2026

6.3.1 Demand along proposed Mass Transit service routes

The City Centre Master Plan proposed two Mass Transit services — one being a Mass Transit service from West End to Newstead and the other an inner-city orbital system. The BSTM forecasts were used to project the demand for 2026 along these proposed Mass Transit corridors.

- **West End–Newstead**

  The forecast demand for in-bound journeys on the West End–Newstead Mass Transit route is illustrated in Table 6-3. In forecasting the demand only peak-period trips originating within the CBD and surrounding suburbs were assumed to use the West End–Newstead Mass Transit line. Only trips originating in the CBD and surrounds which went to or through the CBD were assumed to use the service. Local trips were assumed not to use the Mass Transit system. Based on the BSTM data, only 25% of public transport trips originating from the West End, Kurilpa Point and South Bank and going to destinations other than those in the inner city were assigned to the Mass Transit corridor. A total of 73% of the trips originating in the Valley, Newstead and New Farm with destinations outside the inner city were assigned to the Mass Transit corridor.

  In-bound trips in the morning peak were examined. Trips originating outside the CBD and surrounds but destined for areas along the Mass Transit corridor were found to not be the factor determining the service required. Trips occurring between the peak periods and the off-peak period were not calculated.

Table 6-3: 2026 In-bound demand projections along proposed Mass Transit corridor

Zone (see Appendix C)	2-hour peak period	1-hour peak	Cumulative peak in-bound patronage (passenger per hour)
South-western leg			
West End Riverside	702	428	428
West End	333	203	631
South Bank	589	359	990
Kurilpa Point	632	386	1,376
North-eastern leg			
Valley	663	404	1,952
Valley North	430	262	1,548
Valley West	221	135	1,286
New Farm	998	609	1,151
Newstead	889	542	542

Source: Brisbane Strategic Transport Model

- **Inner City Orbital Service**

  The projected demand for services on the Inner City Orbital Service was similarly determined. Only trips originating in Spring Hill and Roma Street were assigned to the service. Table 6-4 illustrates the projected demand on the Inner City Orbital Service in 2026.

Table 6-4: Demand projections on proposed Inner City Orbital Service

Zone (see Appendix C)	2-hour peak period	1-hour peak
Roma Street	834	515
Spring Hill	1,029	635
Total		**1,150**

Source: Brisbane Strategic Transport Model

Demand from other areas relevant to the investigation

The population living in the suburb of Woolloongabba will grow significantly due to urban renewal projects. The suburb would not be served by the City Centre Master Plan's proposed Mass Transit corridor and orbital service. Although served by the busways, it is likely that additional services would be required to service the demand generated.

It is estimated that trips originating from the Northshore Hamilton development, a planned residential proposal of more than 10,000 persons. It is estimated that this could add more than 1,000 passengers per hour to the morning peak public transport volumes along the Mass Transit corridor.

Table 6-5 illustrates the projected 2026 demand for trips originating from Woolloongabba and terminating in the CBD and surrounds.

Table 6-5: Demand projections from other inner city

Zone (see Appendix C)	2-hour peak period	1-hour peak
Woolloongabba	1,264	767
Northshore	1,647	1,000

Source: Brisbane Strategic Transport Model

7. Constraints and opportunities

This chapter describes the constraints and opportunities that informed the development of proposals. These include the physical constraints and opportunities of the CBD and surrounds, environmental considerations on choices made, the characteristics of Mass Transit modes, and network structure.

7.1 Physical constraints

Any proposal for the improvement of public transport needs to take account of the physical constraints that present themselves. These constraints are discussed below.

- **Brisbane River:** The Brisbane River forms a barrier to trips accessing the CBD from the south and east. It also forms a barrier between the CBD and growth areas immediately to the west. Although the river is now more effectively used for public transport, the carrying capacity of the river limits ferry services to a role of support to other Mass Transit modes.
- **Topography:** The inner-city suburbs to the north of the Brisbane CBD are higher than the CBD. Road gradients on streets accessing Spring Hill and Fortitude Valley may constrain access by light rail.
- **Road network:** The current one-way grid system within the CBD is limited by the exits and access ramps to the Riverside Expressway. Road capacity along all the arterials in the CBD, New Farm, Newstead and Fortitude Valley are severely constrained due to narrow road width. Arterials passing through Fortitude Valley have taken up most of the road reserve leaving limited pedestrian sidewalks. The opening of the North–South Bypass Tunnel and Airport Link will reduce the amount of traffic on certain routes through Fortitude Valley.
- **CBD kerb space:** There is strong competition for limited kerb space within the CBD and adjacent areas. Pedestrian requirements and additional on-footpath commercial space will mean that road space will shrink. This will limit the availability of kerb space for public transport stops if minimum traffic lanes are to be maintained.

7.2 Climate change

Motor vehicles account for 70% of South East Queensland air pollution, and 10% of greenhouse gas emissions. In Queensland, transport accounts for 12% of the State Government's greenhouse gas emissions.

Fuel consumption per vehicle under congested traffic conditions is approximately twice that under free-flow conditions. Congestion has the potential to double the output of greenhouse gas emissions from a stream of vehicle traffic.

To minimise the impact of transport on the environment, it is essential that the contribution of transport to greenhouse gas emissions is reduced.

7.3 Peak oil

Oil is a non-renewable resource. It is projected that the supply of oil is set to peak, or has already peaked and oil demand will begin to exceed supply. This will result in a steady rise in oil prices worldwide. Although natural gas is far more abundant, it is also a finite resource and will also peak.

Transport accounts for 41% of Australia's final energy consumption. On current trends, it is expected to increase by 48% over the next 20 years. Globally there is a concerted effort to investigate alternative energy sources for transport. The impact of a steady increase in fuel prices and the cost of alternative fuels on demand for public transport needs to be considered but is difficult to predict.

The world now stands at a point where things will change as the price of oil rises. Exactly how they will change is difficult to predict with any degree of certainty. There exists however an opportunity now to steer the direction of this change through appropriate policy, strategy and timely investment. It is reasonable to accept the proposition that public transport will be a key element in managing the predicted impact of peak oil.

8. Mass Transit modes

This chapter provides an overview of all modes (vehicle types) Brisbane could consider when investigating Mass Transit options.

8.1 Mass Transit technology overview

The Taskforce undertook an analysis of current public transport systems and emerging technologies from around the world. It developed an overview of Mass Transit systems, their relative costs and infrastructure and associated emerging technologies including vehicle types, fuels, and energy sources.

Without advocating any particular mode over another, the analysis identifies the strengths and weaknesses of various modes. This was used to identify potential modes to satisfy the travel needs of passengers and the functional requirements of Brisbane's transport network.

The Mass Transit modes examined were:

- **Commuter rail:** Commuter rail tends to provide a medium to long-distance line-haul role into major centres from outer areas. Services are provided using high-capacity vehicles on exclusive right-of-way. They tend to maximise the number of seats due to the long journey times. Although most commuter rail is provided on traditional steel rail systems with overhead power supply or diesel propulsion, there are some commuter rail services provided using magnetic levitation (maglev) technology.
- **Metro:** Metro systems are designed to transport large numbers of passengers on short trips of less than 30 minutes within or between high-density areas of development and/or where public transport demand is concentrated. Because most of the trips are short, metros maximise the use of space by having more standing room than commuter rail.

  Metro services have exclusive right-of-way and are often underground or elevated. Most metros utilise traditional rail technology similar to commuter rail systems but with a third rail providing power. Mono-rail technology is sometimes classified as a metro-type public transport service although the service characteristics is often more similar to light rail.
- **Bus Rapid Transit:** Bus Rapid Transit is the mode that has the greatest variation in the type of systems that are currently in operation. 'Bus Rapid Transit' is used to classify a variety of high-capacity, high-speed and/or high-quality service types provided by road-based public transport modes.

  Although the term 'bus' is used to classify these vehicles, the range of vehicle types is almost as broad as that grouped with light rail. Bus Rapid Transit services tend to provide a higher quality bus service through a range of methods providing improved right-of-way and priority (e.g. busway and signal priority signal priority) to improve journey times and improve reliability of services.

  These may be combined with vehicle modifications to improve carrying capacity (bi-articulated and tri-articulated buses), comfort (luxury commuter buses) or to provide a different image (stylised buses with the appearance of light rail).

  The advantage of these bus-based systems is their inherent flexibility allowing for staged development and a mix of operational environments. A variety of power systems are becoming available, including hybrid diesel electric units.

- **Light rail:** The category of light rail includes a wide range of service types and vehicles. Systems termed 'light rail' range from low-capacity, low-speed, high-floored trams operating in shared right-of-way, to high-capacity, high-speed, low-floored vehicles operating on exclusive right-of-way.

  In fact some light rail services are referred to as 'light metro' due to their similarity with metro systems. The smoothness of the ride is one of the key strengths of light rail systems but this outcome relies heavily on the design and construction of the system and the level of priority provided. Power is generally supplied via overhead lines although diesel or hybrid options are also available.

  The electric vehicles receive their energy source through overhead wiring or through a third rail either running alongside or between the tracks. As with Bus Rapid Transit systems, the level of priority provided (grade separated or mixed with traffic) is generally the main factor in the capacity of the system.

- **Ferries:** Although this mode can provide an important part of a public transport mix, its route network is limited to navigable waterways. Where waterways form a major barrier to movement, or a natural channel of movement, they can provide a vital and cost-effective Mass Transit service.

A comparison of each of the modes is included in Appendix D.

8.1.1 New Mass Transit service vehicle options

Light rail is often cited as the most appropriate way to increase the passenger carrying capacity of road-based public transport networks. Brisbane's busway network has been designed to accommodate light rail to enable capacity expansion.

It is important to examine other alternatives and compare them with light rail. Bus Rapid Transit has realised system capacities equivalent to light rail or metro in some South American cities by using bi-articulated buses and structuring the services to replicate the characteristics of metro systems and light rail that allow for high capacity.

The term Mass Transit is used in this report to describe a type of service, not a mode. This ensures that discussions on the appropriate Mass Transit solution for Brisbane are not clouded by preconceptions of what is a 'bus' service when compared with light rail. The aim is to identify the need, and the technology options to fit that need, rather than to choose a technology and impose that on the system.

The new Mass Transit service should have the following characteristics:

- high passenger carrying capacity (greater than 150 passengers per vehicle)
- low floor to allow full accessibility
- able to share road space with general traffic
- distinctive and recognisable as something different to a standard bus
- quiet running with low noise and vibration
- minimal adverse exhaust emissions.

8.1.2 Examples of Bus Rapid Transit systems

The high floor bi-articulated 'Millennium' diesel bus produced by Caio Induscar for Bogota with a capacity of 192 passengers (6 passengers/m^2) is shown in Photo 8-1. Although it has a high floor, the system is fully accessible because station platforms are high and there are no stairs in the vehicles (as with heavy rail or metro). This ensures that these buses have the highest passenger carrying capacity of any bi-articulated bus. The Bogota busway system achieves patronage volumes as high as 38,000 passengers per hour per direction in a corridor, which is equivalent to the performance of metro systems.

Photo 8-1: Bi-articulated Millennium Bus — Caio Induscar

Source: Caio Induscar website

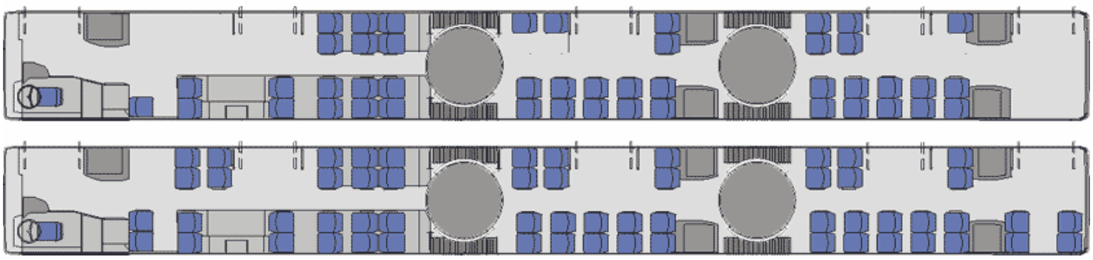
Articulated and bi-articulated buses can be stylised to appear similar to light rail vehicles. Photo 8-2 shows the Civis produced by Irisbus. It is an articulated bus with a design capacity of 117 passengers (4 passengers/m^2) and a maximum capacity of 162 passengers (6 passengers/m^2). It is low floor throughout and is available in a diesel–electric dual-mode vehicle.

Photo 8-2: Civis articulated bus by Irisbus

Source: www.gobrt.org

As with light rail, seating arrangements can vary to balance passenger comfort and carrying capacity. Figure 8-1 shows two seating options for a left-hand drive version of the Van Hool bi-articulated low-floor diesel bus. By minimising seating to 46, a capacity of 180 passengers can be achieved. Multiple doors and wide isles allow for fast passenger boarding and alighting.

Figure 8-1: Van Hool low-floor bi-articulated AGG 300



Source: Van Hool website

The Taskforce compared the implications of using either mode on the existing busway, the proposed Mass Transit corridor, and the inner-city orbital new Mass Transit service. This is illustrated in Table 8-1.

Table 8-1: Comparison of light rail and Bus Rapid Transit

	Light Rail	**Bus Rapid Transit**
Vehicle cost	High: $3.0–$4.0m/vehicle	Moderate: $1.2–$3.0m/vehicle
Passenger capacity per vehicle	High: 150–300	Moderate: 100–190
Track and overhead lines	High: $15–$30m/km	Low: $0–$2m/km*
Overhead conductors	Yes (third rail can be safely used but at great capital cost)	No
Route delineation	Very good	Markings required
Use existing Victoria Bridge	Difficult — Significant upgrading or new bridge required	Yes
Distinctive/attractive	Yes	Yes
Localised air quality	Good	Moderate to good (if CNG or diesel–electric used)
Low floor	Yes	Yes
Traffic impact during construction	High	Nil to low

* Assuming no construction of grade-separated busways required

9. Options to address demand

This chapter examines the gap between transport demand and the appropriate public transport supply serving existing or developing CBD and surrounding area activities. It looks at the public transport options available to best service the future demand, taking into account the constraints and opportunities identified.

The patronage growth experienced in recent years has put considerable strain on public transport services in Brisbane. There is a level of concern from users about the number of services (train, bus and ferry) where peak demand exceeds capacity and people have to wait for the next service.

9.1 Busway capacity

The South East Busway is rapidly reaching its vehicle carrying capacity under the present operational approach. Figure 9-1 illustrates the current peak-hour bus volumes on the South East Busway.

The South East Busway is constrained by the capacity of the intersections of the South East Busway and Melbourne Street, its intersection with North Quay, and the Cultural Centre Busway Station. The busiest section of the South East Busway is just north of Woolloongabba prior to some services exiting the busway to cross into the city on Captain Cook Bridge.

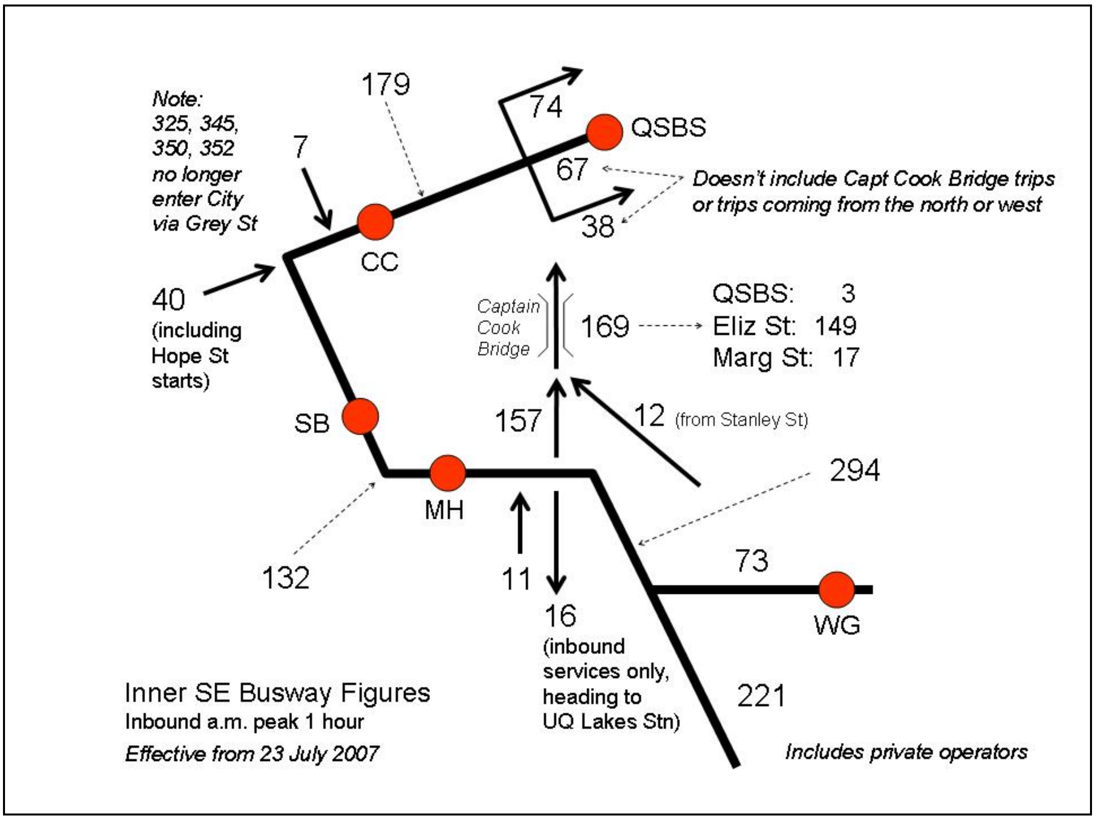
If traffic congestion on Stanley Street or the Captain Cook Bridge delays buses exiting the busway, congestion can occur. As illustrated in Figure 9-1 the current volumes of in-bound buses at the Cultural Centre station in the peak hour is 179 buses per hour or a bus every 20 seconds during the peak hour. At the busiest point of the busway, north of Woolloongabba, 294 in-bound buses pass in the peak hour. This equates to a bus every 12 seconds. This is approaching the maximum vehicle carrying capacity of the South East Busway (using the currently available bus fleet).

Clearly there is an urgent need to provide additional capacity to address existing capacity constraints and short-term growth. The infrastructure capacity of the busways will, however, soon be exceeded if additional capacity is only provided by providing more standard buses.

Acronyms used in Figure 9-1 over the page

WG	Woolloongabba
MH	Mater Hill
SB	South Bank
CC	Cultural Centre
QSBS	Queen Street Bus Station

Figure 9-1: Inner South East Busway peak-hour bus volumes



Source: Brisbane Transport

9.1.1 Rail capacity

The Metropolitan Rail Network Capacity Study undertaken in 2005–2006 evaluated the capacity of the South East Queensland rail network to accommodate future growth in passenger and freight traffic. The study identified several capacity constraints which would require the construction of a new rail line across the inner city. These constraints include:

- the signal headway across Merivale Bridge
- long dwell times at Central Station due to high number of interchanges and scheduling constraints elsewhere in the network
- peak-hour trains returning to Mayne Yard stabling at the end of their service
- congestion at Park Road junction caused by crossing conflicts
- congestion caused by trains merging onto single tracks north of Milton
- line capacity constraints between Northgate and Bowen Hills
- line capacity constraints between Park Road and Roma Street causing congestion as trains merge onto single tracks between South Brisbane and Merivale Bridge.

In the short term, the constraints on services could be relieved without the need for a new line across the city. The new alignment will however be required from 2016 if the projected growth in the region is realised and full benefit is gained from new track construction and rolling stock acquisition.[4]

[4] Metropolitan Rail Network Capacity Study (2006)

Ferry capacity

CityCat and CityFerry services perform a valuable link in the public transport network and have the advantage of not being affected by road traffic congestion. The services have been expanded to accommodate growth in demand but there are constraints on future growth.

Services cannot extend beyond the University of Queensland to the west (upstream) due to the constraints associated with environmentally sensitive areas of the river beyond St Lucia, limiting the provision of river bank protection.

The services are also limited downstream past Northshore Hamilton as travel times beyond this point means the service cannot compete against other modes. However a ferry service to/from Pinkenba and Northshore Hamilton could, in the longer term, provide a feeder service to a Mass Transit stop at Bretts Wharf or Newstead.

An issue in the consideration of the CityCat fleet as a 'Mass Transit' vehicle is the long dwell time required for vessels at ferry terminals. Although having boarding doors fore and aft, only one can be used at a time. This is predominantly due to the boats only having one deckhand onboard. There are also issues relating to the tidal movements and layout of ferry terminals.

Currently 10 CityCats and 9 mono-hull ferries are operated. If all CityCats were upgraded to second-generation designs with a passenger capacity of 159 per vessel and the fleet increased to 20 (at a projected cost of $2.7m per vessel, the service capacity could more than double, allowing services to meet the projected demand.

Providing higher capacity vessels is an option but heavier vessels operate at lower speeds, have greater displacement which may create environmental issues and impact on other river users.

While ferries play an important role in the public transport mix of Brisbane, they would not meet the definition of 'Mass Transit'.

9.2 Options to address projected demand

9.2.1 Vehicle size

The Brisbane City Centre Master Plan puts forward a vision for the city centre to be a pedestrian and cycle friendly environment. To achieve this, there is pressure for widening of footpaths to provide a more pedestrian friendly environment.

The consequent narrowing of road space would restrict areas for bus lanes and stops as well as for private vehicles, taxis and delivery vehicles. In this environment, the number of passenger transport vehicles in the city, especially in peak periods, is an important issue and requires consideration of alternative means of distributing commuters and residents around the city.

Table 9.1 illustrates how, by increasing the carrying capacity of vehicles, the number of vehicle trips in the peak period can be minimised. It is assumed that all vehicle types operate at their maximum capacity in the peak. The maximum capacity assumed for the various buses are standard buses (65), articulated buses (85), bi-articulated bus (180) and light rail (300). The projected passenger volume at the inner screen line on the South East Busway in 2026 was used for illustrative purposes.

Table 9-1: Implications of different vehicles servicing projected bus demand

South East Busway	Standard bus	Articulated bus	Bi-artic bus	Light rail
Peak trips to service demand of 10,746 passengers per hour*	154	127	60	36
Headway (seconds per vehicle)	23	28	60	100

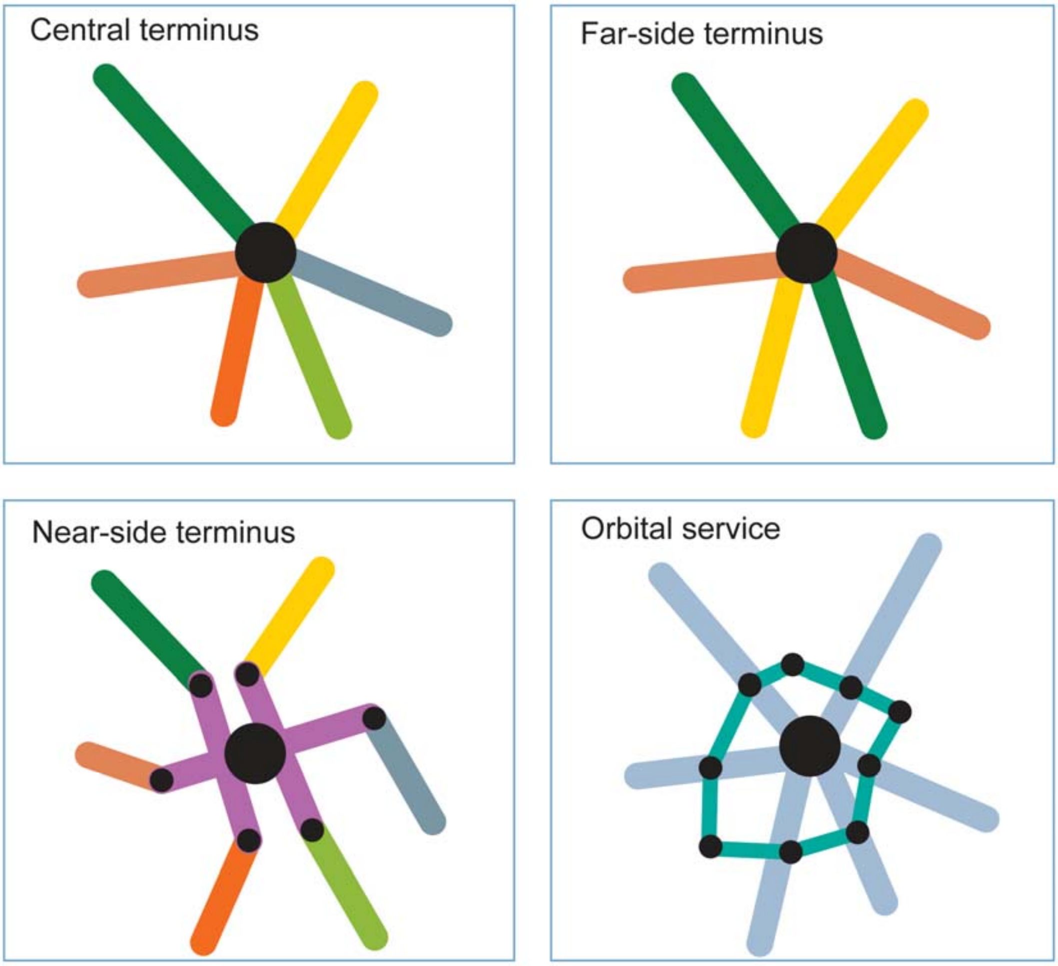
* BSTM projection of trips by bus crossing the CBD screen line in the peak hour

This analysis shows even with light rail operating at maximum capacity, headways of less than 2 minutes would be required.

9.2.2 Network planning options

Mass Transit networks tend to have one of four basic models servicing a major centre. Most Mass Transit systems integrate elements of the models to best service demand within the existing constraints. These models are discussed below and illustrated in Figure 9-2:

Figure 9-2: Conceptual Mass Transit network structures



- Central terminus — services radiate from a major central terminus point in the CBD. All journeys terminate in the CBD and through-routing is only possible through transfers.
- Far-side terminus — services pass through a central interchange point or points but do not terminate in the CBD; through-routing and interchange is possible between routes at interchange points.

- Near-side terminus — services do not enter the CBD but feed into an inner-city distribution system.
- Orbital service — radial services are all connected at major transfer points outside the CBD by an orbital service. The orbital service connects major activity centres on the radial lines and removes the need for all transfers to occur at the central interchange. This works on any of the above three models.

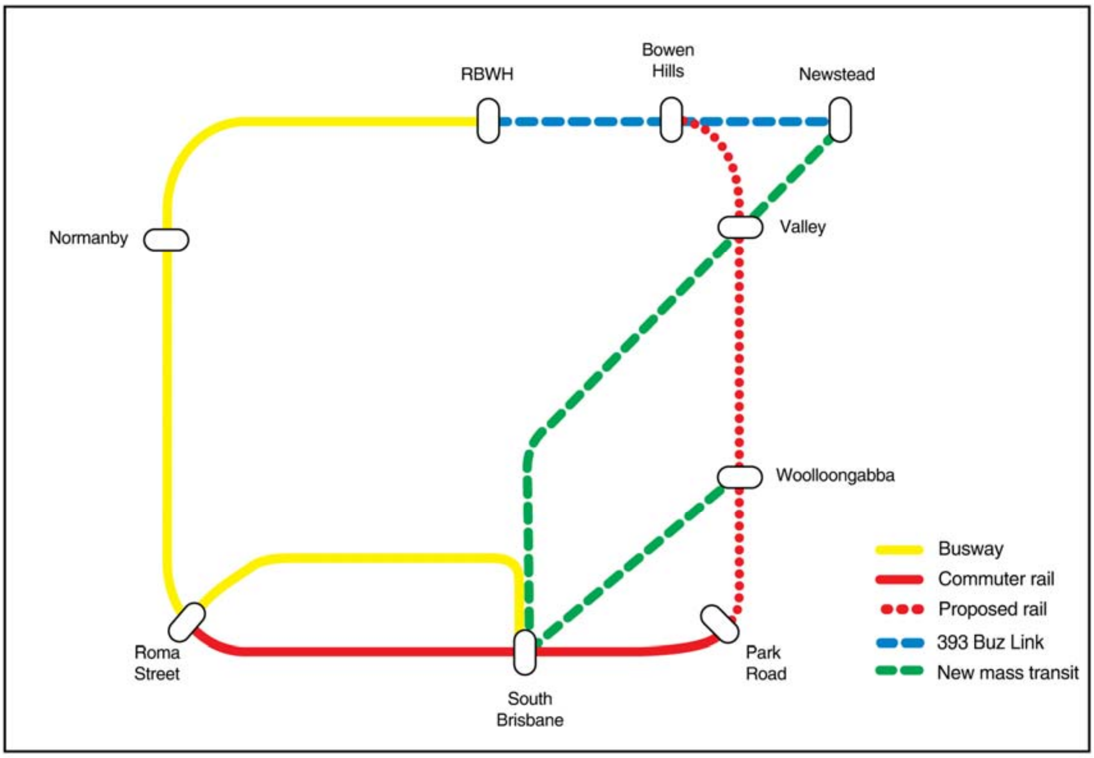
The public transport network in Brisbane is predominantly a central terminus model. Some services, mostly rail, having a far-side terminus. There is currently an inner distributor function within the CBD provided by buses but it does not adequately service the existing and growing activity centres surrounding the CBD.

The investments in bringing the Inner Northern Busway into the CBD and linking it to the South East Busway through Queen Street Station will provide greater opportunity for through-routing of many bus services.

There are opportunities to improve the CBD and surrounding inner-city public transport network in the light of the four models:

- The three isthmuses along the Brisbane River have an inadequate connection by a radial service linking West End, the CBD, Newstead and Bulimba provided by the 199 BUZ route together with the ferry service from Teneriffe to Bulimba and City Cat services.
- Trips to and from Spring Hill to the north of the CBD show a relatively low mode share to public transport and would benefit from an improved inner-city orbital service to distribute trips within the CBD and surrounds.
- There is the potential for a near-city orbital public transport service connecting the radial lines close to the CBD. A high-frequency orbital service is proposed within 5 km of the CBD. The service could connect an improved 393 bus route and rail lines at Bowen Hills and Roma Street and with the ferry and the proposed new Mass Transit services at Teneriffe. The proposed new underground rail line could complete the loop. Until the new rail line is built the loop could be completed by a new BUZ service operating from Park Road Station via Woolloongabba station, Kangaroo Point, Fortitude Valley and Bowen Hills Station. Figure 9-3 is a conceptual diagram of the proposed system. The system would increase integration between modes and would reduce the number of transfers occurring in the CBD.

Figure 9-3: Conceptual diagram of Near-City Orbital Service

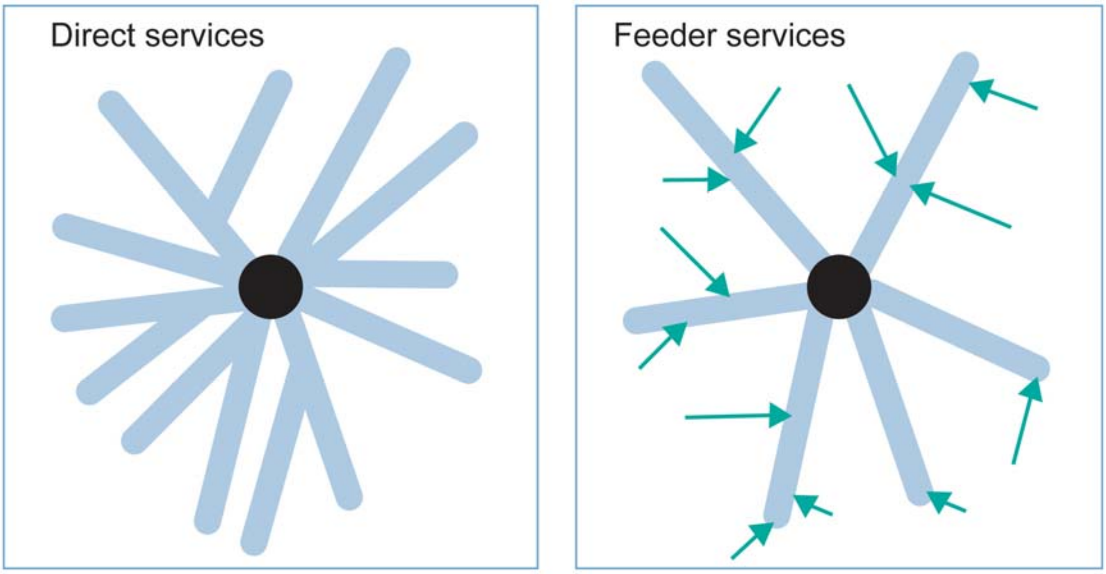


- There is no effective public transport distributor service connecting the radial lines close to the CBD. Currently most transfers occur in the central busway and rail stations. A high-frequency, Mass Transit distributor service is proposed within 5 km of the CBD. The service would link the busways and rail lines with existing or planned activity nodes within 5 km of the CBD. The system would increase integration between modes and would reduce the number of transfers occurring in the CBD.

9.2.3 Feeder network

Feeder networks can maximise public transport system efficiency by feeding to high-capacity, high-frequency line-haul and distributor systems. By minimising the need for transfer, direct services create an excess of routes into the centre. Figure 9.4 illustrates this concept.

Figure 9-4: Conceptual service structures



Currently Brisbane's bus network is largely radial with the majority of bus services providing direct service to the CBD. The capacity of stations and roads within the inner city will be exceeded if the current service structure continues through to 2026.

The Queen Street bus station and the new King George Square busway station will remove some buses from roads in the CBD and potentially reduce the number of on-street bus stops in the CBD. These stations could accommodate most of the current bus services from the north and south but would exceed their capacity within a few years at current growth rates.

Although using larger capacity vehicles could reduce the number of buses in the CBD, these vehicles are not appropriate for all routes. Articulated buses could be run on most BUZ services but bi-articulated buses may not be suitable on all routes due to their length and handling characteristics. Bi-articulated buses would be best operated in corridors designed to accommodate the vehicles.

To further reduce the number of public transport vehicles entering the CBD, there is a need to pursue an effective feeder service to line-haul and/or distributor service structure. With this model buses are diverted to interchange with high-capacity line-haul or inner-city distributor services, thereby reducing the number of buses entering the CBD.

9.2.4 CBD and surrounds service concept

The Taskforce recommends consideration of meeting the needs of 2026 demand into the CBD using high-capacity, high-frequency line-haul services along the busways and rail corridors supported by feeder bus services.

Within 5 km of the CBD non-BUZ and non-busway bus services would feed to a high-frequency underground metro system to service the CBD and surrounds. This service concept combines the CBD direct model with the near-side terminus model and allows through-routing on line-haul and possibly BUZ bus services. The projected demand and possible options for the supply of services in the morning peak hour is set out in Table 9-2 and 9-3.

Table 9-2: Southern Inner Screen Line 2026 service option

Corridor	Mode (passenger carrying capacity)	Frequency (minutes)	Capacity	2026 peak-hour demand
Cleveland	Rail (800)	10.0	4,800	4,500
South Coast rail	Rail (800)	5.0	9,600	6,300 [1]
South East Busway	Light rail (250)*	2.5	6,000	11,300 [1]
South East Busway	Bi-artic bus (180)	2.5	4,320	
Eastern Busway	Bi-artic bus (180)	2.0	5,400	4,800
Other bus	Metro (800)	5.0	9,600	8,226 [2]

1 - Feeder services to south coast rail line to take some patrons currently on BUZ routes 130 and 150

2 – Bus services not accommodated on SE or E Busways feed to Metro

Table 9-3: Northern Inner Screen Line 2026 service option

Corridor	Mode (passenger carrying capacity)	Frequency (minutes)	Capacity	2026 peak-hour demand
Ipswich	Rail (800)	5	9,600	8,600
Ferny Grove	Rail (800)	10	4,800	4,000
North Coast	Rail (800)	5	9,600	15,000
		7.5	6,400	
Northern Busway	Light rail (250)*	2.5	6,000	5,200
North West Bus	Artic bus (85)	5	1,020	1,500
West and South West Bus	Artic bus (85)	5	1,020	1,800 [1]
Hamilton/ATC	Bus Rapid Transit (180)**	5	2,160	1,500
Other bus	Metro (800)	5	9,600	4,052

1 – Assume 50% of bus passengers on Coronation Drive would travel on the western and south western busways services by the proposed Northern Link Tunnel.

* - If adopted after 2026

** - Depending on vehicle selected

10. Mass Transit proposals

Following the investigation of demand and the review of the available modes, a suite of options was developed and assessed against a consistent set of criteria including service quality, constructability, impact, economic cost and alignment with known State Government policies.

To cater for the demand up to and beyond 2026 in the CBD and surrounding areas, the Taskforce developed an inner-city public transport network strategy which builds on and is consistent with planning being undertaken by State Government agencies.

10.1 Existing services

10.1.1 Commuter rail

The provision of additional track and rolling stock is an ongoing program being rolled out by the State Government and the next stage is scheduled for progressive completion over the next 10 years. The Springfield Line has been announced and is expected by 2026.

No timing is given for the proposed line to Browns Plains using the standard gauge route. The implication of these lines on the need for additional bus capacity needs to be assessed.

The proposed new city ‘Parliament’ Line would, preferably, be operational at the same time as track upgrades are completed to enable the timely operation of additional and express services (i.e. around 2016).

This is similar to the underground commuter rail connection between Park Road Station and Bowen Hills Station as put forward in the City Centre Master Plan. This improvement will allow passengers from the north and south to get easier access to the whole CBD and Fortitude Valley. Such additional track capacity will allow additional and express heavy rail services, and overcome the capacity constraint of Merivale Bridge and the city stations.

10.1.2 CityCat service

CityCat services should continue to be expanded to cater for passenger demand within the capacity to move vessels on the river. New ferry terminals should only be considered in strategic locations that benefit the existing network and where terminals are warranted by development.

Services should not extend beyond Northshore Hamilton to the east or the University of Queensland to the west due to the constraints associated with river bank protection and the viability and efficiency of running such services.

10.1.3 Busways

The Taskforce supports the planned busway network and the proposed extensions. In addition, the output of the Western Brisbane Transport Network Investigation will be important in defining the future busway needs in the south west, west and north-west sectors of the city. Advantage should be taken in these areas of combined road and public transport infrastructure such as the Northern Link tunnel. The following measures are proposed to further increase capacity of the system and create improved service recognition for line-haul services that exclusively use the busways.

- Introduce high-frequency services with a far-side terminus along the busways using distinctive high capacity vehicles. These should be easily distinguished from other services using the busway to increase the legibility of these line-haul services. In the short term, high-capacity Bus Rapid Transit vehicles should be introduced.
- In the long term a higher capacity vehicle may need to be implemented on the busways to achieve the capacity required to service demand. The high-capacity vehicle technology should be chosen based on the service capacity and performance requirements and light rail options may be worthy of reconsideration subject to available funding and a review of the impacts of commissioning and operating the system.
- Allow all-door boarding with no on-board ticket sales or validation by the operator to decrease dwell time at stops, and increase station capacity and journey speed.

10.1.4 BUZ services

These high-frequency bus services have been very successful in attracting increased patronage. Additional services are required on existing routes and the use of high-capacity articulated buses (where appropriate) need to be prioritised in fleet acquisition plans.

Improvements in rail and busway line-haul service capacity and frequency should be combined with new feeder BUZ routes which provide high-frequency and reliable feeder services to the rail, busway and future Metro stations

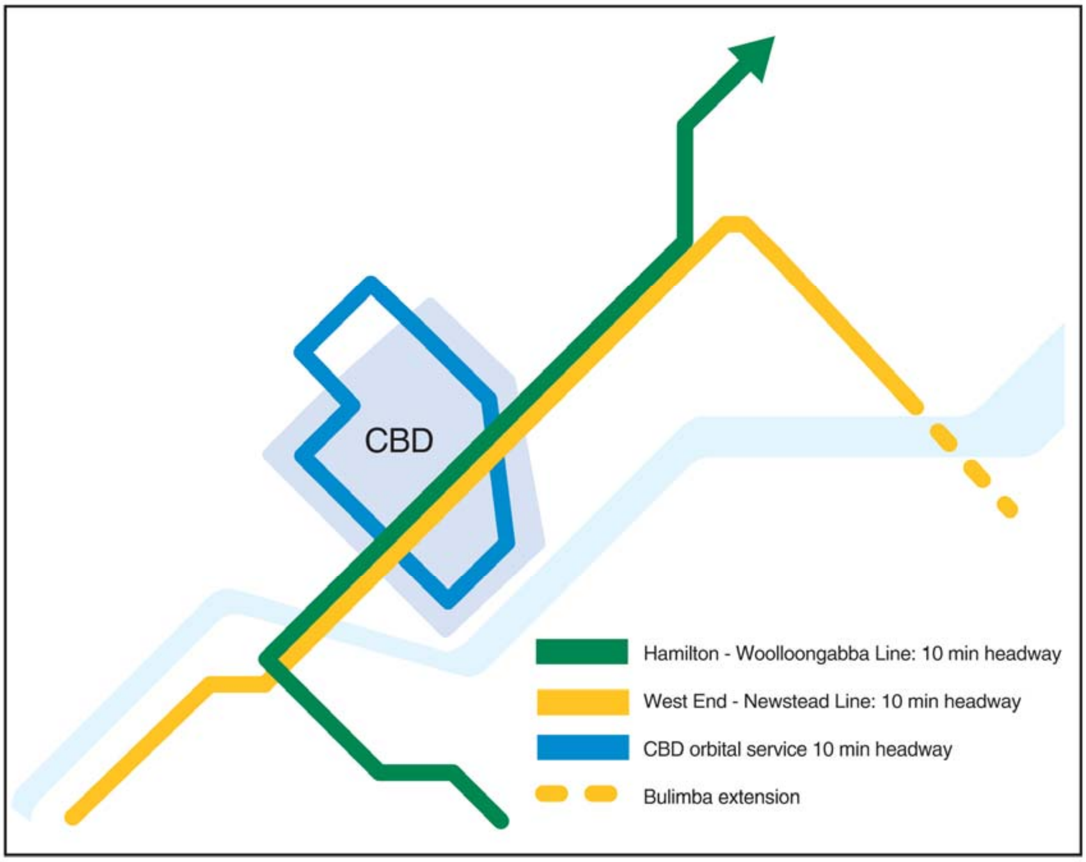
10.1.5 Bus services

By 2026 road and kerb space in the CBD will be at a premium. Many local bus services should be restructured to serve as feeders to the busway, new Mass Transit service, heavy rail corridors and Metro stations to minimise the number of local bus services entering the CBD. Priority would be on ensuring high reliability and journey speeds on both feeding and receiving services.

10.2 New Mass Transit service

It is proposed to develop a new surface running Mass Transit network distributing trips within the inner city and linking adjacent development nodes. Detailed planning and design is required to determine the appropriate route and alignment. Two possible new Mass Transit services with possible expansions to these services are proposed. A conceptual representation of the proposed routes is illustrated in Figure 10-1.

Figure 10-1: Conceptual new Mass Transit route network



- **West End–Newstead Line:** Existing demand warrants an improved connection between West End, South Brisbane, CBD, Valley and Newstead. This would be a service with a distinctive, increased capacity vehicle providing a high-frequency service between these areas of expected higher density and growth.

  The service would operate predominantly on shared right-of-way with station locations reserved for new Mass Transit. Signal priority and/or some sections of exclusive right-of-way would be required to ensure a reliable, high-frequency service can be provided.

  The route through the CBD would most likely be along Adelaide Street and the service would terminate respectively at the West End and Newstead ferries. Peak headways in 2026 should be 10 minutes through the West End and Newstead and 5 minutes through the CBD and Fortitude Valley.

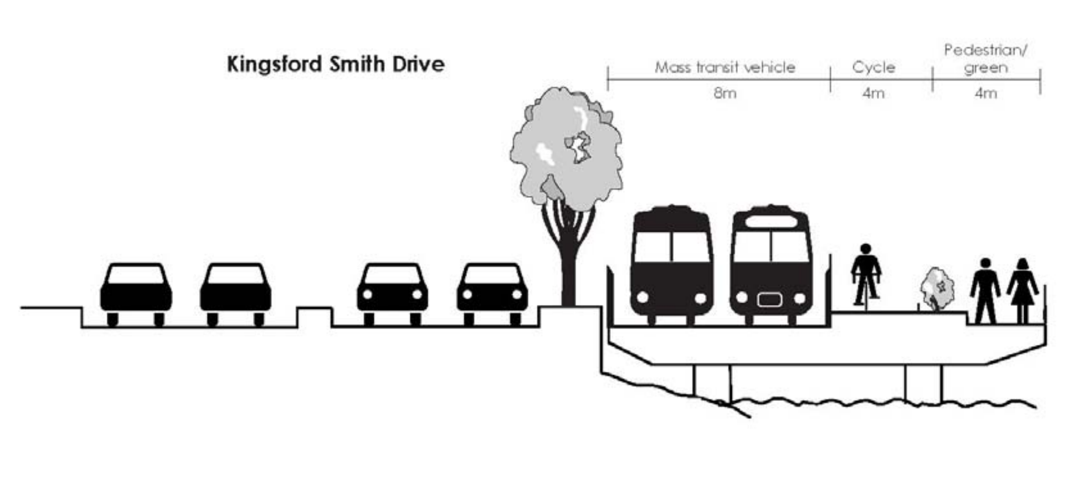
- **Hamilton–Woolloongabba Line:** The West End–Newstead service requires a 5 minute peak frequency through the CBD and Fortitude Valley to cater for the high demand in this portion of the corridor. This could be conveniently provided in conjunction with an extension of the services to Northshore Hamilton and the Australia TradeCoast and Woolloongabba to serve trips generated by these developments.

  The Australia TradeCoast and the planned Northshore development will create significant public transport demand. In the future the corridor could include a 'green' viaduct adjacent to Kingsford Smith Drive with improved provision for pedestrians and cyclists. Figure 10-2 shows an indicative sketch of the proposed viaduct.

Urban renewal resulting in significantly increased densities is planned for Woolloongabba. Line-haul services along the South East Busway and East Busway may have difficulty in accommodating this demand and there will be a need to provide high-capacity services from Woolloongabba.

Peak headways should be 10 minutes. When combined with the West End-Newstead line with a 10 minute frequency the required 5 minute frequency through the CBD would be achieved.

Figure 10-2: Concept for a Kingsford Smith Drive viaduct

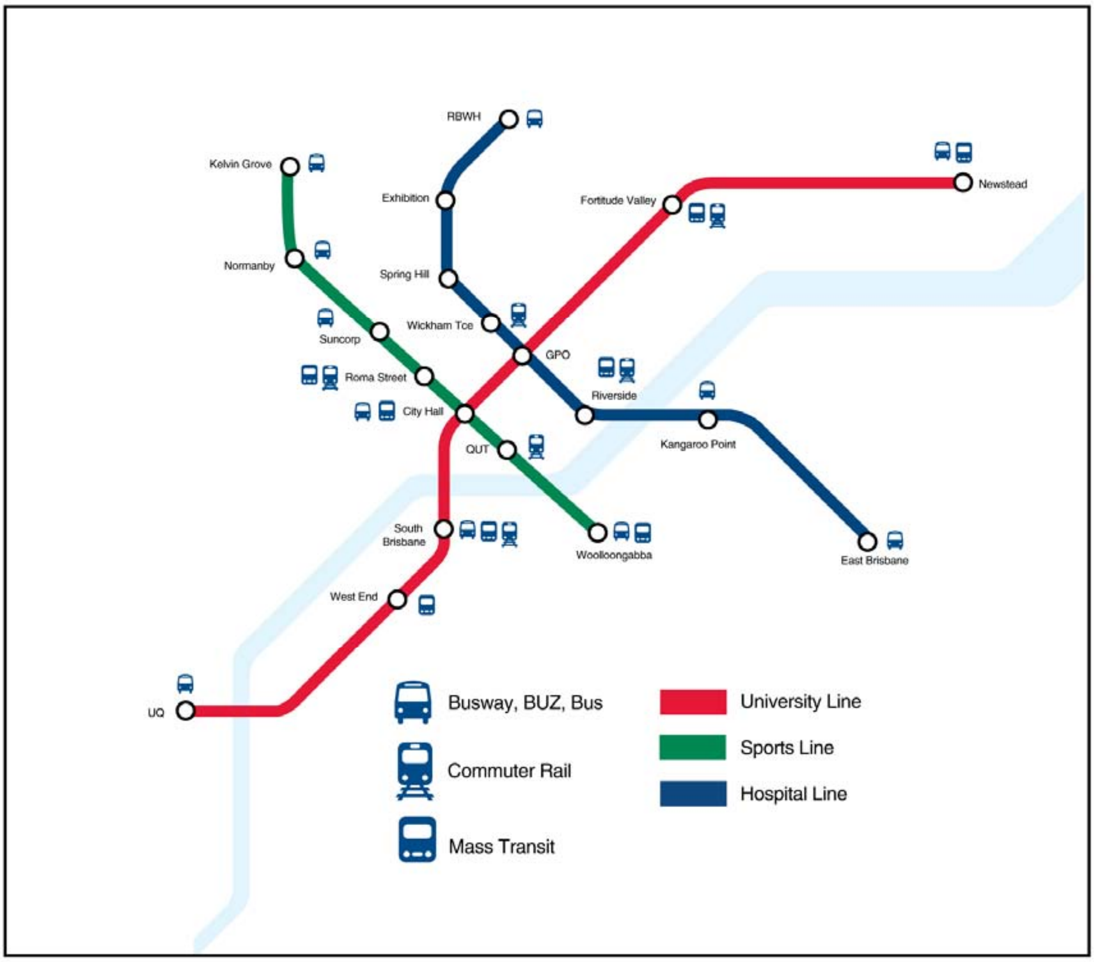


- **Bulimba extension:** The West End–Newstead service would connect to cross-river ferry connections at Newstead and West End. In the long term the Teneriffe ferry could be replaced by a 'green' bridge allowing use for pedestrians, cyclists and public transport services, thus extending the use of the bridge proposal of the State Government for a pedestrian bridge at this location.
- **Inner City Orbital Service**: The existing CBD loop bus service would be extended to provide a Spring Hill/CBD orbital service between Wharf, Eagle, Mary, George Streets and Roma Street Parklands operating in conjunction with the West End–Newstead service operating on Adelaide Street. The service would operate predominantly on shared right-of-way. Signal priority and/or some sections of priority measures may be required to ensure that a reliable, high-frequency service can be provided. The service would integrate with existing and planned pedestrian routes across and into the CBD including the proposed Kangaroo Point pedestrian bridge.

10.3 Metro

A high-frequency underground Metro system that distributes passengers across the inner city is proposed for consideration after 2026. The Metro would provide a high-frequency service to connect major passenger generators such as hospitals, universities, busway and heavy rail stations, sporting venues, and major commercial and residential centres. The Metro terminal stations would be located to facilitate interchange with bus and BUZ services. A conceptual route network for the Metro system is shown in figure 10-3.

Figure 10-3: Conceptual route network for proposed Metro system



10.4 System-wide proposals

10.4.1 Service integration

There is a need to improve service integration between local bus services and line-haul rail and higher capacity busway services to minimise the number of buses entering the CBD. The means of transfer must be simple, quick, convenient and requires high-frequency line-haul services. Adequate pedestrian infrastructure capacity is required within and between stations to make transfers acceptable.

There needs to be improved interconnection between line-haul services to facilitate cross-town movements, optimise passenger capacity of public transport vehicles and make more of the city accessible.

10.4.2 Electronic ticketing

A single ticketing system, applicable across all modes and for multi-trip journeys, is essential for the operation of an efficient Mass Transit system. TransLink's Smart Card system to be implemented should further improve the existing integrated ticketing system and will make boarding quicker by taking the vehicle operator out of the process of fare collection/ticket validation.

It is important that the electronic ticketing system is convenient, easy to use, easily understood, can be used with confidence, and has a short transaction period. This will strongly support improved service integration but should also be used to increase journey speeds.

The introduction of electronic Smart Cards will also provide accurate and timely information on passenger use of the system to enable better optimisation of services.

10.4.3 Multi-door access

Currently bus services spend more than half of the trip time stationary, loading and unloading passengers. Long dwell times at stops increases journey time and decreases the capacity of stations. There is an urgent need to decrease boarding and alighting times to increase speeds and increase station capacity on busways.

Multiple door entry and exit is essential. As a minimum this needs to be applied as soon as possible on busways.

10.4.4 Cross-town services

The growth of employment in suburban developments will require improvements in existing cross-town services and the establishment of new services. These cross-town services need to link developing areas and the line-haul radial network with high-frequency BUZ services. These services will require adequate priority to ensure reliability.

11. Impacts of proposals

This chapter details traffic, environmental impacts and implications for the existing public transport system. More detailed impact assessment would be required as part of the detailed planning and design stage.

11.1 Desired attributes

The Taskforce concluded the recommended system should:

1. enhance the accessibility of the people of Brisbane to home, work, recreation and other desired destinations
2. attract increased patronage because of its reliability, frequency, reduced travel time, comfort, safety, and price
3. provide enhanced environmental outcomes
4. be affordable in general and specifically in relation to economic cost and benefit, installation costs, operating cost, effect on the general community's transport cost
5. be able to be constructed and gain support from impacted residents
6. be integrated, in that it links modes together, makes interchange easy, and promotes confidence about connecting services
7. be able to be incorporated into the TransLink integrated ticketing system
8. not compete directly with other modes for patronage but should complement other modes and networks
9. provide both single-mode and multiple-mode journey options — for example, Express bus or feeder bus/rail combination
10. provide enhanced radial access to the CBD and major centres including the Australia TradeCoast and also, cross-town movement between town centres and transport corridors
11. link areas of existing and future high-density residential and commercial/industrial development
12. be consistent with Brisbane City Council's draft Transport Plan 2006–2026 and the central theme of a balanced approach to passenger transport which includes roads, feeder services, walking, cycling, taxis as well as factors that create and control demand
13. be compatible with the approach to public transport developed by the State Government and outlined in the TransLink Network Plan
14. in keeping with the vision of the City Centre Master Plan, limit the number of surface passenger transport vehicles entering the CBD to preserve and enhance the pedestrian environment of the CBD and surrounds.

11.2 Impact on traffic

The proposed new Mass Transit routes could be operated using either light rail or Bus Rapid Transit. The extent of the traffic impacts during commissioning of the service would depend on the vehicle technology used. Most operational impacts of the new Mass Transit service would result irrespective of the mode chosen.

It is desirable for the new Mass Transit service to have priority through intersections to reduce the impact of congestion.

The impacts determined by the vehicle type and those specific to corridors are detailed.

- **Bus Rapid Transit vehicles**

  Bus Rapid Transit vehicles would require minimal infrastructure improvements. The traffic impact during commissioning of the service would mostly be caused by the construction of stops and the provision of priority at some intersections. The impact of construction on pedestrian traffic may be briefly significant if there is a need for the raising of kerbs to allow fully accessible boarding.

- **light rail vehicles**

  Light rail vehicles would create significant disruption to road and pedestrian traffic to allow for service relocation, the laying of track and installation of overhead conductors. Local access will be affected by road and lane closures. Significant night work would be required to minimise major traffic impacts. The impact of stop construction on pedestrian traffic may be severe but brief if there is a need for the raising of kerbs to allow fully accessible boarding.

  If a new public transport bridge is not constructed adjacent to Victoria Bridge, there would be extensive disruptions of public transport and general traffic to allow Victoria Bridge to be modified to carry light rail, assuming that it is technically possible. If a new bridge is constructed it will cause some dislocation to adjacent areas and traffic disruption.

  Light rail tracks are a hazard for cyclists and would restrict the ease of use of the corridors for cyclists and other road users. The track may also be a hazard to general traffic during wet weather due to the low skid resistance of the steel rails.

Route-specific impacts

- **Hamilton–Woolloongabba Line:** The line could operate on Kingsford Smith Drive but would interfere with heavy traffic volumes. It is preferable that the new Mass Transit use a separate low-level viaduct on the river side of Kingsford Smith Drive. As such, no traffic impact would result. The construction of this viaduct could be used to upgrade walking and cycling facilities along this corridor and provide pedestrian and cycle overpasses or underpasses at stations and walkways to the north side of Kingsford Smith Drive.

- **Bulimba extension**

  The extension to Bulimba would predominantly impact on river traffic. This could be minimised though the use of a bascule bridge. A 'green' bridge is proposed to prevent general motor vehicle traffic using the bridge and impacting on local communities. The construction phase of the 'green' bascule bridge could impact on river traffic and local road traffic.

- **Inner City Orbital Service**

  The new Mass Transit Inner City Orbital Service is proposed to operate in both directions on George Street consistent with the City Centre Master Plan. It would operate two way in Creek Street. The route structure would need further investigation in conjunction with a review of traffic management in the CBD as proposed in the City Centre Master Plan.

- **Woolloongabba-Hamilton Line**

  The portion of this line from the CBD to Woolloongabba would operate mainly on the South East Busway with a short section running along Grey Street between the Cultural Centre and Vulture Street, accessing the busway tunnel at the end of Grey Street. Provision for this connection already exists. The traffic impact in Grey Street would be minimal.

- **Metro**

  The construction of a Metro system would require the construction of underground track, stations and stabling facilities. Metro construction is at shallow depth, eight to ten metres, depending on terrain, and with a tunnel diameter a little over four metres.

  Construction would be by 'cut and cover' under existing streets and parkland for tube and stations. Deeper driven tunnels would be required in hilly terrain and at river crossings.

  Metro stabling can be at end stations or track extensions to avoid difficult interconnections and resumptions. During construction there would be significant traffic disruption where cut and cover works are in progress. Careful road space management and diversions would be required. However once operational, the Metro would significantly reduce the number of local buses and cars needing to enter the CBD.

11.3 Implications for existing public transport system

Implementing the Mass Transit proposals provides an opportunity to redeploy the current buses servicing these areas to new BUZ and feeder routes. It does not imply that the expansion of the fleet should not continue, as more buses will be required than are available from existing operations.

Depot requirements for new Mass Transit vehicles will need to be addressed and may see changes to the operation of existing services.

Over time, as line-haul capacity and frequency improves, and interchanges become more user friendly, there will be fewer services travelling direct to the CBD. However there will always be an important mix of radial, feeder, distribution and line-haul services to optimise appeal and transport efficiency.

11.4 Impact on greenhouse gas emissions

A report was commissioned by the Taskforce to analyse the greenhouse gas emissions of the potential Mass Transit modes. This study was not a full life-cycle analysis of the transit options, but an investigation of the direct greenhouse gas emissions arising from the daily operation of alternative transport modes (i.e. Bus Rapid Transit and light rail) over the route.

The data was modelled using the actual fuel consumption of specific vehicle types in a defined situation similar to the Brisbane's CBD and surrounds, specifically the West End-Newstead service.

This methodology was advantageous given that it considered the actual vehicle type, route and loading characteristics. Using this approach, the mode of transport which displays the best emissions efficiency at a given passenger loading could be identified based upon the energy consumption of the vehicles themselves.

The results of this investigation were expressed in either grams of carbon dioxide equivalent emissions per vehicle kilometre (gCO_{2-e}/vkm) or grams of carbon dioxide equivalent emissions per passenger kilometre (gCO_{2-e}/pkm).

The analysis compared the emissions of a modern bus, light rail vehicle and Bus Rapid Transit vehicle. Figure 11-1 compares the greenhouse gas emissions of each of these vehicles on the proposed West End-Newstead Mass Transit route.

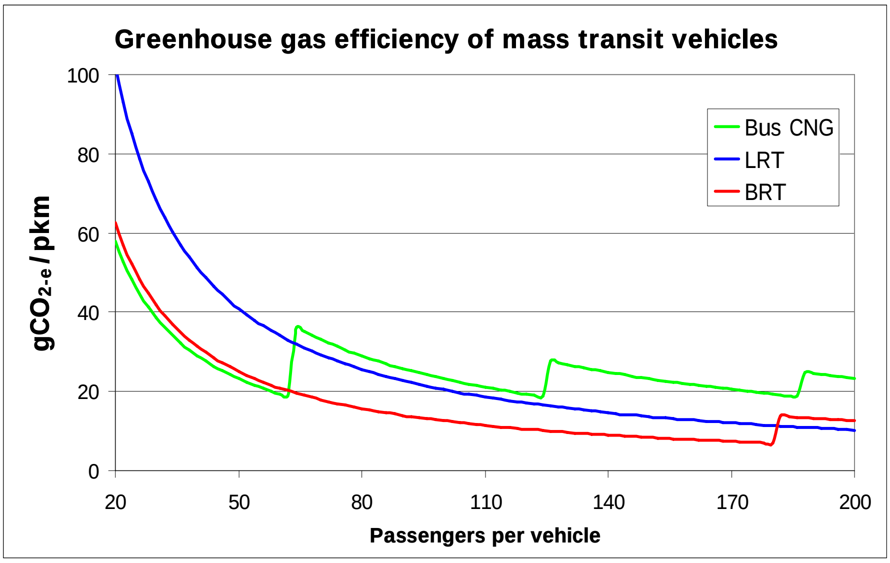
The bus used in the analysis was the Scania L94UB CNG powered bus.

Bus Rapid Transit vehicle emissions are from a double/bi-articulated bus with a capacity for up to 200 passengers powered by a diesel-electric series hybrid drivetrain. The vehicle is currently on trial in Switzerland and is from the Victorian based manufacturer Volgren. The analysis is based on a preliminary estimate of fuel efficiency from Volgren and will need to be confirmed once the vehicle trials are completed.

The light rail vehicle emissions were based on energy consumption data from Melbourne's Yarra Trams. Although the localised greenhouse gas emissions of light rail are low, the remote emissions from electrical power generation are taken into account in the comparison. The greenhouse gas emissions for operating such a vehicle in Queensland were based on the representative emissions factor for Queensland Electricity.

No investigation of particulate emissions and local air quality impacts of the proposals was done. A detailed planning and implementation study would need to examine these impacts.

Figure 11-1: **Results of passenger loading sensitivity analysis on the various vehicles**



Source: Matrixplus Consulting – Patrick Hearps

The investigation used the following assumptions:

- Emissions associated with the installation of infrastructure and manufacturing of vehicles are not taken into account.
- Flow on effects of a Mass Transit network, such as the reduced emission from cars and congestion were not examined.
- The emissions intensity of the different energy sources included the full fuel cycle emissions related to each particular fuel.
- Average energy/fuel consumption values under normal operating conditions were used to each of the vehicles. This took into account many variables that can affect fuel consumption, including but not limited to: slope, speed, frequency of stopping, congestion, weight of passengers, skill of driver, and road conditions. Modelling every factor that can affect fuel consumption was beyond the scope of the study.

The key conclusion to be drawn from the analysis is that it is only at higher passenger loadings that the greenhouse gas emissions efficiency of light rail match that of the Bus Rapid Transit vehicle. At this point another Bus Rapid Transit vehicle is required. The Bus Rapid Transit vehicle analysed is less emissions efficient than CNG powered buses in the existing fleet until a passenger loading of 63 passengers is reached, at which point additional buses are needed. At this point the performance of Bus Rapid Transit vehicle becomes comparable with and slightly better than the existing bus fleet.

It should be noted that both Bus Rapid Transit and light rail vehicles are efficient at high passenger loadings but are less efficient than CNG buses at low loadings. Utilising larger vehicles less frequently result in greater emissions efficiency, however less frequent services could result in the public transport user being disadvantaged and could potentially result in a decline in patronage.

12. Estimated costs

This chapter details the preliminary cost estimates for each of the Mass Transit proposals. The cost estimates are high-level estimates intended to give an order of magnitude of cost. This was used to allow for comparison of proposed technology options. An indicative assessment of the financial and economic impact associated with the proposed West End-Newstead and Inner City Orbital Mass Transit services over the next 20 years was undertaken.

Capital and operating costs were estimated for the proposed West End–Newstead new Mass Transit route, the Hamilton–Woolloongabba Line and the Inner City Orbital Service. The cost for the Bulimba extension was not estimated since this extension is unlikely to be warranted prior to 2026. A benefit–cost analysis was done for each of the proposed new Mass Transit services for both vehicle options.

The proposed new Mass Transit routes could be operated using either light rail or Bus Rapid Transit. The construction and operating cost would depend on the vehicle technology used. Costs have been estimated to give an estimate of the order of magnitude of costs for both options and are summarised in Tables 12-1 and 12-2. The assumptions made in the calculation of these costs are contained in Appendix E.

Table 12-1: Cost for proposed new Mass Transit services

2007 Costs **($ million — capital costs include 30% contingency)**	**light rail**	**Bus Rapid Transit**
West End-Newstead		
Construction	$375	$33
Victoria Bridge upgrades/new bridge	New bridge = $94 m	not required
Vehicles (20 vehicles)*	$120	$60
Total capital cost *	$589	$93
Annual operating cost*	$7.8	$3.1
Hamilton-Woolloongabba line		
Construction (no viaduct)	$326	$32
Additional vehicles required (3 vehicles) **	$18	$9
Total capital cost	$344	$41
Future Kingsford Smith Drive viaduct	$220	$220
Additional annual operating cost **	$9.5	$3.8
Inner city orbital service		
Construction	$188	$11
Vehicles (9 vehicles)	$54	$27
Total capital cost	$242	$38
Annual operating cost	$3.1	$1.3

* - Peak service frequency of 5 minutes if Hamilton-Woolloongabba line is not commissioned

** - Additional costs required for services to be provided in conjunction with West End-Newstead service with 10 minute frequency on each line

12.1 Financial evaluation

The financial analysis captures the incremental capital and operating cost implications associated with meeting forecast demand and the additional fare-box revenue that will be captured with diverted car trips and entirely new public transport trips.

It was assumed that existing heavy rail, bus and ferry services would be progressively expanded to meet additional demand, with a significant diversion to the new Mass Transit service occurring with the commissioning of the West End–Newstead service and the Inner City Orbital service.

The financial analysis shows that the financial cost of meeting additional demand for inner city trips is estimated at between $1,234 million and $1,835 million expressed as a Net Present Value (NPV) in 2007 prices. The financial analysis confirms that a significant increase in public transport funding will be required to meet both capital and operating costs associated with the provision of additional inner city services.

12.2 Economic evaluation

The economic evaluation was conducted using standard Cost Benefit Analysis (CBA) principles. The estimates of capital and operating cost impacts derived for the financial appraisal were rolled over to the economic evaluation. Similarly, the estimate of additional farebox revenue was included in the economic evaluation in the context of increased 'producer surplus'.

However, two key additional benefit streams needed to be included in the assessment.

Firstly, we needed to consider the 'consumer surplus' associated with meeting the higher level of demand under the 'high' forecast. The additional demand accommodated by improved public transport service levels and service quality under the 'high' forecast will reflect a mix of 'diverted' (i.e. trips that would otherwise have been made by car) and 'generated' (i.e. entirely new public transport trips).

For the purpose of this analysis, it was assumed that 80% of the incremental demand for public transport (i.e. represented by the difference between the 'high' and 'trend' forecasts in any given year) would in fact be diverted car trips. The balance (i.e. 20%) was assumed to represent generated or entirely new public transport trips.

In transport planning terms, the full or 'generalised' cost of a public transport trip can be represented in one of two ways (i.e. either in equivalent in-vehicle time minutes or in monetary terms by applying an appropriate value of time). This thereby captures the full cost of a public transport trip including both price (i.e. fare paid) and non-price components (i.e. access and egress time, in-vehicle time, interchange penalties etc).

In this case, the consumer surplus concept measures the value of improved services for new public transport trips (i.e. both diverted and generated) with reference to the estimated change in generalised cost as service levels and service quality progressively improves.

Under the options considered, this is reflected by way of both improved service levels offered by current modes and the 'step change' in service levels and service quality offered by the progressive introduction of the new Mass Transit services to the inner city. The analysis thereby provides for a progressive reduction in generalised costs to and from the inner city over time, which is captured in the analysis as a benefit (i.e. increased consumer surplus).

The second class of benefits that needed to be considered is the reduction in the external costs associated with private car use. As suggested above, it was assumed that 80% of the additional demand accommodated under the 'high' forecast would be diverted car trips. This includes (net) reductions in road congestion, road accidents, road damage, air pollution, noise pollution, greenhouse gases, 'upstream' and 'downstream' costs of transport (including energy production) and urban separation costs.

Table 12-2 presents the results of the analysis of light rail and Bus Rapid Transit for the West End-Newstead Line and Inner City Orbital based on two measures of project viability:

- Net Present Value (NPV)
- Benefit Cost Ratio.

It is important to note that the NPV is the preferred measure for assessing project viability.

Table 12-2: Economic assessment of inner city public transport options ($ million)

Measure	Estimate	
	Bus Rapid Transit	***light rail***
Capital and Operating Costs	($2,329.3)	($2,930.1)
Benefits	$5,757.9	$5,882.2
Net Present Value (NPV)	$3,428.5	$2,952.2
Benefit Cost Ratio	2.47	2.01

Source: Prepared by Booz Allen Hamilton

The following observations can be made concerning the results obtained:

- The proposed development of new Mass Transit services to meet the transport needs of the inner city produces a positive Net Present Value (NPV) of between $2,952.2 million (light rail) and $3,428.5 million (Bus Rapid Transit).
- With capital and incremental operating costs of $2,930.1 million (light rail) and $2,329.3 million (Bus Rapid Transit) in discounted terms, the investment in new Mass Transit produces a benefit cost ratio of between 2.01 (light rail) and 2.47 (Bus Rapid Transit).

Appendix A

Taskforce terms of reference

Taskforce Terms of Reference

The terms of reference for the investigation were as follows:

> In order to fulfil the vision of the City Centre Master Plan 2006 and ease overcrowding on existing and planned high frequency suburban bus services: assess existing demand drivers and develop a plan for a world class Mass Transit system for Brisbane.
>
> This plan will build on existing services, infrastructure and assets with the aim of increasing the carrying capacity and accessibility of our public transport network. It will also identify opportunities for future expansion of this Mass Transit system into suburban areas not presently served by the rail network.
>
> While detailing a long-term vision for Mass Transit, the plan should take into consideration the need to increase public transport capacity in the short term to deal with the significant increases in demand since 2004.
>
> Recommendations should give due regard to relevant plans and studies, including but not limited to: the City Centre Master Plan 2006, CityShape, Brisbane Transport Plan Update 2006–2026, the Climate Change and Energy Taskforce report; as well as the South East Queensland (SEQ) Regional Plan, South East Queensland Infrastructure Plan and Program and South East Queensland Integrated Regional Transport Plan.
>
> The final report should provide:
>
> - a preferred option for the establishment of this Mass Transit system, including recommended routes
> - details of any infrastructure requirements
> - implications and integration opportunities for existing and proposed public transport services
> - an overview of impacts on the existing road network
> - estimated costs
> - a timeframe for implementation.

Appendix B

Previous light rail investigations

Previous light rail investigations

Brisbane discontinued its tram services in the 1960s and replaced them with bus services. On three occasions since, attempts have been made to re-establish tram or light rail systems in the CBD and frame. None of these attempts have been successful. The Taskforce examined these to better understand the reasons for these plans not being implemented.

Brisbane Light Rail Transit

In the early 1990s Brisbane City Council established urban renewal Taskforce teams to guide development in the CBD and the surrounding CBD frame — in particular the inner northern precincts of Fortitude Valley, Teneriffe and Newstead. The planning process recommended that the feasibility be established for a Light Rail Transit (LRT) system to connect Newstead, Teneriffe and Fortitude Valley with the CBD.

In 1992 a study examined the proposed light rail linkage and also provided for a link to the Gardens Point campus of Queensland University of Technology and a possible future link over the river to the redeveloping West End precinct and into suburban corridors in the long term. The route through the CBD sought to link the retailing, commercial, financial, and government-office precincts into a single inner-city loop. The proposed alignment is illustrated in Figure B-1.

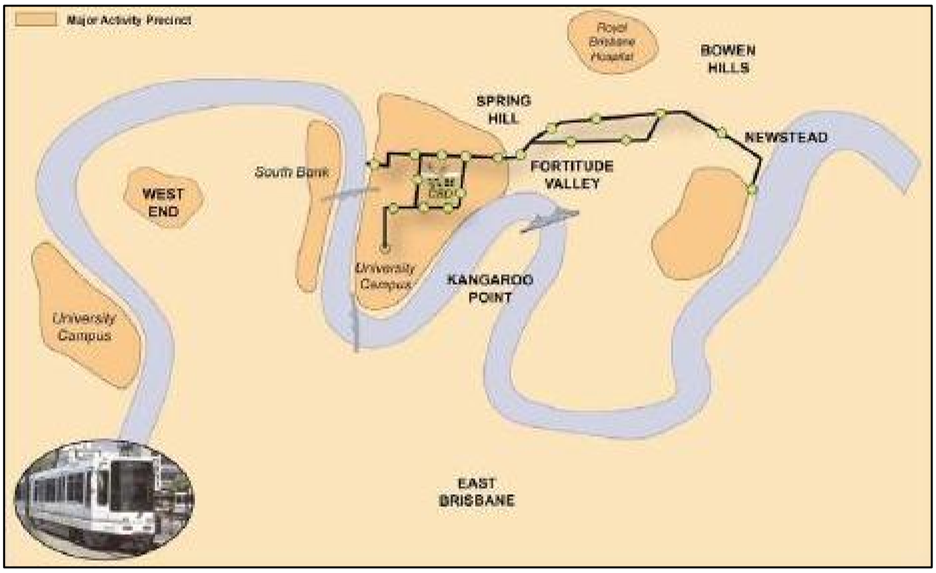


Figure B-1: Brisbane Light Rail Transit: proposed alignment

The proposal forecast low patronage levels (10,000–15,000 passengers per peak hour per direction). Neither Queensland Treasury nor the Brisbane City Council were willing to fund the project due to the low patronage levels projected. It was not included in the South East Queensland Integrated Regional Transport Plan (IRTP) prepared by Queensland Transport at the time. The proposal however received considerable private sector interest.

BRIZTRAM

In 1997 the Queensland State Government announced plans to develop a light rail system in Brisbane to further revitalise inner Brisbane and deliver major benefits for business, tourism, the community and the environment. The announcement corresponded with the Federal Government's announcement of a 'federation fund' to provide start-up grants for successful projects of regional or historical significance.

The proposal was submitted for start-up funding as a heritage project to revive Brisbane's trams. To be eligible for these funds the proposal, named BRIZTRAM, needed to become operational during 2001 and had to include an historical element. This was to be achieved by refurbishing old Brisbane trams from the local tram museum and implementing a local training program for tram refurbishment and maintenance. The proposal was supported by the Federal Government and received a $65-million start-up grant.

The proposal was costed at approximately $250 million, would carry some 45,000 passengers per day, and would be built, owned and operated by a private consortium under contract to the State Government. The project was to help the Integrated Regional Transport Plan achieve its aggressive mode-share targets set some 5 years previously.

BRIZTRAM was promoted as both a sustainable transport solution and a historical tramway. The proposed alignment is illustrated in Figure B-2.

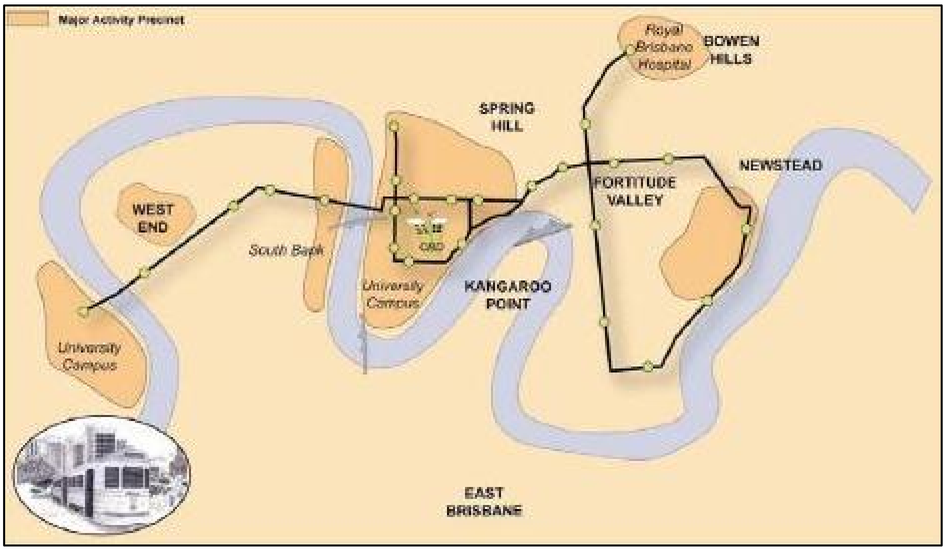


Figure B-2: BRIZTRAM: proposed alignment

Community reaction to the proposal was mixed. Many residents supported the concept but a degree of resident opposition emerged in the West End precinct where the proposal was seen as destroying the local-village atmosphere of the West End. The BRIZTRAM proposal also included a bridge across the river to the university which was strongly opposed by a local group. The difficulty in co-locating a light rail alignment with a proposed busway in the Cultural Centre precinct in the South Bank area also presented difficulties.

Additionally, the Brisbane City Council was not included in the proposal, and at that time opposed any additional river crossings. When the incumbent State Government was unseated in an election in 1998, the project was shelved. The Taskforce concluded that the BRIZTRAM proposal faltered for the following reasons:

- the limited time allowed for adequate planning and consultation, particularly with key stakeholders such as Brisbane City Council
- the plan to use the old heritage trams in the fleet
- the lack of integration and coordination with other modes
- failure to address the issues of light rail priority and impacts on traffic.

Brisbane Light Rail

Almost a year later the concept of an inner-city light rail was relaunched by the State Government as Brisbane Light Rail (BLR) after undertaking further planning. The BLR proposal was different from the original BRIZTRAM proposal in that the BLR was to be developed as a central-city distribution network, unlike the latter which had a line-haul function. The BLR was to service three inner-city railway stations (Brunswick Street, South Brisbane, and Roma Street) and three busway stations (Cultural Centre, Roma Street, and the Royal Brisbane Hospital). It was to essentially act as an inner-city distribution mode for the growing number of CBD visitors coming into the city centre by the busway and the region's heavy-rail networks. The proposed alignment is illustrated in Figure B-3.

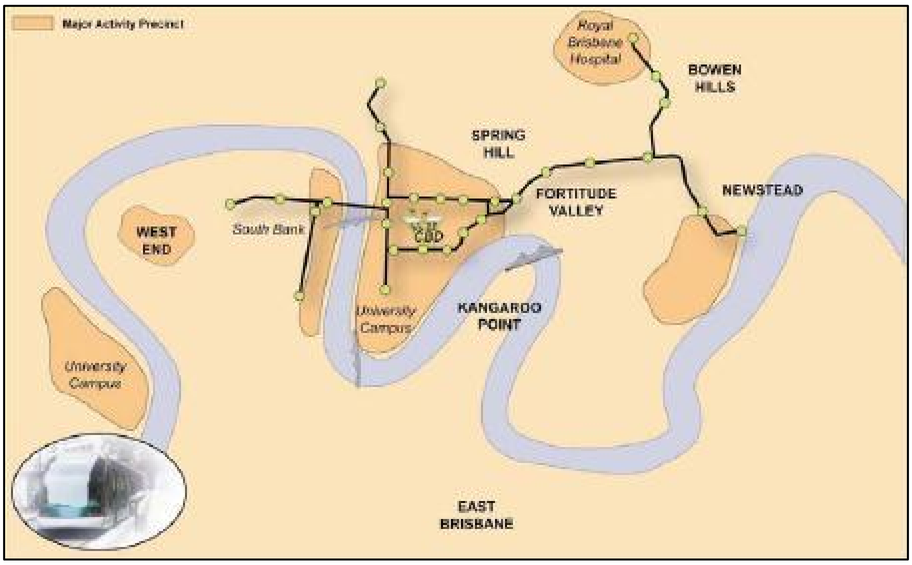


Figure B-3: Brisbane light rail: proposed alignment

The stated objectives of the BLR were to:

- enhance the inner-city environment with improved urban design
- increase overall use of public transport and contribute to the IRTP mode-share targets
- improve local air quality and reduce other environmental impacts of traffic in the city
- make public transport more permanent and increase its accessibility and understanding
- improve circulation of shoppers, workers, and tourists within the central city area
- stimulate development in the city, Valley, New Farm, and West End precincts
- provide for extensions of the BLR on to the suburban rail network and into suburban environments.

The BLR study concentrated on resolving some technical issues related to the proposal. These included:

- choosing the appropriate wheel profiles for possible future dual-gauge running in street and on the heavy-rail network
- improving modal integration to connect the developing busway services and ferry network into the light rail system
- resolving detailed track and station design issues, such as structure gauges, signalling systems, design loads, and rail-fixing techniques
- investigating low-profile rail and rail-fixing options for the link over the Victoria Bridge
- developing operations plans, traffic impacts, environmental impacts, and construction schedules
- projecting revenue and estimating capital and operating cost.

The concerns of the community and Brisbane City Council with the BRIZTRAM proposal were addressed in the BLR proposal by not passing through the West End. Although these objections were resolved the concerns of the Queensland Property Council over potential construction impacts on access to many of its members' inner-city properties could not be resolved. The Property Council thus actively opposed the project.

Despite this opposition, expressions-of-interest were called for the construction and operation of the Brisbane light rail. Four consortia submitted expressions-of-interest but the bids were significantly higher than the cost estimates of the study. The private sector priced in what they saw as unresolved project risks (including revenues, costs, public opposition). The project could not proceed due to the cost exceeding the budget allocated.

Lessons learnt

Lessons learnt from these previous studies are:

- The primary purpose of a new public transport service must be to satisfy transport demand. Without this primary purpose the service will not be economically viable.
- The public transport service should be designed to optimally service the demand within the constraints of the environment and budget. The choice of mode or technology should be chosen because of its ability to provide the required service within the constraints, not vice versa.
- The need for a partnership between the Brisbane City Council, State Government and the private sector in proposing to develop new or innovative public transport improvements.

Appendix C

Brisbane Strategic Transport Model demand projections

2004 MOTORISED

From	To -> WER	WE	SB	KP	CBD	CBDN	GP	RS	S	V	VN	VW	NF	N	BH	Rest	Total
West End Riverside	338	129	198	69	56	78	51	21	48	17	11	6	13	9	10	1,017	**2,071**
West End	515	110	320	49	64	103	66	27	86	22	10	5	12	7	9	1,143	**2,548**
South Bank	112	37	369	57	74	102	73	25	61	24	17	8	21	13	12	1,601	**2,607**
Kurilpa Point	104	27	129	68	56	72	50	20	48	16	10	6	12	8	9	807	**1,443**
CBD	46	18	65	44	156	214	130	38	65	35	29	16	33	23	17	1,422	**2,351**
CBD Nth	60	23	87	55	219	686	214	62	180	110	73	39	85	55	41	2,553	**4,542**
Gardens Point	42	17	66	39	140	228	202	29	59	34	27	14	33	22	16	1,656	**2,623**
Roma St	18	6	23	16	42	68	30	26	37	12	10	6	11	8	8	630	**951**
Springhill	30	9	53	21	74	189	63	33	278	60	32	23	38	24	24	1,399	**2,351**
Valley	14	4	22	12	43	113	40	15	68	62	39	20	39	27	25	724	**1,267**
Valley Nth	15	4	28	11	42	106	41	15	74	63	82	17	83	53	40	939	**1,614**
Valley West	8	2	13	6	21	51	19	8	62	29	18	15	17	12	15	419	**714**
New Farm	34	9	58	25	113	284	118	43	145	97	111	26	350	102	55	1,918	**3,486**
Newstead	19	5	33	14	56	138	58	22	85	58	71	16	115	92	58	1,289	**2,127**
Bowen Hills	13	3	21	9	24	57	23	11	72	37	39	13	32	41	54	968	**1,416**
Rest	4,921	1,242	7,285	3,454	10,305	21,111	11,802	4,900	9,027	3,555	3,178	1,495	2,782	2,693	3,771	840,682	**932,204**
Total	**6,289**	**1,646**	**8,771**	**3,948**	**11,485**	**23,600**	**12,980**	**5,294**	**10,396**	**4,231**	**3,755**	**1,725**	**3,675**	**3,190**	**4,162**	**859,166**	**964,314**

2004 PT

From	To -> WER	WE	SB	KP	CBD	CBDN	GP	RS	S	V	VN	VW	NF	N	BH	Rest	Total
West End Riverside	19	6	11	3	13	22	13	6	15	5	2	1	3	1	2	165	**287**
West End	42	7	19	6	34	62	38	16	38	10	4	3	5	3	5	291	**583**
South Bank	5	1	25	3	18	29	21	7	22	8	3	2	4	2	3	317	**469**
Kurilpa Point	5	1	8	3	12	18	12	5	18	5	2	1	2	1	2	155	**248**
CBD	8	3	16	8	3	3	3	1	3	1	1	0	2	1	0	226	**278**
CBD Nth	10	5	21	10	5	22	6	2	13	9	2	1	6	2	1	430	**546**
Gardens Point	7	4	17	7	7	14	15	2	5	2	1	1	3	1	1	344	**428**
Roma St	3	1	6	3	2	5	2	2	4	1	0	0	1	0	1	103	**135**
Springhill	7	2	18	5	8	29	9	5	52	8	2	2	3	1	2	214	**367**
Valley	3	1	7	3	6	16	6	2	10	8	2	2	2	1	2	109	**181**
Valley Nth	4	1	9	3	6	18	7	2	10	8	5	1	6	3	3	124	**210**
Valley West	2	0	4	1	2	6	2	1	10	3	1	1	1	1	1	60	**97**
New Farm	13	3	21	12	32	93	35	13	29	18	13	5	34	9	9	302	**642**
Newstead	6	1	11	5	14	39	15	6	15	9	8	2	12	7	6	165	**323**
Bowen Hills	3	1	7	2	3	9	4	2	12	5	2	1	2	2	4	126	**184**
Rest	1,157	221	2,571	1,043	5,341	11,596	6,436	2,532	4,204	1,624	1,140	629	846	747	1,623	54,477	**96,187**
Total	**1,294**	**258**	**2,770**	**1,116**	**5,507**	**11,983**	**6,625**	**2,602**	**4,462**	**1,724**	**1,189**	**651**	**931**	**783**	**1,663**	**57,607**	**101,165**

2004 PT Mode Share

From	To -> WER	WE	SB	KP	CBD	CBDN	GP	RS	S	V	VN	VW	NF	N	BH	Rest	Total
West End Riverside	6%	4%	5%	5%	23%	28%	26%	28%	32%	28%	18%	18%	20%	16%	22%	16%	**14%**
West End	8%	7%	6%	12%	54%	61%	58%	59%	44%	47%	45%	50%	39%	39%	52%	25%	**23%**
South Bank	5%	4%	7%	5%	24%	28%	28%	28%	37%	31%	19%	20%	20%	16%	22%	20%	**18%**
Kurilpa Point	5%	4%	6%	5%	21%	25%	25%	24%	37%	30%	16%	17%	21%	15%	18%	19%	**17%**
CBD	17%	19%	24%	17%	2%	2%	2%	2%	5%	4%	2%	2%	6%	4%	2%	16%	**12%**
CBD Nth	17%	22%	24%	17%	2%	3%	3%	3%	7%	8%	3%	2%	7%	4%	3%	17%	**12%**
Gardens Point	17%	22%	26%	18%	5%	6%	7%	6%	8%	6%	4%	4%	8%	5%	4%	21%	**16%**
Roma St	17%	21%	25%	18%	6%	7%	8%	6%	11%	6%	4%	4%	8%	5%	6%	16%	**14%**
Springhill	24%	21%	34%	22%	11%	16%	14%	15%	19%	13%	6%	7%	8%	5%	7%	15%	**16%**
Valley	23%	20%	30%	24%	13%	15%	15%	16%	15%	13%	6%	8%	6%	5%	8%	15%	**14%**
Valley Nth	25%	19%	32%	25%	14%	17%	17%	17%	14%	13%	7%	7%	7%	5%	7%	13%	**13%**
Valley West	22%	18%	32%	22%	10%	12%	12%	13%	16%	12%	6%	6%	7%	5%	8%	14%	**14%**
New Farm	39%	31%	36%	47%	29%	33%	30%	30%	20%	19%	12%	19%	10%	9%	16%	16%	**18%**
Newstead	33%	27%	34%	39%	25%	28%	26%	26%	18%	16%	11%	14%	10%	8%	11%	13%	**15%**
Bowen Hills	23%	20%	35%	23%	14%	16%	16%	16%	16%	12%	5%	6%	7%	4%	7%	13%	**13%**
Rest	24%	18%	35%	30%	52%	55%	55%	52%	47%	46%	36%	42%	30%	28%	43%	6%	**10%**
Total	**21%**	**16%**	**32%**	**28%**	**48%**	**51%**	**51%**	**49%**	**43%**	**41%**	**32%**	**38%**	**25%**	**25%**	**40%**	**7%**	**10%**

2026 MOTORISED

From	To -> WER	WE	SB	KP	CBD	CBDN	GP	RS	S	V	VN	VW	NF	N	BH	Rest	Total
West End Riverside	987	122	594	78	162	254	119	87	228	90	17	17	27	19	24	2,591	**5,417**
West End	464	50	451	28	64	100	50	32	125	41	6	6	12	6	8	1,221	**2,663**
South Bank	190	35	1,021	69	119	155	88	41	180	79	16	12	29	20	17	2,570	**4,641**
Kurilpa Point	334	28	813	63	121	157	85	54	345	98	13	11	29	14	14	2,487	**4,665**
CBD	64	18	97	58	340	444	203	74	91	117	37	33	49	49	38	2,423	**4,135**
CBD Nth	79	22	117	68	446	1,351	293	110	206	290	90	78	117	109	84	3,997	**7,456**
Gardens Point	48	12	93	37	205	315	203	41	85	87	24	20	36	32	25	2,118	**3,382**
Roma St	28	6	40	22	79	118	42	58	61	41	12	12	16	16	15	1,129	**1,693**
Springhill	36	7	73	24	113	281	69	45	429	139	31	36	44	35	39	1,724	**3,125**
Valley	30	7	50	23	145	369	94	49	162	312	82	78	94	87	85	1,814	**3,482**
Valley Nth	15	3	34	9	69	173	50	26	118	155	73	30	96	73	57	1,104	**2,084**
Valley West	10	2	16	7	41	98	26	16	86	89	24	39	24	24	33	627	**1,161**
New Farm	29	5	55	19	173	439	134	74	171	223	96	44	366	139	77	2,096	**4,140**
Newstead	31	4	78	15	121	290	91	49	243	243	99	39	242	222	83	2,251	**4,103**
Bowen Hills	25	3	58	10	58	130	42	23	289	177	58	36	80	59	129	2,225	**3,402**
Rest	4,697	895	8,340	2,873	17,299	35,088	15,429	10,105	11,359	9,708	3,019	2,907	3,407	3,651	5,811	1,081,141	**1,215,729**
Total	**7,065**	**1,219**	**11,931**	**3,403**	**19,554**	**39,761**	**17,018**	**10,884**	**14,179**	**11,891**	**3,697**	**3,399**	**4,666**	**4,554**	**6,539**	**1,111,518**	**1,271,278**

2026 PT

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	73	7	34	6	75	141	63	51	94	48	7	9	13	8	10	729	**1,370**
West End	34	3	26	3	34	61	30	20	53	23	3	4	6	3	4	368	**675**
South Bank	9	1	74	3	50	72	51	19	94	43	6	8	12	7	6	885	**1,340**
Kurilpa Point	21	1	58	5	42	70	38	25	174	55	5	5	14	5	5	775	**1,298**
CBD	12	4	22	11	7	8	9	8	12	26	7	11	8	8	15	1,301	**1,469**
CBD Nth	17	5	25	15	9	38	9	10	26	62	17	25	19	16	31	1,986	**2,310**
Gardens Point	12	3	31	9	12	23	16	7	18	25	6	8	8	7	12	1,370	**1,566**
Roma St	16	4	32	14	16	15	17	8	19	13	3	6	5	5	8	654	**834**
Springhill	13	2	32	8	18	49	13	11	83	32	6	3	14	10	3	731	**1,029**
Valley	7	1	14	6	16	48	12	8	22	30	4	5	6	4	5	718	**906**
Valley Nth	5	1	13	3	15	43	12	7	20	25	8	3	10	5	5	420	**594**
Valley West	2	0	5	2	4	11	3	2	13	7	1	2	2	1	2	243	**300**
New Farm	11	2	21	8	52	151	41	24	35	46	13	9	43	15	13	876	**1,361**
Newstead	10	1	29	5	32	86	25	14	43	42	12	6	32	18	10	867	**1,232**
Bowen Hills	7	1	25	2	9	24	8	5	54	26	4	3	8	3	8	803	**989**
Rest	1,327	208	3,394	967	10,803	22,513	10,159	6,463	6,213	5,277	1,360	1,534	1,439	1,441	2,974	121,919	**197,992**
Total	**1,576**	**246**	**3,834**	**1,068**	**11,193**	**23,354**	**10,505**	**6,682**	**6,972**	**5,780**	**1,463**	**1,640**	**1,639**	**1,557**	**3,111**	**134,645**	**215,265**

2026 PT Mode Share

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	7%	6%	6%	8%	46%	56%	53%	59%	41%	53%	44%	54%	47%	44%	43%	28%	**25%**
West End	7%	6%	6%	9%	53%	61%	59%	63%	43%	56%	52%	66%	51%	49%	49%	30%	**25%**
South Bank	5%	4%	7%	5%	42%	46%	58%	46%	52%	55%	39%	62%	43%	36%	37%	34%	**29%**
Kurilpa Point	6%	5%	7%	8%	35%	45%	45%	46%	50%	56%	39%	46%	50%	39%	34%	31%	**28%**
CBD	19%	20%	23%	19%	2%	2%	4%	10%	13%	22%	19%	34%	17%	16%	39%	54%	**36%**
CBD Nth	22%	24%	21%	22%	2%	3%	3%	9%	13%	21%	18%	31%	16%	15%	37%	50%	**31%**
Gardens Point	25%	25%	33%	24%	6%	7%	8%	18%	21%	29%	25%	41%	21%	21%	48%	65%	**46%**
Roma St	56%	65%	79%	63%	20%	12%	41%	13%	32%	32%	30%	46%	34%	35%	53%	58%	**49%**
Springhill	35%	33%	43%	34%	16%	18%	19%	24%	19%	23%	19%	8%	32%	30%	8%	42%	**33%**
Valley	23%	21%	28%	24%	11%	13%	13%	16%	13%	10%	5%	6%	6%	4%	6%	40%	**26%**
Valley Nth	30%	23%	38%	30%	21%	25%	24%	27%	17%	16%	11%	12%	10%	7%	10%	38%	**28%**
Valley West	22%	20%	30%	22%	9%	11%	11%	14%	15%	8%	5%	5%	7%	4%	6%	39%	**26%**
New Farm	40%	33%	38%	44%	30%	34%	31%	33%	20%	21%	13%	21%	12%	11%	17%	42%	**33%**
Newstead	33%	26%	37%	36%	26%	30%	28%	29%	18%	17%	12%	15%	13%	8%	12%	39%	**30%**
Bowen Hills	28%	20%	43%	25%	16%	19%	18%	20%	19%	15%	7%	7%	10%	4%	6%	36%	**29%**
Rest	28%	23%	41%	34%	62%	64%	66%	64%	55%	54%	45%	53%	42%	39%	51%	11%	**16%**
Total	**22%**	**20%**	**32%**	**31%**	**57%**	**59%**	**62%**	**61%**	**49%**	**49%**	**40%**	**48%**	**35%**	**34%**	**48%**	**12%**	**17%**

2004 - 2026 Growth in Motorised

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	193%	-6%	200%	14%	188%	227%	136%	317%	370%	429%	52%	174%	110%	110%	140%	155%	**162%**
West End	-10%	-55%	41%	-43%	-0%	-3%	-23%	18%	45%	85%	-37%	11%	1%	-8%	-18%	7%	**5%**
South Bank	69%	-6%	177%	20%	61%	53%	20%	65%	197%	227%	-5%	54%	38%	53%	41%	60%	**78%**
Kurilpa Point	220%	2%	529%	-7%	115%	118%	71%	167%	613%	507%	25%	95%	142%	65%	64%	208%	**223%**
CBD	38%	1%	49%	31%	118%	108%	56%	97%	39%	239%	30%	113%	47%	109%	121%	70%	**76%**
CBD Nth	31%	-4%	34%	24%	104%	97%	37%	77%	14%	164%	23%	102%	38%	97%	108%	57%	**64%**
Gardens Point	14%	-27%	41%	-5%	46%	38%	1%	44%	45%	160%	-10%	47%	9%	44%	57%	28%	**29%**
Roma St	60%	4%	72%	36%	89%	74%	39%	126%	66%	235%	17%	102%	44%	83%	73%	79%	**78%**
Springhill	18%	-18%	37%	14%	53%	48%	10%	36%	54%	133%	-5%	57%	14%	48%	61%	23%	**33%**
Valley	116%	59%	126%	103%	237%	227%	133%	227%	138%	400%	110%	288%	142%	225%	248%	151%	**175%**
Valley Nth	3%	-36%	21%	-17%	63%	63%	21%	75%	60%	144%	-11%	73%	16%	37%	41%	18%	**29%**
Valley West	25%	-7%	27%	18%	97%	92%	38%	99%	37%	203%	34%	167%	41%	97%	125%	50%	**63%**
New Farm	-15%	-39%	-5%	-25%	53%	55%	14%	71%	18%	130%	-13%	68%	5%	37%	40%	9%	**19%**
Newstead	65%	-8%	135%	10%	116%	110%	56%	122%	186%	323%	40%	140%	111%	143%	45%	75%	**93%**
Bowen Hills	95%	-8%	180%	10%	139%	130%	82%	112%	303%	382%	51%	176%	149%	41%	141%	130%	**140%**
Rest	-5%	-28%	14%	-17%	68%	66%	31%	106%	26%	173%	-5%	94%	22%	36%	54%	29%	**30%**
Total	**12%**	**-26%**	**36%**	**-14%**	**70%**	**68%**	**31%**	**106%**	**36%**	**181%**	**-2%**	**97%**	**27%**	**43%**	**57%**	**29%**	**32%**

2004 - 2026 Growth in PT

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	283%	32%	220%	84%	483%	540%	384%	785%	514%	917%	267%	712%	394%	480%	369%	341%	**377%**
West End	-18%	-57%	34%	-54%	-2%	-2%	-22%	25%	41%	120%	-28%	48%	33%	17%	-23%	26%	**16%**
South Bank	82%	-9%	196%	9%	182%	148%	146%	170%	320%	470%	96%	375%	201%	241%	134%	179%	**186%**
Kurilpa Point	327%	25%	661%	48%	259%	297%	211%	425%	868%	1,035%	197%	439%	478%	328%	210%	401%	**423%**
CBD	57%	7%	43%	49%	167%	160%	187%	1,091%	244%	1,932%	1,105%	4,124%	353%	854%	4,219%	476%	**428%**
CBD Nth	63%	5%	18%	58%	76%	69%	47%	454%	92%	630%	754%	2,551%	224%	580%	2,685%	362%	**323%**
Gardens Point	67%	-16%	80%	25%	76%	63%	8%	357%	275%	1,216%	503%	1,545%	199%	477%	1,766%	298%	**266%**
Roma St	422%	225%	455%	377%	546%	200%	613%	379%	381%	1,570%	679%	2,044%	540%	1,064%	1,384%	532%	**518%**
Springhill	72%	32%	74%	74%	116%	68%	45%	128%	61%	321%	210%	79%	344%	704%	68%	241%	**180%**
Valley	116%	61%	111%	101%	182%	188%	107%	225%	112%	270%	95%	205%	140%	195%	173%	559%	**401%**
Valley Nth	26%	-24%	45%	-3%	144%	144%	73%	180%	91%	200%	42%	190%	67%	101%	106%	238%	**183%**
Valley West	27%	5%	19%	21%	78%	76%	23%	110%	30%	108%	20%	140%	39%	74%	63%	308%	**209%**
New Farm	-14%	-35%	-1%	-29%	62%	63%	17%	88%	18%	152%	-4%	85%	26%	62%	47%	190%	**112%**
Newstead	65%	-11%	154%	1%	123%	121%	63%	147%	180%	364%	54%	153%	171%	155%	62%	427%	**282%**
Bowen Hills	140%	-4%	245%	17%	165%	160%	106%	168%	355%	469%	103%	211%	254%	56%	133%	537%	**438%**
Rest	15%	-6%	32%	-7%	102%	94%	58%	155%	48%	225%	19%	144%	70%	93%	83%	124%	**106%**
Total	**22%**	**-5%**	**38%**	**-4%**	**103%**	**95%**	**59%**	**157%**	**56%**	**235%**	**23%**	**152%**	**76%**	**99%**	**87%**	**134%**	**113%**

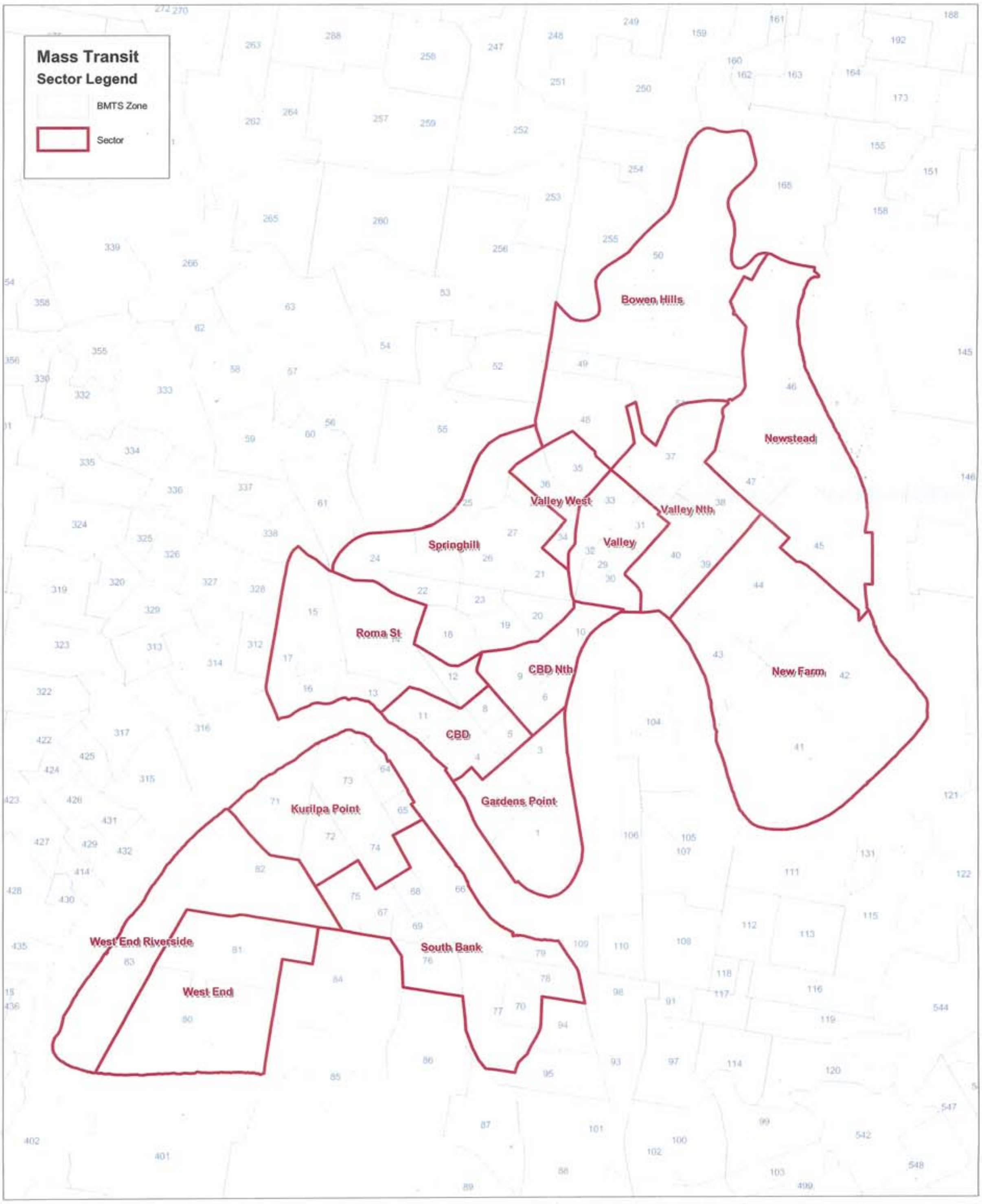
2004 - 2026 Mode Share Change

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	2%	2%	0%	3%	23%	27%	27%	31%	10%	25%	26%	36%	27%	28%	21%	12%	**11%**
West End	-1%	-0%	-0%	-2%	-1%	1%	1%	4%	-1%	9%	7%	17%	12%	11%	-3%	5%	**2%**
South Bank	0%	-0%	0%	-1%	18%	18%	30%	18%	15%	23%	20%	42%	23%	20%	15%	15%	**11%**
Kurilpa Point	2%	1%	1%	3%	14%	20%	20%	23%	13%	26%	23%	29%	29%	24%	16%	12%	**11%**
CBD	2%	1%	-1%	2%	0%	0%	2%	8%	8%	18%	17%	33%	12%	13%	37%	38%	**24%**
CBD Nth	4%	2%	-3%	5%	-0%	-0%	0%	6%	5%	14%	16%	29%	9%	10%	34%	33%	**19%**
Gardens Point	8%	3%	7%	6%	1%	1%	1%	12%	13%	23%	21%	37%	13%	16%	44%	44%	**30%**
Roma St	39%	44%	54%	45%	14%	5%	33%	7%	21%	26%	25%	42%	27%	29%	47%	41%	**35%**
Springhill	11%	13%	9%	11%	5%	2%	5%	10%	1%	10%	13%	1%	24%	24%	0%	27%	**17%**
Valley	-0%	0%	-2%	-0%	-2%	-2%	-2%	-0%	-2%	-3%	-0%	-2%	-0%	-0%	-2%	25%	**12%**
Valley Nth	6%	4%	6%	4%	7%	8%	7%	10%	3%	3%	4%	5%	3%	2%	3%	25%	**15%**
Valley West	0%	2%	-2%	0%	-1%	-1%	-1%	1%	-1%	-4%	-1%	-1%	-0%	-1%	-2%	25%	**12%**
New Farm	0%	2%	2%	-3%	2%	2%	1%	3%	-0%	2%	1%	2%	2%	2%	1%	26%	**14%**
Newstead	-0%	-1%	3%	-3%	1%	1%	1%	3%	-0%	2%	1%	1%	3%	0%	1%	26%	**15%**
Bowen Hills	5%	1%	8%	1%	2%	2%	2%	4%	2%	2%	2%	1%	3%	0%	-0%	23%	**16%**
Rest	5%	6%	5%	3%	11%	9%	11%	12%	8%	9%	9%	11%	12%	12%	8%	5%	**6%**
Total	**2%**	**5%**	**1%**	**3%**	**9%**	**8%**	**11%**	**12%**	**6%**	**8%**	**8%**	**11%**	**10%**	**10%**	**8%**	**5%**	**6%**

2004 - 2026 Growth in PT - Growth in Motorised

	To ->																
From	**WER**	**WE**	**SB**	**KP**	**CBD**	**CBDN**	**GP**	**RS**	**S**	**V**	**VN**	**VW**	**NF**	**N**	**BH**	**Rest**	**Total**
West End Riverside	90%	38%	20%	70%	295%	313%	248%	467%	144%	488%	215%	537%	284%	370%	229%	186%	216%
West End	-8%	-2%	-7%	-11%	-1%	1%	2%	7%	-4%	35%	9%	37%	32%	25%	-5%	20%	11%
South Bank	13%	-3%	19%	-11%	121%	96%	126%	104%	122%	242%	101%	322%	163%	188%	93%	119%	108%
Kurilpa Point	106%	24%	132%	55%	144%	178%	140%	258%	255%	528%	173%	344%	336%	262%	146%	193%	199%
CBD	20%	6%	-6%	19%	50%	52%	131%	994%	205%	1,692%	1,075%	4,011%	306%	745%	4,098%	405%	352%
CBD Nth	32%	9%	-16%	33%	-28%	-28%	10%	377%	77%	466%	731%	2,450%	186%	483%	2,577%	305%	259%
Gardens Point	53%	11%	39%	30%	29%	26%	7%	313%	230%	1,056%	513%	1,498%	190%	433%	1,710%	271%	237%
Roma St	362%	221%	382%	341%	458%	126%	574%	253%	316%	1,336%	662%	1,942%	497%	981%	1,311%	453%	440%
Springhill	54%	50%	37%	59%	63%	19%	36%	92%	7%	188%	215%	21%	330%	656%	7%	218%	147%
Valley	-1%	2%	-15%	-2%	-55%	-39%	-26%	-2%	-26%	-130%	-14%	-83%	-2%	-30%	-75%	409%	226%
Valley Nth	23%	12%	24%	14%	81%	81%	52%	105%	31%	56%	53%	116%	51%	63%	64%	221%	154%
Valley West	2%	12%	-8%	3%	-19%	-16%	-15%	11%	-7%	-95%	-14%	-28%	-2%	-23%	-62%	258%	147%
New Farm	1%	4%	4%	-4%	9%	8%	3%	17%	-0%	22%	9%	17%	21%	25%	6%	181%	93%
Newstead	-0%	-3%	20%	-9%	7%	11%	7%	25%	-6%	41%	13%	13%	60%	12%	18%	352%	189%
Bowen Hills	44%	4%	65%	7%	26%	30%	25%	56%	51%	87%	53%	35%	105%	14%	-7%	407%	297%
Rest	19%	22%	18%	10%	34%	28%	27%	49%	22%	52%	24%	49%	48%	57%	29%	95%	75%
Total	**9%**	**21%**	**2%**	**10%**	**33%**	**26%**	**27%**	**51%**	**20%**	**54%**	**25%**	**55%**	**49%**	**56%**	**30%**	**104%**	**81%**

Brisbane Mass Transit System Demand Sectors



Appendix D

Comparison of mode characteristics

Introduction

The City of Brisbane commissioned PB in June 2007 to assemble a discussion paper on emerging transit systems to inform the investigation of the Taskforce. This preliminary investigation provides an overview of different Mass Transit modes, tabulated against a given set of criteria. The summary table comparing the various Mass Transit alternatives was produced through a desktop review on ferry, Bus Rapid Transit (Bus Rapid Transit), light rail, metro rail, and heavy rail. This review involved researching previous work completed by PB, various transport agency and government reports and websites as well as journal articles. The data used was considered in terms of its relevance to the Brisbane context.

The capital and operating costs given are indicative only. Costs are expressed in Australian dollars and have been converted from the original currency using current conversion rates. Such factors as the year of the original estimate and scope of inclusions are more often than not provided in reference documents so all estimates should be taken as a guide only to the order of magnitude of costs.

Capital costs are provided on a per kilometre basis. An indicative range of cost is shown for each mode at the top of the column. Generally, there is a wide range and in some cases there are 'outliers' which have the potential to distort the costs. In these instances the range which incorporates the main body of the data is shown.

Examples were drawn from a variety of cities. Costs for systems varied greatly across each mode. The existence of grade separation is one of the biggest factors, as are ground conditions, the presence of river crossings, complexity, and age of the existing network.

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
				

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Capital costs (per km of track/road)				
	Indicative range: $1m–32m	Indicative range: $10m-$100m	Indicative range: $30m-$500m	Indicative range: $60m-$300m
CityCat Brisbane: n/a op. hours CityFerry Brisbane: n/a op. hours	$0.39m–$0.78m (rapid bus)[AF 5] $1.8m (Porto Alegre Busways)[AG] $2.2m/km (LPT exclusive corridor)[B 4] <$2.4m (bus, London)[AE 7] $2.4m–$4.8m (max priority, London)[AE 7] $2.4m–$48m (busway, London)[AE 7] $3.4m/km (LPT shared, on median of arterials)[B 4] $4.1m/km (LPT shared, outside arterial lanes)[B 4] $3.2m/km (LPT shared, on one side of road)[B 4] $2.8m/km (LPT greenfield exclusive corridor)[B 4] $3.8m (busway, London) [AE 7] $3.9m–$42.7m (indicative range, busway)[AF 5] $3.9m–$23.3m (indicative range, rail-like vehicles)[AF 5] $7.4m (Bogotá Phase I)[AM 5] $9.5m (Bogotá TransMilenio phase 1)[AG] $11.2/km (LPT Sydney)[A O] $16.6m (Bogotá Phase II — difference primarily due to increased investment in public space and infrastructure improvements)[AM 5] $18m (Quito Busway)[AG] $22.4m (South East Busways, Brisbane — fully grade separated, tunnels/viaducts, stations)[AI] $27.2m (av. of 22 automated guided systems in US)[Y 7] $31.3m (Orange Line Bus Rapid Transit	$10m (Yarra Trams — ballpark figure, includes overhead power cabling, stations and services etc. does not include new sub station)[W] $12m–$24m (trams — double track. Rising to around $72m if substantial lengths of elevated track or tunnel are required. Costs include depot, workshops, rolling stock and infrastructure)[W] $16m (Tunis, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $18m–$22m (Gold Coast estimate)[E] $18.6m (Midland Metro)[AE 7] $23m–$78m (indicative range)[AF 5] $23.4m (Manchester Metrolink)[AE 7] $24m–$106m (indicative range)[AE 7] $24–$32m (Stockholm, Sweden), $24.2m (Tunis)[AG] $27m (US average – covers planning and construction costs, technical equipment and rolling stock)[AN 5] $35.2m (Montpellier, France)[Y 7] $40m (Tramlink extensions, London)[AE 7] $63m (PUTRA — Kuala Lumpur: elevated, driverless, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $91m (PUTRA — Kuala Lumpur)[AG] $106m (Docklands LR)[AE 7]	$29m (Madrid, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $52m (Mexico City, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $57m (Madrid extensions)[AG] $75m (Mexico City, Line B)[AG] $93m (Skytrain: Bangkok, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $128m (Santiago Line 5 extension)[AG] $134m (BTS: Bangkok)[AG] $155m–$272m[AF 5] $164m (Caracas Line 4)[AG] $180m (Caracas, Venezuela: covers planning and construction costs, technical equipment and rolling stock)[AN 5] $514m (Jubilee Line Extension, London, estimate)[AE 7]	$63m (STAR — Kuala Lumpur: largely elevated, covers planning and construction costs, technical equipment and rolling stock)[AN 5] $106–$590m (indicative range)[AE 7] $275m (West Rail Hong Kong: 38% tunnel — covers planning and construction costs, technical equipment and rolling stock)[AN 5]

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
	— L.A) [AE 5]			
Operating costs per vehicle km				
	Typical Australian cost \$3–\$4[W]	Typical Australian cost \$5–\$15		
CityCat Brisbane: 45–50 litres per hour CityFerry Brisbane: 5–16 litres per hour	\$4.50/vkm (not 'next generation' Bus Rapid Transit)[AH] \$9–\$19/vkm (bus)[AE 7]	\$12/vkm (Tramlink, London)[AE 7] \$13/vkm[W] \$14/vkm[AH]	\$3.70/vkm (MTR, Hong Kong)[M] \$75/vkm (London, includes maintenance)[AE 7]	\$3.30/vkm (Hong Kong)[P] \$60/vkm (Sydney CityRail)[AQ]
Cost per vehicle				
	\$187,500–\$437,500 (CNG,LPG)[AC 5] \$250,000–\$500,000 (Hybrid Electric)[AC 5] \$312,000 (single decker)[W] \$384,000 (double decker)[W] \$480,000 (articulated single decker)[W] \$550,000–\$800,000 (18 m, articulated, low-floor, standard, diesel or CNG)[AF, AU 5] \$780,000–\$1.2m (18 m, articulated, low-floor, stylised (looks like light rail), diesel or CNG)[AF, AU 5] \$960,000 (optically guided, articulated single decker)[W] \$1m (high-capacity buses, Sydney estimates)[AK] \$1.2m–\$2m (specialised Bus Rapid Transit vehicles — e.g. Civis by Irisbus in Las Vegas)[AU 5] \$1.2m–\$2m (18 m Bus Rapid Transit vehicle with guidance, internal combustion, electric or hybrid) [AV] \$1.25m–\$1.88m (Fuel Cell)[AC 5] \$2.16m (French GLT articulated single	\$2.9m (double-articulated) average 2005–2006[AZ 5] \$3m (Sydney estimates)[A & AK] \$3.2m (Madrid)[BA 8] \$3.5m (modern low-floor)[AI] \$3.4m (articulated) average 2005–2006[AZ 5] \$5.3m (1-level cab) average 2005–2006[AZ 5]	\$2m–\$4m (Metro Rail Car)[AC 5]	\$3.4m

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
	decker)[W]			
Patronage capacity per hour per direction				
	Indicative range: < 3,000 (bus on street)[A] 1,000–20,000 per hour (Bus Rapid Transit, exclusive ROW)[A]	Indicative range: 4,000–12,000 (tram)[A] 4,000–25,000 (segregated — exclusive ROW)[A]	Indicative range: 10,000–40,000[A]	Indicative range: 10,000–75,000[A]
	1,000–3,000 (US, bus: mixed traffic)[AH] 2,000–10,000 (US, Bus Rapid Transit/bus lanes)[AH] 10,000–12,000 (U.S, bus. Small because don't take small headways into account)[AM]	3,000–6,000 (estimated for Gold Coast)[E] 3,000–14,000 (US, on-street ROW)[AH] 7,000–18,000 (US, exclusive ROW)[AH]	13,000–41,000 (US)[AH] 20,000 ('Generally' — worldwide)[A]	2,000–20,000 (US)[AH] 50,000 (U.S.)[AM]
Examples of patronage capacity per hour per direction				
CityCat Brisbane: 149 x 8 first-generation 162 x 2 new-generation CityFerry Brisbane: 53–54 pax x 6 ferries 79 pax x 3 ferries	1,500 (TVM, Paris)[AT] 2,000 (Route 5, Hamburg)[AT] 2,500 (London, bus)[AE] 2,800 (L 12, Utrecht)[AT] 3,300 (Teor, Roeun, Paris)[AT] 4,000 (London, max bus priority) [AE] 5,000 (L.A.)[AF] 6,000 (London, busway)[AE] 9,000 (South East Busways)[AL] 10,000 (Ottawa Transitway)[AN] 11,000 (Curitiba)[AD] 11,500 (Goiania, Brazil)[AN] 15,000 (Quito Trolleybus)[AN] 15,100 (Curitiba, Eixo Sul)[AN, AA] 21,100 (Belo Horizonte, Brazil)[AN] 25,600 (Porto Alegre, Farrapos)[AN] 26,000 (Porto Alegre)[AA] 28,000 (Porto Alegre, Assis)[AN] 29,800 (Recife Caxanga, Brazil)[AN] 33,000 (Bogota)[AN]	4,000 (T2, Paris)[AT] 6,000 (Yellow Line, Porto)[AT] 6,000 (Strasbourg)[AA] 13,400 (Tunis)[AA] 18,000 (London)[AE] 26,000 (U.S.)[AM] 30,000 (Putra Kuala Lumpur — theoretical estimate only)[AN]	5,000 (Buenos Aires Line E)[AN] 14,000 (Guangzhou)[AA] 20,000 (Buenos Aires Line D)[AN] 25,000 (London Victoria Line)[AA, AA] 36,000 (Santiago)[AA] 36,000 (Santiago La Moneda)[AN] 60,000 (Sao Paulo East Line)[AN, AA] 81,000 (Hong Kong)[AN]	7,000 (Kuala Lumpur — Elev. Rail)[AA] 13,800 (Western Line, Sydney) [AP] 30,000+ (London)[AE] 42,000 (Bangkok BTS)[AA]

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
	34,900 (Sao Paulo 9 de Julho)[AN] -- 7,500/hour (Adelaide)[A] 10,000/hour (Ottawa)[A] 67,000/hour (Bogotá, TransMilenio)[A]			
Patronage capacity per vehicle				
	60–75 (standard bus)[AB] 75 passengers per bus[Q] 140–170 (articulated bus)[AB] 160 (Bogotá)[AC] 250–280 (bi-articulated bus)[AB]	200–300[E] 217 passengers per vehicle (Variotram capacity)[O]	170 per car[AO] 350 passengers per car [M]	120–200 per car (Sydney — up to eight cars)
Vehicle type				
CityCat, Brisbane: high-speed, low-wash catamaran CityFerry Brisbane: monohull ferry	Low floor, disabled access, standard rigid/articulated/bi-articulated, manual/guided technology.	Articulated, double-articulated low floor; can operate in multiple car tram sets; overhead electric power; third rail, diesel/hybrid.	Multiple doors, lighter construction than heavy rail, high acceleration and breaking, emphasis on maximising standing space, multiple car train sets using third rail, high platform cars.	Heavy construction, emphasis on maximising seating space, multiple car train sets.
Floor height (from pavement)				
n/a	<38 cm is desirable[AV] 33–92 cm (typical US and Canadian Bus Rapid Transit vehicles)[AV] 87–93 cm (Bogota) [AC]			

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Number of door channels				
	4–7 (18mtr buses — typical US and Canadian Bus Rapid Transit vehicles)[AV] 7–9 (24mtr buses — typical US and Canadian Bus Rapid Transit vehicles)[AV] 3–5 (18mtr standard)[AW] 3–6 (18mtr stylised Bus Rapid Transit)[AW] 4–8 (24mtr stylised Bus Rapid Transit)[AW] 'Rule of thumb' is 1 channel per 3 metres in corridors that run radially from a dense urban core to lower density suburbs. More if significant boarding and alighting take place simultaneously. Less if express peak services with all boarding or all alighting stops[AV]	Same as for Bus Rapid Transit		
Energy source				
CityCat Brisbane: ultra light sulfur diesel (ULSD) CityFerry Brisbane: ultra light sulfur diesel (ULSD)	Internal combustion engines fuelled by ultra-low sulfur diesel or CNG with spark-ignition coupled with an automatic transmission (most common). Biodiesel. Diesel emulsion blends. LNG. Electric trolley bus drives powered by overhead catenary-delivered power. Thermal-electric drive, coupled with an internal combustion engine to a generator (e.g. Civis in Las Vegas). Hybrid–electric drives (improved performance and fuel economy with reduced emissions), incorporating on-board storage device (e.g. batteries or ultra capacitors) — usually diesel thermal or combustion engines, but can also be CNG or gasoline. Fuel cell.	Electric (overhead lines) Electric (third rail) Electric (ground-level third rail — safer version of third rail)	Electric	Electric (generally) Diesel

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Ease of implementation				
CityCat Brisbane: suitable for river environment, not open water. Operates 19 km route from University of Queensland (St Lucia) to Bretts Wharf (Hamilton). CityFerry Brisbane: suitable for shorter routes. Operates cross-river services and inner-city service.	Time from commencement of planning to implementation depends on extent of land acquisition. 5–6 years (South East Busways, Brisbane; Liverpool to Parramatta, Sydney; Western Sydney Rapid Bus Transitway). High-quality operations (fully separated ROW) have similar land acquisition requirements of light rail. May require construction of tunnels on short sections in city centres. Low lane construction requirements. Suits cross-regional routes, express routes and routes serving lower density areas. Flexible operation[G].	Time from commencement of planning to implementation depends on extent of land acquisition. Requires upgrading of street operations to separate ways. May require construction of tunnels on short sections in city centres. Medium line construction requirements. Performs best in terms of marginal operating efficiency and total system operating cost efficiency[O]. Suitable for medium distance, medium demand corridors and for applications in city centre. Own right-of-way, if on street, same as bus[G].	More complex planning and engineering design required. Can require considerable land acquisition. Large amounts of tunnelling needed. High line construction requirements. Suitable for medium distance, high-volume corridors with standing passenger majority[G].	More complex planning and engineering design required. Can require considerable land acquisition. May require considerable tunnelling in city centres. High line construction requirements. Suitable for long distance, high volume corridors[G].
Environmental impact				
CityCat Brisbane: designed for low-wash	Emissions depend on fleet mix. Clean on-street buses using Euro V technology. Diesel-powered vehicles have potential to contribute to nitrogen oxides and particulates emissions.[G] But the use of alternative fuels and noise and air pollution reduction technologies (e.g. Euro V) can help protect the environment[I]. Stations can require only a small allocation of land.	Cleaner due to electric propulsion[H]. Can reduce motor vehicles in area by 10–15%[H]. Stations can require only a small allocation of land.	Issues include property acquisition, noise and vibration impacts[K].	Issues include property acquisition, noise and vibration impacts[K]. Emissions savings possible but may be offset if not running at high capacity.
Existing road impact				
n/a	Likely to consume lane space. Can operate in either totally segregated alignment, dedicated lanes or mix with general traffic but with priority signalling if necessary.	Likely to consume lane space. Largely on segregated alignments.	Independent from road network. Totally segregated.	Independent from road network. Totally segregated.

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Theoretical land use 'best fit'				
	Best suited to lower density dispersed urban development form (bus) [AE] . Best suited to lower density dispersed urban development form (max priority). Higher densities of development or connecting denser urban centres (busway)[AE] .	Higher densities of development, or connecting denser urban centres[AE].	Very high-density urban development form.	Very high-density urban development form[AE].
Vehicle dimensions				
Length				
	18 m (conventional articulated) [AW] 18–18.8 m (stylised articulated Bus Rapid Transit) [AW] 24–26 m (stylised articulated Bus Rapid Transit — APTS Phileas)[AW]	15–24 m per car (up to four car trains)[AX] 11–19 m (trams)[AX]		
Width				
	2.6 m (conventional articulated) [AW] 2.6 m (stylised articulated Bus Rapid Transit) [AW]			
Height				
	3 m (conventional articulated) [AW] 3.1–3.5 m (stylised articulated Bus Rapid Transit) [AW]			
Turning radius				
	15 m (turning radius for double-articulated bus) 20 m (turning radius for long rigid bus — 14.5 m) 12.5 m (stylised articulated Bus Rapid Transit — APTS Phileas)[AX]	15–30 m[AX] 12–25 m (trams)[AX] 35 m (minimum curve radius achieved in Madrid)[BA]		100 m [AX]
Corridor requirements (indicative only)				
Grade separation				
	preferred[A]	preferred[A]	required[A]	required[A]

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Width of reservation (minimum)				
	12 m[A]	12 m[A]	12 m[A]	14.5–16.6 m[A] 40 m (allowing for stabling/turnback, station, fencing, cycleway and footpath)[A]
Width at stations (minimum)				
	22 m[A] 5 m (Bogotá — station width not corridor)[AM]	14 m[A]	Assume heavy-rail standards	22 m[A]
Platform length				
	25–190 m (Bogota)[AM]	30 m[AS]	Assume heavy-rail standards	170 m[A]
Desirable minimum horizontal curve radius				
	25 m (30 m if mixed with light rail) [B]	30 m (30 m if mixed with bus)[B] 35 m (minimum achieved in Madrid)[BA]	Assume heavy-rail standards	400 m[X]
Absolute minimum horizontal curve radius				
	20 m (30 m if mixed with light rail) [B]	15 m (30 m if mixed with bus) [B]	Assume heavy-rail standards	160 m[X]
Desirable maximum main line gradient				
	3% (3% if mixed with light rail) [B] 3–4% (fully grade separated with future conversion to rail anticipated)[AV] 3–5% (fully grade separated with no conversion)[AV] 3–4% (partially grade separated with future conversion to rail anticipated)[AV] 4–6% (partially grade separated with no conversion)[AV]	7% (3% if mixed with bus) [B]	Assume heavy-rail standards	1.25%[X]

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Absolute maximum main line gradient				
	12% (8% if mixed with light rail)[B] 13% (stylised articulated Bus Rapid Transit — APTS Phileas)[AX]	10% (5% if mixed with bus)[B] 12% (depending on vehicle design, motor power, and other technical capabilities) Eg. Sheffield has short section at 10% 6% (maximum in Madrid)[BA]	Assume heavy-rail standards	3.3%[X]
Absolute minimum vertical clearance				
	4.42 m (5 m if mixed with light rail) [B]	4.4 m (5 m if mixed with bus) [B]	Assume heavy-rail standards	4.3 m[X]
Minimum horizontal clearance				
	10.2 m (10.2 m if mixed with light rail) [B]	7.2 m (10.2 m if mixed with bus) [B]		
Track/lane width				
	3.5 m [B]	3.7 m[A]		
Other				
River walls	n/a	n/a	n/a	n/a
Visual impact on streetscape				
n/a	An opportunity to join existing urban fabrics and allow greater permeability[J]	Potential for improved urban streetscape with outdoor cafes, and tree planting. But overhead and catenary could be a visual issue. [G]		
Legibility				
Terminal entry point easily distinguishable	Dependent on system used but fully dedicated and similar to light rail	Station and tracks easily distinguishable on street	Station entry points easily distinguishable on street	Station and tracks easily distinguishable on street
Speed				
Maximum				
CityCat Brisbane: 25 knots (but subject to various speed zones on the river) CityFerry Brisbane: 10–12 knots	100 km/h[A]	100 km/h[A]	100 km/h[A]	130 km/h[A] 80 km/h (Sydney urban)[A]

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Average				
CityCat Brisbane: approx. 15 knots CityFerry Brisbane: approx. 6 knots	10–14 km/h (bus)[AE] 14–18 km/h (max priority)[AE] 15–22 km/h (busway)[AE] 22–29 km/h (full Bus Rapid Transit)[AA] 30–60 km/h[A] 45–50 km/h (South East Busway) [AL]	18–40 km/h[AE] (light rail) 30–50 km/h[A] 20–22 km/h[AE] (tram)	18–40 km/h[AE] 30–65 km/h[A]	35–60 km/h[A] 40–90 km/h[AE] (refers to long distance rail) 50–70 km/h[AF]
Frequency				
	8–10 minutes during peaks (South East Busway)[AL] 2 minutes peak; 10 minutes off peak (Bogota)[AM]	6 minutes in peak (Gold Coast estimate)[E] 20 minutes in off peak (Gold Coast estimate)[E]	2 minutes[AO]	3–4 minutes in peak[P] 5–8 minutes in off-peak[P]
Use in other cities				
CityCat Brisbane: designed in Australia. May suit other calm water environments.	O-Bahn, Adelaide Busway, Brisbane LPT, Sydney Leeds, UK TEOR, Rouen, France Nancy, France Ottawa, Canada Pittsburgh East Busway, USA Boston, USA L.A., USA Porto Alegre, Brazil Bogata, Columbia Quito, Ecuador Curitiba, Brazil Sao Paolo, Brazil Kunming Busways, China	Melbourne Gold Coast Sydney London, UK Manchester, UK Montpellier, France Strasbourg, France Tunis Stockholm, Sweden Zurich, Switzerland Portland Streetcar, USA Boston, USA Calgary, USA Denver, USA KCRC Light rail, Hong Kong Kuala Lumpur, Malaysia	London, UK Madrid, Spain Paris, France New York City Subway Santiago, USA MTR, Hong Kong Bangkok, Thailand Mexico City, Mexico Caracas, Venezuela	Sydney S Bahn, Germany Metrolink, California Boston, USA KCRC East Rail, Hong Kong Kuala Lumpur, Malaysia Bangkok, Thailand

Ferry	Bus Rapid Transit	light rail	Metro	Heavy Rail
Emerging technology				
CityCat Brisbane: biodiesel has been trialled	Compressed natural gas (CNG)[R] Hydrogen[R] Hybrid[R] Optical guidance Automated vehicle location Contactless smart card Rubber tyre trams (no rails or overhead wires)	Ultra light rail (ULR)[A] Electrified third rail[S] Docklands driverless light railway[T]		Magnetic levitation
NOx Emissions (grams per passenger km)				
	0.2 (Washington DC scenario) [AQ]	0.3 (Washington DC scenario) [AQ]	0.4 (Washington DC scenario) [AQ]	
PM 2.5 Emissions (grams per passenger km)				
	0.0004 (Washington DC scenario) [AQ]	0.008 (Washington DC scenario) [AQ]	0.01 (Washington DC scenario) [AQ]	
CO² 2.5 Emissions (grams per passenger km)				
	44 (Washington DC scenario) [AQ]	131 (Washington DC scenario) [AQ]	162 (Washington DC scenario) [AQ]	

1. Depends on average distances between stations or stops, values are indicative only.
2. This parameter will depend on the system chosen. Will be further defined in comparison with travel demand estimates.
3. Required for sections with average speeds greater than 15km/hour. light rail and bus passengers can cross the alignment in station areas only, however, grade separation is recommended.
4. Amounts are converted from 1998 dollars to 2006 dollars using RBA inflation calculator (27.4%).
5. A$1=US80c is the assumed exchange rate
6. A$1=HK$6 is the assumed exchange rate
7. A$1=£0.42 is the assumed exchange rate
8. A$1=€0.63 is the assumed exchange rate

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Appendix E

Cost calculations

NEW MASS TRANSIT SYSTEM COSTING (2007$)

INFRASTRUCTURE COSTS

Assumptions: Light rail construction cost (2003) = $20m/km (estimate from Gold Coast Rapid Transit pre-feasibility)
Light rail construction cost (2007) = $20m/km x1.3 = $26m/km

West End-Newstead Line

Option	Light rail	Bus Rapid Transit
Corridor characteristics		
Length	8 km	
Costs		
Track + sub stn + oh + stns [1]	$208m *	
New bridge	$73m	
Road surface upgrade & stations		$15m
Services relocation item	$50m	
Stabling item	$30m	$10m
Subtotal	$361m	$25m
Contingency (@ 30%)	$108m	$8m
Total infrastructure cost	$469m	$33m

Inner City Orbital Service

Option	Light rail	Bus Rapid Transit
Corridor characteristics		
Length	4 km	
Costs		
Track + sub stn + oh + stns [1]	$104m	
Road surface upgrade & stations		$8m
Services relocation item	$40m	
Subtotal	$144m	$8m
Contingency (@ 30%)	$44m	$3m
Total infrastructure cost	$188m	$11m

Hamilton–Woolloongabba Line

Portion of route runs along same alignment as West End-Hamilton Line.

Option	Light rail	Bus Rapid Transit
Corridor characteristics		
Length	14 km	
Cost		
Track + sub stn + oh + stns	$206m	
Service Items	$35m	
Road works and stations		$15m
Entry to bus tunnel	$10m	$10m
Subtotal	$251m	$25m
Risk (@ 30%)	$75m	$7m
Total infrastructure cost	$326m	$32m

Kingsford Smith Viaduct from Breakfast Creek to Riverview Terrace

Viaduct characteristics	
Viaduct length	1.7 km
Overall width	18 m (includes 4 m footpath and 4 m cycleway)
Cost	
Cost of viaduct @ 4,200/m2	$129m
Stations and pedestrian bridges/underpasses	$8m
Traffic management	$18m
Services	$14m
Subtotal for viaduct	$169m
Contingency (@ 30%)	$ 51m
Total for viaduct	$220m

VEHICLE NEEDS AND COSTS

Peak vehicle requirements – Without Woolloongabba-Hamilton Line

	Distance (one way)	Peak frequency (minutes)	Operating speed	Stops	Time per stop (seconds)	Layover time per circuit	Vehicles needed	Spare vehicles	Total vehicles
West End-Newstead	8	5	20	17	1	5	16	4	20
Inner City orbital	4	10	20	9	1	5	7	2	9

Peak vehicle requirements – With Woolloongabba-Hamilton Line

	Distance (one way)	Peak frequency	Operating speed	stops	Time per stop (seconds)	Layover time per circuit	Vehicles needed	Spare vehicles	Total vehicles
West End-Newstead	8	10	20	17	1	5	8	2	10
Hamilton-Woolloongabba	14	10	20	25	1	5	10	3	13
Inner City rbital	4	10	20	9	1	5	7	2	9

Assumptions on cost per vehicle

Bus Rapid Transit vehicle pricing (2005 prices) comes from 'BRT Practioners Guide' p. 4–66, based on Specialised Bus Rapid Transit vehicle, 25 m long, $A 1.2m–A$2m plus $0.15m for hybrids. Indexed to 2007 plus hybrid cost gives $2.3m per vehicle.

Light rail vehicle cost = $4.6m each (American Public Transport Association 2006/2006 average costs converted to Australian dollars and escalated to 2007 costs)

Vehicle Costs with no Woolloongabba-Hamilton line

	No Contingency		**30% Contingency**	
	Bus Rapid Transit	**Light rail**	**Bus Rapid Transit**	**Light rail**
West End-Newstead	46	92	60	120
Inner City Orbital	21	41	27	54
Total	**67**	**133**	**87**	**174**

Vehicle Costs with Woolloongabba-Hamilton line

	No Contingency		**30% Contingency**	
	Bus Rapid Transit	**Light rail**	**Bus Rapid Transit**	**Light rail**
West End-Newstead	23	46	30	60
Woolloongabba-Hamilton	30	60	39	78
Inner City Orbital	21	41	27	54
Total	**74**	**147**	**96**	**192**

OPERATING COSTS

Assumptions

Operating costs used were the typical average Australian operating costs identified detailed in Appendix D. Bus Rapid Transit = $4 per km and light rail = $10 per km.

Weekend and public holiday services run an 18 hour service at the off-peak frequency.

It is assumed that the deport / stabling will be located close to the routes. Positioning kilometres are therefore not included in calculations.

	Peak frequency	Off-peak frequency	Peak period	Off peak period	Km/year	Bus Rapid Transit	Light rail
West End-Newstead	5	10	6	12	778,752	$3.1m	$7.8m
Inner City rbital	10	10	6	12	314,496	$1.3m	$3.1m
						$4.4m	**$10.9m**

	Peak frequency	Off-peak frequency	Peak period	Off peak period	Km/year	Bus Rapid Transit	Light rail
West End-Newstead	10	10	6	12	628,992	$2.5m	$6.3m
Hamilton-Woolloongabba	10	10	6	12	1,100,736	$4.4m	$11.0m
Inner City rbital	10	10	6	12	314,496	$1.3m	$3.1m
						$8.2m	**$20.4m**