Forrestfield-Airport Link
METRONET

Tunnel fit-out and track laying

Fact Sheet | August 2020

ABOUT THE PROJECT

The $1.86 billion Forrestfield-Airport Link is jointly funded by the Australian and Western Australian governments and will deliver a new rail service to the eastern suburbs of Perth – with three new stations at Redcliffe, Airport Central and High Wycombe.

The rail link forms part of the METRONET vision to create liveable communities connected by world class public transport. The Airport Line will spur off the existing Midland Line near Bayswater Station and run to High Wycombe through twin-bored tunnels.

In April 2016 the Public Transport Authority awarded the design, construct and maintenance contract to Salini Impregilo – NRW Joint Venture.

First trains will operate on the new line in late 2021.

Tunnel fit-out is an essential part of the project and includes installation of rail infrastructure and electrical, mechanical, hydraulic, safety and communications systems.

Early fit-out of the tunnels and preparation works for rail began mid-2019. The tunnel boring machines completed their work in April 2020, paving the way for track laying and other fit-out works.

For rail within the tunnels, a fixed slab track method is used with rail fastening systems affixed to embedded sleepers and infill concrete.

The construction is completed in three stages:

- installation of rail and sleepers
- setting the track to line and level
- concrete placement and finishing

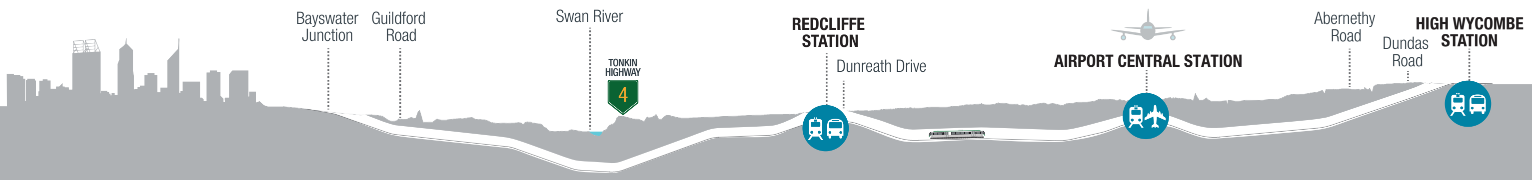
Track located outside the tunnels and dive structures is placed on a bed of crushed stones, referred to as ballast.

Once the track laying process is underway, work will begin on the installation of overhead line equipment to power the trains, as well as associated rail systems.

2400 tonnes of Australian-made track steel

More than **25,000** concrete sleepers

40km Total length of rail strings



Preparing the tunnels

Preparation works include laying a length of PVC half-pipe at the base of the tunnels. This half-pipe forms part of the drainage system, with surface pits every 30m. A layer of concrete, called the invert slab, is poured on top of the half-pipe to form a flat surface approximately 250mm deep. This creates the base for the rail and sleepers.

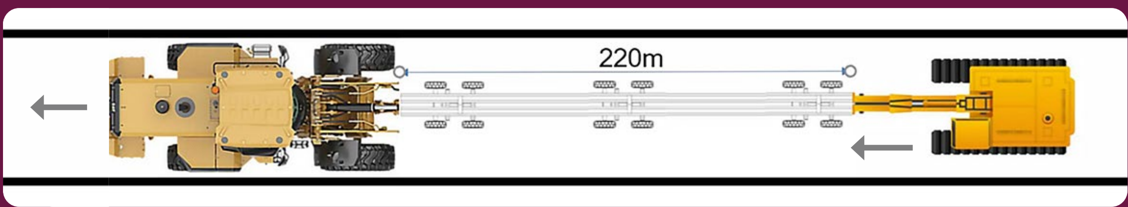
A PVC half-pipe supports drainage within the tunnels (pictured left). The invert slab creates the base for the rail and sleepers (pictured right)

Stage 1 - Installation of rail and sleepers

Giant strings of rail, each made up of eight 27.5m lengths, are joined together above ground using the flashbutt welding (electrical energy-powered) technique. More than 1200 welds are required to produce these 220m-long rail strings.

Placed on trolleys, the rail strings are pulled into the tunnels using a loader at the front and an excavator at the rear. At their required location they are lifted off the trolleys and placed on either side of the invert slab using mobile gantries.

The sequence is repeated multiple times until all rail is delivered into the tunnel.



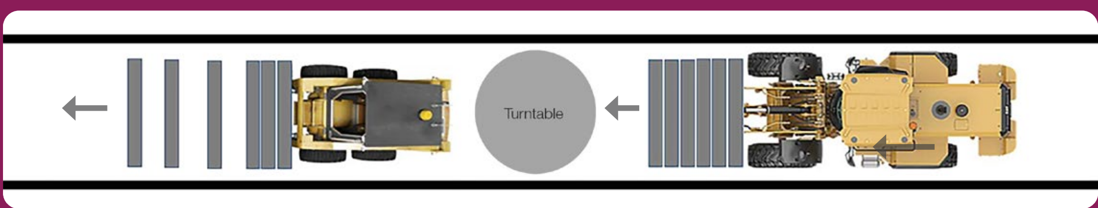
Rail strings on trolleys (above)

A loader and excavator manage rail deliveries into the tunnels (left)

A loader delivers stacks of concrete sleepers into the tunnel and places them on the invert slab. A smaller loader then picks up the sleepers, rotates on a turntable and spaces them 700mm apart.

From here a self-propelled, hydraulically-driven rail threader is used to lift the rail strings onto the sleepers, where they are clipped into place using rail fasteners.

The skeleton track is now in place.



Rail threader used for lifting rail onto sleepers (above left)

A close up of the rail fasteners (above right)

Sleeper delivery and placement (left)

Stage 2 - Setting the track to line and level

The skeleton track is lifted up from the invert slab to rough line and level using track jacks spaced six metres apart. Approximately 300m of track will be set at a time.

A track adjustment system is then used to set the track to the specified line and level, with spindles and push-pull props holding the track at the correct alignment.

A surveyor ensures the track is set to the correct design alignment using a rail survey trolley. The rail is now ready for the final stage.

Track adjustment system used to set rail to design line and level

Track jacks used to lift rail to rough line and level

Rail survey trolley used to survey the track

Stage 3 - Concrete placement and finishing

Skeleton track is laid in approximate sections of 300m at a time. Once each section has been levelled and adjusted the concrete placement commences, averaging 100m per day. Concrete is pumped into the tunnels via long pipes from ground level.

Vibrators and trowels are used to detail the finished slab and an epoxy coating is applied.

Once the concrete has cured to the required level, the track adjustment system framework is removed and rail strings are welded together. This process continues along the entire length of the tunnels.

An epoxy coating to the edge of slab and tunnel walls is applied at the final stage, after all construction works have been completed.

Once concreting is completed and all rail is in place, a rail grinder is used along the alignment. This process ensures a consistent rail profile and removes any irregularities.

A close up of the sleepers before the rail is placed on top

Connecting trains to power

Above-ground trains are powered via overhead wires, referred to as Overhead Line Equipment (OLE).

Underground, where limited space is available between trains and tunnel lining, a rigid Overhead Conductor Rail (OCR) system is used to provide 25kV power to the trains.

The OCR system allows the contact wire to be permanently fixed, with support arms every six metres. Installation of the support arms, which are affixed to the tunnel rings and station structures, takes place in sections where the track slab has been installed.

After the complete OCR and OLE systems have been installed and certified, the traction power will be energised, supplied by the Airport Line's own 132kV/25kV substation located in High Wycombe.

Power substation at High Wycombe

Drainage

The tunnel drainage system is an important part of tunnel infrastructure. Water can be present in the tunnels for a variety of reasons, including cleaning, normal water ingress and, during wet weather, trains may bring water into the tunnels.

The drainage system has been designed to guide water to low points at the base of the tunnels into the PVC half-pipe. Once the water reaches a certain level in the pipes, it will travel toward drainage basins that are installed in some of the cross passages.

Signalling systems

Fixed signalling systems within the tunnels include axle counters and automatic train protection devices, allowing the train driver to obtain automated information about the train's location and headway between subsequent trains.

Bi-directional signalling enables single line operations (trains moving either way on one track) if required.

Safety and emergency systems

A vital part of the tunnel fit-out is the installation of safety devices and equipment.

Radio systems and transmission channels allow communications between the train driver and the Public Transport Authority's train control centre.

Raised walkways with handrails are fitted along the entire length of the tunnels, with distance markers at 25m intervals.

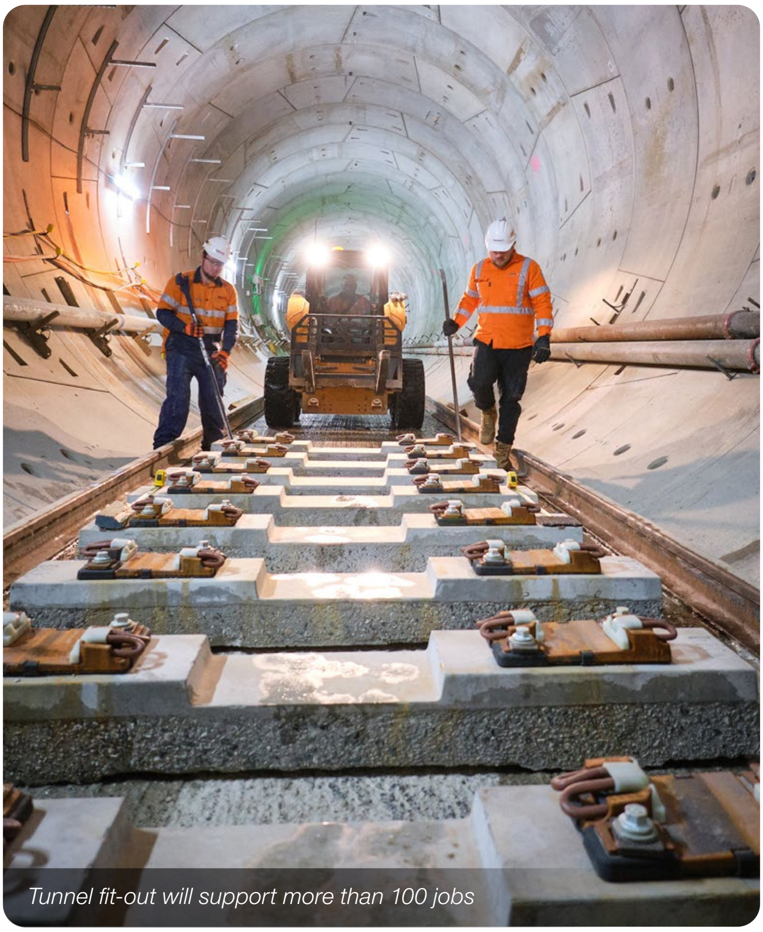
Emergency luminescent directional signage throughout the tunnels assists with safe evacuation at designated emergency egress locations. All cross passages and emergency egress shafts will be equipped with fire-proof doors to contain both fire and smoke.

In the event of a fire, a linear heat detection cable secured to the tunnel ceiling will detect heat and trigger the emergency fire safety system, which determines the location of the fire. Tunnel emergency ventilation systems are set to automatically respond, moving air in the direction the train is travelling. This pushes any smoke past the train and out of the nearest open-air source.

Both tunnels are equipped with emergency telephones and fire hydrants.

Cameras and intruder alarms at portals, stations, cross passages and the emergency egress shafts will enable the train control centre to monitor any unauthorised movement within the tunnels.

All underground structures have access to back-up power in case of a power failure.



Tunnel fit-out will support more than 100 jobs

Public Transport Authority

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