

Crossrail and our international tunnelling expertise

Analyst briefing

Thursday 1 October 2015



Neil Thomas

Managing director
Water, Ground and Environment



Crossrail

ATKINS

Crossrail

Crossrail has one purpose – to change the way people travel in the capital

- We are increasing London's rail capacity by 10%, supporting regeneration and cutting journey times
- Bringing an extra 1.5 million people to within 45 minutes of central London and linking London's key employment, leisure and business districts
- An estimated 200 million annual customers will use Crossrail.



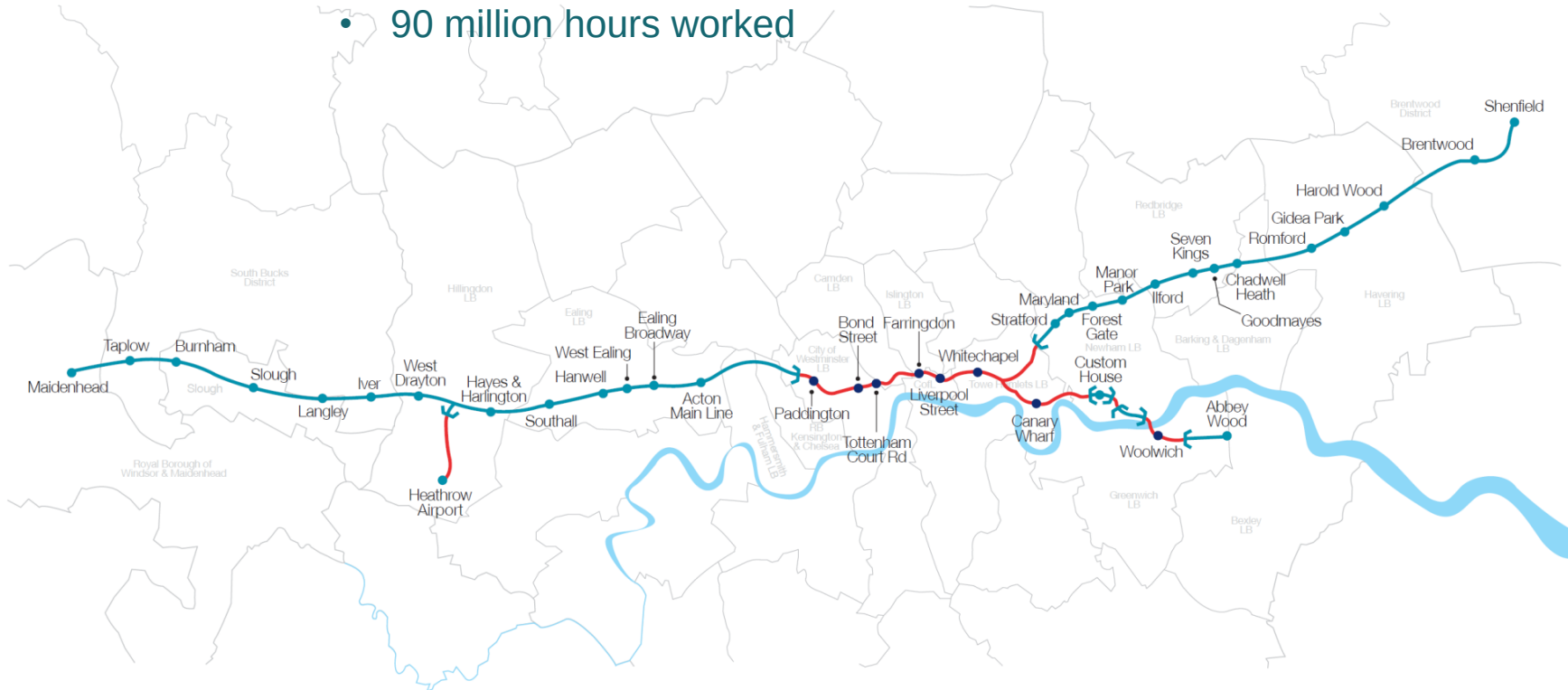
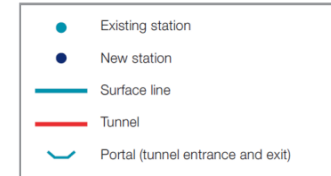
Crossrail route



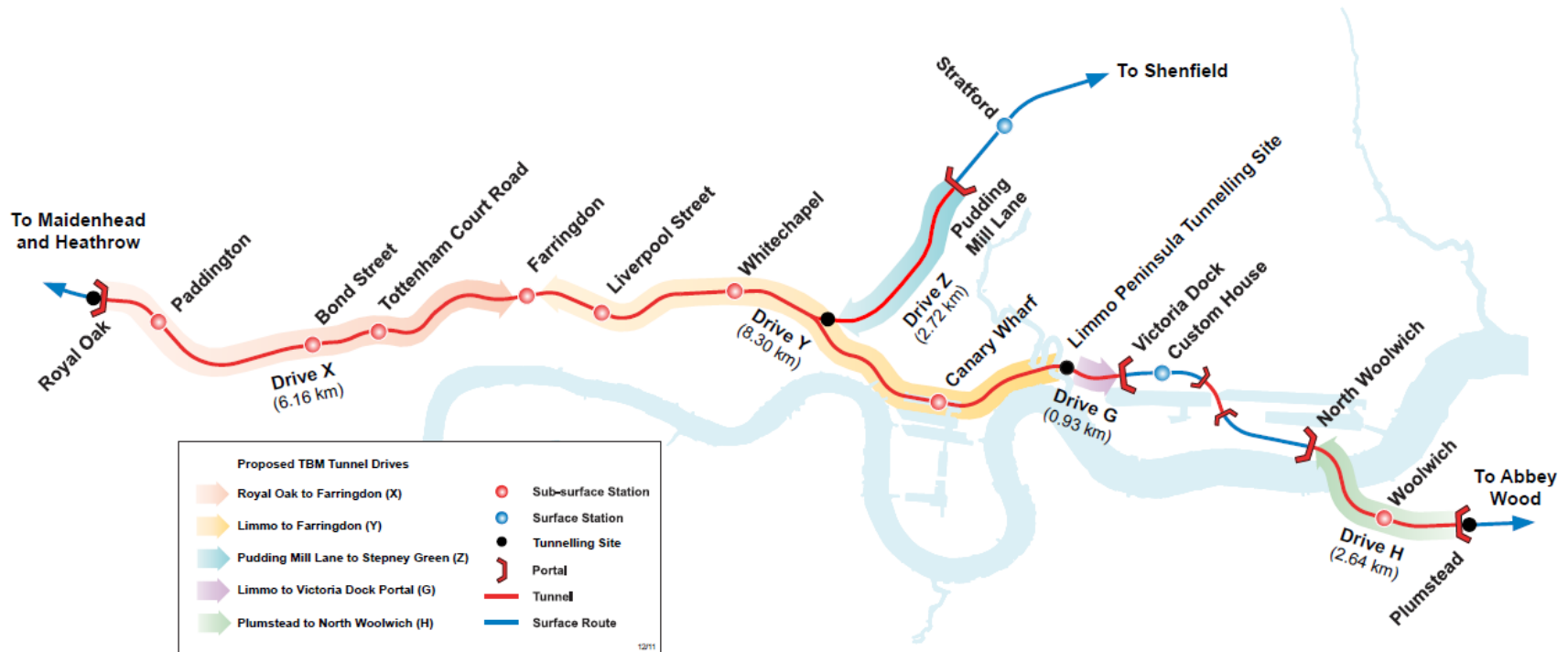
Crossrail

Regional Map

- Reading to Shenfield and Abbey Wood
- 110km route length
- 29 surface stations (1 new)
- 40 Crossrail stations, 10 new stations
- 10,000 people working on it
- 90 million hours worked



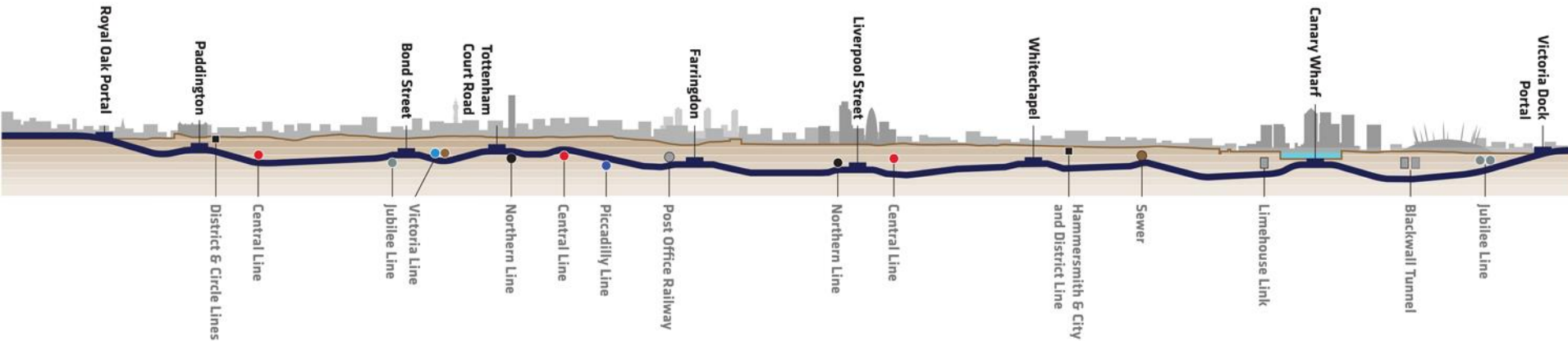
Tunnelling alignment – central section





One of the most complex infrastructure projects in London, with more than 40 construction sites across its route

ATKINS



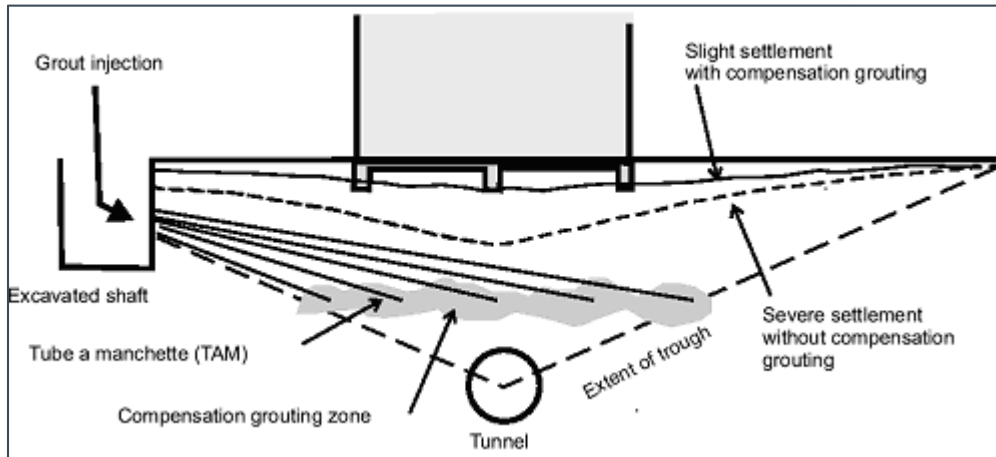
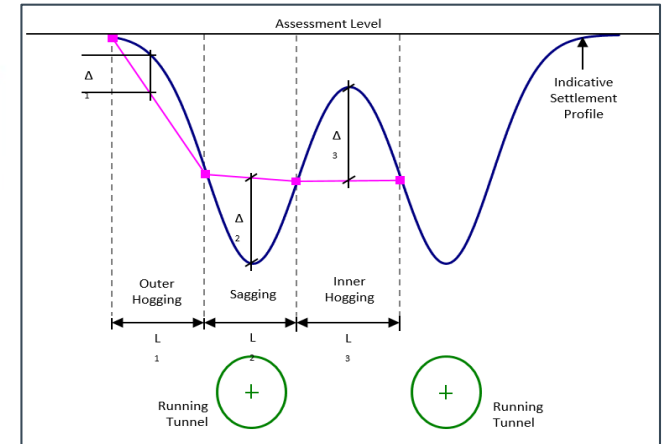
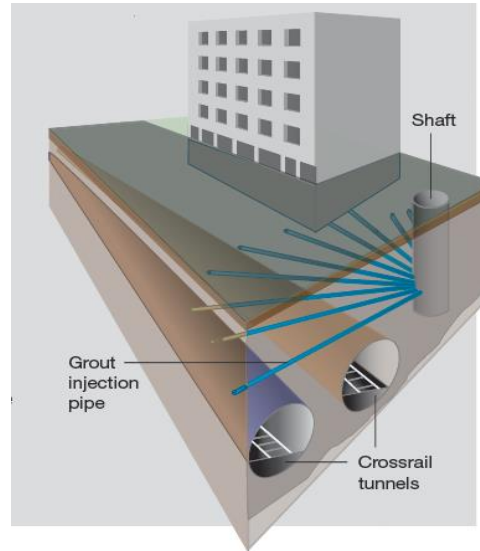
Atkins and Crossrail

Atkins, in partnership with Arup, produced the detailed design of Crossrail's twin-bore tunnels

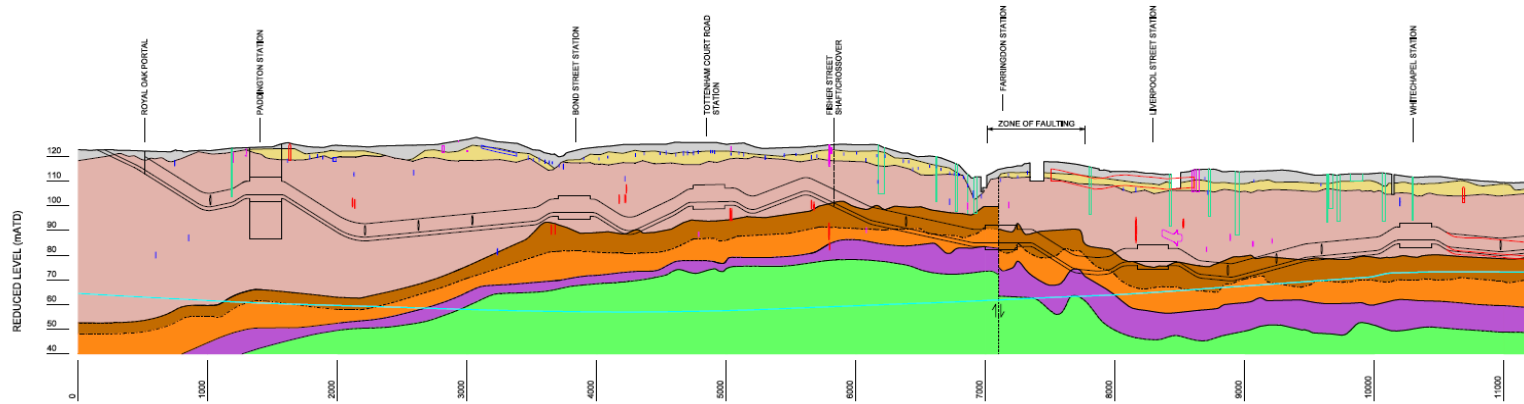
- Completion of 21km of twin bore (42km) tunnels
- Engineering and design of new stations
 - Tottenham Court Road
 - Custom House
 - Woolwich
- Atkins is also undertaking the architectural components work package
- More active role of designers through the construction phase.

Tunnelling: asset protection

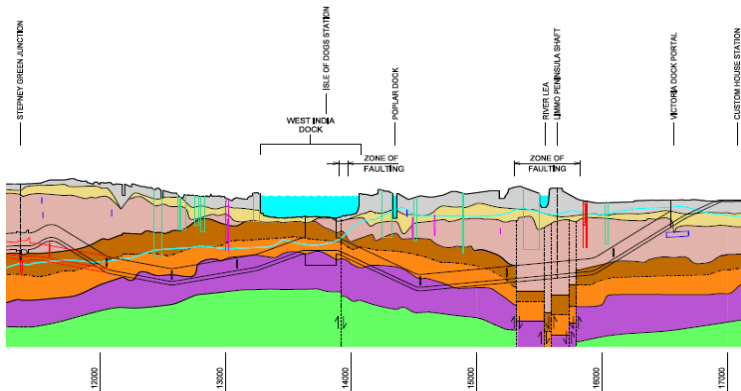
- 249 overground structures
- 3,284 buildings
- 669 heritage structures
- 370 underground structures
- 13,384 utilities



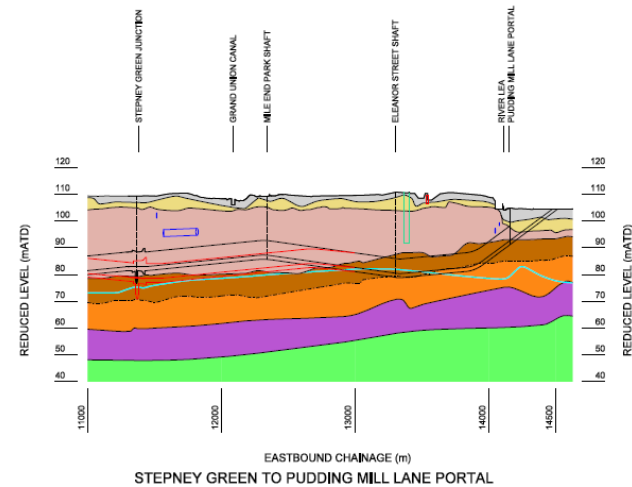
Tackling complex geology



Royal Oak to Stepney Green



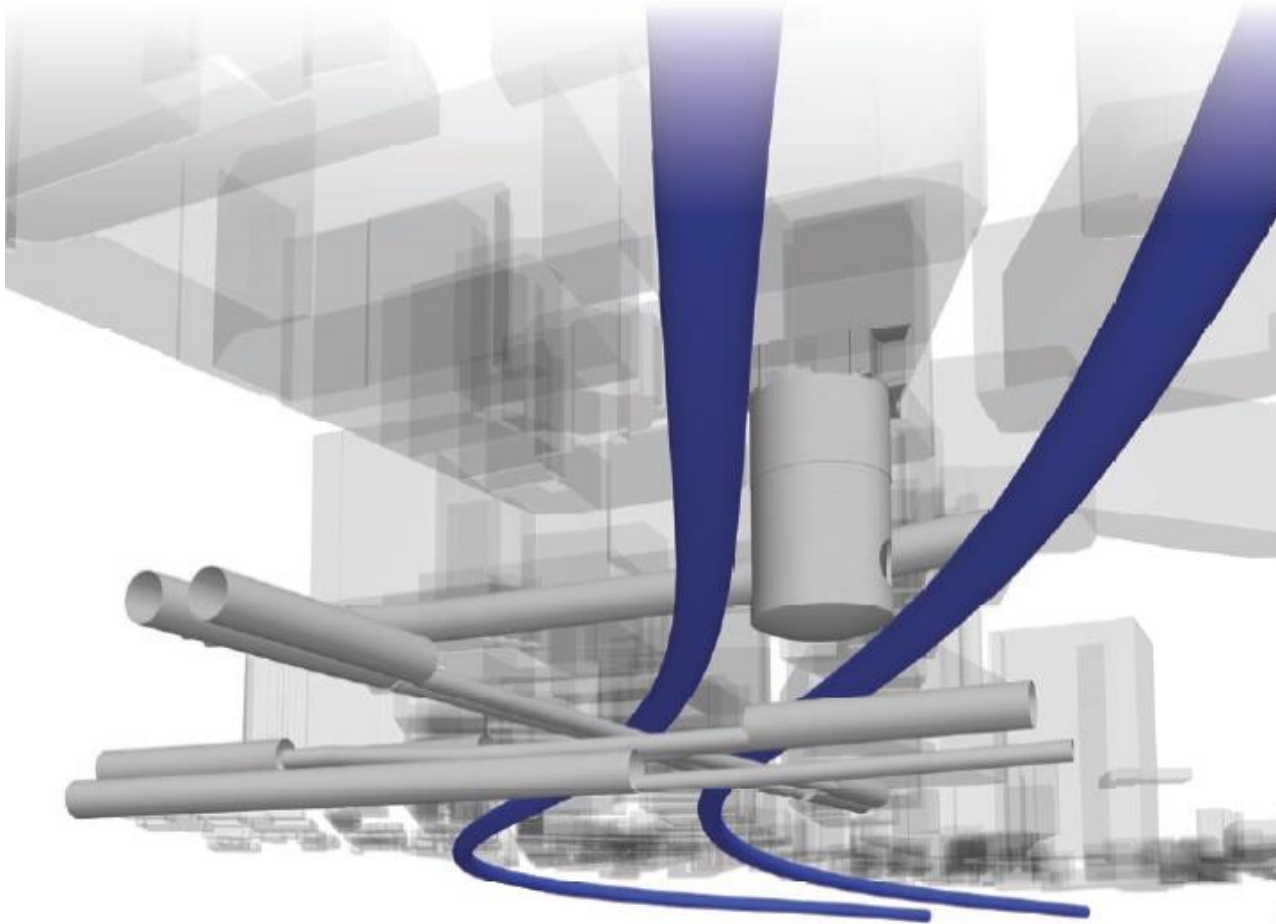
Stepney Green to Victoria Dock



Stepney Green to Pudding Mill Lane

Tunnelling

Navigating existing infrastructure



CAD visualisation of a typical section of the Crossrail route (in blue) showing the high geometrical constraints of tunnelling below central London.

The tunnel drives

Solving other technical challenges

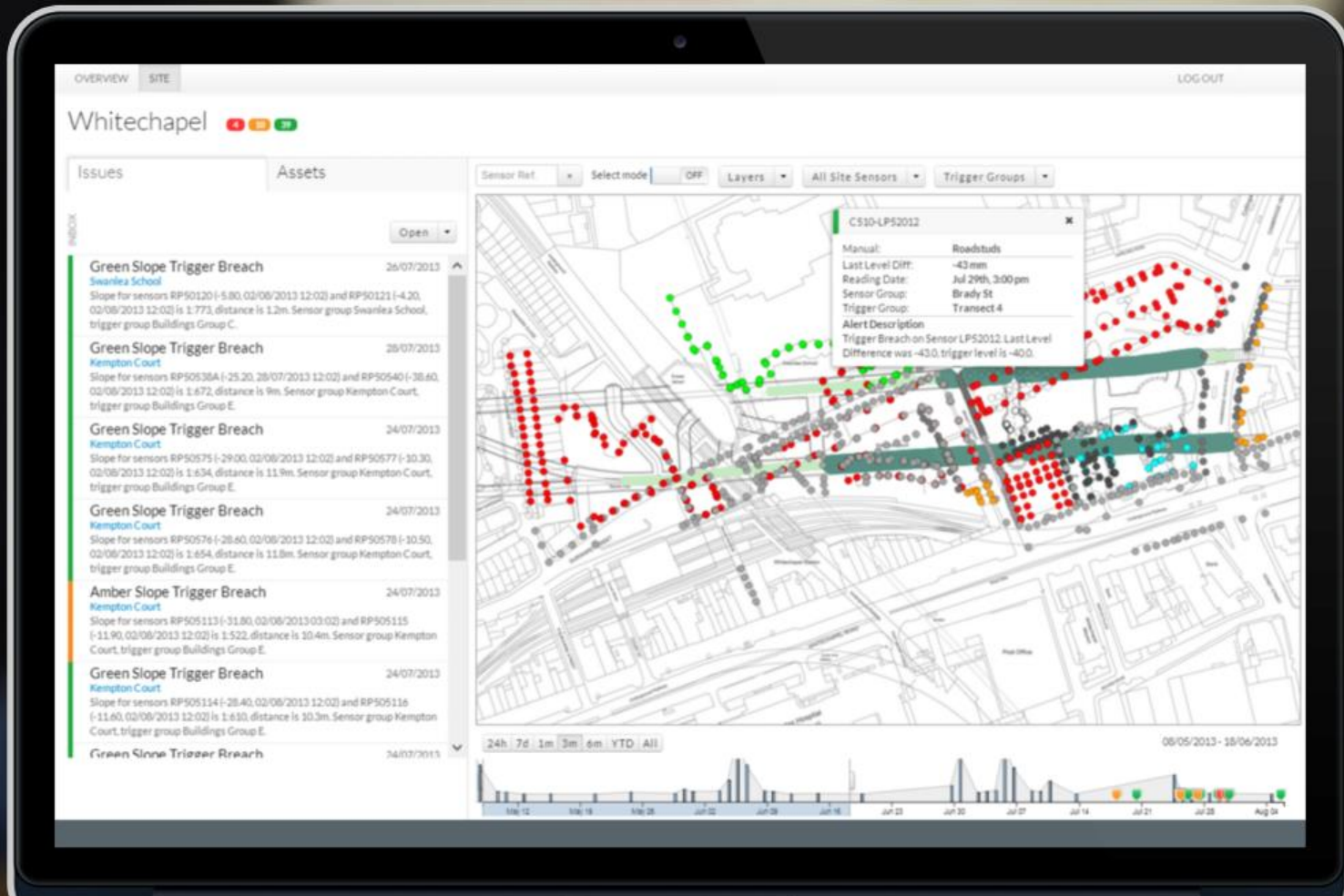
- Ground engineering: complex range of ground strata along the route required different types of tunnel boring machines, from London clay in the west to the more permeable, weaker strata such as Thanet Sands in the east
- Safe application of excavation methods including station caverns to minimise surface footprints
- Control of ground movements with extensive assessment of the impact on the hydrogeological regime and surface settlement
- Optimise tunnelling logistics – 3 million tonnes of excavated material was shipped to Wallasea Island in Essex to create a new 1,500 acre RSPB nature reserve.

Our use of technology

- **Materials technology** - tunnel linings advancing the state-of-the-art, fibre and polypropylene reinforced concrete
- **Risk management** - with the increasing complexity of large underground projects we have developed efficient ways of modelling ground movements and assessing the impact on surrounding assets.
- **Predictive analytics** - Quantum Black, Arup and Atkins developed AIM (adaptive instrumentation and monitoring), a web-based application using data with complex statistical analysis to understand spatial and time dependent correlation between monitoring points.

Simple web application

Combines powerful analytics with visual interpretation



Crossrail summary

- One of the most complex infrastructure projects in London in which Atkins has been involved for ten years
- Crossrail has driven a step-change in the way tunnelled infrastructure is designed and delivered
- Our experience on the project demonstrates the Group's differentiated offering and has helped secure other major infrastructure opportunities across the world.



International tunnelling market

Demand drivers increasing

- Soaring urbanisation
- Increasing transport demand
- Rapidly rising land prices
- Congestion and limited space for construction
- Cost (underground land is 'cheap'), reduced disruption

Growing need for innovative and complex underground infrastructure, be it:

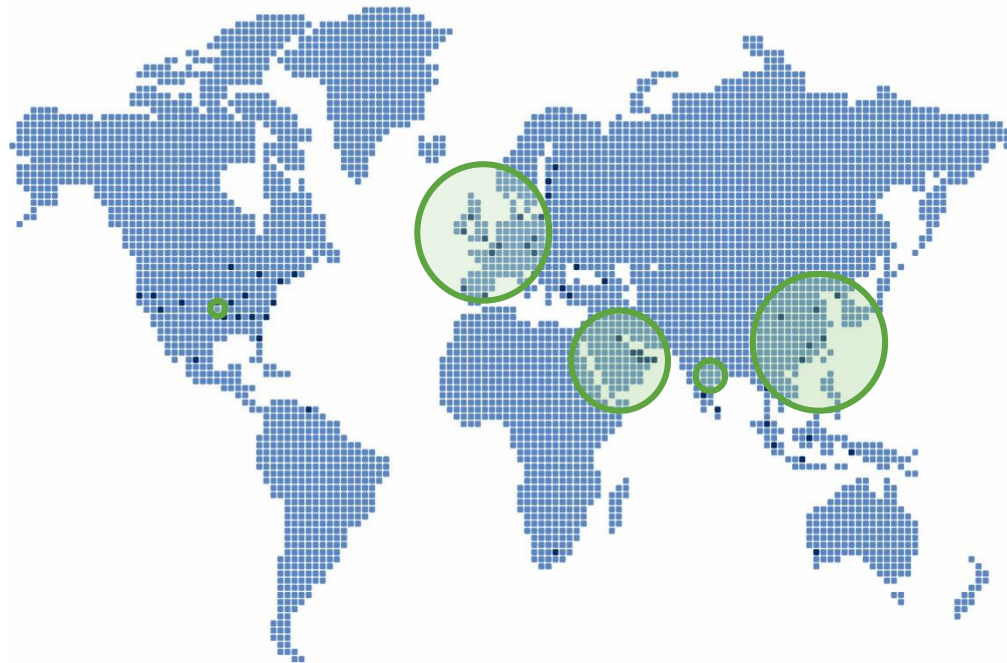
- Railways – high capacity metro systems combat congestion and spur economic development
- Roads
- Utilities, water and sewerage.

Attractive market characteristics

- High value consultancy work with significant technical barriers to entry
- Tunnel engineering capability is often the key to accessing a far greater scope of works
- Prestige of undertaking challenging projects of international significance
- Tunnel engineering is a key offering in “design and build” opportunities, allowing us to ‘piggy-back’ with contractors into new markets.

Our global tunnels team

- Core group of experts in London, Dubai/Doha and Hong Kong
- Significant network of tunnels people (around 200), more than half being overseas
- We are located where our historic and current clients are based
- Appointment of Atkins Fellow in tunnelling and technical network to share expertise.



Our experience

 **Tunnels around the world,
engineered, constructed or surveyed
by Atkins**

 We've built over
285km
of rail and metro tunnels
around the world



That covers the same distance
as placing **34,000** London
buses end to end!

 In total, we've
been involved in over
780km
of tunnelling projects
around the world

Over **5 million** dollar bills
placed end to end would
cover the full length of the
tunnels we've worked on
around the world!



 It would take over

1,350
Airbus A380s lined
up nose to tail to fill
all our water tunnels
around the world!



Our clients and their projects

	Clients	Projects	Atkins' roles
Type	• Project owners (eg MTR Corporation, CrossRail) • International contractors (eg Samsung, CRCC, Obayashi, Vinci) • Others (eg lenders, 3rd parties)	• Metro • Railway • Water • Utilities • Highways	• Scheme design • Design and supervision • Contractor's detailed design • Advisory services
Trend	More than half of our global tunnel work is for contractors Long term relationships with international contractors are becoming more important.	Increasing global tunnels need, particularly metro and water tunnels Project sizes increasing	Increasing trend for more Design & Build engagement as lead designer to the contractor.

Dubai Metro

Atkins provided full multidisciplinary design and management of the civil works on Dubai Metro which included geotechnical and site investigations, bored tunnels and viaducts and bridges. The first line of the Dubai Metro opened to the public in September 2009. It is the longest automated, driverless system in the world.



Riyadh Metro

Atkins is the lead consultant for the detailed design for the FAST contracting consortium. Package 3 comprises lines 4,5 and 6. When complete, there will be approx. 26km of twin track tunnel about half of which will be driven by tunnel boring machines.



West Island Line, Hong Kong

Atkins (in a joint venture) is the lead consultant for the detailed design of this 3km section of the extension to the MTRC West Island Line. There are two stations at Sai Ying Pun and University, both of which will be constructed in cavern. The scope involved tunnelling in soft ground under existing buildings in close proximity to their foundations.



Liantang – Heung Yuen Wai boundary

One of the largest TBM in the world (14 metre diameter) earth pressure balance tunnel boring machine and the largest in Hong Kong is on site at the Liantang-Heung Yuen Wai boundary crossing point. We are the designers for the contractor.



I-70 twin tunnels, Colorado

Atkins provided construction management on the project to widen eastbound Interstate 70 to accommodate three traffic lanes, build a new bridge and 1.6 miles of retaining walls. I-70 is one of North America's major east-west transportation corridors.



Current and pipeline projects

- High Speed 2
- Thames Tideway Tunnel
- London's Silvertown Tunnel
- Crossrail 2
- EXPO 2020 extension to Dubai Metro
- Mecca Metro
- Jeddah Metro

Our Crossrail experience has driven a step-change in the way tunnelled infrastructure is designed and delivered.

Summary

Summary

- There is a growing need for innovative and complex underground infrastructure
- Tunnelling projects offer high value consultancy work with significant technical barriers to entry
- The pipeline for future tunnelling work is strong
- With our global expertise (centred in London, Middle East and Asia Pacific) and experience we are well positioned in this market going forward.



Disclaimer

The information in this presentation pack, which does not purport to be comprehensive, has been provided by Atkins and has not been independently verified. While this information has been prepared in good faith, no representation or warranty, express or implied, is or will be made and no responsibility or liability is or will be accepted by Atkins as to or in relation to the accuracy or completeness of this presentation pack or any other written or oral information made available as part of the presentation and any such liability is expressly disclaimed. Further, whilst Atkins may subsequently update the information made available in this presentation, we expressly disclaim any obligation to do so

The presentation contains indications of likely future developments and other forward-looking statements that are subject to risk factors associated with, among other things, the economic and business circumstances occurring from time to time in the countries, sectors and business segments in which the Group operates. These and other factors could adversely affect the Group's results, strategy and prospects. Forward-looking statements involve risks, uncertainties and assumptions. They relate to events and/or depend on circumstances in the future which could cause actual results and outcomes to differ materially from those currently expected. No obligation is assumed to update any forward-looking statements, whether as a result of new information, future events or otherwise.