October 2015: Size and scale of a TBM in action at Castle Hill

**HOW BIG IS IT?**

- **Length:** up to 120m
- **Weight:** >900 tonnes
- **Number of people:** 15
- **Concrete segments:** 99,200
- **Volume of rock:** 9,400 Olympic swimming pools or 5.9 million tonnes of crushed rock

**HOW A TUNNEL BORING MACHINE (TBM) WORKS**

1. Grippers extend out to the rock surface. Rock is crushed by high strength alloy steel discs on the cutterhead.
2. Crushed rock is scooped into the machine's head and on to a conveyor belt.
3. The machine moves forward about 1.7m and then the process starts again.
4. The gap between the concrete ring and the rock is filled with grout – this helps keep water out of the tunnel.
5. Concrete ring segments are delivered to the ring building area.
6. Concrete ring is built by putting together the segments using a special vacuum lifting device.
7. When complete, the ring is connected to the previous ring.
8. The conveyor moves the rock through the machine and out of the tunnel behind it.

**FACTS**

- **5** tunnel boring machines (TBMs), including one specialised TBM for tunnelling under Sydney Harbour
- **15.5** kilometres of twin tunnels from Chatswood to Sydenham
- **93%** boring through Sydney sandstone, the rest shale
- **120** metres of tunnel cut every week, on average
- **6** metres internal tunnel diameter
- **99,200** concrete segments will line the tunnels
- **58** metres Maximum tunnel depth
- **35** metres Average tunnel depth
- **3** TBM launch sites
- **15.5** kilometres of twin tunnels from Chatswood to Sydenham
- **940** Olympic swimming pools or 5.9 million tonnes of crushed rock
- **24/7** around-the-clock operation underground
- **570** Holden Commodores
- **1** Olympic swimming pool

**TUNNEL BORING MACHINE**

- Sydney Metro
- Marrickville TBM dive site
- Barangaroo TBM dive site
- Chatswood TBM dive site
Specialised tunnelling technology

A slurry TBM will be used to tunnel through different ground conditions under Sydney Harbour.

The slurry TBM uses pipes and fluid to control the pressure in the machine, by turning the excavated material into a slurry and pumping it out.

1. Fluid pumped into chamber behind the cutterhead
2. Crushed rock (spoil) is mixed with fluid to create a slurry inside pressurised chamber
3. Slurry pumped to the surface. Spoil removed from the fluid, which is re-used
4. Any large rock pieces are crushed in the chamber before being pumped to the surface in slurry
5. Concrete ring segments delivered to the ring building area
6. Concrete ring is built by putting together the segments using a special vacuum lifting device
7. When complete, the ring is connected to the previous ring
8. The gap between the concrete ring and the rock is filled with grout – this keeps water out of the tunnel
9. The machine moves forward about 1.7 metres then the process starts again

Concrete ring is built by putting together the segments using a special vacuum lifting device.

Crushed rock (spoil) is mixed with fluid to create a slurry inside a pressurised chamber.

Fluid pumped into chamber behind the cutterhead.

Any large rock pieces are crushed in the chamber before being pumped to the surface in slurry.

When complete, the ring is connected to the previous ring.

The gap between the concrete ring and the rock is filled with grout – this keeps water out of the tunnel.

The machine moves forward about 1.7 metres then the process starts again.