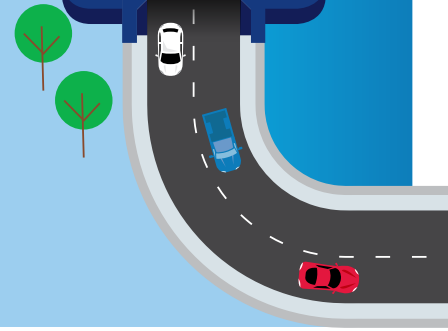




Western Harbour Tunnel and Warringah Freeway Upgrade



How we build the project

Artist's impression of cofferdam construction in Sydney Harbour



Building across the harbour

We will be using immersed tube tunnels to cross the Sydney Harbour. These types of tunnels have been built many times before and we will be using techniques similar to when the Sydney Harbour Tunnel was built.

Cofferdams

We will be building a cofferdam at each end of the harbour crossing to connect the land tunnel to the immersed tube tunnels. These cofferdams will each be about the shape and size of an Olympic sized pool. They are temporary and we will remove them once the work is finished.

Cofferdams are made up of interlocking piles (like round hollow metal pipes) to form an enclosed wall. Each pile will be driven into the sandstone below the harbour floor until it is secure and cannot move. Piling will take place from a barge using a crane fitted with a hydraulic vibrating hammer, offshore pile driving hammer and/or a similar piece of construction equipment.



Interactive portal

nswroads.work/whtportal

Visit our interactive portal to see how we will build and use the cofferdams to construct the tunnel in Sydney Harbour

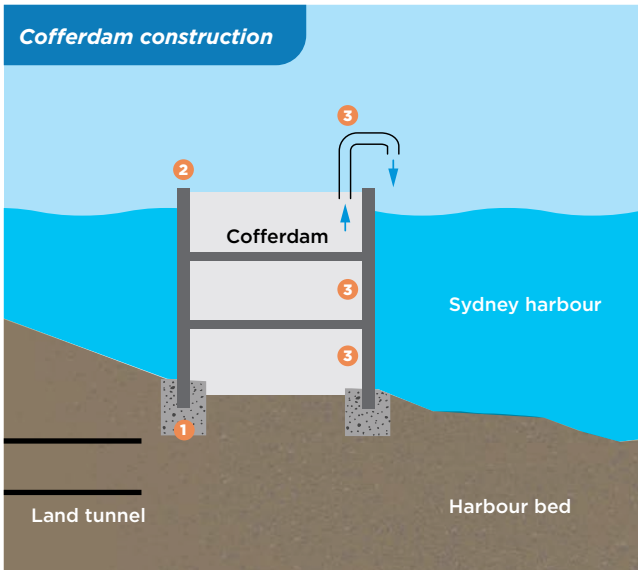
Once the cofferdams are in place, we will pump the water out of the cofferdam and install the structural steel to make it structurally sound and safe to work inside.

Building within the cofferdams

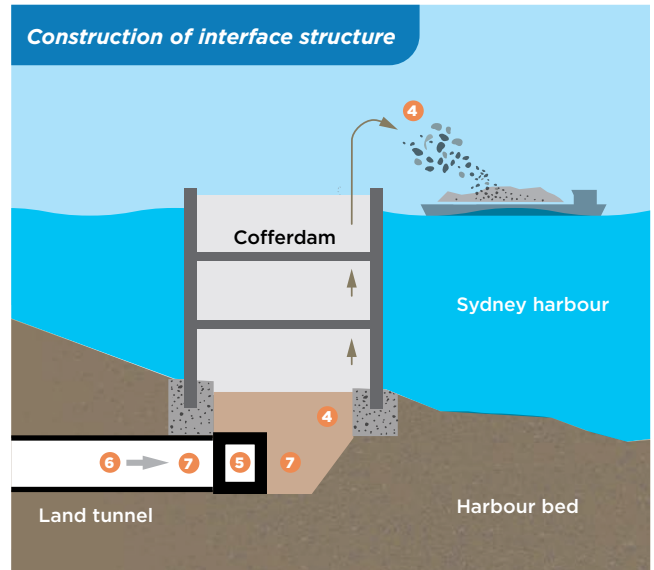
Once in place, we will build a concrete structure in each of the cofferdams known as an interface structure, which will connect the tunnel under the water to the tunnel under the land.

Removing the cofferdams

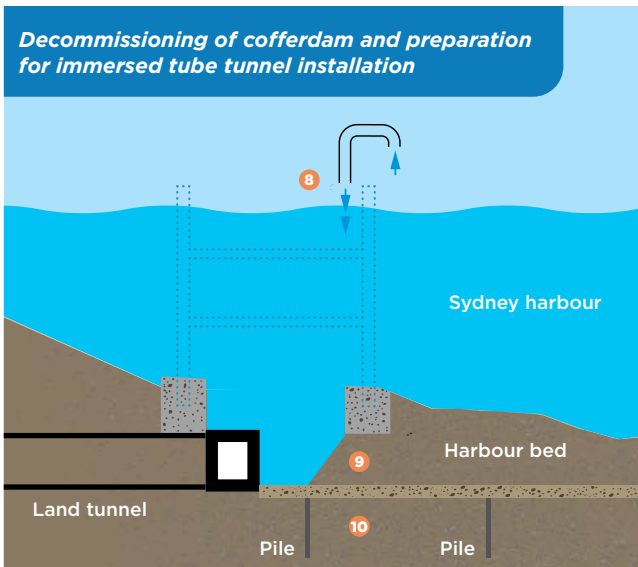
Once we have finished our work the cofferdams will be removed. This will include filling them with water to the same level as the water level outside and removing the piles. The marine environment will be rehabilitated as needed, for example restoring the seabed profile to the same levels as before construction.



- 1 Ground treatment to improve the strength of the ground surface
- 2 Pile installation to create the outer structure of the cofferdam
- 3 Dewatering and installation of the structure support



- 4 Excavation of rock within the cofferdam to final design level of the tunnel
- 5 In-situ construction of the tunnel interface structure
- 6 Breakthrough of land tunnel into interface structure using roadheaders
- 7 Installation of bulkhead structures at tunnel interface structure to provide a waterproof seal



- 8 Filling of cofferdam with water and removal of structure support
- 9 Dredging of the harbour bed to create a trench
- 10 Installation of a gravel bed and supporting piles within the trench in preparation for immersed tube tunnel installation

Seabed profiling

To get ready to place the immersed tube tunnels below the seafloor we will need to prepare the seabed. This will involve creating a slot for the immersed tube tunnel to lie in, so the top of the protective rock layer on top of the tunnel will be about level with the seafloor when completed.

How we do this will depend on what type of material we are removing, for example we use different equipment to remove rock and sand.

In planning our work and selecting our equipment, we have carried out marine ecology surveys, sediment testing and modelled water movements to ensure we have a strong understanding. We will be using a number of safeguards to manage the potential impacts to ecologically sensitive areas.

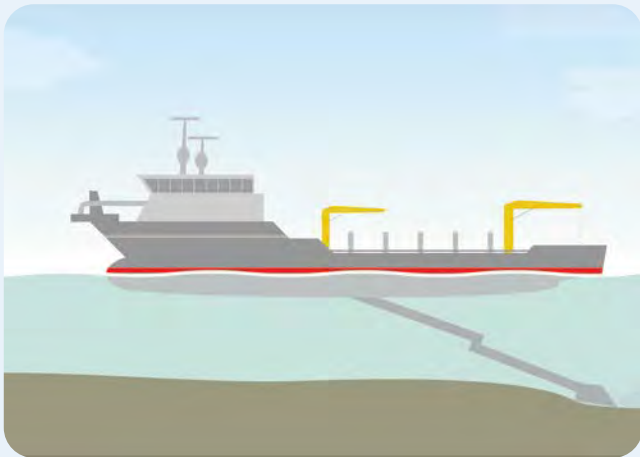
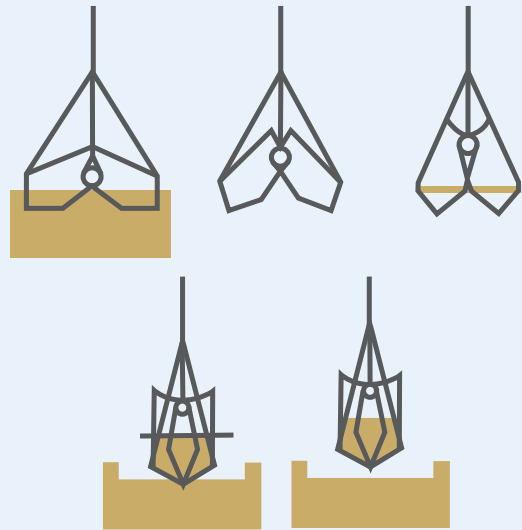
Removing materials from the seabed

Backhoe dredge with closed environmental bucket

A closed environmental clamshell is a closed bucket attached to a backhoe dredger. This is used to avoid the spread of material into the water as it is being removed. Materials will be immediately loaded onto barges to be transported and treated at White Bay.

Type of material

Used to remove soft sediments which are not suitable for reuse or disposal offshore. They will be tested and treated before being disposed of in licensed facilities.



Trailer suction hopper dredger

This machine operates like a large vacuum cleaner. It uses suction tubes and a pump that vacuums up a mixture of sand, soil and water into the 'hopper' of the ship. Once full the ship will take the clean material to the offshore disposal site for disposal.

Type of material

Clean soft ground materials suitable for offshore disposal.

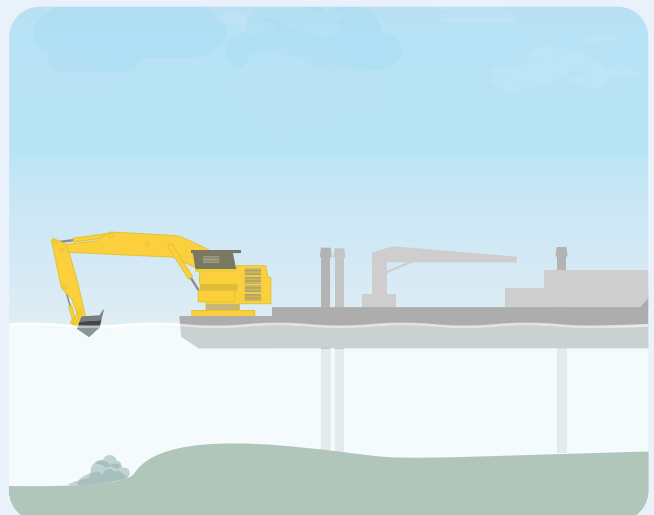
Cutter suction dredge and backhoe dredge

A cutter suction dredger uses rotating cutter head or drum cutters to cut and fragment rock underwater. After the material is cut using the cutter head, a backhoe will lift the materials from the water and load it into a barge.

This material will be transported by barge to the offshore disposal site for disposal.

Type of material

Rock suitable for offshore disposal.



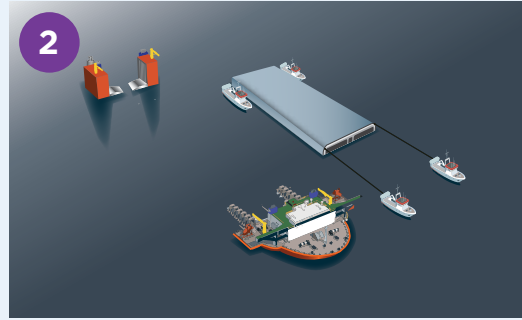
Building the tunnel units

The immersed tube tunnel will be around 630 metres long and have five individual pieces, called units. These will be made locally at our construction site at White Bay. Once completed, each unit is sealed to keep the water out, allowing the unit to float. The units will be stored at Snails Bay in Sydney Harbour near Birchgrove. Once we have built the interface structures and completed the seabed profiling, we will move them via tugboat one piece at a time to their final destination.

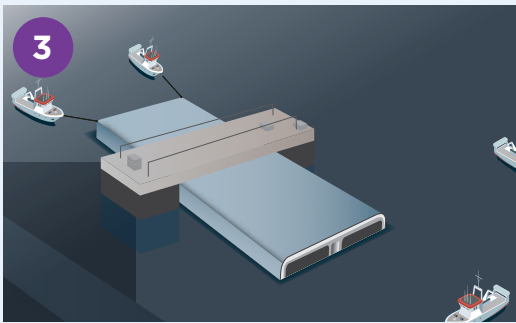
Building the tunnel units



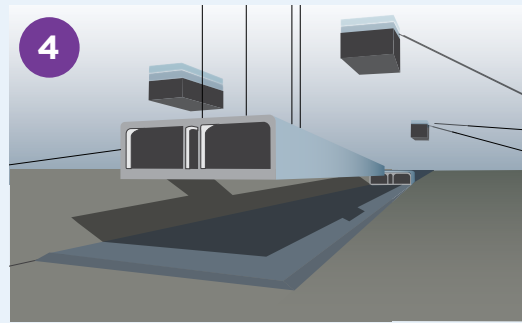
1 Construction and fitout of immersed tube tunnel units at White Bay



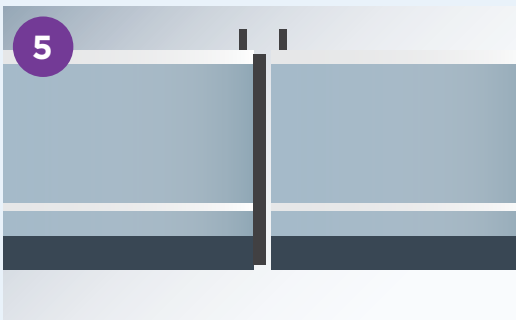
2 Tunnel unit floated in deep water in preparation for installation



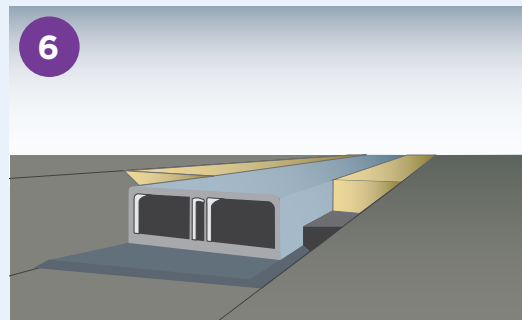
3 Tunnel unit transported to site by tug boats



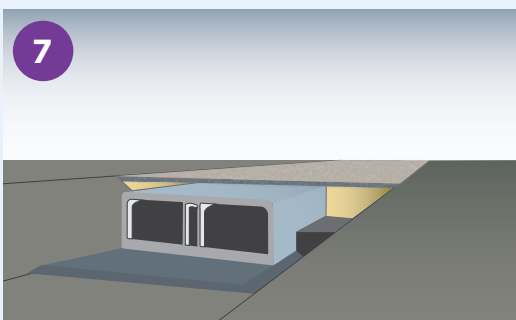
4 Immersion of tunnel unit



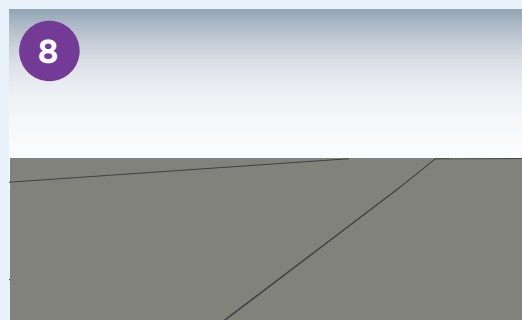
5 Water tight seal between tunnel units



6 Backfilling of trench



7 Rock armour placement over unit



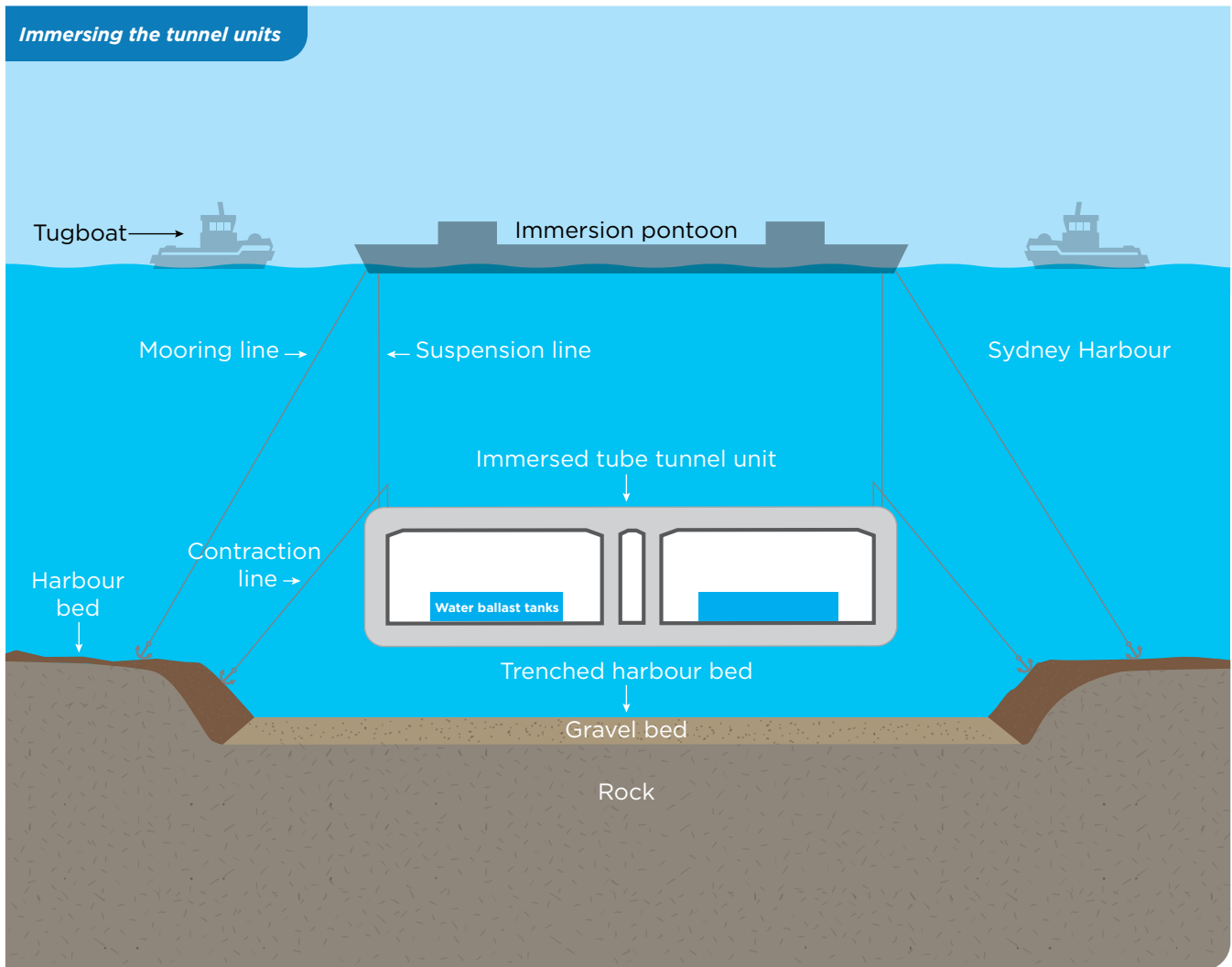
8 Seabed restored following completion of immersed tube tunnel

Immersing the tunnel units

We will be placing the immersed tube units using pontoons, tug boats and a guidance system. Each unit is immersed by remotely pumping water into tanks within the units - similar to a submarine. The units have large seals on each end to create a watertight joint with the adjacent unit.

After each unit is immersed, fill will be placed around the unit to lock it into place. This is followed by a rock protection layer to protect the tubes from situations such as falling or dragging anchors, during their lifetime.

We will be placing units one at a time. It will take around 24 to 48 hours to install each unit. There will be some localised harbour closures in the area when this is happening.



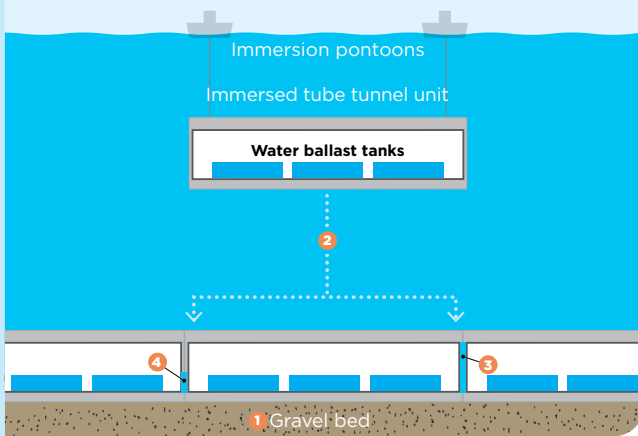
Managing spoil and waste when building in the water

We will be removing any materials from the seabed and immersed tube tunnel construction by using barges. Some dredged material associated with the construction of the crossing of Sydney Harbour will be eligible for disposal offshore. We will transport suitable dredged material to the offshore disposal site using barges. We have submitted an application to

the Commonwealth Department of the Environment and Energy for offshore disposal of suitable dredged material.

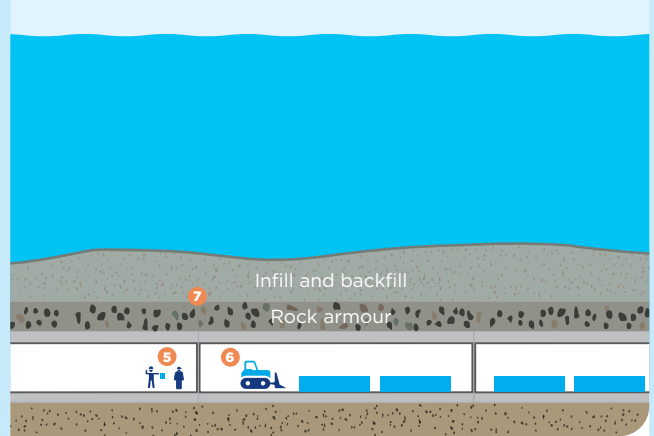
We will transport any dredged material not suitable for offshore disposal by barge to White Bay. We will stabilise this material and then dispose of it at a land-based, licensed facility. This is very similar to the process recently used for construction work at Garden Island.

Process for immersion of tube tunnel units



- 1 Installation of gravel bed within trench
- 2 Lowering of immersed tube tunnel element against existing units
- 3 Connection of immersed tube tunnel unit with previous immersed tube tunnel unit or interface structure
- 4 Dewatering of immersion joint

Process for fitout and finishing work

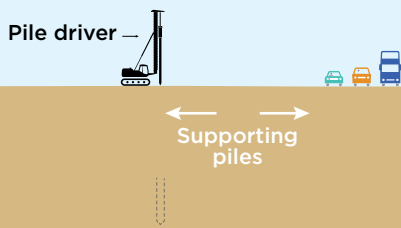


- 5 Casting work of the immersion joint
- 6 Finishing work (casting internal wall and ballast concrete) and removal of water ballast tanks
- 7 Placement of infill, backfill and rock armour around immersed tube tunnel

Bottom-up

Stage 1

Install support piles



Stage 2

Partial excavation to temporary support strut level

Excavator

Stage 3

Install temporary support strut

Supporting strut

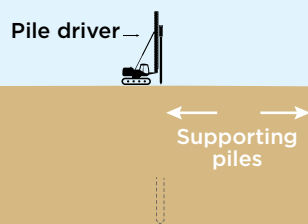
Supporting strut

Floor

Top-down

Stage 1

Install support piles



Stage 2

Partial excavation

Excavator

Stage 3

Install roof

Roof

Roof

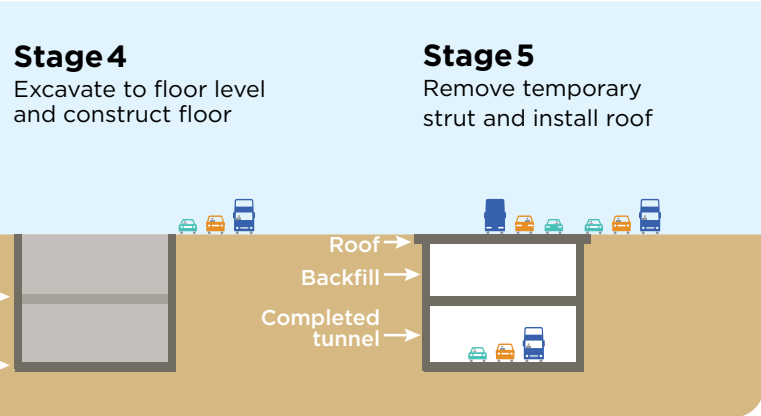
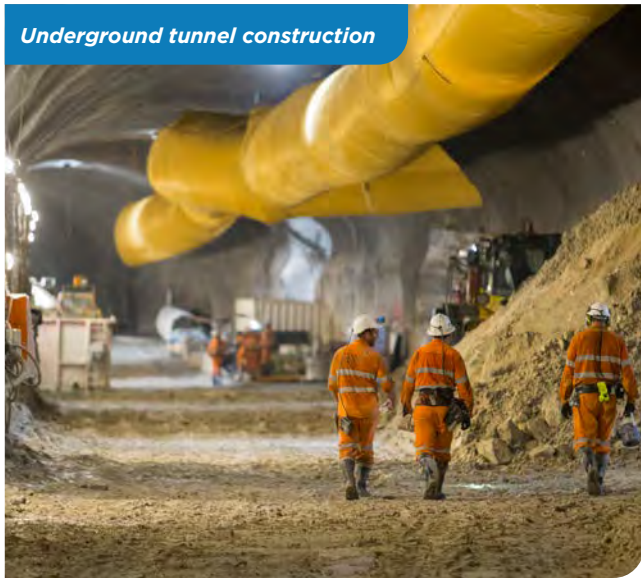
Floor level

Building on land

Tunnelling

We will be tunnelling using roadheaders. Roadheaders are extremely powerful and advanced rock-cutting machines designed to continuously excavate roadways, tunnels and chambers.

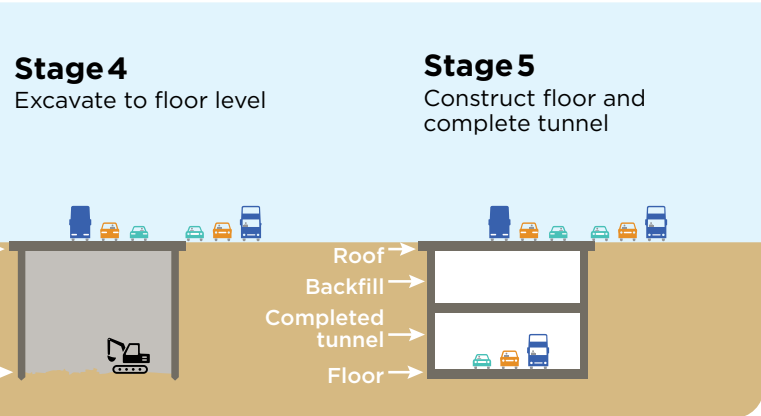
The Beaches Link tunnel emerges within the Warringah Freeway, near the Ernest Street overbridge. We will be building the Beaches Link cut and covers now so we do not need to disrupt the local community by coming back later to complete this work. (Beaches Link is subject to a separate environmental assessment and planning approval.)



Cut and cover

We will be building cut and cover tunnels when there is not enough rock cover to support the construction of the tunnels from underground. This is generally where the tunnels come to the surface.

Cut and cover is a tunnelling method generally involving excavating downwards from the surface of the ground, and installing a tunnel structure including a base, walls and a roof. Cut and cover can be built using a bottom-up or top-down method of construction. Once the roof is in place, the tunnels are generally covered with fill and re-vegetated.



Cut and cover tunnels will be built where the Western Harbour Tunnel:

- emerges within the Warringah Freeway, to the north of the Ernest Street overbridge
- off ramp to Falcon Street emerges in the southeast corner of Ridge Street North
- on ramp from Berry Street dives into the Warringah Freeway corridor, near North Sydney.

Surface roads

We will be building some new roads and upgrading a number of existing roads as part of the project. The main surface road work will take place on the Warringah Freeway.



Warringah Freeway

This work will involve:

- removing existing kerbs and pavement
- relocating and protecting services and utilities like power and water
- carrying out earthworks including excavation and preparing the foundations of the road by placing and compacting materials and rock
- building retaining walls to hold back soil and earth
- building and diverting drainage including adjusting existing and building new drains and pits, and installing pipes and culverts
- laying pavement, which generally includes a couple of layers of base foundations with a top of either asphalt or concrete
- carrying out finishing work (including line marking, installing signage and road furniture like lights and landscaping).

Bridges

We will be demolishing, building, upgrading and replacing a number of bridges across the project. Work will vary depending on the type of bridge being removed, but may include activities such as:

- relocating and protecting service and utilities like power and water
- relocating and managing traffic, pedestrian and cyclist lanes and installing traffic and environmental controls
- using cranes to place pre-built concrete pieces on the bridge
- building or upgrading the bridges
- laying asphalt or concrete on the top of the bridge
- marking lines, installing barriers, drainage and road furniture as required.




Contact the Western Harbour Tunnel and Beaches Link team

 nswroads.work/whtbl

 whtbl@transport.nsw.gov.au

 1800 931 189

 Customer feedback
Transport for NSW, Locked Bag 928
North Sydney NSW 2059

Visit our interactive web portal

Read the EIS, find out more or ask our team a question.

 nswroads.work/whtportal



If you need help understanding this information, please contact the Translating and Interpreting Service on 131 450 and ask them to call us on 1800 931 189.

Privacy Transport for NSW is collecting your personal information in connection with the Western Harbour Tunnel and Warringah Freeway Upgrade ("the Project"). In addition to collecting your name and contact details we may collect other information such as your submissions and other communications with us. We will retain and use this information for consultation purposes, including communications and analysis in connection with the Project. We will not disclose your personal information to third parties unless authorised by law and if we include your submissions in any public report we will not identify you. Providing your personal information is voluntary but if you do not provide it we may not include you on our stakeholder database and you might miss further consultation opportunities. Your personal information will be held by us and you can contact us to access or correct it. Please write to us at either whtbl@transport.nsw.gov.au or Transport for NSW, Locked Bag 928, North Sydney NSW 2059.