Chapter 23

# Hazards and risks



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# 23 Hazards and risks

This chapter assesses potential hazards arising from incidents during project construction and operation that could pose a risk to public safety, the surrounding community or the environment and summarises the approaches taken to manage these risks. Other potential environmental hazards resulting from construction and operation of the project, and measures to avoid, mitigate and manage these risks are addressed in Chapter 8 (Construction traffic and transport) to Chapter 27 (Cumulative impacts) of this environmental impact statement. The impacts associated with human health risks are detailed in Chapter 13 (Human health).

The Secretary's environmental assessment requirements as they relate to hazard and risk impacts, and where in the environmental impact statement these have been addressed, are detailed in Table 23-1.

The proposed environmental management measures relevant to hazards and risks are included in Section 23.4.

**Table 23-1 Secretary's environmental assessment requirements – Hazards and risks**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Transport and traffic** | |
| 1. The Proponent must assess construction transport and traffic (vehicle, marine, pedestrian and cyclists) impacts, including, but not necessarily limited to:<br>a. a considered approach to route identification and scheduling of marine and land transport movements, particularly outside standard construction hours;<br>j. impacts to water based traffic and shipping channels on Sydney Harbour. | **Chapter 6** (Construction work), **Section 6.7** and **Section 6.8** show the land and maritime construction traffic/vessel movements for each construction support site, as well as the operating hours of each site.<br>Construction traffic routes are discussed in **Chapter 8** (Construction traffic and transport). **Section 8.4** discusses the proposed marine and land transport movements. **Section 23.2.4** outlines interactions between maritime traffic and tunnel infrastructure during construction. |
| **Health and Safety** | |
| 2. The assessment must:<br>f. assess the likely risks of the project to public safety, paying particular attention to pedestrian safety, subsidence risks, bushfire risks and the handling and use of dangerous goods; | An assessment of bushfire risks relating to construction and operation is presented in **Section 23.2.6** and **Section 23.3.5** respectively.<br>The handling, transport and use of dangerous goods is described in **Section 23.2** and **Section 23.3**.<br>An assessment of potential ground movement associated with the project is provided in **Chapter 16** (Geology, soils and groundwater). Ground movement due to construction activities is also discussed in **Section 23.2.3.**<br>Pedestrian safety is discussed in **Chapter 8** (Construction traffic and transport).<br>**Section 23.3.3** provides an assessment on the impacts of potential traffic incidents during operation. |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Socio-economic, Land Use and Property** | |
| 4. The Proponent must assess potential impacts on utilities (including communications, electricity, gas, fuel and water and sewerage) and the relocation of these utilities. | **Chapter 6** (Construction work) details utilities impacted during construction. **Chapter 5** (Project description) outlines utilities and services management for the project and **Appendix D** (Utilities management strategy) provides a detailed description of utilities likely to be impacted and a framework for utility installations, relocations, adjustments and protection. |
| **Hazards** | |
| 1. The Proponent must describe the process for assessing the risk of emissions from ventilation facilities on aircraft operations taking into consideration the requirements of the *Airports Act 1996 (Commonwealth)* and the Airports Regulation 1997. | The process for the assessment of risk of emissions from ventilation facilities on aircraft operation is described in **Chapter 2** (Assessment process), and the findings of this assessment are summarised in **Section 23.3.6**. |

## 23.1 Assessment methodology

An assessment was carried out to identify environmental hazards and risks that could arise during construction and operation of the project, as well as appropriate risk management measures.

The assessment focused on those hazards with the potential to adversely affect the surrounding environment, and the general public. It took into account the following guidelines:

- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, 2011)
- *Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)* (National Transport Commission, 2007)
- *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005)
- *Planning for Bushfire Protection* (Rural Fire Service (RFS), 2006)
- *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees* (RFS, 2008)
- Bushfire prone land mapping developed and published by the relevant local councils.

## 23.2 Assessment of potential construction impacts

During construction, potential hazards and risks to public safety, the surrounding community or the environment may be associated with:

- Storage and handling of dangerous goods and hazardous substances (Section 23.2.1)
- Transport of dangerous goods and hazardous substances (Section 23.2.2)
- Ground movement (settlement) or geotechnical uncertainty (Section 23.2.3)
- Interactions between maritime traffic and tunnel infrastructure (Section 23.2.4)
- Damage to or disruption of underground utilities and services (Section 23.2.5)

- Bushfires (Section 23.2.6).

Other potential environmental hazards resulting from the construction of the project are considered and addressed in the relevant chapters of this environmental impact statement.

### 23.2.1 Storage and handling of dangerous goods and hazardous substances

The anticipated types and quantities of dangerous goods and hazardous substances that would be stored and used within the project construction support sites are listed in Table 23-2. The types and quantities of dangerous goods and hazardous substances would be confirmed during further design development, and if necessary, further screening of potential risks would be carried out at that time. The screening would be used to confirm that the project would not pose a significant off-site risk.

While State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) would not apply to the project (refer to Chapter 2 (Assessment process)), the principles of SEPP 33 have been followed to consider potential hazards associated with the project. The screening thresholds specified in Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Applying SEPP33) (Department of Planning, 2011) have been applied to inventories of dangerous goods to be stored at each construction support site. These screening thresholds represent the level at which dangerous goods may present a credible off-site consequence requiring further, more detailed assessment of risks. Assessment against the screening thresholds is included in Table 23-2.

Table 23-2 demonstrates that the Applying SEPP 33 inventory thresholds would not be exceeded for any material on any site. The storage and use of dangerous goods and hazardous materials on the project construction support sites would therefore not pose an unacceptable risk of harm beyond the construction support site boundary.

Environmental hazards and risks associated with the on-site storage and use of chemicals, fuels and materials would be managed through standard mitigation measures (refer to Section 23.4). Storage of dangerous goods and hazardous substances would be in accordance with the supplier's instructions, and would comply with applicable legislation, guidelines and Australian Standards.

**Table 23-2 Indicative dangerous goods and hazardous substances stored at construction support sites**

| Material | Australian Dangerous Goods Code class | Storage method | Assessment against Applying SEPP 33 inventory thresholds | Construction support site |
|---|---|---|---|---|
| Explosives | 1.1 | No on site storage – delivery would be timed to avoid the need for on-site storage | Explosives would not be stored on site and would therefore not be subject to the Applying SEPP 33 thresholds. | N/A |
| Diesel | C1[1], 3 PG III[2] | Self-bunded fuel tank (up to 2.5 kilolitres) and 20 litre jerrycans | Diesel would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds. | All land based construction support sites. |
| Petrol | C1[1], 3 PG III[2] | Self-bunded fuel tank (up to 2.5 kilolitres) and 20 litre jerrycans | Petrol would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds. | All land based construction support sites. |
| Lubricating and hydraulic oils and grease | C2 | 20 litre drums | Lubricating and hydraulic oils and grease would not be stored with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds. | All construction support sites. |

| Material | Australian Dangerous Goods Code class | Storage method | Assessment against Applying SEPP 33 inventory thresholds | Construction support site |
|---|---|---|---|---|
| Industrial grade acetylene | 2.1 | 3.2 $m^3$ cylinders (13 kilograms) | Individual cylinders containing acetylene would not trigger the Applying SEPP 33 thresholds (100 kilograms).<br>Maximum stored inventories (250 kilograms) would be located more than 25 metres away from the nearest construction support site boundary and would therefore not trigger the Applying SEPP 33 thresholds if considered in aggregate. | All construction support sites. |
| Industrial grade oxygen | 2.2 | 8.9 $m^3$ cylinders | Industrial grade oxygen is a class 2.2 dangerous good and is therefore not subject to the Applying SEPP 33 thresholds. | All construction support sites. |
| Accelerator for shotcrete | 3.2 | 1000 litre intermediate bulk containers (IBC) | Individual IBCs containing accelerator fluid would not trigger the Applying SEPP 33 thresholds (five tonnes).<br>Maximum stored inventories (20,000 litres) would also be located more than eight metres away from the nearest construction support site boundary and would therefore also not trigger the Applying SEPP 33 thresholds if considered in aggregate. | • Victoria Road (WHT2)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10 and WFU8). |
| Retardants for concrete | 3 PGIII | 205 litre drums | Retardants would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. | All land based construction support sites. |

| Material | Australian Dangerous Goods Code class | Storage method | Assessment against Applying SEPP 33 inventory thresholds | Construction support site |
|---|---|---|---|---|
| Epoxies | 3 PGIII | 20 litre drums | Epoxies would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. | All construction support sites. |
| Acids | 8 PGIII | 1000 litre IBC (and smaller containers) | Acids would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. | All construction support sites. |
| Bases | 8 PGIII | 1000 litre IBC | Bases would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. | All construction support sites. |
| Disinfectants | 8 PGIII | 500 litre IBC | Disinfectants would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. | All land based construction support sites. |
| General purpose Portland cement | N/A | 20 kilogram bags | Cement is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | All land based construction support sites. |

| Material | Australian Dangerous Goods Code class | Storage method | Assessment against Applying SEPP 33 inventory thresholds | Construction support site |
|---|---|---|---|---|
| Road and joint sealants | N/A | 12 litre boxes | Road and joint sealants are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds. | All Warringah Freeway Upgrade construction support sites and the following construction support sites associated with the Western Harbour Tunnel component of the project:<br>• Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• Berry Street north (WHT8)<br>• Ridge Street north (WHT9)<br>• Cammeray Golf Course (WHT10). |
| Concrete curing compounds | N/A | 1000 litre IBC | Concrete curing compounds are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds. | All land based construction support sites. |
| Pavement layers curing compound | N/A | 1000 litre IBC | Pavement layers and curing compounds are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds. | All construction support sites associated with the Warringah Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project:<br>• Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• Berry Street north (WHT8)<br>• Ridge Street north (WHT9)<br>• Cammeray Golf Course (WHT10). |

| Material | Australian Dangerous Goods Code class | Storage method | Assessment against Applying SEPP 33 inventory thresholds | Construction support site |
|---|---|---|---|---|
| Paint for tunnel roof | N/A | 1000 litre IBC | Paint is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Cammeray Golf Course (WHT10). |
| Paints | N/A | 50 litre drums | Paints are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds. | • Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Cammeray Golf Course (WHT10 and WFU8)<br>• Blue Street (WFU1). |
| Coagulants | N/A | 1000 litre IBC | Coagulants are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds. | • Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10). |
| Anti-scalent | N/A | 100 litre drums | Anti-scalent is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10). |

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids
Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids

### 23.2.2 Transport of dangerous goods and hazardous substances

Dangerous goods and hazardous materials that would be transported to each construction support site are outlined in Table 23-3. Potential transportation hazards and risks have been considered through comparison of the type, quantity and frequency of dangerous goods and hazardous materials transportation with the thresholds presented in the Applying SEPP 33 Guideline. In all cases, the transportation of dangerous goods and hazardous materials to project construction support sites would be below the Applying SEPP 33 thresholds. This indicates that risks associated with transport of dangerous goods and hazardous materials would not be significant.

The proposed haulage routes outlined in Chapter 6 (Construction work) have been identified to avoid local roads where possible and would therefore minimise the risks associated with the transport of dangerous goods and hazardous materials.

**Table 23-3 Indicative dangerous goods and hazardous substances transported to construction support sites**

| Material | Australian Dangerous Goods Code class | Transport frequency | Transport quantity | Assessment against Applying SEPP 33 transport thresholds | Construction support site destination |
|---|---|---|---|---|---|
| Explosives | 1.1 | As required, if blasting is carried out | As required | Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods. | • Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10). |
| Diesel[1] | C1[2], 3 PG III[3] | Daily | 1500 litres | Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods.<br>Refuelling at cofferdam sites would be carried out by fit-for-purpose refuelling barge. | All construction support sites. |
| Petrol[1] | C1[2], 3 PG III[3] | Weekly | 50 litres | Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods.<br>Refuelling at cofferdam sites would be carried out by fit-for-purpose refuelling barge. | All construction support sites. |
| Lubricating and hydraulic oils and grease | C2 | Weekly | 40 litres | Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods. | All construction support sites. |
| Industrial grade acetylene | 2.1 | Monthly | 410 litres[4] | Transport quantities would not trigger the Applying SEPP 33 thresholds. | All construction support sites. |
| Industrial grade oxygen | 2.2 | Monthly | 410 litres[4] | Not subject to Applying SEPP 33 transport thresholds. | All construction support sites. |

| Material | Australian Dangerous Goods Code class | Transport frequency | Transport quantity | Assessment against Applying SEPP 33 transport thresholds | Construction support site destination |
|---|---|---|---|---|---|
| Accelerator for shotcrete | 3PGII | Weekly | 100 litres[4] | Transport quantities would not trigger the Applying SEPP 33 thresholds. | • Victoria Road (WHT2)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10 and WFU8). |
| Retardants for concrete | 3PGIII | Monthly | 205 litre drum | Transport quantities would not trigger the Applying SEPP 33 thresholds. | All land based construction support sites associated with the Western Harbour Tunnel component of the project and the following construction support sites associated with the Warringah Freeway Upgrade component of the project:<br>• Blue Street (WFU1)<br>• High Street south (WFU2)<br>• Cammeray Golf Course (WFU8). |
| Epoxies | 3PGIII | Monthly | 20 litres[4] | Transport quantities would not trigger the Applying SEPP 33 thresholds. | All construction support sites. |
| Acids, bases and detergents | 8PGII | Monthly | 20 litres[4] | Not subject to Applying SEPP 33 transport thresholds. | All construction support sites. |
| General purpose Portland cement | N/A | Monthly | 72 bags | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | All land based construction support sites. |
| Road and joint sealants | N/A | Monthly | 4 x 12 litre boxes | This is not a dangerous good and therefore does not trigger the Applying | All construction support sites associated with the Warringah |

| Material | Australian Dangerous Goods Code class | Transport frequency | Transport quantity | Assessment against Applying SEPP 33 transport thresholds | Construction support site destination |
|---|---|---|---|---|---|
| | | | | SEPP 33 thresholds. | Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project:<br>• Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• Berry Street north (WHT8)<br>• Ridge Street north (WHT9)<br>• Cammeray Golf Course (WHT10). |
| Concrete curing compounds | N/A | Monthly | 50 litres | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | All Western Harbour Tunnel and Warringah Freeway Upgrade land based construction support sites. |
| Pavement layers curing compound | N/A | Monthly | 100 litres | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | All construction support sites associated with the Warringah Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project:<br>• Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• Berry Street north (WHT8)<br>• Ridge Street north (WHT9)<br>• Cammeray Golf Course (WHT10). |

| Material | Australian Dangerous Goods Code class | Transport frequency | Transport quantity | Assessment against Applying SEPP 33 transport thresholds | Construction support site destination |
|---|---|---|---|---|---|
| Paint for tunnel roof | N/A | 5 to 6 deliveries | 50 litre drums | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Cammeray Golf Course (WHT10). |
| Paints | N/A | Monthly (during second half of construction program) | 250 litres | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Rozelle Rail Yards (WHT1)<br>• Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Cammeray Golf Course (WHT10 and WFU 8)<br>• Blue Street (WFU1). |
| Coagulants | N/A | Monthly | 150 kilograms | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10). |
| Anti-scalent | N/A | Monthly | 1000 litres | This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds. | • Victoria Road (WHT2)<br>• White Bay (WHT3)<br>• Yurulbin Point (WHT4)<br>• Berrys Bay (WHT7)<br>• Cammeray Golf Course (WHT10). |

Note 1: For some construction support sites, the quantity of diesel and unleaded petrol delivered to site would be greater than the quantity stored within the facility at any time, because the delivery volume takes into the account fuel that is brought to the facility by mini-tanker and used to directly refuel plant. As this fuel is 'in use' in the plant it is not classified as 'stored'.
Note 2: Classified as C1 if not stored with other Class 3 flammable liquids.
Note 3: Classified as 3 PG III if stored with other Class 3 flammable liquids
Note 4: Per construction support site.

### 23.2.3 Ground movement and geological uncertainty

Ground movement (or settlement) refers to a localised lowering of the ground level due to construction activities involving excavation or disturbance below ground. If unmanaged, ground movement can present a risk to the stability of nearby buildings and other structures, including building basements and ground support structures.

An assessment of potential ground movement associated with the project is provided in Chapter 16 (Geology, soils and groundwater). Preliminary ground movement investigations indicate that there may be potential settlement of greater than 40 millimetres around the Warringah Freeway portal, while the Rozelle portal could potentially experience maximum total settlement of 30 to 35 millimetres. This would be assessed as 'slight' severity under relevant guidelines.

No buildings were found to be in the 'slight' to 'very severe' damage categories. Buildings categorised with 'very slight' damage would be mainly located at shallow cover tunnels near portals and/or larger span cavern locations as those found at Cammeray.

'Very slight' damage (fine cracks) would be easily treated during normal decoration. Damage would generally be restricted to internal wall finishes, with small cracks visible on external brickwork or masonry.

Building/structure condition surveys would be carried out as applicable prior to commencement of construction. Any impacts from settlement caused by the project would be rectified to the condition prior to construction works. For further information regarding potential ground movement associated with the project, please see Chapter 16 (Geology, soils and groundwater).

Geotechnical investigations have been carried out to understand the ground conditions where construction would occur. These investigations have confirmed that high quality Hawkesbury sandstone would be encountered for the majority of the proposed tunnel alignment. Furthermore, the alignment of the proposed tunnels means that they would be very deep for the majority of their length, with a significant layer of stone between the tunnels and surface.

This data has been used to inform the project design and tunnel conduction methods to reduce the construction risks associated with uncertain ground conditions (additional geotechnical investigations would be carried out during further design development to confirm ground conditions, where required). Primary support for the project tunnels would be installed as the excavation progresses, as recommended by an appropriately qualified geotechnical or tunnel engineer, to ensure tunnel stability during construction.

### 23.2.4 Interactions between maritime traffic and tunnel infrastructure

The project would require marine vessel movements during construction of the immersed tube tunnels in Sydney Harbour, including:

- Barges for delivering material, removing cofferdam spoil, removing dredged material, or for other construction activities
- Barges with piling equipment and cranes
- Tugboats for manoeuvring barges
- Transport vessels for workers.

During immersion of the tube tunnel units, there is a risk that maritime traffic could collide with these units if they pass over the tunnels before they are in the final position on the bed of the

harbour. The timeframe for immersion would be very short (less than two days per unit), and measures would be put in place to manage this risk, such as restrictions to marine vessel movements passing over the crossing location during immersion of the tube tunnels. As outlined in Chapter 8 (Construction traffic and transport), simulation work carried out has demonstrated that the installation of immersed tube tunnels can be carried out safely.

## 23.2.5 Damage or disruption to underground utilities

The project has been designed, where possible, to avoid utilities, taking into account the results of utility investigations and consultation with utility providers carried out during the design process (refer to Chapter 7 (Stakeholder and community engagement)). Where the project is unable to avoid utilities, if possible, they would be relocated and/or protected prior to the commencement of construction to avoid impacts. Otherwise relocation and protection would occur during construction.

Consultation with utility infrastructure providers would continue during the design and construction phases of the project to mitigate the risk of unplanned and unexpected disturbance of utilities. In rare circumstances, the relocation of utilities may result in short term outages of some utilities to surrounding areas. Utilities which would be directly impacted and require protection and/or relocation have been considered in Appendix D (Utilities management strategy).

## 23.2.6 Bushfires

A bushfire risk assessment was carried out to assess potential bushfire implications of the project. In accordance with *Planning for Bushfire Protection* (RFS, 2006) the predominant vegetation class (bushfire prone land) has been assessed to a distance of 140 metres from the project in all directions. Table 23-4 provides the assessed bushfire risk level for construction support sites located on, or in proximity to, bushfire prone land. The level of bushfire risk is determined using a combination of likelihood and consequence, with the likelihood of bushfire risk for all assets being defined as the chance of a bushfire igniting and spreading and the consequence being the outcome or impact of a bushfire event (RFS, 2008).

**Table 23-4 Bushfire risk level for construction support sites**

| Construction support site(s) | Bushfire risk level | Proximity to bushfire prone land |
|---|---|---|
| Rozelle Rail Yards (WHT1)<br>Victoria Road (WHT2)<br>White Bay (WHT3)<br>Yurulbin Point (WHT4)<br>Berry Street north (WHT8)<br>Ridge Street north (WHT9)<br>Cammeray Golf Course (WHT10)<br>Waltham Street (WHT11)<br>All Warringah Freeway Upgrade construction support sites (WFU1 to WFU 9) | Low | No bushfire prone land within 140 metres. |

| Construction support site(s) | Bushfire risk level | Proximity to bushfire prone land |
|---|---|---|
| Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6) | Low | Not applicable as the construction support sites are located within Sydney Harbour. |
| Berrys Bay (WHT7) | Low | The south-western portion of the site is located in an area classified as bushfire prone land (dry Sclerophyll forest). |

The bushfire risk assessment concluded that all areas of the project are considered to have a bushfire risk level of 'low'. It should be noted however that the Berrys Bay construction support site (WHT7) is situated within 140 metres of Balls Head Reserve, which is bushfire prone land given the presence of dry Sclerophyll forests. As such, Balls Head Reserve is considered a potential bushfire hazard with a 'possible' likelihood of occurrence.

Balls Head Reserve is managed by North Sydney Council, including fuel management, as identified in the *Mosman North Sydney Willoughby Bushfire Risk Management Plan 2017-2022* (Mosman North Sydney Willoughby Bush Fire Coordinating Committee, 2008). Council management of Balls Head Reserve would contribute to the bushfire protection measures for the construction support site at Berrys Bay.

Strategies to reduce risk from bushfire, such as site layout, setbacks from bushfire prone vegetation, access and emergency procedures at Berrys Bay construction support site (WHT7) would be developed and implemented during construction (refer to Section 23.4).

## 23.3 Assessment of potential operational impacts

During operation, the following potential hazards and risks may be associated with the project:

- Storage and use of dangerous goods and hazardous substances (Section 23.3.1)
- Transport of dangerous goods and hazardous substances (Section 23.3.2)
- Traffic incidents on surface roads and within tunnels (Section 23.3.3)
- Interactions between maritime traffic and tunnel infrastructure (Section 23.3.4)
- Bushfires (Section 23.3.5)
- Atmospheric turbulence caused by discharges from the ventilation outlets and motorway facilities at the Rozelle Interchange and at the Warringah Freeway and the interface with aviation (Section 23.3.6).

Other potential environmental hazards resulting from the operation of the project are considered and addressed in the relevant chapters of this environmental impact statement.

### 23.3.1 Storage and handling of dangerous goods and hazardous substances

Dangerous goods and hazardous materials would be stored at the operational facilities to be provided as part of the project and used during operation of the project. The types and quantities of dangerous goods and hazardous materials to be stored on-site during operation are summarised in Table 23-5. Additional small quantities of other materials may be required on-site from time to time to support occasional maintenance activities. Managed in accordance with the measures in Section 23.4, these materials would not pose a substantial risk to the general public during operation of the project.

Comparison of the types and quantities of dangerous goods and hazardous materials to be stored on-site with the thresholds in Applying SEPP 33 demonstrates that operational inventories would not pose a significant risk of harm beyond the boundary of the operational facilities.

**Table 23-5 Indicative dangerous goods and hazardous substances stored on-site during operation**

| Material and Australian Dangerous Goods Code class | Storage method (amount stored at any one time) | Inventory thresholds in the SEPP 33 Guidelines | Assessment against Applying SEPP 33 inventory thresholds |
|---|---|---|---|
| Diesel<br>C1[1], 3 PG III[2] | Bunded tanks on site | N/A | Diesel would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds. |
| Grease<br>C2 | 400-gram cartridge, 20 litre containers stored undercover on site | N/A | Grease would not be stored with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds. |
| Adhesives<br>C2, PGIII | 375-gram cartridge, 20 litre containers stored on site | 5 tonnes | Adhesives would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. |
| Acetylene<br>C2.1 | Size G cylinders on site | 100 kilograms | Individual cylinders containing acetylene would not trigger Applying SEPP 33 thresholds. Maximum stored inventories would not trigger the Applying SEPP 33 thresholds if considered in aggregate. |
| Line-marking aerosol<br>C2.1 | 375 millimetre aerosol container stored undercover on site | 100 kilograms | Line-marking aerosol would not trigger the Applying SEPP 33 thresholds. |
| Oxygen<br>C2.2 | Size G cylinders on site | N/A | Industrial grade oxygen is a Class 2.2 dangerous good and is not subject to the Applying SEPP 33 thresholds. |
| Kerosene<br>C3, PGIII | 20 litre container stored in an undercover bunded area on site | 5 tonnes | Kerosene would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. |

| Material and Australian Dangerous Goods Code class | Storage method (amount stored at any one time) | Inventory thresholds in the SEPP 33 Guidelines | Assessment against Applying SEPP 33 inventory thresholds |
|---|---|---|---|
| Oxygen (subsidiary risk)<br>C5.1 | Size G cylinders on site | 5 tonnes | Oxygen has a subsidiary risk Class of 5.1. It would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. |
| Sodium hydroxide<br>C8, PGII | 10,000 litre feed tank in an undercover bunded area on site | 25 tonnes | Sodium hydroxide would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. |
| Bitumen<br>C9 | 12,000 litre tanker (brought onto site as required) | N/A | Bitumen is a Class 9 dangerous good and is not subject to the Applying SEPP 33 thresholds. |
| Coagulant<br>N/A | 12,000 litre feed tank in an undercover bunded area on site | N/A | Coagulant is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |
| Polymers<br>N/A | 20 kilogram bags stored in a container undercover on site | N/A | Polymers are not classified as a dangerous good and would not trigger the Applying SEPP 33 thresholds. |
| Non-shrink grout<br>N/A | 20 kilogram bags stored undercover on site | N/A | Non-shrink grout is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |
| Release agent (lanolin-based)<br>N/A | 20 litre drums stored undercover on site | N/A | Release agent (lanolin-based) is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids.
Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids.

### 23.3.2 Transport of dangerous goods and hazardous substances

Dangerous goods and hazardous materials that would be transported to the project during operation are outlined in Table 23-6. The risks associated with transport of dangerous goods and hazardous materials would not be significant.

The mainline tunnels would be listed as prohibited areas under Road Rules 2014 – Rule 300-2: NSW rule: carriage of dangerous goods in prohibited areas (Regulation 300-2) prior to opening to traffic. The transport of dangerous goods in prohibited areas, including the mainline tunnels, would be prohibited. Signage would be provided near tunnel entry portals advising of applicable restrictions to ensure compliance with Regulation 300-2.

**Table 23-6 Dangerous goods and hazardous substances transported during operation**

| Material and Australian Dangerous Goods Code class | Transport frequency | Transport quantity (indicative only) | Transport thresholds in the SEPP 33 Guidelines | Assessment against Applying SEPP 33 transport thresholds |
|---|---|---|---|---|
| Diesel<br>C1[1], 3 PG III[2] | As required | As required | N/A | Diesel would not be transported with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds. |
| Grease<br>C2 | Weekly | 50 cartridges (20 kilograms) | N/A | Grease would not be transported with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds. |
| Adhesives<br>C2, PGIII | Weekly | 50 cartridges (19 kilograms) | Minimum transport load or transport frequency of 10 tonnes, more than 60 times per week. | Adhesives would not trigger the Applying SEPP 33 thresholds. |
| Acetylene<br>C2.1 | Weekly | 50 cylinders | Minimum transport load or transport frequency of two tonnes, more than 30 times per week. | Industrial grade acetylene would not trigger the Applying SEPP 33 thresholds for minimum transport load or transport frequency of two tonnes, more than 30 times per week. |
| Line-marking aerosol<br>C2.1 | Quarterly | 50 cans | Minimum transport load or transport frequency of two tonnes, more than 30 times per week. | Line-marking aerosol would not trigger the Applying SEPP 33 thresholds. |
| Oxygen<br>C2.2 | Weekly | 50 cylinders | N/A | Industrial grade oxygen is a Class 2.2 dangerous good and is not subject to the Applying SEPP 33 thresholds. |
| Kerosene<br>C3, PGIII | Monthly | 80 litres | Minimum transport load or transport frequency of 10 tonnes, more than 60 times per week. | Kerosene would not trigger the Applying SEPP 33 thresholds. |

| Material and Australian Dangerous Goods Code class | Transport frequency | Transport quantity (indicative only) | Transport thresholds in the SEPP 33 Guidelines | Assessment against Applying SEPP 33 transport thresholds |
|---|---|---|---|---|
| Oxygen (subsidiary risk)<br>C5.1 | Weekly | 50 cylinders | Minimum transport load or transport frequency of two tonnes, more than 30 times per week. | Oxygen has a subsidiary risk Class of 5.1. It would not trigger the Applying SEPP 33 thresholds. |
| Sodium hydroxide<br>C8, PGII | Six monthly | 10,000 litres | Minimum transport load of 25 tonnes. | Sodium hydroxide would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate. |
| Bitumen<br>C9 | Quarterly | 12,000 litres | Minimum transport frequency of more than 60 times per week. | Bitumen would not trigger the Applying SEPP 33 thresholds. |
| Coagulant<br>N/A | Quarterly | 10,000 litres | N/A | Coagulant is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |
| Polymers<br>N/A | Quarterly | 1000 kilograms | N/A | Polymers are not classified as a dangerous good and would not trigger the Applying SEPP 33 thresholds. |
| Non-shrink grout<br>N/A | Monthly | 1900 kilograms | N/A | Non-shrink grout is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |
| Release agent (lanolin-based)<br>N/A | Twice monthly | 180 litres | N/A | Release agent (lanolin-based) is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds. |

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids.
Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids.

### 23.3.3 Traffic incidents

The project has been designed to provide efficient, free flowing traffic conditions with capacity to safely accommodate forecast traffic volumes. The project design incorporates all feasible and reasonable traffic safety measures including those related to geometry, pavement, lighting, signage and shared user facilities consistent with current Australian Standards, road design guidelines and industry best practice. In doing so, the design of the project inherently minimises the likelihood of incidents and accidents.

Each project tunnel would be one directional, reducing the risk of crashes through head on collisions and simplifying smoke management and egress requirements. The transport of dangerous goods and hazardous substances would be prohibited through the mainline tunnels and entry and exit ramps, reducing the risk of very large fires or the release of toxic materials in the tunnels.

Notwithstanding, human factors in particular cannot be entirely removed during operation of the project and there would remain a residual risk of incidents and accidents. In the event of incidents and accidents, the project has been designed to meet appropriate fire and life safety requirements. The key fire and life safety aspects of the project are described in Chapter 5 (Project description), and would include maintenance and emergency breakdown bays, fire and incident detection equipment, communication systems, fire suppression systems, emergency lighting, smoke management and power systems, cross passages or longitudinal egress passages, and tunnel closure systems. The fire and life safety systems would be installed in accordance with Australian Standard *AS 4825:2011 Tunnel Fire Safety*, applicable Austroads and Transport for NSW guidelines, and the outcomes of consultation with emergency services.

In the event of an incident, approaching traffic would be prevented from entering the mainline tunnels. Vehicle occupants upstream of the fire or incident would be instructed to stop their vehicles, and exit in the opposite direction through the section of carriageway that would be protected by the smoke management system, or through an exit door to a pressurised and fire rated cross-passage leading to the other non-incident mainline tunnel.

Occupants downstream of the fire or incident would be encouraged to continue driving out of the tunnel. If this is not possible and they are forced to evacuate on foot, egress would be provided via exit doors to pressurised and fire rated cross-passages leading to the non-incident mainline tunnel. Emergency services would be able to reach the fire or incident via the non-incident tunnel, or from the upstream direction in the affected tunnel. Emergency vehicle cross passages have also been included in the design at key locations.

During emergency conditions the ventilation system would extract smoke from the affected tunnels. Depending on the location of the incident, smoke would be emitted from one or more of the ventilation outlets and from the tunnel portals at the mainline tunnel surface connections.

### 23.3.4 Interactions between maritime traffic and tunnel infrastructure

The crossing of Sydney Harbour would comprise two immersed tube tunnels between Birchgrove and Waverton. The immersed tube tunnels would be placed in a dredged trench on the bed of Sydney Harbour and then backfilled with a combination of locking fill and rock armour to secure the tunnel on the bed of the harbour and protect the tunnel from impact loading. Existing depth in the main channel would be maintained to provide sufficient clearance for all harbour traffic in Sydney Harbour.

With respect to maritime traffic, the immersed tube tunnel units would be designed to protect against:

- Falling and dragging anchors
- Sinking vessels
- High currents
- Propeller wash and vessel wake.

As such, it is not expected that there would be any risk to the tunnels during operation of the project as a result of maritime traffic.

### 23.3.5 Bushfires

Most of the project's operational facilities would not be vulnerable to bushfire risk due to its incombustible nature (road surface materials, retaining walls, road barriers), fire safety ratings and/or location underground.

No operational facilities would be located within 140 metres of bushfire prone vegetation.

### 23.3.6 Aviation risks

The operational design of the project has considered airspace protection and associated risks and hazards. As discussed in Chapter 2 (Assessment process), under the *Airports Act 1996*, a 'controlled activity' in relation to a prescribed airspace must not be carried out or caused to be carried out without the approval of the Secretary of the Department of Infrastructure and Regional Development or otherwise exempt under the Airspace Regulations 2007.

Regulations define the 'prescribed airspace' for Sydney Airport as the airspace above any part of either an obstacle limitation surface (OLS) or procedures for air navigation systems operations (PANS-OPS) surface for Sydney Airport.

The OLS is an invisible level that defined the limits to which objects may project into the airspace around an aerodrome so that aircraft operations may be conducted safely. The OLS defines the airspace to be protected for aircraft operating during the initial and final stages of flight or manoeuvring near Sydney Airport. This has been established in accordance with International Civil Aviation Organisation specifications, as adopted by the Civil Aviation Safety Authority.

PANS-OPS surfaces are conceptual surfaces in space that establish the airspace that is to remain free of any potential disturbance (including physical objects and other disturbances such as emissions from ventilation outlets) so that aircraft operations may be conducted safely. Where structures may (under certain circumstances) be permitted to penetrate the OLS, they would not normally be permitted to penetrate any PANS-OPS surface.

Operational buildings and structures that form part of the project, including the ventilation outlets and motorway facilities at the Rozelle Interchange and at the Warringah Freeway, are designed to be below the prescribed airspace heights.

The Civil Aviation Safety Authority stipulates requirements for the construction and operation of new infrastructure that has the potential to influence aviation safety. The Civil Aviation Safety Authority may determine that exhaust from a ventilation outlet is a hazardous object if the vertical velocity of the emissions exceeds 4.3 metres per second within the OLS and/or PANS-OPS surfaces.

A plume rise assessment was carried out in accordance with the *Civil Aviation Safety Authority Advisory Circular Plume Rise Assessments AC 139-5(1) November 2012* to determine whether

plume rise resulting from the operation of the ventilation outlets and motorway facilities at the Rozelle Interchange and Warringah Freeway would be a controlled activity as defined in section 183 of the *Airports Act 1996*. The modelling considered the expected case scenario, based on predicted weekday traffic flows within the project tunnels and the capacity case, based on the maximum theoretical airflow that can be discharged from each ventilation outlet, for the project only. The capacity case scenario is a conservative upper bound of potential plume rise extents from the ventilation outlets, and the ventilation outlets are not expected to operate at design capacity on a regular basis. In addition, the cumulative case was modelled, which considered co-located ventilation outlets at the Warringah Freeway for Western Harbour Tunnel and Beaches Link program of works.

A plume rise assessment found that the ventilation outlet and motorway facilities at the Warringah Freeway would not exceed 4.3 metres per second at the OLS and PANS-OPS surfaces under the expected case scenario. During the capacity case, the plume velocities would exceed the OLS during the project only and cumulative scenarios. However, the plume velocities would not exceed 4.3 metres per second at the PANS-OPS surface in the project only and cumulative scenarios.

A plume rise assessment for the ventilation outlet and motorway facilities at the Rozelle Interchange found that:

- Under the expected case, plume velocities from the ventilation outlet and motorway facilities would not exceed 4.3 metres per second at the PANS-OPS and OLS surfaces
- Under the capacity case, the plume velocity from the ventilation outlet and motorway facilities would exceed 4.3 metres per second at the PANS-OPS surface only (noting that the PANS-OPS surface at the Rozelle Interchange is lower than the OLS surface). However, the assessment found that although an exceedance for the PANS-OPS surface was predicted, this is estimated to occur very infrequently (0.02 per cent of the time).

The design of the ventilation outlets and motorway facilities would be finalised during further design development and would be designed to satisfy requirements set by the Department of Infrastructure, Regional Development and Cities in relation to erected structures (such as ventilation outlets), equipment manoeuvring and lighting. A plume rise application would be prepared for the approval under the *Airports Act 1996* to cover both the ventilation outlet and motorway facilities at the Rozelle Interchange and at the Warringah Freeway where they may constitute a controlled activity.

## 23.4 Environmental management measures

The implementation of environmental management measures for the project would avoid, to the greatest extent possible, risks to public safety and achieve the desired performance outcomes in relation to the hazards identified in this chapter. Environmental management measures relating to hazards and risk identified in this chapter are outlined in Table 23-7. Management measures relating to other potential environmental hazards resulting from the construction or operation of the project are outlined in Chapter 8 (Construction traffic and transport) to Chapter 27 (Cumulative impacts) of this environmental impact statement.

**Table 23-7 Environmental management measures – hazards and risks**

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| HR1 | Construction | Storage of dangerous goods and hazardous | Dangerous goods and hazardous materials will be stored in accordance with supplier's instructions and relevant legislation, Australian Standards, and | WHT/WFU |

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| | | substances | applicable guidelines and may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds. | |
| HR2 | Construction | Transportation of dangerous goods and hazardous substances | Dangerous goods and hazardous substances will be transported in accordance with relevant legislation and codes, including the *Dangerous Goods (Road and Rail Transport) Act 2008,* Road and Rail Transport (Dangerous Goods) (Road) Regulation 1998 and the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2007). | WHT/WFU |
| HR3 | Construction | Bushfire | Adequate access and egress for fire fighting vehicles and construction vehicles and staff will be provided at the Berrys Bay construction support site (WHT7). Access roads will have a minimum width of four metres to allow passage of fire fighting vehicles. | WHT (Berrys Bay construction support site (WHT7)) |
| HR4 | Construction | | Adequate setbacks from bushfire prone vegetation will be provided for the Berrys Bay construction support site (WHT7). | WHT (Berrys Bay construction support site (WHT7)) |
| HR5 | Construction | | First response capabilities, including fire extinguishers, water carts and hoses, will be provided at the Berrys Bay construction support site (WHT7). | WHT (Berrys Bay construction support site (WHT7)) |
| HR6 | Operation | Fire and life safety | The fire and safety systems and measures adopted for the project will be equivalent to or exceed the fire safety measures recommended by NFPA502 (American), PIARC (European), AS4825 and AS3959-2009 (Australian) and relevant Transport for NSW standards. | WHT/WFU |
| HR7 | Operation | Transportation of dangerous goods and hazardous substances | The transport of dangerous goods and hazardous substances will be prohibited through the mainline tunnels and on and off-ramp tunnels. | WHT/WFU |

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| HR8 | Operation | Incident response | The response to incidents within the motorway will be managed in accordance with the memorandum of understanding between Transport for NSW and the NSW Police Service, NSW Rural Fire Service, NSW Fire Brigade and other emergency services. | WHT/WFU |
| HR9 | Operation | Aviation risks | The ventilation outlet and motorway facilities at Rozelle Interchange and Warringah Freeway will be operated in accordance with any conditions of approval from the Secretary of Department of Infrastructure and Regional Development to manage penetration of the OLS and PANS-OPS surfaces. | Ventilation outlet and motorway facilities at the Rozelle Interchange and at the Warringah Freeway |

Western Harbour Tunnel = WHT, Warringah Freeway Upgrade = WFU

Chapter 24

# Resource use and waste management

January 2020

# 24 Resource use and waste management

This chapter describes the resources and materials, including potential sources and the expected quantities that would be used to construct and operate the project.

Construction and operation of the project would also generate waste streams which would require management and disposal in accordance with relevant state policies and guidelines. This chapter provides a description of likely waste streams, expected quantities, and waste management strategies.

The Secretary's environmental assessment requirements as they relate to resource use and waste management, and where in the environmental impact statement these have been addressed, are detailed in Table 24-1 (Secretary's environmental assessment requirements checklist).

The proposed environmental management measures relevant to resource use and waste management are discussed in Section 24.6.

**Table 24-1 Secretary's environmental assessment requirements – resource use and waste management**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Waste** | |
| 1. The Proponent must assess predicted waste generated from the project during construction and operation, including:<br>a. classification of the waste in accordance with the current guidelines; | Waste streams are classified in **Section 24.3.2** and **Section 24.4.2**. |
| b. estimates/details of the quantity of each classification of waste to be generated during the construction of the project, including bulk earthworks and spoil balance; | Estimates of the quantities of waste are provided in **Sections 24.3.1** and **24.4.1**. Spoil balance and management is also outlined in **Section 24.3.3**. |
| c. handling of waste including measures to facilitate segregation and prevent cross contamination; | Construction waste management measures are provided in **Section 24.6**. |
| d. management of waste including estimated location and volume of stockpiles; | Indicative stockpile locations and volumes is provided in **Section 24.3**. |
| e. waste minimisation and reuse; | The reuse of construction and operational waste is discussed in **Section 24.3.1** and **Section 24.4.1** respectively. |
| f. lawful disposal or recycling locations for each type of waste; and | Disposal and recycling options are outlined in **Section 24.3.2** and **Section 24.5**. |
| g. contingencies for the above, including managing unexpected waste volumes. | Contingencies for managing unexpected waste is discussed in **Section 24.6**. |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| 2. The Proponent must assess potential environmental impacts from the excavation, handling, storage on site and transport of the waste particularly with relation to sediment/leachate control, noise and dust. | Potential environmental impacts associated with the handling, storage and transport of waste are discussed in **Section 24.3.1** and **Section 24.4.1**.<br>Dust impacts and management are discussed in **Chapter 12** (Air quality).<br>Noise impacts and management are discussed in **Chapter 10** (Construction noise and vibration).<br>Sediment control and potential environmental impacts associated with the excavation of waste are described in **Chapter 16** (Geology, soils and groundwater) and **Chapter 17** (Hydrodynamics and water quality). |

## 24.1 Legislative and policy framework

Waste management and recycling is regulated in NSW through the *Protection of the Environment Operations Act 1997*, the Protection of the Environment Operations (Waste) Regulation 2014 (including the requirement to track certain types of waste) and the *Waste Avoidance and Resource Recovery Act 2001*.

The *Waste Avoidance and Resource Recovery Act 2001* aims to promote efficient use of resources, and avoidance and minimisation of waste through the following resource management hierarchy:

- Avoidance of unnecessary resource consumption
- Resource recovery, including reuse, reprocessing, recycling and energy recovery
- Disposal.

By minimising consumption and encouraging the efficient use of resources, the *Waste Avoidance and Resource Recovery Act 2001* aims to reduce the generation and impacts of waste.

The following guidelines inform or respond to the regulatory framework and have been applied to the assessment of the project:

- *Waste Classification Guidelines* (NSW EPA, 2014a)
- *Technical Guide: Management of Road Construction and Maintenance Wastes* (Roads and Maritime, 2016c)
- *NSW Sustainable Design Guidelines*, Version 4.0 (Transport for NSW, 2017e)
- *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2* (DECC, 2008).

A number of policies and strategic documents are relevant to the project's resource use and waste management. The *NSW Government Resource Efficiency Policy* (Office of Environment and Heritage, 2014b) aims to drive resource efficiency by NSW Government agencies and reduce harmful air emissions from government operations. As a government agency, Transport for NSW has a responsibility under this policy to incorporate resource-efficiency considerations in all major decisions to address rising costs for energy, water, clean air and waste management.

The *NSW Waste Avoidance and Resource Recovery Strategy 2014–21* (NSW EPA, 2014b) supports the avoidance and minimisation of waste and provides a framework and targets for waste management and recycling in NSW until 2021–2022.

Transport for NSW, as a NSW Government agency, supports these targets by:

- Implementing complementary policies and programs, including sustainable procurement policies
- Incorporating resource recovery and waste reduction objectives into its operations
- Complying with relevant regulations.

The aims of these policies are incorporated into the *Environmental Sustainability Strategy 2015–2019* (Roads and Maritime, 2016d), which outlines specific focus areas for integrating sustainability into Transport for NSW projects and services. Under the Sustainability Strategy, resource use and waste reduction initiatives include:

- Consideration of earthworks in project design and construction, including the recovery of materials for reuse
- Recycling materials
- Reducing resource use through appropriate project design and operation.

## 24.2 Assessment methodology

The assessment of resource use and waste management comprised:

- Review of the likely resources required for the construction and operation of the project, including construction materials, water and power
- Review of the likely waste streams, volumes and classifications
- Identification of opportunities for the avoidance, minimisation and reuse of wastes, including targets for the beneficial reuse of solid wastes, wastewater and other wastes consistent with the project's sustainability framework (refer to Chapter 25 (Sustainability))
- Identification of the environmental impacts associated with resource use and the generation (and subsequent disposal) of residual waste materials
- Management strategies for waste during construction and operation, including:
  - Managing construction waste through the resource management hierarchy established under the *Waste Avoidance and Recovery Act 2001*
  - Developing procedures for the assessment, handling, stockpiling and disposal of potentially contaminated materials and wastewater, in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014a).

## 24.3 Assessment of potential construction impacts

Potential impacts during construction of the project relate to:

- Construction resource use, including construction materials, water and electricity
- Generation and management of wastes (non-spoil)
- Generation and management of spoil, including dredged material from Sydney Harbour.

## 24.3.1 Construction resource use

### *Construction materials*

Given the scale of the project, substantial quantities of materials would be used for construction. Indicative quantities and the potential sources of construction materials are provided in Table 24-2. Other items such as timber, electrical materials and landscaping materials would also be required.

**Table 24-2 Indicative quantities of resources required for construction**

| Material | Estimated quantity required | Anticipated source/origin |
|---|---|---|
| Asphalt | 371,400 tonnes | Sydney suppliers |
| Sprayed bitumen | 1000 tonnes | Sydney suppliers |
| Ready mixed concrete | 378,600 cubic metres | Sydney suppliers located close to the project and on-site batch plant |
| Precast concrete | 33,600 cubic metres | Sydney, central and mid north coast of NSW |
| Aggregates – gravel/sand | 54,800 cubic metres | NSW South Coast and Central Coast |
| Aggregates – general fill | 162,900 cubic metres | Re-use spoil from tunnelling works if timing permits, or imported fill from the Greater Sydney region |
| Steel | 80,600 tonnes | Australia and/or overseas |
| Aluminium | 80 tonnes | Overseas |
| Glass | <1 tonne | Australia and/or overseas |
| PVC piping | 2200 tonnes | Australia and/or overseas |
| Concrete piping | 4700 tonnes | Australia |
| Plastic sheeting | 520 cubic metres | Australia and/or overseas |
| Composites – cement fibreboard | 800 tonnes | Australia |
| Coatings and finishes | 1 tonne | Australia and/or overseas |
| Water treatment chemicals | 50 tonnes | Australia and/or overseas |

Construction material requirements for the project are typical for a motorway project of this scale. While the resource requirements of the project do have the potential to impact resource availability within the Sydney metropolitan region over the construction period, the concurrent construction of NorthConnex, M4-M5 Link and Sydney Metro Northwest demonstrates that the market is able to manage the concurrent construction of major infrastructure projects given sufficient opportunity to forward plan. The period between the approval of the project and the start of major construction

would be sufficient to allow the market to prepare for the needs of the project in conjunction with the concurrent infrastructure projects listed in Chapter 27 (Cumulative impacts).

The design of the project has included careful consideration of the construction methodology and selection of materials and resources to ensure fitness for purpose, and minimise resource consumption. Consistent with the resource management hierarchy of the *Waste Avoidance and Resource Recovery Act 2001*, resource consumption would be further minimised during construction through reuse, where possible. For example, temporary work structures such as road plates and tunnel formwork would be reused, and asphalt from decommissioned paving would be reused in new paving where possible.

### *Water*

Water would be required during construction activities including:

- Tunnelling activities such as dust suppression
- Surface works such as during compaction of pavement materials and for dust suppression
- Concrete batching
- Site offices and ablutions.

Measures to avoid and minimise water consumption, particularly of potable water, have been included in the design and construction planning for the project. Examples of these measures include:

- Use of dust extraction and ventilation systems to control dust in tunnels during construction to minimise the use of water as a dust suppressant
- Capture, treatment and use of wastewater and rain water at construction sites to minimise the use of potable water during construction.

Water for construction of the project would be sourced according to the following hierarchy, where feasible and reasonable, and where water quality and volume requirements are met:

- Stormwater harvesting (non-potable water)
- On-site construction water treatment and reuse, including groundwater (non-potable water)
- Mains supply (potable water).

The average total water demand during construction is estimated to be 1327 kilolitres per day. About 837 kilolitres per day would be sourced from mains supply (potable water) with the remainder coming from treated groundwater or harvested rainwater (non-potable water).

A summary of the indicative construction water balance is presented in Chapter 17 (Hydrodynamics and water quality). Connection to and supply of mains water would be confirmed during further design development, in consultation with Sydney Water.

### *Electricity*

Electricity supply would be required at all construction support sites, including high voltage supply for tunnelling support sites. Table 24-3 summarises the indicative electricity demand at construction support sites where tunnelling is proposed.

Infrastructure required to connect each construction support site with the electricity supply network outside the project corridor would be subject to separate design, assessment and approval. Further information on the coordination and management of electricity infrastructure delivery is provided in Appendix D (Utilities management strategy).

Measures to avoid and minimise electricity consumption have been included in the design and construction planning for the project. Examples of these measures include:

- Use of guidance systems for tunnel excavation and rock bolting to ensure efficient use of tunnelling equipment to minimise excessive electricity consumption
- Use of energy efficient site buildings and equipment on construction support sites, including use of solar powered lights and signage where feasible and reasonable
- Efficient design of electricity transmission systems to supply power as efficiently as possible.

**Table 24-3 Construction electricity demand for tunnelling construction support sites**

| Construction support site | Indicative temporary power requirement (megavolt ampere (MVA)) |
|---|---|
| Rozelle Rail Yards (WHT1) | 5.5 |
| Victoria Road (WHT2) | 8.5 |
| Yurulbin Point (WHT4) | 4 |
| Berrys Bay (WHT7) | 5 |
| Cammeray Golf Course (WHT10) | 5 |

## 24.3.2 Construction waste generation and management (non-spoil)

This section details the solid and liquid wastes, and the wastewater expected to be generated during construction of the project. Generation and management of spoil, including dredged material, is considered in Section 24.3.3.

### *Solid and liquid wastes*

Measures to minimise the generation of waste and to maximise resource recovery have been included in the design and construction planning for the project. Examples of these measures include:

- Prioritisation of pre-cast concrete structural elements to improve efficiency and minimise waste
- On-site sorting of materials like timber, steel and concrete to maximise resource reuse on-site or nearby to the site where possible.

Table 24-4 summarises indicative solid and liquid waste streams that would be generated during construction, including examples of these waste streams, indicative waste stream quantities and anticipated waste classifications.

These waste streams are typical of construction and demolition activities and can be adequately managed with the implementation of common environmental management measures (refer to Section 24.6). Consistent with the resource management hierarchy under the *Waste Avoidance and Resource Recovery Act 2001*, solid wastes would be reused and recycled where feasible and reasonable. Construction waste would be disposed of at appropriate licenced facilities.

**Table 24-4 Indicative solid and liquid waste streams generated during construction**

| Waste stream | Examples of wastes | Indicative quantity | Likely waste classification |
|---|---|---|---|
| Demolition wastes | Concrete, bricks, tiles, timber, metals, plasterboard, carpets, | 61,980 cubic metres | General solid waste (non-putrescible) |

| Waste stream | Examples of wastes | Indicative quantity | Likely waste classification |
|---|---|---|---|
| | electrical and plumbing fittings, furnishings | | |
| Aggregates – crushed rock/concrete | Concrete | 2,318,340 cubic metres | General solid waste (non-putrescible) |
| Hazardous wastes | Asbestos, heavy metals | 1850 tonnes | Hazardous waste and/or special waste |
| Vegetation wastes | Trees, shrubs, ground cover | 5.5 hectares | General solid waste (putrescible) |
| General construction wastes | Timber formwork, scrap metal, steel, concrete, plasterboards, packaging materials | 23,000 tonnes | General solid waste (non-putrescible) |
| Wastes from the operation and maintenance of construction vehicles and equipment | Adhesives, lubricants, waste fuels, oils, engine coolant, batteries, hoses, tyres | 8 tonnes | Hazardous waste |
| General wastes from site offices | Putrescibles (food waste), paper, cardboard, plastics, glass, printer cartridges | 860 tonnes | General solid waste (putrescible and non-putrescible) |

### *Wastewater*

Wastewater volumes generated during construction would vary depending on the types of construction activities being carried out and the stage of construction. The majority of wastewater generated during construction would be through groundwater infiltration in the tunnels.

The average infiltration rate across the project tunnels is expected to be less than the design standard of an average one litre per second per kilometre applied to other recent motorway tunnel projects, including NorthConnex and M4-M5 Link. Further information on groundwater infiltration and groundwater effects is provided in Chapter 16 (Geology, soils and groundwater).

Smaller volumes of wastewater would be generated by other construction activities, such as dust suppression and equipment washdown.

Opportunities for wastewater reuse would be investigated and pursued where feasible and reasonable, and subject to meeting water reuse quality requirements. Options for wastewater reuse may include on-site reuse for construction purposes, such as dust suppression.

The anticipated generation of wastewater from tunnel construction would be greater than the potential for reuse. Therefore, treatment of surplus wastewater and off-site discharge would be required. Chapter 2 (Assessment process) outlines the requirement for an environment protection licence for road construction under Chapter 3 of the *Protection of the Environment Operations Act 1997*. The wastewater collected from tunnelling activities would be tested and treated at construction wastewater treatment plants prior to reuse or discharge.

Site-specific trigger values would be used during construction planning when setting the wastewater treatment plant discharge criteria to ensure wastewater would be treated to a level that is representative of background concentrations at the receiving environment.

Indicative wastewater treatment plant discharge volumes at the construction support sites used to support tunnelling are summarised in Table 24-5. These volumes conservatively assume that all wastewater would be treated and discharged, and do not take into account the opportunities for wastewater reuse identified above. The generation of wastewater at the Berry Street north (WHT8) and Ridge Street north (WHT9) construction support sites and those for the Warringah Freeway Upgrade would be minimal and are therefore not included in the table. Further information on water treatment and discharge water quality, as well as the complete water balance for the project, is provided in Chapter 17 (Hydrodynamics and water quality).

**Table 24-5 Indicative average wastewater treatment plant discharge volumes**

| Construction support site | Estimated daily discharge (kilolitres) | Treated wastewater available for reuse daily (kilolitres) | Discharge point |
|---|---|---|---|
| Rozelle Rail Yards (WHT1) | 214 | 30 | Rozelle Bay |
| Victoria Road (WHT2) | 413 | 177 | Iron Cove |
| Yurulbin Point (WHT4) | 214 | 92 | Snails Bay |
| Berrys Bay (WHT7) | 249 | 107 | Berrys Bay |
| Cammeray Golf Course (WHT10) | 196 | 84 | Willoughby Creek |
| **Total** | **1286** | **490** | |

Note: The generation of wastewater at the Berry Street north (WHT8) and Ridge Street north (WHT9) construction support sites and those for the Warringah Freeway Upgrade would be minimal and are therefore not included in the Table 24-5.

### 24.3.3 Spoil generation and management

About 2.1 million cubic metres of spoil would be produced from land-based construction activities (terrestrial spoil) during construction, made up of:

- Soil and rock from construction of the project tunnels underground
- Soil and rock from bulk excavation works on the surface.

The majority of land-based spoil generated by the project would be crushed sandstone from tunnelling. This material is generally considered as a desirable engineering fill, and is typically reused in development sites and major earthworks projects across Greater Sydney.

In addition, marine construction works for the project within Sydney Harbour would produce around 900,000 cubic metres of dredged material, made up of:

- Rock excavated from temporary cofferdams in Sydney Harbour
- Soil and rock from the installation of the immersed tube tunnel.

The management of spoil and dredged material during construction of the project would depend on its composition, the location from which it was removed (ie land-based or marine-based construction), and whether it is considered to be suitable or unsuitable for reuse. The approach to management of land-based spoil and dredged materials is shown in Figure 24-1.

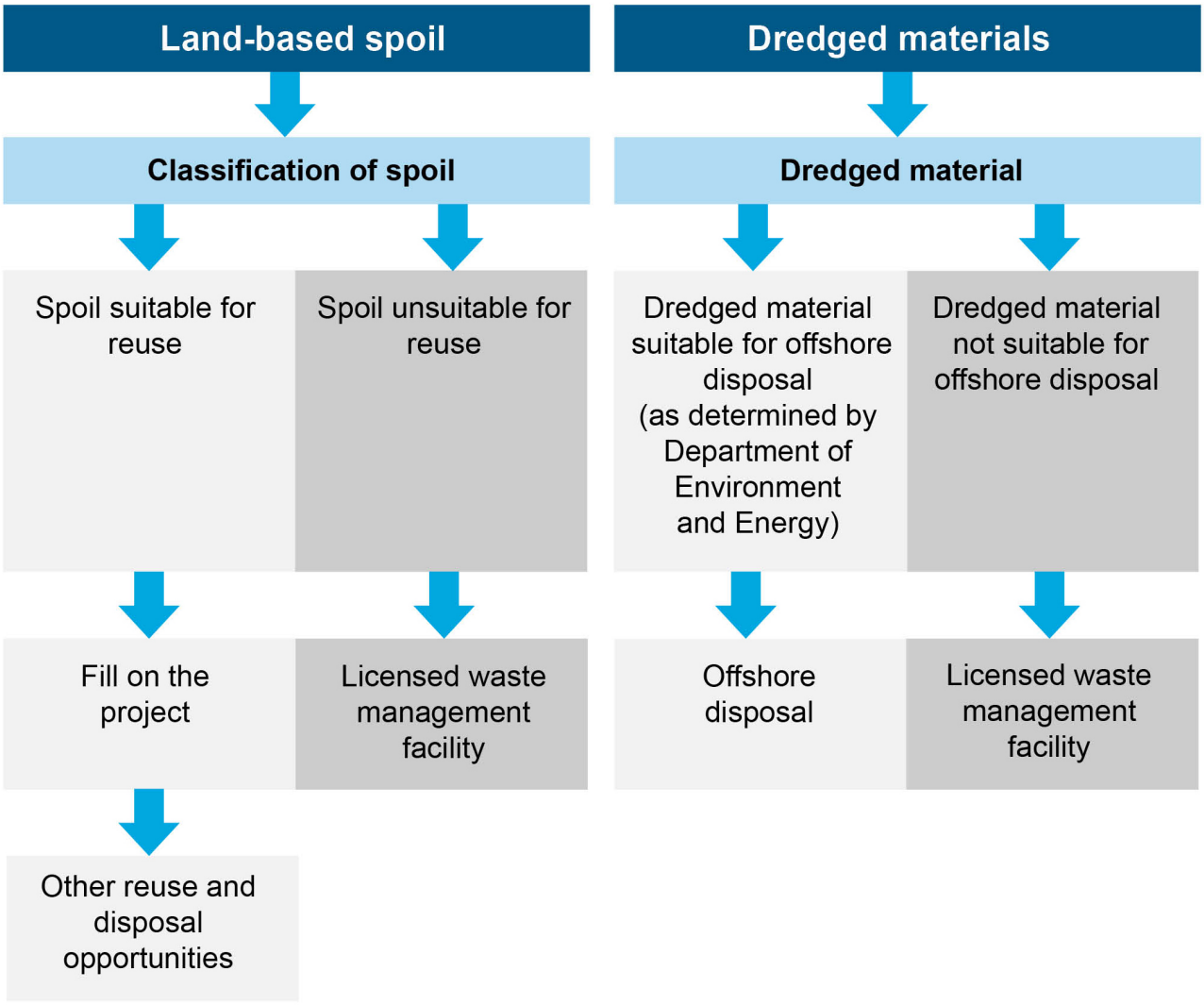



**Figure 24-1 Spoil management approach**

### *Spoil from land-based construction activities*

#### Land-based spoil generation

The project's land-based construction activities would generate about 2.1 million cubic metres of spoil as part of project construction.

The construction support sites supporting tunnelling would be the main generators of spoil during construction. Additional, smaller quantities of spoil would be generated at other construction areas along the project alignment, associated with surface road works at Rozelle Interchange and the Warringah Freeway Upgrade. The indicative volume of surplus land-based spoil to be extracted and managed through each of the construction sites is summarised in Table 24-6.

**Table 24-6 Indicative land-based spoil generation**

| Construction site | Spoil volume (cubic metres) | Spoil composition |
|---|---|---|
| **Spoil generation – Western Harbour Tunnel** | | |
| Rozelle Rail Yards (WHT1) | 34,650 | Sandstone |
| Victoria Road (WHT2) | 565,740 | Sandstone |

| Construction site | Spoil volume (cubic metres) | Spoil composition |
|---|---|---|
| Yurulbin Point (WHT4) | 339,280 | Sandstone |
| Berrys Bay (WHT7) | 260,940 | Sandstone |
| Cammeray Golf Course (WHT10) | 410,510 | Sandstone |
| Warringah Freeway | 164,240 | Sandstone |
| Waltham Street (WHT11) | 500 | Clay, shale and sandstone |
| **Total – Western Harbour Tunnel** | **1,775,860** | |
| **Spoil generation – Warringah Freeway Upgrade** | | |
| Berry Street east (WFU5) | 12,290 | Sandstone |
| Multiple sites within Warringah Freeway | 224,280 | Sandstone, general fill |
| Falcon Street surface works | 28,270 | Sandstone |
| Alfred Street, Mount Street and High Street surface works | 27,770 | Sandstone, general fill, construction rubble |
| Ernest Street surface works | 3600 | Sandstone, general fill |
| Miller Street surface works | 7800 | Sandstone, general fill |
| Brooks Street surface works | 14,360 | Sandstone, general fill |
| Willoughby Road surface works | 2190 | Sandstone, general fill |
| **Total – Warringah Freeway Upgrade** | **320,560** | |
| **Total land-based spoil generation** | **2,096,410** | |

Spoil from tunnelling works would be transported from the tunnel face to the surface using dump trucks. Where required, tunnel spoil stockpiles would be largely contained within acoustic sheds. This would also minimise the potential for impacts from runoff and sedimentation associated with stockpiling.

Spoil would be classified prior to leaving the site in accordance with NSW and Australian standards and guidelines. It is anticipated that the majority of this material would be used at development, construction or remediation sites across Greater Sydney.

Other earthworks such as those required for surface road works, cut-and-cover tunnels and trough structures may require the stockpiling of material on site if the material cannot be loaded directly into trucks. These stockpiles would be located outside of acoustic sheds; however, appropriate measures, including bunding, would be in place to avoid potential impacts associated with runoff, sedimentation and leachate. The indicative location and volume of spoil stockpiles located outside of acoustic sheds is provided in Table 24-7.

Potential impacts from runoff and sedimentation would be further minimised through the implementation of the environmental management measures described in Chapter 17 (Hydrodynamics and water quality).

Potential impacts related to leachate (ie contaminated liquid that drains from a landfill or stockpile) are considered to be unlikely during construction as the project does not involve the excavation or disturbance of landfill areas. Stockpiles would be managed appropriately to avoid potential impacts associated with runoff, sedimentation and leachate.

**Table 24-7 Indicative stockpile locations and volumes – outside of acoustic sheds**

| Location | Indicative stockpile volume |
|---|---|
| **Western Harbour Tunnel** | |
| Victoria Road (WHT2) | 500 cubic metres |
| White Bay (WHT3) | 10,000 cubic metres |
| Berry Street North (WHT8) | 750 cubic metres |
| Cammeray Golf Course (WHT10) | 4500 cubic metres |
| Waltham Street (WHT11) | 250 cubic metres |
| **Warringah Freeway Upgrade** | |
| Warringah Freeway | 750 cubic metres |
| Falcon Street | 500 cubic metres |

The design of the project and preferred construction methodology has taken into consideration the waste hierarchy by aiming to reduce the volume of excess spoil generated, as far as practical. Where possible, the project would maximise reuse of spoil generated during construction before alternative off-site spoil disposal options are pursued.

The geochemistry of the spoil material as well as its consistency and quality would determine the reuse options. The spoil produced by the project would have the following potential reuse opportunities:

- Granular sandstone fill is likely to be suitable for use as structural fill
- Excavated clay and clayey sand material is likely to be suitable for use as general fill following moisture conditioning
- Excavated weathered shale and sandstone could be suitable for use as structural fill following moisture conditioning to reduce reactivity
- Medium strength or better quality shale is likely to be suitable for use as non-reactive fill
- Medium to high strength sandstone may be suitable for use as structural fill
- Wet clay and wet shale spoil is unlikely to be suitable for reuse on site without substantial moisture conditioning.

Where spoil cannot be reused for the project, opportunities to reuse this material on other projects (preferably within the Sydney region to reduce transport distances) would be identified.

The following sites are potential options for spoil reuse/disposal:

- Western Sydney Airport (about 50 kilometres from the project)

- Moorebank Intermodal Terminal Precinct (about 30 kilometres from the project)
- Kurnell Landfill (about 30 kilometres from the project)
- Penrith Lakes Scheme (about 60 kilometres from the project).

These sites have a need for spoil or fill material and represent viable reuse locations. Other re-use or disposal sites may be used depending on need at the time the spoil is generated.

### Disposal of contaminated material

There is potential to discover contaminated material during excavation works for the project. A Stage 1 contamination assessment has been carried out to determine the potential for encountering contaminated material during construction (refer to Chapter 16 (Geology, soils and groundwater)).

The contamination assessment identified nine locations within or adjacent to the construction footprint of the project that are considered to be potential areas of environmental interest. These locations, and types of potential contaminated material, are provided in Chapter 16 (Geology, soils and groundwater). Further investigations of these sites are required to quantify the exposure risk. These investigations would be carried out prior to construction activities so that contamination (if present) can be adequately planned for and appropriately managed.

Management of contaminated spoil would be in accordance with the mitigation measures outlined in Chapter 16 (Geology, groundwater and soils). Any contaminated material disturbed during construction would be separated from uncontaminated material on site to prevent cross contamination. This spoil would be loaded into sealed and covered trucks for disposal at a suitably licenced landfill.

## *Dredged material from harbour construction activities*

About 900,000 cubic metres of soft soil, sediments and rock would need to be removed from Sydney Harbour for the construction of the immersed tube tunnels and associated transition structures. The indicative volume and composition of dredged material to be removed as part of marine construction activities is included in Table 24-8.

**Table 24-8 Indicative dredged material volumes**

| Construction area | Dredged material volume (cubic metres) | Indicative composition of dredged material |
|---|---|---|
| White Bay (WHT3) construction support site | 142,500 | Dredged sediment not suitable for offshore disposal |
| Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6) construction support sites | 44,000 | Sandstone suitable for offshore disposal under Commonwealth permit |
| Sydney Harbour immersed tube tunnel construction | 610,000 | Sediment suitable for offshore disposal under Commonwealth permit |
| | 108,000 | Sandstone suitable for offshore disposal under Commonwealth permit |
| **Total dredged material** | **904,500** | |

### Dredged material suitable for potential offshore disposal

An application for offshore disposal of suitable dredged material has been submitted to the Commonwealth Department of the Environment and Energy. Dredged material suitable for offshore disposal would be transported from Sydney Harbour on split hopper barges and disposed within the existing designated offshore disposal site, which is located about 10 to 15 kilometres east of Sydney Heads and regulated by the Commonwealth. Offshore disposal would reduce the number of heavy vehicle movements required to transport dredged material. As detailed in Chapter 2 (Assessment process), assessment for offshore disposal dredged material is subject to a separate assessment process by the Commonwealth Department of the Environment and Energy.

The potential impacts to marine water quality from the transport, treatment and/or temporary storage of dredged material is assessed in Chapter 17 (Hydrodynamics and water quality). The potential impacts of shipping movements is discussed further in Chapter 8 (Construction traffic and transport).

### Dredged material unsuitable for potential offshore disposal

Some sediments in Sydney Harbour contain high concentrations of metallic and non-metallic contaminants (refer to Chapter 16 (Geology, soils and groundwater)). Most of the harbour's contamination results from a combination of historical inputs that remain in the sediments and some current sources of input such as stormwater.

Of the 904,500 cubic metres of material to be removed from Sydney Harbour, it is expected that about 142,500 cubic metres from the top 1.5 metres of the harbour bed would not be suitable for potential offshore disposal. The nature of existing contamination within Sydney Harbour is described in more detail in Chapter 16 (Geology, soils and groundwater).

Dredged material not suitable for potential offshore disposal would be loaded onto hopper barges and transferred to the White Bay construction support site (WHT3).

Dredged material would be subject to waste classification under the *Waste Classification Guidelines 2014* (NSW EPA, 2014a) and would be treated to make the material spadable (a consistency which allows the material to be spaded or shovelled). During this process, additives such as lime or absorbent polymers would be mixed into the dredged material to assist in mitigating potential odour and to neutralise any potential acid sulfate soils. This process is widely understood and has been applied on recent projects in Sydney Harbour, including Garden Island dredging works completed in 2010 and 2019.

Once treated, materials would be loaded into covered trucks for transport to a suitably licensed waste disposal facility.

## 24.4 Assessment of potential operational impacts

Potential impacts during operation of the project relate to:

- Operational resource use, including operational materials, water and electricity
- Generation and management of wastes.

### 24.4.1 Operational resource use

#### *Operational materials*

Materials used for the operation of the project would be limited to those required for ongoing maintenance activities, and for the operation of the motorway control centre and tunnel support facilities. As outlined in Chapter 5 (Project description), ongoing maintenance activities are not

included as part of the project and would be considered separately at the relevant time in the future.

### *Water*

During operation of the project, water would be required for:

- Testing and operation of the tunnel deluge system, which forms part of the fire and life safety system
- Tunnel cleaning systems
- Motorway control centre ablutions
- Landscape irrigation.

Measures to avoid and minimise water use, particularly of potable water, have been included in the project design. An example of these measures includes the reuse of groundwater entering the project tunnels where possible to satisfy the project's operational water requirements and reduce the demand for potable water.

Water for operation of the project would be sourced according to the following hierarchy, where feasible and reasonable and where water quality and volume requirements are met:

- Treated groundwater (non-potable water)
- Rainwater harvesting (non-potable water)
- Mains supply (potable water).

Indicative volumes and potential sources of water for each operational activity are provided in Table 24-9. Connection to and supply of mains water would be confirmed during further design development, in consultation with Sydney Water.

**Table 24-9 Indicative operational water requirements**

| Project component | Total water demand (kilolitres/year) | |
|---|---|---|
| | Washdown | Deluge testing |
| **Western Harbour Tunnel** | 365 | 1825 |
| **Warringah Freeway Upgrade** | 0 | 0 |

### *Electricity*

An operational electricity supply would be required for the mainline tunnels (including associated mechanical and electrical equipment), traffic control facilities (including the motorway control centre and electronic signage) and surface street lighting. As described in Chapter 5 (Project description), the project includes a series of five underground substations at regular intervals within the tunnel, and aboveground substations at the Western Harbour Tunnel motorway facilities.

The project would likely be connected to the Rozelle sub-transmission substations due to its proximity to the tunnel portals. Initial discussions with Ausgrid indicate that these substations would have sufficient capacity to supply the project without negative impacts on the local power supply.

Measures to minimise energy consumption and maximise energy efficiency have been included in the project design. Examples of these measures include:

- Use of low heat emission LED lighting to reduce operational energy requirements
- Efficient and effective longitudinal ventilation system design with outlets located in close proximity to tunnel portals, taking advantage of the movement of vehicles within tunnels to reduce fan usage and reducing energy needed to move exhaust to outlet locations

- Opportunities to install solar panels at the tunnel portals and on tunnel support and traffic control facility buildings to supplement non-renewable power sources where feasible and reasonable.

Opportunities to further minimise energy consumption and maximise energy efficiency would be considered during further design development, where feasible and reasonable.

The anticipated operational electricity consumption of the project would be about 32 MVA.

### 24.4.2 Operational waste generation

This section details the solid and liquid wastes and the wastewater expected to be generated during operation of the project.

#### *Solid and liquid wastes*

The type and volume of wastes generated from operation of the motorway would depend on the nature of the activity but would predominantly consist of minor volumes of general office waste (such as paper, plastics and food waste).

The volumes and types of waste would be typical of motorway operations and could be accommodated by existing metropolitan waste management facilities. With the implementation of standard waste management practices, the overall impact of operational waste streams would be minimal.

Maintenance and repair activities would be subject to separate assessment processes, which would include the assessment of waste impacts associated with these activities.

#### *Wastewater*

The project tunnels would include drainage infrastructure to capture groundwater and stormwater, spills, maintenance wastewater, fire deluge and other potential water sources. The tunnel drainage streams would receive water containing a variety of potential pollutants (such as fuel, oil grease, and fire suppressants) requiring different treatment before discharge.

Tunnel wastewater (including collected groundwater) would be pumped to an operational wastewater treatment facility at the Rozelle Interchange (refer to Chapter 5 (Project description)). On average, the project tunnels would generate about 184 megalitres per year of treated groundwater.

Following treatment, discharges would enter into the local stormwater network. Further information is provided in Chapter 17 (Hydrodynamics and water quality) including potential impacts associated with operational stormwater runoff and water discharge.

## 24.5 Waste disposal locations

There are a number of options for recycling and disposal of construction and operational waste generated by the project. A large number of waste facilities in Sydney are licensed to accept general solid waste (putrescible) and general solid waste (non-putrescible). Specific facilities and collection contractors for the disposal of putrescible and non-putrescible general solid waste would be selected during the later stages of the project and documented in the construction waste management plan.

Recyclables generated during construction and operation of the project would be collected by an authorised contractor for off-site recycling. There are a number of resource recovery facilities in Sydney. Recycling facilities for the project would be determined by the contractor engaged to collect the material.

Special and hazardous wastes would be disposed of at appropriately licensed waste management facilities to be selected during the later stages of the project and documented in the construction waste management plan.

## 24.6 Environmental management measures

### 24.6.1 Contingency management of waste

Contingency measures would be implemented to manage unexpected waste volumes and types of waste materials generated from the construction of the project. Suitable areas would be identified, where feasible, to allow for contingency management of unexpected waste materials, including contaminated materials. These areas would be hardstand or lined areas that are appropriately stabilised and bunded, with sufficient area for stockpile storage and segregation.

As detailed in Chapter 16 (Geology, soils and groundwater), in the event of discovery of previously unidentified contaminated material, all relevant work would cease in the vicinity of the discovery and the unidentified contaminated material would be managed in accordance with an unexpected contaminated lands discovery procedure, as outlined in the Guideline for the Management of Contamination (Roads and Maritime, 2013a).

The environmental management measures outlined in Table 24-10 would be consistently implemented in the event of unexpected waste volumes and materials generated from the construction of the project, along with adherence to all waste principles and relevant legislation and regulations.

### 24.6.2 Management of waste

The project design has taken into account the principles of the resource management hierarchy as defined in the *Waste Avoidance and Resource Recovery Act 2001* and as described in Section 24.1. Where feasible and reasonable, resources would be managed according to the following hierarchy:

- Avoidance of unnecessary resource consumption through design, efficient construction methodologies and management
- Resource recovery, including reuse, reprocessing, recycling and energy recovery within the project
- Resource recovery, including reuse, reprocessing, recycling and energy recovery outside the project
- Where resource recovery is not feasible or reasonable, disposal would be the last resort.

Measures to avoid, minimise or manage resource consumption and waste generation as a result of the project are detailed in Table 24-10. Environmental management measures relating to contamination, including acid sulfate soils, are provided in Chapter 16 (Geology, soils and groundwater).

**Table 24-10 Environmental management measures for resource use and waste management**

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| WM1 | Construction | Resource use | Construction materials will be sourced in accordance with the project's Sustainability Framework and with a preference for Australian materials and prefabricated products with low embodied energy, where feasible and reasonable. | WHT/WFU |
| WM2 | Construction | Resource management | The resource management hierarchy principles established under the *Waste Avoidance and Recovery Act 2001* of avoid/reduce/reuse/ recycle/dispose will be applied. | WHT/WFU |
| WM3 | Construction | Waste generation and disposal | Wastes will be classified in accordance with the NSW Environment Protection Authority *Waste Classification Guidelines: Part 1 Classifying Waste*. | WHT/WFU |
| WM4 | Construction | Storage and transport of wastes | Wastes will be appropriately transported, stored and handled according to their waste classification and in a manner than prevents pollution of the surrounding environment. | WHT/WFU |
| WM5 | Construction | Wastewater generation and disposal | Opportunities for wastewater reuse and recycling will be pursued, including recirculating water during tunnel excavation to use for dust suppression. Wastewater not used onsite will be appropriately treated to a level that is representative of background concentrations at the receiving environment prior to discharge into the local stormwater system. | WHT/WFU |
| WM6 | Operation | Resource use and waste generation | The project will be operated in accordance with the relevant aims of the project's Sustainability Framework to optimise resource efficiency and waste management. | WHT/WFU |
| WM7 | Operation | Waste generation and disposal | Waste will be managed and disposed of in accordance with relevant applicable legislation, policies and guidelines, including the *Waste Avoidance and Resource Recovery Act 2001* and the *NSW Waste Avoidance and Resource Recovery Strategy 2014–21* (NSW EPA, 2014b). | WHT/WFU |
| WM8 | Operation | Water use and discharge | Opportunities to reuse treated groundwater during project operation will be considered where feasible and reasonable. | WHT |

Western Harbour Tunnel = WHT, Warringah Freeway Upgrade = WFU

Chapter 25

# Sustainability

January 2020

# 25 Sustainability

This chapter describes the overall approach to sustainability through design, construction and operation of the project. A sustainability framework has been prepared for the project (refer to Section 25.2).

The Secretary's environmental assessment requirements as they relate to sustainability, and where in the environmental impact statement these have been addressed, are detailed in Table 25-1.

The proposed environmental management measures relevant to sustainability are discussed in Section 25.4.

**Table 25-1 Secretary's environmental assessment requirements - Sustainability**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Sustainability** | |
| 1. The Proponent must assess the sustainability of the project in accordance with the *Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability Rating Tool* and recommend an appropriate target rating for the project. | The assessment of the sustainability of the project in accordance with the ISCA. Infrastructure Sustainability Rating Tool is discussed in **Section 25.2**.<br>The Sustainability Management Plan will detail measures to meet the sustainability objectives and targets. |
| 2. The Proponent must assess the project against the current guidelines including targets and strategies to improve Government efficiency in use of water, energy and transport. | Discussion of the sustainability framework and relevant documents is provided in **Section 25.2.1**. The sustainable use of water and energy resources is discussed in **Chapter 24** (Resource use and waste management). |

## 25.1 Overview

Sustainable development refers to "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

The Infrastructure Sustainability Council of Australia provides a definition specific to sustainable infrastructure development, being that which is "designed, constructed and operated to optimise environmental, social and economic outcomes over the long term" (Infrastructure Sustainability Council of Australia, 2016).

This chapter describes how sustainability principles have been applied to the design, construction and operation of the project including:

- The sustainability framework that has been developed for the project, including the application of the Infrastructure Council of Australia's Infrastructure Sustainability rating scheme to the project
- Legislation and policies relevant to the project
- Application of the principles of ecologically sustainable development to the project.

## 25.2 Western Harbour Tunnel and Warringah Freeway Upgrade sustainability framework

A sustainability framework has been developed for the project. The sustainability framework has been prepared to ensure that sustainability is embedded in project planning, design, construction and operation. The sustainability framework provides the overarching vision, objectives, targets and implementation approaches for the project.

Figure 25-1 shows the key elements of the sustainability framework. Each element is described in detail in the sections below.

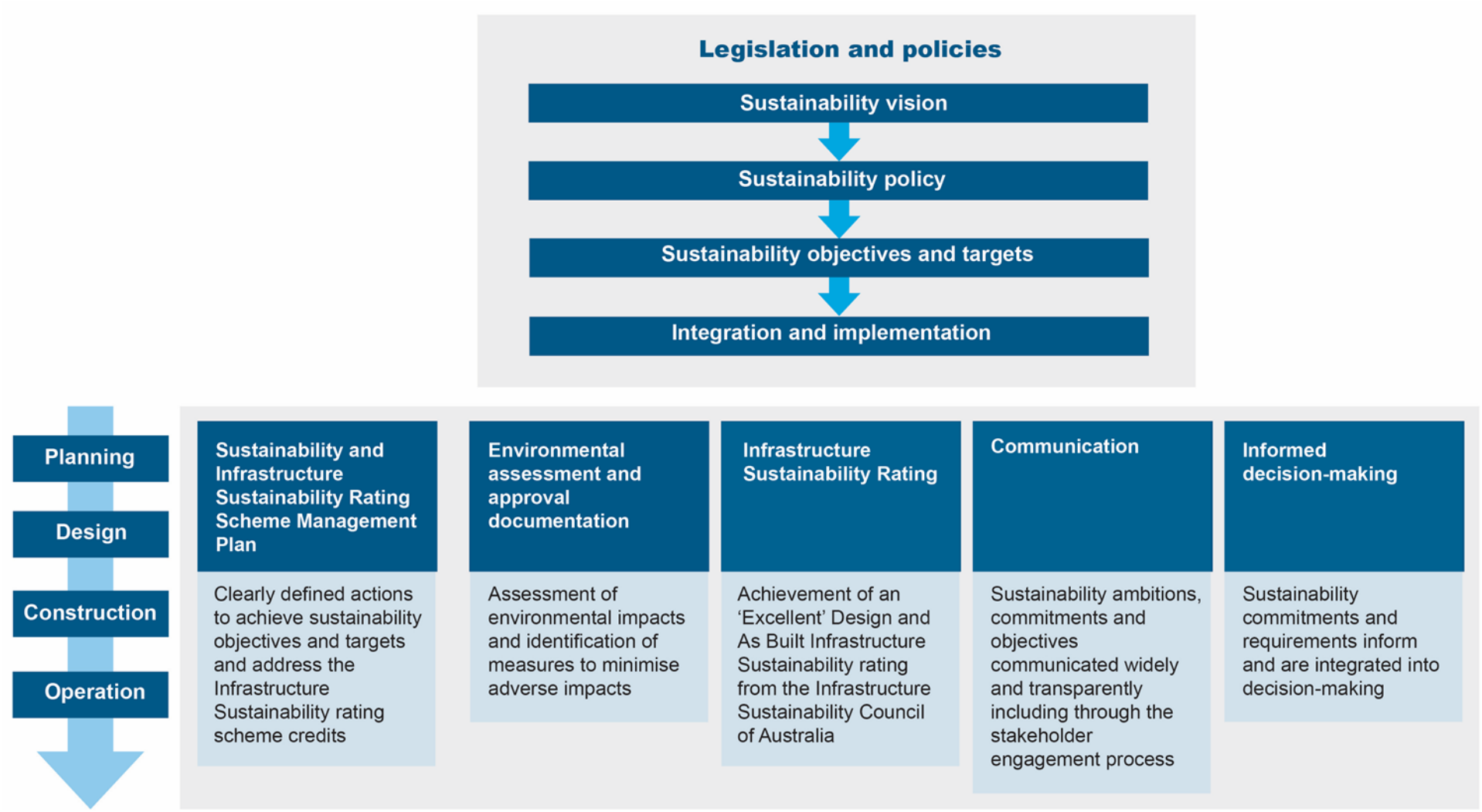



**Figure 25-1 Western Harbour Tunnel and Warringah Freeway Upgrade sustainability framework**

## 25.2.1 Legislative and policy framework

The sustainability framework is underpinned by sustainability principles outlined in applicable legislation, policies and guidelines. The NSW Government, Transport for NSW and the Infrastructure Sustainability Council of Australia each set sustainability principles, objectives and targets within their respective policies.

Key legislation, policies and guidelines that have directed the consideration and integration of sustainability in the project design and assessment are summarised in Table 25-2. Other relevant legislation, policies and guidelines that include sustainability outcomes relevant to the project are outlined in Table 25-3. Table 25-3 shows the recurring sustainability themes found in these documents and where specific principles, objectives and targets are set.

**Table 25-2 Key legislation, policies and guidelines**

| Legislation, policy or guideline | Overview |
|---|---|
| *Environmental Planning and Assessment Act 1979* | The *Environmental Planning and Assessment Act 1979* facilitates ecologically sustainable development in NSW by integrating relevant economic, environmental and social considerations in decision making about environmental planning and assessment. As an object of the Act, ecologically sustainable development must be incorporated in the planning of the project (refer to Section 25.3). |
| *Transport Environment and Sustainability Policy Framework and Statement* (Transport for NSW, 2015) | The *Transport Environment and Sustainability Policy Framework* provides a collective and coordinated approach to deliver the NSW Government's environmental and sustainability agenda across the transport network. The framework outlines the commitment of Transport for NSW and key transport agencies to deliver transport projects and services in a manner that balances economic, environmental and social issues. |
| *Environmental Sustainability Strategy 2019-23* (Roads and Maritime, 2019) | The *Environmental Sustainability Strategy 2019-2023* (Roads and Maritime, 2019) aligns with the *Transport Environment and Sustainability Policy Framework* and outlines specific focus areas for integrating sustainability into Transport for NSW projects and services. |
| *Infrastructure Sustainability Rating Tool v1.2* (Infrastructure Council of Australia, 2016a) | The Secretary's environmental assessment requirements for the project require the assessment of the project in accordance with the Infrastructure Sustainability Rating Tool and recommendation of an appropriate target rating. The Infrastructure Sustainability rating scheme was developed by the Infrastructure Sustainability Council of Australia as a comprehensive process for evaluating sustainability across the design, construction and operation of infrastructure. |
| *Sustainable Design Guidelines v4.0* (Transport for NSW, 2017) | The Transport for NSW *Sustainable Design Guidelines v4.0* are aimed at embedding sustainability initiatives across seven key themes into the planning, design, construction, operations and maintenance of infrastructure projects. The Secretary's environmental assessment requirements for the project reference the *Sustainable Design Guidelines v4.0* as the current guidelines to be considered as part of the preparation of this environmental impact statement. |

## Table 25-3 Relevant sustainability legislation, policies and guidelines

| Sustainability theme | NSW Government legislation, policies and guidelines | | | | | | | | Transport for NSW's policies and guidelines | | | | Roads and Maritime's policies and guidelines | | Infrastructure Sustainability Council of Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ Principle<br>✓ Objective<br>✓ Target | *Environmental Planning and Assessment Act 1979* | NSW Long Term Transport Master Plan | NSW Sustainable Design Guidelines v4.0 | NSW Government Resource Efficiency Policy | NSW Waste avoidance and Resource recovery Strategy | NSW Government Training Management Guidelines | Aboriginal Participation in Consultation Guidelines | Aboriginal Participation in Construction Policy | Transport Social Procurement Policy | Transport Environment and Sustainability Policy Framework | Sydney's Cycling Future, Cycling for everyday transport | Sydney's Walking Future, Connecting people and places | Roads and Maritime Services Sustainability Strategy | Beyond the Pavement | |
| Management and participation | | ✓✓ | ✓✓ | | | | | | ✓ | ✓✓ | | | ✓✓ | ✓✓ | ✓✓ |
| Energy, carbon and materials | ✓✓ | ✓ | ✓✓ | ✓✓ | | | | | ✓ | ✓✓ | | | ✓✓ | | ✓✓ |
| Resources and waste | ✓ | ✓ | ✓✓ | ✓ | ✓ | | | | | ✓ | | | ✓ | ✓ | ✓✓ |
| Climate change | | ✓✓ | ✓✓ | | | | | | | ✓ | | | ✓✓ | | ✓✓ |
| Communities and liveability | | ✓ | ✓✓✓ | | | | | | ✓ | ✓✓ | ✓✓ | ✓✓✓ | ✓✓ | ✓✓ | ✓✓ |
| Water | | | ✓✓ | ✓ | | | | | | ✓✓ | | | ✓ | | ✓✓ |
| Pollution and emissions | ✓✓ | ✓ | ✓✓ | ✓ | | | | | | ✓✓ | | | ✓✓✓ | | ✓✓ |
| Ecology | ✓ | ✓ | ✓✓ | | | | | | | ✓ | | | ✓ | ✓ | ✓✓ |
| Employment and opportunities | | | | | | ✓✓✓ | ✓✓✓ | ✓✓✓ | | | | | | | |

### 25.2.2 Sustainability vision and policy

The sustainability framework establishes the sustainability vision and policy for the project (refer to Figure 25-2). The sustainability vision and policy set the overall direction for implementing sustainability initiatives during the delivery of the project. The vision and policy reflect and align with State and Transport for NSW strategic sustainability policies (refer to Section 25.2.1). The policy acknowledges the need to deliver services and infrastructure that benefit the community and minimise negative environmental, social and economic impacts while maximising positive outcomes. The vision and policy may continue to be refined as the project progresses.

| Vision | The Western Harbour Tunnel and Warringah Freeway Upgrade project is committed to improving quality of life for current and future generations by maximising social, economic and environmental value. The project will achieve excellence in sustainability, and embed sustainability thinking across all stages, moving industry forward by setting the bar higher for both the process and delivery of sustainability. |
|---|---|

## Policy

**The Western Harbour Tunnel and Warringah Freeway Upgrade project is committed to:**

- Aligning with, supporting and, wherever feasible, exceeding the ambitions of the Roads and Maritime Services Environmental Sustainability Strategy 2019-23
- Optimising sustainability outcomes, transport service quality, and cost effectiveness
- Being environmentally responsible by avoiding pollution, enhancing the natural environment and maintaining or reducing the project ecological footprint
- Using resources (energy, water and materials) efficiently and reducing waste
- Providing a safe and accessible motorway integrated into the urban environment and transport system
- Raising awareness of environmental issues and sharing sustainability knowledge with the community and broader industry
- Creating desirable places, promoting liveability and cultural heritage, and optimising both community and economic benefit

**To deliver these commitments, the Western Harbour Tunnel and Warringah Freeway Upgrade project will:**

- Establish robust sustainability objectives and targets
- Ensure balanced consideration of environmental, social and economic costs and benefits during decision making
- Encourage innovation and setting high environmental and sustainability standards
- Establish positive relationships with community and stakeholders to maximise opportunities to add value to local communities
- Develop and maintain an environmental management framework to embed best practice pollution management and sustainable outcomes during construction
- Apply effective assurance processes to monitor performance against the project environment and sustainability objectives and identify appropriate reward or corrective action, as required
- Integrate environment and sustainability-specific processes into the procurement of delivery activities and suppliers
- Hold employees and contractors accountable for proactively meeting their environmental and sustainability responsibilities
- Provide local training, education, apprenticeships and employment opportunities

**The project will comply with environmental legislation and regulations, and proactively support initiatives that go beyond compliance requirements. The project will also exhibit leadership in environmental practices and sustainability, supporting innovation, creating beneficial social and environmental impacts, and creating a positive economic legacy.**

**Figure 25-2 Western Harbour Tunnel and Warringah Freeway Upgrade sustainability vision and policy**

## 25.2.3 Sustainability objectives and targets

To achieve the sustainability vision for the project and to contribute to the desired outcomes of the relevant State and Transport for NSW policies and guidelines (refer to Section 25.2.1) the project would establish robust sustainability objectives and targets. The process being followed to develop the objectives and targets is shown in Figure 25-3.

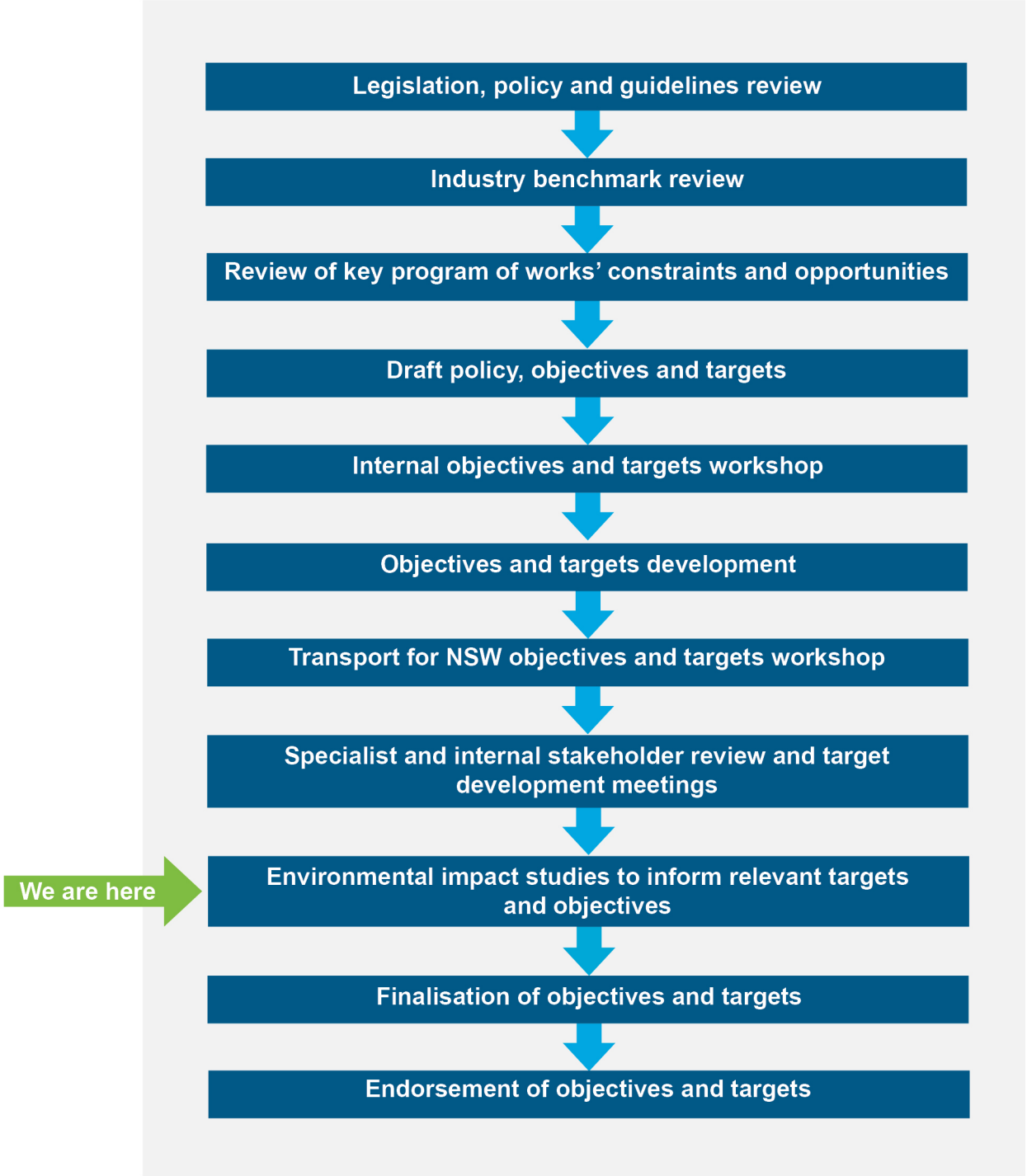



**Figure 25-3 Western Harbour Tunnel and Warringah Freeway Upgrade sustainability objectives and targets development process**

The outcomes from this environmental impact statement, including any relevant conditions that may be applied to the project by the Minister for Planning and Public Spaces, would be used to finalise the sustainability objectives and targets for the project. Indicative objectives and targets (subject to later refinement to allow for incorporation of any relevant approval conditions) are outlined in Table 25-4.

**Table 25-4 Indicative sustainability objectives and target themes**

| Objective | Target themes |
|---|---|
| Maximise sustainability knowledge and awareness | • Sustainability commitments (including procurement commitments)<br>• Sharing of sustainability outcomes with the community/stakeholders and industry<br>• Sustainability awareness training. |
| Minimise energy use and greenhouse gas emissions | • Operational greenhouse gas emissions<br>• Construction greenhouse gas emissions<br>• Embodied energy within construction materials<br>• Energy efficient lighting. |
| Optimise resource efficiency and waste management | • Resource recovery of virgin excavated natural material<br>• Reuse of topsoil<br>• Diversion of office waste from landfill<br>• Resource recovery of concrete and reclaimed asphalt<br>• Cementitious substitution materials<br>• Recycled content in road base<br>• Recycling of other waste and wastewater<br>• Recycled paper use<br>• Avoidance of single use kitchen items. |
| Maximise resilience to climate change impacts | • Climate change risk mitigation and/or adaptation measures. |
| Enhance liveability of local communities | • Heritage values<br>• Community benefit initiatives<br>• Public open space<br>• Urban design. |
| Maximise employment and training opportunities for young people, Aboriginal and Torres Strait Islanders, disadvantaged groups, long term unemployed and people who live along the project's alignment | • Apprenticeships<br>• Training and development<br>• Workforce participation. |
| Efficiently manage water | • Water use during construction<br>• Water use during operation<br>• Use of non-potable water. |
| Minimise pollution generated by the project | • Air quality<br>• Noise and vibration<br>• Water quality<br>• Reporting and tracking of environmental incidents. |

| Objective | Target themes |
|---|---|
| Minimise impacts on biodiversity | • Ecological value and biodiversity. |
| Maximise sustainable procurement | • Sustainability and social aspects selection criteria<br>• Labour practices<br>• Procurement of sustainable timber. |

### 25.2.4 Integration and implementation of sustainability framework

The sustainability framework would continue to be developed and refined in future phases of the project's delivery. The key implementation tools and processes that have been, and would continue to be, applied to the delivery of the sustainability framework are shown in Figure 25-1.

Activities to implement the sustainability framework, including requirements from the Infrastructure Sustainability rating scheme, would be implemented through a Sustainability Management Plan. The management plan would detail measures to meet the sustainability objectives and targets and Infrastructure Sustainability rating scheme credit requirements (refer to Section 25.4).

The project would seek to achieve an 'Excellent' Design and 'As Built' Infrastructure Sustainability rating under Version 1.2 of the Infrastructure Sustainability Council of Australia rating scheme.

## 25.3 Ecologically sustainable development

Facilitating ecologically sustainable development is adopted as an object of the *Environmental Planning and Assessment Act 1979*. This object requires the integration of 'relevant economic, environmental and social considerations in decision making about environmental planning and assessment'.

Ecologically sustainable development is defined under the *Protection of the Environment Administration Act 1991* (NSW) and includes four principles:

- The precautionary principle
- Intergenerational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation and pricing of environmental resources.

The principles of ecologically sustainable development have been an integral part of the design and assessment of the project. This has included the integration of relevant economic, environmental and social considerations in project design and assessment decisions, as summarised in Table 25-5.

**Table 25-5 Application of the principles of ecologically sustainable development to the project**

| Principle | Application to the project |
|---|---|
| **Precautionary principle**<br>If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. | Applied during the design and development of the project:<br>• Potential environmental impacts associated with the project considered in the alternatives and options analysis<br>• Opportunities identified to avoid and minimise surface disturbance<br>• Sustainability workshops and meetings held during design development with planning and design teams to develop draft sustainability targets and objectives for the project.<br>Applied during the preparation of this environmental impact statement:<br>• Prepared with a conservative approach, including assessment of worst case impacts and scenarios<br>• Carried out using the best available technical information and has adopted best practice environmental standards, goals and measures<br>• Potential environmental risks associated with the project identified and considered, with safeguards and management measures developed to manage and reduce identified risks<br>• Sustainability workshops and meetings held during the development of the environmental impact statement with planning and design teams to inform relevant sustainability targets and objectives for the project. |
| **Intergenerational equity**<br>The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. | • Project designed to meet with needs of both current and future generations with a design life of about 100 years<br>• Support for Sydney's long term economic growth through improved motorway access and connections across Sydney's Global Economic Corridor, particularly the strategic centres of Sydney CBD and North Sydney<br>• Contribution to improving the capacity, functionality and safety of Sydney's transport network for motorists, buses and freight<br>• Contribution to the increased resilience of the Sydney transport network through the provision of an additional harbour crossing west of the CBD<br>• Reduction of operational greenhouse gas emissions on Sydney's road network when compared to the project not being built<br>• The project's resilience to future climate change is considered in Chapter 26 (Climate change risk and adaptation), which identifies potential climate change risks to the project, and adaptation measures incorporated into the design or options for further consideration during further design development<br>• Management measures for potential environmental impacts have been provided throughout this |

| Principle | Application to the project |
|---|---|
| | environmental impact statement to protect the future health, diversity and productivity of the environment<br>• During construction and operation of the project, opportunities would be taken to reduce material use and maximise the use of materials with low embodied environmental impact, where feasible<br>• The mainline tunnel ventilation system has been designed for coordinated operation with adjacent and connecting tunnel projects, including the M4-M5 Link and the Beaches Link and Gore Hill Freeway Connection project. The tunnel ventilation would meet the in-tunnel air quality criteria and would be operated in accordance with licensing requirements. |
| **Conservation of biological diversity and ecological integrity**<br>Conservation of biological diversity and ecological integrity should be a fundamental consideration of the project. | • Project designed and assessed with the aim of identifying, avoiding, minimising and mitigating impacts<br>• Residual impacts to native plant community types would be offset<br>• Detailed terrestrial and marine biodiversity assessments provided, which identify potential impacts on biodiversity and provide a range of mitigation measures to further avoid and minimise potential impacts<br>• About seven hectares of vegetation would be removed however no vegetation consistent with any plant community types or threatened ecological communities would be impacted<br>• Impacts to marine habitats would not be significant and would recover quickly through natural processes<br>• Identified impacts to potential foraging and sheltering habitat for Grey-headed Flying-fox, Eastern Bent-wing Bats, threatened microbats and threatened marine species would not be significant. |
| **Improved valuation and pricing of environmental resources**<br>Environmental factors should be included in the valuation of assets and services. | Value placed on avoiding and minimising environmental impacts demonstrated by:<br>• The opportunities identified in the design development to improve local amenity, improve public transport access and active transport connections, and create additional green spaces<br>• The opportunities identified to avoid and minimise environmental impacts in the project development and alternatives analysis<br>• The extent of environmental investigations carried out to inform this environmental impact statement<br>• The measures developed to further avoid and minimise potential impacts of the project in this environmental impact statement<br>• The inclusion of costs associated with planning, design and implementation of avoidance and mitigation measures in the overall project costs. |

## 25.4 Environmental management measures

Environmental management measures relating to sustainability are outlined in Table 25-6.

**Table 25-6 Environmental management measures – Sustainability**

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| SU1 | Design | Project sustainability outcomes | Project sustainability objectives and targets will be finalised during further design development, informed by the requirements of the project planning approval. | WHT/WFU |
| SU2 | Construction | Project sustainability outcomes | Activities to implement the sustainability framework, including requirements from the Infrastructure Sustainability rating scheme, will be implemented through a Sustainability Management Plan. The management plan will detail measures to meet the sustainability objectives and targets as well as achieving 'Design' and 'As Built' ratings of Excellent under the Infrastructure Sustainability Council of Australia rating scheme. | WHT/WFU |

WHT = Western Harbour Tunnel, WFU = Warringah Freeway Upgrade

Chapter 26

# Climate change risk and greenhouse gas

January 2020

# 26 Climate change risk and greenhouse gas

This chapter assesses the potential impacts of climate change on the project and adaptation measures that have been incorporated into the design of the project. Greenhouse gas emissions generated by the construction and operation of the project are also assessed in this chapter. Detailed greenhouse gas calculations and climate change projections are provided in Appendix X (Climate change and greenhouse gas calculations).

The Secretary's environmental assessment requirements as they relate to climate change and greenhouse gas emissions, and where in the environmental impact statement these have been addressed, are detailed in Table 26-1.

The proposed environmental management measures relevant to climate change risk and greenhouse gas emissions are included in Section 26.2.5.

**Table 26-1 Secretary's environmental assessment requirements – climate change risk**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Climate change risk** | |
| 1. The Proponent must assess the risk and vulnerability of the project to climate change in accordance with the current guidelines. | **Chapter 26**, and **Appendix X** (Climate change and greenhouse gas calculations), present a climate change risk assessment for the project in accordance with current guidelines as listed in **Section 26.1.1**. |
| 2. The Proponent must quantify specific climate change risks with reference to either the NSW Government's climate projections at 10 km resolution (or lesser resolution if 10 km projections are not available) or equivalent projection tool (such as the Climate Futures Tool from CSIRO and BoM (attenuated for project region)) and incorporate specific adaptation actions in the design. | Climate change risks to the project are identified in **Section 26.1** and **Appendix X**, with reference to current climate change projections also presented in **Section 26.1.3**. |

## 26.1 Climate change risk assessment

This section outlines the legislation, policies and climate change projections relevant to the project, assesses the risks of climate change to the project and outlines adaptations to manage those risks.

### 26.1.1 Legislative and policy framework

The climate change risk assessment has been conducted in line with the following relevant standards and current guidelines:

- *National Climate Resilience and Adaptation Strategy* (Department of the Environment and Energy, 2015)
- *NSW Climate Change Policy Framework* (Office of Environment and Heritage, 2016)
- *Environmental Sustainability Strategy* 2019-2023 (Roads and Maritime, 2019)

- Australian Standard AS 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk-based approach*
- Australian and New Zealand Standard AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*
- *Climate Change Impacts and Risk Management – A Guide for Business and Government* (Australian Government, 2006)
- *Technical Guide for Climate Change Adaptation for the State Road Network* (Roads and Maritime, in draft)
- *Guideline for Climate Change Adaptation*, Rev2.1: October 2011. (Australian Green Infrastructure Council, 2011).

## 26.1.2 Assessment methodology

The methodology for the climate change risk assessment was based on the Australian Standard AS 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk based approach*. This standard follows the International Standard ISO 31000:2009, *Risk management – Principles and guidelines* (adopted in Australian and New Zealand as AS/NZS ISO 31000:2009), which provides a set of internationally endorsed principles and guidance on how organisations can integrate decisions about risks and responses into its existing management and decision-making processes. The methodology was also guided by the draft *Technical Guide: Climate Adaptation for the Road Network* (Roads and Maritime (in draft)).

While adhering to the above guidance documents, the following key steps were carried out to complete the climate change risk assessment:

- Determination of the climate change context, including greenhouse gas emissions scenarios and projections, data on climate variables and past meteorological record
- Identification of the climate risks and assess the likelihood and consequence of each risk
- Identification of adaptation responses.

To assist with the determination of climate change context as well as the identification of climate change risks and the likelihood of such risks, a risk workshop was held with multidisciplinary members of the project team (ie members of the design and environmental assessment teams) early in the design phase. The preliminary risks identified at the workshop were then formalised in a risk register, and thorough risk descriptions, including cause, impact/consequence and current and proposed future treatment were identified.

A climate change risk update was subsequently carried out based on the design that forms the basis of this environmental impact statement. The update identified treatments that had been incorporated into the design since the initial climate change risk workshop, risk treatments to be implemented or investigated in future design stages, as well as some updates to risk ratings.

A hazard-receiver pathway model has been applied to identify and analyse risks to the project with respect to climate change. Climate or climate influenced attributes with potential to influence the project were identified (hazards), along with the component of the project, user or surrounding environment that would be impacted by the hazard (receivers).

The appropriate risk rating level was identified by:

- Determining the consequences of each risk occurring
- Determining the likelihood of each risk occurring
- Considering what is already inherent in the design, and the business as usual controls expected to be applied through design, construction, maintenance and operation

- Determining the residual risk, incorporating the above factors.

The risk assessment matrix in Appendix X was applied to produce risk ratings for the hazards and receivers identified.

### 26.1.3 Climate change projections

Climate change projections used for the climate change risk and adaptation assessment are summarised in Table 26-2.

The projections were developed for three periods, broadly reflecting the operating timeframes of different elements of the project:

- Year 2030: assets and systems with short operating timeframes, such as communications and other electronic systems, landscaping and road surfaces
- Year 2050: assets and systems with long operating timeframes, such as drainage structures and barriers/rails
- Year 2090: "permanent" assets, which would become fixed and ongoing features of project, such as: tunnel civil structures (including rock bolts), bridges, embankment culverts (and other inaccessible drainage), and buildings.

Projections were derived from the Intergovernmental Panel on Climate Change's Fifth Assessment Report (AR5, IPCC (2013) which are incorporated into the Climate Futures Tool by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Department of Environment and Energy. Projections are provided for a number of emissions and pathway scenarios for a range of climate parameters. The projections are based on the 'worst case' scenario (Representative Concentration Pathways 8.5), which reflects the highest emissions projected for the time period.

**Table 26-2 Summary of climate change projections – Sydney region**

| Climate variable | Baseline (1986-2005) | 2030 | 2050 | 2090 |
|---|---|---|---|---|
| **Temperature** | | | | |
| Mean minimum temperatures (°C) – annual | 14.4 | 15.5 | 16.3 | 18.4 |
| Mean maximum temperatures (°C) – annual | 22.4 | 24.3 | 24.4 | 26.5 |
| Days over 35°C – annual | 3.5 | 5.6 | 5.9 | 11.3 |
| **Rainfall** | | | | |
| Mean precipitation (mm) – annual | 1238 | 1206 | 1151 | 1049 |
| Extreme rainfall events – max 1-day rainfall | Projected to increase 2 – 22% | | | |
| Extreme rainfall events – 20-year return level of max 1-day rainfall | Projected to increase 5 – 42% | | | |

| Climate variable | Baseline (1986-2005) | 2030 | 2050 | 2090 |
|---|---|---|---|---|
| **Evapotranspiration** | | | | |
| Annual change in potential evapotranspiration (% change) | 375mm (1961–1990) | 4.2 | No data | 14.3 |
| **Fire regimes** | | | | |
| The number of days where the fire danger rating is ‘severe’ or ‘extreme’ | 0.9 | 1.3 | No data | 2.1 |
| **Severe wind** | | | | |
| Average maximum daily wind speed (% change) | 120 km/h | -0.2 to 1.9 | 1.8 to 3.2 | 0.3 to 5.7 |
| **Sea conditions** | | | | |
| Sea level rise (m) | 0 | 0.14 | - | 0.66 |
| Sea surface temperature (°C) | - | 1.0 | - | 3.1 |
| **Atmospheric $CO_2$** | | | | |
| Atmospheric $CO_2$ concentration | 401 ppm | - | - | 940 ppm (2100) |

## 26.1.4 Climate change risk evaluation

Climate change risks with a medium or high rating (based on the design presented in this environmental impact statement), prior to additional treatment measures being implemented, are summarised in Table 26-3 (ie ‘initial rating’). These ‘initial ratings’ assume the incorporation of business as usual design, construction and operational controls.

Treatment methods have been identified and are proposed for those ‘initial ratings’, based on current design or proposed to be carried out as part of future investigations associated with the detailed design of the scheme. The ‘final rating’ (ie post-treatment), incorporating treatment options and further investigations, are also presented in Table 26-3.

Low risks identified during the assessment were not considered to require any additional risk treatment, as these risks are considered tolerable. As such, risks classified as ‘low’ or ‘negligible’ risks have therefore not been included in the table below.

In summary, the assessment of climate change risks identified the following risks prior to additional treatment:

- No extreme risks
- No high risk ratings
- Nine medium risk ratings.

Medium risks are anticipated in respect to increased ambient temperatures and heatwaves, rainfall and surface flooding, concrete carbonation and sea level rise.

**Table 26-3 Climate change risk assessment**

| Risk ID | Hazard Category | Description | Initial Rating | Measures incorporated into the current design and business as usual practice | Proposed treatment or further investigation | Final Rating |
|---|---|---|---|---|---|---|
| 7 | **Increased ambient temperatures and heatwaves** | Increased occurrence of extreme heat events leading to a greater potential for adverse effects on infrastructure elements (ie the integrity of joints in retaining walls, noise walls and barriers) due to greater and more frequent variations in temperature ranges. | Medium | Standard tolerances for such installations as per Australian Standards. | No additional control. | **Low** |
| 13 | **Rainfall and surface flooding** | Subsurface structures and foundations (steel and concrete) could be impacted or damaged with changed groundwater levels due to lower than average annual rainfall. | Medium | Current design standards AS3735, AS2159, AS5100 provide the required guidance on the design and durability requirements. | No additional measures. | **Low** |

| Risk ID | Hazard Category | Description | Initial Rating | Measures incorporated into the current design and business as usual practice | Proposed treatment or further investigation | Final Rating |
|---|---|---|---|---|---|---|
| 14 | **Rainfall and surface flooding** | Increase in rainfall events leading to greater ground and stormwater flooding, potentially impacting the operation of water pumps associated with the project but also nearby water treatment plants. | Medium | Plant has been sized to accommodate deluge system which is beyond any climate change rainfall scenario. | No additional measures. | **Low** |
| 25 | **Concrete carbonation** | Exacerbated degradation of concrete structural elements associated with the project due to increased carbonation of concrete and exposure of reinforcement from a rise in average atmospheric temperatures or extreme heat events. | Medium | $CO_2$ diffusion modelling has been carried out with current $CO_2$ levels with an annual rate of increase; typically 440ppm with a rate of 2 ppm per year for Australian conditions, in accordance with international best practice probabilistic methods. Outcomes of this modelling have informed the design. | No additional measures. | **Low** |

| Risk ID | Hazard Category | Description | Initial Rating | Measures incorporated into the current design and business as usual practice | Proposed treatment or further investigation | Final Rating |
|---|---|---|---|---|---|---|
| 26 | **Sea level rise** | Potential for key project elements (ie tunnel portals, ventilation and motorway control centres) to be flooded as a result of sea level rise, resulting in operational failure. | Medium | Key project elements are designed above PMF and above future projected sea level. | Flood modelling during detailed design would continue to use sea level rise projections and rainfall projections. | **Low** |
| 36 | **Rainfall and surface flooding** | Potential for key project elements (ie tunnel portals, ventilation and motorway control centres) to be flooded in extreme rainfall/stormwater events, resulting in operational failure. | Medium | Facilities have been designed to be immune in the PMF. | Flood modelling for detailed design would continue to use sea level rise projections and rainfall projections. | **Low** |
| 44 | **Rainfall and surface flooding** | Drainage channels and exits of culverts suffer increased scour as one per cent AEP storms (the design standard) are more severe as a result of climate change. | Medium | Preliminary scour protection identified. | The extent of scour protection would be refined during detailed design. | **Low** |

| Risk ID | Hazard Category | Description | Initial Rating | Measures incorporated into the current design and business as usual practice | Proposed treatment or further investigation | Final Rating |
|---|---|---|---|---|---|---|
| 45 | **Rainfall and surface flooding** | Design of drainage channels and culverts are not adequate in respect to climate change projections/predictions leading to induced flooding. | Medium | Culverts designed for one per cent AEP event, inclusive of climate change projections. | Sensitivity testing for climate change would carried out in the detailed design of drainage channels and culverts. Increased capacity would be provided where feasible and reasonable. | **Low** |
| 46 | **Rainfall and surface flooding** | The exacerbation of flooding (inclusive of climate change projections) in flood-risk areas surrounding the project as a result of the construction of new built form related to the project. | Medium | Sensitivity testing is carried out for climate change as required in the Secretary's environmental assessment requirements. | Detailed design would address any specific property impacts from flooding where feasible and reasonable. | **Medium** |

### 26.1.5 Adaptation for climate change

Table 26-4 lists the actions that would be carried out during further design development to ensure climate change is addressed effectively.

**Table 26-4 Environmental management measure – climate change risks**

| Ref. | Phase | Risks | Environmental management measure | Location |
|---|---|---|---|---|
| CC1 | Design | Sea level rise, rainfall and flooding | The following actions will be carried out during further design development to ensure climate change is adequately addressed:<br>a) Flood modelling will continue to use sea level rise projections and rainfall projections<br>b) The extent of scour protection will be refined<br>c) Sensitivity testing for climate change will be carried out for drainage channels and culverts. Increased capacity will be provided where feasible and reasonable<br>d) Any specific property impacts from flooding will be addressed where feasible and reasonable. | WHT/WFU |

Western Harbour Tunnel = WHT, Warringah Freeway Upgrade = WFU

## 26.2 Greenhouse gas

Atmospheric greenhouse gases absorb and re-radiate heat from the sun, trapping heat in the lower atmosphere and influencing global temperatures. This is known as the greenhouse effect and is linked to climate change.

The emission of greenhouse gases into the atmosphere occurs as a result of both natural processes (eg bushfires) and human activities (eg burning of fossil fuels to generate electricity).

This section outlines the legislation and policies relevant to the project, and the greenhouse gas emissions and potential impacts caused by the construction and operation of the project.

### 26.2.1 Legislative and policy framework

This assessment was prepared according to the principles and objectives outlined in the following legislation and policies:

- *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (the Kyoto Protocol) (UNFCCC, 1998)
- *Doha Amendment to the Kyoto Protocol (UNFCCC, 2012)*
- *Paris Agreement (UNFCCC, 2015)*
- *National Greenhouse and Energy Reporting Act 2007 (Cth)*
- *Direct Action Plan (Australian Government, 2014)*
- *NSW Climate Change Policy Framework (OEH, 2016)*
- *Environmental Sustainability Strategy* 2019-2023 (Roads and Maritime, 2019).

## 26.2.2 Assessment methodology

The methodology for this greenhouse gas and energy assessment has been based on the following tools and protocols:

- *Greenhouse Gas Protocol: A Corporate Accounting and Reporting St*andard (World Council for Sustainable Business Development (WBCSD) and World Resources Institute (WRI & WBCSD, 2004)
- *Greenhouse Gas Assessment Workbook for Road Projects* (the TAGG Workbook) (Transport Authorities Greenhouse Group (TAGG), 2013)
- *Infrastructure Sustainability Materials Calculator* (Infrastructure Sustainability Council of Australia, 2016b)
- *Tools for Roadside Air Quality* (Roads and Maritime, 2005).

Greenhouse gas emissions are reported as kilotonnes of carbon dioxide equivalent ($ktCO_2$-e).

Emissions are categorised into three different scopes in accordance with the Greenhouse Gas Protocol.

The three greenhouse gas scopes are:

- Scope 1 emissions – direct emissions generated by the project, eg emissions generated by the use of diesel fuel in project construction plant, equipment or vehicles
- Scope 2 emissions – indirect emissions from the consumption of purchased electricity for project equipment or operation of the project
- Scope 3 emissions – all other indirect emissions (not included in Scope 2) generated as a consequence of the project, eg emissions associated with the mining, production and transport of materials used in construction.

## 26.2.3 Assessment of potential construction impacts

The primary sources of construction greenhouse gas emissions and the indicative Scope 1, 2 and 3 emissions are presented in Table 26-5 and Figure 26-1.

The construction stage of the project is expected to generate about 784 $ktCO_2e$ of greenhouse gas emissions. As shown in Figure 26-1, about 50 per cent of emissions are expected to be contributed by construction materials, and about 26 per cent from terrestrial electricity consumption.

The estimated construction stage emissi2ons represent about 0.6 per cent of NSW emissions and about 0.15 per cent of Australia's national emissions in 2016. Due to the indirect nature of Scope 3 emissions, a proportion of these emissions may be generated interstate or internationally. While these percentage contributions are small within the NSW and national contexts, the environmental management measures outlined in Section 26.2.5 will further minimise greenhouse emissions during the construction of the project.

**Table 26-5 Indicative construction phase greenhouse gas emissions by scope**

| Emission source | Emissions ($ktCO_2e$) | | | |
|---|---|---|---|---|
| | Scope 1 | Scope 2 | Scope 3 | Total |
| Diesel combustion (plant and equipment) | 40 | - | 2 | 42 |
| Diesel combustion (generators for marine construction) | 28 | - | 1 | 29 |
| Diesel combustion (transport of materials to terrestrial construction support sites) | - | - | 216 | 16 |
| Diesel combustion (transport of waste and spoil from terrestrial and harbour construction support sites) | - | - | 77 | 77 |
| Vegetation removal | Less than 1 | - | - | Less than 1 |
| Electricity consumption (terrestrial) | - | 186 | 27 | 213 |
| Construction materials | - | - | 407 | 407 |
| **Total** | **68** | **186** | **530** | **784** |

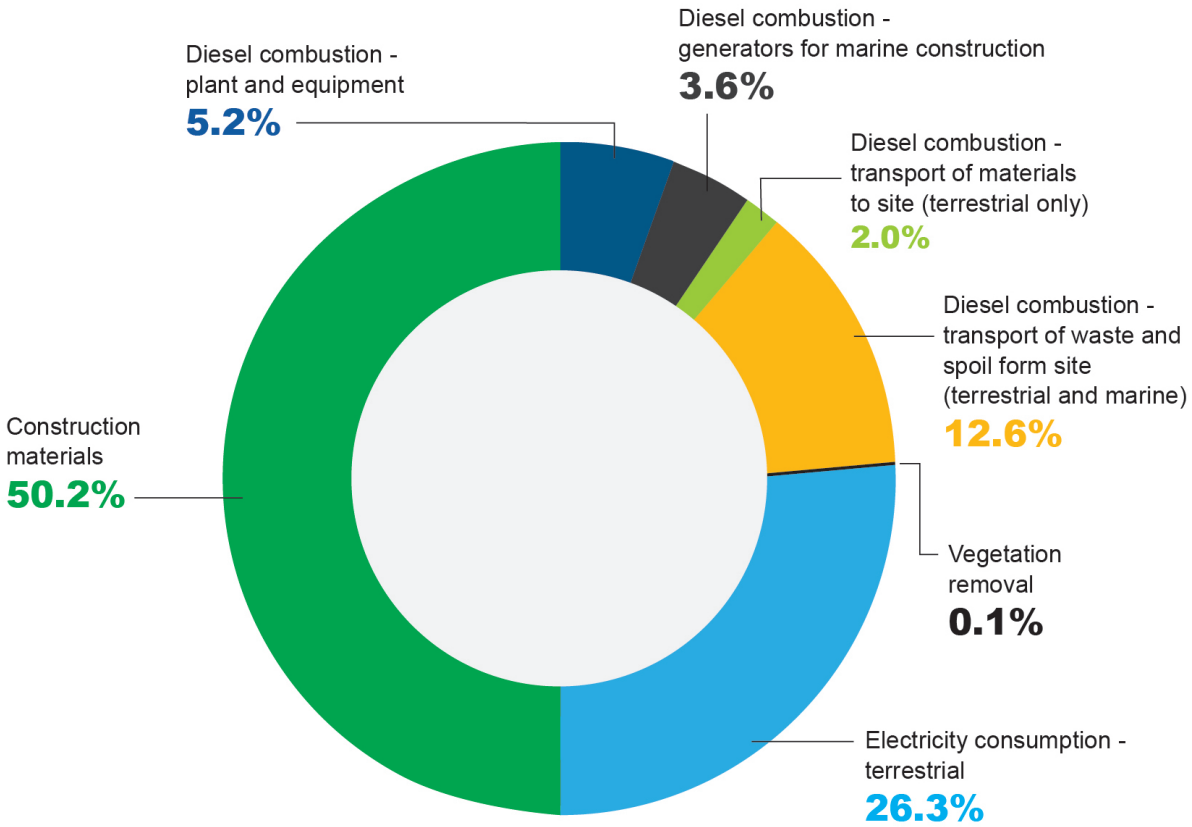



**Figure 26-1 Estimated greenhouse gas emissions by source for construction**

## 26.2.4 Assessment of potential operational impacts

The primary sources of operational greenhouse gas emissions and the indicative Scope 1, 2 and 3 emissions are presented in Table 26-6. Emissions estimates are provided for operational scenarios in 2027 (opening) and 2037 (10 years after opening).

### *Electricity*

Operational greenhouse gas emissions would be associated with electricity consumption required to power operational infrastructure and facilities, including:

- Tunnel ventilation
- Surface and tunnel lighting
- Motorway control centre
- Wastewater treatment plant
- Substations.

Operational electricity consumption is projected to increase over time, due to the projected increase in traffic volumes using the roads, increasing tunnel ventilation requirements.

### *Maintenance*

Greenhouse gas emissions generated from the maintenance of road infrastructure would be relatively small in comparison with other operational sources. Emissions would result from the use of diesel fuel maintenance vehicles and equipment, as well as being embedded in the construction materials used for maintenance activities.

### *Traffic*

Operational greenhouse gas emissions would be associated with fuel consumed by vehicles using the road network. Greenhouse gas emissions are projected to increase as traffic numbers across the road network grow. However, the expected reduction in congestion as a result of the project and expected improvements in fuel efficiency and increases in electric vehicles are projected to result in improvements to the overall efficiency of emissions. The project would increase the number of road links across the network but would result in fewer vehicle stop and start movements, less congestion and a greater average vehicle speed, which would further increase the efficiency of vehicles and assist in reducing emissions. Table 26-6 outlines the difference between operation greenhouse gas emissions associated with traffic, with and without the project.

### *Emission estimates*

The estimated operational emissions would represent about 0.04 per cent and 0.05 per cent of projected NSW emissions in 2027 and 2037 respectively, and 0.01 per cent of Australia's projected national emissions in 2027 and 2037. While these percentage contributions are small within the NSW and national contexts, the environmental management measures outlined in Section 26.2.5 would be implemented to further minimise greenhouse emissions during the operation of the project.

**Table 26-6 Indicative operational phase greenhouse gas emissions by scope**

| Source | Emissions ($ktCO_2e$) | | | |
|---|---|---|---|---|
| | Scope 1 | Scope 2 | Scope 3 | Total |
| **2027** | | | | |
| Operational electricity | - | 32.3 | 4.7 | 36.9 |
| Maintenance | 0.53 | - | 0.47 | 1.0 |
| Traffic (difference between existing levels and levels with the project) | - | - | 20.6 | 20.6 |
| **Total** | **0.53** | **52.9** | **4.7** | **58.5** |
| **2037** | | | | |
| Operational electricity | - | 34.4 | 5.0 | 39.4 |
| Maintenance | 0.53 | - | 0.47 | 1.0 |
| Traffic (difference between existing levels and levels with the project) | - | - | 31.7 | 31.7 |
| **Total** | **0.53** | **66.1** | **5.47** | **72.1** |

## 26.2.5 Environmental mitigation measures

Environmental management measures relating to greenhouse gas emissions are outlined in Table 26-7.

**Table 26-7 Environmental management measures – greenhouse gas emissions**

| Ref. | Phase | Risks | Environmental management measure | Location |
|---|---|---|---|---|
| GHG2 | Design | Energy efficiency | Energy efficiency will be considered during further design development with energy efficient systems installed where reasonable and practicable. | WHT/WFU |
| GHG1 | Construction | Emission of greenhouse gases during construction | Greenhouse gas emissions will be managed and minimised as part of the Sustainability Management Plan which will be implemented to assist in achieving 'Design' and 'As Built' ratings of Excellent under the Infrastructure Sustainability Council of Australia rating scheme. | WHT/WFU |

Western Harbour Tunnel = WHT, Warringah Freeway Upgrade = WFU

Chapter 27

# Cumulative impacts

January 2020

# 27 Cumulative impacts

This chapter provides an overview of the potential cumulative impacts associated with the construction and operation of the project and identifies mitigation measures to minimise these impacts.

The Secretary's environmental assessment requirements as they relate to cumulative impacts and where in the environmental impact statement these have been addressed in Table 27-1.

The proposed environmental management measures relevant to cumulative impacts are discussed in Section 27.5.

**Table 27-1 Secretary's environmental assessment requirements checklist – Cumulative impacts**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Environmental Impact Statement** | |
| 1. The EIS must include, but not necessarily be limited to, the following:<br>o. an assessment of the cumulative impacts of the project taking into account other projects that have been approved but where construction has not commenced, projects that have commenced<br>q. a chapter that synthesises the environmental impact assessment and provides:<br>- the reasons justifying carrying out the project as proposed, having regard to the biophysical, economic and social considerations, including ecologically sustainable development and cumulative impacts; and | Projects that have been assessed and may have potential cumulative impacts are identified in **Section 27.2**. Potential cumulative impacts are described in **Section 27.3** and **Section 27.4**. |
| **Assessment of key issues** | |
| 2. For each key issue the Proponent must:<br>c. identify, describe and quantify (if possible) the impacts associated with the issue, including the likelihood and consequence of the impact (comprehensive risk assessment), and the cumulative impacts of: a) concurrent project construction activities; and b) proposed and approved projects (where information is available at the time of writing) | Potential cumulative impacts during construction and operation for the key issues discussed in **Chapters 8** to **26** are described in **Section 27.3** and **Section 27.4**. |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Consultation** | |
| 4. The Proponent must assess the potential for complaint fatigue to occur during construction of the project and describe how mitigation measures, complaint handling procedures and community consultation mechanisms will mitigate complaint fatigue. The assessment must consider the cumulative impacts from the project and other major projects in the local area. | The potential for complaint fatigue to occur and proposed mitigation measures and complaint handling procedures are described in **Chapter 7** (Stakeholder and community engagement).<br>Potential impacts of construction and complaint fatigue are described in **Section 27.3.5**. |

## 27.1 Assessment methodology

Cumulative impacts can occur when impacts from the project interact or overlap with impacts from other projects and potentially result in a larger overall effect on the environment, businesses or local communities. Cumulative impacts may also occur when projects are constructed consecutively with construction activities occurring over extended periods of time with little to no break in between, resulting in construction fatigue for local receivers. Construction fatigue incorporates the potential for complaint fatigue, which may impact communication of community concerns during construction.

This section provides a description of how projects were initially identified for consideration of cumulative impacts with the Western Harbour Tunnel and Warringah Freeway project, the screening criteria applied to determine whether the identified projects should be assessed for cumulative impacts, and an overview of the type of assessment carried out for the relevant cumulative impacts.

The cumulative impact assessment in this environmental impact statement is based on the broad requirements set out by the Secretary's environmental assessment requirements. There are currently no NSW or Australian Government guidelines on carrying out cumulative impact assessments. The adopted methodology is shown in Figure 27-1.

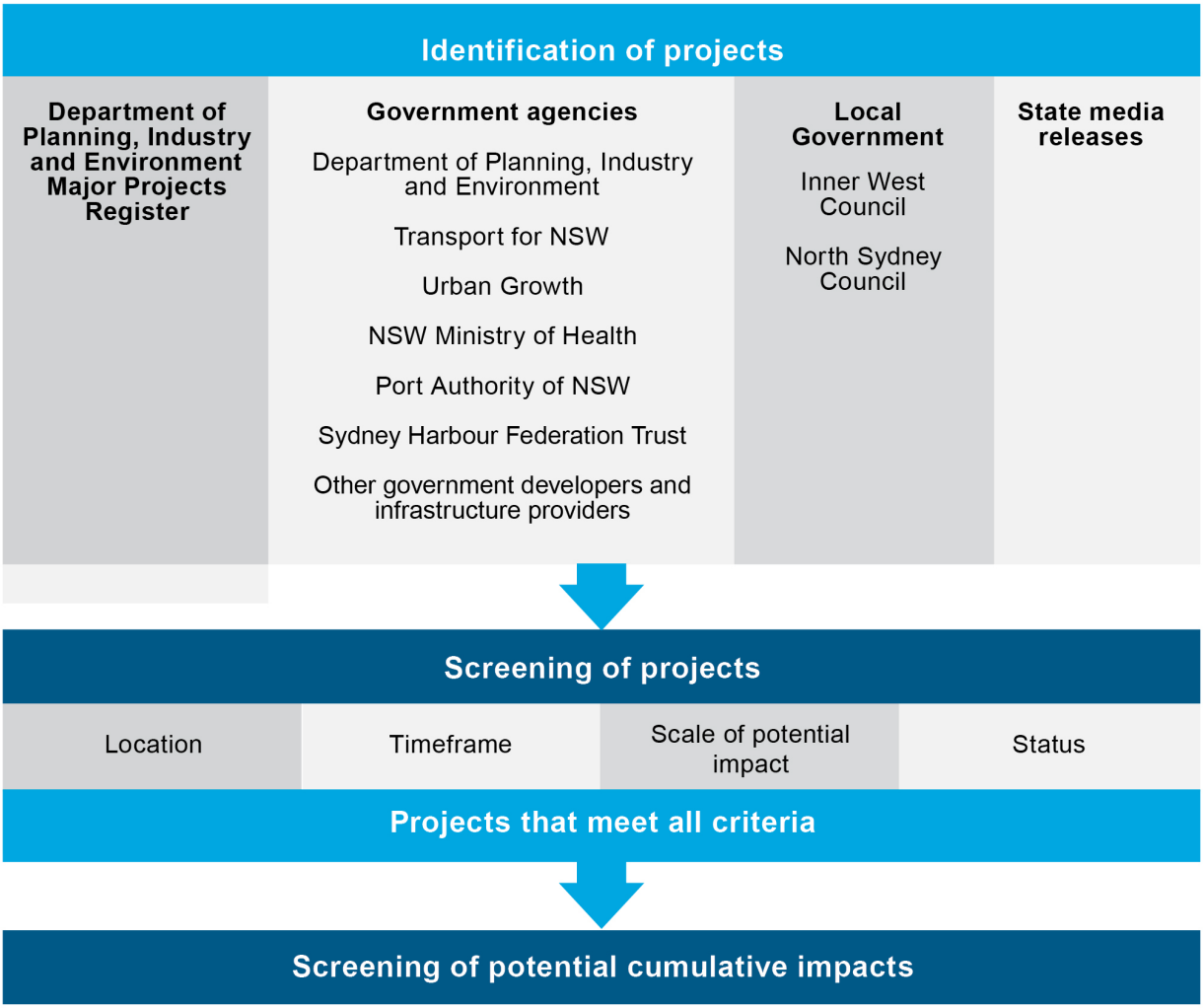



**Figure 27-1 Overview of the cumulative impact assessment methodology**

## 27.1.1 Identification of projects

An initial list of major projects for potential inclusion in the cumulative impact assessment was identified from the sources outlined in Figure 27-1.

Projects identified for inclusion in the screening assessment were those likely to meet at least one of the screening criteria described in Table 27-2. The list of projects identified can be broadly categorised as:

- **Category 1: The Western Harbour Tunnel and Beaches Link program of works**, including the Beaches Link and Gore Hill Freeway Connection project
- **Category 2: Other major transport infrastructure projects**, including related Transport for NSW projects and public transport projects
- **Category 3: Other major projects**, including urban development and other infrastructure projects.

Local strategic planning documents were also considered where they may result in future development with potential cumulative impacts with the project.

## 27.1.2 Screening of projects

The screening criteria shown in Table 27-2 were applied to determine whether a project or strategic plan should be included in the cumulative impact assessment. Projects and plans that satisfied all of these criteria were included and are described in Section 27.2.

**Table 27-2 Screening criteria for cumulative impact assessment**

| Criteria | Relevance |
|---|---|
| **Location**<br>A project was considered relevant where that project was within one of the following areas | Direct overlap: project footprints intersect |
| | In close proximity: within 500 metres of the project footprint |
| | In the locality: within two kilometres of the project footprint |
| **Timeframe**<br>A project was considered relevant where that project involved one of the following timeframes | Concurrent construction programs |
| | Consecutive construction programs (construction fatigue considerations) |
| **Scale of potential impact**<br>A project was considered relevant where that project involved one or more of the following impacts | Substantial temporary or permanent changes to existing traffic conditions |
| | Substantial temporary or permanent changes to the existing noise environment |
| | Impacts on numerous heritage items and/or heritage items with State, National, Commonwealth or World significance |
| | Substantial changes to the existing land use |
| | Substantial changes to the existing urban landscape |
| **Status**<br>A project was considered relevant where that project was at one of the following stages of the statutory assessment and approval process | Approved projects (statutory approvals received), including approved projects that have not started construction, projects currently under construction, and recently completed projects |
| | Proposed projects (currently under statutory environmental impact assessment) |
| | Future strategic government projects (where commitment on construction program and methodology has been made) |

## 27.1.3 Screening of potential cumulative impacts

The assessment of potential cumulative impacts has considered the potential for cumulative impacts at the following key locations:

- Rozelle and White Bay
- Birchgrove
- Waverton

- North Sydney and Cammeray.

Potential cumulative impacts have been considered based on likely interactions of the Western Harbour Tunnel and Warringah Freeway Upgrade project with other projects and plans listed in Table 27-3 and Table 27-4.

Where potential cumulative impacts may occur, these could relate to:

- Additional impacts due to concurrent construction periods
- Prolonged impacts due to consecutive construction periods.

The assessment of potential cumulative impacts has considered the key issues identified in Chapters 8 to 26 of this environmental impact assessment. In locations where cumulative impacts relating to a key issue has been assessed as negligible, the issue is not considered further.

The potential cumulative impacts during construction and operation are described in sections 27.1 and 27.4 respectively.

## 27.2 Projects assessed

Following the application of the screening criteria to identified projects, the projects included in Table 27-3 have been considered in the cumulative impact assessment. The location of these projects is shown in Figure 27-2.

Local strategic plans listed in Table 27-4 have been considered in the assessment where relevant, as they will influence development that has the potential to result in cumulative impacts with the project. The potential impacts have not been considered in detail given the uncertainty of the status and timing of associated projects, construction methodologies, and the existing coordination arrangements between Transport for NSW and Sydney Metro Authority for works in North Sydney.

**Table 27-3 Projects assessed in the cumulative impact assessment**

| Project name, status and expected construction period | Brief project description | Relevant locations where cumulative impacts might occur[1] |
|---|---|---|
| **Category 1: Western Harbour Tunnel and Beaches Link program of works** | | |
| Beaches Link and Gore Hill Freeway Connection project<br>*Proposed*<br>*2021 – 2026* | The Beaches Link and Gore Hill Freeway Connection project comprises a new tolled motorway tunnel connection from the Warringah Freeway to Balgowlah and Frenchs Forest and upgrade and integration works to connect to the Gore Hill Freeway. | • Waverton<br>• North Sydney and Cammeray |
| **Category 2: Transport infrastructure projects** | | |
| Sydney Metro City & Southwest (Chatswood to Sydenham)<br>*Approved*<br>*2017 – 2024* | The Chatswood to Sydenham component of Sydney Metro City & Southwest involves the construction and operation of a 15.5 km metro line from Chatswood, under Sydney Harbour and through Sydney's CBD out to Sydenham.<br>Components of the project relevant to this assessment include:<br>• Crows Nest Station<br>• Victoria Cross Station<br>• Blues Point temporary construction site<br>• Barangaroo Station<br>• White Bay truck marshalling yard. | • Rozelle and White Bay<br>• Birchgrove<br>• Waverton<br>• North Sydney and Cammeray |
| M4-M5 Link<br>*Approved and proposed modification pending determination*<br>*2018 – 2023* | The M4-M5 Link project is being delivered in two stages:<br>• M4-M5 Link tunnels – construction of the mainline tunnels between the New M4 at Haberfield and the New M5 at St Peters. This will also include stub tunnels for the Rozelle Interchange<br>• M4-M5 Link Rozelle Interchange – construction of a mostly underground interchange at the Rozelle Rail Yards providing surface connectivity between the New M5 and M4 corridors to Victoria Road, The Crescent, City West Link, Anzac Bridge and the future Western Harbour Tunnel. | • Rozelle and White Bay |

| Project name, status and expected construction period | Brief project description | Relevant locations where cumulative impacts might occur[1] |
|---|---|---|
| Sydney Metro West<br>*Proposed*<br>*Construction starting 2020* | The Sydney Metro West will service the key precincts of Greater Parramatta, Sydney Olympic Park, The Bays Precinct and the Sydney CBD. The project is proposed to include:<br>• A new Metro Station in The Bays precinct<br>• A new metro station under an existing suburban station on the T1 Northern Line east of Sydney Olympic Park<br>• At least one Sydney Metro West station under the Sydney CBD, delivering an easy interchange between suburban rail, new light rail and the new metro stations currently under construction. | • Rozelle and White Bay |
| **Category 3: Other projects and strategic developments** | | |
| Wenona School New Education Building<br>*Approved*<br>*Construction commenced (construction overlap assumed)* | This project involves the demolition of existing structures and construction of a six-storey school building at 255-265 Miller Street, North Sydney. | • Waverton<br>• North Sydney and Cammeray |
| Shore School Physical Education Centre<br>*Approved*<br>*Proposed completion in 2020* | This project involves the demolition of existing buildings at 4-5 Hunter Crescent and 16 William Street, North Sydney and construction works comprising an aquatic centre, new sports facilities, additional learning and staff spaces, car parking and landscaping. | • Birchgrove<br>• Waverton<br>• North Sydney and Cammeray |
| Commercial and hotel development on Berry and Walker Streets at North Sydney<br>*Approved*<br>*No timeframe information* | This project involves the construction of two new buildings, one for commercial and the other for hotel use. The commercial building will be positioned on Berry Street and the hotel building on Walker Street. The commercial building will be 35–40 storeys high and the hotel building will be 28–30 storeys high. | • Waverton<br>• North Sydney and Cammeray |

| Project name, status and expected construction period | Brief project description | Relevant locations where cumulative impacts might occur[1] |
|---|---|---|
| *(construction overlap assumed)* | | |
| St Aloysius' College Redevelopment<br>*Approved*<br>*No timeframe information (construction overlap assumed)* | This proposal is for a staged redevelopment at St Aloysius' College.<br>Stage 1 would include a masterplan and concept approval for the three existing campuses in Kirribilli, and detailed built form approval for two campuses.<br>Stage 2 would include detailed built form approval for the third campus, to be sought under a future development application. | • Waverton<br>• North Sydney and Cammeray |
| Loreto Kirribilli Staged Redevelopment<br>*Approved*<br>*No timeframe information (construction overlap assumed)* | This proposal is for a staged redevelopment at Loreto Kirribilli. Works would involve the demolition, excavation and construction of various buildings and associated landscaping works on the school site at Carabella Street, Kirribilli. | • Waverton<br>• North Sydney and Cammeray |
| Glebe Island concrete batching plant (Hanson Construction Materials Pty Ltd)<br>*Proposed (2019-2020)* | This proposal is for the construction and operation of a new aggregate handling and concrete batching facility, with the capacity to produce up to one million cubic metres of concrete per annum. | • Rozelle and White Bay |
| Glebe Island Multi-User Facility<br>*Approved*<br>*No timeframe information (construction overlap assumed)* | The project is proposed to include construction and operation of a ship off-loading, storage and despatch facility for bulk construction materials such as sand, aggregates and other dry bulk construction materials. The project site is located within land owned by the Port Authority on the eastern side of Glebe Island. | • Rozelle and White Bay |

| Project name, status and expected construction period | Brief project description | Relevant locations where cumulative impacts might occur[1] |
|---|---|---|
| The new Sydney Fish Market (Stage 1 and Stage 2)<br>*Proposed (2020-2023)* | The new Sydney Fish Market will include wholesale facilities and auction rooms, offices and commercial space, culinary education, retail premises including food and beverage premises (potentially with liquor licenses), back-of-house facilities and car and delivery vehicle parking spaces and ancillary uses. The new facility will be set within an improved public domain including the creation of a waterfront promenade with improved access to Blackwattle Bay and linking to surrounding areas and to public transport. | • Rozelle and White Bay |

[1] Relevant locations where cumulative impacts might occur include locations where surface works for the Western Harbour Tunnel and Warringah Freeway Upgrade project occur within two kilometres of a Category 1, 2 or 3 project

**Table 27-4 Strategic plans considered in the cumulative impact assessment**

| Strategic plan | Brief description | Relevant locations where cumulative impacts might occur |
|---|---|---|
| The Bays Precinct Urban Transformation Plan | This 20-30 year plan provides for a mix of cultural, maritime, recreational, retail and commercial uses around eight waterfront locations including White Bay Power Station, Glebe Island, White Bay, Blackwattle Bay including Sydney Fish Market, Wentworth Park, Rozelle Bay and Bays Waterways and Rozelle Rail Yards.<br>UrbanGrowth is currently conducting studies to inform development of the Bays Markets District (Blackwattle Bay) and White Bay Power Station, which cover locations relevant to this assessment. | • Rozelle and White Bay |
| Waverton Peninsula Strategic Master Plan | The Waverton Peninsula Strategic Master Plan was adopted by Council in 1999. The master plan is being progressively implemented in stages as funding permits.<br>Future proposed works include:<br>• Coal Loader Tunnel No. 1 restoration<br>• Coal Loader lower terrace picnic/barbeque and stage area<br>• Coal Loader harbourlink steps. | • Waverton |
| Ward Street Precinct Master Plan (North Sydney) | This master plan by North Sydney Council proposes to replace the Ward Street car park at North Sydney with a major new community facility and a public plaza connected by active, pedestrian focused laneways. | • North Sydney and Cammeray |
| St Leonards Park Landscape Masterplan | The St Leonards Park Landscape Masterplan is designed to guide future upgrade works with recognition of the park's recreational and heritage values. The Masterplan includes restoration works for key heritage items with the park and the provision of new and improved recreational facilities, including active transport pathways, playground and sporting equipment. | • North Sydney and Cammeray |

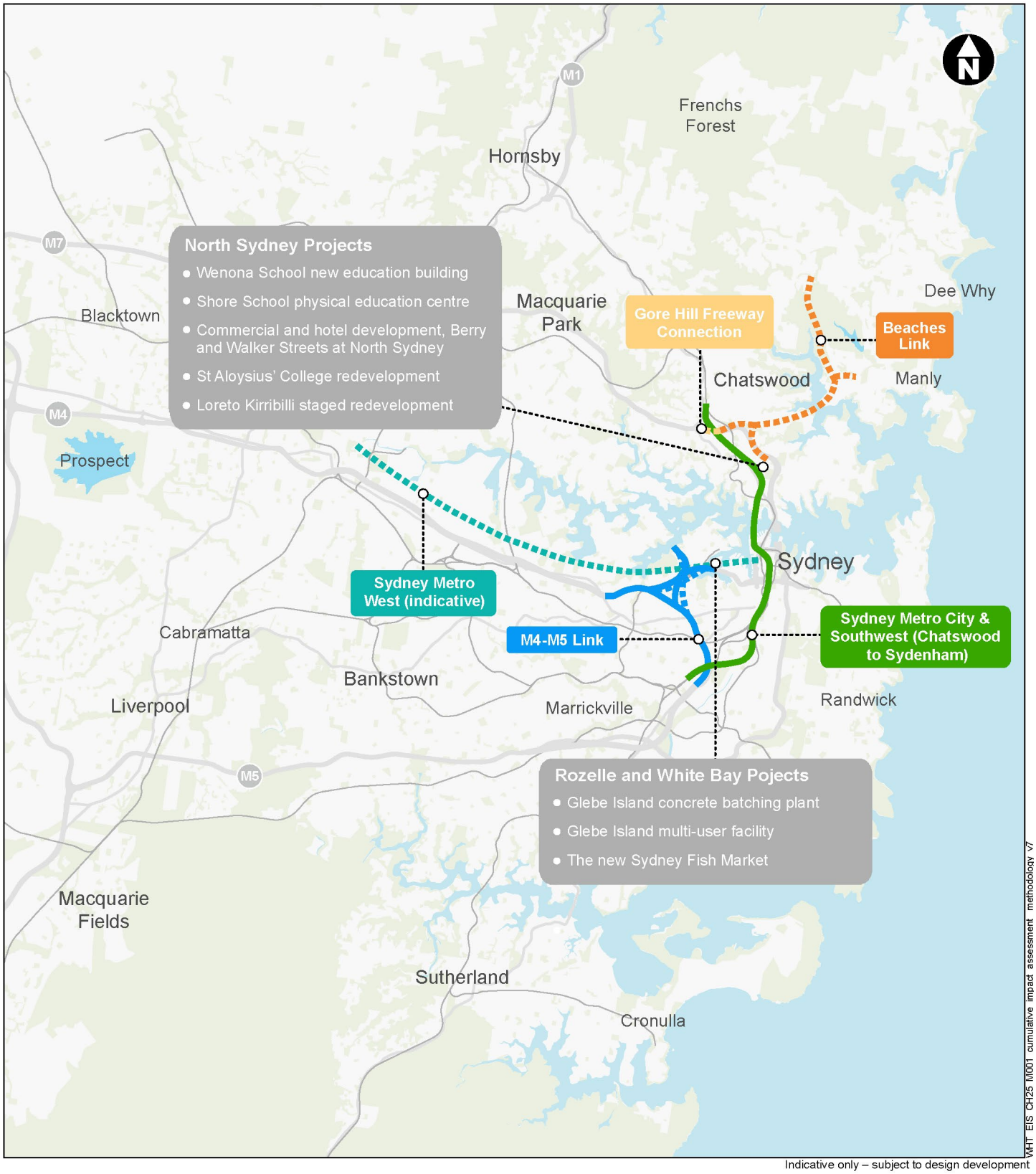



**Figure 27-2 Projects assessed in the cumulative impact assessment**

## 27.3 Assessment of potential cumulative construction impacts

The following sections describe the potential cumulative impacts during construction of the project based on likely interactions with the projects and plans listed in Table 27-3 and Table 27-4.

Impacts outlined in each section are unmitigated potential cumulative impacts. Mitigation measures are included in Section 27.5.

### 27.3.1 Rozelle and White Bay

#### *Projects*

Construction activities at Rozelle and White Bay would occur in close proximity to the following projects:

- M4-M5 Link
- Sydney Metro West
- Sydney Metro City & Southwest (White Bay truck marshalling yard)
- Glebe Island Concrete Batching Plant and Aggregate Handling
- Glebe Island Multi-User Facility
- The new Sydney Fish Market (Stage 1 and Stage 2).

Construction activities at Rozelle and White Bay would occur in the locality of the Sydney Metro City & Southwest project (Barangaroo Station).

#### *Potential cumulative impacts*

Potential cumulative construction impacts at Rozelle and White Bay are identified in Table 27-5.

In summary, cumulative impacts are most likely to be experienced by receivers around the Rozelle Interchange at Rozelle, Lilyfield and Annandale as a result of concurrent and consecutive construction activities for the project and the M4-M5 Link project. Potential cumulative impacts may also be experienced in the vicinity of White Bay, Blackwattle Bay and Glebe Island at Balmain as a result of concurrent and consecutive construction activities for the project, Sydney Metro City & Southwest, and major projects at Glebe Island and the upgrade of the Sydney Fish Markets.

Construction traffic generated by the projects considered has the potential to result in cumulative impacts to the road network at Rozelle and around White Bay. Roads most likely to be affected include the City West Link, The Crescent and Victoria Road at Rozelle, and James Craig Road at White Bay. There is potential for the departures from Glebe Island Berths 7 & 8 to be affected by dredge spoil barges occupying White Bay Berth 3. There would need to be cooperation between the occupants of White Bay during the arrival and departure of cargo ships, bulk carriers or cruise lines. However this level of cooperation is considered to be the status quo.

There is potential for cumulative temporary construction noise, visual amenity, and social and economic impacts may also be experienced by receivers at Rozelle, Lilyfield, Balmain and Annandale due to the number of projects under construction both concurrently and consecutively in close proximity. There is also potential for drawdown impacts to a domestic groundwater bore at Rozelle due to the number of tunnelling projects in close proximity.

The construction of projects may provide cumulative benefits for local construction workers, and to local business and services by increasing passing trade during construction periods.

The potential for construction fatigue and complaint fatigue at Rozelle and White Bay is discussed in Section 27.3.5.

Additional cumulative construction impacts at Rozelle and White Bay may be generated by future projects associated with the Bays Precinct Urban Transformation Plan (refer to Table 27-4), however construction program and specific scope of these projects have not yet been released.

Cumulative impacts resulting from the construction of the projects considered are expected to be negligible for the following issues:

- Air quality
- Non-Aboriginal heritage
- Aboriginal heritage
- Hydrology and water quality
- Flooding
- Biodiversity
- Hazard and risk
- Resource use and waste management
- Sustainability
- Climate change and greenhouse gases.

As such, these issues are not considered further in Table 27-5.

**Table 27-5 Potential cumulative construction impacts – Rozelle and White Bay**

| Environmental impact | Potential cumulative environmental impacts – category 2 projects |
|---|---|
| **M4-M5 Link** | |
| Traffic and transport | • Prolonged heavy and light vehicle traffic on City West Link, The Crescent, James Craig Road and Victoria Road[1]<br>• Prolonged adjustments to bus stops along The Crescent, north of Johnston Street[1]. |
| Health and safety | • Additional risk of contamination exposure around the Rozelle Interchange<br>• Additional health effects for residential receivers around Rozelle, Lilyfield and Annandale from stress and anxiety from changes in the urban environment. |
| Noise and vibration | • Additional temporary minor increase in construction noise for receivers around the Rozelle Rail Yards, White Bay, Blackwattle Bay and at Rozelle, Lilyfield and Annandale<br>• Prolonged duration and frequency of construction noise for receivers around the Rozelle Rail Yards and White Bay[2]. |
| Urban design and visual amenity | • Additional and prolonged moderate to high landscape and visual impacts for residential and recreational receivers in the vicinity of Rozelle Rail Yards, the Glebe foreshores, and residential receivers around Annandale and Lilyfield<br>• Additional and prolonged moderate to high landscape and visual impacts for receivers using transport corridors around the Rozelle Interchange, including The Crescent and City West Link. |
| Socio-economic, land use and property | • Additional and prolonged increase in passing trade for local businesses and services around Darling Street and Victoria Road at Rozelle, and around James Craig Drive, Chapman Road and Robert Street at White Bay<br>• Additional and prolonged land use impacts at Rozelle Rail Yards and the Glebe foreshores due to consecutive construction periods<br>• Additional and prolonged amenity impacts for residential receivers near the Rozelle Rail Yards and for industrial and commercial receivers around White Bay and Glebe Island<br>• Additional and prolonged impacts to community perceptions of public health and safety due to increases in construction traffic for residential receivers near the Rozelle Rail Yards and for industrial and commercial receivers around White Bay and Glebe Island<br>• Additional and prolonged increased demand for construction workers, providing benefits for local workers. |

| Environmental impact | Potential cumulative environmental impacts – category 2 projects |
|---|---|
| Geology, groundwater and soils | Water table drawdown impacts at one domestic groundwater bore around the Rozelle Interchange[3]. |
| **Sydney Metro City & Southwest** | |
| Traffic and transport | White Bay truck marshalling yard:<br>• Prolonged heavy and light vehicle traffic on James Craig Drive<br>Barangaroo Station:<br>• Additional marine construction traffic in Sydney Harbour in the vicinity of White Bay, Johnstons Bay and Darling Harbour. |
| Health and safety | Negligible |
| Noise and vibration | Negligible |
| Urban design and visual amenity | Negligible |
| Socio-economic, land use and property | Additional and prolonged increase in passing trade for local businesses and services around James Craig Drive at White Bay. |
| Geology, groundwater and soils | Negligible |

[1] Quantitative cumulative assessment presented in Chapter 8 (Construction traffic and transport)
[2] Quantitative cumulative assessment presented in Chapter 10 (Construction noise and vibration)
[3] Quantitative cumulative assessment presented in Chapter 16 (Geology, soils and groundwater).

## 27.3.2 Birchgrove

### *Projects*

Construction activities at Birchgrove, including within Sydney Harbour, would not be in close proximity to any projects identified in Section 27.2, but would occur in the locality of the following projects:

- Sydney Metro City & Southwest Chatswood to Sydenham (Blues Point temporary construction site).

### *Potential cumulative impacts*

Potential cumulative construction impacts at Birchgrove are identified in Table 27-6.

In summary, potential cumulative impacts at Birchgrove would be limited to temporary minor construction noise impacts due to the proximity of construction support sites (WHT 4 and 5) to the temporary construction site for Sydney Metro City & Southwest (Chatswood to Sydenham) at Barangaroo.

The potential for construction fatigue and complaint fatigue at Birchgrove is discussed in Section 27.3.5.

Cumulative impacts resulting from the construction of the projects considered are expected to be negligible for the following issues:

- Traffic and transport
- Air quality
- Health and safety
- Non-Aboriginal heritage
- Aboriginal heritage
- Geology, groundwater and soils
- Hydrology and water quality
- Flooding
- Biodiversity
- Land use and property
- Social and economics
- Hazard and risk
- Resource use and waste management
- Sustainability
- Climate change and greenhouse gases.

As such, these issues are not considered further in Table 27-6.

**Table 27-6 Potential cumulative construction impacts – Birchgrove**

| Environmental impact | Potential cumulative environmental impacts |
|---|---|
| | **Category 2 projects** |
| | **Sydney Metro City & Southwest** |
| **Noise and vibration** | • Additional temporary minor increase in noise and vibration for receivers around the Sydney Harbour south temporary construction site (WHT5) at Birchgrove[1]<br>• Prolonged duration and frequency of construction noise and vibration for receivers around the Sydney Harbour south temporary construction site (WHT5) at Birchgrove[1]. |

[1] Quantitative cumulative assessment presented in Chapter 10 (Construction noise and vibration)

## 27.3.3 Waverton

### *Projects*

Construction activities at Waverton, including within Sydney Harbour, would not be in close proximity to any projects identified in Section 27.2, but would occur in the locality of the following projects:

- Sydney Metro City & Southwest (Chatswood to Sydenham) (Victoria Cross Station and Blues Point temporary construction site)
- Wenona School New Education Building
- Shore School Physical Education Centre

  Commercial and hotel development on Berry and Walker Streets at North Sydney.

### *Potential cumulative impacts*

Potential cumulative construction impacts at Waverton are identified in Table 27-7.

In summary, potential cumulative impacts at Waverton would be limited to temporary reductions in visual amenity due to the proximity of construction support sites (WHT 6 and 7) to the temporary construction site for Sydney Metro City & Southwest (Chatswood to Sydenham) at Blues Point.

The potential for construction fatigue and complaint fatigue at Waverton is discussed in Section 27.3.5.

Additional cumulative construction impacts at Waverton may be generated by future projects associated with the Waverton Peninsula Strategic Masterplan (refer to Table 27-4), however construction program and specific scope for these projects have not yet been released.

Cumulative impacts resulting from the construction of the projects considered are expected to be negligible for the following issues:

- Traffic and transport
- Air quality
- Health and safety
- Non-Aboriginal heritage
- Aboriginal heritage
- Geology, groundwater and soils

- Hydrology and water quality
- Flooding
- Biodiversity
- Land use and property
- Social and economics
- Hazard and risk
- Resource use and waste management
- Sustainability
- Climate change and greenhouse gases.

As such, these issues are not considered further in Table 27-7.

Negligible cumulative impacts are expected to result from construction activities at Waverton from the following projects:

- Wenona School New Education Building
- Shore School Physical Education Centre
- Commercial and hotel development on Berry and Walker Streets at North Sydney.

As such, these projects have not been considered further in Table 27-7.

**Table 27-7 Potential cumulative construction impacts – Waverton**

| Environmental impact | Potential cumulative environmental impacts |
|---|---|
| | **Category 2 projects** |
| | **Sydney Metro City & Southwest** |
| **Urban design and visual amenity** | Additional and prolonged moderate to high landscape and visual impacts for residential receivers at McMahons Point and recreational receivers at Barangaroo Reserve. |

## 27.3.4 North Sydney and Cammeray

### *Projects*

Construction activities at North Sydney and Cammeray would occur in close proximity to the following projects:

- Beaches Link and Gore Hill Freeway Connection project
- Sydney Metro City & Southwest (Victoria Cross Station and Crows Nest Station)
- Wenona School New Education Building
- Shore School Physical Education Centre
- Commercial and hotel development on Berry and Walker Streets at North Sydney
- St Aloysius' College Redevelopment
- Loreto Kirribilli Staged Redevelopment.

### *Potential cumulative impacts*

Potential cumulative construction impacts at North Sydney and Cammeray are identified in Table 27-8.

In summary, cumulative impacts may potentially be experienced by receivers around the Cammeray Golf Course, the North Sydney CBD and the Warringah Freeway corridor between Milsons Point and Cammeray.

Cumulative traffic impacts have the potential to be experienced at Cammeray due to the interaction of the project with the Beaches Link and Gore Hill Freeway Connection project. In particular, the local road network at Cammeray is likely to be affected due to the consecutive use of Cammeray Golf Course as construction support sites for the Western Harbour Tunnel and Beaches Link program of works.

Cumulative temporary construction noise, visual amenity and social and economic impacts may also be experienced by receivers at North Sydney and Cammeray due to the number and proximity of construction sites associated with the project, the Beaches Link and Gore Hill Freeway Connection project, and the Sydney Metro City & Southwest project. It is likely that these construction sites would operate both concurrently and consecutively, with prolonged impacts to residential, commercial and recreational receivers.

The consecutive use of a portion of the Cammeray Golf Course as construction support sites for the Western Harbour Tunnel and Beaches Link program of works also has the potential to result in prolonged cumulative land use and heritage impacts as well as impacts to public open space.

These projects may also provide cumulative benefits for local construction workers and to local business and services in these areas by increasing passing trade during construction periods.

The potential for construction fatigue and complaint fatigue at North Sydney and Cammeray is discussed in Section 27.3.5.

Additional cumulative construction impacts at North Sydney may be generated by future projects associated with the Draft Ward Street Precinct Masterplan and the St Leonards Park Landscape Masterplan (refer to Table 27-4), however the construction program and specific scope for these projects have not yet been released.

Cumulative impacts resulting from the construction of the projects considered are expected to be negligible for the following issues:

- Air quality
- Aboriginal heritage
- Geology, groundwater and soils
- Hydrology and water quality
- Flooding
- Biodiversity
- Hazard and risk
- Resource use and waste management
- Sustainability
- Climate change and greenhouse gases.

As such, these issues are not considered further in Table 27-8.

Negligible cumulative impacts are expected to result from construction activities at North Sydney and Cammeray from the following projects:

- Wenona School New Education Building
- Shore School Physical Education Centre
- Commercial and hotel development on Berry and Walker Streets at North Sydney
- St Aloysius' College Redevelopment
- Loreto Kirribilli Staged Re-development.

As such, these projects have not been considered further in Table 27-8.

**Table 27-8 Potential cumulative construction impacts – North Sydney and Cammeray area**

| Environmental impact | Potential cumulative environmental impacts | |
|---|---|---|
| | **Category 1 projects** | **Category 2 projects** |
| | **Beaches Link and Gore Hill Freeway Connection** | **Sydney Metro City & Southwest** |
| **Traffic and transport** | Additional and prolonged reduction in level of service on Ernest Street, Falcon Street and Miller Street at Cammeray due to construction traffic volumes[1]. | Negligible |
| **Health and safety** | Health effects for residential receivers around Cammeray from stress and anxiety from changes in the urban environment. | Negligible |
| **Noise and vibration** | Additional and prolonged temporary increase in construction noise from construction works at Cammeray Golf Course and construction sites at Cammeray Golf Course and Flat Rock Drive for the Beaches Link and Gore Hill Freeway Connection project[2]. | Additional and prolonged temporary increase in construction noise from construction works at Cammeray Golf Course and construction sites at Victoria Cross and Crows Nest for the Sydney Metro City & Southwest project[2]. |
| **Urban design and visual amenity** | Additional and prolonged moderate to high landscape and visual impacts for receivers around the Warringah Freeway corridor, residential receivers around Cammeray, North Cremorne and Neutral Bay, and recreational receivers at Cammeray Park. | Prolonged minor to moderate landscape and visual impacts for receivers in the North Sydney CBD, particularly around Berry Street and Miller Street. |
| **Socio-economic, land use and property** | • Additional and prolonged increase in passing trade for local businesses and services in North Sydney and Cammeray, particularly along Miller Street<br>• Additional and prolonged land use impacts at Cammeray Golf Course due to consecutive construction periods<br>• Additional temporary and permanent loss of open space, parks | • Additional and prolonged increase in passing trade for local businesses and services in North Sydney and Crows Nest<br>• Additional and prolonged amenity impacts for commercial receivers in the North Sydney CBD<br>• Additional and prolonged impacts to community |

| Environmental impact | Potential cumulative environmental impacts | |
|---|---|---|
| | **Category 1 projects** | **Category 2 projects** |
| | **Beaches Link and Gore Hill Freeway Connection** | **Sydney Metro City & Southwest** |
| | and recreational facilities at Cammeray Golf Course<br>• Additional and prolonged amenity impacts for receivers around the Warringah Freeway and for residential and recreational receivers at Cammeray<br>• Additional and prolonged impacts to community perceptions of public health and safety due to increases in construction traffic for residential and recreational receivers at Cammeray<br>• Additional and prolonged increased demand for construction workers, providing benefits for local workers. | perceptions of public health and safety due to increases in construction traffic in the North Sydney CBD<br>• Additional and prolonged increased demand for construction workers, providing benefits for local workers. |
| **Non-Aboriginal heritage** | • Additional and prolonged moderate impacts on Cammeray Park (including golf course)<br>• Minor temporary impacts to additional heritage items in the vicinity of North Sydney and Cammeray. | Minor temporary impacts to additional heritage items in the vicinity of North Sydney. |

[1] Quantitative cumulative assessment presented in Chapter 8 (Construction traffic and transport)
[2] Quantitative cumulative assessment presented in Chapter 10 (Construction noise and vibration)

## 27.3.5 Construction and complaint fatigue

### *Construction fatigue*

There is potential for construction fatigue to be experienced by receivers in the vicinity of the project. Construction fatigue may be experienced by receivers that are in the vicinity of concurrent or consecutive project construction activities where the activities overlap or have little or no break between the activities of one project, or multiple adjacent projects.

Areas considered most likely to experience sustained impacts to receivers that may result in construction fatigue include residential receivers in the vicinity of the Rozelle Rail Yards, White Bay and Glebe Island, commercial receivers in the North Sydney CBD, residential receivers in Cammeray, and regular users of the Warringah Freeway. Construction fatigue in the above areas may occur as a result of the close proximity of multiple construction sites for the project, and from construction activities associated with the following projects:

- Rozelle and White Bay
  - M4-M5 Link
  - Sydney Metro West
  - Sydney Metro City & Southwest (White Bay truck marshalling yard)
  - Glebe Island concrete batching plant
  - Glebe Island Multi-User Facility
  - The new Sydney Fish Market
- North Sydney and Cammeray
  - Beaches Link and Gore Hill Freeway Connection
  - Sydney Metro City & Southwest (Victoria Cross Station and Crows Nest Station).

Based on the environmental impact assessments the project and for those projects listed above, potential impacts considered most likely to result in construction fatigue include construction traffic and parking, construction noise and vibration, visual and amenity impacts, and impacts to community perceptions of public health and safety.

There is also potential for construction fatigue to be experienced by residential receivers in Birchgrove, Waverton and McMahons Point as a result of works on the Sydney Metro City & Southwest project at Blues Point. Construction fatigue at these locations may be generated by temporary visual amenity and construction noise impacts from both projects.

Work would be coordinated between the various project construction sites, where feasible and reasonable to minimise construction fatigue.

Community consultation would be undertaken to gauge key impacts and issues and identify any unknown impacts from concurrent or consecutive sets of construction works. The community consultation framework presented in Chapter 7 (Stakeholder and community engagement) and Appendix E (Community consultation framework).

### *Complaint fatigue*

Complaint fatigue may occur where community perceptions of project complaint management systems result in failure to report concerns about construction impacts. Complaint fatigue may be compounded where multiple agencies are responsible for issues in the same area where construction of multiple projects occurs.

There is potential for complaint fatigue to be generated in the vicinity of any construction site for the project (refer to Chapter 6 (Construction work)). Areas considered most likely to

generate complaint fatigue include Rozelle and White Bay, and North Sydney and Cammeray, due to the proximity of multiple construction sites for the project, as well as construction sites for the following projects:

- Rozelle and White Bay
  - M4-M5 Link
- North Sydney and Cammeray
  - Beaches Link and Gore Hill Freeway Connection
  - Sydney Metro City & Southwest (Victoria Cross Station, Crows Nest Station, Blues Point temporary construction site).

A complaints management system would be implemented for the duration of construction, which would include a number of different complaint mechanisms to cater to different needs and preferences (refer to Chapter 7 (Stakeholder and community engagement)). The complaints management system for the project is outlined in Appendix E (Community consultation framework).

The community relations team for the project would build a working relationship with the project teams for other major projects under construction at the same time as the project to identify stakeholders and community members who may be susceptible to complaint fatigue.

### 27.3.6 Summary

In summary, the potential cumulative impacts during construction of the project based on likely interactions with other projects and plans would be concentrated around Rozelle and White Bay areas in the south of the project footprint, generated by interactions between the project, M4-M5 Link and various major projects at White Bay.

Potential cumulative impacts around North Sydney and Cammeray in the north of the project footprint would be generated by interactions between the project, Beaches Link and Gore Hill Freeway Connection, and Sydney Metro City & Southwest sites at Victoria Cross and Crows Nest.

Limited cumulative impacts may also be experienced in the vicinity of temporary construction sites at Birchgrove and Waverton as a result of interactions with Sydney Metro City & Southwest construction activities at Blues Point.

Without mitigation, key potential cumulative impacts in the vicinity of Rozelle would likely include minor to moderate temporary increases in traffic volume, construction noise and vibration, decreased visual amenity and land use impacts. There is also potential for construction fatigue and complaint fatigue to be experienced by surrounding receivers at these locations as a result of concurrent and consecutive construction programs. Overall, the cumulative impacts in Rozelle and surrounds is moderate and manageable. The potential impacts would be mitigated by considered and tailored cumulative construction traffic planning, based on confirmed cumulative activities at the time of construction.

The design and construction methodology has been developed with consideration of these issues, and attempts to mitigate many of these issues where possible. The community consultation framework presented in Chapter 7 (Stakeholder and community engagement) and Appendix E (Community consultation framework) has also been developed with consideration of complaint fatigue and includes procedures to proactively manage this issue where possible. Potential cumulative construction impacts would be managed in accordance with the measures outlined in Section 27.5.

## 27.4 Assessment of potential cumulative operational impacts

A number of potential cumulative impacts during the operation of the project are included in the operational modelling. This has been used to inform the assessment of key issues, including for traffic, air quality, noise and vibration, and human health.

The operational modelling considered the following scenarios:

- Without the project ('Do minimum')
- With the project ('Do something')
- With the project and other planned proposed projects ('Do something cumulative').

The operational modelling scenarios have considered cumulative impacts associated with the Category 1 and 2 projects listed in Table 27-3. Category 3 projects were excluded as they were considered unlikely to generate cumulative operational impacts. Within the operational models:

- As part of the 'Do minimum' scenarios, the M4-M5 Link is considered as this project is approved and would be operational prior to the Western Harbour Tunnel and Warringah Freeway project
- As part of the 'Do something cumulative' scenarios, the Beaches Link and Gore Hill Freeway Connection is considered as this project is subject to planning approval.

In addition to Category 1 and 2 projects some additional projects have been considered outside the two-kilometre radius (refer to Table 27-9) as they are considered to be relevant to some operational models, which operate on a wider scale to the cumulative assessment in this chapter.

The cumulative assessments are discussed in detail in their assessment chapters and technical working papers listed below, and are therefore not considered further in this chapter:

- Traffic and transport: Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport)
- Noise and vibration: Chapter 11 (Operational noise and vibration) and Appendix G (Technical working paper: Noise and vibration)
- Air quality: Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality)
- Human health: Chapter 13 (Human health) and Appendix I (Technical working paper: Health impact assessment).

**Table 27-9 Additional projects included in the operational 'Do something cumulative' modelling scenarios for the environmental impact assessment**

| Projects included in operational model | Traffic and transport | Noise and vibration | Air quality | Human health |
|---|---|---|---|---|
| WestConnex program of works | ✓ | ✓ | ✓ | ✓ |
| Sydney Gateway | ✓ | ✓ | ✓ | ✓ |
| F6 Extension (Stage 1) | ✓ | ✓ | ✓ | ✓ |
| F6 Extension (full project) | × | × | ✓ | ✓ |

Excluding the above assessments, the potential cumulative operational impacts are expected to be limited to social, economic and visual amenity issues.

Potential cumulative social and economic impacts would be generated by Category 1 and 2 projects. The Category 3 projects identified in Table 27-3 were considered unlikely to generate cumulative operational social and economic impacts. Cumulative operational impacts would be associated with improved travel benefits for communities, business and industry, including freight, across the Sydney transport network.

Potential cumulative visual amenity impacts would be concentrated around Rozelle and Cammeray. Potential cumulative impacts at Rozelle would be generated with the M4-M5 Link project. This project has been incorporated into the baseline operational scenario for landscape character and visual amenity in Chapter 22 (Urban design and visual amenity) and is therefore not considered further in this chapter.

Potential cumulative visual impacts at Cammeray would be primarily generated with the Western Harbour Tunnel and Beaches Link program of works. Operational facilities for both projects introduce new built forms into existing open space at Cammeray Golf Course and generate cumulative landscape character and visual amenity impacts for residential receivers at Cammeray and motorists on the Warringah Freeway and Ernest Street.

There would be no cumulative impacts to geology, groundwater and soils, hydrology and water quality, flooding, hazard and risk, resource use and waste management, sustainability, Aboriginal heritage, non-Aboriginal heritage, climate change and greenhouse gases, and biodiversity during the operation of the project, as impacts to heritage items and biodiversity would be limited to the construction phase of the project.

## 27.5 Environmental management measures

The implementation of environmental management measures for the project would avoid, to the greatest extent possible, cumulative impacts with surrounding development. As each of the study disciplines presented in this environmental impact statement have identified site specific management measures to reduce the potential impact to acceptable levels, cumulative mitigation measures have focused on broader opportunities around inter-project coordination and communication with stakeholders.

Construction fatigue is recognised as an important issue for communities in the vicinity of large construction projects that overlap in time or space. Substantial effort to coordinate with other projects through construction would be made to further manage fatigue impacts where possible.

Further opportunities to more effectively manage construction fatigue would be considered during the design and construction of the project.

Environmental management measures relating to cumulative impacts are outlined in Table 27-10.

**Table 27-10 Environmental management measures – Cumulative impacts**

| Ref | Phase | Impact | Environmental management measure | Location |
|---|---|---|---|---|
| CI1 | Pre-construction | Cumulative impacts | Considered and tailored multi-party engagement and cooperation will be established prior to construction to ensure all contributors to impacts are working together to minimise adverse impacts or enhance benefits of multiple projects occurring concurrently or consecutively. Haulage routes and road occupancy will be coordinated with other major transport projects via the Sydney Coordination Office. | WHT/WFU |
| CI2 | Pre-construction | Cumulative construction fatigue | Multi-party engagement and cooperation will be established prior to construction to coordinate with the following projects to manage fatigue impacts where possible:<br>a) M4-M5 Link<br>b) Beaches Link and Gore Hill Freeway Connection<br>c) Sydney Metro City & Southwest. | WHT/WFU |
| CI3 | Construction | Cumulative impacts | Communication strategies for the project will be managed consistently across the NSW Government transport portfolio and in accordance with the Community Consultation Framework for the project, particularly with the Beaches Link and Gore Hill Freeway Connection project. | WHT/WFU |
| CI4 | Construction | Cumulative complaints fatigue | Cumulative complaints fatigue will be managed as outlined in Chapter 7 (Stakeholder and community engagement). Complaint management tools for the project are outlined in Appendix E (Community consultation framework). | WHT/WFU |

WHT = Western Harbour Tunnel, WFU = Warringah Freeway Upgrade

Chapter 28

# Synthesis of the environmental impact statement

January 2020

# 28 Synthesis of the environmental impact statement

This chapter provides a synthesis of the findings of the environmental impact statement for the project, in response to the Secretary's environmental assessment requirements issued for the project. The main body of the environmental impact statement and appendices should be referred to for further information.

The Secretary's environmental assessment requirements as they relate to the synthesis of the environmental impact statement, and where in the environmental impact statement these have been addressed, are detailed in Table 28-1.

A summary of the proposed environmental management measures relevant to the project are included in Section 28.4.

**Table 28-1 Secretary's environmental assessment requirements –synthesis of the environmental impact statement**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Environmental impact statement** | |
| 1. The EIS must include, but not necessarily be limited to, the following:<br>q. a chapter that synthesises the environmental impact assessment and provides: | This **Chapter 28** (Synthesis of the environmental impact statement) provides the following: |
| - a succinct but full description of the project for which approval is sought; | A full description of the project in **Section 28.1.** |
| - a description of any uncertainties that still exist around design, construction methodologies and/or operational methodologies and how these will be resolved in the next stages of the project; | A description of any uncertainties related to the design, construction methodologies and/or operational methodologies and their proposed resolution in **Section 28.3.** |
| - a compilation of the impacts of the project that have not been avoided; | A compilation of the impacts of the project that have not be avoided in **Section 28.4.** |
| - a compilation of the proposed measures associated with each impact to avoid or minimise (through design refinements or ongoing management during construction and operation) or offset these impacts; | A compilation of the proposed measures associated with each impact to avoid or minimise (through design refinements or ongoing management during construction and operation) or offset these impacts in **Section 28.4.** |
| - a compilation of the outcome(s) the proponent will achieve; and | A compilation of the outcome(s) the project would achieve in **Section 28.6.** |
| - the reasons justifying carrying out the project as proposed, having regard to the biophysical, economic and social considerations, including ecologically sustainable development and cumulative impacts. | Project justification and conclusions in **Section 28.1** and **Section 28.7.**<br>**Chapter 27** (Cumulative impacts), **Section 27.2** presents the projects that have been assessed and may have potential cumulative impacts. Potential cumulative impacts are described in **Section 27.3** and **Section 27.4**. |

# 28.1 Overview and key features of the project

## 28.1.1 Overview of project need

The Sydney Harbour Bridge, Warringah Freeway and Eastern Distributor have been identified as three of Australia's 30 most congested road corridors, generating a congestion cost of $65,000 per day in 2016 (Infrastructure Australia, 2019). These corridors are integral to the economic growth of Sydney's Eastern Economic Corridor. As Sydney's population and economy continues to grow, so will the pressure on access to this corridor. Consequently, improvements to existing transport networks and creation of new transport connections will be essential for Sydney to continue to be a competitive economy.

*The Greater Sydney Region Plan – A Metropolis of Three Cities* (Greater Sydney Commission, 2018a) identifies the importance of investing in and delivering efficient and effective transport systems including road infrastructure that would relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors. The project would reduce congestion and improve road network performance and efficiency, enabling sustained growth and productivity across Sydney's Eastern Economic Corridor. The project would also enhance the resilience of the road network across the Eastern Harbour City.

The public transport network connecting the major centres of North Sydney and the Sydney CBD provide many people with direct access to a range of job locations, as well as access to education facilities, health centres and hospitals, and sporting, cultural and entertainment facilities. The project would improve access to major centres and would result in more people having better access to jobs, goods and services.

The Western Harbour Tunnel and Warringah Freeway Upgrade project is identified as a *priority initiative* by Infrastructure Australia's *Australian Infrastructure Plan: The Infrastructure Priority List* in recognition of its importance in addressing urban congestion on Sydney's road network and to provide cross-harbour connectivity. This new harbour crossing would serve through journeys between the south and west of Sydney, including the international gateways of Sydney Airport and Port Botany, and strategic centres north of the harbour including North Sydney, Chatswood and Macquarie Park. Increased network capacity and connectivity as a result of the project would also result in travel time savings for freight movements, further serving the growth of Sydney's Eastern Economic Corridor.

Transport for NSW is seeking approval under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* to construct and operate the Western Harbour Tunnel and Warringah Freeway Upgrade, which would comprise two main components:

- A new crossing of Sydney Harbour involving twin tolled motorway tunnels connecting the M4-M5 Link at Rozelle and the existing Warringah Freeway at North Sydney (the Western Harbour Tunnel)
- Upgrade and integration works along the existing Warringah Freeway, including infrastructure required for connections to the Beaches Link and Gore Hill Freeway Connection project (the Warringah Freeway Upgrade).

Key features of the project are described in Section 28.1.3.

## 28.1.2 Project objectives

The project objectives were developed to respond to the current and future network challenges and include:

- Reduce congestion on distributor roads around the Harbour CBD, including the Sydney Harbour Bridge, Western Distributor and ANZAC Bridge
- Create faster and more reliable cross-harbour journeys, particularly for traffic bypassing the Harbour CBD to the west
- Improve productivity along the Eastern Economic Corridor
- Increase the resilience for the critical cross-harbour transport corridor
- Improve traffic performance on the Warringah Freeway to support long-term increased demand
- Improve urban amenity.

## 28.1.3 Key features of the project

Key features of the Western Harbour Tunnel component of the project would include:

- Twin mainline tunnels about 6.5 kilometres long and each accommodating three lanes of traffic in each direction, connecting the stub tunnels from the M4-M5 Link at Rozelle to the Warringah Freeway and to the Beaches Link mainline tunnels at Cammeray. The crossing of Sydney Harbour between Birchgrove and Waverton would involve a dual, three lane, immersed tube tunnel
- Connections to the stub tunnels at the M4-M5 Link project in Rozelle and to the mainline tunnels at Cammeray (for a future connection to the Beaches Link and Gore Hill Freeway Connection project)
- Surface connections at Rozelle, North Sydney and Cammeray, including direct connections to and from the Warringah Freeway (including integration with the Warringah Freeway Upgrade), an off ramp to Falcon Street and an on ramp from Berry Street at North Sydney
- A ventilation outlet and motorway facilities (fitout and commissioning only) at the Rozelle Interchange
- A ventilation outlet and motorway facilities at the Warringah Freeway in Cammeray
- Operational facilities including a motorway control centre at Waltham Street within the Artarmon industrial area and tunnel support facilities at the Warringah Freeway in Cammeray
- Other operational infrastructure including groundwater and tunnel drainage management and treatment systems, signage, tolling infrastructure, fire and life safety systems, lighting, emergency evacuation and emergency smoke extraction infrastructure, CCTV and other traffic management systems.

Key features of the Warringah Freeway Upgrade component of the project would include:

- Upgrade and reconfiguration of the Warringah Freeway from immediately north of the Sydney Harbour Bridge through to Willoughby Road at Naremburn
- Upgrades to interchanges at Falcon Street in Cammeray and High Street in North Sydney
- New and upgraded pedestrian and cyclist infrastructure
- New, modified and relocated road and shared user bridges across the Warringah Freeway
- Connection of the Warringah Freeway to the portals for the Western Harbour Tunnel mainline tunnels and the Beaches Link tunnels via on and off ramps, which would consist of a combination of trough and cut and cover structures

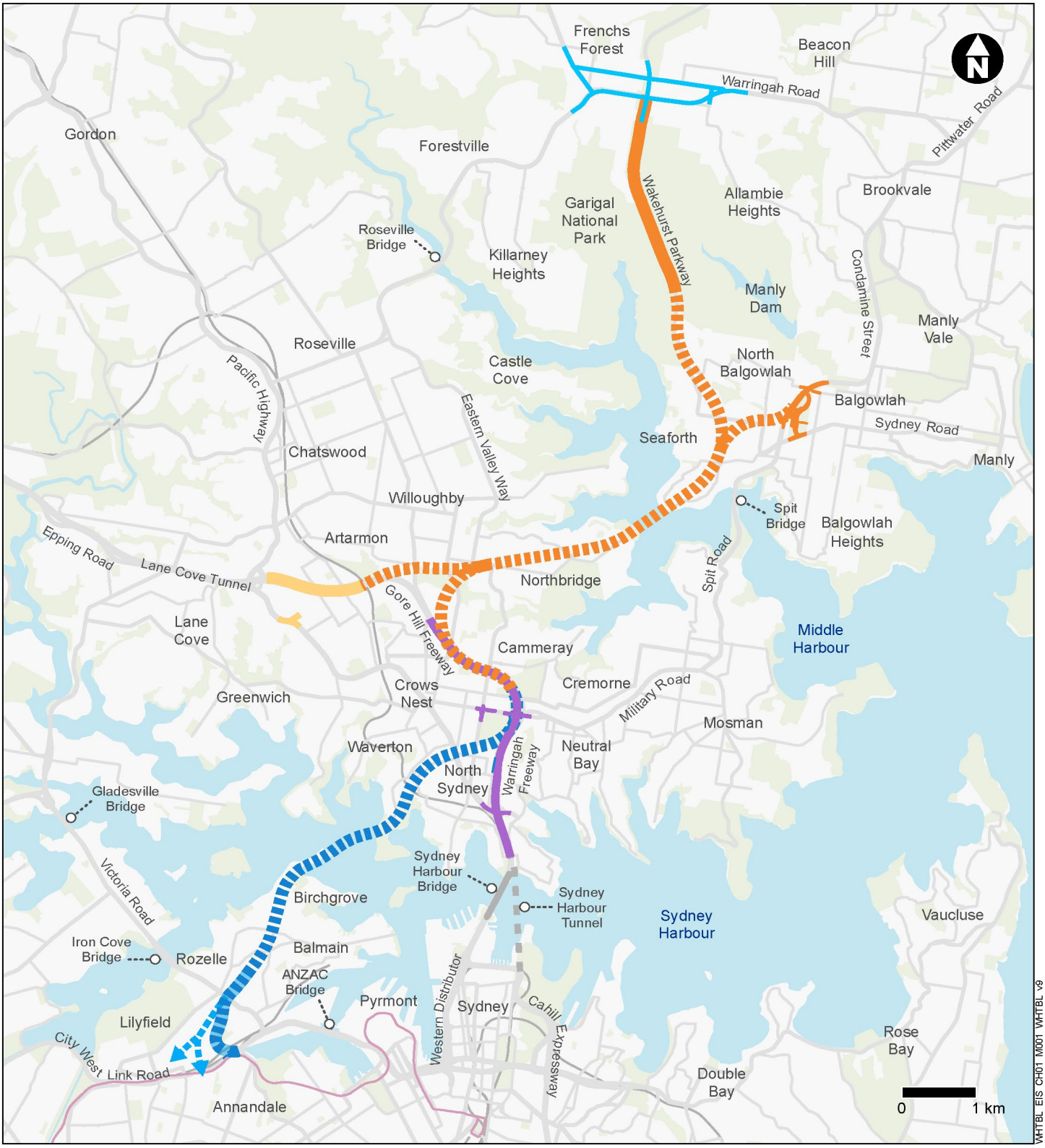
- Upgrades to existing roads around the Warringah Freeway to integrate the project with the surrounding road network
- Upgrades and modifications to bus infrastructure, including relocation of the existing bus layover along the Warringah Freeway
- Other operational infrastructure including surface drainage and utility infrastructure, signage, tolling, lighting, CCTV and other traffic management systems.

The location of the project is shown in Figure 28-1 and key features are shown in Figure 28-2 and Figure 28-3.

The project does not include ongoing motorway maintenance activities during operation or future use of residual land occupied or affected by project construction activities, but not required for operational infrastructure. These would be subject to separate planning and approval processes at the relevant times and in consultation with relevant stakeholders.

The residual land created as a result of the project would largely continue to remain suitable for future development in accordance with the relevant land use zonings and applicable development standards. Where a part of any lot is identified as being usable post construction and surplus to operational requirements, or requiring boundary adjustment following the completion of construction, Deposited Plans of subdivision would be lodged at NSW Land Registry Services.

A detailed description of the project is provided in Chapter 5 (Project description).




**Legend**

**Operational features**

- Beaches Link
- Gore Hill Freeway Connection
- Western Harbour Tunnel
- Warringah Freeway Upgrade
- M4-M5 Link tunnel fitout and commissioned as part of Western Harbour Tunnel

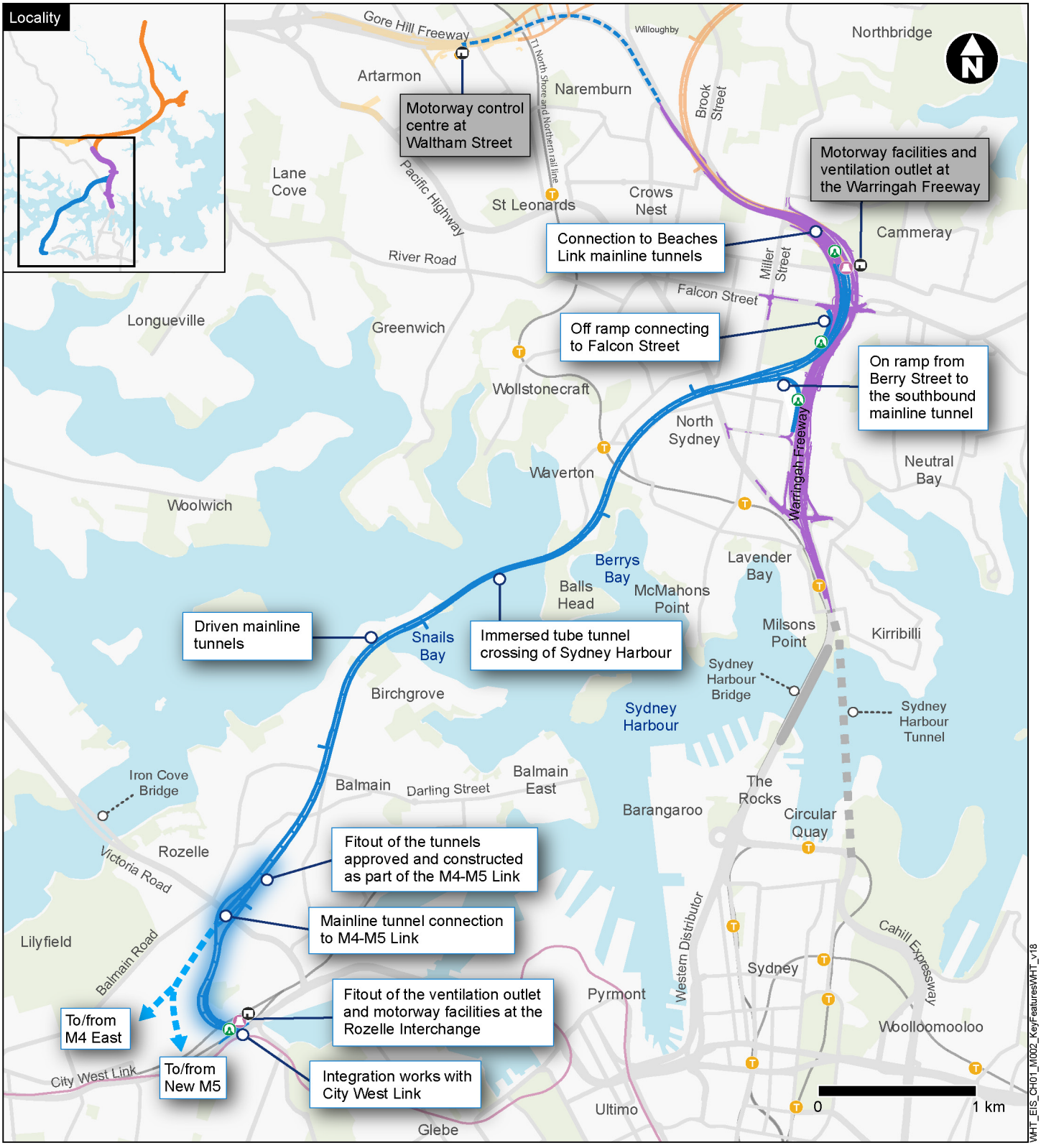
**Connecting projects**

- M4-M5 Link connections (indicative)
- Northern Beaches Hospital road upgrade

**Existing rail network**

- Heavy rail
- Light rail

**Figure 28-1 Location of the project**




**Legend**

**Operational features**

- Western Harbour Tunnel
- Warringah Freeway Upgrade
- Communications cable for motorway control centre
- M4-M5 Link tunnel fitout and commissioned as part of Western Harbour Tunnel
- Surface connection
- Permanent operational facility
- Ventilation outlet

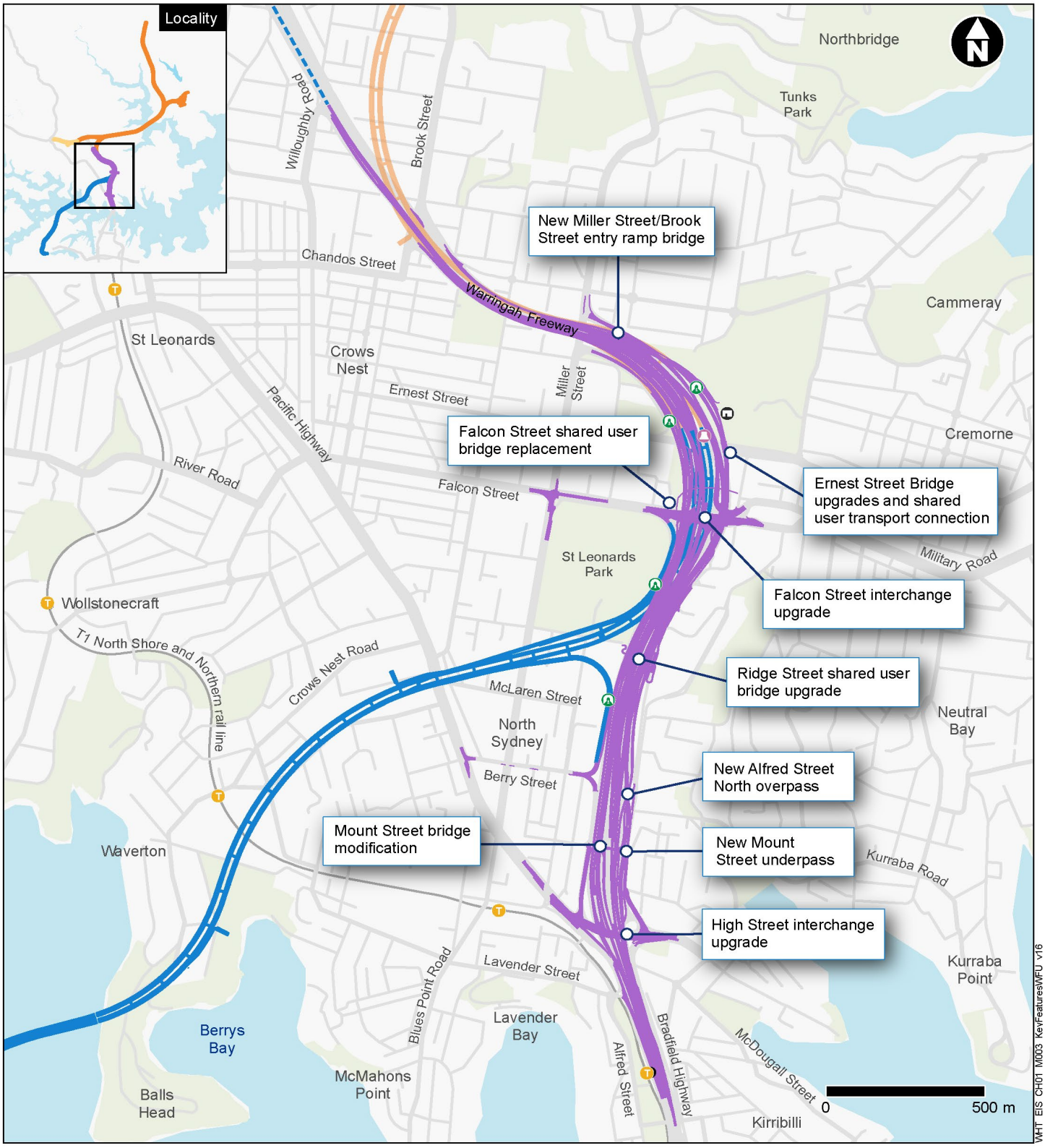
**Connecting projects**

- Beaches Link
- Gore Hill Freeway Connection
- M4-M5 Link connections (indicative)

**Existing rail network**

- Heavy rail
- Light rail
- Train station

**Figure 28-2 Key features of the Western Harbour Tunnel component of the project**




**Legend**

**Operational features**
- Warringah Freeway Upgrade
- Western Harbour Tunnel
- Communications cable for motorway control centre
- Surface connection
- Permanent operational facility
- Ventilation outlet

**Connecting projects**
- Beaches Link

**Existing rail network**
- Heavy rail
- Train station

**Figure 28-3 Key features of the Warringah Freeway Upgrade component of the project**

## 28.2 Construction of the project

Most of the construction for the Western Harbour Tunnel component of the project would occur underground with the mainline tunnels being constructed using roadheaders. Where the tunnel crosses Sydney Harbour, an immersed tube tunnel would be constructed in a trench excavated through the bed of the harbour between Birchgrove and Waverton. Surface works would also be required to support tunnelling activities and to construct the surface connections, tunnel portals, surface road works, active transport facilities (pedestrian and cyclist facilities) and operational facilities. Construction activities for the Warringah Freeway Upgrade would generally include surface earthworks, bridgeworks, construction of retaining walls, installation of stormwater drainage and pavement construction. Subject to planning approval, construction of the project is planned to commence in 2020, with completion of construction anticipated in 2026.

### 28.2.1 Key construction activities

The area required to construct the project is referred to as the construction footprint. Most of the project would be located underground within the mainline tunnels. However, surface areas would be required to support tunnelling activities, to construct the tunnel connections, tunnel portals and operational ancillary facilities and the Warringah Freeway Upgrade component.

Key construction activities would include:

- Early works and site establishment, with typical activities being property acquisition and condition surveys, utilities installation, protection, adjustments and relocations, installation of site fencing, environmental controls (including noise attenuation and erosion and sediment control), traffic management controls, vegetation clearing, earthworks and demolition of structures, establishment of construction support sites including acoustic sheds and associated access decline acoustic enclosures (where required), construction of minor access roads and the provision of property access, temporary relocation of pedestrian and cycle paths and bus stops, temporary relocation of swing moorings within Berrys Bay and relocation of historic vessels
- Construction of Western Harbour Tunnel, with typical activities being excavation of tunnel construction accesses, construction of driven tunnels, cut and cover and trough structures and construction of cofferdams, dredging activities in preparation for the installation of immersed tube tunnels, casting and installation of immersed tube tunnels and civil finishing and tunnel fitout
- Construction of operational facilities comprising a motorway control centre at Waltham Street in Artarmon, motorway and tunnel support facilities, ventilation outlets at the Warringah Freeway in Cammeray, construction and fitout of the project operational facilities that form part of the M4-M5 Link Rozelle East Motorway Operations Complex, a wastewater treatment plant at Rozelle and the installation of motorway tolling infrastructure
- Construction of the Warringah Freeway Upgrade, with typical activities being earthworks, bridgeworks, construction of retaining walls, stormwater drainage, pavement works and linemarking and the installation of road furniture, lighting, signage and noise barriers
- Testing of plant and equipment, and commissioning of the project, backfill of access declines, removal of construction support sites, landscaping and rehabilitation of disturbed areas and removal of environmental and traffic controls.

Further details are provided in Chapter 6 (Construction work).

### 28.2.2 Construction support sites

Temporary construction support sites would be required as part of the project and would include tunnelling and tunnel support sites, civil surface sites, cofferdams, mooring sites, wharf and berthing facilities, laydown areas, parking and workforce amenities. Construction support sites for the Western Harbour Tunnel component of the project would include:

- Rozelle Rail Yards (WHT1)
- Victoria Road (WHT2)
- White Bay (WHT3)
- Yurulbin Point (WHT4)
- Sydney Harbour south cofferdam (WHT5)
- Sydney Harbour north cofferdam (WHT6)
- Berrys Bay (WHT7)
- Berry Street north (WHT8)
- Ridge Street north (WHT9)
- Cammeray Golf Course (WHT10)
- Waltham Street (WHT11).

During the construction of the Warringah Freeway Upgrade, smaller construction support sites would be required to support the construction works, and would include:

- Blue Street (WFU1)
- High Street south (WFU2)
- High Street north (WFU3)
- Arthur Street east (WFU4)
- Berry Street east (WFU5)
- Ridge Street east (WFU6)
- Merlin Street (WFU7)
- Cammeray Golf Course (WFU8)
- Rosalind Street east (WFU9).

A detailed description of construction works for the project is provided in Chapter 6 (Construction work).

## 28.3 Project uncertainties

As with any project of the nature and scale of this project, the project design presented in this environmental impact statement would continue to be refined during further design development. As such, the design of the project would continue to be refined and would be guided by the key principles developed during the design and environmental impact statement phase. Some flexibility has been provided in the design to:

- Allow for refinement during further design development to consider alternative construction techniques
- Allow for refinement in response to submissions received following the exhibition of this environmental impact statement
- Respond to improved technologies or materials

- Improve value for money.

The final design may vary from that described in Chapter 5 (Project description). Any changes to the project would be reviewed for consistency with the assessment contained in the environmental impact statement including relevant environmental management measures, environmental performance outcomes and any future conditions of approval. If design refinements are not consistent with the approval issued by the Minister for Planning and Public Spaces, approval would be sought from the Minister for any such modifications in accordance with the requirements of Division 5.2 of the *Environmental Planning and Assessment Act 1979*.

Areas where further work would be carried out to optimise the design outcomes and construction method include refinements to:

- Avoid services and utilities that present significant construction difficulties in terms of logistics, time and/or cost
- Reduce the duration of construction
- Avoid areas of environmental sensitivity
- Reduce impacts on the community during construction and/or operation
- Improve operation of the project without increasing the potential environmental impacts.

For any future design refinements, a screening assessment would be carried out to consider whether the refinement would:

- Result in any inconsistency with the conditions of approval
- Result in any inconsistency with the objectives and operation of the project as described in the environmental impact statement
- Result in a change to the approved project that may require a modification of the approval
- Result in any potential environmental or social impacts of a greater scale or impact on previously unaffected receivers than that considered by the environmental impact statement or the submissions and preferred infrastructure report.

Table 28-2 outlines key project components that have been identified as requiring resolution during further design development, construction and/or operation of the project and references where these uncertainties are discussed in this environmental impact statement.

**Table 28-2 Resolution of project uncertainties**

| Project uncertainties | Proposed resolution | Timing | Where discussed |
|---|---|---|---|
| Design details for ventilation outlets | Refinement of the architectural design of the project ventilation outlets would be confirmed during further design development. A design for the ventilation outlets would be developed that aims to incorporate the ventilation outlets as an integral component of surrounding land use in accordance with the project's urban design framework (refer to Appendix V (Technical working paper: Urban design, landscape character and visual impact) for more information). | Design | **Chapter 22** (Urban design and visual amenity) |
| Tunnel alignment | • Confirmation of the final tunnel alignment would be carried out by the construction contractor, once appointed<br>• Future consultation to engage with communities and affected stakeholders about the final alignment of the mainline tunnels and to explain any differences between the design presented and assessed in this environmental impact statement and the design refined during further development, as required. | Design | **Chapter 5** (Project description) |
| Spoil disposal locations | • Confirmation of the locations that would accept spoil from the project for reuse and/or disposal would be carried out during development of the detailed construction method for the project by the construction contractor, once appointed<br>• A review of spoil transport and disposal options identified in the environmental impact statement would be carried out by the construction contractor, once appointed<br>• Spoil transport options would be adjusted as required and the relevant construction management plans updated, in accordance with relevant requirements of the conditions of approval. | Design and construction | **Chapter 6** (Construction work)<br>**Chapter 24** (Resource use and waste management) |
| Construction method and staging | Final construction methods and staging plans including road possessions would be prepared by the construction contractor, once appointed. The staging plans would be based on further design development and refinement of the construction method. The plans would describe how construction areas | Construction | **Chapter 6** (Construction work)<br>**Chapter 8** (Construction traffic and transport) |

| Project uncertainties | Proposed resolution | Timing | Where discussed |
|---|---|---|---|
| | associated with road works would be established to safely maintain traffic flows in areas of reduced traffic capacity, and to minimise delays to motorists, public transport, pedestrians and cyclists. | | |
| Final noise mitigation requirements | • Further noise modelling would be carried out during further design development to confirm the receivers (as identified in this environmental impact statement) that are eligible for at-property treatments. Feasible and reasonable environmental management measures would be considered for each of the receivers during further design development in accordance with the *Noise Mitigation Guideline* (Roads and Maritime, 2015b)<br>• The operational noise performance of the project would be reviewed during further design development and operational noise mitigation (low noise pavement, noise barrier, at-property treatment or a combination) would be confirmed<br>• Ongoing community and stakeholder engagement to assist in informing and determining appropriate noise mitigation would be carried out throughout project development and construction. | Design | **Chapter 11** (Operational noise and vibration) |
| The locations and extent of potential settlement impacts. | • Further assessment would be carried out with regards to settlement, including groundwater and geotechnical modelling during further design development to refine the level of predicted settlement, where required<br>• Building condition surveys would be carried out as necessary and monitor settlement during construction would be carried out by the contractor. | Design | **Chapter 16** (Geology, soils and groundwater). |
| Urban design detail of fixed infrastructure (ventilation outlets, substations, portals, water treatment facilities and bridges) and other key features. | • A detailed Urban Design and Landscape Plan would be developed for the project during further design development, considering the Urban Design Framework for the project (refer to Appendix V (Technical working paper: Urban design, landscape character and visual impact)). | Design | **Chapter 22** (Urban design and visual amenity) |

| Project uncertainties | Proposed resolution | Timing | Where discussed |
|---|---|---|---|
| Location and degree of contamination | • Further investigations of potentially contaminated sites are required to quantify the exposure risk. These investigations would be carried out prior to construction activities so that contamination (if present) can be adequately planned for and managed. | Design | **Chapter 16** (Geology, soils and groundwater). |
| The presence of, and potential impacts to areas of archaeological potential | Additional archaeological investigations would be carried out at:<br>• Yurulbin Park, Birchgrove<br>• Former BP site, Waverton. | Design | **Chapter 14** (Non-Aboriginal heritage) |
| The presence of, and potential impacts on, registered Aboriginal Heritage Information Management System (AHIMS) sites and sites containing potential Aboriginal heritage significance | • Further consultation with Department of Premier and Cabinet (Heritage), Metropolitan Local Aboriginal Land Council (LALC), and Registered Aboriginal Parties would be carried out to determine appropriate management of Aboriginal sites not assessed during archaeological surveys due to site accessibility issues<br>• Aboriginal site condition surveys would be completed using photogrammetry and 3D capture techniques employed to record Aboriginal sites prior to, and post construction, to determine impacts from construction activity. | Design | **Chapter 15** (Aboriginal cultural heritage) |
| The presence of, and potential impacts on, maritime heritage | • Investigate the potential to relocate or redesign the temporary wharves at Berrys Bay construction support site (WHT7) to minimise impact on maritime heritage<br>• Any pre-dredge clearance of the bed of the harbour to include involvement by maritime archaeologist to minimise the risk of impact to potential maritime heritage remains such as maritime infrastructure, shipwrecks and discarded objects<br>• Complete and review the sidescan sonar survey for areas to be affected by project works<br>• Carry out high-resolution geophysical survey to further investigate potential submerged cultural heritage material where necessary<br>• Carry out controlled archaeological investigations to recover any artefacts if required and feasible. | Design and construction | **Chapter 14** (Non-Aboriginal heritage)<br>**Chapter 15** (Aboriginal cultural heritage) |

| Project uncertainties | Proposed resolution | Timing | Where discussed |
|---|---|---|---|
| Construction and operational water treatment plant design and development of discharge criteria | • The relevant discharge criteria would be identified in consultation with relevant agencies and include within the relevant environmental management plans<br>• The construction water treatment plants would be refined to achieve site specific trigger values to ensure wastewater would be treated to a level that is representative of background concentrations at the receiving environment<br>• The water treatment plant design at Rozelle and associated treatment systems would be refined to achieve the adopted discharge criteria<br>• The local stormwater system capacity to receive discharge flows would be confirmed during further design development, and environmental management measures implemented in the event of a capacity issue. | Design | **Chapter 17** (Hydrodynamics and water quality) |
| Construction support sites – location, layout and facilities | The final location and layout of construction support sites would be confirmed during construction planning, the final construction method and the conditions of approval. | Design | **Chapter 6** (Construction work) |
| Interface of the project with the M4-M5 Link at Rozelle Interchange, including location and design of operational infrastructure. | Continued consultation with the M4-M5 Link project team to:<br>• Inform the design of project infrastructure at the Rozelle Interchange, as determined during further design development of the Rozelle Interchange<br>• Manage potential cumulative impacts (construction). | Construction | **Chapter 2** (Assessment process)<br>**Chapter 5** (Project description)<br>**Chapter 27** (Cumulative impacts) |

## 28.4 Summary of project impacts and management measures

This section provides a summary of the impacts of the project that could not be avoided. These impacts are discussed in detail in Chapter 8 (Construction traffic and transport) through to Chapter 26 (Climate change risk and adaption) of this environmental impact statement.

### 28.4.1 Key impact avoidance

Many potential impacts have been avoided through the project development process which included input from key stakeholders and the community. A number of corridor alternatives were evaluated to identify the most technically, socially and environmentally acceptable alternative with the most efficient transport connections (refer to Chapter 4 (Project development and alternatives) for more information on the alternatives considered). Following identification of the preferred corridor for the project, further design development and refinements have been carried out which have resulted in the avoidance or minimisation of environmental impacts and include:

- Selection of roadheaders instead of tunnel boring machines for construction of the land-based tunnels, resulting in lower spoil volumes and fewer heavy vehicle movements
- The selection of precast immersed tunnel units on top, or within the top layers, of harbour rock and sediments as the preferred harbour crossing method, rather than the use of driven tunnel, thereby avoiding the need for tunnelling in challenging geology and enabling better grades and journey experience (eg safety, long-term emissions)
- Refinements to the location of the North Sydney connections, resulting in improved connectivity and network performance, improved constructability and design, and minimising traffic impacts
- Ventilation system design alternatives. A longitudinal system with elevated ventilation outlets was selected as the preferred option as it is able to meet the requirement to minimise portal emissions as far as practicable, manage smoke in the tunnel in the event of a fire and ensure emissions are dispersed and diluted so that there is minimal or no effect on ambient air quality and is less costly to construct and operate
- Construction support site location alternatives were considered to minimise impacts to environmental and community locations while minimising property disturbance and acquisition requirements. Locations were also selected to maximise opportunities for direct access to arterial roads or water transport opportunities
- Alternatives for the transport of spoil were considered, including the use of rail, barge or truck. A combination of trucks and some barging was selected as the preferred spoil transport option for the project as it reduces the amount of double or triple handling of spoil required (ie transfer spoil to a loading facility) while also providing the ability to move large volumes of spoil, thereby reducing the number of heavy vehicle movements on the wider road network
- Dredged material management alternatives were considered. An application for offshore disposal of suitable dredged material has been submitted to the Commonwealth Department of the Environment and Energy. It is proposed that suitable dredged material would be transported by barge and disposed of at a designated offshore disposal site (in accordance with legislative requirements)
- Further refinement of the design including consideration of community issues through the environmental impact statement exhibition process may further reduce and if possible avoid impacts.

Potential impacts would also be further avoided and minimised, where possible, through the implementation of the environmental management measures complying with the performance outcomes identified in Chapter 4 (Project development and alternatives).

### 28.4.2 Key project impacts

The environmental impact statement has assessed the potential environmental impacts that may occur as a result of the project and recommends measures to manage these impacts. Table 28-3 provides a summary of potential impacts of the project that could not be avoided and the associated environmental management measures. Table 28-3 is not a comprehensive list of all environmental management measures proposed in this environmental impact statement. For further details refer to the individual chapters. Unavoidable impacts would be addressed through design refinements or ongoing management during construction and operation.

**Table 28-3 Summary of key project impacts and environmental management measures**

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| **Traffic and transport**<br>• Increased heavy vehicle movements around work sites during construction<br>• Increased traffic volumes and delays for traffic in the North Sydney area during construction<br>• Temporary, full or partial closures of the Warringah Freeway for short periods of time to carry out key construction activities which are located above or within the road corridor<br>• Temporary increase in travel times and reduction in bus speeds particularly along bus routes in North Sydney<br>• Temporary changes to access in and around North Sydney that would streamline movements around North Sydney CBD but limit access for some residents and businesses in the area<br>• Temporary impacts to ferry infrastructure<br>• Temporary impacts on maritime traffic associated with the partial closures of Sydney Harbour for recreational, commercial and passenger vessels between Yurulbin Point, Birchgrove and Berrys Bay, Waverton to enable construction works for the crossing of Sydney Harbour. | Construction | • Extensive community and stakeholder consultation will be carried out in conjunction with the Sydney Coordination Office to manage impacts along the Warringah Freeway and North Sydney road network. This is likely to include a Community and Road User Campaign which will be implemented before the start of works to inform all road users including bus operators of the upcoming network changes and proposed detour routes<br>• Directional signage and line marking will be used to direct and guide drivers, cyclists and pedestrians past construction sites and on the surrounding network. This will be supplemented by Variable Message Signs to advise drivers of potential delays, traffic diversions, speed restrictions, or alternative routes<br>• Any adjustments to existing bus stops will be determined in consultation with relevant stakeholders including other divisions of Transport for NSW, and advanced notification will be provided to affected bus customers. Relocations will be as close as feasible and reasonable to their existing position<br>• Truck marshalling areas will be identified and used where feasible and reasonable to minimise potential queueing and traffic and access disruptions in the vicinity of construction support sites<br>• Activities requiring partial and full road closures will be carried out outside of peak periods and/or during night time to minimise the impact of these activities on the road network where feasible and reasonable<br>• Partial or full closures of Warringah Freeway will be carried out in consultation with the Sydney Coordination Office<br>• Opportunities to relocate the Birchgrove Ferry Wharf will be investigated during construction planning. Birchgrove Ferry Wharf customers would be notified of alternative travel arrangements in advance of the wharf closure<br>• Construction marine traffic activities will be scheduled to avoid times and locations of high recreational marine traffic where feasible and reasonable. |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| **Noise and vibration**<br>• Construction noise levels predicted to exceed noise management levels at some sensitive receiver locations<br>• Potential for sleep disturbance impacts during the night<br>• Construction traffic movements may result in road traffic noise levels above the relevant criteria<br>• Potential underwater noise impacts to marine mammals, reptiles and sharks generated through construction dredging and piling activities. | Construction | • Monitoring will be carried out at the commencement of new noise and vibration intensive activities and works in new locations<br>• Opportunities to manage high noise impact activities though scheduling, the provision of feasible and reasonable respite, and the early installation of operational noise management measures, will be identified during further design development and construction planning to limit the number of highly noise affected receivers<br>• An out-of-hours works protocol will be developed for the construction of the project. The protocol will be prepared in consultation with the Department of Planning, Industry and Environment and the NSW Environment Protection Authority and implemented during construction of the project<br>• Refinement of the piling method will consider reasonable and feasible alternatives, attenuated mitigation methods and programming to minimise underwater noise. |
| **Human health and air quality**<br>• Underwater noise and vibration impacts affecting water users. | Construction/ operation | • Opportunities for refinement of piling and associated scheduling will be considered during further design development and in consultation with relevant authorities and stakeholders<br>• An underwater noise monitoring program and adaptive management measures for the construction period of the project will be developed. This would include a monitoring program with an initial trial of piling with corresponding communication measures to validate the predicted underwater acoustic thresholds and management areas, and an ongoing review of management measures and monitoring outcomes<br>• Communication and management measures will be implemented during construction to manage potential underwater noise impacts to water-based recreational users during dredging and piling activities in Sydney Harbour. |
| **Non-Aboriginal heritage**<br>• Direct and indirect impacts to non-Aboriginal heritage items in the vicinity of the project | Construction | • Non-Aboriginal historical heritage awareness training will be provided for contractors prior to commencement of construction works to ensure understanding of potential heritage items that may be impacted during the |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| including:<br>- Major impacts at Yurulbin Park, as a result of the temporary establishment and operation of the Yurulbin Park construction support site (WHT4) and the Sydney Harbour south cofferdam (WHT5)<br>- Moderate and permanent impacts to Cammeray Park (including Golf Course) as a result of the construction activities and the installation of permanent operational infrastructure within the heritage boundary<br>- Installation of architectural noise treatments at heritage listed properties such as within the boundary of Cammeray Conservation Area and Holtermann Estate Conservation Area. | | project, and the procedure required to be carried out in the event of discovery of historical heritage materials, features or deposits, or the discovery of human remains<br>• Archival recording will be carried out in accordance with the *Photographic Recording of Heritage Items Using Film or Digital Capture* guideline for areas/items subject to change<br>• Archaeological investigations would be carried out to collect archaeological information from heritage sites where necessary before construction<br>• Should at-property noise treatment be required at a premises that is heritage listed, this will be carried out in a manner to minimise heritage impact, and advice of a heritage conservation architect will be sought prior to carrying out the works<br>• Yurulbin Park would be rehabilitated in line with the design vision provided by the original landscape architect (Bruce Mackenzie AM) as soon as practicable at the completion of construction. The design would seek to retain and enhance the existing character and the original design intent as much as possible. The project would not impact on the long-term viability of the site to continue to be used for public recreation and open space purposes. These works would also improve the quality and long-term viability of landscaping and useability of the park. |
| **Biodiversity**<br>• Removal of potential roosting habitat for some bat species at Yurulbin Park and Berrys Bay and the removal of a potential hollow-bearing tree in Jefferson Jackson Reserve<br>• Potential impacts to key fish habitats in Sydney Harbour due to the removal of some rocky reef and deepwater soft sediment habitats, turbidity and sedimentation from dredging, and underwater noise from dredging and piling | Construction | • Pre-clearing surveys for microbat roosts will be carried out on the wharf structures to be demolished at Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites<br>• Carry out inspections of Eastern Bent-wing bat roosting sites in the surrounding locality (eg concrete box culverts, jetties) prior to construction to determine the roosting capacity of each site<br>• Carry out monthly monitoring of Eastern Bent-wing bats in the Coal Loader tunnel prior to construction (in the months of March to September)<br>• Subtidal rocky reef and intertidal rocky shore habitat removed along the shoreline will be rehabilitated and restored as close as possible to pre- |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| • Potential impacts on marine threatened species in Sydney Harbour, such as the Black Rockcod, White's seahorse and Little Penguin that would reside, forage or transit through habitat affected during construction<br>• Potential impacts on some marine mammals, turtles and sharks, which may forage or transit through seagrass, rocky reef or deepwater soft sediment habitats<br>• Potential underwater noise impacts to marine mammals, reptiles and sharks generated through construction dredging and piling activities. | | construction conditions where reasonable and feasible<br>• Exclusion zones will be implemented to avoid disturbance to sensitive marine habitats not proposed to be directly impacted by the project. These include any intertidal sand and mudflats, intertidal rocky shore, subtidal rocky reef and seagrass habitats with potential to occur within or next to transit routes and vessel movements<br>• Routine inspections and maintenance of exclusion fencing would be carried out<br>• Silt curtains will be monitored for effectiveness particularly following inclement weather and maintenance carried out when required. Records of monitoring and maintenance will be kept<br>• Visual monitoring from the harbour surface will be carried out to identify any underwater noise related impacts on marine mammals, reptiles, sharks and other fish. If required, additional at source protection measures such as qualified observers to spot marine mammals, reptiles and sharks would be used during marine construction activities. A stop-work procedure would be implemented upon sighting of the species in proximity of the works area. |
| **Land use and property**<br>• Temporary lease or acquisition of three properties for Western Harbour Tunnel and one property for the Warringah Freeway Upgrade<br>• Temporary land use changes to some areas associated with construction activities or construction support sites<br>• Temporary relocation of boat moorings in the Birchgrove to Berrys Bay area to provide safe access to construction support facilities<br>• Temporary closure of Birchgrove ferry wharf. | Construction | • Land subject to temporary use, including areas of public open space, will be rehabilitated as soon as practicable to an appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses. This will be carried out in consultation with the relevant council and/or the land owner<br>• Transport for NSW will consult with the owners and/or leaseholders and/or licence holders of moorings that require temporary relocation to determine alternative arrangements. All efforts will be made to relocate facilities as close to their original locations as possible<br>• Birchgrove Ferry Wharf customers would be notified of alternative travel arrangements in advance of the wharf closure. |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| **Land use and property**<br>• Permanent acquisition of four properties for Western Harbour Tunnel and 20 properties for the Warringah Freeway Upgrade<br>• Permanent land use changes where permanent project infrastructure is established<br>• Permanent acquisition of part of Cammeray Golf Course for permanent operational facilities<br>• Air quality impacts for future elevated receivers located around ventilation outlets and motorway facilities. | Operation | • Land acquisition for the project will be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW), the *Roads and Maritime Services Land Acquisition Information Guide* (Roads and Maritime, 2014a) and *Fact sheet: Property acquisition of subsurface lands* (Roads and Maritime, 2015) and in accordance with the land acquisition reforms announced by the NSW Government in 2016<br>• Residual land remaining following construction of the project would be confirmed to identify appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses<br>• Transport for NSW will continue to work with Cammeray Golf Club with a view to maintaining the long-term viability of Cammeray Golf Course<br>• Transport for NSW would assist Inner West Council, North Sydney Council and the Department of Planning, Industry and Environment (as appropriate) in determining relevant land use considerations applicable to future development in the immediate vicinity of ventilation outlets for inclusion in local environmental plans or development control plans, where required, to manage interactions between the project and future development. This may include procedures for identifying the requirement for consultation with Transport for NSW. |
| **Urban design and visual amenity**<br>• Visual impacts during construction as a result of the presence of construction works, plant and equipment<br>• Loss of vegetation providing screening and amenity | Construction | • Construction support sites, including the locations of visible structures and plant and perimeter fencing and treatments, will be developed to minimise visual impacts for adjacent receivers where feasible and reasonable<br>• Existing trees will be retained and protected adjacent to the works where possible to screen construction support sites, minimising clearing where possible<br>• Early planting works will be considered to provide a screening buffer that has time to mature before the project is fully operational. |
| **Geology, soils and groundwater**<br>• Ground movement may occur as a result of the | Construction | • Detailed predictive settlement models will be developed for areas of concern to guide tunnel design and construction method. Building/structure |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| construction of project or associated components or from groundwater drawdown<br>• The project is situated adjacent to a number of areas that are considered to have a 'moderate' or 'high' risk rating of contaminated material<br>• The project requires the works within Sydney Harbour, sediments of which could potentially pose a contamination risk due to the contamination associated with historical industrial use. | | condition surveys will be prepared for properties (and heritage assets) within the zone of influence of tunnel settlement<br>• Potentially contaminated areas directly affected by the project will be investigated and managed in accordance with the requirements of guidance endorsed under section 105 of the *Contaminated Land Management Act 1997*<br>• The dredging methodology has been designed to minimise impacts on the marine environment and would include the use of a closed environmental bucket to avoid the spread of potentially contaminated material and the use of silt curtains. |
| **Resource use and waste management**<br>• About 2.1 million cubic metres of spoil would be produced from land-based construction activities (terrestrial spoil) during construction. In addition, marine construction works for the project within Sydney Harbour would produce around 900,000 cubic metres of dredged material. | Construction | • The design of the project and preferred construction methodology has taken into consideration the waste hierarchy by aiming to reduce the volume of excess spoil generated, as far as practical. Where possible, the project would maximise reuse of spoil generated during construction before alternative off-site spoil disposal options are pursued<br>• An application for offshore disposal of suitable dredged material has been submitted to the Department of the Environment and Energy. Dredged material suitable for offshore disposal would be transported from Sydney Harbour on hopper barges and disposed within the existing designated offshore disposal site, which is located about 10 to 15 kilometres offshore of Sydney Heads and regulated by the Commonwealth. Offshore disposal would reduce the number of heavy vehicle movements required to transport dredged material. |
| **Hydrodynamics and water quality**<br>• Potential to reduce water quality and disturb contaminated sediments through dredging and piling. | Construction | • The dredging method has been designed to minimise impacts on the marine environment and would include the use of a closed environmental bucket to avoid the spread of potentially contaminated material and the use of silt curtains. |

| Summary of key impact | Construction / operation | Management measure |
|---|---|---|
| **Socio-economic**<br>• Loss of open space, parks and recreational facilities, due to use for construction support sites and permanent project facilities<br>• Potential reduction in amenity at social infrastructure due to reduced visual amenity and increased air-borne construction noise, dust and traffic<br>• Potential impacts on community cohesion due to temporarily restricting access to some social infrastructure and meetings places, which may reduce opportunities for social and community interaction<br>• Changes in passing trade to business, employee and customer access, servicing and deliveries, business visibility, demand for services, displacement of business and potential impacts on maritime businesses and freight and efficiency. | Construction/ operation | • Ongoing engagement will be carried out with managers of social infrastructure located near to surface construction works/construction support sites and sensitive social infrastructure<br>• Where feasible and reasonable, the extent of permanent impact on public open space areas (for example, ANZAC Park, St Leonards Park, Cammeray Golf Course) will be minimised in further design development<br>• Parks, open space and sport and recreation areas impacted by construction and not required for permanent infrastructure will be reinstated and rehabilitated<br>• Specific consultation will be carried out with businesses potentially impacted during construction. Consultation will aim to identify specific potential construction impacts for individual businesses. |
| **Cumulative impacts**<br>There is the potential for construction fatigue and complaint fatigue to be experienced by surrounding receivers as a result of concurrent and consecutive construction programs. | Construction | Multi-party engagement and cooperation will be established prior to construction to coordinate with the following projects to manage fatigue impacts where possible:<br>• M4-M5 Link<br>• Beaches Link and Gore Hill Freeway Connection<br>• Sydney Metro City & Southwest.<br>Cumulative complaints fatigue would be managed in accordance with the Community Consultation Framework. |

### 28.4.3 Residual impacts

An environmental risk analysis for the project has been carried out and is detailed in Appendix C (Environmental risk analysis). The risk analysis identifies an initial risk rating for each of the environmental issues and the residual risk rating derived after the application of environmental management measures developed and recommended by this environmental impact statement. It involved:

- Rating the risk of each identified potential impact by identifying the consequences of the impact and the likelihood of each impact occurring
- Considering the probable effectiveness of the proposed environmental management measures to determine the likely residual risk of each impact.

The risk analysis outlined in Appendix C (Environmental risk analysis) has identified several 'medium' level residual risks. No potential impacts with a residual risk rating of 'high' were identified for the project. During further design development, opportunities would be identified for 'medium' level residual risks to:

- Resolve residual impacts and risks through further design refinement
- Develop effective construction methodologies and planning to ensure that environmental management measures can be effectively implemented
- Implement a process of review, correction and audit for the management measures that were identified in this environmental impact statement and summarised in Appendix Y (Compilation of environmental management measures). This would be a process of continuous improvement that would form part of the construction environmental management plan and operational environmental management plan and would allow for environmental management measures to be updated or improved during construction and operational phases, where practical.

Where 'medium' level residual risks are considered to still be likely after further design development, additional refined environmental management measures would be developed where appropriate to ensure those risks are suitably mitigated.

Where 'low' level residual risks are identified, an appropriate process of continuous improvement would be applied to address these potential impacts during construction and operation as far as is reasonable and feasible.

## 28.5 Environmental management plan framework

The implementation of environmental management measures during further design development, construction and operation of the project would minimise any potential adverse impacts arising from the proposed work on the surrounding environment.

These environmental management measures related to construction would be captured in a construction environmental management plan. The plan would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The plan would be prepared prior to construction of the project and would be reviewed and certified by Transport for NSW and the Department of Planning, Industry and Environment, prior to the commencement of any on-site work. The construction environmental management plan would be a working document, subject to ongoing change and updated as necessary, to respond to specific requirements. The construction environmental management plan would include a framework for the management of environmental impacts during construction including details on the following:

- Traffic and transport management

- Noise and vibration management
- Heritage management
- Air quality management
- Waste and resource management, including spoil management
- Visual amenity management
- Soil and water management
- Flora and fauna management
- Construction support site and ancillary works management
- Sustainability management.

In addition, the design, construction and operation of the project would be carried out in accordance with the Utilities management strategy (Appendix D) and Community consultation framework (Appendix E).

During operation, the project's environmental performance would be managed under Transport for NSW existing environmental management system (or similar) for asset maintenance prepared in accordance with the *AS/NZS ISO 14000 Environmental Management System* series. This EMS has been developed to be consistent with the broad environmental objectives and policies set out in the Transport for NSW environmental management system. Transport for NSW is committed to managing its impacts on the environment and undertaking its activities so as to avoid, minimise or mitigate environmental impacts. Accordingly, any project-specific operational environmental management practices and procedures will be incorporated into the existing environmental management system.

## 28.6 Performance outcomes

The project's performance outcome as measured against those identified for key impacts in the Secretary's environmental assessment requirements is provided in Table 28-4 along with a summary of how each performance outcome would be achieved by the project.

**Table 28-4 Design performance outcomes and project outcomes**

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| **Environmental impacts assessment process**<br>The process for assessment of the proposal is transparent, balanced, well focussed and legal. | • This environmental impact statement has been prepared in accordance with Part 3 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*<br>• Based on the results of the environmental investigations carried out for this environmental impact statement, it is considered that matters of national environmental significance are not likely to be significantly impacted by the project. Accordingly, Transport for NSW has decided that a referral to the Commonwealth is not required at this stage. |
| **Environmental impact statement**<br>The project is described in sufficient detail to enable clear understanding that the project has been developed through an iterative process of impact | • The project has been described in detail in Chapter 5 (Project description)<br>• The merits of the project, and the design options were considered in the context of a range of alternatives based on how well they performed with reference to |

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| identification and assessment and project refinement to avoid, minimise or offset impacts so that the project, on balance, has the least adverse environmental, social and economic impact, including its cumulative impacts. | transport, environmental, engineering, social and economic factors (refer to Chapter 4 (Strategic context and project need)). The preferred design provides a combination of benefits compared with other options assessed, including improved access, minimised impacts on properties and on future development potential. |
| **Assessment of key issues**<br>Key issue impacts are assessed objectively and thoroughly to provide confidence that the project would be constructed and operated within acceptable levels of impact. | • The assessment of key issues has been conducted objectively and thoroughly. The implementation of environmental management measures would ensure the project is constructed and operated within acceptable levels of impact. Refer to Chapter 8 (Construction traffic and transport) to Chapter 26 (Climate change risk and greenhouse gas) for further details. |
| **Consultation**<br>The project is developed with meaningful and effective engagement during project design and delivery. | • Consultation has been carried out to inform the design process and project development (refer to Chapter 7 (Stakeholder and community engagement))<br>• The construction contractors would respond to complaints in a timely and appropriate manner, to ensure all stakeholders' concerns are managed effectively and promptly. |
| **Transport and traffic**<br>• Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts<br>• The safety of transport system customers is maintained<br>• Impacts on network capacity and the level of service are effectively managed<br>• Works are compatible with existing infrastructure and future transport corridors. | In respect to transport and traffic, the project has been developed such that it would:<br>• Minimise impacts to local streets from loss of parking, road closures and heavy vehicle movements during construction<br>• Minimise impacts to road network efficiency during construction<br>• Enable access to properties to be maintained during construction and operation<br>• Improve the performance and capacity of Sydney's road network<br>• Provide an efficient motorway link which improves traffic flow on Sydney's motorway network<br>• Relocate a significant volume of through traffic underground<br>• Improve traffic conditions, and eases future congestion on the road network<br>• Provide functional connectivity between the subsurface and surface road network<br>• Provide future motorway connections to support a growing Sydney<br>• Maintain pedestrian and cyclist safety along surface roads near the project<br>• Provide significant travel time savings for motorists and freight vehicles using Sydney's motorway network<br>• Enable long-term development of Sydney's motorway network, including facilitating new cross-harbour capacity and connections to Sydney's north. |

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| **Air quality**<br>The project is designed, constructed and operated in a manner that minimises air quality impacts (including nuisance dust and odour) to minimise risks to human health and the environment to the greatest extent. | In respect to air quality, the project has been developed such that it would:<br>• Provide effective management of dust, odour and other emissions during construction<br>• Result in zero portal emissions during normal operations<br>• Provide effective dispersion of emissions from the tunnels.<br>Tunnel ventilation design would be developed to maintain in-tunnel air quality in accordance with relevant criteria. |
| **Health and safety**<br>The project avoids or minimises any adverse health impacts arising from the project.<br>The project avoids, to the greatest extent possible, risk to public safety. | In respect to health and safety, the project has been developed such that:<br>• Incidents and crashes and risks to public safety would be minimised during construction<br>• The motorway design would achieve safe and efficient road user movements<br>• Establishment and operation of ancillary facilities and construction sites would protect road users and public<br>• The project avoids, to the greatest extent possible, risk to public safety<br>• Hazardous materials within project areas would be managed to protect human health. |
| **Noise and vibration – Amenity**<br>Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity.<br>Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and well-being of the community. | In respect to noise and vibration (amenity), the project has been developed such that it would:<br>• Relocate a significant volume of through traffic on surface arterials underground, improving surface road noise<br>• Comply with the relevant criteria from the NSW Industrial Noise Policy<br>• Minimise increases in road traffic noise, where possible<br>• Include effective implementation of noise management measures during operation<br>• Include effective management of construction noise and vibration in accordance with relevant guidelines, for example through the use of acoustic sheds<br>• Minimise surface activity and associated noise at tunnelling sites, as once tunnelling starts the majority of the work at these sites would be underground<br>• Minimise impacts to the local community by:<br>- Controlling noise and vibration at the source<br>- Controlling noise and vibration on the source to receiver transmission path<br>- Controlling noise and vibration at the receiver<br>- Implementing practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers. |
| **Noise and vibration – Structural**<br>Construction noise and vibration (including airborne noise, ground-borne | In respect to noise and vibration (structural), the project would minimise impacts to structures by:<br>• Controlling vibration at the source |

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.<br>Increases in noise emissions and vibration affecting environmental heritage as defined in the *Heritage Act 1977* during operation of the project are effectively managed. | • Controlling vibration on the source to receiver transmission path<br>• Implementing practicable and reasonable measures to minimise vibration impacts of construction activities on structures<br>• Carrying out building/structure condition surveys for properties (and heritage assets) within the zone of influence of tunnel settlement prior to the commencement of construction. |
| **Biodiversity**<br>The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity.<br>Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation. | In respect to biodiversity, the project has been developed such that:<br>• It would minimise impacts on biodiversity<br>• Where practicable, the design would minimise the need to clear vegetation<br>• Potential impacts on biodiversity would be managed in accordance with relevant legislation, including the *Environmental Planning and Assessment Act 1979*, *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*. |
| **Place making and urban design**<br>The project design complements the visual amenity, character and quality of the surrounding environment.<br>The project contributes to the accessibility and connectivity of communities. | In respect to place making and urban design, the project has been developed such that:<br>• It would connect disconnected communities<br>• The tunnel would relocate a significant volume of through traffic on surface arterials underground, improving urban amenity<br>• Sympathetic urban design would integrate with adjacent and historical land uses<br>• It would establish and operate ancillary facilities to minimise adverse impacts on the visual amenity of the local community<br>• It would provide for new and improved active transport links. |
| **Socio-economics, land use and property**<br>The project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities.<br>The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure. | In respect to socio-economics, land use and property, the project has been developed such that it would:<br>• Minimise property acquisition<br>• Manage the property acquisition process to minimise impacts to community<br>• Minimise impacts to businesses during construction<br>• Make provision for social infrastructure<br>• Ease future congestion on the road network, supporting future urban regeneration<br>• Avoid barriers and division of the community through the tunnel solution. |

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| **Water – Hydrology**<br>Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised.<br>The environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved).<br>Sustainable use of water resources. | In respect to water (hydrology), the project has been developed such that:<br>• Design and construction of the tunnels would minimise groundwater inflow<br>• Opportunities for reuse of treated water during construction has been considered throughout project development<br>• The environmental values of nearby, connected and affected water sources would be improved and/or maintained. |
| **Water – Quality**<br>The project is designed, constructed and operated to protect the NSW Water Quality Objectives where they are currently being achieved, and contribute towards achievement of the Water Quality Objectives over time where they are currently not being achieved, including downstream of the project, to the extent of the project impact including estuarine and marine waters (if applicable). | In respect to water (quality), the project has been developed such that it:<br>• Would operate under water quality discharge criteria with consideration of NSW Water Quality Objectives<br>• Would effectively treat water to meet water quality discharge criteria. |
| **Flooding**<br>The project minimises adverse impacts on existing flooding characteristics.<br>Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards, or dam failure. | In respect to flooding, the project has been developed such that:<br>• Construction would be carried out in a manner that minimises the potential for adverse flooding impacts, through staging of works and the implementation of environmental management measures<br>• Construction support sites and construction sites would be laid out such that flows are not significantly impeded<br>• The project would maintain or reduce flood levels within and adjacent to the alignment. |
| **Soils**<br>The environmental values of land, including soils, subsoils and landforms, are protected.<br>Risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination. | In respect to soils, the project has been developed such that:<br>• Erosion and sediment controls would be implemented in accordance with *Managing Urban Stormwater – Soils and Construction, Volume 1 (*Landcom 2004) and *Volume 2D (*DECC 2008*),* commonly referred to as the 'Blue Book'<br>• Acid sulfate soils would be managed in accordance with good practice measures<br>• Contamination would be managed to protect environmental values and human health. |

| Desired performance outcome | How performance outcomes would be achieved |
|---|---|
| **Heritage**<br>The design, construction and operation of the project facilitates, to the greatest extent possible, the long term protection, conservation and management of the heritage significance of items of environmental heritage and Aboriginal objects and places. | • In respect to heritage, the project has been developed such that it would:<br>  - Establish archival recordings of items of heritage significance that would be demolished<br>  - Minimise impacts on heritage items during construction<br>  - Incorporate key heritage values and stories into the final urban design and landscaping outcome<br>  - Minimise damage to features of heritage conservation significance from vibration<br>• The design would be sympathetic to the heritage significance of surrounding listed heritage items, and where practicable, avoids and minimises impacts to heritage<br>• Impacts on heritage would be managed in accordance with relevant legislation, including the *Environmental Planning and Assessment Act 1979*, the *Heritage Act 1977*, and relevant guidelines. |
| **Sustainability**<br>The project reduces the NSW Government's operating costs and ensures the effective and efficient use of resources.<br>Conservation of natural resources is maximised. | In respect to sustainability, the project has been developed such that:<br>• Sustainability considerations would be integrated throughout design, construction, and operation<br>• The project would seek to achieve an 'Excellent' Design and 'As Built' Infrastructure Sustainability rating<br>• The project would be carried out in accordance with the sustainability framework developed for the project<br>• Activities to implement the sustainability framework, including requirements from the Infrastructure Sustainability rating scheme, would be implemented through a Sustainability Management Plan. |
| **Waste**<br>All wastes generated during the construction and operation of the project are effectively stored, handled, treated, reused, recycled and/or disposed of lawfully and in a manner that protects environmental values. | In respect to waste, the project has been developed such that:<br>• Where feasible and reasonable, the project would recycle or reuse clean spoil either onsite or off-site<br>• Off-site waste re-use would be managed in accordance with relevant NSW Environment Protection Authority resource recovery exemptions and requirements<br>• Waste would be disposed of at appropriately licensed facilities. |
| **Climate change risk**<br>The project is designed, constructed and operated to be resilient to the future impacts of climate change. | In respect to climate change risk, the project has been developed such that it:<br>• Would incorporate climate change and sea level rise adaptation measures during further design development and construction planning for the project. |

## 28.7 Project justification and conclusion

### 28.7.1 Biophysical, economic and social considerations

The environmental impact statement has been prepared with regard to the key issues associated with the project and the integration of biophysical, economic and social considerations.

While the development of the project would have some unavoidable impacts (associated with, for example, construction impacts from heavy vehicle traffic, noise, vibration and dust, access disruptions and visual impacts) overall, the project would deliver a large number of benefits and opportunities including:

- Reducing congestion on distributor roads around the Harbour CBD, including the Sydney Harbour Bridge, Western Distributor and ANZAC Bridge
- Creating faster and more reliable cross-harbour journeys, particularly for traffic bypassing the Harbour CBD to the west
- Improving productivity along the Eastern Economic Corridor
- Increasing the resilience for the critical cross-harbour transport corridor
- Improving traffic performance on the Warringah Freeway to support long-term increased demand
- Improving urban amenity.

### 28.7.2 Sustainable development

Facilitating ecologically sustainable development is adopted as an objective of the *Environmental Planning and Assessment Act 1979*. This objective requires the integration of 'relevant economic, environmental and social considerations in decision making about environmental planning and assessment'.

Ecologically sustainable development is defined under the *Protection of the Environment Administration Act 1991* (NSW) and *Environmental Planning and Assessment Regulation 2000* and includes four principles. The project is consistent with these four principles of ecologically sustainable development:

- **Precautionary principle:** The environmental impact statement was prepared adopting a conservative approach, which includes an assessment of the worst case impacts and scenario and using the best available technical information and has adopted best practice environmental standards, goals and measures. The design and development of the project included consideration of potential environmental impacts associated with the project alternatives and options analysis and opportunities identified to avoid and minimise surface disturbance. In addition, sustainability workshops and meetings were held during design development with planning and design teams to develop draft sustainability targets and objectives for the project
- **Intergenerational equity:** The project is designed to meet needs of both current and future generations with a design life of about 100 years and would contribute to an increase in resilience and capacity of the Sydney transport network. During construction and operation of the project, opportunities would be taken to reduce resource and material use and maximise the use of materials with low embodied environmental impact, where feasible
- **Conservation of biological diversity and ecological integrity:** The design and assessment of the project has been carried out with the aim of identifying, avoiding, minimising and mitigating impacts to biodiversity and ecological integrity. Consistent with the *Biodiversity*

*Conservation Act 2016* and the Secretary's environmental assessment requirements, a biodiversity offset strategy has been developed to compensate for the potential threatened species impacted by the project

- **Improved valuation and pricing and incentive mechanisms:** The value placed on avoiding and minimising environmental impacts is demonstrated in the design features incorporated into the project (for example identifying opportunities to improve local amenity, and improve public transport access and active transport connections). The costs of planning, design and implementation of avoidance and environmental management measures have been incorporated into the project cost.

### 28.7.3 Objects of the *Environmental Planning and Assessment Act 1979* (NSW)

A consideration of the project against the objects of the *Environmental Planning and Assessment Act 1979* is outlined in Table 28-5.

**Table 28-5 Objects of the *Environmental Planning and Assessment Act 1979* (NSW)**

| **Objects of the *Environmental Planning and Assessment Act 1979*** | **Project attributes** |
|---|---|
| (a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources, | The project would enable long-term development of Sydney's motorway network, including facilitating new cross-harbour capacity and relieving pressure on the critical cross-harbour road network, providing improved traffic conditions, safety and efficiency for motorists and freight vehicles using Sydney's motorway network.<br>The combination of freight and business travel time savings using the Harbour CBD and wider Eastern Economic Corridor as a result of the project would generate significant productivity benefits for the Harbour CBD and the wider region.<br>During construction and operation the following opportunities would be taken to reduce material use and maximise the use of materials with low embodied environmental impact, where practical:<br>• Water efficiency measures would be implemented where possible, with the reuse of non-potable water from stormwater harvesting and on-site reuse of treated water from groundwater inflows, where water quality and volume requirements are met<br>• The design of the project has included careful consideration of the construction methodology and selection of materials and resources to minimise resource consumption<br>• Consistent with the resource management hierarchy under the *Waste Avoidance and Resource Recovery Act 2001*, solid wastes would be reused and recycled where feasible and reasonable.<br>Where possible, the project has been designed to avoid impacts on the natural environment and to minimise the need for land acquisition, as well as impacts on existing development and local communities. |
| (b) to facilitate ecologically sustainable development | The project is consistent with the principles of ecologically sustainable development as outlined in Section 28.7.2. |

| Objects of the *Environmental Planning and Assessment Act 1979* | Project attributes |
|---|---|
| by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment, | |
| (c) to promote the orderly and economic use and development of land, | The project has been designed to:<br>• Provide improved efficiency of the road network, in particular for freight and commercial users, resulting in economic benefits for NSW<br>• Provide an additional underground motorway alternative for the crossing of Sydney Harbour, which is an orderly and economic approach to support wider network improvements<br>• Minimise impacts to the surrounding natural and built environments where possible, for example by integrating design features such as tunnel portals and ventilation facilities, into the existing road corridors as far as practical<br>• Integrate with, and thereby minimise disruption to, existing development and other projects (such as M4-M5 Link at the Rozelle Interchange)<br>• Provide ancillary facilities, such as ventilation outlets at the Warringah Freeway, for use as part of the wider program of work to avoid additional future civil works. |
| (d) to promote the delivery and maintenance of affordable housing, | Not applicable to this project.<br>The residual land created as a result of the project would largely continue to remain suitable for future development in accordance with the relevant land use zonings and applicable development standards. Land use considerations would be required to manage any interaction between the project and future development for buildings with habitable structures above 20 metres and within 300 metres of the ventilation outlet. |
| (e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats, | While construction would not result in the clearing of native vegetation, some areas of planted vegetation would be removed. Management measures have been proposed to minimise the potential for direct and indirect impacts.<br>Some terrestrial fauna species would be impacted by the project. Management measures including pre-clearing surveys and monitoring would be carried out to minimise the risk of impacts to native species.<br>Mitigation and rehabilitation works would be carried out to protect and restore any subtidal rocky reef and intertidal rocky shore habitat removed along the shoreline.<br>In accordance with the SEARs and the requirements of the *Biodiversity Conservation Act 2016,* a biodiversity offset strategy has been developed to compensate for the loss of ecological values as a result of the project. |

| Objects of the *Environmental Planning and Assessment Act 1979* | Project attributes |
|---|---|
| (f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage), | • Impacts on heritage items would be minimised during construction where possible, and works would be carried out in accordance with relevant management strategies where impacts are unavoidable<br>• Visual and physical impacts to Yurulbin Park would be mitigated through appropriate landscape and reinstatement treatments, which would be in line with the design vision provided by the original landscape architect (Bruce Mackenzie AM). The new design would seek to retain and enhance the existing character and the original design intent as much as possible. These works would also improve the quality and long-term viability of landscaping and useability of the park<br>• Possible indirect impacts associated with vibration and settlement from tunnelling works or surface works beneath or near to Aboriginal sites would be managed in accordance with relevant management measures. |
| (g) to promote good design and amenity of the built environment, | The project would provide:<br>• Additional and upgraded shared user facilities<br>• Reduction in traffic noise at a significant number of receivers, most notably around Warringah Freeway, due to the redistribution of traffic. The project is expected to lead to an overall improvement in noise levels within the community (compared with the existing situation). Noise mitigation (such as at-property treatment) would be implemented where required<br>• Improved access and connectivity through improved travel time and improved travel time reliability, including to local and regional infrastructure within and near the project. |
| (h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants, | The construction of the project, including motorway facilities, ventilation outlets and tunnel portals would be completed in line with the applicable Australian and international safety standard as well as any applicable Transport for NSW Safety in Design guidelines. |
| (i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State, | Consultation has been carried out with the relevant local councils and government agencies throughout the development of the project and the preparation of this environmental impact statement. All levels of government have been encouraged to be actively involved in and to contribute to the evolution of the project through consultation to date and continuing consultation activities. |
| (j) to provide increased opportunity for community participation in environmental planning and assessment. | Consultation has been carried out through all stages of the project development, with targeted community consultation periods undertaken in 2017 and 2018, consultation with key community and interest groups, and a business survey carried out in November 2017 across nine local centres potentially affected by the project. Community feedback has been considered at each stage of the project development to inform the selection of the preferred corridor |

| Objects of the *Environmental Planning and Assessment Act 1979* | Project attributes |
|---|---|
| | alignment and subsequent design development and refinements. Community consultation would continue through public exhibition of this environmental impact statement and during detailed design and construction, should the project be approved, in accordance with the Community Consultation Framework. |

## 28.7.4 Cumulative impacts

Once operational, the Western Harbour Tunnel and Beaches Link program of works is expected to deliver beneficial cumulative impacts including significant increases in travel speeds through sections of the surface road network, increased reliability, and a reduction in average travel times.

Adverse cumulative impacts could occur when impacts from the project interact or overlap with impacts from other projects and potentially result in a larger overall impact. Cumulative impacts may also occur when there are projects that are constructed consecutively, resulting in construction fatigue for local receivers. Cumulative impacts for the project are presented in Chapter 27 (Cumulative impacts).

The implementation of environmental management measures for the project would avoid, to the greatest extent possible, cumulative impacts with surrounding development. In particular, the design of the project has carefully considered minimising construction fatigue as far as practical. The intent is to reduce the overall cumulative or consecutive impacts on the community over a longer period.

## 28.7.5 Conclusion

This environmental impact statement addresses the key issues identified in the Secretary's environmental assessment requirements issued under Division 5.2 of the *Environmental Planning and Assessment Act 1979* and the relevant provisions of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (NSW).

The project is part of the NSW Government's commitment to investing in and delivering efficient and effective transport systems including road infrastructure that would relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors. In particular, the project would relieve congestion on the Sydney Harbour Bridge and Sydney Harbour Tunnel, enabling faster, more reliable journeys for bus customers, freight and private vehicle users on all road corridors crossing Sydney Harbour.

The merits of the project were considered in the context of a range of other alternatives including do-nothing, based on the extent to which they could meet the project objectives and how well they performed with reference to other transport, environmental, engineering, social and economic factors. No other alternative would satisfy the need and objectives as effectively as the project.

As for any major infrastructure project to be constructed through the middle of major urban areas, there are expected to be impacts. Designing and constructing the project mainly underground has significantly reduced impacts and largely confined these to the construction stage. The design and construction method would continue to be developed with the objective of further minimising potential impacts taking into account the input of stakeholders and the local community.

Notwithstanding there would be a range of residual impacts. With the implementation of the proposed environmental management measures, the potential residual environmental impacts of the project are considered manageable and the project would be in the public interest.

Chapter 29

# References

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# 29 References


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