Part of the Waterview Connection will be underground in two 2.4km long tunnels. These tunnels are being built using a tunnel boring machine.

Half of the new Waterview Connection motorway link will be underground in Australasia’s largest road tunnel. This tunnel is being constructed using a custom-built tunnel boring machine (TBM) called Alice.

What is a tunnel boring machine?

A tunnel boring machine (TBM) is like a giant drill, except that it also builds as it drills. The TBM is drilling two holes, each big enough for a three lane motorway. It will travel north from Ōwairaka to Waterview to dig one tunnel, then turn around at Waterview and begin its journey back to Ōwairaka.

Why is the TBM needed?

By digging the tunnel and taking the motorway underground for 2.4km, the existing roads, parks, rivers, houses and businesses above ground are saved. The tunnels will reach a depth of 45m below the surface to go beneath a layer of very hard volcanic rock formed a long time ago from a volcanic eruption in the area.

How the TBM works

The front section of the TBM is called the shield. At the front of the shield is the cutting face, which is like a giant, round cheese grater. The shield has two jobs; it drills through the ground to create a large hole which it then lines with concrete segments to form complete rings. These concrete segments are 2 metres wide and 450mm thick.

Ten of these segments are needed to make a complete ring of tunnel lining. Each segment weighs about 10 tonne. Therefore a complete, 2-metre wide ring of tunnel lining is made up of 100 tonnes of concrete and steel.

The TBM could also be called the TMM because it is also the 'Tunnel Making Machine' not just the 'Tunnel Boring Machine'. The TBM lines the hole that it has dug with concrete segments and completes the process of making the tunnel.
Why the TBM is called Alice

Auckland school children were able to enter a naming competition for the TBM. 'Alice' from Alice in Wonderland was the winner by public vote. 'Alice' was submitted by 9-year-old Branden Hall from Everglade Primary in Manukau. Branden chose Alice because just like Alice in Wonderland, the tunnel boring machine (TBM) would go through a tunnel (rabbit hole) and 'Wonderland' would be on the other side.

Female names are traditionally given to drilling machines because in the past tunnellers always looked to Saint Barbara for protection. Saint Barbara is the patron saint of artillerymen, armourers, military engineers, gunsmiths, miners and anyone else who works with canons and explosives.
Facts about the TBM

- Top speed is 8cm/minute (also the top speed of a snail)
- It will take about a year to travel 2.4km to build one tunnel
- Soil in front of the TBM is turned into a slurry by injecting foam and water through the cutting head of the TBM so it does not get stuck
- 24,040 two metre wide concrete segments will be used to line the tunnel
- A pilot operates the TBM and is part of a crew of 16 people
- 800,000 cubic metres of ground will be excavated to build the tunnels – that’s enough to fill 320 Olympic sized pools
- The TBM has a diameter of 14.4m which is larger than the trunk of Tane Mahuta – New Zealand’s largest Kauri tree
- The TBM is approximately the same height as a four storey building
- The TBM weighs about 3000 tonnes or about the same weight as 750 elephants
- The total length of the TBM is 87.7m which is nearly as long as a rugby field
- It is the tenth largest tunnel boring machine in the world.

Ready for a quiz? [5]

Half of the new Waterview Connection motorway link will be underground. This tunnel is being constructed using a tunnel boring machine (TBM) [3] called Alice which was built for this project.

What is a tunnel boring machine?

A tunnel boring machine (TBM) is like a giant drill, except that it also builds as it drills. The TBM is drilling two holes, each big enough for a three lane motorway. It will travel north from Ōwairaka to Waterview to dig one tunnel, then turn around at Waterview and begin its journey back to Ōwairaka to build the second tunnel.

Why is the TBM needed?

By digging the tunnel and taking the motorway underground for 2.4km, the roads, parks, rivers, houses and businesses above ground are saved. The tunnels will reach a depth of 45m below the surface to go under a layer of very hard volcanic rock formed a long time ago from a volcanic eruption in the area.
How the TBM works

The front section of the TBM is called the shield. At the front of the shield is the cutting face, which is like a giant, round cheese grater. The shield has two jobs; it drills through the ground to make a large hole. It then lines this hole with concrete segments to form complete rings.

The TBM not only cuts the hole for the tunnel it also lines it with concrete and completes the process of making the tunnel.

Why the TBM is called Alice

Auckland school children were able to enter a naming competition for the TBM. 'Alice' from Alice in Wonderland was the winner by public vote. 'Alice' came from 9-year-old Branden Hall from Everglade Primary in Manukau. Branden chose Alice
because just like Alice in Wonderland, the tunnel boring machine (TBM) would go through a tunnel (rabbit hole) and 'Wonderland' would be on the other side.

**Facts about the TBM**

- Top speed is 8cm/minute (also the top speed of a snail)
- It will take about a year to travel 2.4km to make one tunnel
- Soil in front of the TBM is turned into a slurry by pushing foam and water through the cutting head of the TBM so it does not get stuck
- 24,040 two metre wide concrete segments will be used to line the tunnel
- A pilot operates the TBM and is part of a crew of 16 people
- 800,000 cubic metres of ground will be dug out to build the tunnels – that is enough to fill 320 Olympic sized pools
- The TBM has a width of 14m which is larger than the trunk of Tane Mahuta – New Zealand’s largest Kauri tree
- The TBM is about the same height as a four storey building
- The TBM weighs about 3000 tonnes or the same weight as 750 elephants
- The total length of the TBM is about 88m which is nearly as long as a rugby field
- It is the tenth largest tunnel boring machine in the world.

**Ready for a quiz?**

[Image of a quiz]

Māori keywords:

<table>
<thead>
<tr>
<th>Māori keyword</th>
<th>English translation</th>
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</thead>
<tbody>
<tr>
<td>anaroa [6]</td>
<td>tunnel</td>
</tr>
<tr>
<td>hanga [7]</td>
<td>to make, construct or build</td>
</tr>
<tr>
<td>Tāmaki-makau-rau [8]</td>
<td>Auckland</td>
</tr>
<tr>
<td>huke [9]</td>
<td>dig, excavate</td>
</tr>
<tr>
<td>rori matua [10]</td>
<td>motorway, highway, main road</td>
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</tbody>
</table>

Audio Māori keywords:

- anaroa - tunnel [12]
- hanga - to make, construct or build [13]
- Tāmaki-makau-rau - Auckland [14]
- huke - dig, excavate [15]
- rori matua - main road, motorway, highway [16]
- mīhini - machine [17]

Samoan keywords:

<table>
<thead>
<tr>
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Tongan keywords:

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Cook Islands Maori keywords:

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Niuean keywords:

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Find out where else in the world tunnel boring machines are being used and the projects in which they are involved.

Meet Alice the Tunnel Boring Machine built especially for the Waterview Connection Project. Image: NZTA.

The tunnel is lined with two-metre wide concrete segments. Image: NZTA.
Looking down a completed section of the Waterview Tunnel. Image: NZTA.

This tunnel is for services. It will carry the key services like water, electricity and telecommunications under the new motorway.

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Links