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Technical Note

Brisbane City Council

To: **CPO – Civil & Transport** Date: **27/10/2014**	**Transport Planning and Strategy**
Attn:	Transport Engineering Group
CC:	Brisbane Square 266 George St Brisbane Qld 4000
From:	
Re: **Lytton Rd Stage 1 Upgrade - BCR Calculation**	Phone: Facsimile: Email: Internet: www.brisbane.qld.gov.au

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1.0 INTRODUCTION

This technical note documents the benefit cost analysis undertaken for Stage 1 of the 6 lane upgrade for Lytton Road from Latrobe St to Laidlaw Parade. The following aspects of the project are documented in this Technical Note:

- methodology
- vehicle operational benefits
- crash benefit analysis
- BCR

The purpose of this technical note is to document the analyses and assumptions made in undertaking a benefit-cost analysis (BCA) for the project. Benefit Cost Analysis is a technique for assessing the economic merits of proposals and justifying the need for resource allocation. It is a useful tool in the decision making process for determining the most appropriate option or setting priorities for transport projects.

It provides a means of comparing alternative approaches to individual projects and to set priorities for competing projects. It uses a framework of values for all costs and benefits to the community that are quantified as a dollar value. Only costs and benefits that can be quantified in money terms are included in the analysis.

Often there are many environmental and social benefits or costs that arise from transport projects, which cannot be quantified in a dollar value. These benefits and costs are not included in the analysis.

The BCA primarily includes changes in vehicle operating costs, user time costs, emission costs, capital costs, and changes in vehicle crash costs. The BCA process used in this report is consistent with the recommendations included in the AUSTROADS – "*Benefit Cost Analysis Manual*" and the "*Guide to Project Evaluation*".

2.0 METHODOLOGY

The methodology has been designed to allow a preliminary calculation to be undertaken in a short timeframe with the available information.

The following summarises the methodology:

- extract vehicle operating costs from SATURN models created for this project during earlier phases of the project. The SATURN models that were used were:
  - 2021 Base (AM and PM)
  - 2031 Base (AM and PM)
  - 2021 Stage 1 Upgrade Option (AM and PM)
  - 2031 Stage 1 Upgrade Option (AM and PM)
- the following SATURN outputs were extracted for analysis:
  - vehicle operating costs (based on fuel consumption and emissions of CO, CO2, NOX and HC)
  - travel time
  - travel distance
  - congested link speed
  - total volumes
- determine vehicle operating cost benefits between Base and Option at 2021 and 2031.
- extrapolate 2031 year benefits to 2051 to determine project benefits for the 30 year project life
- determine total 30 year project life benefits based on the upgrade's crash reduction
  - crash data for intersections and midblock in the corridor between 2007 – 2011
- determine project benefits in 2014 dollars based on 6% discount rate in NPV calculations
- determine the project's BCR based on the Cost Plan provided by CPO

3.0 VEHICLE OPERATIONAL BENEFITS

3.1 Period of Benefit

The period of benefit needs to be determined to define the length of time during the day that the benefits of the upgrade from 4 lanes to 6 lanes will be realised. An hourly volume profile was developed for both and inbound and outbound peak hours at the Lytton Rd / Latrobe St intersection to use in this assessment. This was aligned with the desired hourly operating capacity of the 4 lane cross section to ascertain the length of time during the day that the capacity would be exceeded without the upgrade.

An assessment of the desired hourly operating capacity was also undertaken in parallel to determine the lane capacity that would achieve a desired Level of Service equivalent to D for the corridor. The assessment determined that the Level of Service D capacity is 1,150 vehicles per lane.

Future year benefit time periods were also investigated by developing a predicted future year flow profile for 2021. Based on the derived future flow profile for 2021 the operational benefits were predicted to extend to a wider flow period compared to existing peak flow time periods. The operational benefits were predicted to extend for a total of 9 hours during the day (3.5 and 5.5 hours during the morning and afternoon periods, from 6:00am – 9:30am and 1:30pm - 7:00pm respectively). These operational benefits were annualised into a calendar year and then translated into a present value over a 30 year period using a 6% discount rate.

Figure 1 below presents the hourly volume profile developed at the intersection of Lytton Rd / Latrobe St for both the inbound and outbound direction of travel.

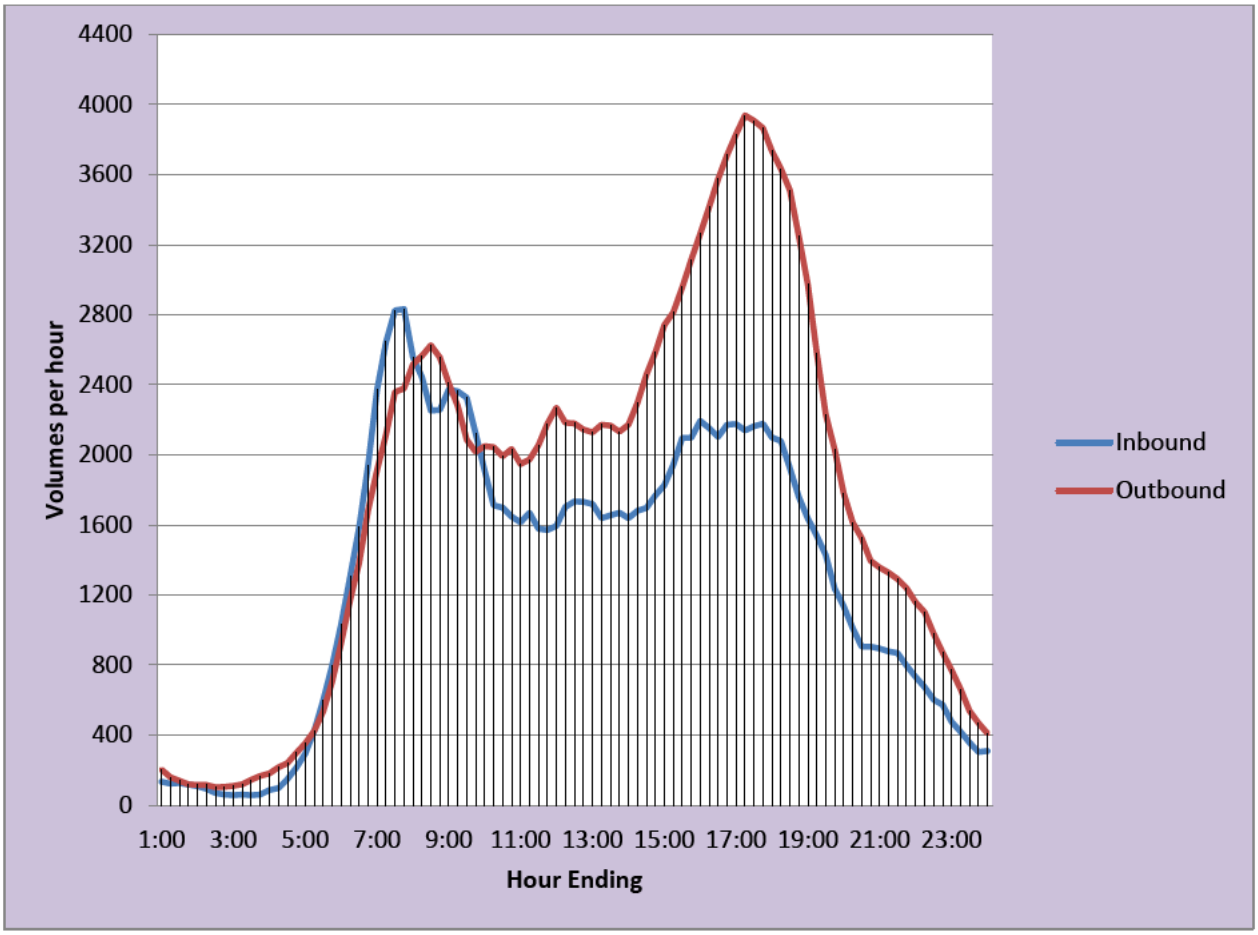

Figure 1 – Hourly Volume Profile at Lytton Rd / Latrobe St intersection

3.2 Operating Benefit

The analysis projected travel time savings until the year 2051, with the value of time at $22.60 per person hour (approximately $34.00 per vehicle hour). These travel time savings represent the combined values of person time savings and vehicle operating cost savings.

The vehicle operating costs extracted from the SATURN modelling are shown in **Table 1** below. The values presented below are net present values, represented in 2014 dollars.

Table 1 - Estimated Annual Vehicle Operating Costs

Model	Estimated Vehicle Operating Costs NPV (2014$)			
	2021		2031	
	BASE	OPTION	BASE	OPTION
Annual Modelled Network Cost	$1,819,456,913	$1,806,000,863	$2,307,664,562	$2,273,219,793
Annual Operating Benefit	$13,456,050		$34,444,769	

4.0 CRASH BENEFIT ANALYSIS

Crash benefit analysis was undertaken using data for the corridor that was recorded for the 5 year time period between 2007 and 2011.

4.1 Claimable crashes

"Claimable crashes" for the purposes of BCA are those with particular DCA codes, which are shown to be reducible by engineering solutions. This differs between intersections, depending on the recorded crash history and proposed intersection treatments.

4.2 Treatments

All proposed treatments for each intersection were selected from a researched and documented list of treatments. Reduction factors and service life were sourced from a Treatment Reduction Matrix from DTMR's Treatment Reduction Matrix for the Federal Blackspot Program.

4.3 Total crash benefits

The NPV for each intersection was calculated using the 6% treasury discount rate and the result is summarised in **Table 2**. The assessment methodology for the life of the proposed upgrade assumes a 15 year design life for crash reductions. This is based on the research that feeds the DTMR Treatment Reduction Matrix.

Table 2 - Project Crash Treatment Benefit NPV

Location	Project Crash Treatment Benefit NPV (2014$)
	6% Treasury Discount Rate
Project Corridor	**$12,825,738**

5.0 BENEFIT COST ANALYSIS

5.1 Total project benefits

Table 3 summarises the estimated project benefit NPV after combining the crash treatment benefit and operational benefit.

Table 3 - Project Total Benefit NPV

Design Horizon	Project Total Benefit NPV (2014$)
	6% Treasury Discount Rate
Total Benefits 2021 to 2051	**$539,185,520**

5.2 Total estimated project cost

CPO has prepared a project cost estimate for the project. The estimate includes construction costs, service relocations, internal Council costs and land acquisitions.

Total project cost estimate at October 2014 = $115,000,000

5.3 Benefit cost ratio

The project BCR (total benefit/total cost) summary is presented in Table 4 below.

Table 4 - Project BCR Summary

Design Horizon	Project Benefit-Cost Ratio
	6% Treasury Discount Rate
BCR (2021 to 2051)	4.69

6.0 SUMMARY

Stage 1 – 6 lane upgrade of Lytton Road (between Latrobe St and Laidlaw Pde) has been assessed for its road network and environmental benefits (undertaken in SATURN) and for its crash reduction benefits (undertaken adopting the Blackspot methodology).

The assessments have allowed quantifiable benefits of the option to be determined. The project results in a BCR of 4.69 for a 30 year project life, which is presented in Table 5 below.

Table 5 - Benefit/Cost Analysis Summary

Benefit/Cost Analysis	6% Discount Rate (2014$)
Sum of Annual Vehicle Operating Benefits (2021 – 2051)	$526,359,782
Sum of corridor's Crash Benefits	$12,825,738
TOTAL BENEFITS (2021 – 2051)	$539,185,520
TOTAL Project Costs	$115,000,000
BCR (2021 – 2051)	**4.69**

6.1 Other Benefits

The AUSTROADS Benefit Cost Manual outlines other benefits along the lines of "Developmental Benefits" and "Secondary Benefits".

6.1.1 Developmental Benefits

Developmental benefits may arise when an improvement to the road network stimulates or facilitates the realisation of economic opportunity which could not be realised in its absence.

The proposed Lytton Road (Stage 1 – 6 lane) upgrade provides an improved access between the eastern suburbs and the CBD and northern suburbs of Brisbane via the Story Bridge. This area is largely covered by suburbs of East Brisbane, Norman Park and Morningside. Completing the upgraded corridor will assist in the development of this area and help to realise the full potential of the earlier stages of the upgraded corridor which are difficult to quantify.

6.1.2 Secondary Benefits

Secondary benefits are benefits to road users or their customers not measured in the normal vehicle operating, time, and accident costs.

Additional secondary benefits will be achieved for pedestrians and cyclists with improved facilities included in the project for pedestrian and cyclist movement. Provision of facilities to encourage walking and cycling will lead to further benefits associated with reducing car based trips with the most notable being the achievement of further reductions in vehicle emissions. These benefits are too difficult to quantify but have been mentioned to highlight that the project is likely to achieve further unquantifiable benefits to the community.