BUILDING QUEENSLAND

BRUCE HIGHWAY—DECEPTION BAY ROAD INTERCHANGE UPGRADE PROJECT DETAILED BUSINESS CASE 2018

BUSINESS CASE/COST BENEFIT ANALYSIS SUMMARY

Purpose of this document	This document provides an overview of the Bruce Highway—Deception Bay Road Interchange Upgrade Project. The primary objective of this document is to outline the economic analysis undertaken 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 July 2018. The information presented may be subject to change as the proposal progresses through future stages of development, delivery and operations.

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1 SUMMARY INFORMATION

Project name	Bruce Highway—Deception Bay Road Interchange Upgrade Project	
Location	South East Queensland	
Proposal owner	Queensland Department of Transport and Main Roads	
Proposed delivery agency	Queensland Department of Transport and Main Roads	
P90 cost estimates	Nominal[1]	Present value[2]
Capital cost	$152 million	$115 million
Incremental ongoing cost	$26 million	$1 million
Net present value		$234 million
Benefit cost ratio		3.0

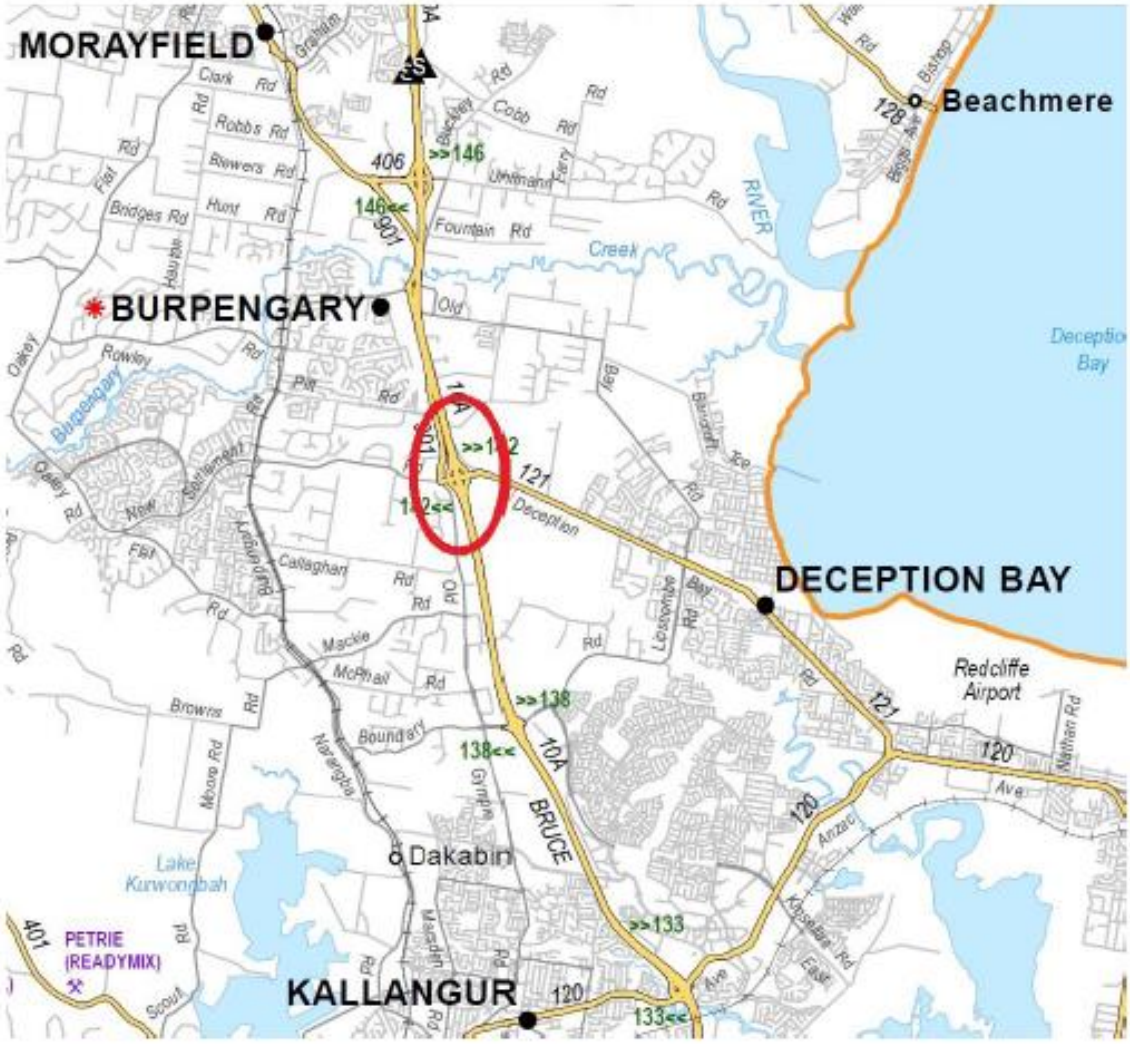
[1] Financial.
[2] Discounted at 7 per cent.

2 Proposal overview

The Bruce Highway is a national highway serving as the major north-south transport route between Brisbane and Cairns. The Bruce Highway's primary function is to safely and efficiently cater for major regional and inter-regional traffic (both freight and general traffic). The Queensland Government is progressively upgrading the highway and its interchanges and intersections to meet Australian standards. The Bruce Highway Action Plan (BHAP), developed in 2012, is guiding this work. This engineering-based plan was developed to address critical safety, flood immunity and capacity issues through a suite of projects over a 10-year period. BHAP nominated the upgrading of interchanges between the Pine River and Caloundra Road as a high priority, with intervention required by 2020 to meet forecast service demand.

The Deception Bay Road Interchange is approximately 13.5 kilometres north of the Pine River on Brisbane's outskirts, and is critical to maintaining the Bruce Highway as an important inter-state, regional and local link, supporting efficient national road user movements as well as local travel requirements. Upgrading the highway from the Pine River to Caloundra, where the Deception Bay Road interchange is a critical component, was identified as a key project to 'fix the Bruce' with a delivery timeframe by 2017–2019.

Figure 1. Bruce Highway—Deception Bay Road Interchange Upgrade study area



3 Service need

Sustained population and economic growth in Brisbane, and the Moreton Bay and Sunshine Coast regions to the north is constrained by the capacity of this section of the highway. Congestion is increasing on both the highway and at key junctions such as the Deception Bay Road interchange, thus reducing the highway's safety and efficiency.

Road users currently experience major delays at the Deception Bay Road interchange during peak hours, with congestion frequently resulting in unacceptable levels of service at the ramp terminal intersections, highway overbridge and nearby state arterial road intersections on Deception Bay Road. Forecast urban expansion and increasing road freight are expected to generate traffic volumes that exceed the capacity of the existing 'diamond' interchange, resulting in severe congestion and increased crash risk.

4 Options assessment

The preliminary evaluation investigated better use of existing assets (upgrading or modifying the existing road network along the corridor). New infrastructure options identified were further refined, with the intention of utilising a combination of upgrades to existing infrastructure and the addition of new infrastructure to better meet service requirements identified in the strategic assessment of service requirement.

The service requirements identified in the strategic assessment and preliminary evaluation were reconfirmed in the detailed business case, including meeting safety and network efficiency/congestion requirements. Options selection was carried out using detailed mesoscopic traffic modelling and analysis with the project model (covering the Deception Bay Road interchange and immediately adjacent intersections), which was developed from the 2031 Moreton Bay Regional Council Visum mesoscopic model.

After completing this analysis, a number of options were shortlisted for the next phase of geometric design refinement. The options selected for further investigation were considered as part of a multi-criteria analysis workshop.

5 Base case

The base case is the benchmark against which the reference project[3] is assessed. The base case was modelled on a whole-of-life basis and includes all expected impacts, costs and benefits of the situation that would exist without the project.

Modelling for the base case assumes the Deception Bay Road interchange retains its existing configuration (diamond interchange) with future improvements limited to traffic signal re-timing. Upgrades to surrounding roads however were factored into traffic models. Traffic volumes are anticipated to grow from historical levels of 2 to 3 per cent per annum to 5.2 per cent (morning peak) and 3.8 per cent (afternoon peak) to 2021, returning to approximately 3 per cent thereafter.

Modelling indicates the base case would have inadequate capacity to cope with forecast traffic flows, exacerbating congestion and heightening safety risks for traffic on the highway and local connector roads. Insufficient lanes across the overpass and limited turning capacity at ramp terminals are already causing intersection delays. Operational quality on ramps and intersections, which generally operate at LOS D/F and

[3] In the context of an economic analysis, a reference project represents an indicative investment proposal which addresses the identified service need. While the reference project may be subject to change during the detailed design process, it provides a reference point to assess the potential costs and benefits of the infrastructure proposal.

E/F, could be expected to progressively deteriorate. Base case modelling shows more movements will operate at LOS F for all future years, with 17 movements at LOS F by 2021, 24 movements at LOS F by 2026 and 29 movements at LOS F by 2031.

Queue lengths will also exceed the maximum available distance for numerous intersection approaches between 2021 and 2031. Traffic already queues back down exit ramps onto the highway during peak hours, affecting its efficiency and safety.

6 Reference project

The reference project for the Deception Bay Road Interchange Upgrade includes:

- upgrading the existing Deception Bay Road interchange including two, new parallel overbridges at the Bruce Highway and removing the existing two-lane bridge
- upgrading two signalised intersections on Deception Bay Road immediately west of the interchange at Old Gympie Road and immediately east of the interchange at Eastern Service Road
- increasing the length and capacity of existing entry and exit ramps
- removing the existing signalised intersection between the existing exit ramps and Deception Bay Road
- constructing a new segregated off-road pedestrian and cycle facility to safely cross the Bruce Highway.

The reference project will result in significantly reduced travel times for traffic crossing, accessing and exiting the Bruce Highway. Crash rates are expected to be 42 per cent lower than without the reference project. While the reference project will not improve the Bruce Highway's flood immunity directly, the reference design will not have a worsening impact on afflux now or when the mainline is upgraded in the future.

7 Economic methodology

A cost benefit analysis was undertaken to establish the economic case for the project. The economic appraisal of transport infrastructure estimates the economic benefits and costs of the project, in comparison to a base case scenario. This provides a quantifiable net economic impact, which can be used to inform the decision-making processes.

The benefits and costs of the project have been estimated, with the key benefits of the project expected to accrue from:

- increased capacity of the network, resulting in improved average travel speeds and travel times
- reduction in vehicle operating costs
- reduction in crash costs.

The cost benefit analysis was completed using the assumptions shown in Table .

Table 1 Key assumptions and parameters adopted for use in the economic appraisal

PARAMETER	VALUE	SOURCE
Discount rate	A 7% real discount rate is used for the central case with sensitivity tests conducted at 4% and 10%.	Infrastructure Australia Assessment Framework (2018)
Price year	2018	Cost estimate
Appraisal period	30 years from first full year of measured benefits (2023).	ATAP (Category 4, section 2.4)
Temporal treatment of benefits and costs	Demand model outputs have been provided for 2023, 2026 and 2031. Linear interpolation has been undertaken to estimate benefits between these years, while benefits have been held constant at 2031 levels for the remainder of the appraisal period.	TMR Traffic modelling and KPMG Economic Appraisal
Indexation	Unit costs and parameter value indexed to the price year by the Consumer Price Index (CPI) (including sub-categories as appropriate), Average Weekly Earnings (AWE) and Producer Price Index (PPI).	Australian Bureau of Statistics
Annualisation	258 days	TMR traffic modelling report and analysis of permanent traffic count data

The transport demand modelling is a significant input into the cost benefit analysis framework. Key traffic characteristics are forecast for both 'with' and 'without' project cases. These forecasts are used to determine the economic benefit of the project.

8 Demand forecasts

Detailed traffic modelling was undertaken to assess demand over the road network under the base and project case scenarios to inform the economic appraisal.

The project followed a three-tiered process:

- Tier 1: Regional multi-modal strategic travel forecasting model—estimates or forecasts travel demand characteristics (trip generation, trip distribution, mode of travel, time of day and route assignment) based on land use planning or demographic data and transport network assumptions.
- Tier 2: Regional mesoscopic/detailed assignment model—contains detailed representation of intersections and provides more accurate representation of route choice compared to the Tier 1 models.
- Tier 3: Microsimulation model—detailed traffic simulation of complex interactions between vehicles and can evaluate network dynamics, queues blocking back, merging, weaving, detailed travel times and interactions between vehicles, traffic control process and network geometry.

Traffic modelling undertaken for the project predicts that traffic volumes in the project area (interchange and highway) will increase annually by approximately 5.2 per cent in the morning peak and 3.8 per cent in the afternoon peak between 2013 and 2021. Thereafter, growth is expected to continue at a rate of approximately three per cent per annum to 2031.

The detailed traffic modelling outputs identify that while total demand is the same for both scenarios, under the base case, some of this demand is unable to enter the network during the modelled period (latent demand). The delivery of the project enables these unassigned vehicles to enter the network under the project case, which results in the network statistics for the project case capturing the additional Vehicle Hours Travelled (VHT) and Vehicle Kilometres Travelled (VKT) associated with these vehicles. In order to

enable an appropriate comparison of the relative economic benefits of this project, the network statistics for the project case have been adjusted to exclude the VHT and VKT of the unassigned trips in the base case.

9 Cost benefit analysis results

The results of the cost benefit analysis indicate the reference project is economically viable at the seven per cent discount rate, with a benefit cost ratio of 3.03 and a net present value of $233.95 million. Savings in travel times account for the majority (67.3 per cent) of the reference project benefits, with most of these accruing to light vehicles. Vehicle operating cost savings account for a further 24.6 per cent of total benefits. The remainder of the benefits accrue to crash benefits (7.7 per cent) and residual value (0.6 per cent), with a marginal environmental externality dis-benefit of 0.1 per cent.[4]

Productivity benefits of $187.79 million (present value, seven per cent) are anticipated due to travel time and vehicle operating cost savings for light vehicles used for business purposes and freight movements.

The summary results of the reference case for a P90 level of risk are presented in Table 2.

Table 2 Cost benefit analysis results

COST BENEFIT ANALYSIS RESULTS (P90)	TOTAL, $ MILLION	PRESENT VALUE (7%), $ MILLION
Project costs		
Capital expenditure	142.21	115.25
Maintenance and rehabilitation (incremental to base case)	3.38	0.88
TOTAL	**145.59**	**116.13**
Project benefits		
Value of time	811.58	235.55
Light vehicles—private	341.19	99.05
Light vehicles—business	431.06	125.15
Heavy vehicles	39.33	11.35
Vehicle operating costs	301.60	85.99
Light vehicles—private	120.55	34.70
Light vehicles—business	89.88	25.86
Heavy vehicles	91.17	25.43
Externalities	-1.07	-0.45
Crash	88.58	26.95
Residual value	20.34	2.04
TOTAL	**1,221.03**	**350.08**

[4] Externalities are calculated from the application of parameter values to vehicle kilometres travelled (VKT) applied to demand forecasts over the evaluation period. These externalities may be negative, for example where there is a net incremental reduction in modelled network VKT.

COST BENEFIT ANALYSIS RESULTS (P90)	TOTAL, $ MILLION	PRESENT VALUE (7%), $ MILLION
Net present value		233.95
Benefit cost ratio		3.03
Internal rate of return		18.7%
First year rate of return		9.7%
Productivity benefits		187.79

10 Sensitivity analysis

Sensitivity analysis indicates that the overall investment proposition provided by the reference project remains strong even where a number of assumptions underpinning the assessment differ from the central case. The sensitivity analysis for the project is summarised in Table 3.

Table 3 Sensitivity analysis results

SENSITIVITY TEST	BCR	NET PRESENT VALUE, $MILLION
Reference case	3.03	233.95
Costs at P50	3.23	241.25
Discount rate four per cent	4.52	443.07
Discount rate 10 per cent	2.15	121.67
Capital cost +20 per cent	2.52	210.73
Capital cost -20 per cent	3.79	257.18
Total benefits +20 per cent	3.64	303.97
Total benefits -20 per cent	2.42	163.94
Reduced share of business travel assumption	2.87	215.74
Sensitivity test—Bruce Highway Upgrade	4.95	454.85
Benefits -20 per cent, Costs +20 per cent	2.00	140.71
Annualisation factor—300 days	3.48	286.23
Annualisation factor—220 days	2.62	186.66
Crash reduction factor sensitivity	2.94	223.31

11 Wider economic impacts

Excluding risk (P90) and contingency, the project is expected to support approximately 141 full-time equivalent (FTE) jobs. Productivity benefits of $188 million accrue from travel time and vehicle operating cost savings for light vehicle use for business purposes and heavy vehicle/freight movements.

12 Social impacts

The reference project is expected to deliver three material positive social impacts and no material negative social impacts. The three material positive social benefits are as follows:

- **Employment:** Constructing the reference project will generate direct employment opportunities and indirect benefits through the employment of those providing goods and services as inputs during construction.
- **Heavy vehicle productivity:** By reducing freight travel times, the reference project will cut transport costs and improve vehicle utilisation, benefiting both freight operators and producers that use their services.
- **Safety:** The reference project will significantly improve motorist safety on the highway and through the interchange, reducing the frequency and severity of accidents.

13 Project implementation

The procurement options analysis assessed the following forms of delivery contract:

- Transport infrastructure contract—construct only (TIC–CO)
- Design and construct (D&C), including with early contractor involvement (ECI)
- Competitive alliance (CA) contracting.

The TIC–CO is the recommended delivery model for the reference project.