Transport for NSW

Beaches Link and Gore Hill Freeway Connection

Chapter 24

Resource use and waste management

24 Resource use and waste management

This chapter describes the resources and materials, including potential sources and expected quantities that would be used to construct and operate the project, and identifies measures which address these impacts.

Construction and operation of the project would generate waste streams which would require management and disposal in accordance with relevant state policies and guidelines. This chapter also 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.

Avoiding or minimising impacts has been a key consideration throughout the design and development process for the Beaches Link and Gore Hill Freeway Connection project. A conservative approach has generally been used in the assessments, with potential impacts presented before implementation of environmental management measures. The environmental management measures proposed to minimise the potential impacts in relation 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
Spoil	
1. The Proponent must identify and assess spoil generation and reuse including: a. type and quantity	Spoil balance and management is outlined in **Section 24.3.3**. Estimates of the type and quantities of spoil are provided in **Section 24.3.3**.
b. onsite storage (including capacity to minimise amenity impacts);	Indicative stockpile locations, volumes and descriptions of onsite storage is provided in **Section 24.3.3**.
c. reuse potential and disposal sites;	The reuse of construction spoil is discussed in **Section 24.3.3**. Waste disposal locations are discussed in **Section 24.5.**
d. transport and handling options (including traffic, distance, road safety and related amenity and environmental impacts); and	Spoil transport alternatives that were considered for the project are outlined in Section 4.5.8 of **Chapter 4** (Project development and alternatives).
e. illegal dumping	The potential for illegal dumping of spoil generated by the project is discussed in **Section 24.3.3**. Management of waste disposal is outlined in **Section 24.6.2**.
Waste	
1. The Proponent must assess predicted waste generated from the project during construction and operation, including:	Waste streams are classified in **Section 24.3.2** and **Section 24.4.2**.

Secretary's requirement	Where addressed in EIS
a. classification of the waste in accordance with the current guidelines;	
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 24.3.2** and **24.4.2**. Spoil balance and management is 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**.
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 24.6**.
g. contingencies for the above, including managing unexpected waste volumes.	Contingencies for managing unexpected waste are discussed in **Section 24.6**.
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** and **Section 24.4**. Dust impacts and management are discussed in **Chapter 12** (Air quality). Noise impacts and management are discussed in **Chapter 10** (Construction noise and vibration). 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 Services, 2016b)
- *Sustainable Design Guidelines*, Version 4.0 (Transport for NSW, 2017)
- *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 (OEH), 2019) 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 2019–2023* (Roads and Maritime Services, 2019), which outlines specific focus areas for integrating sustainability into Transport for NSW road projects and services. Under the *Environmental Sustainability Strategy 2019–2023,* 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.

The Department of Planning, Industry and Environment is leading the development of a 20-year waste strategy for NSW with a focus on sustainability, reliability and affordability. The *20-Year Waste Strategy Issues Paper* and complementary NSW Plastics Plan Discussion Paper *Cleaning Up Our Act: Redirecting the Future of Plastic* were released for public consultation in early 2020. The Department of Planning, Industry and Environment is currently reviewing the feedback received through the consultation process.

24.2 Assessment methodology

The assessment of resource use and waste management comprised:

- A review of the likely resources required for the construction and operation of the project, including construction materials, water and power
- A review of the likely waste streams, volumes and classifications
- Identification of opportunities for the avoidance, minimisation and reuse of waste, including targets for the beneficial reuse of solid waste, wastewater and other waste 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 waste (non-spoil)
- Generation and management of spoil, including dredged and excavated materials from Middle 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	124,400 tonnes	Sydney suppliers
Sprayed bitumen	500 tonnes	Sydney suppliers
Ready-mixed concrete	322,100 cubic metres	Sydney suppliers located close to the project and on-site concrete batching plants
Precast concrete	8600 cubic metres	Sydney, NSW Central and Mid North Coast
Aggregates – gravel/sand	25,400 cubic metres	NSW South Coast and Central Coast

Material	Estimated quantity required	Anticipated source/origin
Aggregates – general fill	183,400 cubic metres	Reuse spoil from tunnelling works if timing permits, or imported fill from the Greater Sydney region
Steel	58,400 tonnes	Australia and/or overseas
Aluminium	20 tonnes	Overseas
Glass	2 tonnes	Australia and/or overseas
PVC piping	3000 tonnes	Australia and/or overseas
Concrete piping	2100 tonnes	Australia
Plastic sheeting	30 cubic metres	Australia and/or overseas
Composites – cement fibreboard	500 tonnes	Australia
Coatings and finishes	less than 1 tonne	Australia and/or overseas
Water treatment chemicals	1 tonne	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, M8, M4-M5 Link and Sydney Metro City & Southwest 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 fit 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 pavements would be reused in temporary and new pavements, where technically feasible.

Water

Water would be required during construction activities including:

- Tunnelling activities such as dust suppression and equipment wash down
- Surface works such as during compaction of earthworks and pavement materials and for dust suppression and equipment wash down
- Concrete batching
- Site offices and ablutions
- Irrigation for landscaping.

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
- Collection, treatment and use of wastewater and rainwater at temporary construction support sites to minimise the use of potable water sources 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 sourced from infiltration into tunnelling works (non-potable water)
- Mains supply (potable water).

The average total water demand during construction is estimated to be 2645 kilolitres per day. About 1442 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 temporary construction support sites, including high voltage supply for tunnelling support sites. Table 24-3 summarises the indicative electricity demand at temporary construction support sites where tunnelling is proposed.

Infrastructure required to connect each temporary 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 at temporary 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 Indicative construction electricity demand for tunnel support sites

Temporary construction support site	Indicative temporary power requirement (megavolt ampere (MVA))
Cammeray Golf Course (BL1)	3
Flat Rock Drive (BL2)	7
Punch Street (BL3)	3
Balgowlah Golf Course (BL10)	3
Wakehurst Parkway east (BL13)	3

24.3.2 Construction waste generation and management (non-spoil)

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

Solid and liquid waste

Measures to minimise the generation of waste and 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 near to the site where possible
- Chipping and mulching of cleared vegetation for reuse on site as a preference to disposal where appropriate or reusing salvaged logs for fauna connectivity structures and habitat enhancement measures.

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 well-established environmental management measures (refer to Section 24.6). Consistent with the resource management hierarchy under the *Waste Avoidance and Resource Recovery Act 2001*, solid waste 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 waste	Indicative quantity	Likely waste classification
Demolition waste	Concrete, bricks, tiles, timber, metals, plasterboard, carpets, electrical and plumbing fittings, furnishings	12,585 cubic metres	General solid waste (non-putrescible)
Aggregates – crushed rock/concrete	Concrete	3,206,710 cubic metres	General solid waste (non-putrescible)
Hazardous waste	Asbestos, heavy metals	1000 tonnes (subject to further investigation)	Hazardous waste and/or special waste
Vegetation waste	Trees, shrubs, ground cover	Up to 12,552 tonnes[1] (noting vegetation waste would be reused on site if possible)	General solid waste (putrescible)
General construction waste	Timber formwork, scrap metal, steel, concrete, plasterboards, packaging materials	19,600 tonnes	General solid waste (non-putrescible)
Waste from the operation and maintenance of construction vehicles and equipment	Adhesives, lubricants, waste fuels, oils, engine coolant, batteries, hoses, tyres	5 tonnes	Hazardous waste

Waste stream	Examples of waste	Indicative quantity	Likely waste classification
General waste from site offices	Putrescibles (food waste), paper, cardboard, plastics, glass, printer cartridges	960 tonnes	General solid waste (putrescible and non-putrescible)

Note 1: Vegetation waste has been assumed as 600 tonnes per hectare of vegetation removal.

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 and compaction of earthworks and pavement materials.

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. Discharges from wastewater treatment plants during the construction phase would be required to meet the following discharge criteria:

- The relevant physical and chemical stressors set out in of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000)
- The ANZG (2018) 90 per cent species protection levels for toxicants generally, with the exception of those toxicants known to bioaccumulate, which will be treated to meet the ANZG (2018) 95 per cent species protection levels
- The ANZG (2020) default guideline values for iron (in fresh and marine water) and zinc (in marine water).

Indicative wastewater treatment plant discharge volumes at the temporary 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. 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 daily average wastewater discharge volumes

Temporary construction support site	Estimated daily discharge (kilolitres)	Treated wastewater available for reuse daily (kilolitres)	Discharge point
Cammeray Golf Course (BL1)	296	127	Willoughby Creek via stormwater system
Flat Rock Drive (BL2)	711	305	Flat Rock Creek via stormwater system
Punch Street (BL3)	308	130	Flat Rock Creek via stormwater system
Balgowlah Golf Course (BL10)	428	263	Burnt Bridge Creek via stormwater system
Wakehurst Parkway east (BL13)	10	199	Drainage pit on the eastern boundary of the support site. Discharge would subsequently flow into nearby golf course dam via overland flow, for reuse by the golf course.
Surface works	0	185	N/A
Total	1754	1208	

24.3.3 Spoil generation and management

About three 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 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 Middle Harbour would produce around 163,000 cubic metres of dredged and excavated materials, made up of:

- Soft soils, sediment and rock excavated from the two temporary cofferdams in Middle Harbour
- Soft soils, sediment and rock dredged for the installation of the immersed tube tunnels.

The management of spoil and dredged and excavated materials 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 and excavated materials is shown in Figure 24-1.

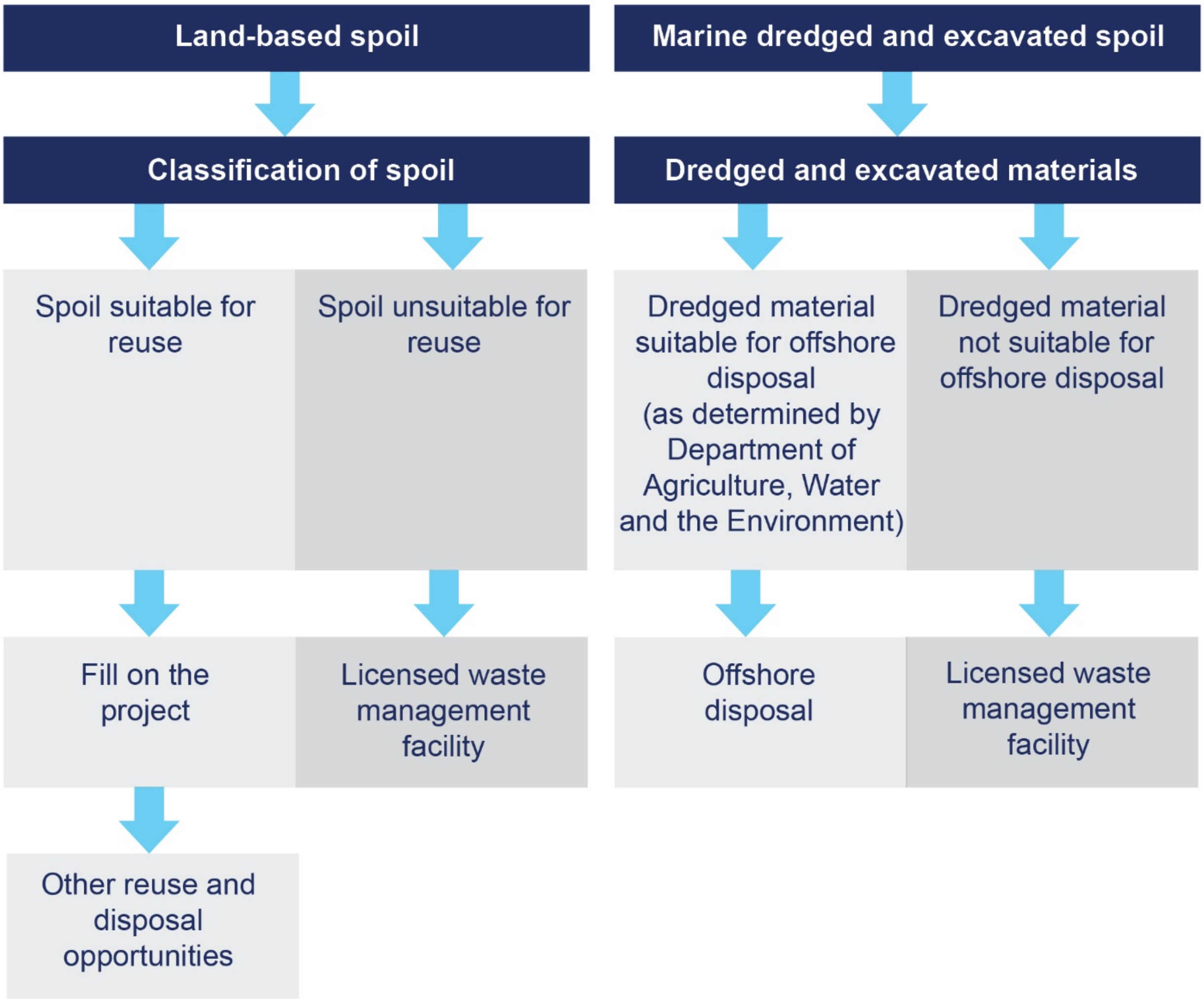

Figure 24-1 Spoil management approach

Spoil from land-based construction activities

Land-based spoil generation

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

The temporary construction support sites supporting tunnelling operations 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. The indicative volume of surplus land-based spoil to be extracted and managed through each of the temporary construction support sites is summarised in Table 24-6.

Table 24-6 Indicative land-based spoil generation

Construction site	Spoil volume (cubic metres)	Spoil composition
Cammeray Golf Course (BL1)	222,000	Sandstone
Flat Rock Drive (BL2)	929,880	Sandstone
Punch Street (BL3)	450,860	Sandstone
Balgowlah Golf Course (BL10)	673,940	Sandstone and soil
Wakehurst Parkway surface works	157,120	Sandstone and soil

Construction site	Spoil volume (cubic metres)	Spoil composition
Wakehurst Parkway east (BL13)	564,850	Sandstone
Gore Hill Freeway surface works	32,080	Sandstone and soil
Total land-based spoil generation	3,030,730	-

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 or below ground within the tunnels being excavated. This would also minimise the potential for impacts from runoff (including from contaminated materials) and sedimentation associated with stockpiling. Storage of stockpiles within the acoustic sheds would also minimise amenity impacts to the surrounding area.

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 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. Environmental management measures provided for construction noise and vibration (Chapter 10), air quality (Chapter 12) and urban design and visual amenity (Chapter 22) would minimise potential amenity impacts from the proposed stockpiles. Several of the temporary construction support sites that would require stockpiling outside of acoustic sheds are large sites that are located away from residential receivers or within industrial areas which would further minimise potential amenity impacts. Construction stockpiles would also allow for contingency management of unexpected waste materials, including contaminated materials. 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 known historical landfill areas with the exception of the Flat Rock Drive construction support site (BL2). In this instance, it is anticipated that excavated materials would generally be building type waste and non-putrescible waste. Further information is provided in Chapter 16 (Geology, soils and groundwater).

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

Location	Indicative stockpile volume
Cammeray Golf Course (BL1)	4500 cubic metres
Flat Rock Drive (BL2)	500 cubic metres
Dickson Avenue (BL4)	2500 cubic metres
Balgowlah Golf Course (BL10)	1000 cubic metres per stockpile (up to five stockpiles, totalling 5000 cubic metres) 3300 cubic metre stockpiles for concrete batch plants
Wakehurst Parkway south (BL12)	500 cubic metres
Wakehurst Parkway upgrade	Multiple stockpiles of varying volumes up to 2500 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 engineering 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 engineering fill following moisture conditioning to reduce the shrink-swell capacity of the material
- Medium strength or better quality shale is likely to be suitable for use as engineering fill
- Medium to high strength sandstone may be suitable for use as engineering 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 60 kilometres from the project)
- Moorebank Intermodal Terminal Precinct (about 40 kilometres from the project)
- Kurnell Landfill (about 40 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 reuse or disposal sites may be used depending on need at the time the spoil is generated. The final destination(s) for excess spoil from construction of the project would be planned prior to construction commencing.

With the consideration of the above commitment to maximising reuse of spoil generated during construction, the potential options for off-site spoil reuse/disposal, and the environmental management measures included in Section 24.6, the potential risk for illegal dumping of spoil generated by the project is considered negligible.

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 twelve locations within or adjacent to the construction footprint of the project that are considered to be potential areas of interest. These locations and types of potential contaminated material are provided in Chapter 16 (Geology, soils and groundwater). Further investigations of these sites including a Stage 2 contamination assessment 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.

Management of contaminated spoil would be in accordance with the 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. Contaminated material would be encapsulated on site where appropriate, and in accordance with relevant regulatory requirements. Any material that is not suitable for encapsulation would be loaded into sealed and covered trucks for disposal at a suitably licensed facility. Further site investigations during the further design development and construction planning phases would inform contamination management including determining where encapsulation is appropriate.

Dredged and excavated materials from harbour construction activities

About 163,000 cubic metres of soft soil, sediments and rock would need to be removed from Middle Harbour during the dredging activities required for the installation of the immersed tube tunnels and associated transition structures. The indicative volume and composition of dredged and excavated materials to be removed as part of marine construction activities is included in Table 24-8.

Table 24-8 Indicative dredged and excavated material volumes

Construction area	Dredged and excavated material volume (cubic metres)	Indicative composition of dredged and excavated materials
Middle Harbour south cofferdam (BL7) Middle Harbour north cofferdam (BL8)	5000	Soft soils and sediment suitable for offshore disposal under Australian Government permit
	30,000	Sandstone suitable for offshore disposal under Australian Government permit
Middle Harbour immersed tube tunnel construction	58,000	Soft soils and sediment suitable for offshore disposal under Commonwealth permit
	60,000	Sandstone suitable for offshore disposal under Australian Government permit
	10,000	Soft soils and sediment not suitable for offshore disposal
Total material	163,000	

Dredged and excavated materials suitable for offshore disposal

Transport for NSW has submitted an application to the Australian Government Department of Agriculture, Water and Environment for an offshore disposal permit relating to sediments dredged and excavated from Middle Harbour. Dredged and excavated materials suitable for offshore disposal would be transported from Middle Harbour on split hopper barges and disposed of at a designated offshore disposal site (in accordance with legislative requirements). The appropriateness of offshore disposal would be assessed in accordance with the Australian Government *National Assessment Guidelines for Dredging* (NAGD) (Department of Environment, Water, Heritage and the Arts, 2009). Offshore disposal would only be appropriate for material that meets the requirements outlined in the NAGD. Offshore disposal would reduce the number of heavy vehicle movements required to transport dredged and excavated materials. As detailed in Chapter 2 (Assessment process), assessment for offshore disposal of dredged and excavated materials is subject to a separate assessment process by the Australian Government Department of Agriculture, Water and the Environment.

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

Dredged and excavated materials unsuitable for offshore disposal

Some soft soils and sediments in Middle 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 other ongoing sources of input such as stormwater.

Of the 163,000 cubic metres of material requiring removal from Middle Harbour, it is expected that about 10,000 cubic metres from the top 0.5 metre to one metre of the bed of the harbour may not be suitable for offshore disposal. The nature of existing contamination within Middle Harbour is described in more detail in Chapter 16 (Geology, soils and groundwater).

Dredged and excavated materials not suitable for offshore disposal would be loaded onto hopper barges and transferred to a suitable onshore facility for treatment (if required) and disposal.

Dredged and excavated materials 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 material to assist in mitigating potential odour and to neutralise acid sulfate soils. This process is widely used on marine construction projects 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 sealed and covered trucks for transport to a suitably licensed 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 waste.

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 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:

- Groundwater which has been treated after infiltrating into tunnels (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

Activity	Total water demand
Washdown	730 kilolitres/year
Deluge testing	2920 kilolitres/year

Electricity

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

The project would likely be connected to the Warringah sub-transmission substation. Initial discussions with Ausgrid indicate that this substation 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 28 MVA.

24.4.2 Operational waste generation

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

Solid and liquid waste

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

The volumes and types of waste would be typical of motorway operations and could be accommodated by existing metropolitan licenced 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 collect groundwater, stormwater, 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 Gore Hill Freeway (refer to Chapter 5 (Project description)). Volumes of tunnel wastewater to be pumped and treated would be minimised through the installation of tunnel linings which would minimise the ingress of groundwater. On average, the project tunnels would generate about 551 megalitres per year of treated groundwater in the first year of operation, falling to about 436 megalitres per year after 100 years of operation. Tunnel water would be treated to comply with (ANZECC/ARMCANZ, 2000), ANZG (2018) and ANZG (2020) guidelines (refer to Section 17.1.3), and spill controls and water quality monitoring would be implemented to manage operational impacts on ambient water quality within the receiving waterways.

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 Greater 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 Services, 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.

As described in Section 28.5, the construction environmental management plan would outline the management of waste and resources during construction. Waste and resource management would include waste monitoring, reporting and compliance tracking of construction waste generated by the project.

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 - 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.	BL/GHF
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.	BL/GHF
WM3	Construction	Waste generation and disposal	Any surplus material requiring offsite disposal to land, including marine sediments unsuitable for offshore disposal, will be classified in accordance with *Waste Classification Guidelines* (NSW EPA, 2014).	BL/GHF
WM4	Construction	Storage and transport of waste	Wastes will be appropriately transported, stored and handled according to their waste classification and in a manner than prevents pollution of the surrounding environment.	BL/GHF
WM5	Construction	Waste generation and disposal	Opportunities for terrestrial spoil reuse within the project corridor, so as to minimise the quantity of material disposed to land will be investigated and implemented where feasible and reasonable.	BL/GHF
WM6	Construction	Wastewater generation and disposal	Opportunities for wastewater reuse and recycling, including use of stormwater from sediment basins and recirculating water during tunnel excavation to use for dust suppression or off-site reuse, will be investigated and implemented where feasible and reasonable.	BL/GHF
WM7	Construction	Management of mulch	Mulch stockpiles and the potential generation of tannin leachates will be managed through the implementation of *Environmental Direction for the Management of Tannins from Vegetation Mulch* (Roads and Maritime Services, 2012).	BL/GHF
WM8	Construction	Reuse of vegetation waste	Where reasonable and feasible, salvaged logs from the clearing process will be reused on site and/or reused as part of the fauna	BL/GHF

Ref	Phase	Impact	Environmental management measure	Location
			connectivity structures with consideration of the *Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	
WM9	Construction	Waste disposal	Further investigations will be carried out at the Flat Rock Drive (BL2), Balgowlah Golf Course (BL10) construction support sites and surface works and construction support site locations along the Wakehurst Parkway (BL12, BL13 and BL14) to determine the feasibility of encapsulation of contaminated materials on site. Where contaminated soils and other materials are to be encapsulated on-site, encapsulation will be designed in accordance with the requirements detailed in the *Guidelines for the Assessment of On-site Containment of Contaminated Soil* (ANZECC, 1999).	Flat Rock Drive (BL2), Balgowlah Golf Course (BL10), Wakehurst Parkway south (BL12), Wakehurst Parkway east (BL13) and Wakehurst Parkway north (BL14) construction support sites
WM10	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.	BL/GHF
WM11	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).	BL/GHF
WM12	Operation	Water use and discharge	Opportunities to reuse treated groundwater during project operation will be considered where feasible and reasonable.	BL/GHF

Note: BL = Beaches Link, GHF = Gore Hill Freeway Connection