

SMITHFIELD TRANSPORT CORRIDOR UPGRADE PROJECT
COST BENEFIT ANALYSIS SUMMARY



Purpose of this document	This document provides an overview of the economic analysis for the Smithfield Transport Corridor Upgrade Detailed Business Case 2017. 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 Q2 2017. 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	Smithfield Transport Corridor Upgrade Project (STCU project)	
Location	The 3.8-kilometre section of the Captain Cook Highway between Yorkeys Knob Road and McGregor Road to the north west of Cairns.	
Proposal owner	Department of Transport and Main Roads	
Proposed delivery agency	Department of Transport and Main Roads	
Capital cost ¹ (P90)	\$152 million (nominal)	\$136.5 million (real)
Incremental ongoing cost ² (P90)	\$104 million (nominal)	\$60 million (real)
Discount rate	7%	
Net present value (NPV)	\$185 million (P50 costs)	\$174 million (P90 costs)
Benefit cost ratio (BCR)	2.9 (P50)	2.6 (P90)

¹ Nominal capital cost estimates are undiscounted 2016 dollars and have been rounded to the nearest million.

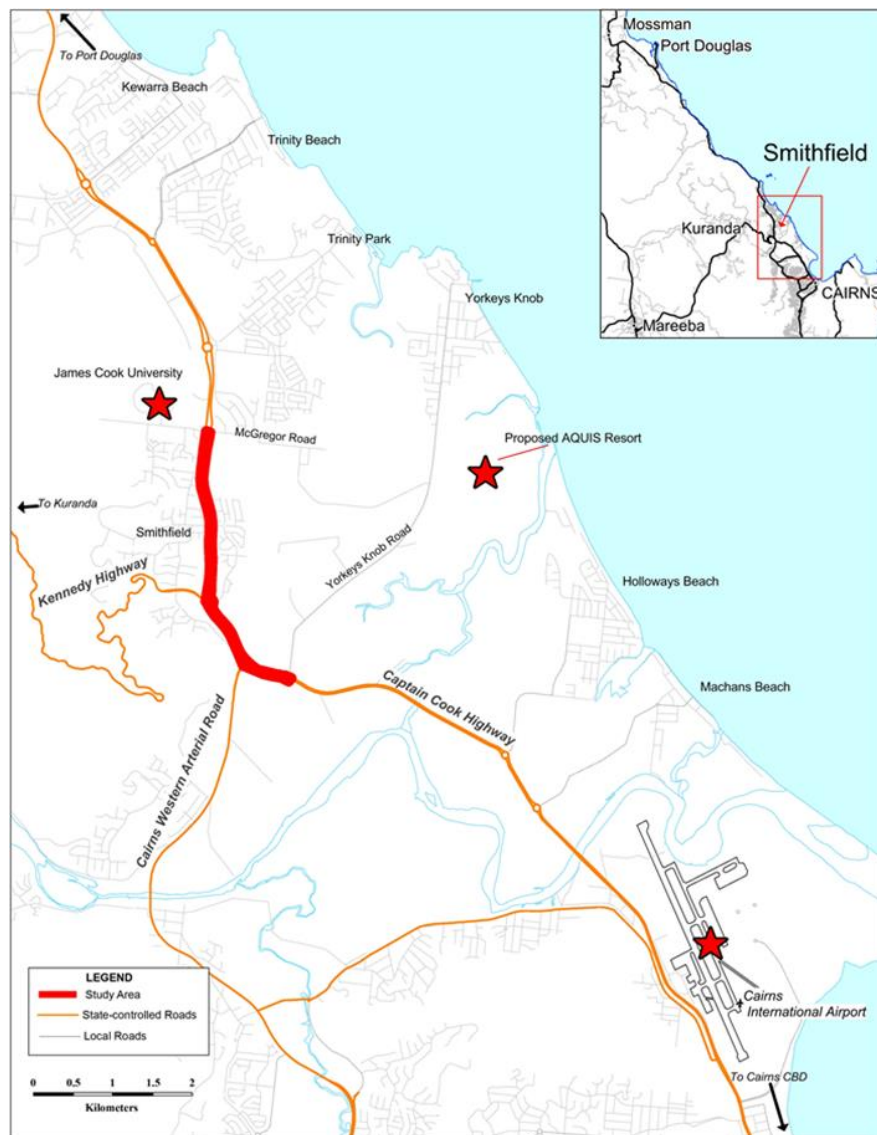
² Incremental ongoing cost estimates have been rounded to the nearest million and presented for the 30 years following construction period of the infrastructure initiative (assumed 2021–2050).



2 Proposal overview

The Smithfield Transport Corridor is a 3.8-kilometre section of the Captain Cook Highway that forms a crucial link in the road network between Cairns and all points north—Cape York, Port Douglas, Kuranda, Mareeba and the Atherton Tableland (see Figure 1).

Figure 1 STCU project location



With the state’s bulk rail freight network terminating in Cairns, the Captain Cook Highway carries virtually all freight bound for northern communities, as well as playing a key role in the tourism industry. Decades of sustained population growth have created a traffic bottleneck, with the transport corridor reaching peak capacity. Safety has become a primary concern, with congestion contributing to crash rates three to six times higher than the Queensland average. As the corridor has become increasingly congested, travel speeds are slowing and journeys are taking longer.

Forecast population growth in the area and increasing industry diversification and urban expansion are forecast to generate traffic growth beyond the reliable capacity of existing infrastructure.



3 Approach

In conducting the benefit cost analysis for the STCU 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, 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 reduction in the project case
- comparison of project benefits with cost estimates
- calculation of key economic indicators
- sensitivity testing of results

Key inputs to the cost benefit analysis include:

- traffic modelling report
- crash benefit analysis
- cost plan report of capital and expected ongoing cost estimates.

4 Base case

The base case is the benchmark against which the reference project³ 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. Network details of the base case (summary in Table 1) include:

- the 3.8 kilometre section of the Captain Cook Highway between Yorkeys Knob Road and McGregor Road with the existing network arrangements plus planned upgrades of:
 - Yorkeys Knob Road roundabout with a left slip lane for southbound traffic
 - Cairns Western Arterial Road roundabout upgraded to a signalised double right turn for southbound Captain Cook Highway vehicles turning onto the Cairns Western Arterial Road
 - Kennedy Highway roundabout upgraded to have metering on both legs of the Captain Cook Highway.
- Stanton Road and McGregor Road intersections will remain in the existing arrangements
- the proposed two-lane two-way collector road between Stanton Road and McGregor Road will be completed

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.



- the section will continue to be the main access to Cairns CBD for areas around Smithfield, the Northern beaches and areas further to the north and west of Cairns including Cape York, Port Douglas, Kuranda, Mareeba and the Atherton Tableland
- costs to maintain the existing level of service including yearly costs of \$242,200 for routine maintenance, \$7,423,500 for periodic maintenance every five year and \$1,920,000 for roundabout resurfacing every three years.

Table 1 Key cost benefit analysis parameters

INTERSECTION LOCATION	EXISTING ROAD NETWORK (2013)	BASE CASE (2021-2036)
Yorkeys Knob Road	Roundabout	Roundabout with left slip lane
Cairns West Arterial Road	Roundabout, right turn metered during PM peak	Roundabout, upgraded to double right turns. Right turn and northbound approach metered at all times.
Kennedy Highway roundabout	Roundabout, metered during AM peak	Fully signalised roundabout
Stanton Road	Signalised, four-way intersection	Signalised, four-way intersection
McGregor Road	Roundabout	Roundabout
HIGHWAY SECTION	EXISTING ROAD NETWORK (2013)	BASE CASE (2021-2036)
Captain Cook Highway (Yorkeys Knob Road to McGregor Road)	Four-lane dual carriageway	Four-lane dual carriageway

Population in Cairns' northern suburbs is forecast to increase from the 2014 estimate of 52,061 to more than 76,000 by 2036. Base Case modelling indicates forecast increase in traffic from 45,000vpd in 2015 to 64,000vpd in 2036. The proposed Aquis Great Barrier Reef Resort development is excluded from the base case and reference project.

Peak hour periods for the key intersections on the Captain Cook Highway were identified as: 7.30 am–8.30 am and 4.30 pm–5.30 pm with a secondary peak associated with the afternoon school pick-up.

Current network performance included excessive queuing and delays during both AM and PM peak periods. Average travel time between the Kennedy Highway roundabout and Yorkeys Knob Road roundabout is 9 minutes in the AM peak, 5 minutes 30 seconds in the PM peak and 4 minutes 30 seconds off peak.

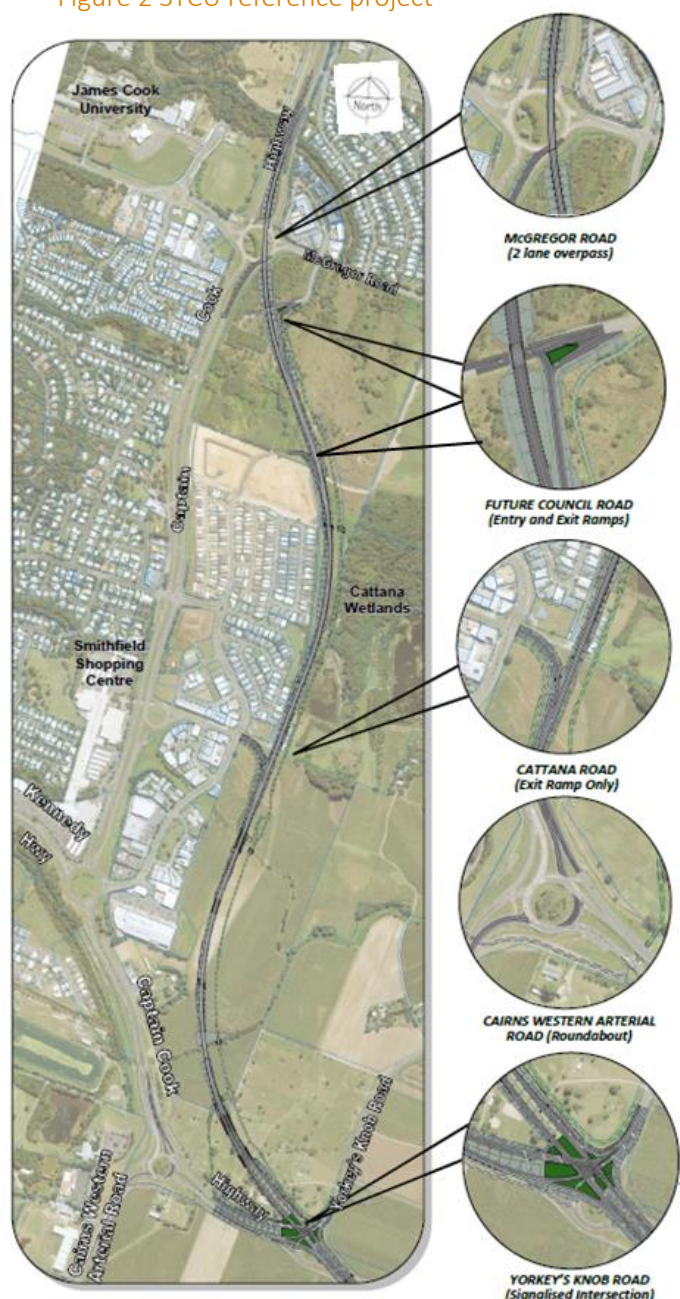
5 Reference project

The reference project incorporates a bypass, roundabout upgrades, overpass construction, wide centre line treatment, and off-road cycle path. The reference project (see Figure 2) is a new road infrastructure project with the following key features:

- bypass route continuity between the Captain Cook Highway at Yorkeys Knob Road roundabout and McGregor Road roundabout
- upgrading of the existing Yorkeys Knob roundabout with a four-legged signalised intersection to cater for the addition of the bypass route traffic
- upgrading of the Cairns Western Arterial Road roundabout with a signalised double right turn from Captain Cook Highway onto the Cairns Western Arterial Road
- northbound left off only exit ramp from the bypass route at Cattana Road
- exit and entry ramp to the proposed future Cairns Regional Council designated road at the northern end of the bypass route
- two-lane bi-directional overpass at McGregor Road roundabout
- wide centre line treatment for improved safety
- off-road cycle path.

The reference project does not change the existing road hierarchy for either state or local government-controlled roads within the boundaries of the study area. The reference project supplements the existing transport network in the Smithfield area and improves its efficiency.

Figure 2 STCU reference project



6 Methodology

A cost benefit analysis was undertaken as part of the detailed business case to test the project's economic viability. Road user travel patterns, including level of service and delay estimates were provided by traffic modelling. Modelling consisted of utilising the Cairns Strategic Transport Model (CSTM) for traffic demand estimation and forecasting for input into detailed microsimulation modelling using AIMSUN (Advanced Interactive Microscopic Simulator for Urban and Non-urban Networks).



Benefits were estimated and calculated in incremental terms (i.e. comparing the difference between the base and project cases).

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 of existing asset
- reductions in crash costs
- provision of bypass
- key intersection upgrades.

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.

Table 2 Key cost benefit analysis parameters

Parameter	Value	Source
Discount rate	A 7% discount rate is used for the central case with sensitivity tests conducted at 4% and 10%	Infrastructure Australia Business Case Assessment Template 2016
Price year	2016	n/a
Evaluation period	30 years from the end of the capital investment (i.e. first year following the construction period). The first year of measured benefits is from 2021 (the year of the bypass opening)	Australian Transport Assessment and Planning (ATAP) Guidelines (Category 4, section 2.4)
Indexation	Unit costs and parameter values indexed from the price year by the Consumer Price Index (including sub-categories as appropriate) and Producer Price Index	Australian Bureau of Statistics (2016)
Unit costs and parameter values	The unit parameters in the ATAP Guidelines are in 2013 prices. To convert 2013 prices to 2016 prices the following Australian Bureau of Statistics indices were applied: Value of time: Average wage price Freight value of time: Producer price index—road freight Vehicle operating costs: Producer price index—private motorist Externalities: Consumer price index	The unit parameters used in the cost benefit analysis were sourced from the Australian Transport Assessment and Planning Guidelines
Modelled periods	The modelling undertaken to support the cost benefit analysis relies on outputs from a transport model. The modelled years from the transport model are 2021, 2031 and 2036	Traffic modelling undertaken adopts traffic growth forecasts based on the Cairns Strategic Transport Model developed and owned by the Department of Transport and Main Roads.

7 Demand forecasts

Demand forecasts form a fundamental component of any economic analysis as the majority of economic benefits are derived based on the number of users.

Traffic modelling undertaken for the STCU project adopts traffic growth forecasts based on the Cairns Strategic Transport Model (CSTM). CSTM is a strategic level travel demand forecasting tool, developed on

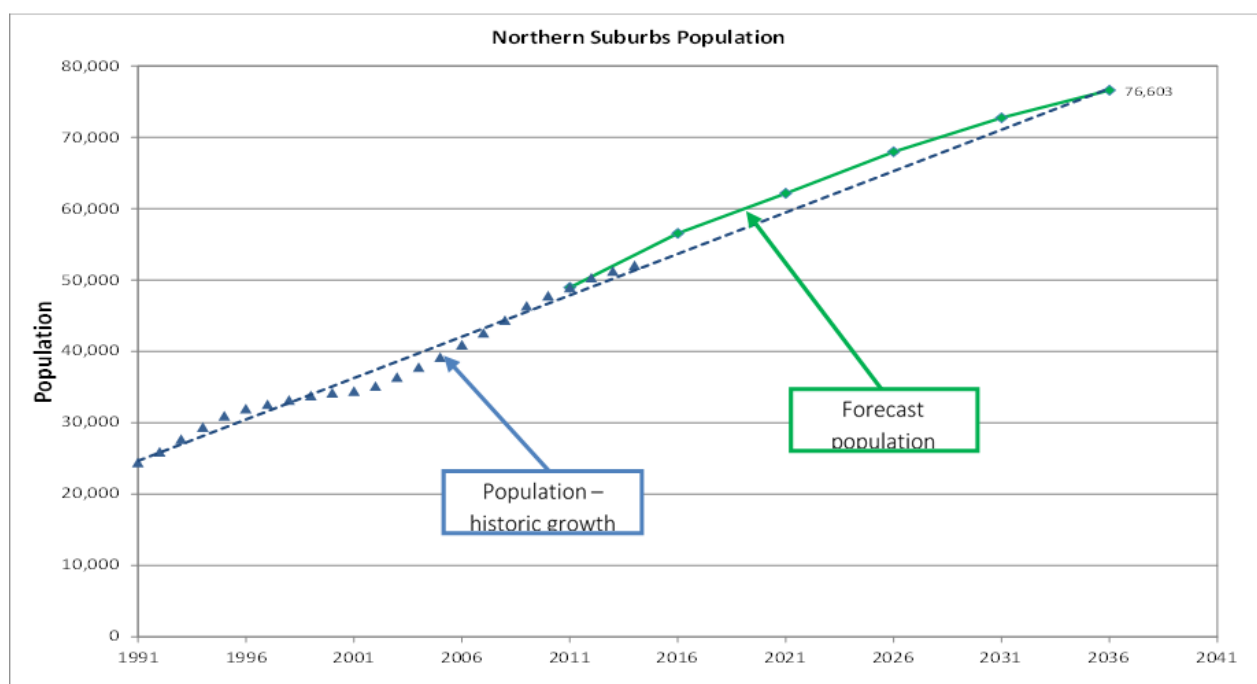


the Emme transport planning platform to support strategic transport planning and infrastructure and policy testing by the Department of Transport and Main Roads.

CSTM was developed for the Department of Transport and Main Roads more than 15 years ago. It has been regularly updated and upgraded as more recent information becomes available (e.g. census updates) and advancements in software occur. CSTM was used in scenario testing when developing the Far North Queensland Regional Plan 2009–2031. The model has underpinned all strategic planning undertaken by the department across the Cairns urban area over the past 15 years.

CSTM demographics have been developed by the Department of Transport and Main Roads and are based on population projections from the Queensland Government Statistician’s Office (2013 Medium Series Projections). Population in the northern suburbs of Cairns is forecast to increase from the 2014 estimate of 52,061 to more than 76,000 by 2036. Review of the historic growth trend in the Cairns northern suburbs indicates the forecast growth generally is in line with the historic trend. Historic and forecast population growth is presented in Figure 3.

Figure 3 Cairns northern suburbs population growth – historical and forecast

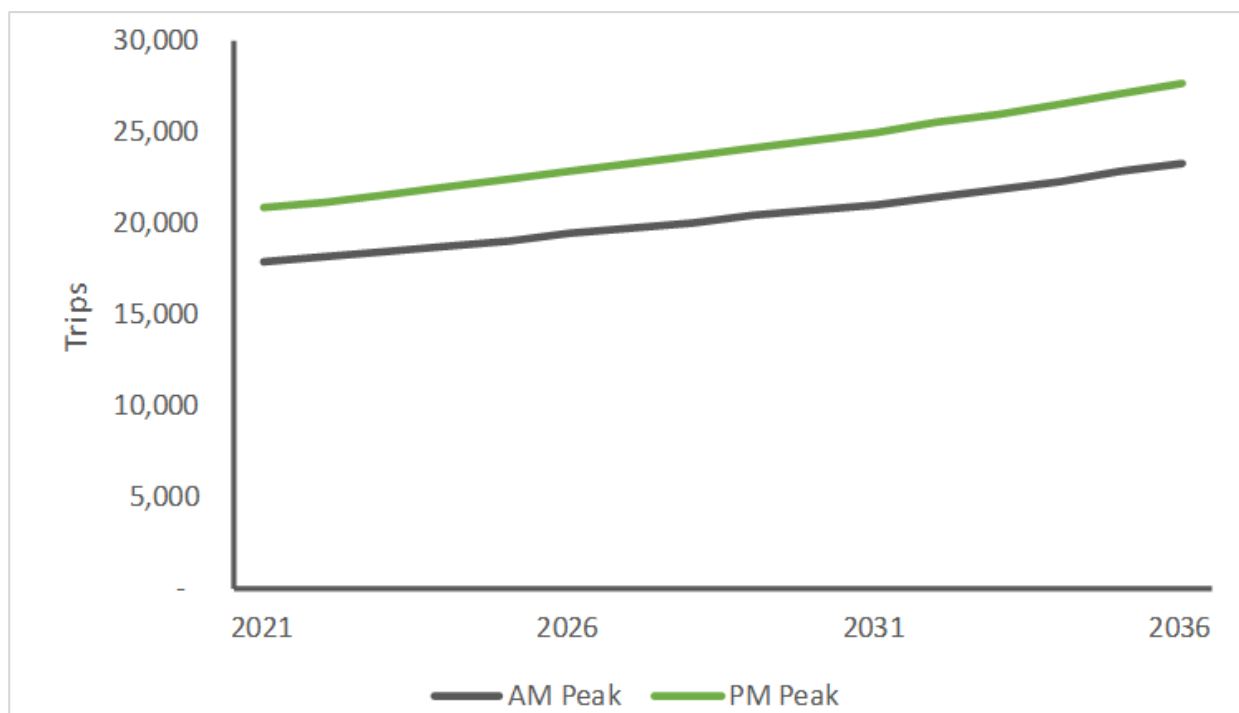


Source: Traffic Modelling Report

Based on the traffic modelling, total trips along the corridor are estimated to grow at a compound annual growth rate of 1.8 per cent per annum between 2021 and 2036 in the morning peak and 1.9 per cent per annum in the afternoon peak (see Figure 4). The afternoon peak traffic is greater than the morning peak in each modelled year.



Figure 4 STCU project area peak period trip growth



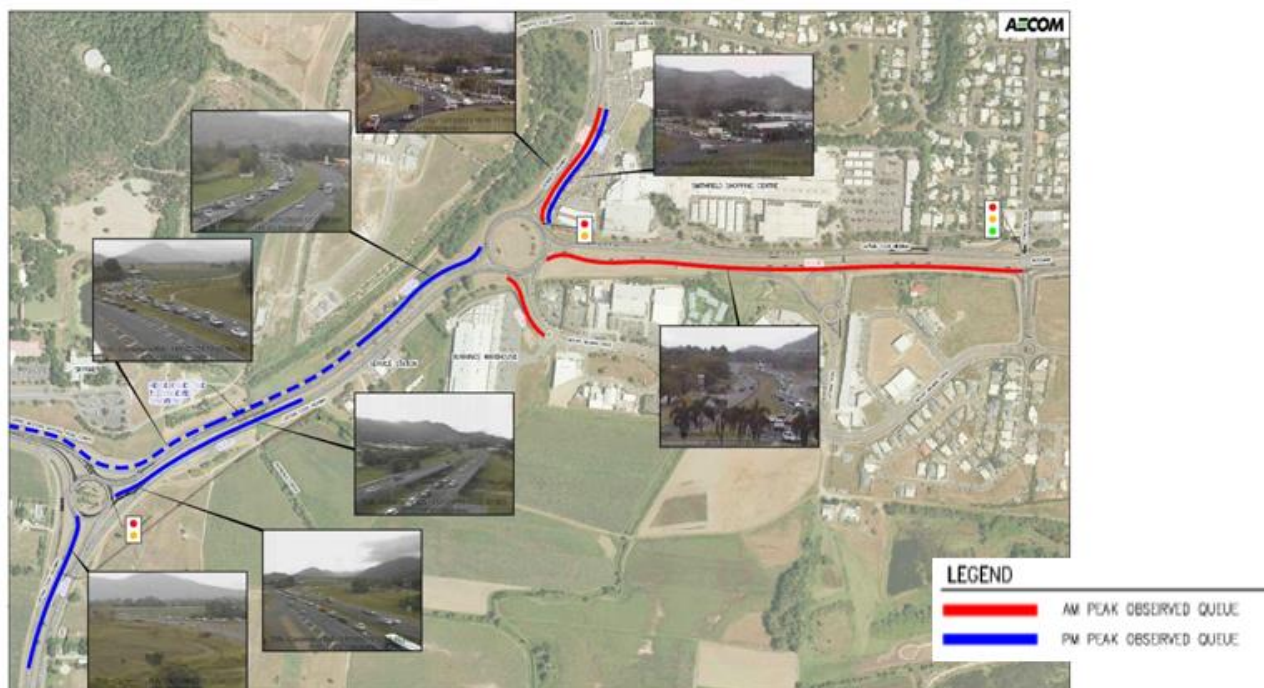
Source: Traffic Modelling Report

The main drivers for the STCU project are congestion and safety. This section of the Captain Cook Highway is congested during morning and afternoon peaks and has a high crash rate, resulting in increased travel times and reduced trip reliability. Photographs showing current congestion levels and diagrammatic representations of the observed queue lengths are shown in Figure 5.

The Captain Cook Highway provides the main access to the Cairns central business district for areas around Smithfield, the northern beaches and areas further to the north and west of Cairns such as Cape York, Port Douglas, Kuranda, Mareeba and the Atherton Tableland.

The section of the Captain Cook Highway, including the Cairns Western Arterial Road and Kennedy roundabouts, is a major confluence point of traffic flows from north and west of Cairns, carrying in the order of 44,000 vehicles per day, with 7 per cent commercial vehicles. The link has experienced average annual growth of 2.6 per cent over the past 10 years. By 2031, the Smithfield Transport Corridor is expected to be able to accommodate 64,000 vehicles per day.

Figure 5 Base case observed intersection queuing



Source: Traffic Modelling Report

Modelling of the base case scenario shows a deterioration in performance of the Captain Cook Highway, with an increase in peak period travel times through the study area as in shown Table 3. Existing average travel times are 9 minutes during the morning peak and 5 minutes 30 seconds during the afternoon peak, with existing average travel speeds of 28km/h and 49km/h during the morning and afternoon peaks respectively.

Table 3 Forecast corridor travel times without STCU project

Year		2021	2031	2036
Time period	Direction of travel/option on Captain Cook Highway	Base case	Base case	Base case
Average travel times				
Morning peak	southbound travel	13 minutes	16 minutes	18 minutes
Afternoon peak	northbound travel	15 minutes	18 minutes	19 minutes
Average travel speed				
Morning peak	southbound travel	25 km/h	18 km/h	16 km/h
Afternoon peak	northbound travel	24 km/h	20 km/h	18 km/h

Source: Traffic Modelling Report



8 Profile of capital, operating/maintenance costs

The STCU project capital cost estimates are outlined in Table 4.

Table 4 STCU project capital cost estimates

Items	Capital cost (\$ million, rounded)
Base Estimate	98
Final out-turn cost (P90)	151

Nominal capital costs were adjusted to real economic costs for use in the economic analysis. The adjustment removes the general increase in prices to reflect real escalation increases over time (e.g. expected increases in labour costs over and above the consumer price index).

In addition to capital costs, ongoing maintenance costs were also identified and estimated at \$104 million (P90, nominal).

9 Project benefits

Benefits of the STCU include:

- additional capacity as the Reference Project can accommodate 1,156 additional trips during the AM peak at 2021, increasing to 3,706 additional trips by 2036. During the PM peak, the Reference Project accommodates 1,915 additional trips at 2021 increasing to 5,022 additional trips at 2036
- significant travel time savings:
 - 1,076 hours saved during the AM peak at 2021 increasing to 1,366 hours at 2031, before dropping slightly to 932 hours at 2036 as the Reference Project becomes congested beyond 2031
 - 1,116 hours saved during the PM peak at 2021 increasing to 2,120 hours at 2036
 - 7 to 10 minutes faster through the study area on the CCH at 2021 and about 10 minutes faster than the Base Case at 2031
 - between 4 and 10 minutes faster travel time on the CCH by 2036 under the Reference Project, with some deterioration during the AM peak as congestion increases in the Reference Project beyond 2031
 - between 8 and 11 minutes saving travel times on the bypass under the Reference Project at 2021, increasing to between 14 and 15 minutes at 2036
- reduced vehicle operating costs
- a reduction in the frequency of crashes for road users
- reduced delays and improved bus travel times and timetable reliability, particularly during morning and afternoon peak periods as a result of the reduction of traffic on the Captain Cook Highway (CCH) attributable to the Reference Project
- improved access to active transport for recreational and commuter cyclists within Smithfield and the wider region as a result of the dedicated cycle path
- increased employment opportunities during construction.

A summary of the quantified economic benefits is shown in Table 5.



Table 5 STCU project economic benefits

Project benefits	Present value (\$ million, rounded, 7% discount rate)	% of benefits
Travel time savings	184	65
Vehicle operating costs	83	30
Crashes	15	5
Externalities	-0.1	<1

10 Cost benefit analysis results

Building Queensland undertook an economic cost benefit analysis of the reference project based on an evaluation of the 30-year benefit stream against the construction and net ongoing costs of the project.

All costs and benefits (which could be monetised) were discounted to present value terms using a real discount rate of 7 per cent per annum.

All benefits are presented in real \$2016 (see Table 6).

Table 6 Cost benefit analysis results

Benefits and costs	Present value (\$million, rounded, price year) @7% real discount rate
Total costs	108
Travel time savings	184
Vehicle operating costs	83
Crash savings	15
Externalities	-0.1
Total benefits	282
NPV	174
BCR	2.6

11 Sensitivity analysis

Sensitivity analysis identifies key economic risks within the conducted analysis. It examines how much the results deviate as a consequence from changes in project driver/s or combinations of drivers.

It is recognised that there will always be some level of uncertainty regarding the future and sensitivity testing is a way to assess uncertainty around assumptions. The sensitivity analysis should focus on varying assumptions regarding key benefit and costs drivers (e.g. demand forecasts, key benefit parameters, growth rates).

The sensitivity analysis conducted for the STCU project is summarised in Table 7.



Table 7 Sensitivity analysis table

Sensitivity analysis	BCR	% change from main case BCR	NPV, \$ million, rounded	% change from main case NPV
Central case	2.61	-	174	-
Costs at P50	2.90	11	185	6
Capital cost + 20%	2.17	-17	152	-13
Capital cost - 20%	3.28	26	196	13
Real capital cost growth	2.60	0	174	0
Operating costs + 20%	2.62	0	174	0
Operating costs - 20%	2.60	0	173	0
Total benefits +20%	3.13	20	230	32
Total benefits - 20%	2.09	-20	118	-32
Travel time benefit +20%	2.95	13	211	21
Travel time benefit - 20%	2.27	13	137	21
Discount rate = 4%	3.79	45	323	86
Discount rate = 10%	1.92	-26	92	-47
Annualisation factor: 270	2.80	7	194	12
Value of time (0.75% growth p.a.)	2.82	8	197	13
Benefits end 2036	1.99	-24	108	-38
First year benefits held constant	2.17	-17	123	-29

12 Other considerations

Assumed project completion times

The detailed business case considered a January 2018 funding decision with the project development and procurement phase, including land acquisitions proceeding through to March 2019, when the construction and management phase begins. The bypass would open to traffic in May 2021.

Wider economic impact assessment

The cost benefit analysis focuses on the direct impacts of the infrastructure investment which is measured by applying values for the estimated reduction in travel times and changes in operating costs for users.

It is important to note that not all infrastructure projects will generate wider economic benefits. In the case of the STCU project, an analysis of wider economic benefits was not undertaken as it would be unlikely to materially impact on the economic rationale for the STCU project; however, productivity gains have been assessed for the project (see Table 8).

Productivity gains for the project have been derived by identifying work related benefits as a subset of the benefits identified in the cost benefit analysis for freight users, public transport users and road users. These include travel time savings and reduced vehicle operating costs for heavy vehicles and business trips and have been determined to be \$39.3 million (present value) over the 30-year evaluation period.



Table 8 Wider economic impact

Wider economic impact	
Estimated number of jobs per annum	Average of 115 direct full-time equivalent jobs supported for four years
Productivity gains	Business related benefits of \$39.3 million

Independent economic peer review

Independent peer reviews of the transport modelling and the economic analysis were completed with all material issues identified by the peer reviewers incorporated in the final economic final analysis.

The sensitivity analysis included:

1. A sensitivity test which assumed the truncation of the analysis by assuming no benefits accrue after 2036.
2. A sensitivity test which involved holding the first-year benefits constant.

These tests indirectly address peer review comments that relate to the robustness and extent of traffic modelling undertaken and the associated estimated benefits (including the reliability of future traffic demand drivers)—particularly beyond the final modelling of 2036.

This sensitivity testing demonstrates that the economic case for the project remains strong under these two sensitivities.