Final Business Case Summary
Western Harbour Tunnel

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Introduction

About this report

This document provides a summary of the submission to the NSW Government seeking an investment decision for the Western Harbour Tunnel (including the Warringah Freeway Upgrade) project, which forms part of the Western Harbour Tunnel and Beaches Link Program. An initial investment decision on the Western Harbour Tunnel (including the Warringah Freeway Upgrade) Project (the Project) has been made. The investment decision for the Beaches Link, a related motorway project, will be presented to the NSW Government for their endorsement in due course.

The Western Harbour Tunnel and Beaches Link Program (the Program) Business Case prepared by Roads and Maritime Services (now Transport for NSW) includes the Beaches Link project. The Beaches Link project is subject to a final investment decision by the NSW Government and will be evaluated in a separate summary at the appropriate time. This Business Case Summary has been prepared by Infrastructure NSW, the NSW Government's independent infrastructure advisory agency.

The Western Harbour Tunnel is designed to increase transport capacity around the Harbour CBD. It provides a new tunnelled harbour crossing between Rozelle and North Sydney, together with an upgrade to the Warringah Freeway. It also provides capacity for the Beaches Link project, a new integrated roadway from the Northern Beaches to North Sydney and Artarmon. Importantly, the project has key connections to the wider Sydney Motorway network.

A Final Business Case was developed in 2016 based on a concept design for the Program. During 2017, further work was undertaken to investigate the technical and environmental aspects of the site, to engage the community and the market, and to develop a reference design for the Program. This additional level of detail augmented the Final Business Case.

Throughout 2018, Transport for NSW undertook extensive community and stakeholder engagement on the Program. This resulted in an Updated Reference Design that incorporates a series of design refinements informed through community and stakeholder consultation, value engineering and detailed planning on construction staging. The core alignment, connectivity and functionality are retained as per the augmented Final Business Case for the Program. The Updated Reference Design features refinements, and reductions in technical and commercial risks.

The totality of this information informed the NSW Government's approach on the investment decision. It is summarised here and referred to as the Business Case.

To better manage the current pipeline of initiatives going into delivery, sequencing and timing of projects within the Program is being undertaken.

The Warringah Freeway Upgrade will be delivered as the first project as part of the Program to ensure connections to the existing network are available for the Western Harbour Tunnel and the future Beaches Link project. The Western Harbour Tunnel project will be delivered second to address the capacity constraints of the existing cross-harbour network. The Beaches Link project is planned to be delivered once cross-harbour resilience has been improved.

Strategic context

Sydney is expanding and the NSW Government is working hard to deliver an integrated transport system that meets the needs of customers now and in the future. The Program is designed to ease congestion throughout Greater Sydney. 4.3 million trips are made across Sydney Harbour each week, making the Warringah Freeway one of the busiest and most complex roads in the country. This program will help to ease pressure on the road network and customers, with a direct connection to WestConnex it will also reduce congestion on the Anzac Bridge, Western Distributor and Sydney Harbour Bridge corridor.

The Program is a major transport infrastructure program that will make it easier, faster and safer to get around Sydney. As Sydney continues to grow, faster and more reliable trips are essential to reducing congestion and providing new levels of access to jobs, recreation, and services such as schools and hospitals. By creating a western bypass of the Sydney CBD, the Western Harbour Tunnel will take pressure off the congested Sydney Harbour Bridge, Sydney Harbour Tunnel and Anzac Bridge; while Beaches Link will create an alternative to the Military Road and Warringah Road corridors to relieve traffic pressure on the North Shore.

The Program has been designed as part of an integrated transport network, with a focus on new public transport connections and improved journey times and reliability for buses. Beaches Link, for example, will improve B-Line services between the Sydney CBD, North Shore and the Northern Beaches, accommodate new express bus service routes, and provide for a fast and efficient bus interchange with Sydney Metro at North Sydney.

At the same time, Western Harbour Tunnel will integrate with public transport and boost reliability for cross-harbour bus trips, creating new options for express bus services between the Inner West and Lower North Shore and beyond. The Western Harbour Tunnel alone will deliver significant time savings for customers, including up to 20 minutes between Leichhardt and North Sydney, 20 minutes between Sydney Olympic Park and North Sydney, and 15 minutes between North Sydney and Sydney Kingsford Smith Airport.

The Program is anticipated to support up to 15,000 jobs during its construction.

The Greater Sydney Commission's Plan for Sydney[1] describes a metropolis of three separate cities where residents of each city have easy access to jobs and services. The three cities are the Eastern Harbour City, Central River City and Western Parkland City.

Complementing the Regional Plan for Sydney are five District Plans, developed to reflect the specific character and needs of the locations that comprise each city[2].

The Eastern City District and the North District are the areas providing the context for the Western Harbour Tunnel and Beaches Link. Together the two districts support 40% of the population and 60% of the jobs in Greater Sydney.

Both districts are economically important:

[1] Greater Sydney Commission (2018), *A Metropolis of Three Cities.*

[2] Greater Sydney Commission (2018), *Eastern City District Plan; South District Plan; Western City District Plan; Central City District Plan; North District Plan.*

- The Eastern City District generates over 45% of Greater Sydney economic activity and at its core is the Harbour CBD, Australia's financial business capital and gateway to the international economy.
- The North District's economy includes the strategic centres of North Sydney, St Leonards, Chatswood, Macquarie Park, Frenchs Forest and Brookvale/Dee Why. These centres have large concentrations of knowledge-intensive, health and education jobs.

The *Future Transport 2056* strategy[3] articulates transport planning to support the vision for Greater Sydney. It identifies the Program as a priority to extend the strategic road and motorway network. The Program has been developed, consistent with objectives in the *Future Transport 2056* strategy, to address congestion, improve access by public transport to jobs and services and improve freight access in the Eastern Harbour City.

The role of the Western Harbour Tunnel in completing Sydney's inner urban motorway network is particularly important. With the completion of the M4-M5 Link and the Western Harbour Tunnel, a complete inner urban motorway will be established. This includes the M1, M2, M5 and M7 with cross-town routes via the M4, WestConnex, Western Harbour Tunnel and Cross City Tunnel (see Figure 1).

Figure 1 – Sydney's inner urban motorway network

[3] Transport for NSW (2018), *Future Transport 2056.*

Project need

Transport is constrained around the Harbour CBD

The transport corridors around the Harbour CBD are the busiest in Greater Sydney. Based on 2016 data over 630,000 trips per day are made to the Harbour CBD and over 1.3 million daily trips pass through the city centre.

The cross-harbour network is particularly constrained, with the Sydney Harbour Bridge road crossing being one of the busiest roads in NSW, carrying 162,000 vehicles a day. The Sydney Harbour Tunnel carries 96,000 vehicles a day and is the 8th busiest road in NSW.

The Sydney Harbour Bridge, Warringah Freeway and Eastern Distributor corridors, which all support traffic accessing the Harbour CBD as well as traffic bypassing the Harbour CBD, generate a congestion cost of $1.2 million per lane kilometre[4], expected to rise to $6.74 million in 2031, the highest cost in NSW.

These levels of congestion pose a risk to the productivity of the Harbour CBD and, given the economic significance of this centre, to the wider NSW economy.

Urban amenity is reduced

Some urban areas located on the road network experience poor amenity. This is the case where important destinations for dining and shopping are located on roads that are also important traffic corridors.

The conflict of through traffic and local traffic causes congestion and reduces amenity due to noise, and the impact on streetscapes, views and physical safety. This reduces the liveability of the area and impacts the role some of these key places play in the visitor economy in the Eastern Harbour City.

[4] In 2011.

Project description

The Warringah Freeway Upgrade

The upgrade of the Warringah Freeway enables the Western Harbour Tunnel and Beaches Link projects to connect to the existing network. This is the key piece of network integration and is also designed to support long-term increased demand along the corridor.

A four-kilometre section of the Warringah Freeway will be upgraded between the northern end of the Sydney Harbour Bridge and Willoughby Road. The upgrade will include:

- Entry and exit portals for the Western Harbour Tunnel north of Ernest Street
- An entry portal (northbound) and an exit portal (southbound) for Beaches Link north of Ernest Street
- An entry portal for Western Harbour Tunnel (southbound) from Berry Street and an exit portal (northbound) to Falcon Street
- Removal of the tidal flow system, including changing the flow on the ramps at Mount Street and Ernest Street
- Provision of new shared user paths on bridges across the Warringah Freeway at Ernest Street, Ridge Street and High Street
- Upgrade of the interchanges at Falcon Street and High Street, including a new northbound ramp at High Street
- Continuous dedicated bus lane between Miller Street and Sydney Harbour Bridge.

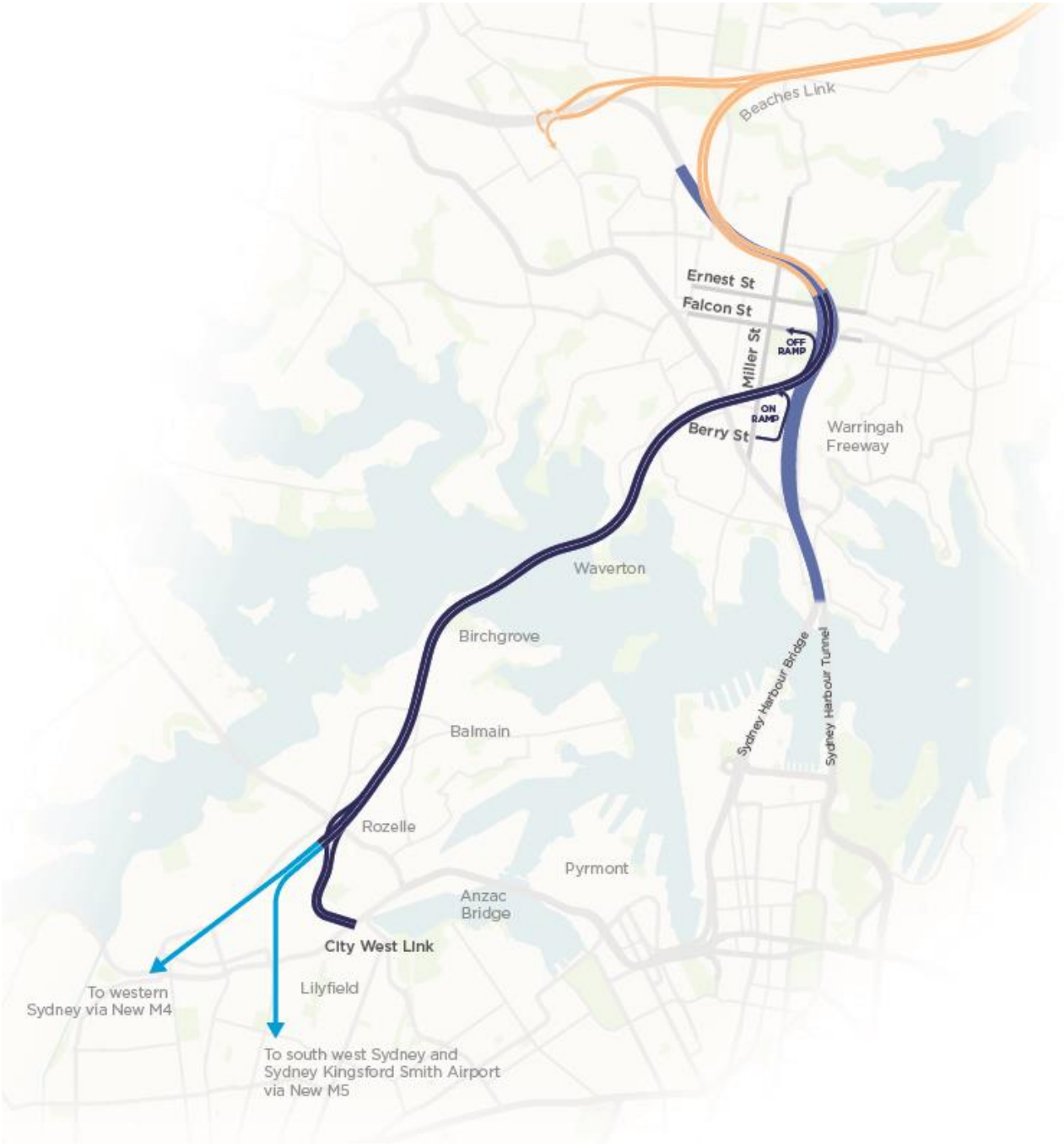
The Western Harbour Tunnel

The Western Harbour Tunnel is a six and a half kilometre, dual three lane tunnelled motorway between Rozelle and North Sydney. It will connect with the existing road network in three places:

- The proposed Rozelle Interchange where it will connect underground directly to the M4 and M5 corridors, and to the City West Link at Rozelle
- North of the Ernest Street overpass of the Warringah Freeway where it will integrate with the M2 and M1 corridors
- Falcon Street North Sydney for northbound movements and at Berry Street North Sydney for southbound movements.

The Western Harbour Tunnel will also connect with Beaches Link via underground ramps.

Figure 2 – The Western Harbour Tunnel and Warringah Freeway Upgrade route map



Options identification and assessment

The concept design for the Western Harbour Tunnel (including Warringah Freeway) Project resulted from an extensive process to develop and evaluate options. The process considered strategic and customer objectives, as well as technical aspects (such as connectivity and network performance, constructability, and impacts on the community, the environment and on property) and cost. The concept design reflected the alignment that best met the objectives of the Project. It was also the best outcome from a constructability, geometry and connectivity perspective.

The concept design was developed into a reference design during 2017. The general alignment and strategic connection points remained unchanged, but more detailed design refinement was undertaken, involving community feedback, field investigations, constructability analysis and value engineering. An additional level of information was also available following consultation with interfacing projects.

The proposed reference design was released in July 2018. Throughout 2018, further engagement was undertaken by Transport for NSW with the community and stakeholders on the Project. This resulted in an Updated Reference Design that incorporates a series of design refinements informed through community and stakeholder consultation; value engineering; and detailed planning on construction staging.

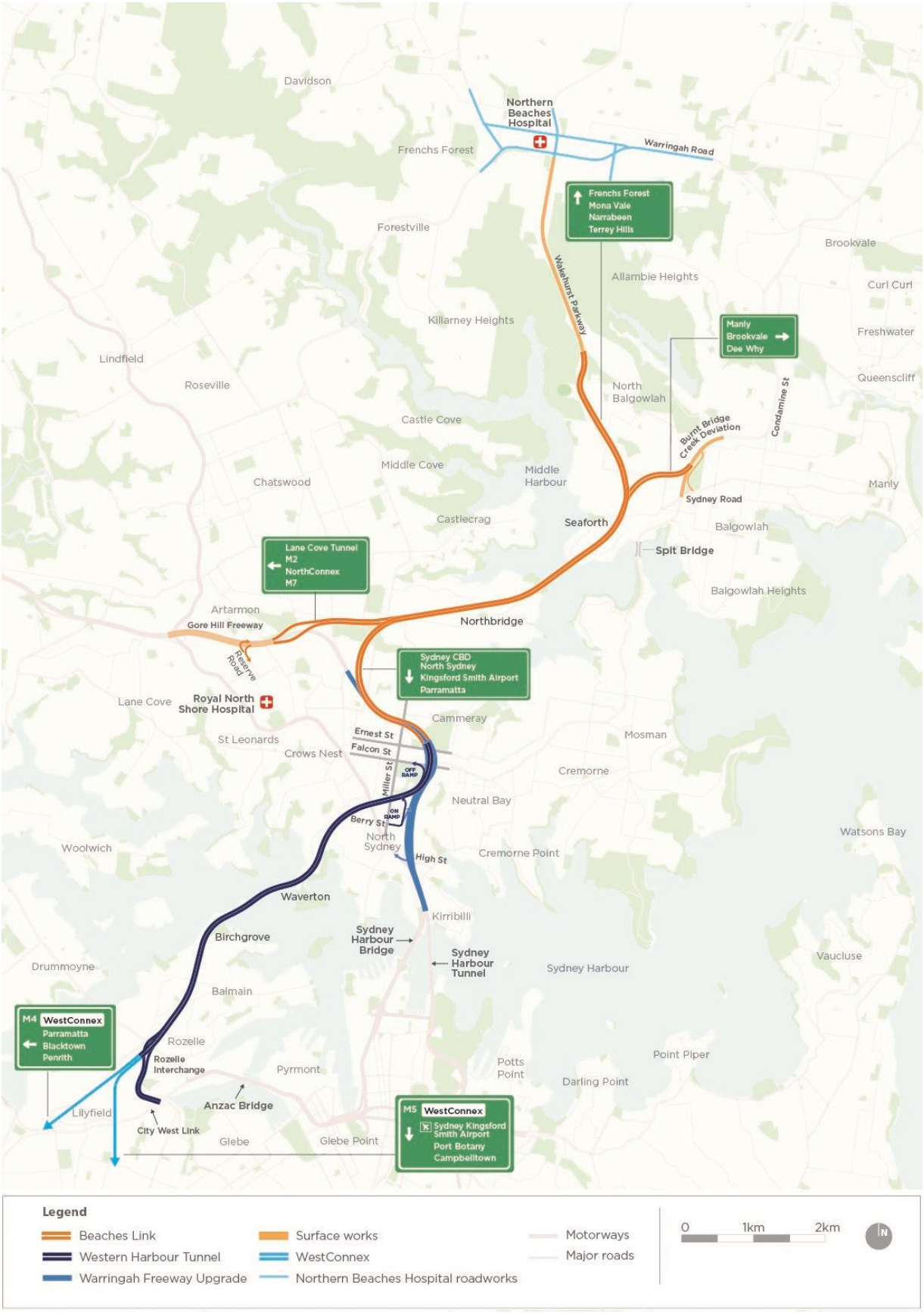
The core alignment, connectivity and functionality are retained as per the augmented Final Business Case for the Western Harbour Tunnel (including Warringah Freeway) Project.

During the development of the reference design, options were developed and key areas of the Program were further assessed. In respect to the Western Harbour Tunnel (including Warringah Freeway Upgrade), these included:

- Western Harbour Tunnel tunnelling strategy
- Western Harbour Tunnel connection to Rozelle Interchange
- Warringah Freeway Upgrade construction staging and interface with the Western Harbour Tunnel and Beaches Link
- Warringah Freeway access points.

The proposed reference design for the Program is shown in Figure 3.

Figure 3 – Western Harbour Tunnel and Beaches Link Program alignment



Economic evaluation

A full economic cost-benefit analysis was undertaken of the complete Program in accordance with NSW Treasury guidelines. A standard discount rate of 7% was used[5] to express all costs and benefits in 2017 values.

Costs

Best practice guidelines[6] were applied in preparing the cost estimates which assumed a construction period of five years for each of the projects. Since that time the capital cost estimates have been updated to reflect the development of the Updated Reference Design, revised unit rates, and to take account of the updated procurement and construction program.

The updated cost estimates to deliver the complete Program remain within the augmented Final Business Case range that formed the basis of the economic appraisal. The capital cost estimate range is subject to the finalisation of the Reference Design, procurement and construction programme and preferred delivery model and commencement of the Program.

Further, the final investment decision is yet to be taken on Beaches Link project. As such, the NSW Government has requested that the estimated cost of the complete Program is not publicised in this summary. Infrastructure NSW understands that the cost will be released by the NSW Government at a commercially appropriate time.

At the time of writing, the NSW Government is in the process of finalising the funding and financing strategy for the Western Harbour Tunnel (including the Warringah Freeway Upgrade) Project and preparing to approach the market for construction of the project.

Operational and maintenance expenditure was estimated based on a combination of first principles and benchmarking. This expenditure was calculated for a period of 35 years from the completion of construction and include operating costs such as energy consumption and traffic and incident response; annual maintenance costs such as inspections, testing, cleaning and minor asset servicing and replacement; and renewal of assets and systems used for monitoring, surveillance, maintaining air quality and ventilation.

At the time of undertaking the augmented Final Business Case the operational and maintenance costs were estimated over a 35-year period. This estimate reflects a P90[7] level of confidence. The operating and maintenance cost estimates are not expected to be adversely impacted by the finalisation of the Updated Reference Design, procurement and construction program and delivery model. To the extent that there are any delays to the commencement of the Program, this will have a cost impact.

[5] With sensitivity testing at 3% and 10%, consistent with NSW Treasury guidelines.

[6] These include: TfNSW (formerly RMS) (2008), Project Estimating Guidelines, March 2008, version 20; Department of Infrastructure and Transport (2011), Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction.

[7] Determined by probabilistic analysis, a P90 value provides a 90 percent level of confidence that the estimated cost will not be exceeded at project completion.

Benefits

The Program is expected to produce transport, productivity and city-shaping benefits:

- Transport benefits result from reduced travel time and better reliability, for all road users travelling between the Northern Beaches and other parts of Sydney, and on key corridors around the Harbour CBD, including the Sydney Harbour Bridge, Sydney Harbour Tunnel, Anzac Bridge and Western Distributor.
- Productivity benefits result from employment growth and increased productivity by better connectivity between the Northern Beaches and strategic centres around the Harbour CBD and Greater Sydney.
- City-shaping benefits result from improving the amenity of Sydney CBD and Military Road and enabling key centres of the Northern Beaches to be renewed by removing through traffic.

Total economic benefits of the Program are estimated at $12,469 million in discounted terms.

Standard transport benefits account for 80% ($10,007 million) of total benefits. The majority of the standard transport benefits are savings in travel time and increases in reliability:

- for road users, $7,873 million (79%)
- for bus users, $718 million (7%).

A further 11% ($1,428 million) of the total benefits are productivity benefits. The majority of these (77%) result from agglomeration, that is, the fact that workers and businesses are better connected.

The benefits of the Program have been assessed over a 30-year operational period[8]. The residual value of assets with a lifespan greater than 30 years has been valued at $463 million and included within the calculation of transport benefits.

Of the total benefits, city shaping account for 6% and flow breakdown[9] accounts for 2%. The key travel time, reliability and productivity benefits expected from the Program are described below.

The Western Harbour Tunnel

The Western Harbour Tunnel (including the Warringah Freeway Upgrade) Project will provide additional capacity on the busiest road corridor in Sydney. Key benefits in travel time and productivity will be realised by:

- Reducing congestion on access and distributor roads around the Harbour CBD. A western bypass of the CBD will remove through traffic and improve journey times for all vehicles accessing North Sydney and the CBD. The Western Distributor, for example, will experience traffic reductions of 35%.

[8] Consistent with NSW Treasury Guidelines.

[9] Flow breakdown occurs when there is insufficient capacity during the travel peak to accommodate all traffic. The benefit of reducing flow breakdown has not been included in the calculation of transport benefits as the methodology is new and not yet routinely included in core benefits.

- Enabling faster and more reliable journeys on Sydney Harbour crossings.
- Increasing resilience of the Harbour CBD road network. The Western Harbour Tunnel will provide an additional road to keep people and goods moving if there is an incident on the Sydney Harbour Bridge, Sydney Harbour Tunnel or Warringah Freeway corridor.
- Improving traffic performance on Warringah Freeway. The upgrade of the Freeway will separate local and through traffic and direct traffic to the harbour crossing best suited to its journey.
- Increasing productivity and access to the Harbour CBD. By reducing congestion, the Western Harbour Tunnel will reduce the cost of freight and business travel.

Beaches Link

Beaches Link will improve travel time and reliability for journeys to and from the Northern Beaches. Further details will be published in that project's own summary at an appropriate time.

Financials

The Business Case assumes that the Western Harbour Tunnel and Beaches Link will be tolled roads, consistent with the framework established for Harbour crossings and motorway projects.

The outcomes of the analysis

The NSW Government is seeking to better manage the sequencing and timing of the release of major projects to market. The Warringah Freeway Upgrade will be delivered as the first project to ensure connections to the existing network are available to support each of the Western Harbour Tunnel and Beaches Link projects. The Western Harbour Tunnel project will be delivered second to address the capacity constraints of the existing cross-harbour network with the Beaches Link project (subject to separate approval by the NSW Government) being delivered once cross-harbour resiliency has been improved.

To that end, the investment decision on the Program will be considered in two parts by Government. The initial investment decision is for the Western Harbour Tunnel (including the Warringah Freeway Upgrade) Project. Therefore, for the purposes of this Business Case summary, commentary by Infrastructure NSW on the outcome of the economic analysis is based on this initial investment decision. An update to this Business Case summary will be undertaken for the Beaches Link project, after the investment decision has occurred.

The outcome of the economic analysis for the Western Harbour Tunnel (including Warringah Freeway Upgrade) Project is summarised in Table 1. The outcome calculates the net present value (the present value of benefits less the present value of costs) using both the upper and lower estimated cost of the Project. It is important to note that these figures are based on the discounted cost and benefits of the project (as per standard NSW Treasury economic requirements).

The Net Present Value estimation is between $827 million and $1,167 million with a Benefit Cost Ratio (BCR) of between 1.2 and 1.3, when only the transport benefits are included (that is, when wider economic benefits, city-shaping benefits and flow breakdown benefits are excluded). This indicates that for every $1 of expenditure, the Western Harbour Tunnel (including Warringah Freeway Upgrade) Project is expected to return between $1.20 and $1.30 to the NSW economy. When all Program benefits are included, the Net Present Value is between $2,449 million and $2,789 million with a BCR between 1.6 and 1.7.

Table 1 – Outcomes of the analysis for the combined Western Harbour Tunnel (including Warringah Freeway Upgrade) Project

	Lower cost estimate	Upper cost estimate
NPV – using standard benefits (excluding WEBs + city-shaping + flow breakdown)	$1,167 million	$827 million
BCR – using standard benefits (excluding WEBs + city-shaping + flow breakdown)	1.3	1.2
NPV – using total benefits	$2,789 million	$2,449 million
BCR – using total benefits	1.7	1.6

Deliverability

The procurement and delivery strategy for the Western Harbour Tunnel (including Warringah Freeway Upgrade) Project was developed by Transport for NSW[10] and included feedback from industry via a Market Interaction Process in 2017. Industry input was sought on technical and commercial issues related to the development, procurement and delivery of the Program. A second round of the Market Interaction Process will be undertaken in late 2019 to inform the recommended procurement and delivery strategy.

The purpose of this activity is to ensure that the program is designed to allow the market to participate in a way that delivers value for money to the NSW Government and encourages industry innovation.

Procurement

Staging

The Warringah Freeway Upgrade is proposed to be the first stage procured and delivered to ensure connections to the existing road network are available for each of Western Harbour Tunnel and Beaches Link projects.

The proposed procurement strategy for the Western Harbour Tunnel and Beaches Link projects is to stage the delivery of the tunnels, with Western Harbour Tunnel to be delivered before Beaches Link.

Delivering the Beaches Link first, before the Western Harbour Tunnel was operational, would lead to extensive congestion on the Warringah Freeway and other approaches to the harbour crossings.

Packaging

The preferred delivery strategy involves three construction stages, with the Warringah Freeway Upgrade as the first stage, then the Western Harbour Tunnel as the second stage and Beaches Link as the third stage.

Transport for NSW is of the view that this approach:

- Reduces and simplifies scope of works within the Warringah Freeway Corridor, leading to reduced interface risks between the three projects.
- Provides better alignment of skills and better management of the different risk profiles of each project, given that the Warringah Freeway Upgrade comprises surface roads reconfigurations and Western Harbour Tunnel includes a submerged water crossing.
- Increases market interest, including Tier 2 contractors, and likely to provide better Value for Money outcomes.

A two-step procurement process is proposed. A call for expressions of interest would identify a short-list of companies who would be invited to prepare full proposals.

[10] Jointly with NSW Treasury and Roads and Maritime Services.

The preferred strategy involves the design and construction of the Warringah Freeway Upgrade as the first stage, with the completed works handed back to Transport for NSW who would be responsible for operating and maintaining the Freeway.

The Market Interaction Process occurred in late 2019 and early 2020 to inform the preferred strategy for delivery of the Western Harbour Tunnel. The Market Interaction Process for Beaches Link is scheduled for late 2020/early 2021.

The Business Case included a preliminary assessment of potential models and identifies several options for further consideration. The procurement and delivery strategy work undertaken through 2019 has identified several other options, which were discussed with industry via the Market Interaction Process.

Timeframe

The procurement process for the Warringah Freeway Upgrade is scheduled to commence in the third quarter of 2020. The procurement process for the Warringah Freeway is expected to take approximately 12 months. The completed works are expected to be open to traffic around 4.5 years after award of contract.

The procurement processes for the Western Harbour Tunnel and Beaches Link projects will be further developed once the preferred procurement and delivery strategy has been developed.

Key risks and mitigation

A comprehensive risk management process is in place with risks to the Program identified, together with strategies to manage these risks. The development of a reference design has provided the Program with increased financial and technical certainty that has reduced the level of risk.

The Updated Reference Design (2019) adopts Immersed Tube Tunnels (IMT) for the Western Harbour Tunnel and Beaches Link projects and the geotechnical conditions of IMT sites have been investigated. Despite this, there remains the possibility of unexpected seabed and harbour conditions. The Program involves integrating Western Harbour Tunnel and Beaches Link projects with the broader motorway network. This is complex technical and logistical work with ongoing risks, including traffic impacts, that will require careful management.

The Infrastructure NSW view

Consistent with the NSW Government's Infrastructure Investor Assurance Framework[11], Infrastructure NSW routinely assesses capital infrastructure project business cases and provides advice to the NSW Government on the efficacy of their findings. The augmented Program Business Case, and the Updated Reference Design and analysis, logic and robustness of key development areas were both reviewed.

The State Infrastructure Strategy 2018-2038 (the Strategy) considers both the Western Harbour Tunnel and Beaches Link projects. The Strategy notes that a Western Harbour Tunnel would create a western bypass of the CBD, completing Sydney's inner urban motorway network. The Strategy observes that such an integrated network that is free of "missing links" will serve Sydney well into the future.

The impact of a western city bypass to remove through traffic from sensitive residential and commercial precincts was also highlighted in the Strategy. This was seen to improve public amenity and enable more surface road space to be allocated to public transport, walking and cycling. Infrastructure NSW recommended in the Strategy, that, subject to the completion of a Business Case, the NSW Government invest in the Western Harbour Tunnel[12].

In reviewing the Business Case documentation for the Program, Infrastructure NSW found the material presented to be comprehensive in considering the key issues and of a high technical standard.

Major risks associated with all stages of the Program have been identified and assessed. Risk management is rigorous and tailored to respond to Program and project-specific risks including the delivery of project interfaces such as with WestConnex at Rozelle, and the upgrade of Warringah Freeway under live traffic conditions.

Refinement of the Program design has removed uncertainty and increased confidence in the estimated cost. Risks have been quantified to establish P50 and P90 costs for the capital and operational phases of the Program.

Infrastructure NSW notes the quantification of flow breakdown benefits within the economic analysis in the Business Case, as an innovation.

Flow breakdown occurs when traffic is forced to travel during shoulder periods because capacity is not available during peak travel periods. The Review supported the treatment of these benefits as "below the line", that is, they were not included as a standard benefit. Flow breakdown benefits are included with other wider economic benefits and city shaping benefits in the economic analysis.

The Business Case presents a lower and upper cost estimate for the Program. The BCR, using only the standard benefits of the Program, ranges from 1.2 to 1.3. This, together with the strategic importance of the Program in completing Sydney's inner urban motorway network, provides a basis for Government's investment decision.

[11] Infrastructure NSW (2018), State Infrastructure Plan 2018-2038: Building Momentum, page 137.

[12] Ibid, page 139.