Australian Government | Infrastructure Australia

Project business case evaluation summary

Western Harbour Tunnel and Warringah Freeway Upgrade

Location
Sydney, New South Wales

Geography
Fast-growing cities

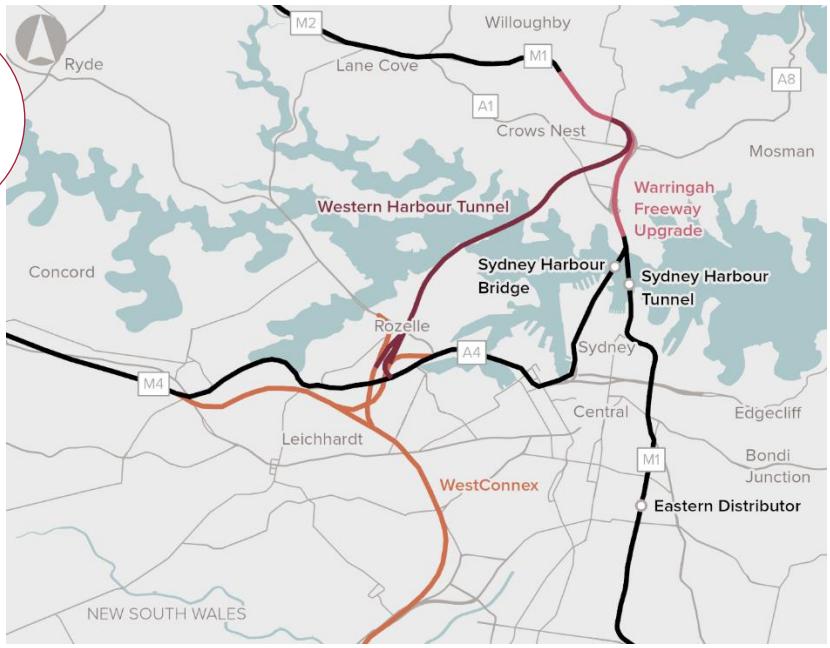
Category
Efficient urban transport networks

Capital cost
Pending (see endnote)

Indicative timeframe
Construction Start: 2021
Project completion by: 2028

Proponent
NSW Government

Evaluation date
15 April 2021



1. Evaluation Summary

The Sydney Harbour Bridge and Sydney Harbour Tunnel are critical road links for Sydney's transport system. Demand for these road links is expected to grow, increasing congestion. The proposed Western Harbour Tunnel and Warringah Freeway Upgrade would provide an additional crossing of Sydney Harbour to serve some traffic currently using the bridge and tunnel. It would also act as a western bypass of the Sydney CBD. In the absence of the project, travel times and congestion in this area are expected to increase significantly, and reliability will decrease.

The Western Harbour Tunnel and Warringah Freeway Upgrade involves construction of a twin three-lane motorway of 6.5 kilometres between Rozelle Interchange and the Warringah Freeway near North Sydney (the Western Harbour Tunnel) and upgrade of the Warringah Freeway corridor between the northern end of Sydney Harbour Bridge and Willoughby Road. The project as proposed in the submitted business case supports federal and state government priorities to manage urban congestion in major cities.

The proponent's business case states that the preferred project option would have a net present value (NPV) of between $827 million and $1,167 million and a benefit-cost ratio (BCR) of between 1.2 and 1.3, using a 7% real discount rate and P50 capital cost estimate. The outcome of the cost-benefit analysis is sensitive to the choice of discount rate. Infrastructure Australia considers this an accurate view of the project's net benefits, using appropriately conservative assumptions about future benefits.

We support the proponents proposed delivery approach, as it appropriately considers identified risks including, but not limited to, interface of Western Harbour Tunnel and Warringah Freeway Upgrade components of the project, differences in the nature of the works and skillsets required for each component, and market appetite, traffic management, and risks associated with tunnelling under Sydney Harbour.

Overall, the project demonstrates strategic fit and strong economic, social and environmental merit. The **Western Harbour Tunnel and Warringah Freeway Upgrade** has been added to the Infrastructure Priority List as a **Priority Project**.

2. Context

The Sydney Harbour Bridge and Sydney Harbour tunnel are critical road links for Sydney's transport system, currently carrying over 250,000 vehicles per weekday. By 2031, this is expected to increase to over 300,000 vehicles per weekday. These harbour crossings serve trips that are both going into the Sydney Central Business District (CBD) and through trips to other destinations.

Population and transport demand are growing in Sydney. Growth in vehicle crossings across Sydney Harbour is expected to be similar to population growth of 1.5% to 2% per year.

The *Urban Transport Crowding and Congestion* supplementary report to the *Australian Infrastructure Audit 2019* identified this section of the Sydney road network to include two of the most congested road corridors in Australia in 2016:

- Artarmon to Sydney Harbour Tunnel via Gore Hill Freeway / Warringah Freeway, southbound (the most congested road corridor in 2016)
- Artarmon to Surry Hills via Pacific Highway / Sydney Harbour Bridge / Cahill Expressway / Eastern Distributor, southbound (the 7th most congested road corridor in 2016).

The southern end of the proposed project connects to the second most congested road corridor in Australia in 2016: Ashfield to Sydney CBD via City West Link / ANZAC Bridge, eastbound. It will also connect to the WestConnex motorway, which is currently partially complete, with the remaining sections to be completed by 2023.

The Artarmon to Sydney Harbour Tunnel, southbound corridor is expected to remain the most congested road corridor in 2031. The Artarmon to Surry Hills, southbound and Ashfield to Sydney CBD, eastbound corridors are expected to remain amongst the ten most congested roads in 2031.

3. Problem description

The transport corridors around the CBD are the busiest in Greater Sydney and are among the most constrained in NSW. In 2017, over 630,000 trips per day were made to the Sydney CBD alone and over 1.3 million daily trips pass through the centre. The cross-harbour network is also constrained, including the Sydney Harbour Bridge road crossing (162,000 vehicles a day) and the Sydney Harbour tunnel (96,000 vehicles per day).

Key road corridors such as the Sydney Harbour Bridge, Sydney Harbour Tunnel and Western Distributor are highly congested as they currently support traffic that is both accessing and bypassing the CBD. Sydney Harbour Bridge, Warringah Freeway and Eastern Distributor generated a congestion cost of $1.2 million per lane kilometre in 2011, which is expected to rise to $6.74 million in 2031, the highest cost in NSW and the fifth highest in Australia.

A growing population and growing vehicle demand will exacerbate the capacity constraints for Sydney's harbour crossings. This will lead to more congestion and slower journey times.

The *Australian Infrastructure Audit 2019* found that congestion in this part of the Sydney road network may cost in excess of $786,000 per day by 2031. This includes the ten most congested roads in Sydney in the AM and PM peaks in 2031:

- Central Coast to Sydney corridor (M1), southbound and northbound
- Northern Beaches to North Sydney corridor (A8), southbound and northbound
- Eastern Distributor / Sydney Harbour Bridge / Warringah Freeway / Gore Hill Freeway corridor (M1), northbound.

Congestion on these corridors is expected to produce delays of more than 32,700 hours per day by 2031 for road users.

4. Options identification and assessment

A wide range of options were assessed for the overall Western Harbour Tunnel and Beaches Link program. The Final Business Case optioneering process reviewed the options and constraints identified in the work completed for the Strategic Business Case. One of the recommendations from this process was that the Warringah Freeway Upgrade be delivered as part of whichever

project commenced first. This is due to the crucial role of the Warringah Freeway Upgrade in integrating the Western Harbour Tunnel and Beaches Link into the existing road network.

The options assessment factors considered include:

- Connectivity and network performance
- Constructability and engineering
- Community and environment impacts
- Property impacts.

The level of detail changed for the longlisted options to the shortlisted options, gradually narrowing down the better options for more rigorous assessment. The process included feedback from Infrastructure NSW gateway review at the Strategic Business Case stage.

The options development process to arrive at a more efficient project solution for the Western Harbour Tunnel focused on:

- Strategic connectivity and alignments — for example the Strategic Business Case had a preferred alignment under Goat Island, while the Final Business Case developed an improved alignment between Birchgrove Wharf and Balls Head. The vertical alignment is to cross over the Sydney Metro rail tunnel to the north of Victoria Cross station
- Tunnel type — such as using a tunnel boring machine, road header and/or immersed tube tunnels. The preferred option involves road header for approaches to the Harbour and immersed tube tunnels to cross the Harbour
- Connection points between the motorways and existing road network — the preferred option has connections at Rozelle, North Sydney and Warringah Freeway.

This assessment demonstrated a better alignment for the Western Harbour Tunnel to that in the Strategic Business Case. It has better outcomes from a transport perspective, better constructability, fewer property impacts and better community and environment impacts.

The development of options for the Warringah Freeway Upgrade focussed on the following key considerations:

- Strategic connectivity – this included providing connectivity between key locations on either side of the Sydney Harbour, balanced demand for each harbour crossing into the future, and ensuring that each harbour crossing performs its intended function
- Operations and safety – separate motorway network and local movements, reduce dysfunctional and unsafe weaving across carriageways, discourage shorter trips along the motorway network, and improve legibility for users
- Local network integration – integrate effectively and safely with local road network, maintain local connectivity, ensure local road network has ability to cope with changed demand, and minimise property, environment and community impacts.

In terms of economic assessment for the Final Business Case, three options were considered:

- Western Harbour Tunnel and Warringah Freeway Upgrade
- Beaches Link
- Western Harbour Tunnel and Warringah Freeway Upgrade plus Beaches Link.

This indicates a fairly limited economic assessment of options, as there is really only one option being evaluated for the Western Harbour Tunnel component. However, the preferred alignment for the Western Harbour Tunnel performs better on all assessment criteria than the other options considered.

Infrastructure Australia considers that a robust process was followed to identify a preferred option.

5. Proposal

The proposal is intended to address a range of problems and opportunities with transport, productivity and city-shaping dimensions:

- Improve travel time and reliability on cross-harbour motorways near Sydney's CBD, including the Sydney Harbour Bridge and Sydney Harbour Tunnel
- Improve travel times and reliability on access and bypass motorways around Sydney's CBD, including the Western Distributor, ANZAC Bridge and Eastern Distributor
- Improve the resilience of the transport network around Sydney's CBD by reducing the impact of incidents on cross-harbour road crossings
- Support the future growth and productivity of Sydney by improving access to labour markets in other regions of Sydney
- Improve the efficiency of connections between businesses and suppliers in Sydney, the Northern Beaches and other regions
- Facilitate improvements to urban amenity in the Sydney CBD by reducing through-traffic movements or congestion.

Specifically, the solution proposes:

- Construction of a twin three-lane motorway of 6.5 kilometres between Rozelle Interchange and the Warringah Freeway near North Sydney (the Western Harbour Tunnel). This will link directly to WestConnex M4-M5 at Rozelle, forming a new western bypass of the Sydney CBD
- Upgrade of the Warringah Freeway corridor between the northern end of Sydney Harbour Bridge and Willoughby Road. This enables the connection of the Western Harbour Tunnel into the existing motorway network, as well as the option for future extension to Beaches Link.

6. Strategic fit

The project has a strong alignment to the stated priorities of the Australian Government and the NSW Government to address urban congestion in major cities. The initiative is currently on the Infrastructure Priority List and is identified as a key project in the NSW Government's transport strategy, Future Transport Strategy 2056.

The Western Harbour Tunnel and Beaches Link was noted as a key initiative for Greater Sydney in Future Transport 2056, which is the NSW Government's overall transport strategy. The proponent notes that the Western Harbour Tunnel and Beaches Link program was developed to align with and support the NSW Government's strategic objectives for Greater Sydney and to respond to recommendations from Infrastructure Australia. While the Western Harbour Tunnel and Warringah Freeway Upgrade deliver net benefits, the full program incorporating the Beaches Link has stronger strategic merit. Beaches Link is currently under consideration by the NSW Government.

The Greater Sydney Commission's Greater Sydney Regional Plan establishes a vision for Greater Sydney as a liveable, productive and sustainable metropolis of three cities, where people can access jobs and services within 30 minutes by public transport or through walking. One of the design considerations in the development of the full Western Harbour Tunnel and Beaches Link program has been enabling public transport improvements by enhancing bus routes (such as the B Line) by reducing traffic along key routes including the Sydney Harbour Bridge.

While the Beaches Link component is not part of the submission being reviewed, the Western Harbour Tunnel and Warringah Freeway upgrade components alone still align with the strategic directions of the NSW Government. The Future Transport Strategy 2056 has been developed by the NSW Government to reshape how people and goods move across the state. The strategy establishes six state-wide outcomes for transport in NSW. The Western Harbour Tunnel and Beaches Link program is listed as one of a number of key initiatives that support the objectives of the Future Transport Strategy 2056 within a 0-10 year timeframe. The Western Harbour Tunnel and Beaches Link program is also identified by the Greater Sydney Commission and Future Transport as a key initiative to address congestion and improve freight access in the Eastern Harbour City.

There are large improvements in travel times expected for key origin-destination pairs. By 2031, AM peak travel time changes expected due to the project are:

- 35 minutes to 24 minutes for Balmain to Chatswood

- 46 minutes to 33 minutes for Chatswood to Kingsford Smith Airport (via WestConnex)
- 66 minutes to 47 minutes for North Sydney to Parramatta (via WestConnex)
- 27 minutes to 15 minutes for Rozelle to North Sydney

The Western Harbour Tunnel is expected to carry 83,000 vehicles per weekday in 2037.

In 2017, Infrastructure Australia included the Western Harbour Tunnel and Beaches Link program as a priority initiative on the Infrastructure Priority List. This was supported by the identification in the *Australian Infrastructure Audit 2015* of road corridors to the Northern Beaches and across Sydney Harbour as among the top 30 most congested corridors in Australia. The *Australian Infrastructure Audit 2019* confirmed that these road corridors remained some of the most congested in Australia in 2016 and are expected to remain so in 2031.

7. Economic, social and environmental value

The proponent's business case indicates that the project is expected to produce a wide range of benefits for road and public transport users, including significant travel time savings and improvements in travel time reliability. The proponent presented the cost-benefit analysis results as a range. The net present value of the project is reported to be between $827 million and $1,167 million with a benefit-cost ratio of between 1.2 and 1.3 excluding wider economic benefits, and between 1.6 and 1.7 including wider economic benefits, using a 7% real discount rate and P50 capital cost estimates in 2017 prices. We have considered the sensitivity of the appraisal to the discount rate and note that:

- Using a 4% discount rate results in a NPV of $4,311 million to $4,703 million and a BCR of 1.9 to 2.1
- Using a 10% discount rate results in a NPV of -$658 million to -$367 million and a BCR of 0.8 to 0.9.

The evaluation methodology used largely aligns to guidance in the Infrastructure Australia Assessment Framework and Australian Transport Assessment and Planning (ATAP) guidance for transport project cost-benefit analysis:

- The transport modelling is based on the Strategic Motorway Planning Model (SMPM), which is a strategic traffic model that can measure the impacts of projects with large network-wide impacts. This was supplemented by operational modelling for design purposes, but no operational modelling was used for the economic appraisal
    - The transport model has been peer reviewed and, if anything, may be underestimating base case travel times and demand, which would likely underestimate the benefits of the project
    - The transport model accounts for induced demand from the project, reducing road travel times
    - The transport model will not measure all the benefits of the project, and may understate benefits, particularly for the Warringah Freeway Upgrade component
- The economic appraisal has taken reasonable assumptions with regards to the use of transport modelling outputs, and these are conservative compared to many other economic appraisals. These include:
    - an evaluation period of 30 years of operations
    - a social real discount rate of 7 per cent
    - extrapolating benefits from the last modelled year (2041) with no growth in benefits
    - expanding benefits from daily to annual at less than the expansion of traffic volumes
    - maintaining values of time at today's levels in real terms
- The main benefits are reduced transport costs for road users — both those using the Western Harbour Tunnel and those on substitute roads that now have reduced traffic.
- Two major type of dis-benefits are identified:

- The reduction in consumer welfare from the charging of tolls on users of the Western Harbour Tunnel
- Road use externalities, which include air pollution, greenhouse gas emissions, noise and water pollution, impacts on landscape, urban separation, and road damage.

There are some benefit categories for which there is only emerging evidence, such as benefits from flow break-down and city shaping benefits. These are not integral to the project's economic merit.

There are major uncertainties that could impact on future traffic demand that were not considered by the proponent in the business case, such as emerging vehicle technologies and long-term impacts from behavioural changes resulting from COVID-19. Infrastructure Australia encourages strategic consideration of these issues for future infrastructure projects.

Infrastructure Australia considers the economic appraisal to provide a robust assessment of the economic merits of the project.

The proponent prepared the business case with information collected prior to the COVID-19 pandemic. The impact of the pandemic was not specifically considered by the proponent in the business case. However, the proponent has indicated that they are continuing to evaluate the ongoing and potential future impacts of the COVID-19 pandemic and that transport data show road traffic volumes to be similar to pre pandemic volumes across the network as of February 2021. Public transport patronage is significantly lower than pre pandemic levels. The proponent advised that they have not changed long-term transport or land use forecasts.

We note that cost estimates presented in the business case submitted by the proponent to Infrastructure Australia are from 2017. There is a risk that these outdated cost estimates may understate the costs of the project, particularly given subsequent changes in market conditions. The proponent's business case included sensitivity analysis with the use of P90 cost estimates, which are 10% higher than the P50 cost estimates used in the central case. Under this scenario, the proposed project is estimated to produce a lower, but positive economic value for Australia, with a net present value of $445 million to $815 million and a corresponding BCR of 1.1 to 1.2.

In response to a request from Infrastructure Australia, the proponent advised that more recent cost estimates prepared in late 2019 yielded P90 capital cost estimates that were within the bounds of the range estimated in 2017. Based on the proponent's sensitivity analysis and updated cost estimates, Infrastructure Australia is confident that the project will produce benefits that exceed its costs.

The following table presents a breakdown of the benefits and costs stated in the business case. Note that both lower bound and upper bound cost estimates are reported.

Benefits and costs breakdown

Proponent's stated benefits and costs	Present value ($m,2017) @ 7% real discount rate	% of total
Benefits		
Travel time savings	$3,312	67.8%
Vehicle operating cost savings	$256	5.2%
Consumer welfare impact of tolls	-$632	-12.9%
Travel time reliability	$604	12.4%
Additional toll revenue	$706	14.4%
VOC resource cost correction	$12	-0.2%
Road use externalities	-$117	-2.4%
Crash cost reduction	$7	0.1%
Foregone maintenance	$79	1.6%
Bus user benefit	$150	3.1%
Residual value	$231	4.7%
Resilience benefit	$278	5.7%

Total Benefits[1]	**$4,887**	(A)	**100%**
Total capital costs (P50): see endnote	$3,450-$3,750		91.9%-92.7%
Operating costs	$270-$330		7.3%-8.1%
Total Costs: see endnote[1]	**$3,720-$4,080**	(B)	**100%**
Net benefits - Net present value (NPV)[2]	**$827-$1,167**	(C)	n/a
Benefit-cost ratio (BCR)[3]	**1.2-1.3**	(D)	n/a

Source: Proponent's business case

(1) Totals may not sum due to rounding.
(2) The net present value (C) is calculated as the present value of total benefits less the present value of total costs (A – B).
(3) The benefit–cost ratio (D) is calculated as the present value of total benefits divided by the present value of total costs (A ÷ B).

The proponent's reported capital costs and funding is presented in the following table.

Capital costs and funding	
Total capital cost	Pending (see endnote)
Proposed Australian Government funding contribution	To be confirmed
Other funding	To be confirmed

Source: Proponent's business case

8. Deliverability

The Western Harbour Tunnel and Warringah Freeway Upgrade project is intended to be delivered through a state-led delivery model involving:

- Separation of the Warringah Freeway Upgrade component and Western Harbour Tunnel component of the project
- Two separate contracts for the Western Harbour Tunnel Main Works component for construction, involving:
    1. Delivery of the immersed tube tunnel and key marine works and
    2. Delivery of the driven tunnel and mechanical and electrical fit-out.

The proponent expects to commence the Western Harbour Tunnel Main Works Request for Tender in the second half of 2021. The NSW Government shortlisted three bidders for Development Partner in December 2020 and the selection process is expected to be completed by June 2021. The Development Partner is intended to be a partner to the proponent and be responsible for managing the procurement and delivery of the Western Harbour Tunnel Main Works.

The proponent is also procuring an Asset Manager for the Western Harbour Tunnel. The Asset Manager is intended to provide whole of life inputs in to the design of the Western Harbour Tunnel main works, take over operations of the Sydney Harbour Tunnel at the end of the current concession in August 2022, and be the operator of the Western Harbour Tunnel. The proponent intends for the Asset Manager to be appointed prior to the Main Works tender period and plans to complete this process from April to July 2021.

The business case was prepared with the assumption that the NSW Government will fund the project. A decision on whether the revenues from the Western Harbour Tunnel and other harbour crossings would be sold was not stated in the business case.

We encourage consideration of optimal tolling arrangements for the Western Harbour Tunnel, and the existing harbour crossings as part of any sale of these revenue streams. The option to bring these tolls into any future network-wide road pricing scheme should also be retained.

The proponent adopted an incentivised target cost model for the Warringah Freeway Upgrade. This model is intended to achieve appropriate risk sharing and collaborative arrangements. This model is expected to result in value for money for the NSW Government. Procurement of the Warringah Freeway Upgrade commenced in 2020, with the NSW Government announcing three preferred bidders for the main works contract in October 2020. Contract award is expected in Q3 2021.

Warringah Freeway Upgrade works are expected to commence in late 2021 and the Western Harbour Tunnel works are expected to commence in 2022.

The procurement and financing arrangements have evolved substantially since the completion of the final business case to Infrastructure Australia. The preferred delivery strategy for the project initially identified by the proponent involved:

- Demand risk public-private partnership
- Toll revenues from Western Harbour Tunnel and other harbour crossings
- Operations and maintenance of Western Harbour Tunnel and Sydney Harbour Tunnel
- Delivery of Warringah Freeway Upgrade and Western Harbour Tunnel as a single package/contract to mitigate Government exposure to interface risk between the projects.

However, the delivery strategy subsequently evolved, reflecting both changes in the design of the projects and market conditions. In particular, the appetite for the market to take on a full demand risk public-private partnership for a project of this size appeared likely to offer less value for money for government than a state-led delivery model, with potential sale of toll revenue streams at a later time. The proponent also decided to separate the Western Harbour Tunnel and the Warringah Freeway Upgrade, as the nature of the two components mean that they require different skill sets and involve different risks. The combined scale of a single package, with its mix of scope and risks, would make it challenging to run a competitive procurement process. Overall, the proponent concluded that it is likely that better value for money can be achieved if the two components are delivered separately.

The NSW Government granted planning approval for the Western Harbour Tunnel and Warringah Freeway Upgrade in January 2021. The proponent has undertaken an Environmental Impact Statement for the project, which was on exhibition from January to March 2020.

The project has a risk management plan. The further work undertaken on deliverability post the final business case and changes to packaging arrangements are expected to have reduced some risks. Key risks identified include those associated with network integration, encountering unknown utilities, risks from working in live traffic on one of the nation's most congested road corridors, ineffective interface between the Western Harbour Tunnel and Warringah Freeway Upgrade contractors within the corridor, other interface issues in the Warringah Freeway Corridor, actual ground conditions encountered in the seabed are different from current geotechnical investigations, and that contamination in Western Harbour may be greater than anticipated.

The risk management approach adopted by the proponent is consistent with the standard Transport for NSW approach to risk assessment and management. Infrastructure Australia considers the proponent's risk management plan to be appropriate at this time and their approach to be reasonable. We encourage the proponent to continue monitoring the identified key risks as the project design is further refined and the project progresses to the delivery phase.

The proponent's decision to deliver the Warringah Freeway Upgrade and the Western Harbour Tunnel under separate contracts with the Warringah Freeway Upgrade procured in advance is intended to address programme risk. This packaging approach is intended to reduce the level of technical risk associated with the interface of the two project components. The proponent will also make an incentive pool available to drive the desired behaviours from the contractors and project outcomes, particularly in managing the interface between the two packages.

The Warringah Freeway Corridor works are priced based on working in live traffic, and network integration issues have been addressed in the project's design. Investigations have been undertaken to identify the major utilities that may be impacted by the works.

The project has specified key performance indicators for the project in 2031, as part of its benefit realisation plan. These are targets for traffic reduction on the Sydney Harbour Bridge and Sydney Harbour Tunnel and travel times. The traffic demand on the Western Harbour Tunnel should also be included as a key performance indicator for the project.

Consideration of COVID-19

The COVID-19 pandemic has significantly affected the use of infrastructure. Infrastructure Australia has been working collaboratively with the Australian Government to provide advice on a staged response for managing, and recovering from, the impacts of the COVID-19 pandemic.

One critical element of our advice is to maintain a pipeline of nationally significant infrastructure investments. Nationally significant infrastructure projects are long-term investments, typically considering a 30-year view of the project's social, environmental and economic impacts. In making this recommendation, Infrastructure Australia continues to take a long-term view and has also considered the sensitivity of key planning assumptions using the best data available to us.

As noted in the 2019 Australian Infrastructure Audit, we must continue to evolve the way we plan for Australia's infrastructure to embrace uncertainty. There are still many uncertainties regarding the long-term impact of the COVID-19 pandemic on infrastructure use.

We will continue to collaborate with industry, the community and governments at all levels to understand the impacts of the COVID-19 pandemic on infrastructure decisions in Australia.

This evaluation summary has been amended to exclude the capital cost (nominal, undiscounted) as the project is currently in active procurement.