Appendix A: Stages 1 – 6

Proposal Summary

Initiative Name:	City to Gungahlin Transit Corridor Study
Location (State/Region(or City)/ Locality):	Australian Capital Territory
Name of Proponent Entity:	ACT Environment and Sustainable Development Directorate
Contact (Name, Position, phone/e-mail):	Ms Kristin Blume – Project Director, ESDD
Executive summary	

About the Project

The Project seeks to assess the feasibility of developing a rapid transit corridor between Gungahlin and the City along Flemington Road and Northbourne Avenue (the 'Project Corridor') using either BRT or LRT technologies. It also assesses the impact of higher population and employment densities, and increased parking charges on the Project's viability.

The options assessed were developed following the definition of Project goals, these goals are:

- Provide greater connectivity and capacity between future growth centres and the City
- Encourage greater use of more sustainable transport modes, such as public transport and active transport.
- Encourage further economic development within the Gungahlin to CBD corridor

The Project and its goals are consistent and aligned with current ACT and Commonwealth Government policy. Most notably, the 2012 Transport for Canberra policy highlights the need for a more effective and efficient transport system. The Plan aims to increase the active and public transport mode share to 30% by 2031 from 20% in 2011.

Outside of transport policy, the Project is also consistent with objectives set out in the ACT Planning Strategy. The key target of the strategy is to achieve 50% of new housing to be established within the urban area of Canberra so as to support other ACT Government policy outcomes.

The Project would support the creation of opportunities for increased density and dispersed employment by leveraging off existing land use of activity centres and inter-town transport connections. It would also alleviate mobility concerns and create more choices for travel by integrating investment in Canberra's transport networks with the land uses it services.

The proposed rapid transit system also addresses Infrastructure Australia's strategic goals through public transport, better asset utilisation of existing transport infrastructure and transforming cities through integrated land use-transport planning. It will have both direct and indirect benefits in terms of enhancing the national significance of Northbourne Avenue by improving public transport along the corridor and promoting more diverse urban development.

Identified Problems

The City to Gungahlin Corridor has a range of current and emerging issues that are intertwined and potentially require investment to resolve. These issues include:

1. Growing road congestion
2. High levels of car dependency
3. A fast growing population
4. A mismatch between jobs and employment

5. Low land productivity
6. Diminishing corridor amenity
7. High greenhouse gas intensity

All of the problems outlined above impede on achieving goals and objectives as outlined by government. Problems 1 to 5 present hurdles to delivering public transport capacity, managing road congestion, supporting Canberra's core advantages, improving equity and liveability. Problem 6 hinders on achieving the goal of maintaining and improving the amenity of the Project Corridor, and Problem 7 is an impediment towards creating an environmentally friendly transport system.

It could be expected that without intervention, future growth within the Project Corridor will serve to lead to a further decline in road speeds, increasing travel time which impedes access to employment, community facilities, social and recreational activities, hence further aggravating the problems identified

Preferred Options

The submission considers a combination of the transport and land use scenarios. Five options were developed, with four do-something options against a base case. The do something options are:

- BRT with business as usual land use and higher parking charges
- LRT with business as usual land use and higher parking charges
- BRT with higher density land use and higher parking charges
- LRT with higher density land use and higher parking charges

The base case option assumes that changes in future transport and land use continue on a business as usual basis, in line with current Government transport commitments and planning strategies

Evaluation Results

The economic evaluation was undertaken on an incremental basis which compared the Project options against a without project case using a discounted cash flow technique on the basis of a real discount rate of 7% in accordance with ATC and Infrastructure Australia investment appraisal guidelines. Project capital expenditure is assumed to take effect from 2012 and all values are expressed in 2011 dollars. The benefits of the project were assessed over a 30 year evaluation period commencing after construction.

The Canberra Strategic Public Transport Model (CSTM) was used as the basis to assess the demand impact for each option, and is maintained by ESDD. The CSTM is a typical four-step Strategic Public Transport demand model covering the ACT and Queanbeyan.

The economic evaluation results shows that the all core Project options are projected to generate a positive economic return based on business as usual and higher density land use projections. Table 12 outlines the headline economic results for the economic evaluation.

Table 12: Economic Results for Project Options

Economic Indicator	BRT with BAU Land Scenario	LRT with BAU Land Scenario	BRT with Higher Density Land Scenario	LRT with Higher Density Land Scenario
Benefit cost ratio	1.98	1.02	4.78	2.34
Net present value ($m)	$243.3	$10.8	$939.1	$701.1
NPVI	$0.68	$0.01	$2.62	$0.87
Internal rate of return	14.6%	7.2%	26.7%	15.7%

It should be noted that benefits for the LRT with a 'business as usual' land use option, are marginal. Incremental benefits for all Project options are dependent on parking revenues and are therefore likely to be sensitive to parking rates, demand and utilisation. Accordingly, further investigation would be order to refine the options should the Project proceed to the next stage

Next steps

Should the Project proceed into the Feasibility and Forward Design Stage, further feasibility, design and planning work will need to be commissioned by the ACT Government to assess the Project's feasibility in more detail. Full government funding for the next stage is considered appropriate as the Project is proposed to be categorised as a 'Real Potential' project.

The Feasibility and Forward Design Stage is projected to cost $30 million over 2013/14 and 2014/15. A 50:50 split funding is sought from the Commonwealth Government on the basis that the Project is consistent with objectives outlined in:

- The Nation Building 2 Program
- The Commonwealth Liveable Cities Program
- The National Capital Plan as a corridor of national significance

It can also be regarded as an opportunity to develop an integrated land use-transport governance structure. The scope for the proposed Feasibility and Forward Design Stage will include the following:

- More detailed option development
- Detailed product definition and design
- Refined cost estimates
- Rationalisation of current bus network with the Project
- Refined land use analysis and value capture
- Further detailed strategic demand modelling
- Confirmation on the need for an Environmental Impact Statement and required planning approvals for the Project to proceed
- Further consideration with respect to appropriate governance arrangements and a procurement strategy

Stage 1 – Goal Definition

Initiative Goals

The development of the Project aims to:

- Provide greater connectivity and capacity between Gungahlin and the City
- Encourage greater use of more sustainable transport modes, such as public transport and active transport
- Encourage further economic development within the Gungahlin to City corridor
- Improve the efficiency of transport movements within the Gungahlin to City corridor.

Initiative Objectives

Upon implementation of the Project, the following objectives are expected to be realised:

- **Delivering transport capacity** by increasing public transport capacity and speeds along the Project Corridor to service fast growing population levels and economic activity along the Project Corridor and at key activity centres
- **Managing road congestion** by increasing the attractiveness of non-car modes in order in to reduce levels of car dependency by increasing the frequency, capacity, reliability and speed of public transport services and through the provision of high quality walking and cycling infrastructure
- **Supporting Canberra's core** by improving accessibility to the City and the Parliamentary Triangle by providing faster, more frequent services with higher levels of capacity and in turn supporting Canberra's role as the nation's capital and preeminent federal political and administrative centre as well as the City Centre's role as the preeminent municipal commercial centre
- **Supporting economic diversity and development** by promoting an increase in the level and diversity of economic activity along the Project Corridor in the City, along Northbourne Avenue and in key town centres including Dickson and Gungahlin by increasing the mix and number of residents and employment positions as well as by improving public transport accessibility along the Project Corridor
- **Creating an environmentally friendly transport system** aimed at reducing levels of greenhouse gas emissions, air and noise pollution by reducing levels of car dependence and increasing the level of public and active transport usage and reducing travel distances
- **Improving equity and liveability** by enhancing access to key centres and community facilities through improved public and active transport, relied upon more by the less well off, the disadvantaged and the elderly and promoting a broader diversity of housing and improving home affordability by increasing the provision of higher density dwellings
- **Maintaining and improving the amenity** of the Project Corridor by reinforcing the linear alignment of Northbourne Avenue, maintaining the avenue of trees and adding the permanency of dedicated bus lanes or light rail tracks, consistent with Burley Griffin's original intention for the Avenue and Northbourne Avenue's nationally significant role as the primary National Gateway

Initiative Alignment

The Project is consistent with policy objectives set out by relevant Commonwealth Government and ACT Government policies and plans listed in Table 13.

Table 13: Relevant Government Policies

Jurisdiction	Territory Policies
National Policies	National Infrastructure Priorities (IA, 2009)
	COAG Report: Getting the fundamentals right for Australia's infrastructure priorities (IA, 2010)
	Nation Building II Program (Commonwealth Government, 2012)
	In particular, the Project's goals are consistent with Infrastructure Australia's theme of 'Transforming our Cities' in terms of improving public transport networks, development of integrated land use and infrastructure planning and contribute to sustainability improvements.
Territory Policies	Strategic Public Transport Network Plan (MRC, 2009)
	Canberra Spatial Plan (ACTPLA, 2004)
	Sustainable Transport Plan (ACTPLA, 2004)
	ACT Government Infrastructure Plan 2011-21 (ACT CM&CD, 2011)
	Transport for Canberra (ESDD, 2012)
	The Project supports ACT Government's strategic goals of providing an integrated transport system, sustainable transport and encourages active transport.
Policies in Development	Draft ACT Planning Strategy (ESDD, 2011)

Stage 2 – Problem Identification

City to Gungahlin Corridor

The Project Corridor has been identified as the Government's priority corridor for new infrastructure investment in the short to medium term, with the view of developing rapid transit, within the Government's Transport for Canberra policy.

The Project Corridor has been identified as a key corridor in the 2031 Strategic Public Transport Plan Network, which aims to deliver public transport services at a high service frequency across the day on the Network. Although the Network has been designed for the provision of a bus-based solution, the Network has been developed to be adaptable to and supportive of rapid transit solutions as well as potential city-building activities.

Also, planning work and investments have been undertaken along other strategic corridors to achieve a whole of network improvement. For instance, construction is due to commence on the Belconnen to City Transitway this year.

Current and Future Problems

The City to Gungahlin Corridor has a range of current and emerging issues that are intertwined and potentially require investment to resolve. These issues include:

1. Growing road congestion
2. High levels of car dependency
3. A fast growing population
4. A mismatch between jobs and employment
5. Low land productivity
6. Diminishing corridor amenity
7. High greenhouse gas intensity.

Further evidence to the problems stated above is presented in Stage 3. All of the problems outlined above impede on achieving goals and objectives as outlined in Stage 1. Problems 1 to 5 present hurdles to delivering public transport capacity, managing road congestion, supporting Canberra's core, improving equity and liveability. Problem 6 hinders achieving the goal of maintaining and improving the amenity of the Project corridor, and Problem 7 is an impediment towards creating an environmentally friendly transport system.

It could be expected that without intervention, future growth within the Project Corridor will lead to a further decline in road speeds, increasing travel time which impedes access to employment, community facilities, social and recreational activities, further aggravating the problems outlined above.

Stage 3 – Problem Assessment

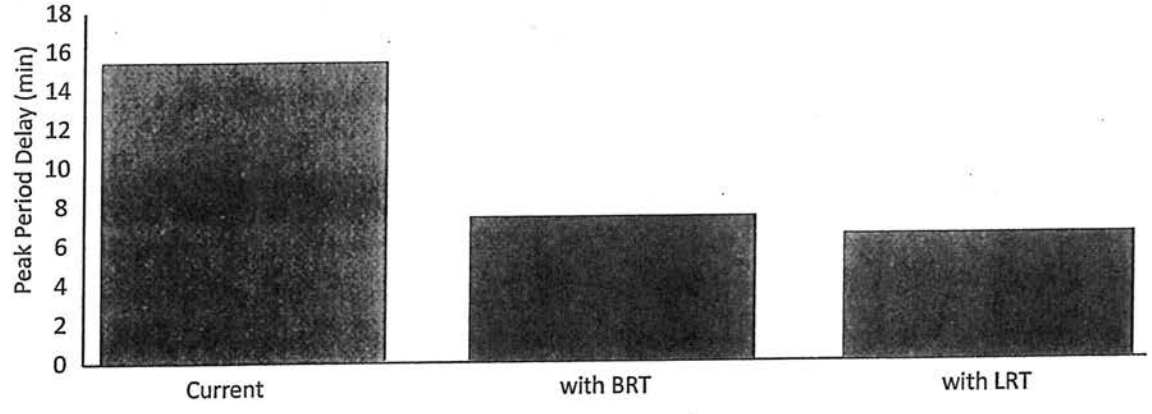
Introduction

This section provides quantitative and qualitative assessments of the problems outlined in Stage 2.

Road Congestion

Even with current demand, Northbourne Avenue already operates at or over capacity during peak periods. Based on current traffic conditions, road congestion adds approximately 15 minutes to a car trip during peak periods. ESDD estimate with investment in BRT or LRT, current delays could be reduced by more than half as shown in Figure 11, a benefit that could be expected to grow over time should an investment in rapid transit be made.

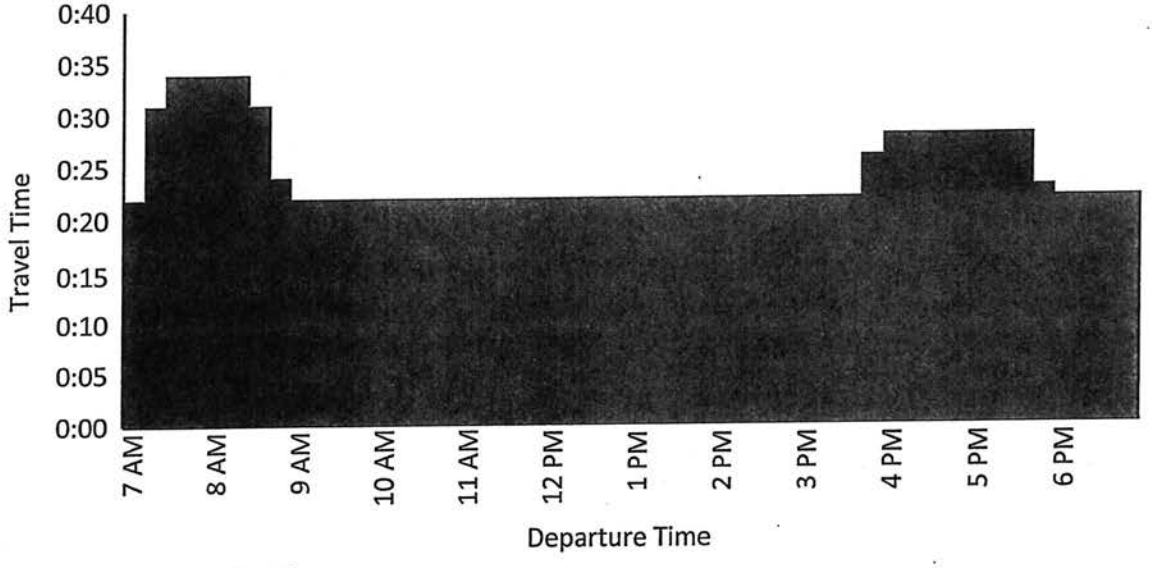
Figure 11: Estimated Peak Period Delays for a Trip between Gungahlin and the City for General Traffic



Source: ESDD

Prevailing road congestion also adversely impacts on the efficiency of bus operations along the Project Corridor. Timetables for current limited stop Red Rapid services that travel along the Project Corridor already add 12 minutes to all morning peak trips to the City. Figure 12 illustrates the current time of day profile for the Red Rapid which travels from Gungahlin to Civic, including unexpected travel times.

Figure 12: Red Rapid Route 200 Gungahlin to Civic: Current Timetabled Travel Times



Source: ACTION Buses (2011)

During the AM and PM peak hour, travel times increase by over 50% and nearly 30% respectively. Under

the current arrangements, public transport services on the Project Corridor compete with general traffic. This limits the speed and reliability of services, as they have no priority or ability to bypass traffic delays in the corridor or bypass other buses, which creates bus bunching and in turn reduces the efficacy of providing a high frequency service.

The impact of congestion on buses is not limited to residents living along the Project Corridor. Northbourne Avenue is a key bus corridor and acts as a trunk for most bus services originating in Canberra's northern suburbs and south of Lake Burley Griffin as far out as Fyshwick and Tuggeranong. As the *Transport for Canberra* envisage more cross-regional (Rapid) bus services to operate along the corridor from destinations including Queanbeyan and Molonglo, the impacts of congestion in the Project Corridor will broaden over time. In short, congestion in the Project Corridor has a broad impact on many residents across Canberra.

High Levels of Car Dependency

In Canberra, the Journey-to-Work (JTW) dataset arguably provides the most reliable snapshot of public transport usage. The JTW dataset suggests that car usage has remained persistently high with more than four of every five commutes made in a private motor vehicle (as shown in Table 14).

Table 14: Canberra Journey to Work Mode Share 1976 – 2006

Mode	1976	1981	1986	1991	1996	2001	2006
Car driver	71.3%	70.9%	72.6%	70.7%	72.7%	73.9%	73.5%
Car passengers	13.8%	12.4%	11.4%	12.1%	10.2%	9.4%	8.7%
Sub-total: private transport	**85.1%**	**83.3%**	**84.0%**	**82.8%**	**82.9%**	**83.3%**	**82.2%**
Public transport	8.9%	9.9%	9.7%	9.9%	8.3%	6.7%	7.9%
Bicycle only	0.9%	2.1%	2.1%	2%	2.2%	2.3%	2.5%
Walk only	4.6%	4.0%	3.6%	4.0%	4.3%	4.2%	4.9%
Other modes	0.5%	0.6%	0.6%	1.4%	2.3%	3.5%	2.4%

Source: ACTPLA (2009)

Although the Project Corridor has the second highest levels of public transport patronage in Canberra, reflecting a high levels of public transport use in North Canberra, levels of car dependency in the Gungahlin SSD are higher with close to nine out of ten commutes were made in a private vehicle (as shown in Table 15).

Table 15: 2006 Journey to Work Mode Share by District

Statistical subdivision	Car driver	Car passenger	Sub-total: private transport	Public transport	Bicycle	Walk	Other
Gungahlin – Hall SSD	79.2%	10.1%	**89.3%**	7.4%	1.1%	1.2%	1.0%
North Canberra SSD	55.0%	7.3%	**62.3%**	10.1%	8.0%	18.2%	1.5%
Belconnen SSD	76.0%	9.2%	**85.2%**	8.8%	2.1%	2.9%	1.1%
South Canberra SSD	71.1%	8.1%	**79.2%**	7.7%	3.3%	8.4%	1.4%
Woden Valley SSD	72.2%	7.8%	**80.0%**	10.0%	2.2%	6.7%	1.2%
Weston Creek – Stromlo SSD	78.7%	9.0%	**87.7%**	6.8%	2.3%	2.1%	1.1%
Tuggeranong SSD	81.0	8.9%	**89.9%**	6.8%	1.0%	1.4%	1.0%
Canberra	73.5	8.7%	**82.2%**	7.9%	2.5%	4.9%	2.4%

Growing Road Congestion

Increasing traffic congestion is not only an irritant for residents, but also adds to the costs of doing business. Road congestion adversely impacts on travel outcomes through longer waiting times and unreliability and imposes significant direct and indirect costs on economic activity and productivity.

Increasing road congestion has implications on the efficiency on Canberra's public transport network, which is likely to rely on a bus-based public transport system for the foreseeable future. In the absence of bus priority measures and segregation of bus operations from general traffic, road congestion will impact on the efficiency and attractiveness of public transport operations in Canberra.

While Canberra may not have the same levels of congestion as seen in Sydney and Melbourne, high levels of accessibility are highly valued by Canberrans and is viewed as a key part of Canberra's competitive advantage in terms of attracting people to live and work in ACT. In the context of the Project, high levels of congestion along the project corridor may serve to compromise the attractiveness of Gungahlin as a place to live, adversely impacting on the speed of development around Gungahlin.

As a reflection of high levels of car dependency, particularly in the northern end of the Project Corridor, during peak travel times, Northbourne Avenue already operates at or over capacity. Peak hourly flow is around 3,000 vehicles per hour over the three traffic lanes with interruptions from traffic lights. Arterial roads similar to Northbourne Avenue typically have a capacity of 1,000 vehicles per lane per hour, although traffic lights and intersections along Northbourne Avenue adversely impact on this potential throughput. Anecdotally, Northbourne Avenue's capacity constraint is evident by the long queues and delays that currently exist along the corridor during the peak periods as demonstrated by Figure 13.

Figure 13: Congestion on Northbourne Avenue during the morning peak

Source: ESDD

Congestion and queuing are expected to worsen along both Northbourne Avenue and Flemington Road with flow due to future population growth in Gungahlin, and in surrounding areas of NSW. Population growth in the surrounding areas of NSW will see additional cross-border traffic using Northbourne Avenue. Traffic flow from NSW into the ACT has increased by more than 15% in the last five years.

Rapid Population Growth

Over the past decade, the districts of Gungahlin and North Canberra, which encompass the Project Corridor, have experienced the fastest (and largest) levels of population growth in the ACT. For the ten years to 2011, the populations of these two districts have increased by an average of 6.8% and 2.6% per annum respectively. By comparison, the ACT population grew at an average of 1.4% per annum over the same period. Table 16 outlines the changes in population between 2001 and 2011 by district.

Table 16: Population Growth by District

District (SSD)	2001	2011	Average Annual Change	
			Growth	Growth Rate
North Canberra	38,585	49,674	1,109	2.6%
Belconnen	85,601	94,947	935	1.0%
Woden Valley	32,494	34,530	204	0.6%
Weston Creek-Stromlo	23,662	23,760	10	0.0%
Tuggeranong	90,875	88,382	(249)	(0.3%)
South Canberra	23,324	26,880	356	1.4%
Gungahlin-Hall	24,398	47,067	2,267	6.8%
ACT	**319,317**	**365,621**	**4,630**	**1.4%**
Queanbeyan	41,598	52,620	1,102	2.4%

Source: ABS Cat. No 3218.0. Population estimates for 2011 are provisional and may change with the release of 2011 Census data.

These high levels of growth are expected to continue. Based on current business as usual projections, the population level in the Gungahlin district is expected to reach 73,000 by 2021, approximately 70% higher than in 2011 and equivalent to an average growth rate of 4.8% per annum.[6] When fully developed, Gungahlin's population is expected to be 90,000, or double the current level.

The pace and location of population growth has long-term implications for liveability and sustainability. Higher levels of population growth increases demand to provide additional transport infrastructure and services. With significant constraints on the ability to expand road capacity in and around the Project Corridor, investment in transport infrastructure would be required to mitigate future congestion on both the road and public transport network and to maintain and enhance connectivity between Gungahlin and the City.

Mismatch in Employment and Population

Although planning policies in Canberra have sought to increase self-containment to reduce demand for longer distance travel, it is apparent that the spatial distribution of employment positions is such that in does not achieve high levels of self-containment.

Most districts in Canberra have insufficient employment to cater for all working age residents and moreover, many of these positions are taken by residents living in other districts. Only in North Canberra, South Canberra and Woden districts, the centre of Canberra, are there more employment positions than residents. Table 17 outlines the number of jobs per person in each district and the proportion of jobs provided within each district taken by district residents.

The concentration of employment positions and the nature of the employment positions in the centre of Canberra is in the provision of services particularly within the public administration, professional/ scientific/technical and education/training sectors. The institutions and organisations that deliver these types of services are most prevalent in the City and the Parliamentary Triangle

Table 17: 2006 Employment Outcomes by District

District	Number of Jobs per Person	Proportion of District Jobs Taken by District Residents
North Canberra	2.55	23%
South Canberra	3.68	14%
Woden	1.30	23%
Weston	0.36	42%
Belconnen	0.55	61%
Tuggeranong	0.33	73%
Gungahlin	0.39	43%
Queanbeyan	0.56	58%

Source: ACTPLA (2009)

It is difficult to foresee the unwinding of the concentration of these types of activities in the City and Parliamentary Triangle. To the extent that planning constraints allow, market forces will tend to encourage economic activities of a complementary nature to consolidate spatially. Furthermore, current government land use projections expect employment and economic activity in the centre of Canberra will continue to increase.

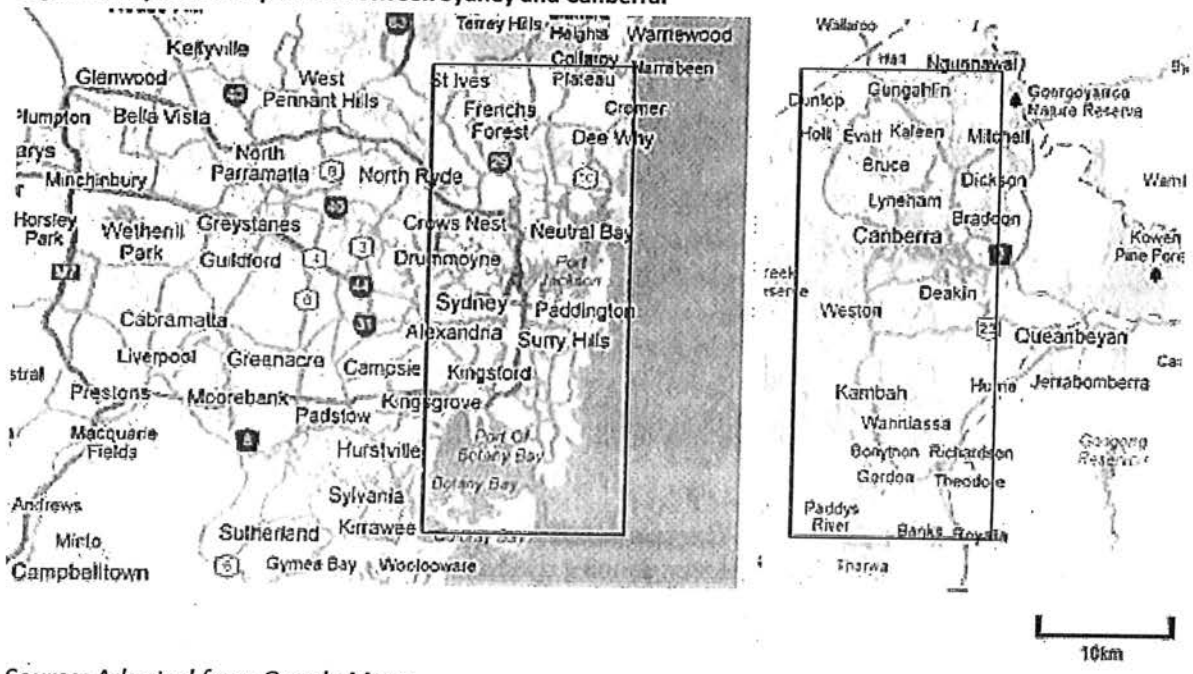
Hence, employment in the City and the Parliamentary Triangle will continue to be a key employment attractor for the foreseeable future. For these these areas to access workers and goods efficiently and effectively, the provision of a transport network to connect residential areas into employment hubs with sufficient capacity, speed and efficiency is imperative.

Without significant changes in how employment is distributed across the territory, no realistic land use scenario can be expected to provide significant growth in employment at town centres. Hence, it is likely that residents living on the northern end of the Project Corridor will generally need to travel towards the City in order to seek employment for the foreseeable future.

Low Land Productivity

By international comparison, the population densities of Australia cities are much lower than that of their international counterparts. Australian cities tend to be more spread out in terms of urban settlement but even by Australian standards, Canberra's density is quite low. Figure 14 shows the same black box that covers Canberra's population of approximately 360,000 people is home to approximately 1 million people in Sydney:

Figure 15: Spatial Comparison between Sydney and Canberra.



Source: Adapted from Google Maps

A land use scenario in favour of low density development has a range of economic and social implications:

- **Higher per capita cost of providing public transport and community services:** Low densities also impact on the costs of providing community services on a per capita basis. To maintain a consistent level of service, in low densities areas agencies are compelled to put into place more infrastructure and services in order to maintain coverage. This phenomenon is perhaps most observable in the provision of public transport services but also occurs with provision of water, sewerage, electricity, communications, schools and hospitals.
- **Risk of social exclusion:** More often than not, the cost of providing community facilities and public transport that is highly accessible in low density areas limits the provision of such social infrastructure and services. With such infrastructure and services being less accessible, those that do not have ready access to a car, which tend to be the most vulnerable and in the most need for access to community services, can lead to a risk of social exclusion.

Diminishing Corridor Amenity

As the main approach route from Sydney or Melbourne and its link to the core of Canberra, the importance of the quality of the urban environment along Northbourne Avenue, is formalised within the National Capital Plan. The Avenue serves a:

- **Nationally significant role:** the presentation of the Avenue forms the visitor's first perception of the city's character. Its role as the primary National Gateway elevates its importance, the importance of urban design and the decision-making for treatments within it
- **Commercial role:** the Avenue is Canberra's key commercial address for apartments, professional and service businesses. The Avenue caters for a range of land uses for residential, commercial, recreational and government purposes
- **Transport role:** The Avenue is the major north-south route north of Lake Burley Griffin, providing connections for cars and public transport between the northern suburbs of Canberra, the City and southern Canberra.

However, the Avenue's current design and functionality, in particular its role as a major arterial road, diminishes the quality of the urban environment along the Avenue:

- **Impact on natural amenity:** The increase in formality is achieved by the introduction of a large central median which is first planted with sporadic clumps of trees which becomes continuous tree planting closer to the city centre. These trees are planted randomly rather than in rows to avoid a missing or dying tree becoming obvious. Due to soil and species selection issues, many of the trees have and will continue to require removal. The Project provides an opportunity to remedy the deteriorating landscaping and natural environment along the Avenue
- **Impact on urban amenity:** Although Northbourne Avenue provides some form of capacity for all modes of transport, the attractiveness of non-car modes is somewhat limited. Combined with a high level of car usage and congestion, the walking (and for public transport users, the waiting) environment is compromised, with pedestrians and passengers exposed to high levels of traffic and associated noise, accidents and pollutants. In such a car dominated space, it can become quite difficult to develop urban forms that encourage the desired future character of the Avenue as a place of activity and vibrancy.

High Greenhouse Gas Intensity

High income levels, the low density levels and location combine to result in the level of greenhouse gas intensity in the ACT to be above national averages. Greenhouse gas emissions are relatively high in the ACT for the following reasons:

- **Low densities:** low residential densities and the associated prevalence of detached dwellings increase the energy intensity of dwellings. Canberra's cold climate serves to increase energy consumption during winter. Low densities also are associated with high levels of car ownership and usage
- **High level of car dependency:** high levels of car use and associated low usage of public transport and active transport combine to increase emissions from the burning of fossil fuels. Without intervention, increasing traffic volumes and congestion will combine to increase emissions from transport further
- The continuation of current land use scenarios are likely to be inconsistent with the ACT Climate Change Strategy as they will continue to encourage the development of detached dwellings and limit the efficacy of public and active transport investments.

The discussion above is based on quantitative analysis of available data regarding the Project Corridor as well as previous work done by precedent studies. For the purpose of this section, a qualitative assessment has been applied in lieu of unavailability of project-specific data.

Qualitative Problem Assessment Framework

The Problem Assessment Framework uses a 7-scale rating to outline the impact of problems on the Project outcome. The 7 ratings are those recommended by Infrastructure Australia when undertaking a qualitative assessment. The suggested rankings are listed in Table 18.

Table 18: Recommended Assessment Ratings

Rating Level	Description	Rating
Highly beneficial	Major positive impacts resulting in substantial and long-term improvements or enhancements of the existing environment.	✓✓✓
Moderately beneficial	Moderate positive impact, possibly of short, medium or longer-term duration. Positive outcome may be in terms of new opportunities or outcomes which enhance or improve on current conditions.	✓✓
Slightly beneficial	Minimal positive impact, possibly only lasting over the short-term. May be confined to a limited area.	✓
Neutral	Neutral—no discernible or predicted positive or negative impact.	–
Slightly detrimental	Minimal negative impact, probably short-term, able to be managed or mitigated, and will not cause substantial detrimental effects. May be confined to a small area.	x
Moderately detrimental	Moderate negative impact. Impacts may be short, medium or long-term and impacts will most likely respond to management actions.	xx
Highly detrimental	Major negative impacts with serious, long-term and possibly irreversible effects leading to serious damage, degradation or deterioration of the physical, economic or social environment. Requires a major re-scope of concept, design, location, justification, or requires major commitment to extensive management strategies to mitigate the effect.	xxx

Assessment Results

Table 19 provides a brief overview of the issues, their impact on Canberra and the Project's objectives. Table 20 outlines the scale of the impacts of each issue on the Project objectives using the aforementioned 7-scale rating.

Table 19: Overview of Current Problems Impacting on Project Objectives

Problem	Impact	Impact on Project objectives
Growing Population	Impacts on congestion (see Growing Road Congestion below) Increases demand for infrastructure Increases demand for additional services Impacts on revenue raised by Government	Northbourne Avenue is expected to cater for a significant share of the projected growth Reduced mobility impacting on efficient transport movement along the Project Corridor Increased private vehicle travel adversely impacts on achieving higher public and active transport mode shares along Project Corridor
Low Land Productivity	Increases travel distances to employment, housing, services and leisure activities Inhibits on benefits of economies of scale Opportunity cost of land use development for other purposes	Decreased productivity due to longer travel times moving in, out and through Northbourne Avenue Inhibits on increasing public and active transport mode shares as private vehicle travel remains more attractive Low density property development impacts on property values – Government relies on property values to raise revenue
Diminishing Corridor Amenity	Decreases perceived character and image of Canberra	Decreased perceived character along Project Corridor as a national approach route
Growing Road Congestion	Increases in travel time Increases in vehicle operation costs Reduced liveability Poorer air quality	Decreased productivity Decreased capacity Decreased regional competitiveness Increased greenhouse gasses
High Car Dependency and Poor Public Transport Usage	Increases operational costs/ subsidy Increases private vehicle travel Increases transport emissions	Decreased public transport mode share Increased noise and air pollution
High Greenhouse Gas Intensity	Poorer air quality Impacts on local environment	Increased greenhouse gases Increased noise and air pollution

Table 20: Qualitative Assessment of Current problems and their Impact on Project Objectives

Problem Objective	Growing Population	Low Density Development	Diminishing Corridor Amenity	Growing Road Congestion	Poor Usage of Public Transport	High Greenhouse Gas Intensity
Delivering transport efficiently	×	×	n/a	×	××	×
Managing congestion	××	×	n/a	××	××	××
Developing a resilient system	××	×	n/a	××	×	-
Supporting economic prosperity/ employment growth	✓✓	××	n/a	××	×	×
Delivering safety and security	×	×	n/a	×	×	×
Creating a low carbon and environmentally responsible transport system	×	××	×	××	××	××
Ensuring equity and accessibility, and protecting amenity and liveability	×	×	×	××	×	××

Stage 4 – Problem Analysis

Many of the issues presented earlier are the result of a range of underlying causes that can be traced back to the development of Canberra, the history of public investment in transport along with the travel behaviour patterns of the travel public due to car, fuel and parking affordability. In summary the causes of the problems can be narrowed to the following sections.

Urban Planning History

At its inception, Canberra was planned as a polycentric city with the Parliamentary Triangle and the City serving as the city's civic centre with town centres at Belconnen, Tuggeranong and Woden, Gungahlin and Weston Creek developed as time progressed. The city was carefully planned to be a self-contained communities surrounded by 'green buffers', containing proportionate areas of residences, businesses and industry. As with many polycentric cities, motorway style parkways and rapid transit links were intended to be built between each town centre and the City.

Planners intended that people would live and work in the same town centre, reducing the need for longer distance travel. With large quantities of available and affordable land this resulted in, over time, low density settlement patterns (or urban sprawl) with detached housing styles.

Whilst the parkway links have been developed, investment in the rapid transit links did not materialise, with investment flowing into the expansion of conventional bus services instead.

Also, the decentralisation of employment did not manifest; the benefits of agglomeration have seen employment centralise in the City and the Parliamentary Triangle.

The proliferation of private vehicle use in ACT has led to transport largely shaping land use rather than through integrated planning strategies as a result of access to low cost private motoring, high quality parkways and an extensive supply of free parking.

While density is not the only factor to support public transport, mixed use developments and higher density housing along public transport mutually support each other.

This in turn is impacting the regional economic performance through the loss of productivity due to time delays and increasing journey lengths to places of work and business. This effect is being realised by, not just the movement of people but the movement of goods as well – economic costs associated with greenhouse gas emissions are also a well-known consequence.

Road Focused Supply Side Measures

While the suburbanisation has been a key cause of many of today's challenges, government investment in transport has always favoured a supply-side approach that favoured roads given the high level of demand for private motor vehicle use, the cost-effectiveness of connecting new residential estates with roads and the limited recurrent financial impact of developing road infrastructure despite the congestion and other costs that road use brings.

Investments in road infrastructure in Canberra have served to adversely impact on the attractiveness of public transport relative to cars in the following ways:

- The development of grade-separated parkways served to increase travel speeds of cars, and lowering car travel times
- With limited separation from general traffic, road congestion would impact on the speed of bus services, increasing bus travel times
- Development of loop and cul-de-sac road networks to reduce rat running further increased travel times for buses and passengers accessing and egressing from these services by forcing buses and pedestrians to follow circuitous routes.

Bus Network Design and Operations

Although the *Transport for Canberra* policy envisages significant changes to the current bus network, the following attributes of the bus network serve to further reduce the efficiency of public transport in Canberra:

- The bus network is currently designed to maximise service coverage, requiring multiple routes operating at low frequencies to service a particular area to ensure that 95% of residents are no further than 500m from a route
- Termination of local services at the local town centre with travellers required to transfer for onward travel to the City and other destinations
- Significant differences in the routing and frequency of services between weekday peak periods, weekday off-peak periods and on weekends.

Governance

Since achieving self-government in 1989, successive ACT Governments have begun to manage the issue of sustainability in the ACT. Shifting demographics, predicted changes in climate, and cost pressures have raised the need for the city to adapt its shape and form – a number of studies and strategies have acknowledged that Canberra, in its current state, is not efficient, sustainable or equitable enough to continue to cater for a dispersed city, reliant on private motor vehicles for all travel.

To overcome historical legacies, the ACT Government has taken a number of steps to implement best-practice approaches to integrated land use and transport strategies by adopting smart land use growth policies, along with a prioritised and multi-modal approach to transport investment.

Stage 5 – Option Generation

A strategic approach was adopted by the Project Sponsor in defining and filtering the range of options considered for economic and financial assessment.

The development of options for the Project has been informed by the outcomes of studies that have been previously undertaken for the Project Corridor.

The option development and filtering process was not developed formally per se. Feedback during stakeholder consultation suggests that a formal option development process to explore issues including alternative cross-sectional treatments, spatial and temporal staging, complementary policy measures as well as modal scenarios is warranted.

This said, the strategic high-level approach to identify and filter options could be considered appropriate given the pre-feasibility nature of the Project and would provide useful input into a formal option development process. The following section outlines the option evaluation framework used by the Project team to develop the options considered in this Submission.

Option Evaluation Framework

A range of investment and reform options could be considered by the ACT Government to reduce the dependence on private vehicles, increase the use of public and active transport and better manage increasing travel demand. At a high level, there exist four broad approaches from which options could be developed:

Road focused approach: The road focused approach would be based on "predict and provide" style transport planning focused primarily on vehicular traffic. It entails maximum investment in additional capacity for general purpose traffic use across the network. It could be described as a "build our way out of traffic congestion" strategy. This includes no emphasis on charging for use of road space. Investment in public transport would be assumed to be set at a 'do minimum' level.

Public transport approach: the public transport strategy focus entails concentration of investment on enhanced public transport infrastructure and services. Road investment beyond currently committed investments would be heavily restricted in favour of major investment in bus and rail. This could be described as a 'public transport can solve it' strategy.

Policy approach: The reform and policy approach uses a range of policy and demand management tools to better manage the level and timing of passenger movements. Such tools can range from land use strategies, subsidised fares, parking charges and road pricing as well as softer measures like individualised transport marketing (e.g. TravelSmart) and workplace travel plans. Such policies have not traditionally been a focus given the ease of implementing supply-side solutions however has become attractive with the high costs of providing additional road and public transport supply and to maximise the use of existing investments.

Comprehensive approach: The comprehensive approach assumes the maximum range of investment and policy initiatives are at work in addressing the transport challenges. This included a very strong focus on shifting people to more sustainable modes (public transport and active transport) commencing in the short to medium-term through a combination of policy tools and small scale investments. In the medium term, major investments in the public transport network are made in conjunction with stronger policy interventions. The merits and drawbacks of each approach are summarised in Table 21.

Table 21: Merits and Drawbacks of Each Approach

Approach	Merits and Drawbacks
Additional road capacity	Whilst there is some ability to enhance road capacity on existing routes, existing planning and environmental controls place significant restrictions in developing road capacity in new corridors. Early planning for Gungahlin included provision for Gungahlin Drive and Monash Drive. Gungahlin Drive was completed in 2008. Together with the soon to be constructed expanded Majura Parkway, these two corridors may provide some relief (although not significant relief) on Northbourne Avenue. The second arterial road, Monash Drive, is unlikely to be constructed as its alignment runs through the Mount Majura and Mount Ainslie nature reserves which have woodland reserves that are protected under the Federal Environment Protection and Biodiversity Conservation Act. The ACT Government has removed this alignment from the Territory Plan. Furthermore, the provision of additional road capacity would run contrary to a range of Project objectives to reduce car dependency and the National Capital Plan which aims to minimise the level of congestion in the vicinity of the City and the Parliamentary Triangle.
Additional public transport capacity	With the objectives of providing additional capacity and to encourage a greater level of public transport usage, the Submission considers a range of possible public transport interventions, which are discussed further on the following page. However, the current low cost recovery of public transport services suggests that complementary and supporting policy measures and land use scenarios may be required to maximise the economic and financial sustainability of public transport operations.
Policy approach	Changes to policy scenarios provide opportunities to better manage demand and make better use of existing infrastructure. A key element of this Submission is the exploration of the impact of changes to current land use scenarios that will encourage a higher level of residential and commercial densities over and above that projected for the Project Corridor in the future. There are opportunities to further increase the viability of the rapid transit options considered as part of this Submission using policy measures. These measures may include higher parking charges and road pricing. However, it is worth noting: • CSTM already makes an allowance for a general increase in parking and fuel costs. Other priced based measures will require further model development to explore • The political and community acceptability of certain policy measures may be low or unknown • It is unlikely that policy measures in their own right will create sufficient capacity to cater for future demand (although it may delay the need for such capacity) • Policy measures are generally provided in a complementary manner rather than as an alternative to infrastructure solutions. For instance, road pricing schemes generally are associated with the provision of more public transport services. Policy measures could be considered further as part of the option development stage during a more detailed feasibility analysis.
Comprehensive approach	As mentioned previously, this Submission considers policy interventions in the form of different land use scenarios. By considering the combined effects of policy and investments, the comprehensive approach generally leads to an improvement in the efficiency of spending by deferring some spending and/or reducing the amount of spending required. However, developing a package of measures can be complex. Such an approach would be warranted as part of the option development stage during a more detailed feasibility analysis.

Considered Options

In considering the merits of the four approaches, the options considered as part of the Submission are either public transport based options or land use options (in conjunction with transport investment). No road options were considered. Furthermore, previous work has been undertaken for new bus priority lanes, BRT and LRT. While new bus lanes could be considered as the more conservative approach to address identified Project Corridor issues, previous studies have shown that new bus lanes would have limited impact on surrounding urban development, as well as to likely not provide a net positive economic return.

Table 22 outlines the range of options that were considered, whether they were shortlisted and the rationale for their inclusion or exclusion:

Table 22: Options Considered

Option	Short listed?	Rationale
Conversion of existing lanes to transit lanes	No	The conversion of existing general traffic lanes to transit lanes may provide some short term relief for buses. However, this treatment may cause congestion as single-occupant vehicles are constrained to fewer lanes. This will increase through traffic on north Canberra suburban roads, negatively impacting on residential amenity and liveability. These types of lanes tend to be ineffective in an Australian context as they require manual enforcement and hence suffer from high violation rates. Furthermore, with significant increases in bus service frequencies and bus bunching issues, transit lanes are unlikely to address in full current or future bus operating issues.
Conversion of existing lanes to bus lanes	No	The conversion of existing lanes to bus lanes may provide some short term relief for buses and may present a cost-effective bus priority measure. However, previous studies have demonstrated that this treatment will cause congestion along Northbourne Avenue and result in rat-running on current day demand levels.
New bus lanes	No	While previous studies agree on the need that should bus lanes be developed, the number of general traffic lanes should not be reduced to avoid creating road congestion. Recent assessments have shown that new conventional bus lanes are not economically and financially viable. This Submission does not consider the viability of dedicated bus lanes where the number of general lanes is kept at current levels.
BRT	Yes	Previous studies have not explored in detail the viability of BRT. This Submission considers the viability of dedicated BRT facilities as a compromise between bus lanes and LRT.
LRT	Yes	Previous studies have not explored in detail the viability of LRT confined to the Project Corridor. Given the high community support for LRT and that LRT is viewed as a long term transport solution within the Project Corridor, this Submission considers the viability of LRT.
Other modes	No	Other transport modes such as monorail, metro rail and heavy rail were not considered as part of this Submission.

Option	Short listed?	Rationale
Increased parking charges	Yes	Higher parking charges are considered within the Submission as a mechanism to encourage alternative transport use and to share the Project costs across all beneficiaries. CSTM is also underpinned with an implicit assumption that parking charges rise over time.
Road pricing	No	Road pricing is not a part of ACT Government policy. Should road pricing be considered further, options for different types of road pricing and an associated assessment of equity, community and political acceptability would need to be undertaken before it is considered a viable option. Whilst CSTM has some capacity to model road pricing, further model development would be required to accurately assess the impact of road pricing.
Land use scenarios	Yes	Land use scenarios are seen as a pivotal element to enhancing the viability of the rapid transit options considered in this Submission. This Submission considers the impact of higher densities in conjunction with transport investment.

Stage 6 – Option Assessment

Based on the shortlisting process, the Project team developed the following set of transport and land use scenarios. A description of these scenarios is provided as follows.

Transport Scenarios

Three transport scenarios were considered by the Project Team:

- Business as usual
- BRT
- LRT

The detail of each transport scenario was workshopped with stakeholders. Stakeholder consultation informed the desired cross section of the corridor for each of the scenarios. The placement of the LRT or BRT corridor on the kerbside or within the median was assessed against factors including safety, amenity, land use and location of utilities. Community consultation indicated a clear preference for a median alignment. The wide median of Northbourne Avenue and Flemington Road allows for the construction of a transit corridor without disruption to existing traffic lanes.

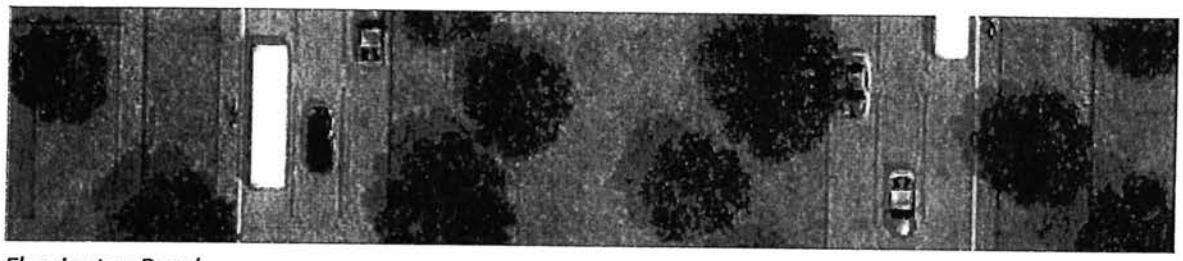
Each of the transport scenarios differ in the degree of priority and segregation that is afforded to public transport services. Key features of each transport scenario are described as follows:

Business as Usual

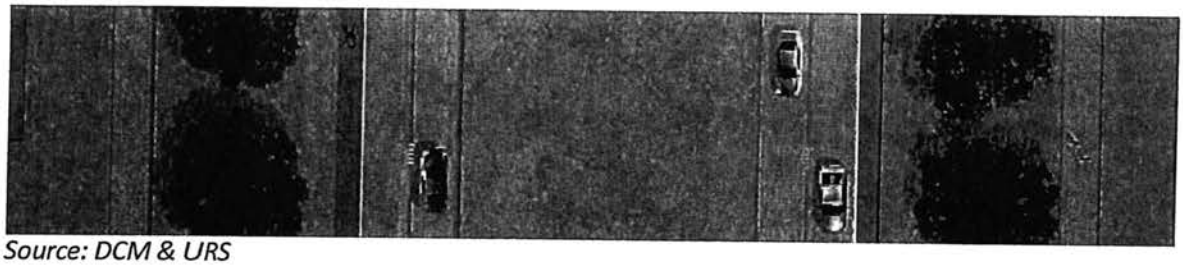
Under the business as usual transport option shown in Figure 15, no changes to the transport network apart from committed road and public transport projects and initiatives are proposed. Buses will continue to share capacity with general traffic along both Northbourne Avenue and Flemington Road (where no bus priority is currently provided).

Figure 15: Projects corridor cross section under business as usual

Northbourne Avenue



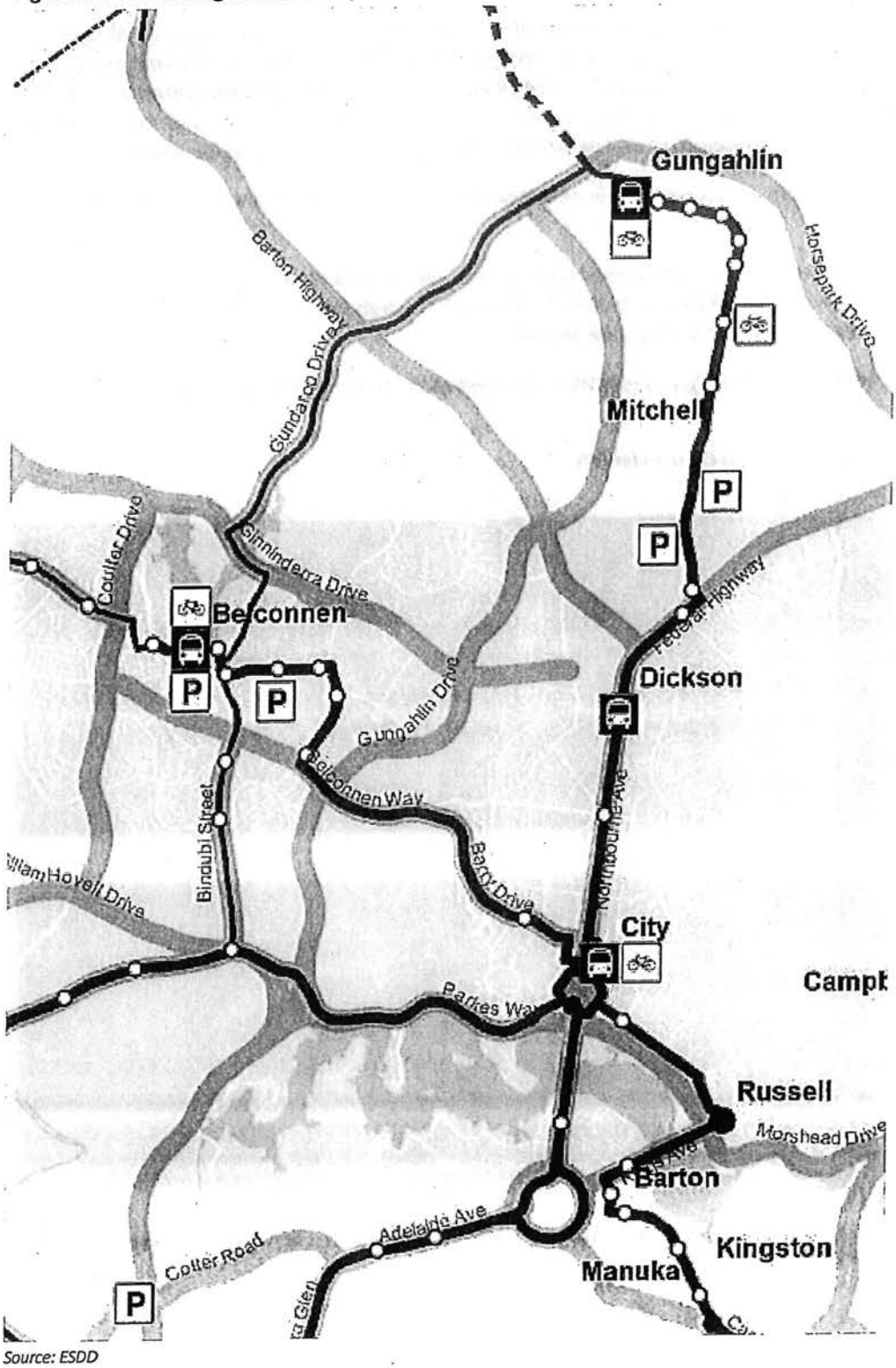
Flemington Road



Source: DCM & URS

The high frequency services provided along identified Frequent and Rapid corridors is assumed to be implemented. The current limited stop Red Rapid service that travels between Gungahlin and Fyshwick via the City will continue to be the primary public transport link between Gungahlin and the City, augmented with local all stop bus services. Figure 16 shows key bus routes that are proposed under the Plan around the Project Corridor.

Figure 16: 2031 Strategic Public Transport Plan Network around the Project Corridor



Source: ESDD

BRT

Under the BRT scenario shown in Figure 17, a new median busway would be constructed on Northbourne Avenue between Alinga Street and Flemington Road and on Flemington Road between Northbourne Avenue and Gungahlin for use by all bus services travelling on Northbourne Avenue and Flemington Road. The civil engineering of the bus lanes will be designed in manner to readily allow for a conversion to light rail should the option be exercised.

The median treatment would utilise available space for a dual dedicated busway in the Northbourne Avenue median. The median of Flemington Road would be developed to provide a dual dedicated busway for bus operations. The BRT scenario makes allowance for 15 stops between Gungahlin and Civic with stops closer to Gungahlin and Civic spaced closer together whilst intermediate stops spaced further apart. Bus bays would be constructed to allow limited stop or express buses to bypass dwelling buses.

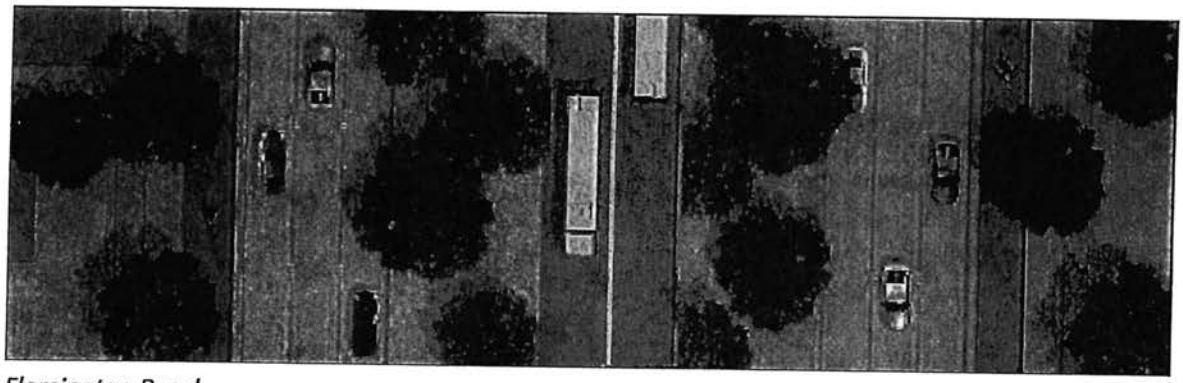
New stations at Gungahlin, Dickson and Civic would be developed to facilitate interchanging with other bus services.

A new BRT service would operate between Gungahlin and Civic and integrate with the remaining Red Rapid route between Civic and Fyshwick and in the future to Queanbeyan. This service would have a minimum headway of 5 minutes during peak periods.

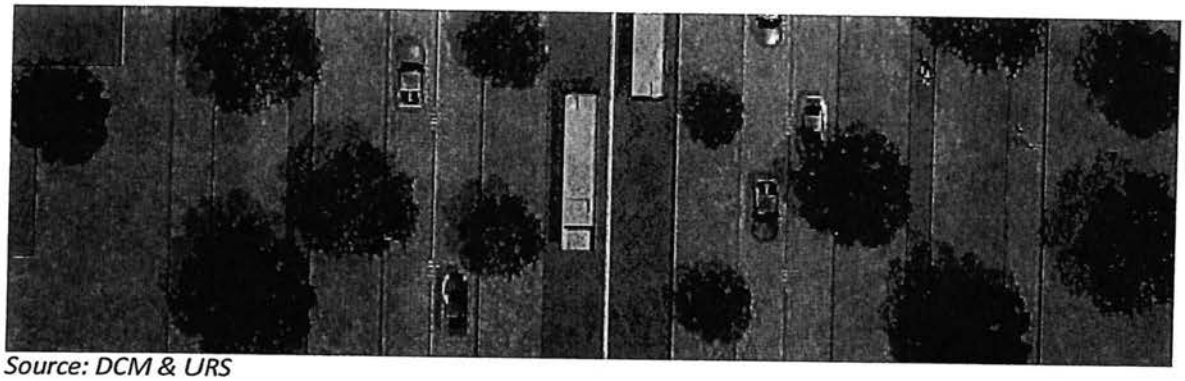
The remainder of the public transport network is assumed to be based on the 2031 Strategic Public Transport Network Plan.

Figure17: Project corridor cross section under BRT

Northbourne Avenue



Flemington Road



Source: DCM & URS

Construction is assumed to commence during 2013 and conclude in 2017. Full operations are assumed to commence in 2018.

LRT

Under the LRT scenario shown in Figure 18, between Gungahlin and Northbourne Avenue, a dedicated light rail corridor would be developed in the median of Flemington Road for the use of light rail services. On Northbourne Avenue between Flemington Road and Civic, a dedicated corridor in the median would be provided for light rail but would be designed to allow the dedicated corridor to be shared by both bus and light rail services. To achieve this, light rail tracks would be embedded into an asphalt road surface along Northbourne Avenue.

No change in the number of general traffic lanes on Northbourne Avenue or Flemington Road is proposed.

The dedicated light rapid transit corridor makes allowance for 15 stops between Gungahlin and Civic with stops closer to Gungahlin and Civic spaced closer together whilst intermediate stops spaced further apart.

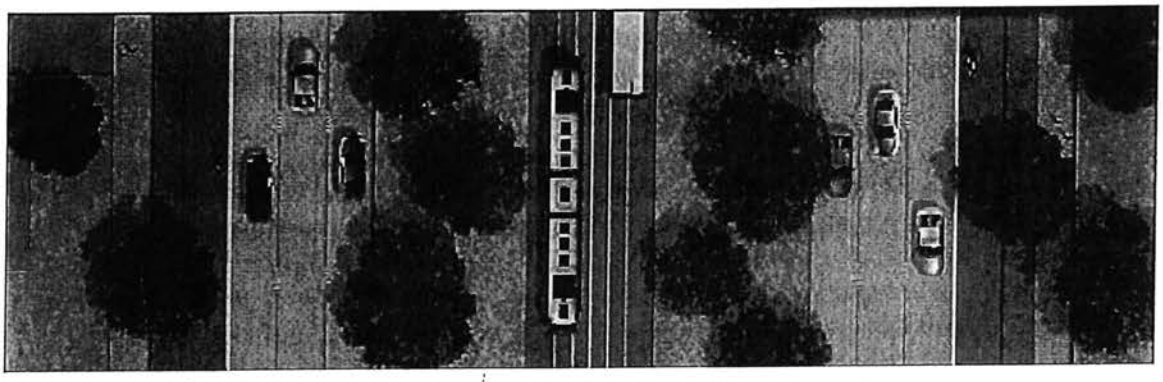
New interchanges at Gungahlin, Dickson and Civic would be developed to facilitate interchanges with other bus services.

A new light rail service would replace the existing Red Rapid service between Gungahlin and Civic and integrate with the remaining Red Rapid route between Civic and Fyshwick and in the future to Queanbeyan. The minimum headway for the light rail service would be 7.5 minutes during peak periods.

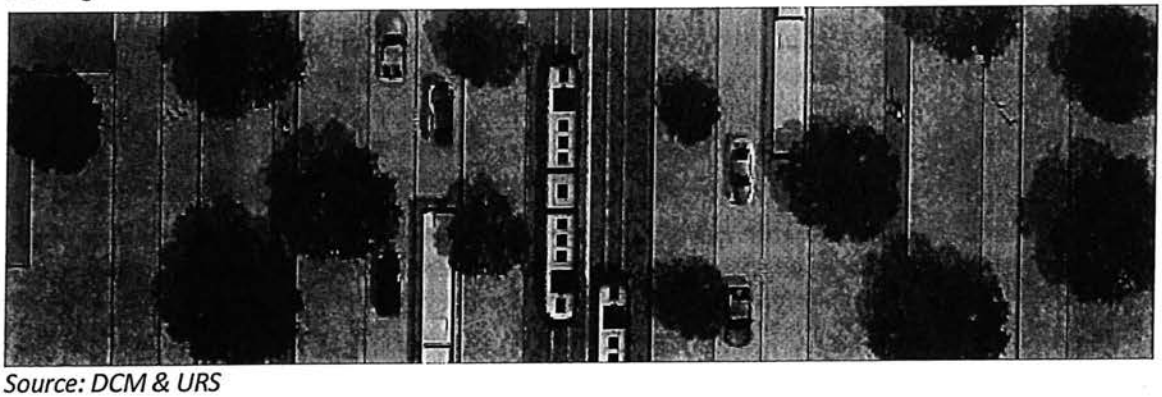
Other buses travelling along Flemington Road or Northbourne Avenue could also use the dedicated corridor. The remainder of the public transport network is assumed to be based on the 2031 Strategic Public Transport Network Plan.

Figure18: Project corridor cross section under LRT

Northbourne Avenue



Flemington Road



Source: DCM & URS

As part of this option, supporting operating infrastructure would be developed including rolling stock, signalling, power supply, substations and depots.

Construction is assumed to commence during 2013 and conclude in 2017. Full operations are assumed to commence in 2018.

Land Use Scenarios

The submission also seeks to explore the effect of changes in land use on the viability of public transport services. The intertwined nature of the issues facing the Project Corridor mean that an integrated transport-land use approach is likely to optimise the economic outcomes of investments in the Project Corridor.

During development and consultation with stakeholders, the three land use scenarios were coined 'low', 'medium' and 'high' scenarios, reflecting the relative level of change in population and employment in the Project Corridor under each scenario. All scenarios assumed an increase in densities over and above that already projected by current Government land use forecasts but total employment and population across the ACT and Queanbeyan was held constant.

Both 'medium' and 'high' scenarios were developed, but have been excluded from economic assessment. The 'medium' scenario assumed a significant level of redevelopment within the Project Corridor but has not been presented in this submission because it had only a marginal impact on the economic results above the low additional development scenario. The 'high' scenario projected growth in the Project Corridor that would require a growth in total ACT population over and above current projections, and therefore could not be compared to business as usual, low or medium scenarios, and was eliminated for this reason.

Hence, this submission tests only the low additional densification scenario, which has been coined as the 'higher density' scenario for the purposes of this submission.

Should the investments in transport infrastructure be sufficiently attractive to potential users, the investments themselves could generate changes in land use. The Project is likely to improve accessibility through reduced travel times, decongestion and improved travel time reliability. In turn, improvements in accessibility may drive land use changes. Where transport interventions provide a significant enhancement in accessibility, people and industries may choose to move the location of their residence, employment, business centres and alter their logistics chains to take advantage of faster travel times. Transport investments, in particular light rail investments, may also result in redevelopment around stations.

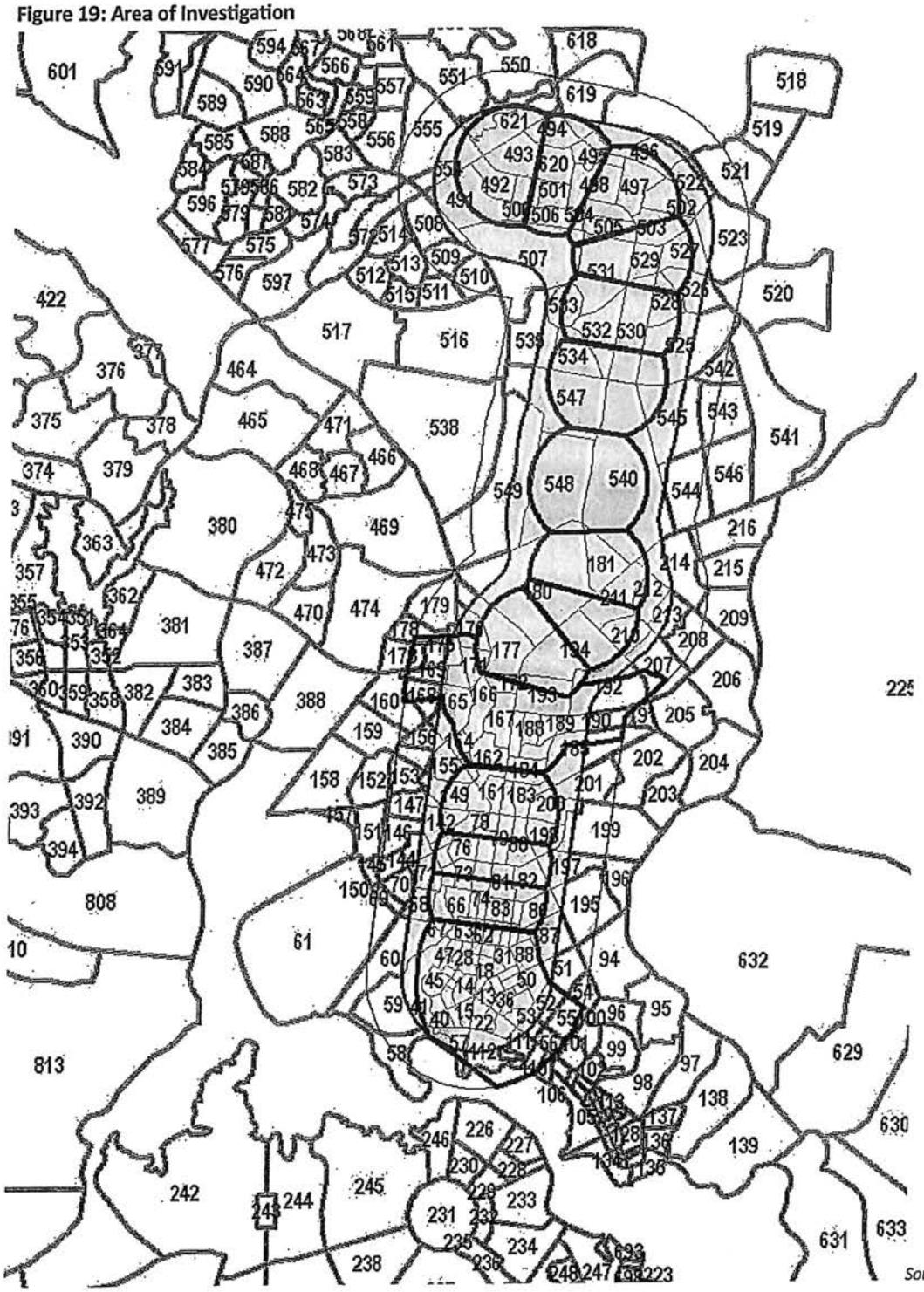
Land use settings are considered an important policy tool. Even without significant changes to existing planning controls, the Project Corridor has a number of properties that could be readily redeveloped by Government to support urban densification. For instance, the ACT Government owns the motor registry site and tourist information site as well as public housing complexes along Northbourne Avenue. There also exists opportunities to rezone underdeveloped sites including parts of EPIC and Canberra Racecourse. The Government may also seek to manage the spatial distribution of demand for housing by constraining supply outside the Project Corridor. Finally, as land in the ACT is sold on a leasehold arrangement, the ACT Government is the ultimate owner of all land and could use these arrangements to effect changes in land use patterns.

However, modelling the relationship between land use and transport is complex. Although the notion is well espoused amongst planners, few strategic demand models attempt to model the impact of transport interventions and accessibility on land use outcomes as there is a dual endogeneity between land use and transport i.e. they both influence each other, a relationship which is challenging to control in both directions simultaneously. Also, accessibility is only one of many factors that would ultimately impact on land use outcomes.

As an alternate approach, the Project team developed land use scenarios to reflect possible urban outcomes from government intervention, whether through investment in transport or through changes in land use scenarios.

Three land use scenarios were developed by the Project team for testing in addition to the 'business as usual' land use scenario. The land use projections focused on a linear corridor around the Project Corridor. The area of investigation for each land use scenario, shown in Figure 19 is assumed to cover a one kilometre buffer zone along the Project Corridor, extending from Lake Burley Griffin in the south to the Gungahlin Town Centre in the north with widening at Dickson to reflect the strategic importance of Dickson as a transport hub with high-frequency transport route connections.

Figure 19: Area of Investigation



Source: URS

Most land use changes were assumed to occur within an 800m catchment of each station. This catchment is based on the commonly recognised walkability catchment for public transport.

The higher density land use scenario is not necessarily a policy setting. The urban outcomes implied by the scenario may arise through a market response to transport investment, as well as through adjustments in land use settings, urban renewal programs or through a combination of these factors.

A brief description of the business as usual and 'higher density' scenario is provided below.

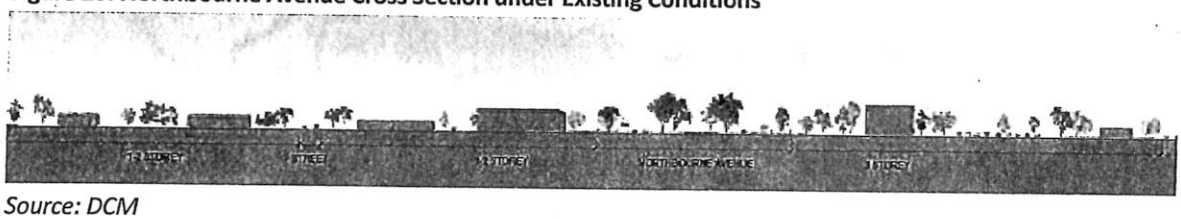
Business as Usual

The 'business as usual' land use scenario is based on current ACT Government population and employment projections, which are used for whole of government decisions.

Current Government projections assume that the combined ACT – Queanbeyan population would exceed 500,000 people by 2031. To cater for future population growth, historic development patterns (mainly 'greenfield' development in the districts of Molonglo, Gungahlin and Queanbeyan) would continue into the future. Under this scenario there is no significant change to land use policies and planning controls in the study area.

The population of Queanbeyan is included in the analysis as the CSTM includes it for the purpose of modelling the transport network.

Figure 20: Northbourne Avenue Cross Section under Existing Conditions



Source: DCM

Higher Density Scenario (Low Additional Densification)

The higher density land use scenario assumes a faster realisation of the Project Corridor's development potential without changes to existing land use controls or policies in the Territory Plan. The scenario allows for recent amendments in planning controls for:

- Dickson
- Gungahlin Town centre
- Inner North urban housing
- City area (ANU Exchange and Griffin Legacy)

Under the higher density scenario, population and employment levels would be 38% and 21% higher than under the business as usual land use scenario within the Project Corridor by 2031.

Parking Scenario

Transport development should not only be concerned with the provision of supply but also effective management of transport demand. Parking changes can be used as a lever to facilitate a mode shift to public transport. Furthermore, the increase of parking rates along the Project Corridor could provide an array of benefits to the community, government and road users.

Canberra has the lowest parking rates amongst Australian capital cities. Colliers International estimated that daily rates in Canberra at $10 – the average rate across Australian cities was $39 per day with Sydney and Melbourne having the highest rates at $64 and $66 respectively.[7]

While this suggests a boon to current private vehicle road users, low parking fees encourage private vehicle use which imposes a range of costs on society and infrastructure. An increase in parking rates could provide the following:

- Encourage the use of public transport and other alternative transport mode, such as active transport, along the Project Corridor
- Ensure that the cost of the Project are shared across all beneficiaries along the Project Corridor
- Potentially provide an additional funding source for the Project

In terms of possible adverse reaction by a society that is heavily car reliant, community consultation (via Time to Talk Canberra 2030) revealed that Canberra's residents were informed with respect to the need for wider public transport options. Survey participants discussed trade-offs they would be willing to accept including the increase of parking charges to discourage private vehicle use.[8]

Shortlisted Options

As a final step, the Project team considered what combination of the three transport scenarios, two land use scenarios and a parking scenario that was most likely to occur. From these considerations, the Project team developed five options, with four do-something options against a base case option:

- BRT with business as usual land use and increasing parking charges
- LRT with business as usual land use and increasing parking charges
- BRT with higher density land use and increasing parking charges
- LRT with higher density land use and increasing parking charges

A conventional bus lane scenario with business as usual or higher density land use was not considered as it was considered unlikely that land uses will change significantly from an investment in bus lanes only. Increased parking charges were assumed for all options as it was considered a key mechanism in facilitating a shift to alternative transport modes, remediate costs for remaining private vehicle users and optimise funding for the Project.

The base case option assumes that changes in future transport and land use continue on a business as usual basis, in line with current Government transport commitments and planning strategies.

Appendix B: Stage 7 Template

Appraisal Summary Table 1: Demand and Economic Modelling Assumptions

1. Demand Modelling, Assumptions and Results

Outline the key drivers of demand

The Canberra Strategic Public Transport Model (CSTM) was used to estimate changes in travel patterns. CSTM is a typical four-step Strategic Public Transport demand model covering the ACT and Queanbeyan.

Changes in travel demand and travel patterns are primarily influenced by either changes in the level of population and employment, the location of people and jobs, and generalised travel times between individual origins and destinations.

Trip Generation

The number of trips generated in each Traffic Analysis Zone is estimated on land use inputs. The level of trip generation is dependent on the trip purpose as well as the assumed socio-economic characteristics of a given zone. Rates and adjustment factors are shown in the following tables:

Table 23: Trip Generation Rates

Trip Purpose		AM Peak Trip Rate
Home based	Work	0.239
	Education	0.104
	Shopping	0.040
	Other	0.085
Non-home based	Business appointments etc.	0.107
	Other	0.039

Source: MRC, Transport Modelling and Analysis 2006/2011, Study Report

Table 24: Trip Rate and Public Transport Usage Adjustment Factors based on Income

Income Level	2006 Trip Rate Adjustment Factors	2006 PT Usage Adjustment Factors
Low (< $25,999 p.a.)	0.593	1.332
Medium ($26,000 to $51,999 p.a.)	1.142	0.959
High (> $52,000 p.a.)	1.327	0.649

Source: MRC, Transport Modelling and Analysis 2006/2011, Study Report

Table 25: Trip Rate and Public Transport Usage Adjustment Factors based on Age

Age Level	2006 Trip Rate Adjustment Factors	2006 PT Usage Adjustment Factors
Under 15 years	0.756	0.781
15 to 24 years	0.704	1.537
25 to 44 years	1.316	1.091
45 to 64 years	1.198	0.795
65 years and above	0.336	0.705

Source: MRC, Transport Modelling and Analysis 2006/2011, Study Report

Generalised Costs

Previous household travel surveys revealed trip-maker behaviour and perceptions, which served as the basis for estimating generalised cost function parameters, as shown in below:

Table 26: Generalised Cost Components

Element	Key Factors	Base Year (2011) Value
Travel time	Distance, Operating Speeds, Lane Capacity	Defined for each link
	Traffic Volumes	Identified through network assignments
Operating Cost	Fixed Vehicle Operating Cost	$0.13/km
	Fuel Price ($/L)	$1.03/L
	Fuel Cost per km ($/km)	$0.09/km
	Value of Time	$10/hr
Road User Charges	Parking Charges	Defined by area and factored with the Parking Charge Factor
	Public Transport Fares	Based on base year fares

Source: MRC, Transport Modelling and Analysis 2006/2011, Study Report

The following equations illustrate the general form of the generalised cost function and its components:

Equation 1: Generalised Cost Equations

Car generalised cost	**=Travel Time ×Value of Time+ (Fixed VOC per km+Fuel Cost per km)×Distance+Parking Cost**
PT generalised cost	**=(In-vehicle time+1.15 walk time+1.2 wait time+1.1 boarding time)×Value of Time+Fare Cost**

All out of vehicle travel time elements are weighted to convert these elements into an in-vehicle travel time equivalent.

Changes in generalised costs, impact primarily upon mode choice within CSTM through the following equations:

Equation 2: Mode Choice Function

$$\text{PT mode share}_{ij,\text{trip purpose}} = \frac{1}{1 + \exp\lambda\,(GC_{Car} - GC_{PT}) + \alpha}$$

The following parameters inform the estimation of the above equation:

Table 27: Mode Choice Parameters

Trip Purpose	Spread Parameter (l)	Constant (a)
Work	-0.27	0.66
Education	-0.2	0.2
Other	-0.3	3

Source: MRC, Transport Modelling and Analysis 2006/2011, Study Report

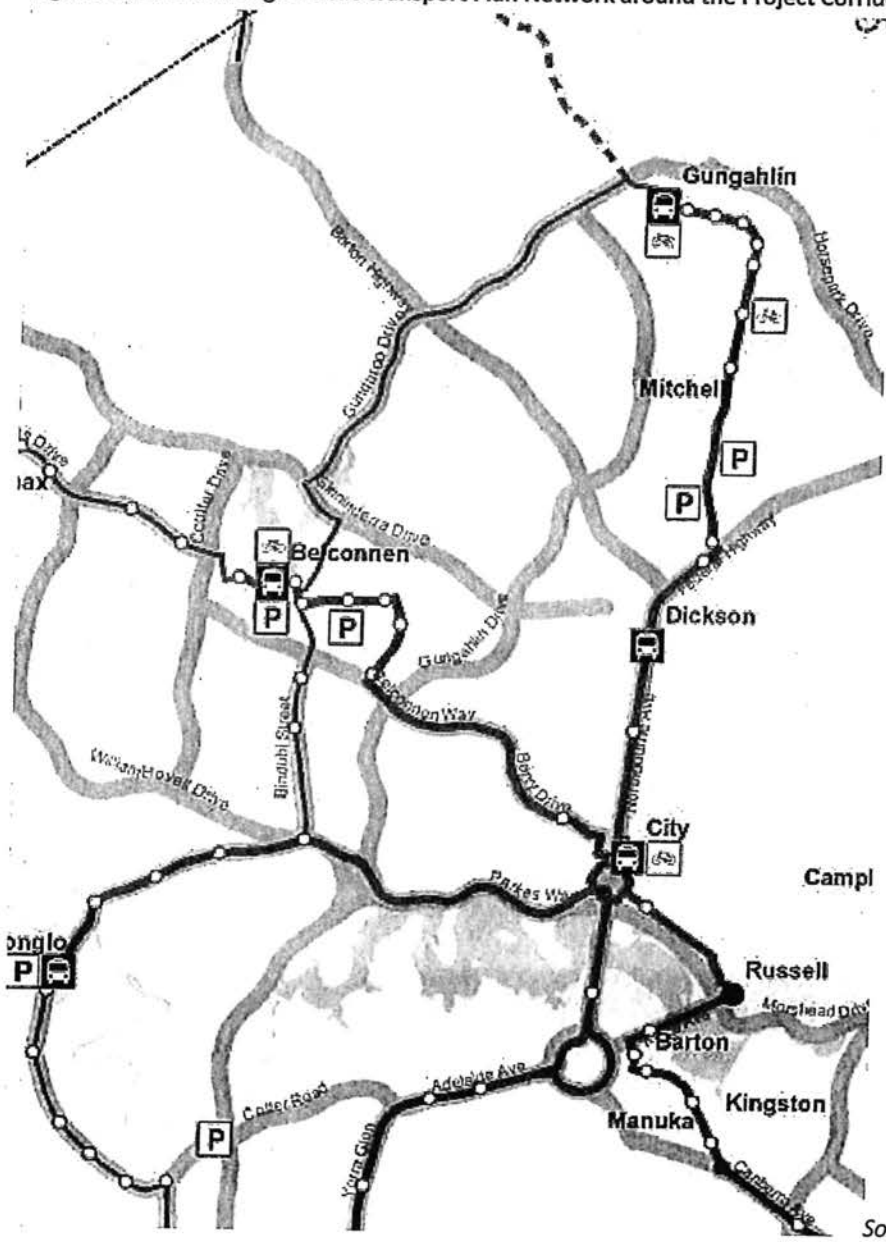
Describe the situation 'without' the initiative, i.e. the base case, including future works and associated capital, maintenance and operating costs

The base case option assumes that changes in future transport and land use continue on a business as usual basis, in line with current Government transport commitments and planning strategies.

Under the business as usual transport option, no changes to the transport network apart from committed road and public transport projects and initiatives are proposed. Buses will continue to share capacity with general traffic along both Northbourne Avenue and Flemington Road (where no bus priority is currently provided).

The *2031 Strategic Public Transport Plan Network* with high frequency services provided along identified Frequent and Rapid corridors is assumed to be implemented. The current limited stop Red Rapid service that travels between Gungahlin and Fyshwick via the City will continue to be the primary public transport link between Gungahlin and the City, augmented with local all stop bus services. Figure 22 shows key bus routes that are proposed under the Plan around the Project Corridor.

Figure 22: 2031 Strategic Public Transport Plan Network around the Project Corridor



Source: ESDD

The 'business as usual' land use scenario is based on current ACT Government population and employment projections, which are used for whole of government decisions.

Current Government projections assume that the combined ACT – Queanbeyan population would exceed 500,000 people by 2031. To cater for future population growth, historic development patterns (mainly 'greenfield' development in the districts of Molonglo, Gungahlin and Queanbeyan) would continue into the future. Under this scenario there is no significant change to land use policies and planning controls in the study area.

2. Land Use, Population and Employment Forecasts

What land use, population and employment forecasts have been used and where have they been sourced from?

Two sets of land use projections have been used for 2011, 2021 and 2031: a 'business as usual' land use scenario and a 'higher density' land use scenario. The following land use information was used for estimating generated trips at a Traffic Analysis Zone level:

- Population
- Employment
- Retail space
- School enrolments

Tertiary enrolments

The 'business as usual' land use projections are based on ACT Government Chief Minister and Cabinet Directorate population projections. The 'higher density' land use projections were prepared by ESDD and URS.

What is the range of projections over the period forecast and used in the economic appraisal? What are the annual employment and residential growth rates implied by these land use forecasts? What are the factors that will affect the likely outcome given the demand drivers identified?

Two sets of land use projections have been used for 2011, 2021 and 2031: a 'business as usual' land use scenario and a 'higher density' land use scenario.

Total population and employment projections across the combined ACT-Queanbeyan region are common to both land use scenarios. Table 28 shows projected total population and employment levels across the region, which shows that population levels are anticipated to exceed half a million people by 2031.

Table 28: Projected Total Population and Employment across ACT-Queanbeyan

Metric	2011	2021	2031
Total			
Population	397,900	459,100	518,900
Employment	223,500	250,400	277,400
Change			
Population		15.4%	13.0%
Employment		12.0%	10.8%
CAGR			
Population		1.4%	1.2%
Employment		1.1%	1.0%

If specific land use forecasts have been undertaken for the proposal what is the difference in terms of number of jobs and residents compared to the base case land use in the last year the forecasts are produced for?

Total population and employment projections across the combined ACT-Queanbeyan region are common to the 'business as usual' and 'higher density' land use scenarios.

Has there been any redistribution of jobs and residents and if so, what are the assumptions underpinning this redistribution?

Although the population and employment totals are common to both land use scenarios, the distribution of population and employment within the region has been altered. The 'higher density' land use scenario reflects an assumption of a faster realisation of the Project Corridor's development potential without relying on changes to existing land use controls or policies in the Territory Plan. The realisation of higher population levels within the Project Corridor has been assumed to be based on a slower realisation of proposed greenfield development sites, in particular within the Molonglo Valley and Queanbeyan. Under the higher density scenario, population and employment levels would be 38% and 21% higher than under the business as usual land use scenario within the Project Corridor by 2031.

Table 29 and Table 30 show land use projections for the Project Corridor and other districts in Canberra for 2011, 2021 and 2031 under the 'business as usual' and 'higher density' land use scenarios.

Table 29: Population Projections by District

District	2011 BAU	2021 BAU	2021 Higher Density	2031 BAU	2031 Higher Density
Project Corridor	50,400	62,500	71,900	74,100	102,600
North Canberra Outer	14,100	14,800	21,100	16,300	21,000
Gungahlin Outer	26,500	41,700	36,800	56,800	45,500
Belconnen	91,300	94,000	93,200	93,000	93,000
South Canberra	26,000	28,800	28,000	34,200	33,900
Tuggeranong	89,000	84,500	84,100	83,000	85,700
Woden	57,400	58,100	58,400	57,000	54,600
Molonglo	600	23,900	21,100	46,000	34,000
Majura	200	200	200	200	200
Queanbeyan	41,900	50,000	44,000	57,700	47,900
Jerrabomberra	700	700	700	700	700
Total	**397,900**	**459,100**	**459,100**	**518,900**	**518,900**

Source: URS & ESDD. BAU estimates based on ACT Government Chief Minister and Cabinet Directorate projections

Table 30: Employment Projections by District

District	2011 BAU	2021 BAU	2021 Higher Density	2031 BAU	2031 Higher Density
Project Corridor	62,100	69,600	81,100	75,800	91,700
North Canberra Outer	14,000	15,900	13,200	17,800	16,400
Gungahlin Outer	2,000	3,700	6,000	4,700	3,600
Belconnen	27,500	29,500	28,100	30,400	29,400
South Canberra	48,400	51,700	48,500	56,200	55,900
Tuggeranong	18,000	20,200	18,000	20,900	18,700
Woden	27,900	29,200	25,300	30,000	30,100
Molonglo	100	2,300	3,500	6,300	5,100
Majura	7,900	10,300	8,700	14,200	10,000
Queanbeyan	10,700	12,500	12,100	13,800	9,500
Jerrabomberra	4,900	5,500	5,800	7,100	6,500
Total	**223,500**	**250,400**	**250,400**	**277,400**	**277,400**

Source: URS & ESDD. BAU estimates based on ACT Government Chief Minister and Cabinet Directorate projections

3. Demand Modelling Outputs

What demand model was used to generate the forecasts and who undertook the demand modelling?

The Canberra Strategic Public Transport Model (CSTM) was used as the basis to assess the demand impact for each option, which is maintained periodically by ESDD. CSTM is a typical four-step Strategic Public Transport demand model covering the ACT and Queanbeyan.

SMEC was contracted by ESDD to prepare land use and network assumptions for modelling, run CSTM and provide demand outputs.

What time period was modelled (for example a one hour AM peak on an average weekday, 24 hour period on an average weekday, etc.)

CSTM models a typical 2 hour weekday AM peak between 7am and 9am.

What expansion factor was used to translate the period of the day modelled into a daily observation? What expansion factor was used to translate the daily observation into an annual observation? What sources informed this expansion factor and / or what logic underpins it?

A range of expansion and annualisation factors are required to convert average weekday peak estimates from CSTM into annual estimates. The following table outlines the range of factors used:

Table 31: Adopted Expansion Factors

Item	AM Peak to Weekday Factor	Weekday to Annual Factor
Public transport demand	4.74	280
Standard bus service provision	5.43	286
Rapid transit service provision	5.00	336
Private vehicle demand	4.74	300

What sources informed this expansion factor?

The following sources were used to inform the estimation of expansion and annualisation factors.

Item	Source
Public transport demand	ATC Guidelines
Standard bus service provision	ACTION Buses operational data
Rapid transit service provision	Based on assumed operating patterns
Private vehicle demand	ATC Guidelines

Service patterns for rapid transit (BRT or LRT) services were assumed to be different to current public transport service patterns. By comparison with current service patterns, rapid transit services are assumed to operate at higher frequencies, particularly during the off-peak and on weekends, and operate for more hours of the day.

Does the model calculate new or "generated" trips (as opposed to using a fixed trip matrix)? How does the demand model deal with the issues of induced demand?

The level of trip generation is based on socio-economic factors including age, income and status. The level of trip generation within a given travel zone in CSTM is only dependent on the level of population and employment as well as the assumed socio-economic characteristics of people residing within the travel zone. The level of trip generation within CSTM is not dependent on generalised costs, reductions in which may create additional trips and increases in which may lead to trips being suppressed.

4. Economic Model Parameters – Costs

First year of construction / Last year of construction

First year of construction: 2014

Last year of construction: 2017

State real discount rates used (if not 4, 7 and 10%), and the basis for any variation from these standard DRs

A real discount rate of 7% per annum was adopted with sensitivity analysis undertaken at 4% and 10%.

State appraisal period in years, and basis for its selection

All economic costs and benefits were evaluated over a 30 year operating period.

Remaining life of the initiative at the end of the appraisal period

BRT and LRT operations within the Project Corridor have been assumed to operate as a going concern after the end of the appraisal period.

Assets of varying economic life have been accounted for within the appraisal. To reflect the level of economic life remaining in assets after the appraisal period, a residual value has been estimated.

Describe the basis for estimating all capital costs (for both base and project cases). Confidence level: are the construction costs P50, P90, P95?

Capital costs have been developed by the Project Team's engineering advisor, URS. Cost estimates reflect that the level of design is at a pre-conceptual or concept screening stage. In these circumstances, the typical range of accuracy varies between a low range (-30% to -15%) to a high range (+20% to +50%). Based on the preliminary nature of the analysis and the lack of a detailed engineering design at this stage of the project, the confidence level associated with the construction costs are likely to be consistent with a P50 level.

The estimates were generally in accordance with the Commonwealth Department of Infrastructure, Transport, Regional, Development and Local Government – Best Practice Cost Estimation for Publicly Funded Road and Rail Construction, 19 June 2008, in particular Appendix 1 & 6.

The "Estimate Class" approach was used based on a level of accuracy of Class 4 (Study or Feasibility). It is important to note that the costs are not base costs, but should be viewed as a mean cost with an upper and lower probability, in our case Class 4.

Traditionally, benchmarking is used where appropriate to establish a range of expected costs and cost ratios for comparison purposes. In addition it provides appropriate cost data where specific detail is not readily available such as high level pre-concept evaluation. Examples of benchmarking projects include the Constitution Avenue Upgrade Project, Gold Coast Rapid Transit, and the Melbourne Hoddle Street Planning Study.

Where benchmarking rates were not used, Rawlinsons Construction Cost Guide was used. In estimating the costs the following factors have been included:

- **Direct Cost** - The direct cost represents the construction costs of the works and specifically covers the costs of plant, labour, materials and specialist subcontractors.
- **Indirect Costs** - The indirect cost represents the design, mobilisation and government costs, where applicable.

Estimates have been technically reviewed internally at URS but not reviewed by an independent organisation. This is consistent with the concept screening stage of a project and the client requirements. An independent review of estimates will be required during the Feasibility and Forward Design phase of the project.

The phase for this project is assumed to be between Project Identification & Project Scoping, with a contingency risk on Base Estimate of +40% to +60% & +25% to +40% respectively

This correlates with the Estimate Class approach as stated above, but negates the possibility that the costs for the project could be less than the Base Estimate. It is important to note that the costs, as indicated in our Cost Estimate, are NOT base costs, but should be viewed as a mean cost with an upper and lower probability, in this case Class 4.

What rate of escalation has been assumed over the construction period?

Unit cost rates are assumed to remain constant across the evaluation period.

What is the profile of the capital cost spending, for example: year 1 – 10%, year n – X%. Who were the capital cost estimates prepared by? Have they been independently verified?

Table 32 shows a profile of capital spending by time period. A proportion of capital spending is incurred during Year 31 – 40 to reflect the replacement of life expired assets (e.g. track, signalling) just prior to the end of the appraisal period.

Table 32: Breakdown of Capital Costs (Undiscounted)

Period throughout the appraisal period incurred with the replacement of life expired assets and staging costs	BRT	LRT
Year 1 – 10	77.2%	76.5%
Year 11 – 20	2.0%	1.4%
Year 21 – 30	12.5%	5.0%
Year 31 – 40	8.3%	17.2%
Total	**100.0%**	**100.0%**

Cost estimates were prepared by URS. No independent verification of the capital costs has been undertaken.

Describe the initiative's out turned costs ($M, nominal, undiscounted)

Table 33 shows upfront outturn costs as well as total outturn costs. Total outturn costs reflect costs incurred with the replacement of life expired assets during the appraisal period.

Table 33: Outturn Costs (Undiscounted)

Item	BRT	LRT
Upfront outturn costs	$276m	$615m
Total outturn costs	$358m	$804m

Economic costs:

Describe and justify any adjustments made to the initiative's out turned costs to generate an economic project cost

No adjustments have been made to the initiatives out turned costs to generate an economic project costs. Unit cost rates used were exclusive of taxes and profit margin.

Economic cost - $M, real, undiscounted; and $M, real, discounted (using a real 7.0% discount rate)

Table 34 shows discounted and undiscounted capital costs for BRT and LRT.

Table 34: Undiscounted and Discounted Capital Costs

Item	BRT	LRT
Undiscounted capital costs	$358m	$804m
Discounted capital costs	$215m	$470m

Residual value - State the size of the residual value, economic lives of the assets included in the residual value and the methodology used to generate it (see note above for methodology).

Assumed asset lives, used to assess the timing of recurrent capital expenditure and residual values, are shown as follows:

Table 35: Assumed Effective Lives

Asset	Assumed Asset Life
Planning	
Enabling works	Nil
Preliminaries and design	Nil
Government costs	Nil
Other general planning and management	Nil
Traffic management and temporary works	Nil
Below rail infrastructure	
Track work	30
Roadway	
Busway	40
Road infrastructure	40
Bridges	100
Segregated Rapid Transport Lanes	40
Road works	40
Drainage	100
Cycle Lanes	60
Footpaths	60
Utilities	50
Electrical	
Signalling	15
Power supply, transformers and sub-stations	40
Other electrical and mechanical systems	15
Passenger interface and communications	
Passenger ticketing	15
Passenger information displays and platform control systems	10
Vehicle monitoring systems	10
Bus stops	20
Bus and light rail stations	50
Other buildings and structures	100
Fleet	
Bus fleet	20
Light rail rolling stock	35

Source: Deloitte assumptions based on ATC (2006d) and ATO (2011)

For long lasting capital assets, some economic life will remain following the evaluation period. The value of the remaining economic life is derived on a 'straight line' basis using the following formula:

Residual Value= (Economic Life – Evaluation Period) ×Capital Expenditure
(Economic Life)

Resultant discounted residual value estimates are shown as follows:

Table 36: Residual Value by Option (Discounted)

Option	Discounted ($m)
BRT	$9
LRT	$23

Maintenance costs - Describe the basis for estimating all maintenance costs, including growth rates over time (for both base and project cases). Are the maintenance costs P50, P90, P95? What is the basis for this estimate and who prepared the maintenance cost estimates?

Table 37 outlines the assumed asset maintenance rates used in the Project Business Case, which have been kept constant in real terms over the appraisal period.

Table 37: Asset Maintenance Cost Rates

Asset Maintenance Component	Unit Rate	Source
Annual BRT lane maintenance cost	$450,000	URS
Annual LRT infrastructure maintenance cost	$78,918 per track kilometre	Australian Transport Council Guidelines

Light rail maintenance costs were indexed to June 2011 prices using the Road and Construction Cost Index

Replacement - Is there a need to replace or refurbish major components of the infrastructure / rolling stock during the appraisal period? If so, how are these replacement or refurbishment costs captured?

A number of assets were assumed to have an economic life of less than 30 years. Accordingly, these assets were assumed to be replaced at the end of their economic life at the cost incurred when they were first acquired.

Operating costs - Describe the basis for estimating all operating costs, including growth rates over time (for both base and project cases). Who were the operating cost estimates prepared by? Have they been independently verified?

Operating costs were based on a service kilometre basis. Public transport service kilometres and hours estimated by CSTM were disaggregated by standard bus, BRT and LRT.

Operating costs were inclusive of:

- Direct costs: driver labour costs, fuel, electricity and other consumables
- Overheads: costs associated with operations overheads (scheduling, rostering, driver supervision and depot related costs), vehicle maintenance overheads (engineering technology services), head office costs (higher management functions) and general labour and non-labour overheads (information technology, human resources, insurance).

Estimates of service kilometre operating costs were based on the assumptions shown in Table 38 and Table 39, which are broadly based on Australian Transport Council Guidelines.