

FACTSHEET

About the Deep Tunnel Sewerage System (DTSS)

A superhighway for used water management, the DTSS is a core water infrastructure which provides a cost-effective and sustainable solution to support Singapore's continued growth and meet its long-term needs for used water collection, treatment, reclamation and disposal.

The DTSS uses deep tunnel sewers to convey used water entirely by gravity to centralised WRPs located at the coastal areas. The used water is then treated and further purified into ultra-clean, high-grade reclaimed water called NEWater, with excess treated effluent discharged to the sea.

DTSS Phase 1, comprising the North and Spur Tunnels, the associated link sewers, the Changi WRP and outfall, was completed in 2008. A NEWater factory, located on the rooftop of the Changi WRP, was built in 2010 to facilitate large-scale water recycling.

The DTSS Phase 2 conveyance system comprises the South Tunnel which conveys domestic used water, the Industrial Tunnel for non-domestic used water and associated link sewers. Expected to complete by 2025, DTSS Phase 2 will extend the deep tunnel system to cover the western part of Singapore, including the downtown area and major upcoming developments such as Tengah Town and Jurong Lake District.

Under DTSS Phase 2, a NEWater factory to be integrated with the Tuas WRP will be built to facilitate water recycling, contributing to the goal of increasing NEWater supply from 40% to up to 55% of total water demand in the long term. Tuas WRP will also be co-located with NEA's Integrated Waste Management Facility (IWMF), to harness potential synergies.

The completed DTSS will also streamline the used water network with three centralised collection and treatment points: Changi WRP in the east, Kranji WRP in the north and Tuas WRP in the west.

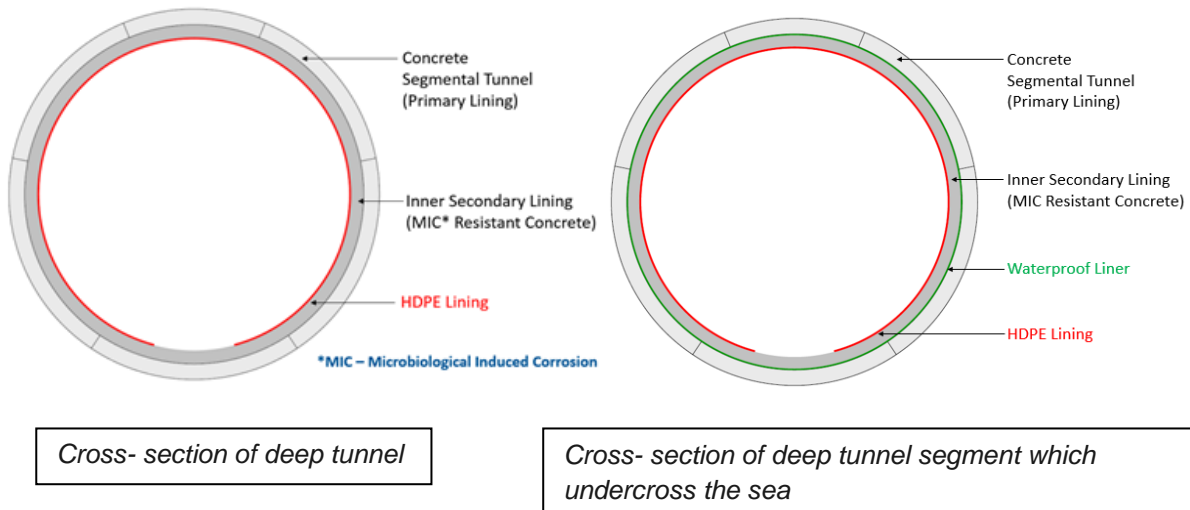
Once Phase 2 is in place, the existing conventional WRPs at Ulu Pandan and Jurong, as well as intermediate pumping stations, will be progressively phased out and the land freed up for higher value development. The implementation of the entire DTSS will result in a 50% reduction in land taken up by used water infrastructure once it is fully completed, from 300 hectares in the 1990s to 150 hectares in the long term. The land freed up by DTSS is equivalent to about 214 football fields.

The DTSS Phase 2 deep tunnels will incorporate the following innovative and advanced features:

- Microbiological-Influenced Corrosion (MIC) – Resistant Concrete

A secondary lining of Microbiological Influenced Corrosion (MIC) - Resistant Concrete and High Density Polyethylene (HDPE) is used to protect against corrosion,

particularly from bacteria and other micro-organisms present and from gaseous fumes in the sewer environment. For tunnel sections that undercross the sea, an additional water proof membrane layer is installed between the concrete segment and the secondary lining to minimise any water ingress into the tunnel. These linings ensure the longer term life span of the tunnel.



- Remote sensing and monitoring via embedded fiber optic system

Fibre optic cables will be cast into the concrete primary lining around the deep tunnel to enable remote monitoring of the long term structural integrity of the tunnel, critical when other construction works are underway in the vicinity, or during other events such as seismic activity.

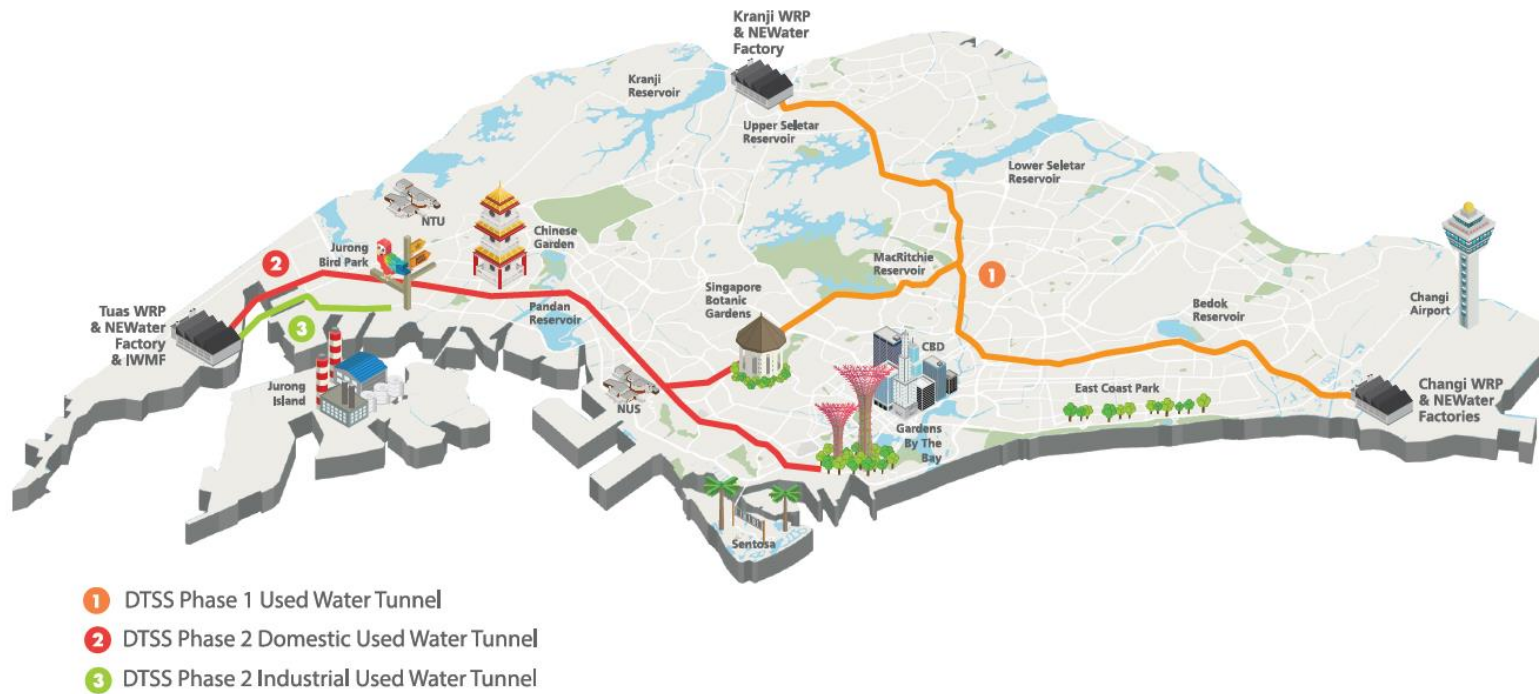
- Isolation Gates

Shafts are designed with gates to be lowered into the deep tunnels, temporarily isolating the tunnels in the event that repairs are required. During which, the incoming used water flow will bypass the isolated part of the tunnel via the link sewer network and rejoin the tunnel downstream. The gates allow for the tunnel to be dry and safe for man access.

- Air Jumpers as part of Air Flow Management

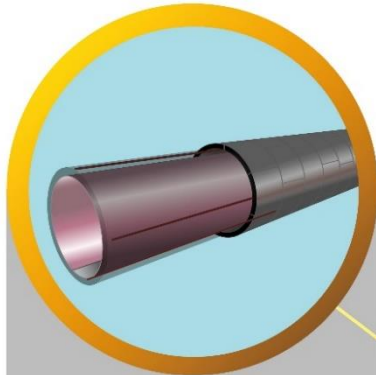
DTSS Phase 2 is the first project in Singapore to use Air Jumpers (AJs) to minimise the number of Odour Control Facilities (OCFs) as part of Air Flow Management. AJs are installed at ground level along the tunnel length to manage air flow within the tunnel. The AJs help to push odorous air rising from the deep tunnel back down, where it flows to the OCFs downstream, located away from residential areas. The odorous air is then treated before being released.

Integrating DTSS Phases 1 and 2



Domestic Used Water Tunnel	Length: Estimated 30 km Diameter: 3m – 6m Tunnel Depth: 35 – 55m
Industrial Used Water Tunnel	Estimated 10km Diameter: 3.3m – 4m Depth: 35 – 55m
Link Sewers	Estimated 60km Diameter: 0.3m – 3m

Advanced features of new DTSS superhighway



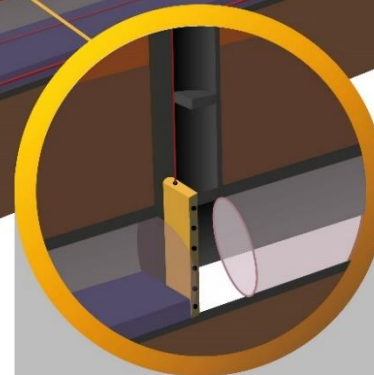
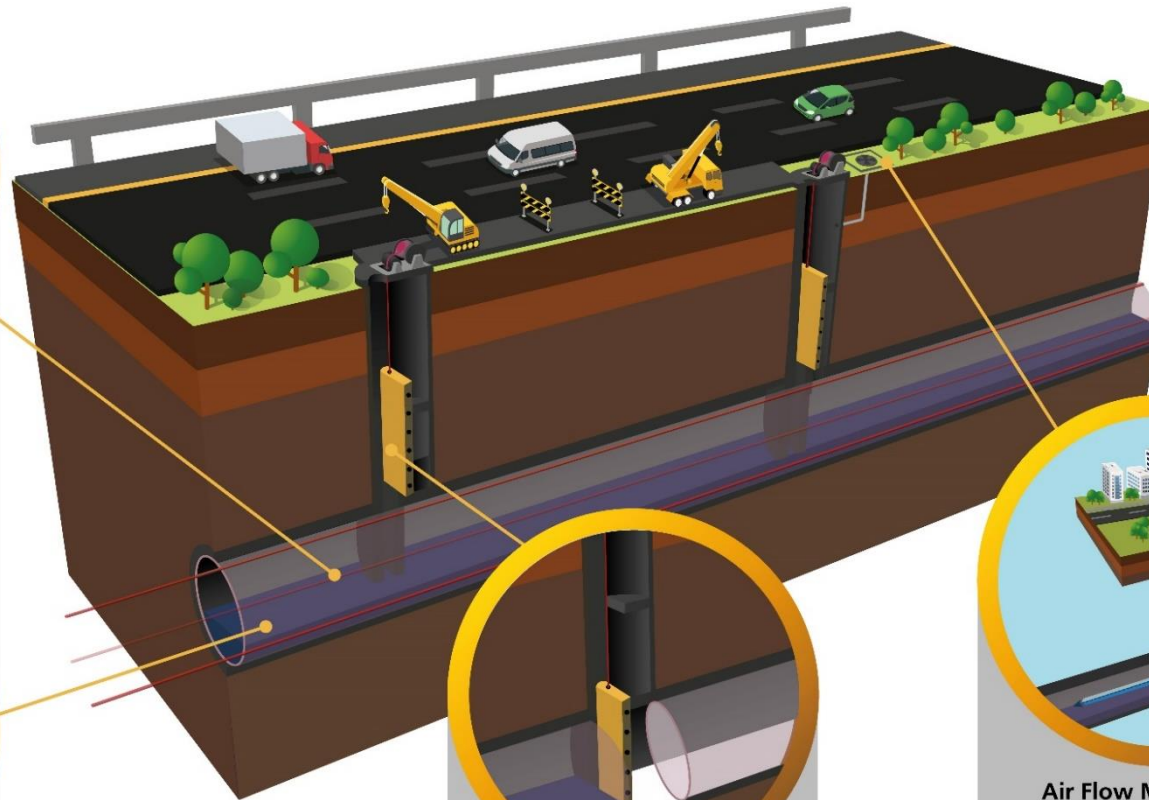
Secondary Lining

In addition to the concrete segments, a secondary lining consisting of Microbiological Influenced Corrosion (MIC) resistant concrete with High Density Polyethylene (HDPE) lining serves as protection against corrosion.



Fibre Optic Cables

Fibre optic cables are installed along the length of the tunnels to remotely monitor its structural integrity.



Isolation Gates

Shafts are designed with gates deployed to isolate the tunnel, allowing safe man-access in the event repairs are required.



Air Flow Management

Air Jumpers act as forced ventilation to push air back into the tunnel for treatment by Odour Control Facilities located downstream.

Design & Build Contractors for first 50km of Deep Tunnels and Link Sewers of DTSS Phase 2

Company	Contract Details	Contract Works Area
Ed Zublin AG (Singapore Branch)	Contract Value: \$499 Mil Length: 12km	Domestic Used Water Tunnel: Intersection of Jurong Pier Rd and AYE and follow AYE to Tuas Road Link Sewer: Jalan Bahar/PIE junction to Benoi Road/AYE junction.
Penta-Ocean Construction Co., Ltd. and Koh Brothers Building & Civil Engineering Contractor (Pte) Ltd. Joint Venture	Contract Value: \$520 Mil Length: 10km	Domestic Used Water Tunnel: Tuas Road to Tuas Water Reclamation Plant. Part of which will pass under Tuas Bay. Industrial Used Water Tunnel: Jalan Buroh/Pioneer Road and Pioneer Section 1 before passing under Tuas Bay and terminate at Tuas Water Reclamation Plant.
Leighton Contractors (Asia) Limited (Singapore Branch)	Contract Value: \$495 Mil Length: 8km	Domestic Used Water Tunnel: Intersection of Clementi Road and AYE to the intersection at Jurong Pier Road and AYE.
Nishimatsu Construction Co Ltd	Contract Value: \$340 Mil Length: 8km	Domestic Used Water Tunnel: Intersection of Portsdowns Road and AYE to the intersection of Clementi Road and AYE Link Sewer: Portsdown Road to Leedon Heights and Intersection of Clementi Road and AYE to Clementi Road and West Coast Road
Shanghai Tunnel Engineering Co (Singapore) Pte Ltd	Contract Value: \$472 Mil Length: 12km	Domestic Used Water Tunnel: Keppel Road to Portsdown Road Link Sewer: Sentosa to Warwick Road

PUB, The National Water Agency

20 November 2017