

- ▶ **Crossrail tunnelling concludes**
- ▶ **Crossrail programme is now 65 per cent complete**
- ▶ **Over 10,000 people are currently working on Crossrail, including 460 apprentices**
- ▶ **Crossrail is being delivered on time and within budget**

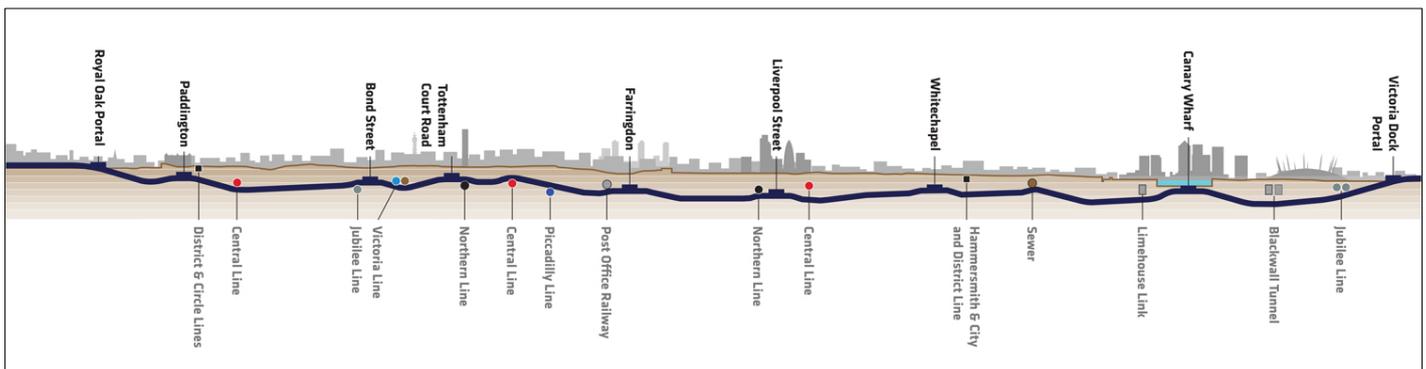
## Overview

Crossrail's tunnelling marathon under London is now complete. Crossrail tunnelling began in May 2012 and ended at Farringdon with the arrival of tunnelling machine Victoria.

Over the last three years, eight 1,000 tonne tunnelling machines have bored 42km or 26 miles of new 6.2 diameter rail tunnels under London.

Teams of dedicated workers have been working 24 hours a day to complete the tunnels for Europe's largest civil engineering project with thousands of others employed to upgrade the existing rail network and build major new stations in central London and Docklands.

The tunnels weave their way between existing underground lines, sewers, utility tunnels and building foundations from station to station at depths of up to 42m.



Tunnelling machine Victoria, named after Queen Victoria who oversaw the birth of modern railways, successfully broke into Farringdon Crossrail station on 23 May at 5.30am. Victoria then constructed the remaining section of Crossrail tunnel as she progressed into Farringdon station, completing the job and linking all Crossrail tunnels.

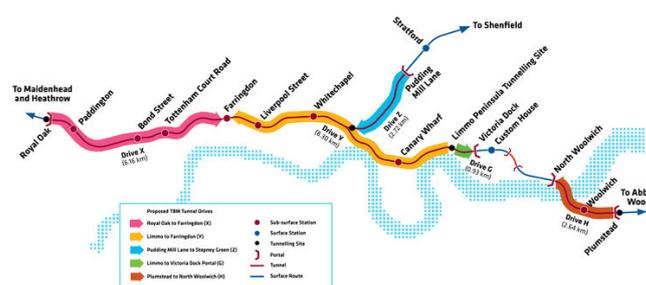
Crossrail tunnelling ended on 26 May 2015 when TBM Victoria completed her journey.

Farringdon is one of 10 new Crossrail stations being built in central London, Docklands and southeast London. The new station will have connections to both London Underground and Thameslink. Farringdon will have the longest platforms on Crossrail at 350 metres so that passengers can connect to both Farringdon and Barbican Tube stations.

Crossrail construction commenced in 2009 at Canary Wharf and is now 65% complete. Services through central London will commence in 2018.

Nearly 70 million working hours have been completed on the Crossrail programme so far.

## Crossrail tunnelling facts



5 twin-bore tunnel drives were undertaken to construct Crossrail's tunnels, which are:

- Royal Oak to Farringdon - length of drive approximately 6.8 km
- Limmo to Farringdon - length of drive approximately 8.3 km
- Pudding Mill Lane to Stepney Green - length of drive approximately 2.7 km
- Limmo to Victoria Dock Portal (Drive G) - length of drive approximately 0.9 km
- Plumstead to North Woolwich (Drive H) - length of drive approximately 2.9 km

## Names of Crossrail tunnelling machines

- Phyllis – Phyllis Pearsall created the London A-Z
- Ada – Ada Lovelace was the world's first computer programmer
- Victoria – named after Queen Victoria
- Elizabeth – named after HM Queen Elizabeth II
- Mary – Mary Brunel was the wife of the famous railway engineer Isambard Kingdom Brunel
- Sophia – Sophia Brunel was the wife of Marc Isambard Brunel who built the first tunnel under the Thames

## Number of tunnelling machine breakthroughs

Crossrail's tunnelling machines had a total of 18 breakthroughs when constructing the eastern tunnels (Docklands to Farringdon) and Thames Tunnel (Plumstead to North Woolwich) as follows:

- Sophia at Woolwich - 15 May 2013
- Elizabeth at Canary Wharf – 21 May 2013
- Victoria at Canary Wharf – 11 June 2013
- Elizabeth at Stepney Green – 6 November 2013
- Elizabeth at Whitechapel – 20 January 2014
- Sophia at North Woolwich – 29 January 2014
- Victoria at Stepney Green – 30 January 2014
- Jessica at Stepney Green – 3 February 2014
- Victoria at Whitechapel – 4 April 2014
- Mary at Woolwich - 4 September 2013
- Mary at North Woolwich – 13 May 2014
- Ellie at Stepney Green – 9 June 2014
- Jessica at Victoria Dock Portal – 9 August 2014
- Ellie at Victoria Dock Portal – 18 October 2014
- Elizabeth at Liverpool Street – 29 January 2015
- Victoria at Liverpool Street – 10 March 2015
- Elizabeth at Farringdon – 9 May 2015
- Victoria at Farringdon – 23 May 2015

The Crossrail tunnelling machines constructing the western tunnels between Royal Oak and Farringdon did not break through into any stations or portals.

In the west, tunnelling machines Phyllis and Ada were launched at Royal Oak Portal and tunnelled towards Farringdon creating the running tunnels first, after which the station tunnels were enlarged around the running tunnels. These TBMs passed under station sites at Paddington, Bond Street, Tottenham Court Road and Farringdon without any break throughs.

For the eastern tunnel drive between Docklands and Farringdon, the station tunnels and underground structures were constructed before the tunnelling machines passed these locations.

### **Deepest point in Crossrail tunnels**

42 metres at Finsbury Circus, near Liverpool Street station.

### **How many metres bored on the fastest day of tunnelling by a single machine?**

72 metres by Ellie on 16 April 2014 between Pudding Mill Lane and Stepney Green.

Crossrail tunnelling progressed at a collective average of 38 metres per day.

### **Type of ground bored through?**

- Between Royal Oak and Farringdon – London Clay for the majority and Lambeth Group
- Between Docklands and Farringdon – London Clay, Lambeth Group and Thanet Sands
- Between Plumstead and North Woolwich – Thanet Sands and chalk.

### **Number of cross passageways connecting the twin-bore tunnels**

- Eastern tunnels (Docklands to Farringdon) – 10
- Western tunnels (Royal Oak to Farringdon) – 6
- Thames Tunnel (Plumstead to North Woolwich) – 4

### **How many tunnel portals are there?**

Five portals were built Royal Oak, Pudding Mill Lane, North Woolwich, Victoria Dock & Plumstead.

### **Tunnel segments / rings**

Crossrail's tunnels are made up of over 200,000 concrete tunnel segments. Each tunnel segment weighs 3.4 tonnes. Seven segments and a key stone slot together to form a completed tunnel ring.

Segments for the western tunnels (Westbourne Park to Farringdon) were made at Old Oak Common in west London while segments for Crossrail's eastern tunnels (Docklands to Farringdon) were made at Chatham, Kent. Segments for the Thames Tunnel (Plumstead to North Woolwich) were made in Ireland.

110,000 segments were produced at Chatham and transported by 260 barge movements to London saving 10,000 lorry trips. 75,000 segments were produced at Old Oak Common.

## Crossrail tunnelling machines

Crossrail's eight tunnelling machines were manufactured by Herrenknecht in Germany and shipped to the UK where they were re-assembled.

Six of the eight tunnelling machines were earth pressure balance tunnelling machines for digging through London Clay, sand and gravel. They weighed 980 tonnes and were 148 metres in length.

Two machines (Mary and Sophia) were mix shield slurry machines for tunnelling through the wet chalk and flint beneath the River Thames in southeast London. A slurry machine is slightly shorter at 110 metres long.

## What happened to each of the TBMs?

**Victoria** and **Elizabeth** will be dismantled. Their 130 metre trailer will be removed from the tunnel via the shaft at Stepney Green and returned to manufacturer Herrenknecht, with parts recycled for future tunnelling projects. The cutterhead will be cut into small pieces and removed via the shaft at Farringdon. The front "cans" of each machine will be left in the tunnel, and Crossrail trains will pass through them when services begin in 2018.

**Phyllis** and **Ada** were dismantled and their 130 metre long trailer systems removed from the tunnel via the Fisher Street shaft, leaving just the front "can" and cutterhead in situ - 30 metres below ground in Farringdon.

**Mary**, **Sophia**, **Jessica** and **Ellie** were dismantled and returned to manufacturer Herrenknecht, with parts recycled for use on future tunnelling projects.

## Start and end dates for each of the TBMs

TUNNELLING MACHINE	LAUNCHED FROM	DESTINATION	STARTED TUNNELLING	COMPLETED TUNNELLING
Phyllis	Royal Oak Portal	Farringdon	04/05/2012	08/10/2013
Ada	Royal Oak Portal	Farringdon	21/08/2012	24/01/2014
Elizabeth	Limmo Peninsula	Farringdon	29/11/2012	11/05/2015
Victoria	Limmo Peninsula	Farringdon	08/12/2012	26/05/2015
Sophia	Plumstead Portal	North Woolwich	09/01/2013	29/01/2014
Mary	Plumstead Portal	North Woolwich	19/05/2013	13/05/2014
Jessica - first drive	Pudding Mill Lane	Stepney Green	15/08/2013	05/02/2014
Ellie - first drive	Pudding Mill Lane	Stepney Green	26/02/2014	13/06/2014
Jessica - second drive	Limmo Peninsula	Victoria Dock Portal	02/06/2014	10/08/2014
Ellie - second drive	Limmo Peninsula	Victoria Dock Portal	11/09/2014	19/10/2014

## Excavated material

Crossrail's eight tunnelling machines excavated a total of 3.4 million tonnes of material. A total of 7 million tonnes of material will be excavated during the construction of Crossrail, 98% of all excavated material will be re-used.

In a landmark partnership with the Royal Society for the Protection of Birds (RSPB), 3 million tonnes of material excavated from deep below the capital is being used to create a flagship wetland nature reserve twice the size the City of London at Wallasea Island in Essex.

Material from Crossrail's western tunnels was transported by rail from Westbourne Park to Northfleet in Kent before being shipped to Wallasea. As many as 5 rail movements took place between Westbourne Park (western tunnels) and Northfleet transfer site per day at peak. Material from Crossrail's eastern tunnels was shipped direct to Wallasea from Instone Wharf near Canning Town.

5 ships were dedicated to transport of Crossrail excavated material to Wallasea Island. 1528 shipments delivered 3 million tonnes of excavated material.