BUILDING QUEENSLAND

BRUCE HIGHWAY – CAIRNS SOUTHERN ACCESS CORRIDOR – STAGE 4 – KATE STREET TO AUMULLER STREET DETAILED BUSINESS CASE 2017

COST BENEFIT ANALYSIS SUMMARY

D18/2444

Purpose of this document	This document provides an overview of the economic analysis for the Bruce Highway—Cairns Southern Access Corridor Stage 4—Kate Street to Aumuller Street Detailed Business Case. The primary objective of this document is to outline the economic analysis and the key outcomes.
Status	This summary was prepared based on the contents of the Detailed Business case presented to the Building Queensland Board in Q3 2017. The information presented may be subject to change as the proposal progresses through future stages of development, delivery and operation.

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1 Summary information[1]

Project name	Bruce Highway—Cairns Southern Access Corridor Stage 4—Kate Street to Aumuller Street	
Proposal owner	Department of Transport and Main Roads	
Proposed delivery agency	Department of Transport and Main Roads	
	P50	**P90**
Capital cost of proposal[2]	$97 million	$104 million
Incremental ongoing costs of proposal[3]	$1.4 million	$1.4 million
Discount rate	7%	
Economic net present value (NPV)	$103 million	$96 million
Benefit cost ratio (BCR)	2.4	2.2

[1] Rounding is used throughout this document in tables and reporting.
[2] Capital cost estimates are nominal, undiscounted 2017 dollars.
[3] Incremental ongoing cost estimates are presented for the 30 years following construction period of the infrastructure initiative.

2 Proposal overview

The Bruce Highway—Cairns Southern Access Corridor Stage 4—Kate Street to Aumuller Street (K2A) project seeks to address traffic congestion by adding capacity and optimising corridor traffic efficiency. The project scope includes the upgrade of 2.4 kilometres of the Bruce Highway between Kate Street and Aumuller Street, extending to Fearnley Street. The project includes new lanes for vehicular traffic, signalisation of key intersections, and new bridge construction.

3 Approach

A cost benefit analysis was undertaken to assess the economic viability of the K2A project as part of the detailed business case. The cost benefit analysis has been based on guidance from the Building Queensland Cost Benefit Analysis Guide: Supplementary Guidance Release 2 December 2016, and conforms to the following sector guidelines:

- Australian Transport Assessment and Planning (ATAP) Framework (2016)
- Austroads' Guide to Road Safety Part 8 (2015)
- Austroads' Guide to Project Evaluation Part 4 (2012)
- DTMR's Cost-Benefit Analysis Manual, Road Projects (2011).

Economic viability is measured on the magnitude of benefits, including road user and impacts on the wider community, compared to investment costs borne by the road operator. The net project impacts are measured by comparing (societal) project benefits to capital investment and operational expenditures.

4 Methodology

In conducting the cost benefit analysis for the K2A project, the following steps were undertaken:

- comparison between the defined base case and project case
- estimation of project impacts, using micro-simulation modelling to develop estimate vehicle fleet delay times, average speeds, vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT)
- application of parameter values to estimate key project impacts, including:
  - travel time savings
  - vehicle operating costs
  - externalities.
- comparison between actual vehicle crashes, and expected crash reductions in the project case
- comparison of project benefits with cost estimates
- calculation of key economic indicators
- sensitivity testing of results.

4.1 Analytical parameters

Key analytical parameters underpinning the cost benefit analysis are outlined in Table 1.

Table 1 Key analytical parameters

PARAMETER	VALUE	SOURCE
Discount rate	7%, with sensitivities for 4% and 10%	Building Queensland, Infrastructure Australia, Department of Transport and Main Roads
Price year	2017	Jacobs
Capital investment period	2017–2021	Jacobs
Evaluation period	30 years post construction	Australian Transport Assessment and Planning (ATAP), Jacobs
Indexation	Components of unit cost are indexed by the Consumer Price Index and Producer Price Index	ATAP, Austroads, Jacobs
Unit costs and parameter values	These include values of occupant time, freight time, fuel, maintenance, injuries, fatalities, air pollution etc.	ATAP, Austroads, Jacobs

Vehicle operating costs for each vehicle type are re-calculated annually to reflect the changing average speeds over the evaluation period, with a stop-start model adopted reflective of average speeds being under 60 km/h. The economic benefit of the crash savings uses the crash cost unit rates from the ATAP guidelines, indexed to current prices. Expected crash reductions have been informed by use of a treatment/crash reduction matrix.

4.2 Inputs and outputs

Key inputs to the cost benefit analysis include:

- transport report (traffic modelling)
- cost estimate report.

The Cairns Strategic Transport Model (CSTM) was used for traffic demand estimation and forecasting for input into detailed microsimulation modelling using Advanced Interactive Microscopic Simulator for Urban and Non-urban Networks (AIMSUN). Generated outputs of the traffic modelling included vehicle kilometres hours (VKT), vehicle hours travelled (VHT), and average vehicle speeds. These outputs were used as inputs into the economic modelling to calculate estimated project benefits. Benefits were estimated and calculated in incremental terms (i.e. comparing the difference between the base and project cases).

4.3 Benefits and costs

The costs and benefits considered in the analysis are outlined in Table 2.

Table 2 Costs and benefits

COSTS	BENEFITS
▪ Capital cost ▪ Whole-of-life cost ▪ Externalities	▪ Travel time savings (private) ▪ Travel time savings (commercial) ▪ Vehicle operating costs (VOC) savings ▪ Enhanced safety (reduced crashes)

Key project benefits are expected to accrue from:

- increases in mean speeds during the AM and PM peak periods, resulting in improved travel times
- increased capacity through addition of new lanes
- reductions in crash costs.

Following the application of parameter values to calculate benefits and account for real increases, the benefit and cost streams were discounted to present day values to calculate key economic indicators, including net present value (NPV), benefit cost ratio (BCR), internal rate of return (IRR) and first year rate of return (FYRR).

The costs incorporated in the cost benefit analysis are based on the capital and ongoing maintenance costs generated from the cost estimation report. Adjustments have been made to these costs for inclusion of real cost changes only.

The developed transport model analysed current and forecast performances of the vehicle types expected to use the project. Transport performance indicators included vehicle hours travelled (VHT) and vehicle kilometres travelled (VKT) metrics, as well as travel times in the base and project cases. The benefit streams outlined in Table 2 have been calculated by analysing the modelled performance metrics and applying conversion factors (such as the ATAP travel time unit cost) to monetise the identified benefits.

5 Base case

The base case describes the existing network arrangements, and the expected scenario in the future should the project not proceed and is reflective of expected levels of service. The Bruce Highway is six lanes wide west of and through the Kate Street signalised intersection, narrowing to four lanes over Chinaman Creek. East of Chinaman Creek the corridor has a four-lane cross section and operates as an urban arterial road with local widening at intersections. The base case includes existing network arrangements and additional works on state-controlled roads, including:

- upgrade to signalisation of Draper Street/Kenny Street roundabout and approaches
- minor capacity upgrades to Comport Street/Draper Street signalised intersection and approaches.

The conducted traffic modelling is suggestive of Kate Street, Lyons Street and Aumuller Street intersections all exceeding capacity in the morning peak by 2033. Inbound traffic would form a constant queue on the Bruce Highway from the Mulgrave Road diverge to the Buchan Street intersection.

In the 2033 evening peak, Lyons Street, Aumuller Street, Draper Street and Kenny Street intersections would all exceed capacity, with a constant queue of outbound traffic forming a queue from Lyons Street to Fearnley Street and from Draper to Sheridan Street. The extent of queueing would affect wider network operations across the peak period. Modelling is reflective of delivery of the Earlville Bypass in the base case in 2033.

6 Reference project

The reference project includes the upgrade of 2.4 kilometres (including transitions) of the Bruce Highway between Kate Street and Aumuller Street, extending to Fearnley Street.

The project scope includes:

- construction of the Bruce Highway to a six-lane configuration comprising a new three-lane inbound carriageway and widening of the outbound carriageway to three lanes
- signalised intersection upgrades at Lyon Street, Aumuller Street and Buchan Street intersections

- construction of a new concrete bridge over Chinaman Creek for the inbound carriageway
- widening of the existing concrete bridge over Chinaman Creek on the existing outbound carriageway
- demolition of the existing bridge over Chinaman Creek and existing inbound carriageway between Kate and Lyons Street.

7 Demand forecasts

Traffic modelling was conducted for the corridor, with and without the project, for the morning and afternoon three-hour peak periods for the following scenarios:

- 2016 (existing)
- 2033 prior to the opening of the Earlville Bypass
- 2033 post opening of the Earlville Bypass
- 2036 (representing the 20-year design horizon for Department of Transport and Main Roads).

The modelling of intersection performance incorporated refinement of layouts, including storage lane lengths and rationalisation of lane movements to respond to physical constraints on the corridor footprint. The model outputs have been interpolated and extrapolated over the evaluation period to inform the quantification of economic benefits. Economic benefits beyond the last modelled year are flatlined.

8 Project costs

Table 3 provides the capital investment profile for the cost benefit analysis.

Table 3 Capital expenditure ($m)[4]

COST ESTIMATES	2017	2018	2019	2020	2021
P50	$4.55	$15.44	$27.29	$37.52	$0.12
P90	$5.97	$17.40	$28.31	$39.11	$0.16

Operational expenditure estimates have been derived from historical maintenance costs provided by Department of Transport and Main Roads. An average square metre rate has been applied for all maintenance and applied to the base and project cases. Table 4 provides the operational expenditure profile used in the cost benefit analysis, with a square meterage cost of $1.33/m^2 applied.

Table 4 Operational expenditure ($m)

P50 ESTIMATE COSTS	SQUARE METRES	ANNUAL EXPENDITURE
Base case	75,804	$0.10
Project case	95,650	$0.13

[4] Additionally, a small residual value for the bridge asset has been calculated using straight-line depreciation and asset life of 100 years.

9 Project benefits

Expected project benefits include:

- reduced congestion from increased capacity
- enhanced levels of service, leading to decreased travel times along the corridor
- more efficient operation of intersections, due to reductions in congestion and optimised signalisation
- reduced crashes.

9.1 Monetisable benefits

Estimated project benefits were monetised using the estimated demand and accepted parameter values from ATAP and Austroads guidance materials and inflated to present day values using consumer price indexing. Table 5 provides a summary of benefits in the estimation of the cost benefit analysis.

Table 5 Cost benefit analysis benefits estimation

TRAVEL COST	COMPONENTS OF UNIT COST	METHOD OF ESTIMATION
Travel time costs	▪ Value of occupant time ▪ Value of freight time	Travel time unit cost × VHT
Vehicle operating costs (VOCs)	▪ Fuel and oil ▪ Tyre wear ▪ Repair and maintenance ▪ Depreciation and interest	VOC unit cost × VKT
Crash costs	▪ Fatality ▪ Serious Injury ▪ Slight injury ▪ Property damage only	Crash rate per VKT × Average Crash Cost × VKT
Externalities	▪ Air pollution ▪ Greenhouse gas emissions ▪ Noise ▪ Water ▪ Nature and landscape ▪ Upstream and downstream costs	Externalities unit cost × VKT

9.2 Non-monetisable benefits

The social impact evaluation identified five non-monetisable impacts that did not form the basis of quantified benefits for the economic analysis. Of these, one was assessed in the social impact evaluation as a material and positive social impact. This impact was access to services and facilities. The upgrade will increase reliable access to services and facilities. It was also recommended that clear signage should be provided on completion to ensure navigability for Cairns locals and visitors.

10 Cost benefit analysis results

A 30-year evaluation period of benefit streams, against construction and operating costs was analysed. Costs and monetised benefits were discounted to present value terms using a real discount rate of seven per cent for the central case. The cost benefit analysis results are presented in Table 6. All costs and benefits are presented in $2017 (real).

Table 6 Cost benefit analysis results

COST BENEFIT ANALYSIS RESULTS (P50)			
DISCOUNT RATE	4%	7%	10%
PROJECT COSTS			
Capital investment costs	-$ 78.08 m	-$ 73.53 m	-$ 69.41 m
Residual	$ 2.00 m	$ 0.78 m	$ 0.31 m
Net operational costs	-$ 0.41 m	-$ 0.27 m	-$ 0.19 m
Total Costs	**-$ 76.49 m**	**-$ 73.02 m**	**-$ 69.29 m**
PROJECT BENEFITS			
Passenger travel time	$ 169.79 m	$ 114.02 m	$ 80.61 m
Freight travel time	$ 8.22 m	$ 5.31 m	$ 3.65 m
Vehicle operating costs (VOC)	$ 74.73 m	$ 49.99 m	$ 35.25 m
Safety (crash)	$ 10.46 m	$ 6.71 m	$ 4.59 m
Externalities	-$ 0.04 m	-$ 0.04 m	-$ 0.03 m
Total Benefits	**$ 263.16 m**	**$ 175.99 m**	**$ 124.07 m**
Net present value (NPV)	**$ 186.67 m**	**$ 102.97 m**	**$ 54.78 m**
Benefit cost ratio	3.4	2.4	1.8
IRR	17.5%	17.5%	17.5%
FYRR	13.8%	12.9%	12.2%

Headline economic indicators show P50 results as a net present value of $103 million, and benefit cost ratio of 2.4, at a discount rate of seven per cent. P90 results are a net present value of $96 million, and benefit cost ratio of 2.2, at a discount rate of seven per cent.

11 Sensitivity analysis

Table 7 presents the results of the sensitivity testing, using simple changes to key project parameters, with a discount rate of seven per cent applied; results are most sensitive to a change in capital expenditure and passenger travel time savings.

Table 7 Sensitivity analysis[5] (@ 7% discount rate)

TEST	NPV ($M)	BCR
Net operating expenditure increase	102.2	2.4
Net operating expenditure decrease	102.2	2.4
Travel time benefits increase	114.1	2.6
Travel time benefits decrease	90.3	2.2

[5] All sensitivity tests were conducted using simple variances of +/- 10%.

TEST	NPV ($M)	BCR
VOC benefits increase	107.2	2.5
VOC benefits decrease	97.2	2.3
Safety benefits increase	102.9	2.4
Safety benefits decrease	101.5	2.4

12 Other considerations

12.1 Wider economic impact assessment

It is estimated that the K2A project will support an average of 80 full-time equivalent jobs over the three-year construction period, with 102 full-time equivalent jobs at the peak. Productivity benefits in the form of freight travel time savings have been calculated at $5.31 million.

12.2 Independent economic peer review

An independent peer review of the cost benefit analysis was undertaken to confirm the veracity of results, application of correct industry standards, source documentation, internal consistency, and confirmation of the methodology underpinning the calculation of project benefits. Further, the peer review sought to assure that key inputs were correct and appropriately incorporated into the economic modelling, assure the soundness of the adopted methodology, adequacy and consistency of documentation, scope and depth of analysis, treatment of key risks and uncertainties, assumptions and results.