

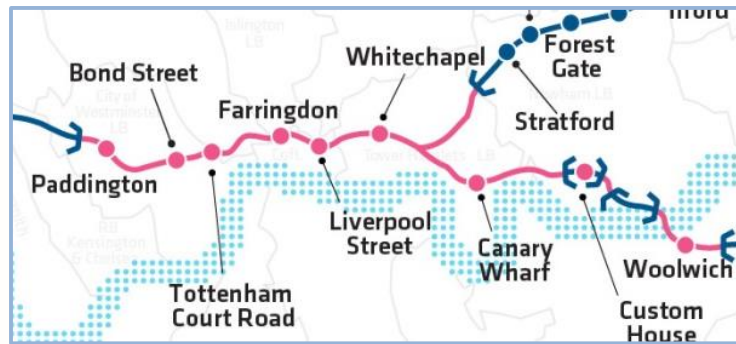


# ◀ Crossrail MOVING LONDON FORWARD

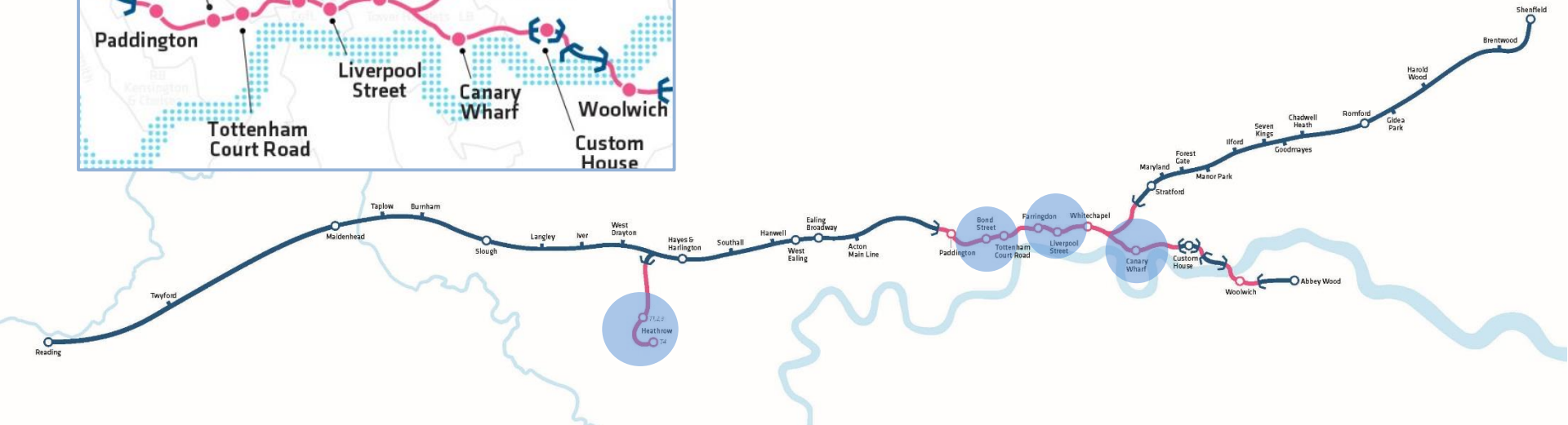
◀ Ilkley U3A Talk – 6<sup>th</sup> March 2018

◀ Danny Fox, Deputy Director Operations

# Elizabeth line – London's RER, S Bahn



## ► High Capacity Metro Railway



**£14.8bn**  
cost

**£42bn**  
net benefit

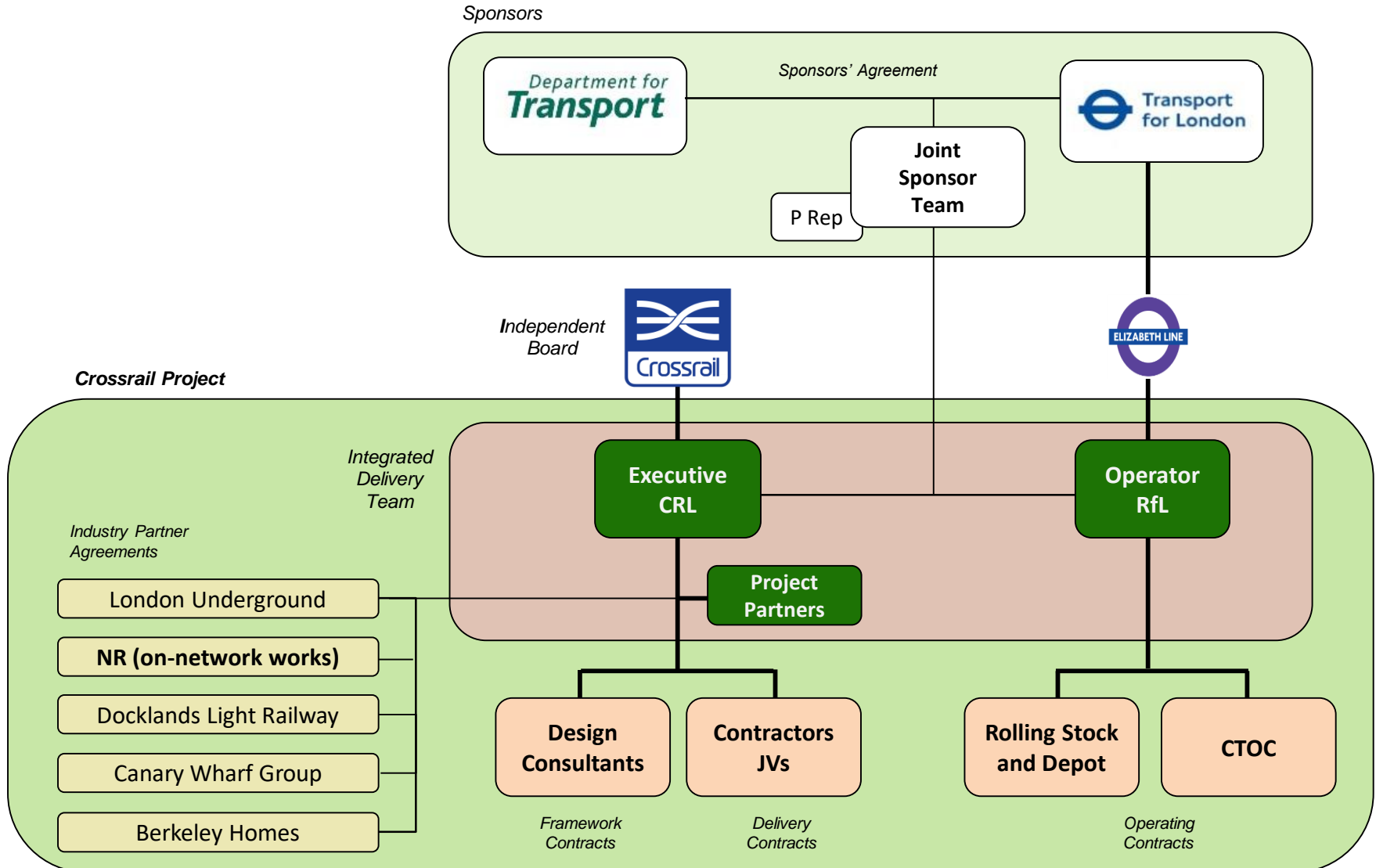
**118 km**  
length

**40 (10 new)**  
stations

**24**  
Trains/hour

**200m**  
journeys pa

# Governance Model



# Funding Model



## Local Government

TfL direct funding £1.9bn

Funding for which TfL is responsible  
£5.25bn

Business rate supplement, borrowing and direct contribution £4.1bn

Community infrastructure levy £300m

Sale of surplus land and property £500m

Developer contributions £300m



Direct Grants

Private Sector Funding



£14.8bn

## Central Government

DfT direct funding £4.8bn

Funding for which DfT is responsible  
£480m

City of London committed funding £250m

Heathrow airport Limited £70m\*

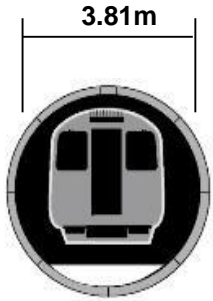
Network Rail financing for work on the existing network £2.3bn

Voluntary funding for London businesses £100m

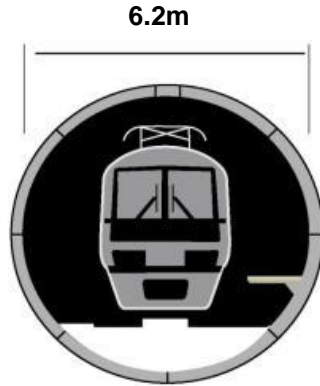




# The Challenge



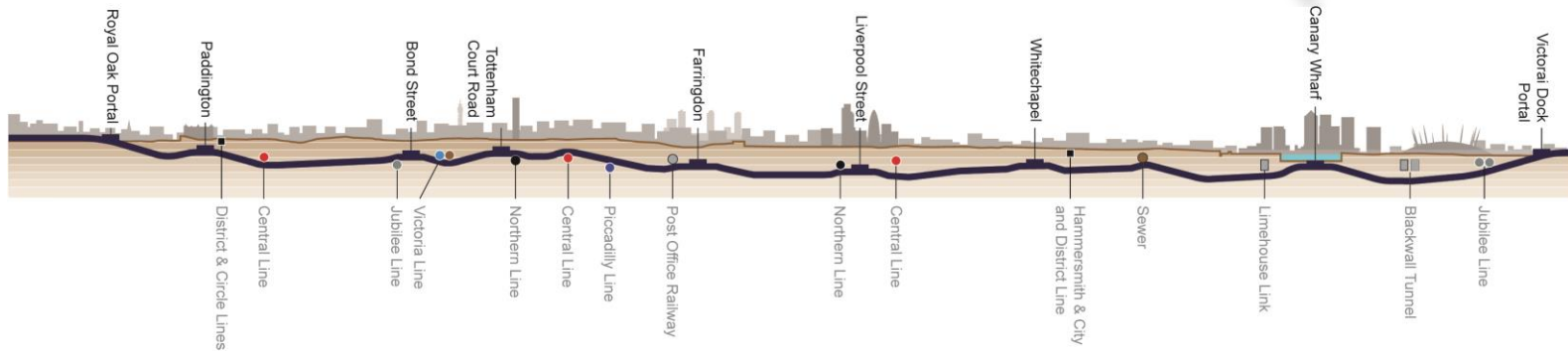
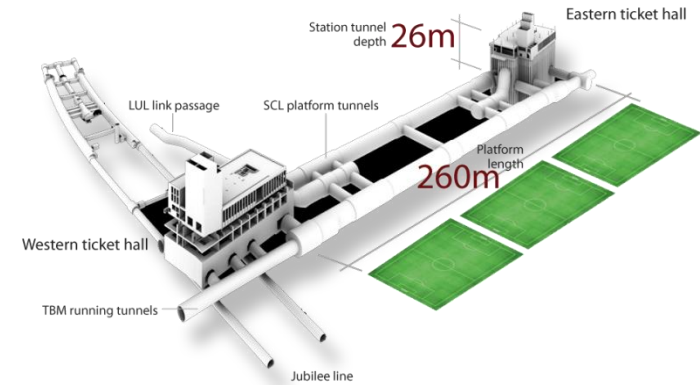
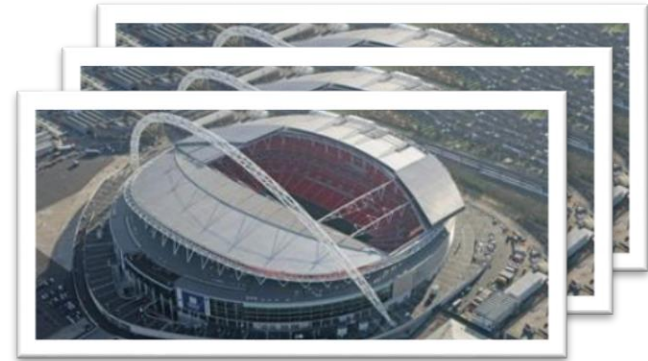
VICTORIA LINE



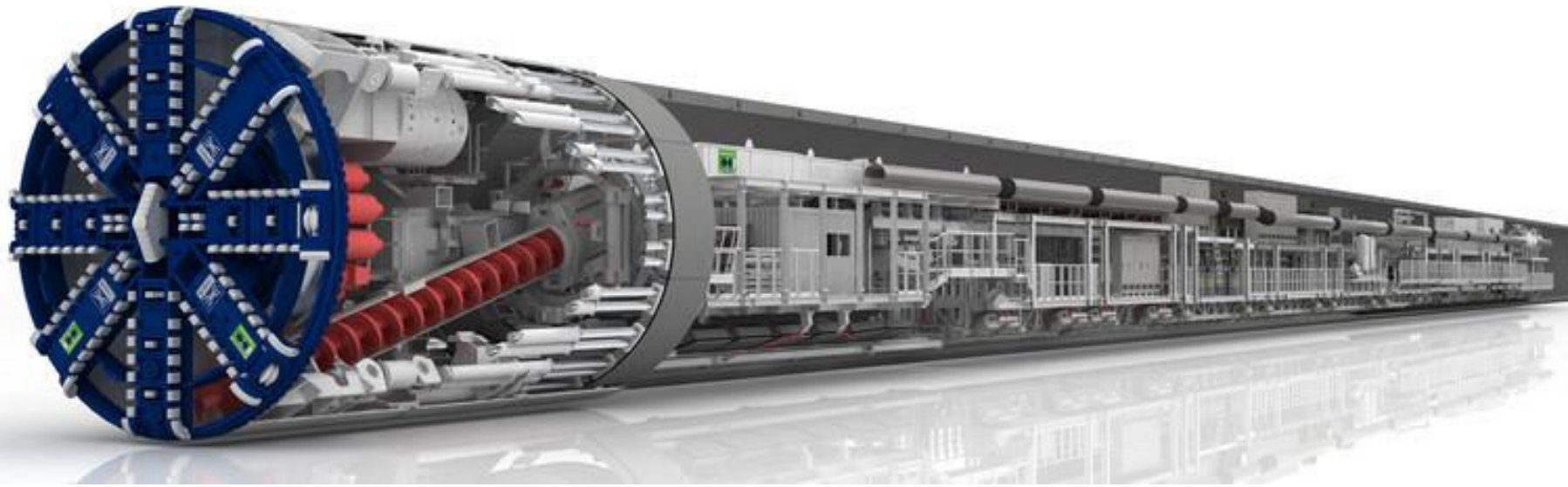
CROSSRAIL

- 250,000 concrete segments
- 400,000 tonnes of steel
- 1.6 million<sup>3</sup> meters of concrete
- 8 TBMs

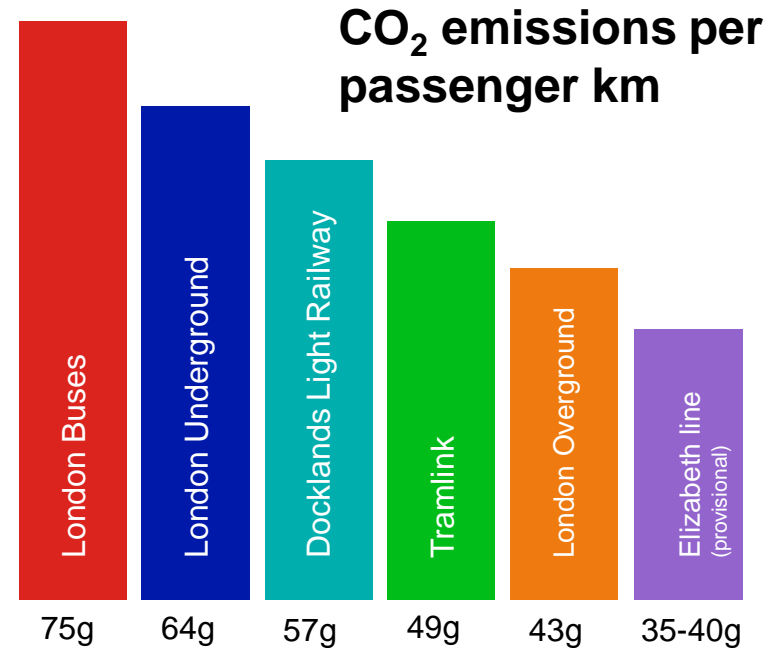
200m long trains



# TBM's and TBM Tunnelling



# Environment



**7.9**

million tonnes of material excavated during construction



**98%**

of excavated material beneficially reused

**11% CO<sub>2</sub>**

saving during construction against baseline emissions

**84%**



construction machinery in central section fitted with emissions controls, reducing air pollutants



OVER 10,000 items spanning 55 million years unearthed across 20 sites



- ◆ 9 Underground Lines
- ◆ Thameslink
- ◆ London Overground
  
- ◆ National Rail
  - ◇ Reading
  - ◇ Ealing Broadway
  - ◇ Paddington
  - ◇ Farringdon
  - ◇ Liverpool St
  - ◇ Stratford
  - ◇ Shenfield
  - ◇ Abbey Wood

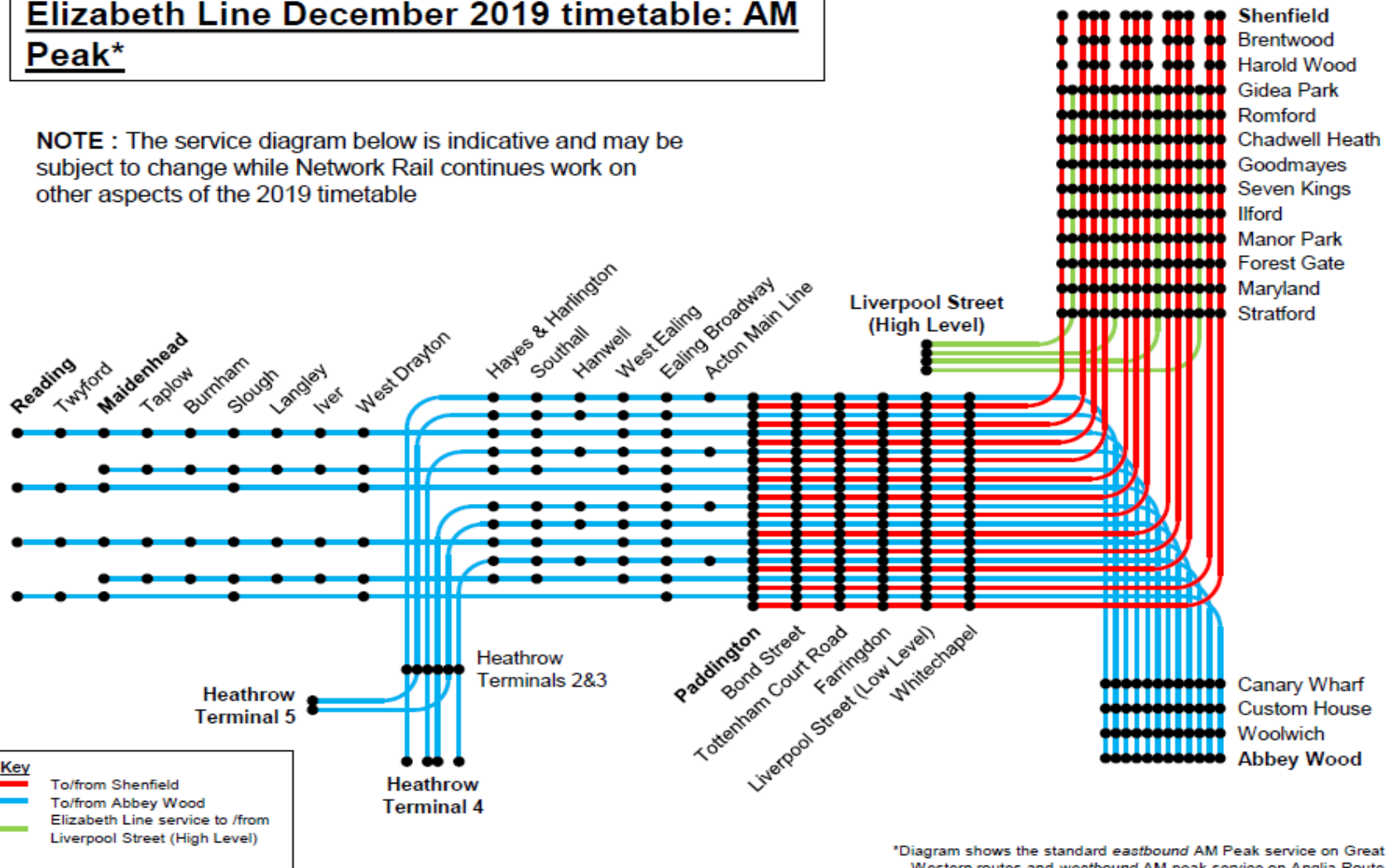


# The Product



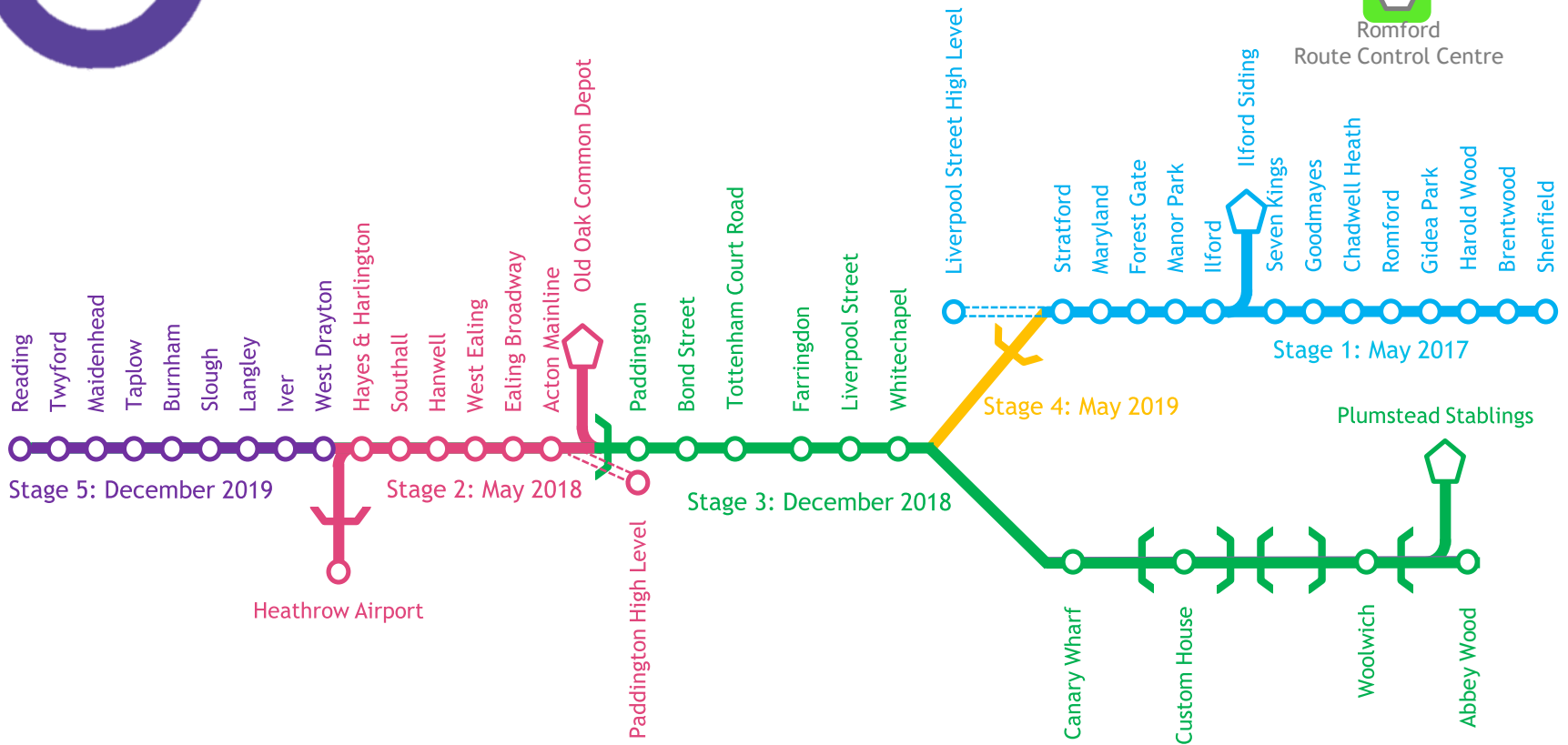
## Elizabeth Line December 2019 timetable: AM Peak\*

**NOTE :** The service diagram below is indicative and may be subject to change while Network Rail continues work on other aspects of the 2019 timetable



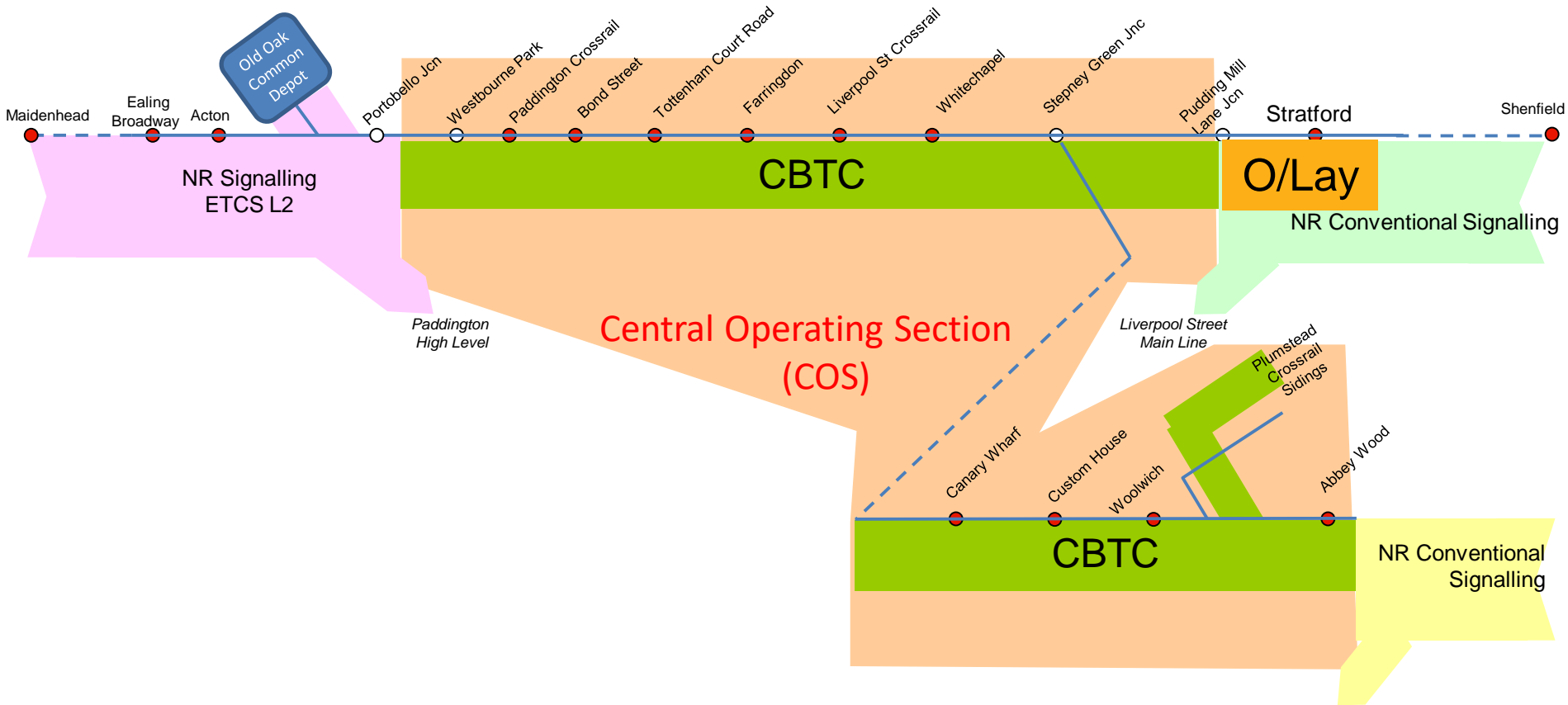
\*Diagram shows the standard eastbound AM Peak service on Great Western routes and westbound AM peak service on Anglia Route

# A Phased Approach





# Three Signalling Systems



# All Change



# Building a New Team

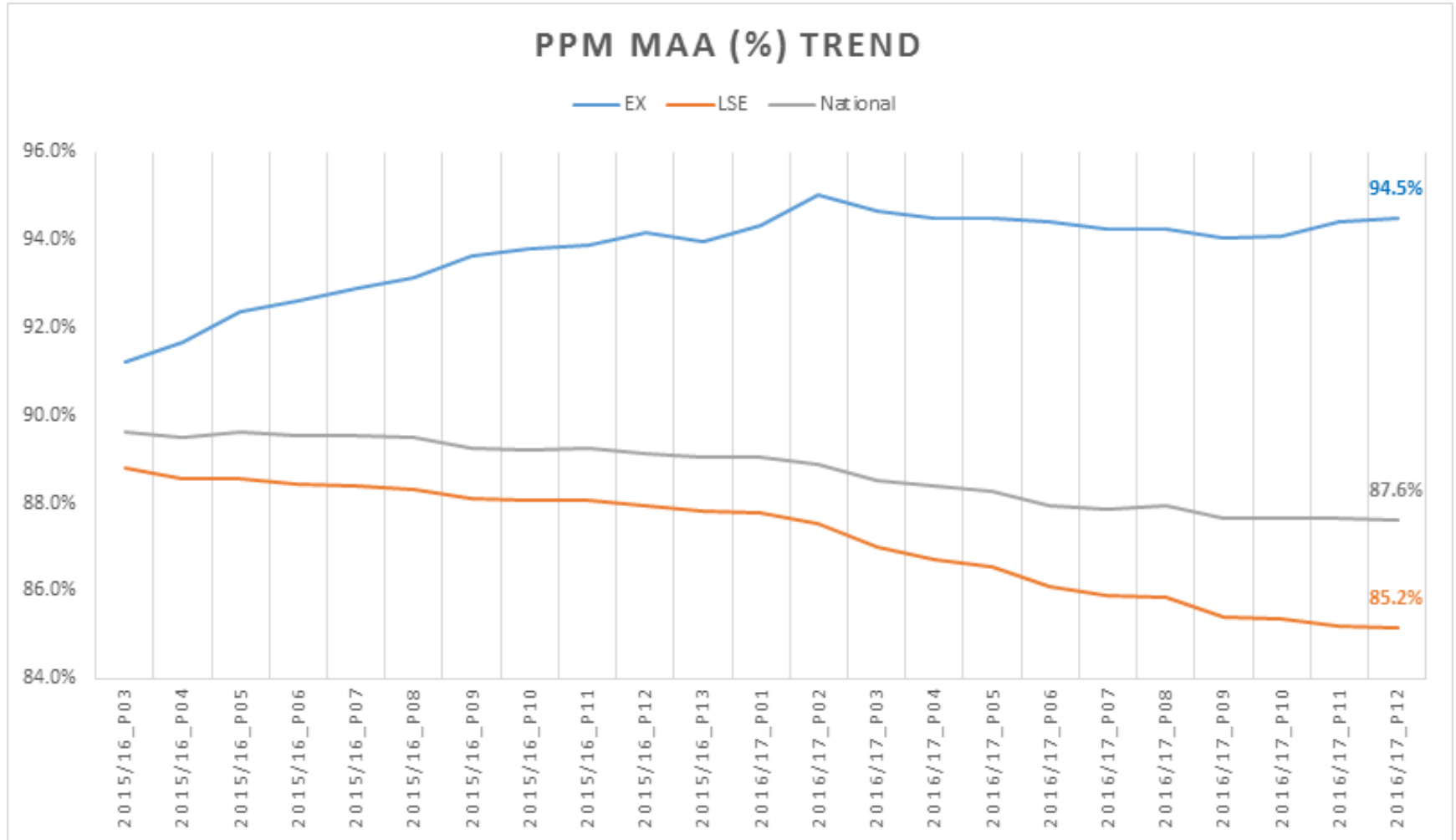




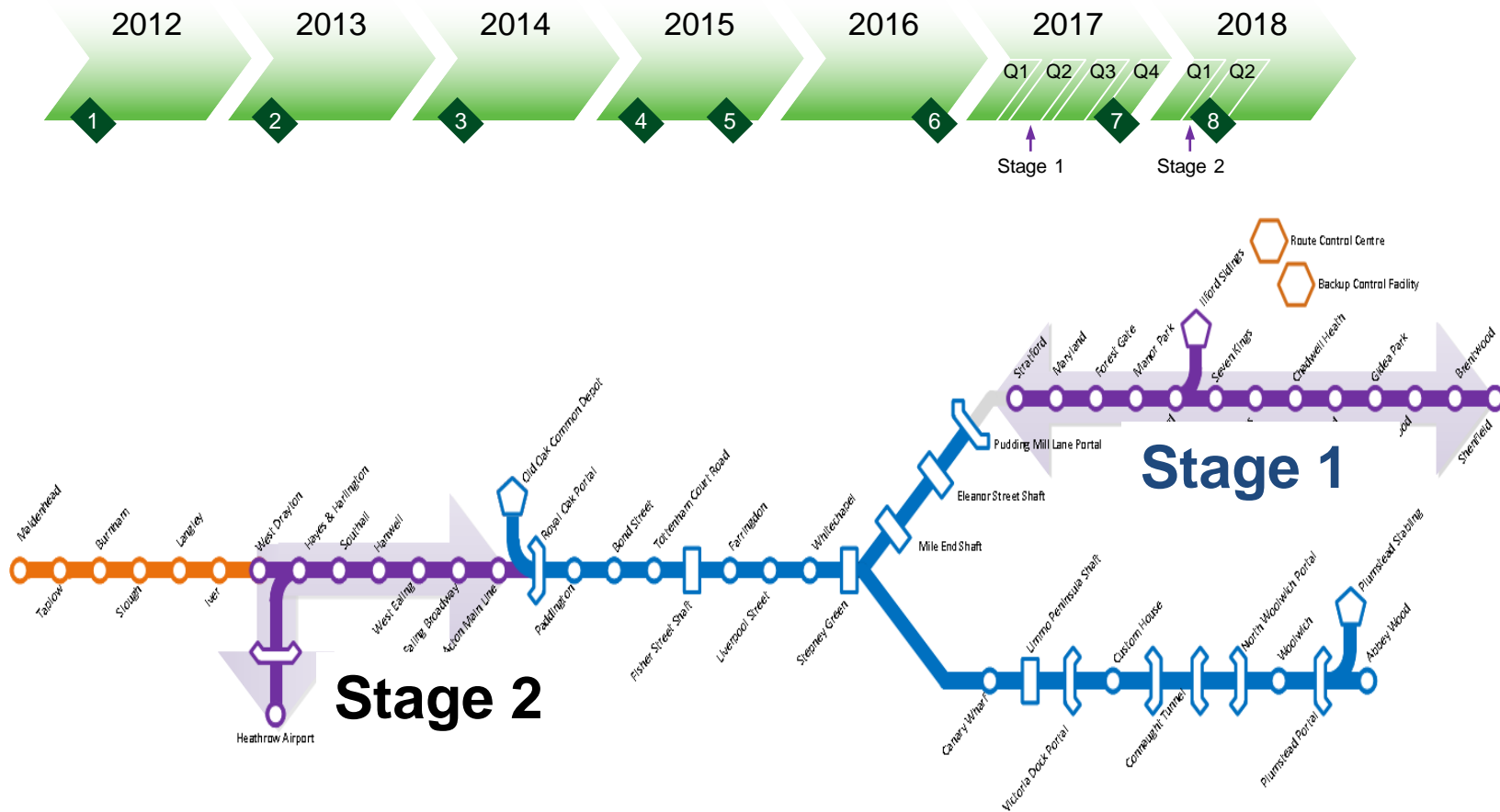
# 'One Liverpool Street' ...and Stratford



# Getting It Right



# Going Through the Gears



- ▶ **Stage 1: May 2017 – New Trains Shenfield – Liverpool St**
- ▶ **Stage 2: May 2018 - Heathrow to Paddington - surface**





# The Elizabeth Line





# Tunnelling





# Vital Training

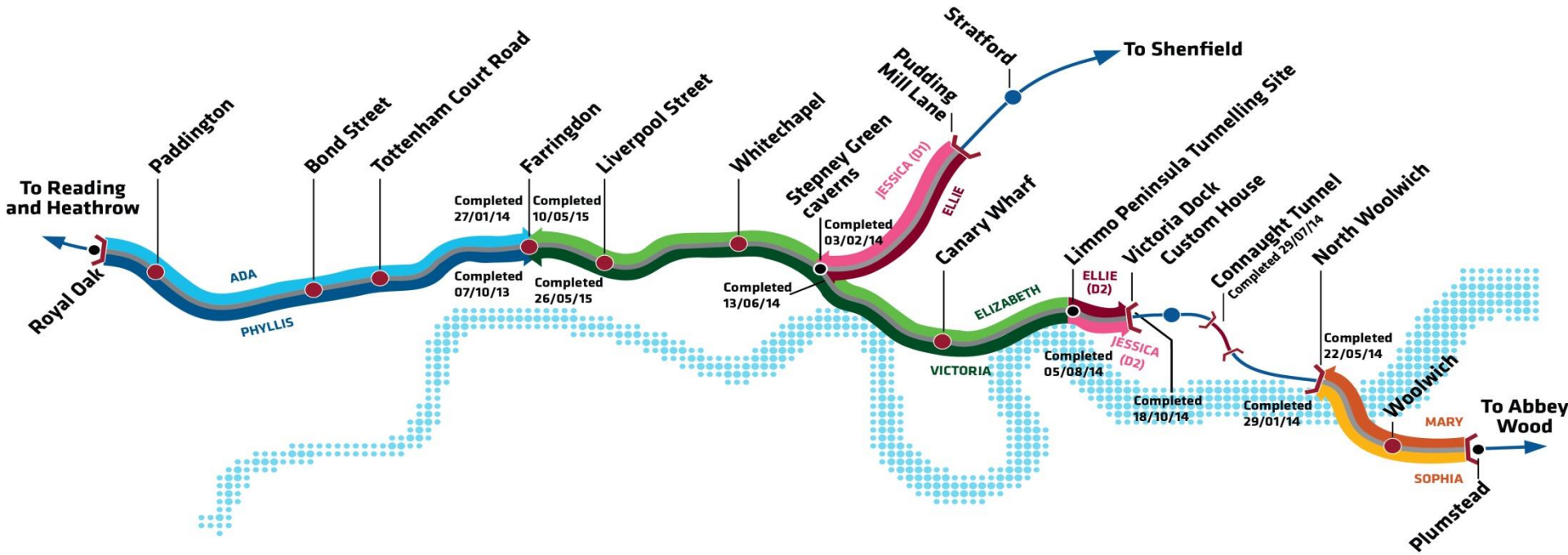


# Mock PSDs and Tunnel





# Tunnelling - Complete





# Track





# Stepney Green



# Track Complete



# Major Engineering Work



- Maidenhead Sidings
- Stockley Flyover
- Hayes & Harlington bay platform
- West Ealing bay platform
- Old Oak Depot
- Portobello Junction
- Plumstead Sidings
- Liverpool St
- Pudding Mill Lane Junction
- Ilford Depot
- Gidea Park Sidings
- Shenfield

# Stations - Abbey Wood





# Abbey Wood





# Abbey Wood





# Stations – East





# Stations – West



# The first station





# TCR





# Paddington: A Cloud Index



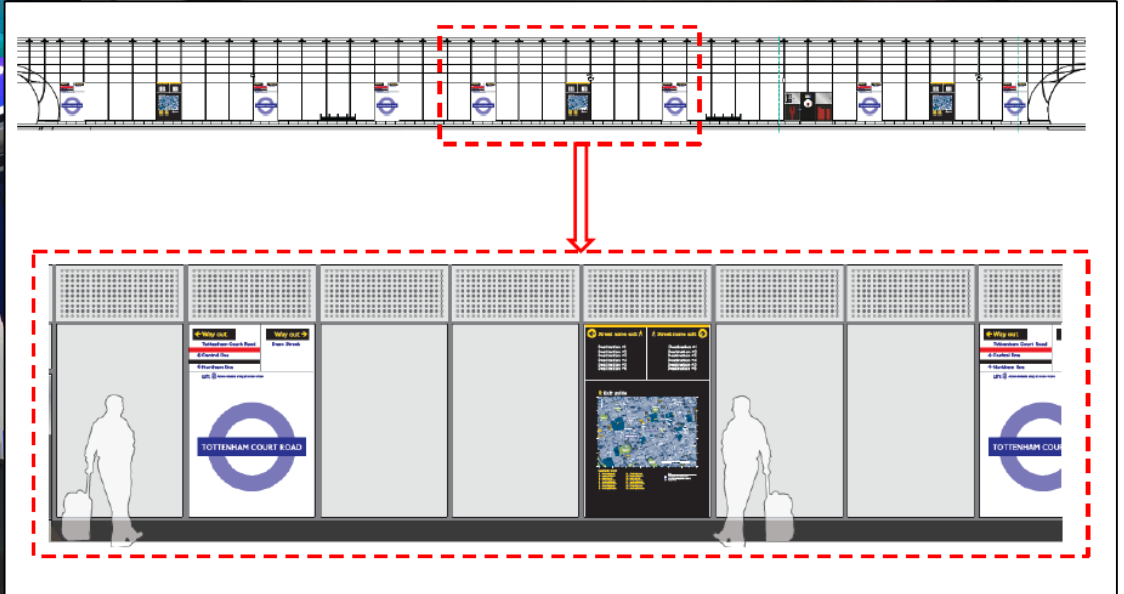


# Stations - Central

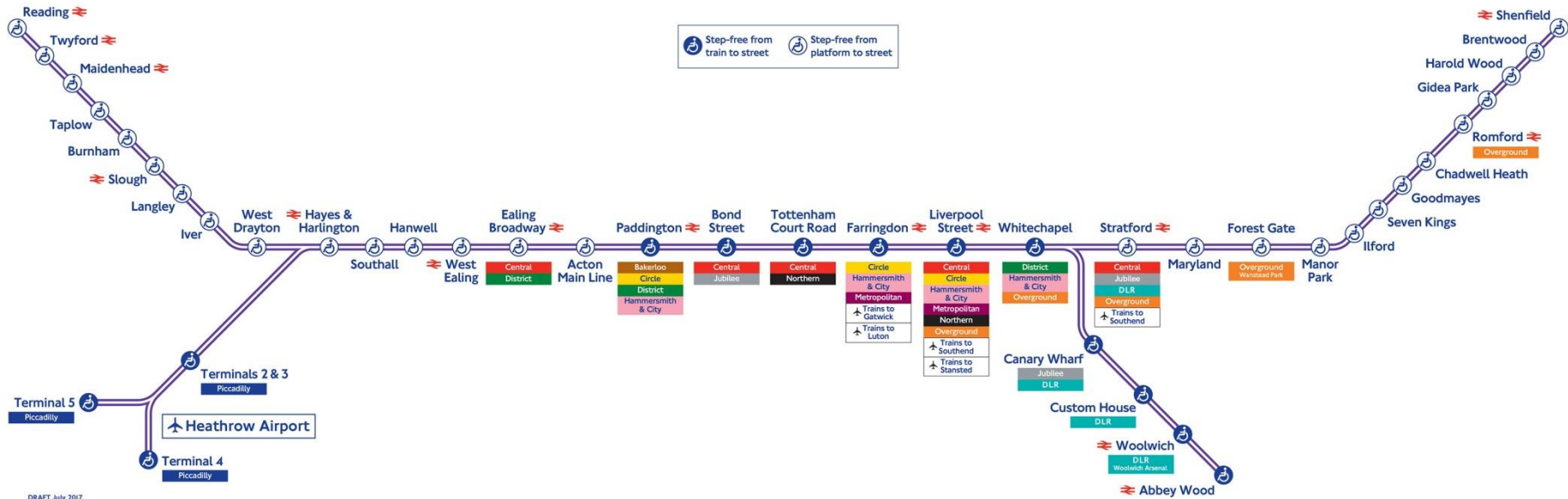




# Elegance and Function



# The Product

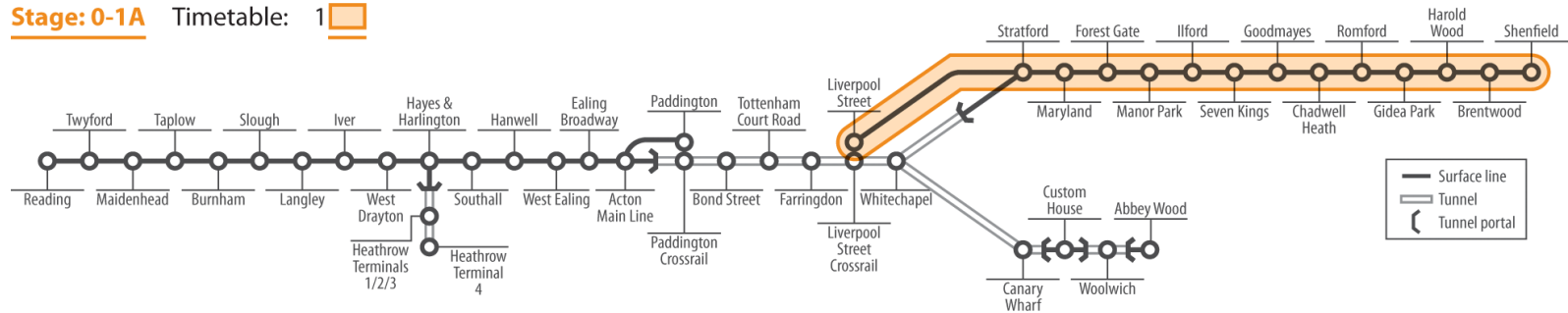




# Stage 1 - May 2017

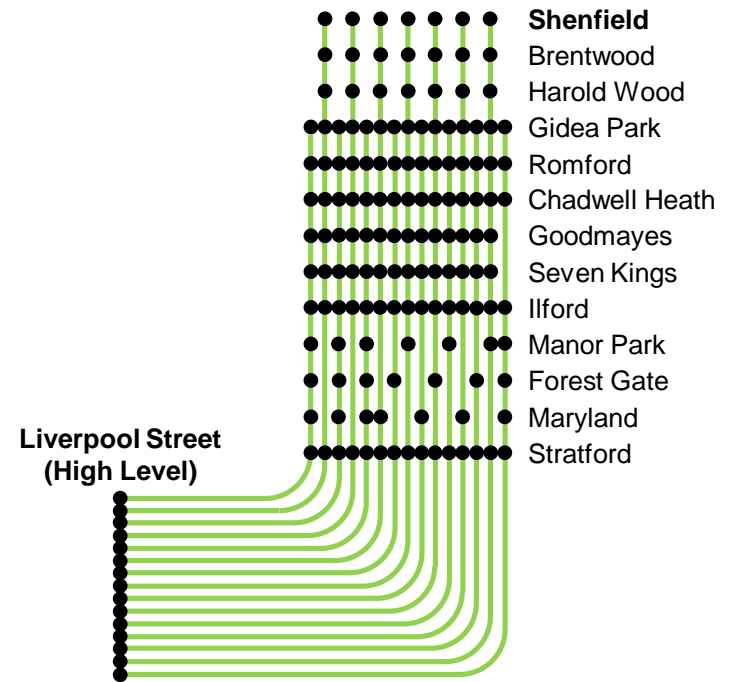


Stage: 0-1A Timetable: 1 



Introduction of class 345 units on 11 SX diagrams out of 20 to the current timetable.  
Possible additional peak trains in December 2017 using 2 driver training class 345 units.  
Weekend service can be resourced entirely with class 345 units

# Stages 0-1A (May 2015 to May 2018): Peak\*



## Key

- To/from Shenfield
- To/from Abbey Wood
- Residual service to/from Liverpool Street (High Level)
- Residual service to/from Paddington (High Level)

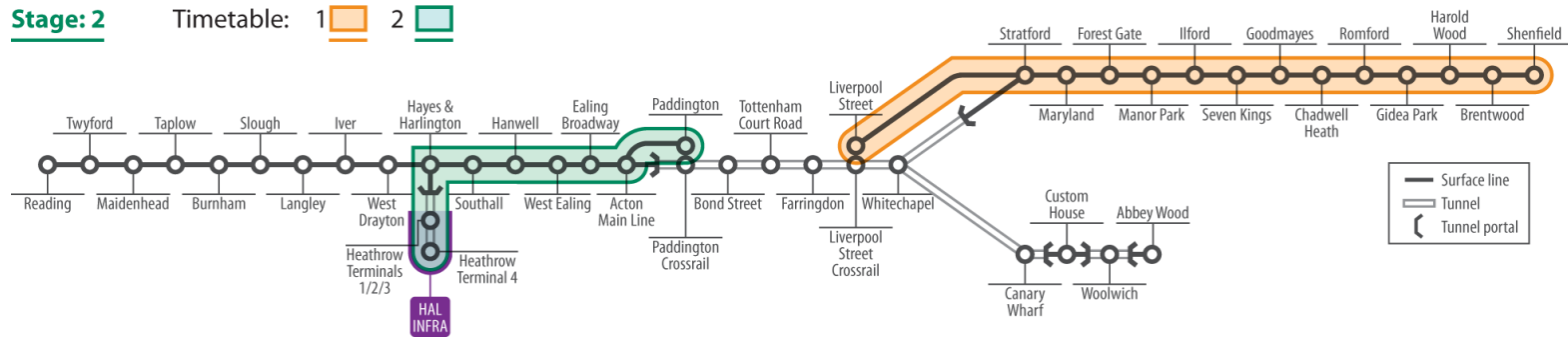
\*WTT arrivals at Liverpool Street 0800-0859

# Stage 2 – May 2018

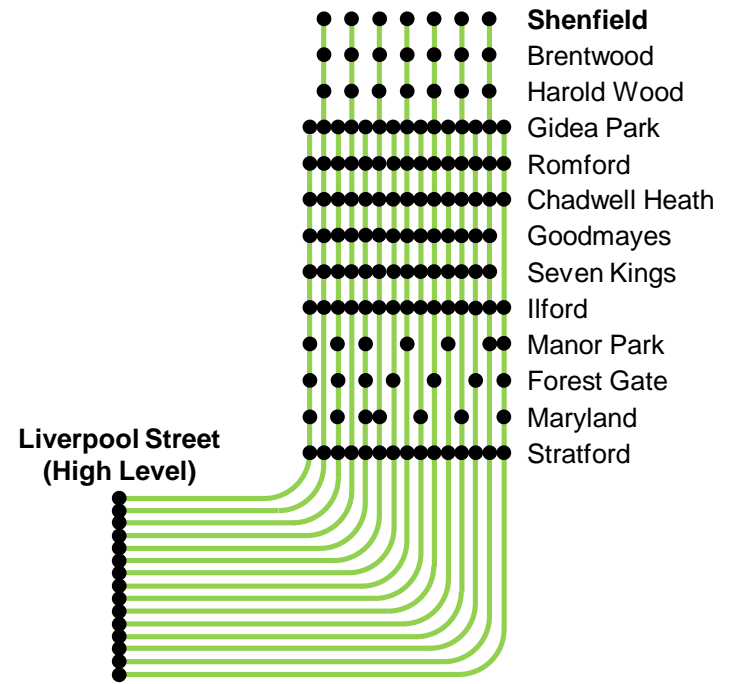
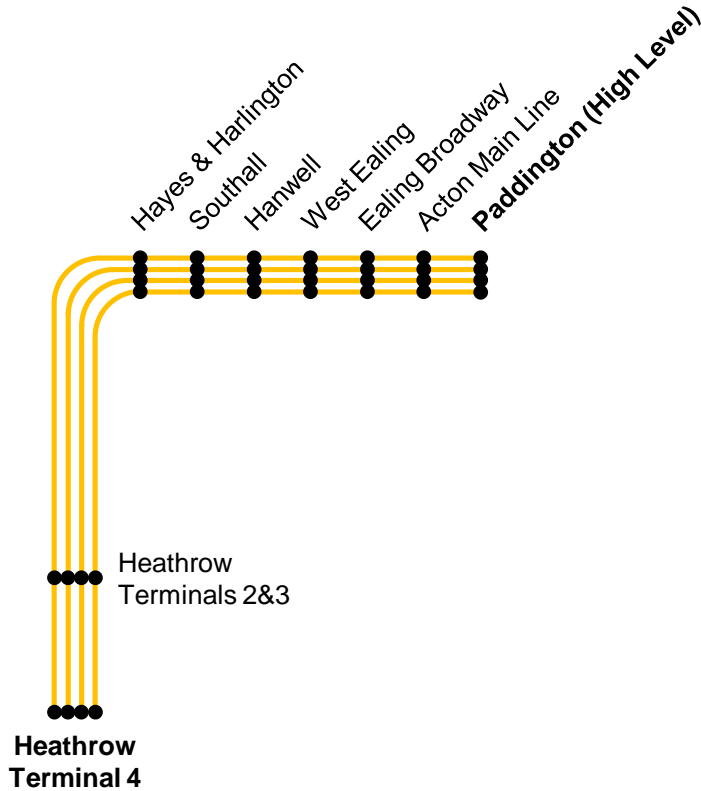


## Stage: 2

Timetable: 1  2 



# Stage 2 (May 2018 to December 2018): Peak\*

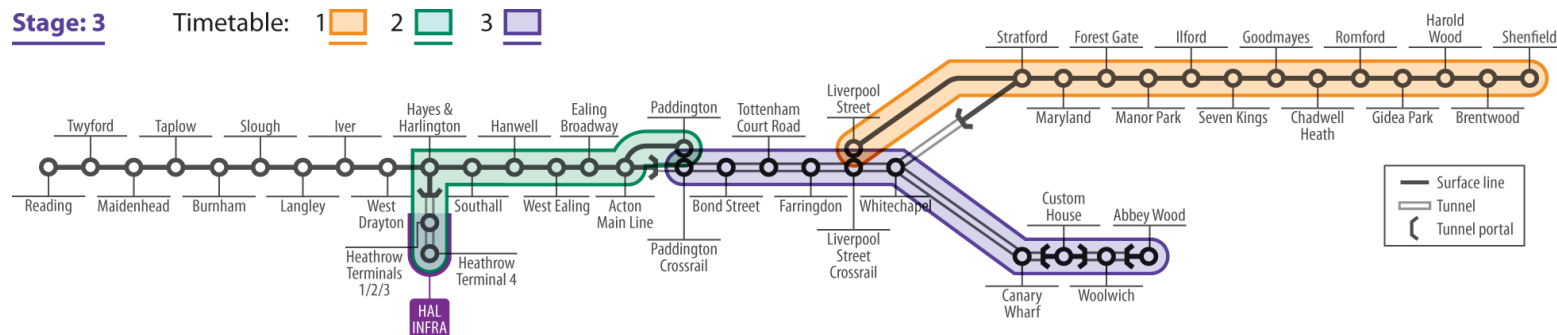


## Key

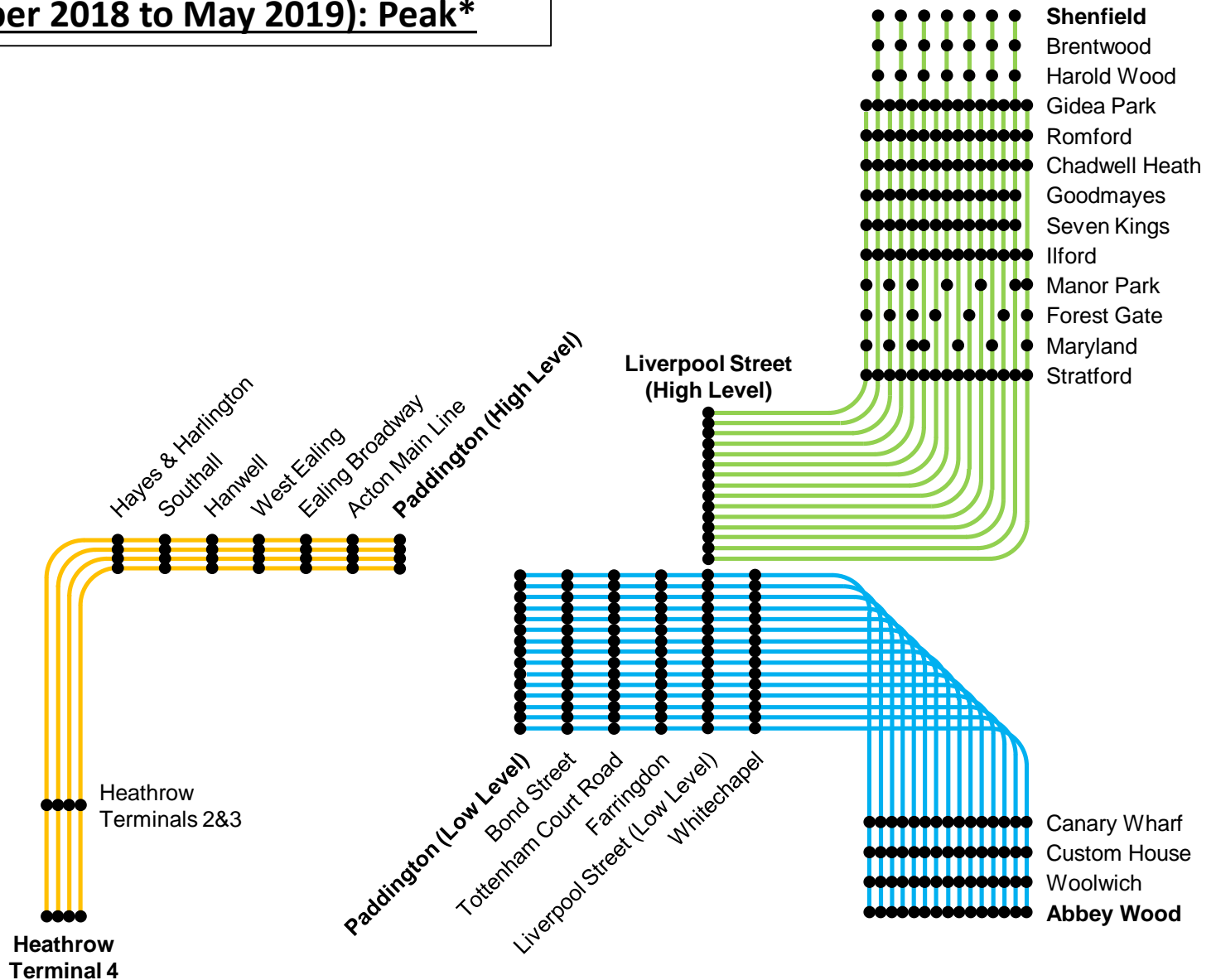
- To/from Shenfield
- To/from Abbey Wood
- Residual service to/from Liverpool Street (High Level)
- Residual service to/from Paddington (High Level)



# Stage 3 – December 2018



# Stage 3 (December 2018 to May 2019): Peak\*



**Key**

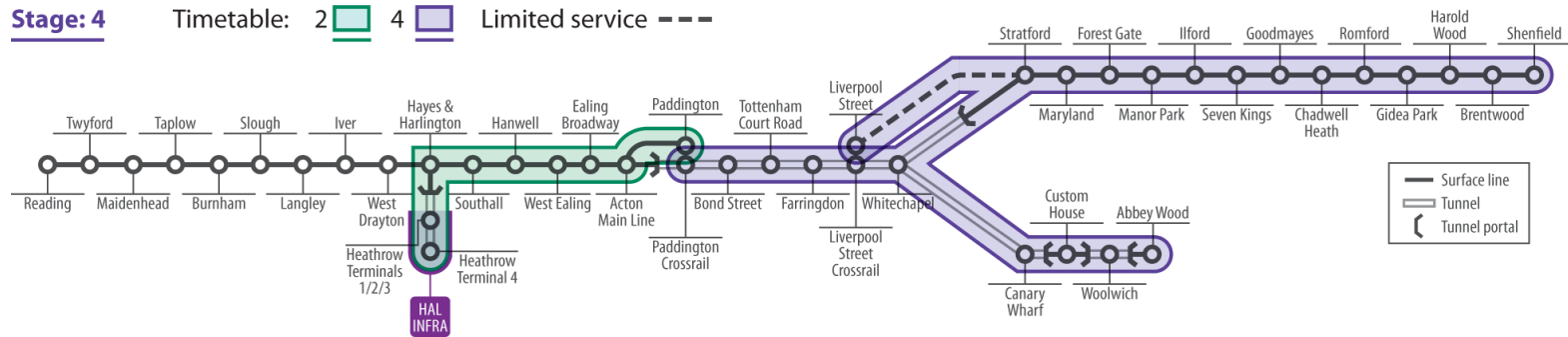
- To/from Shenfield
- To/from Abbey Wood
- Residual service to/from Liverpool Street (High Level)
- Residual service to/from Paddington (High Level)

\*WTT arrivals at Liverpool Street 0800-0859

# Stage 4 – May 2018

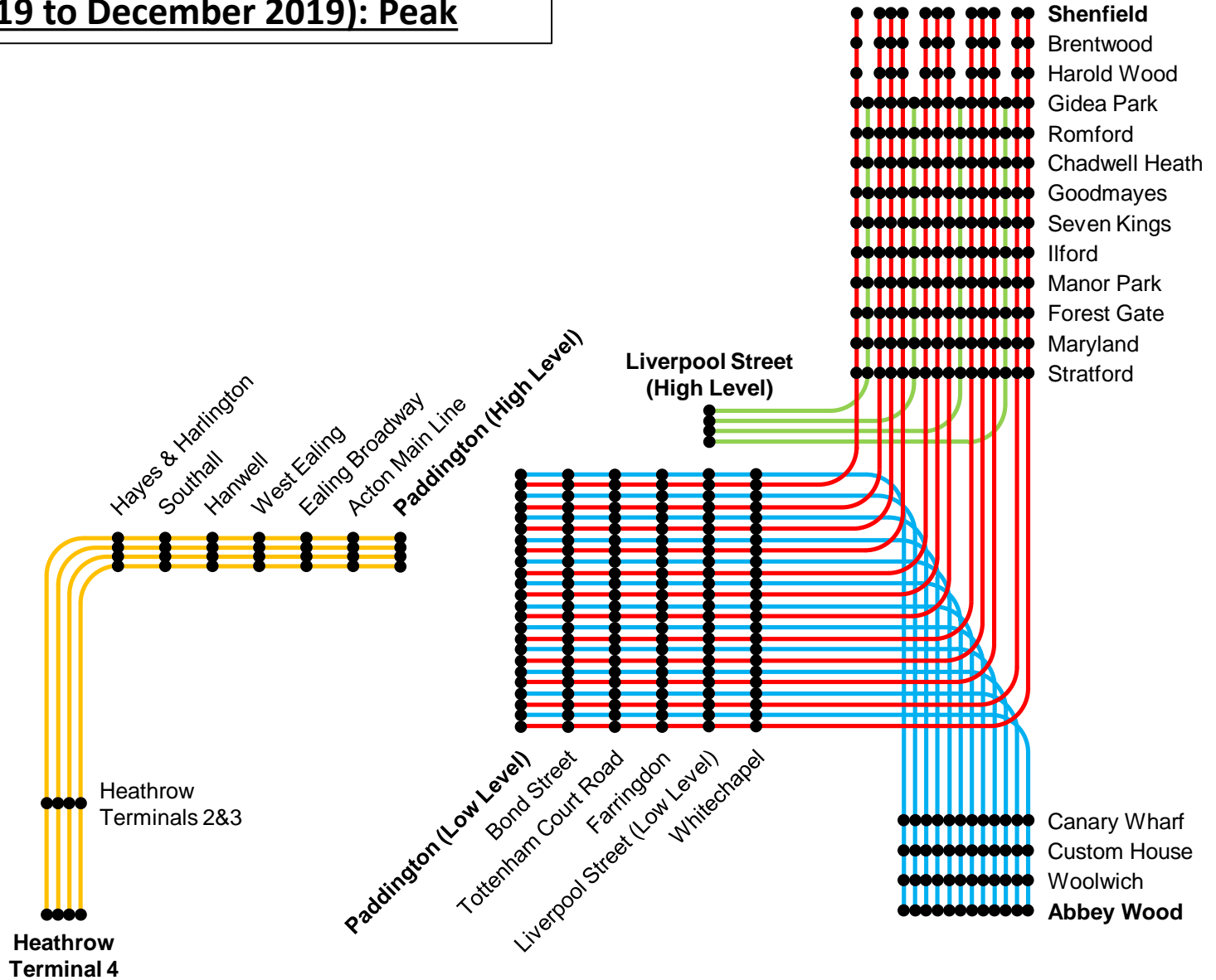


Stage: 4 Timetable: 2 4 Limited service - - -






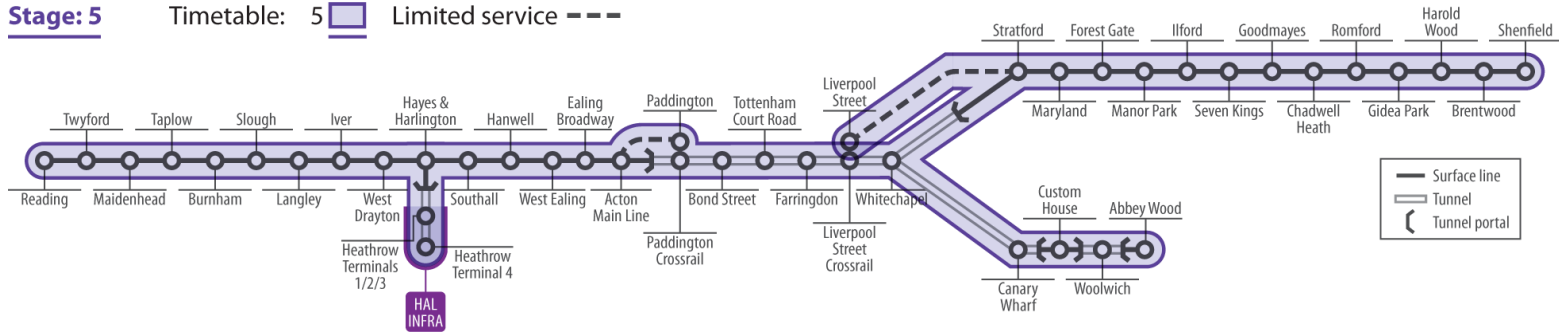
# Stage 4 (May 2019 to December 2019): Peak



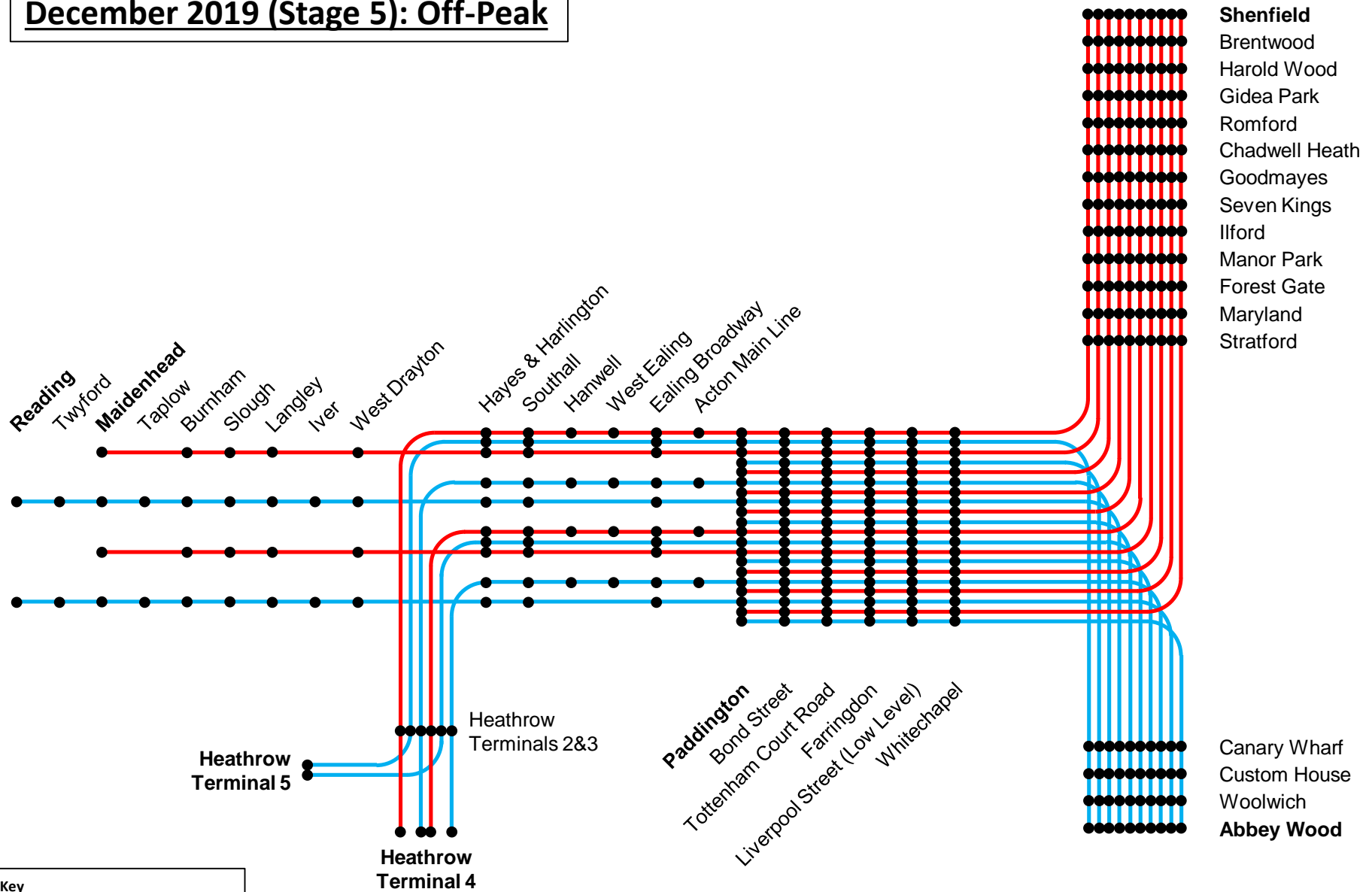
# Stage 5 – December 2019



**Stage: 5** Timetable: 5  Limited service - - -

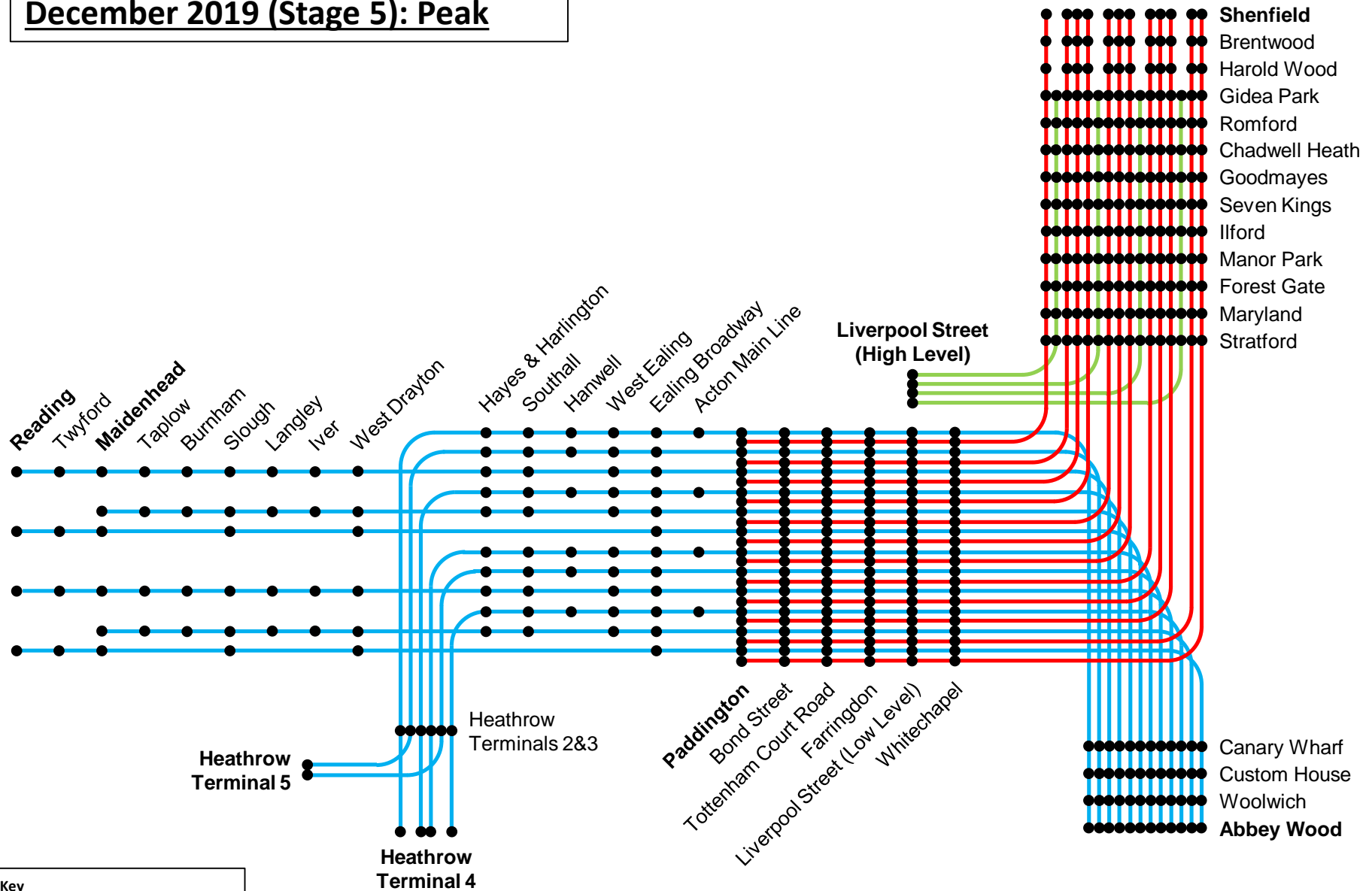


# December 2019 (Stage 5): Off-Peak





# December 2019 (Stage 5): Peak



**Key**

- To/from Shenfield
- To/from Abbey Wood
- Residual service to/from Liverpool Street (High Level)

# Timetable Constraints



- ▶ Heathrow Branch single line to Terminal 4
- ▶ Heathrow Branch interaction with Heathrow Express
- ▶ Forest Gate Junction
- ▶ Ilford London End Junction (Depot exit)
- ▶ Platform arrangements at Terminal stations (12tph terminating on 2 platforms at Abbey Wood and Shenfield)
- ▶ Freight trains

# Factors impacting the timetable



## ▶ Performance

- ◆ Dwell time requirements
- ◆ Integration of services – performance impacts from different routes
- ◆ Infrastructure Maintenance requirements

## ▶ And the less obvious

- ◆ Commercial agreements with funders e.g. Canary Wharf Group
- ◆ Ventilation / Fire Safety arrangements for tunnelled railways



# The Bombardier Aventura class 345



But first....It's Time For Tea!





# Unit Resource Plan



- 66 x 9 car 23m Class 345 units
- Initially 15 x 7 car units for Liverpool St – Shenfield service, maintained at Ilford. To be lengthened to 9 cars May 2019
- By stage 5 all units maintained at Old Oak Depot, and visit every 48 hours for washing and AVIS check

## Stabling Capacity

4 Shenfield

9 Gidea Park

12 Ilford

8 Plumstead

42 Old Oak Common

6 Maidenhead





# Shenfield Line CI 306 1949 - 1980



# Shenfield Line CI 315 1979 - 2019





# Bombardier Derby





# Shenfield line CI 345 2017 – 20??





# Off to Old Dalby





# Longitudinal seating





# 2 + 2 seating





# June 2017



# Driver Simulator Ilford





# Driver Resource Plan



- 460 Drivers
- 6 Drivers Depots
  - 50 Shenfield
  - 70 Gidea Park
  - 60 Ilford
  - 70 Plumstead
  - 160 Old Oak Common
  - 50 Maidnehead
- All drivers sign all main routes
- Three different signalling systems

# Train meets Tunnel –its all very real



## ◀ And What Did Our Customers Think?

First 345 train in Peak Time - Customer Feedback

The Twitter logo, consisting of the word 'twitter' in a white lowercase sans-serif font followed by a white bird icon, all set against a solid blue rectangular background.

twitter





**Lainey**   
@Lainey\_Quartz

Follow



Loving this new Elizabeth Line 🍷 #TFLRail

7:39 AM - 24 Aug 2017



Tweet your reply



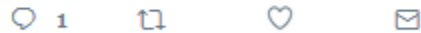
**Fiona Rita Gillespie**  
@fionarita

Follow



I shouldn't be so happy to be on a new @elizabethline train, but there you have it. So spacious and air conditioned! #nerd @TfLRail

9:07 AM - 24 Aug 2017



Tweet your reply



**Elizabeth Kitch**  
@\_lizabekitch

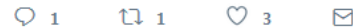
Follow



When you spend too much time commuting and getting on a new @TfLRail train is the most exciting thing 🚆🚆🚆🚆🚆

7:31 AM - 24 Aug 2017

1 Retweet 3 Likes



Tweet your reply



**Danny F** @Danfrench29 · 2h  
Replying to @\_lizabekitch @TfLRail

They are amazing ain't they? I can't wait till they are the regular trains on the line 🚆🚆



**TfL Rail** @TfLRail · 32m  
Hi, glad you enjoyed the new train, we'll continue introduce more new trains in the coming months ahead.





**Jamie Ratcliff**

@Jamrat\_

Follow

I'm actually unbelievably excited at my first commute on the new @elizabethline train! Spacious, clean & smooth. @TfLRail @Crossrail



7:51 AM - 24 Aug 2017

1 Retweet 7 Likes



2 1 7



Tweet your reply



**Rachel Tripp** @rectripp · 1h

Replying to @Jamrat\_ @elizabethline and 2 others

I'm so jealous! I've not seen one yet.

1



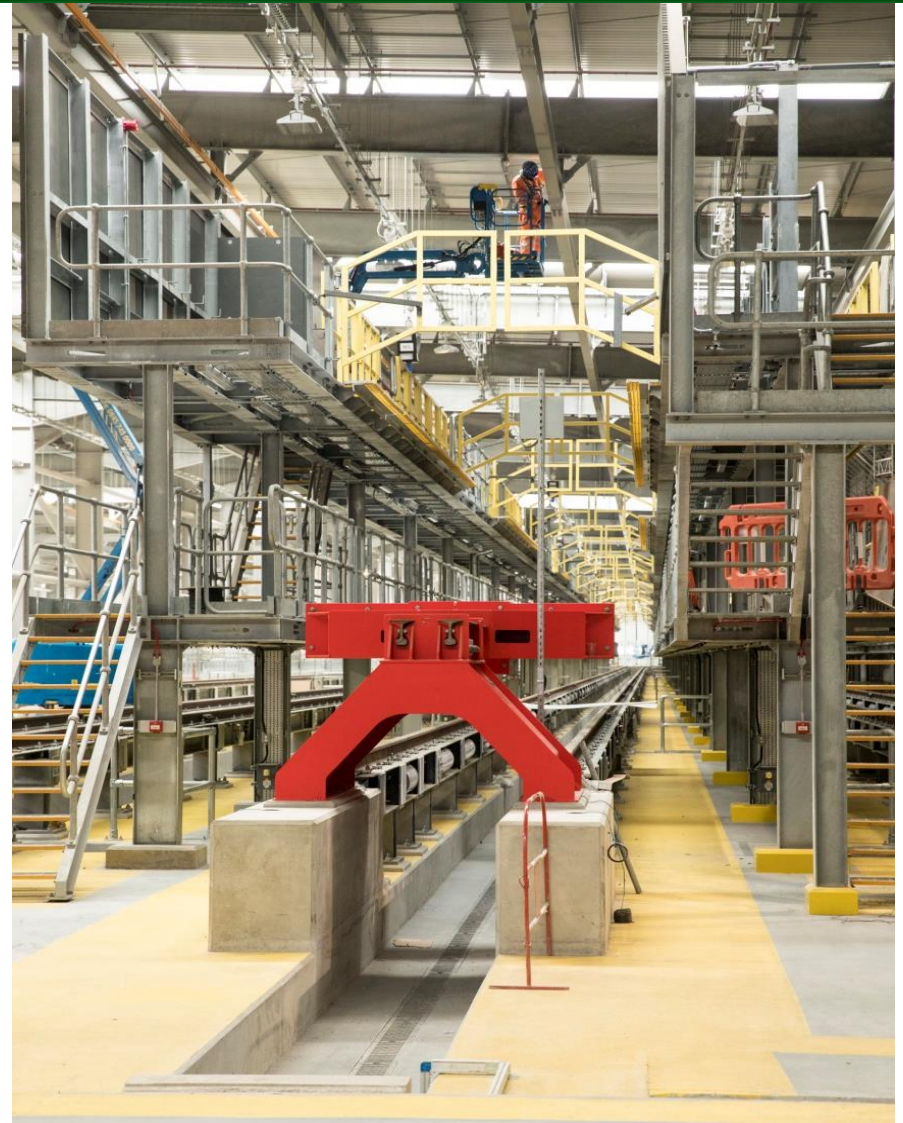
**Jamie Ratcliff** @Jamrat\_ · 1h

Sorry! I'd seen one in testing but this is the 1st I've seen in "the wild". I'm literally bouncing around like Tigger in my excitement!





# OOC - A Home for the Class 345





# Old Oak Maintenance Shed







April 2014 -  
Work began

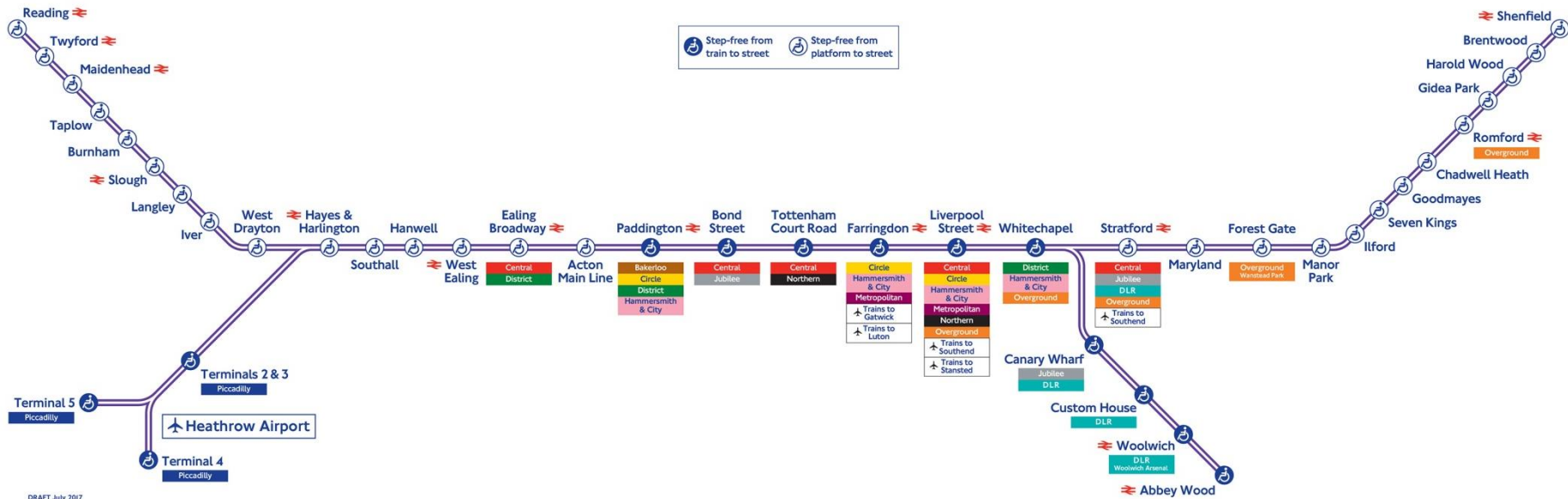
Rebuilt  
former depot

26,000m<sup>2</sup> site

9 roads,  
33 sidings

Completion  
2018

# A Year to Go – All Change



DRAFT July 2017



# Operational Control - Romford RCC



# RCC Commissioning



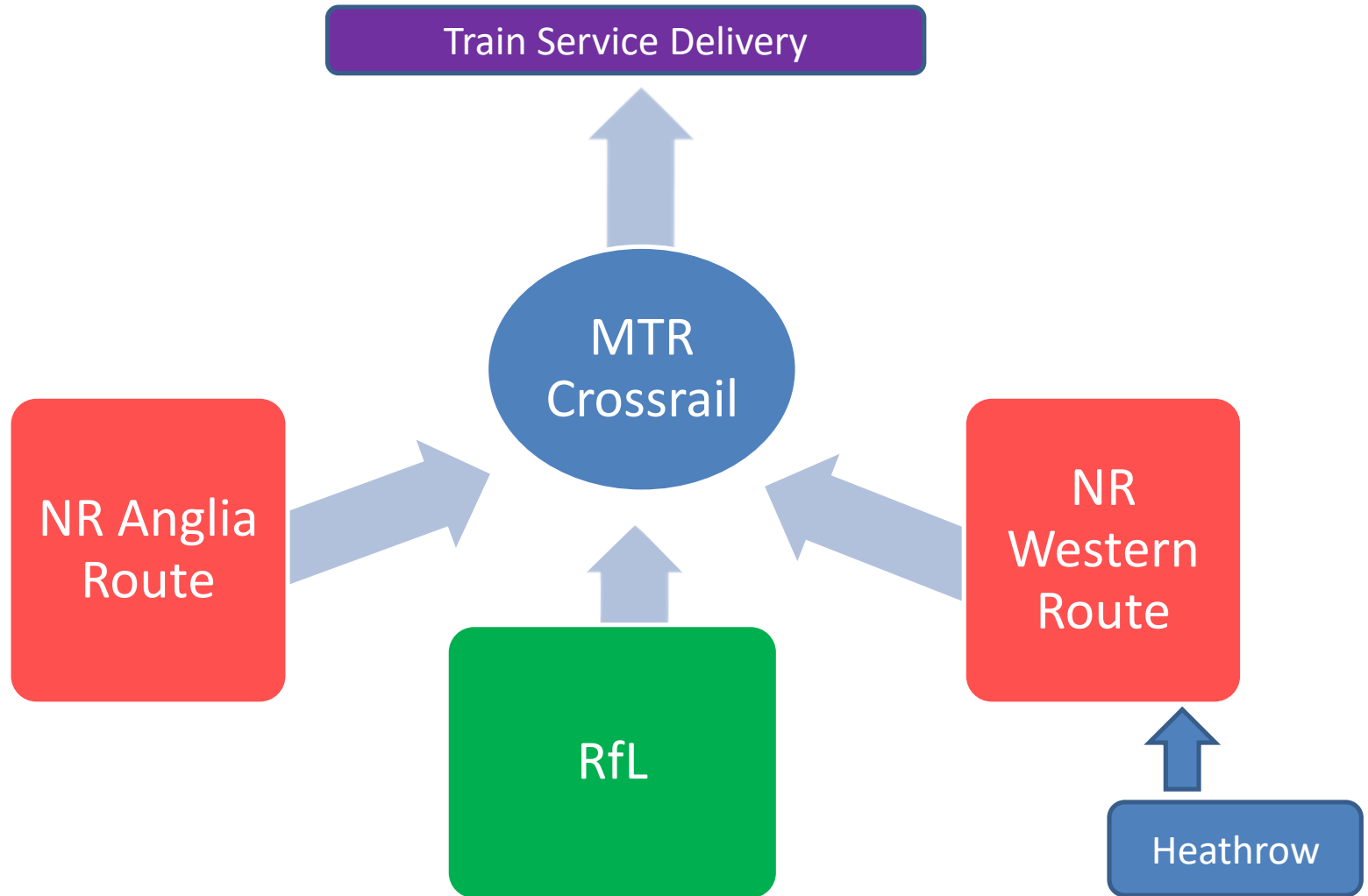


# C660 – Romford ROC





# Railway Control Strategy - Train Service Delivery



# Another New Team



# Testing the Railway



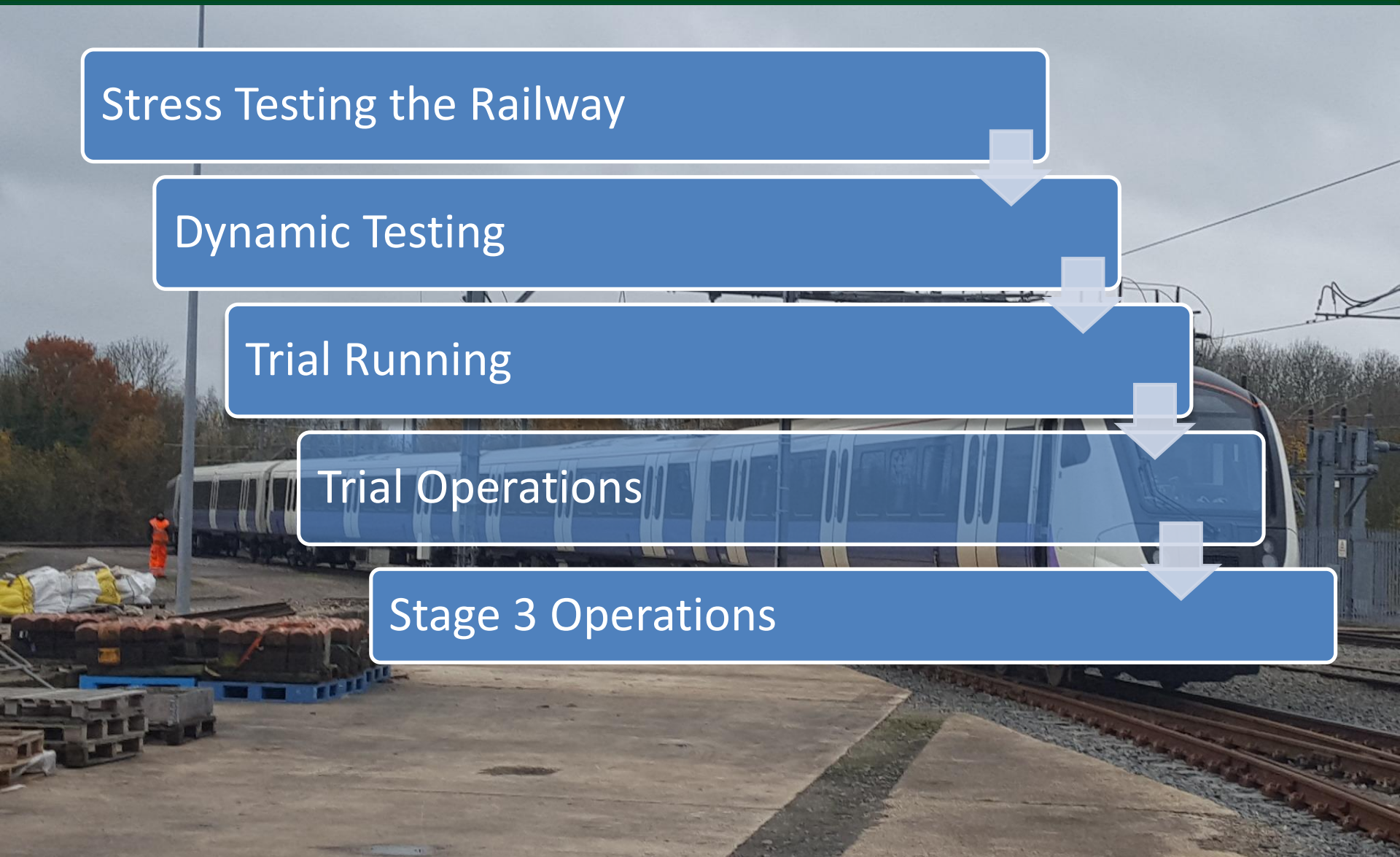
Stress Testing the Railway

Dynamic Testing

Trial Running

Trial Operations

Stage 3 Operations





- ▶ Testing All Systems (Systemwide) Signalling, Traction Power, Ventilation Systems, Non Traction Power Systems
- ▶ Running up to 15 trains per hour
- ▶ Checking the Control Systems operate as expected!
- ▶ No surprises!

# Elizabeth line Trial Operations

Railway tested,  
safe to operate  
and meets  
Sponsors  
performance  
requirements

25<sup>th</sup> February to 5<sup>th</sup> July  
2018 (Dynamic Testing)  
5<sup>th</sup> July 2018 to 5<sup>th</sup> August  
2018 (Trial Running))

**Trial Operations -  
exercises the  
people, processes  
and assets  
together**

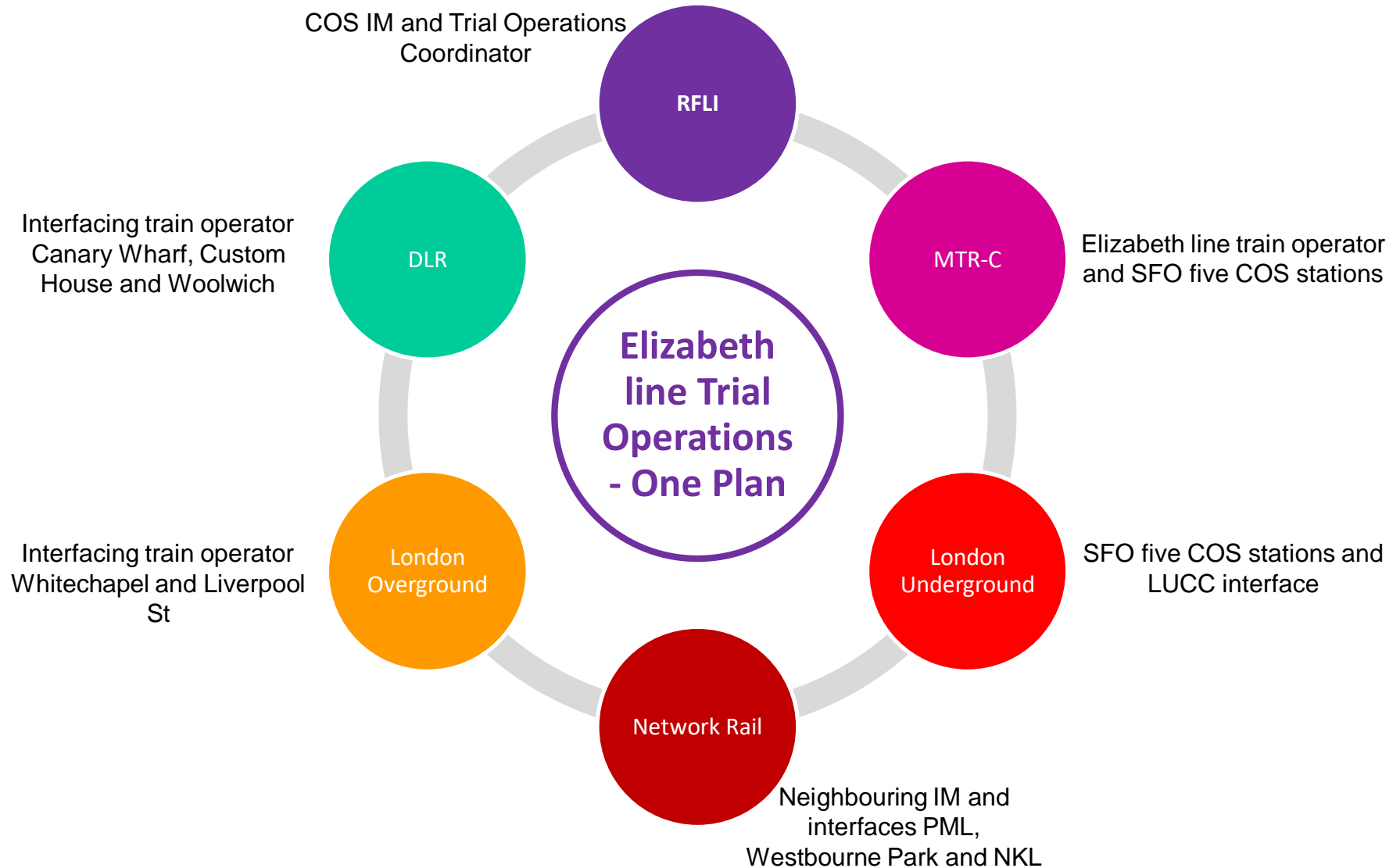
**6<sup>th</sup> August 2018 to 8<sup>th</sup>  
December 2018**

Successful Trial  
Operations →  
start of Elizabeth  
line services

9<sup>th</sup> December 2018



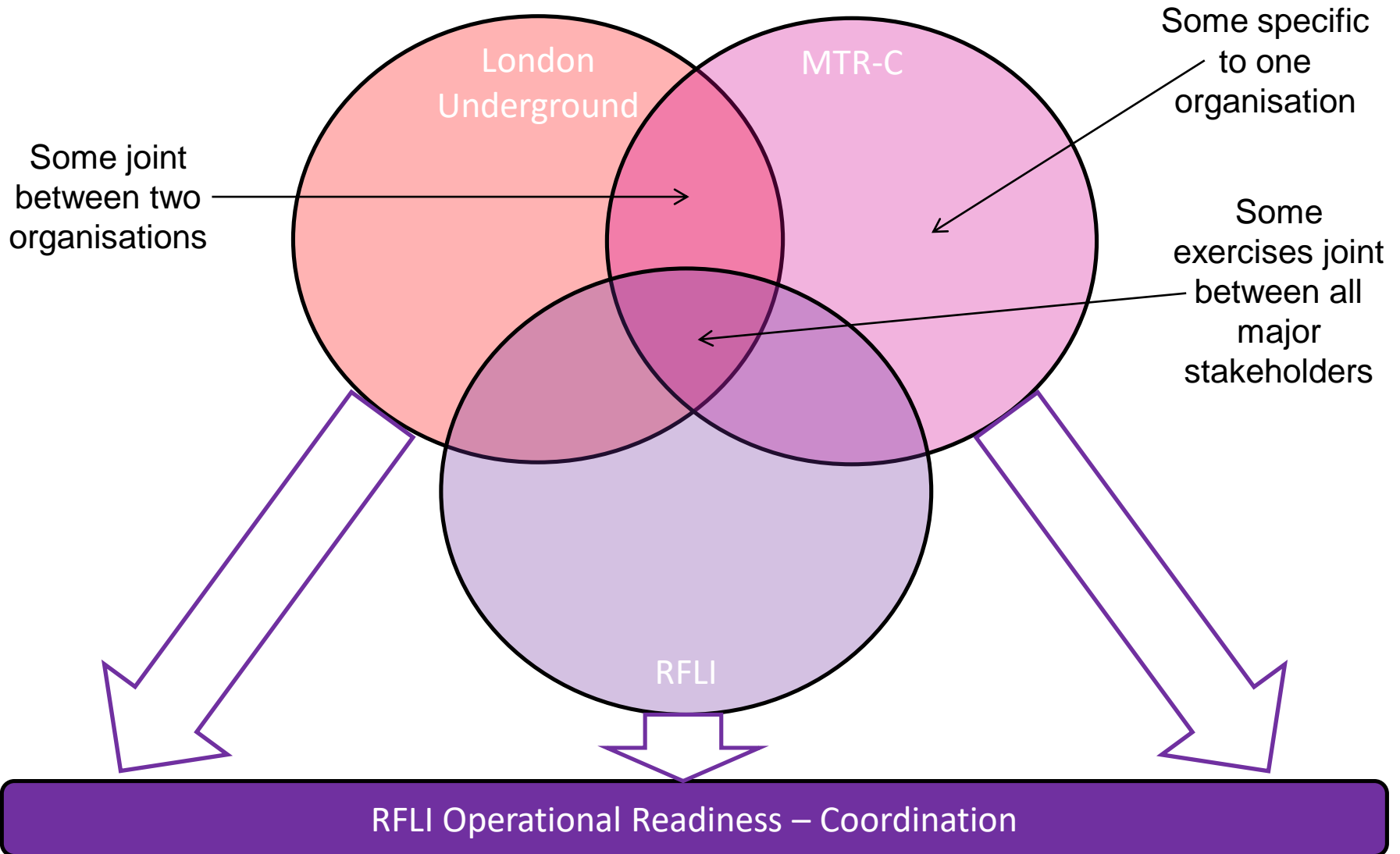
# Elizabeth line Trial Operations



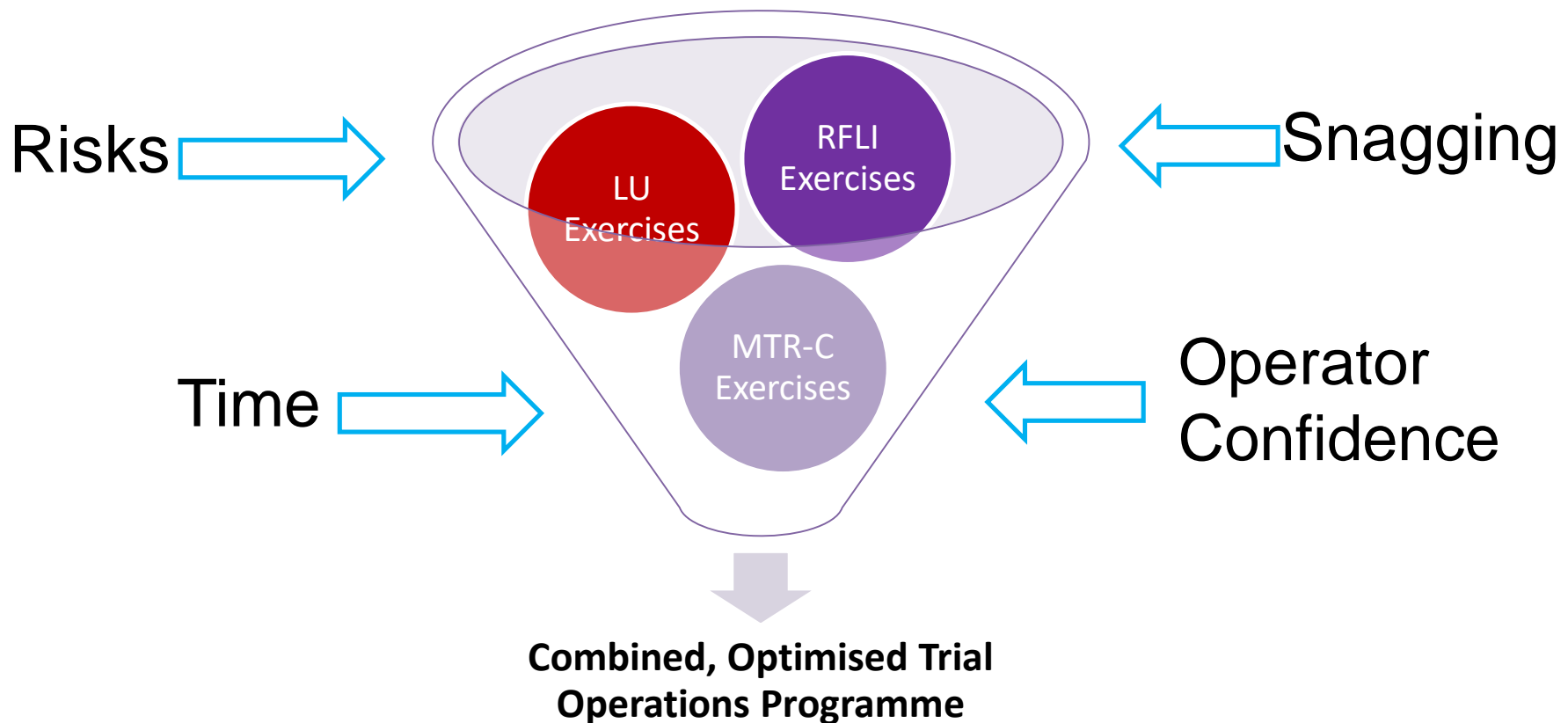


# Elizabeth line Trial Operations

Circa 158 separate Trial Operations Exercise 'scenarios'



# Elizabeth line Trial Operations – Exercise Programme



- Flexible
- Realistic
- Priority Ordered
- Coordinated

**121 days until July 5<sup>th</sup> 2018 &**

**278 days until 9<sup>th</sup> December 2018**





# ARE WE ON TIME?

## Stations, shafts and portals



### Performance Indicators

Escalators Commenced  
(v. plan)

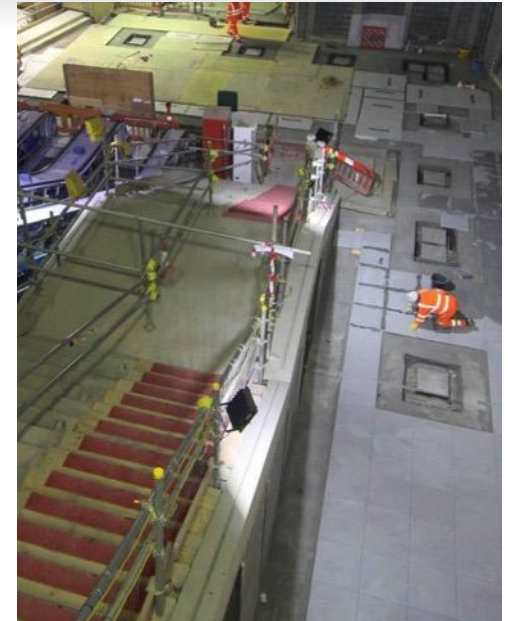
**84%** (v.84%)

Platform Screen Doors  
(v. plan)

**71%** (v.97%)

Room /routes accepted by  
Systemwide (v. plan)

**815** (v. 1,020)



# ARE WE ON TIME?

## Systemwide



### Performance Indicators

Tunnel preparation (v. plan)	<b>55,310m</b> (v. 55,936m)
OHLE ROC Works (v. plan)	<b>33,677m</b> (v.32,926m)
Cable management System (v. plan)	<b>97,487m</b> (v. 97,959m)





# ARE WE ON TIME?

## On Network Works



Performance Indicators

**92%**

On Network Works Complete





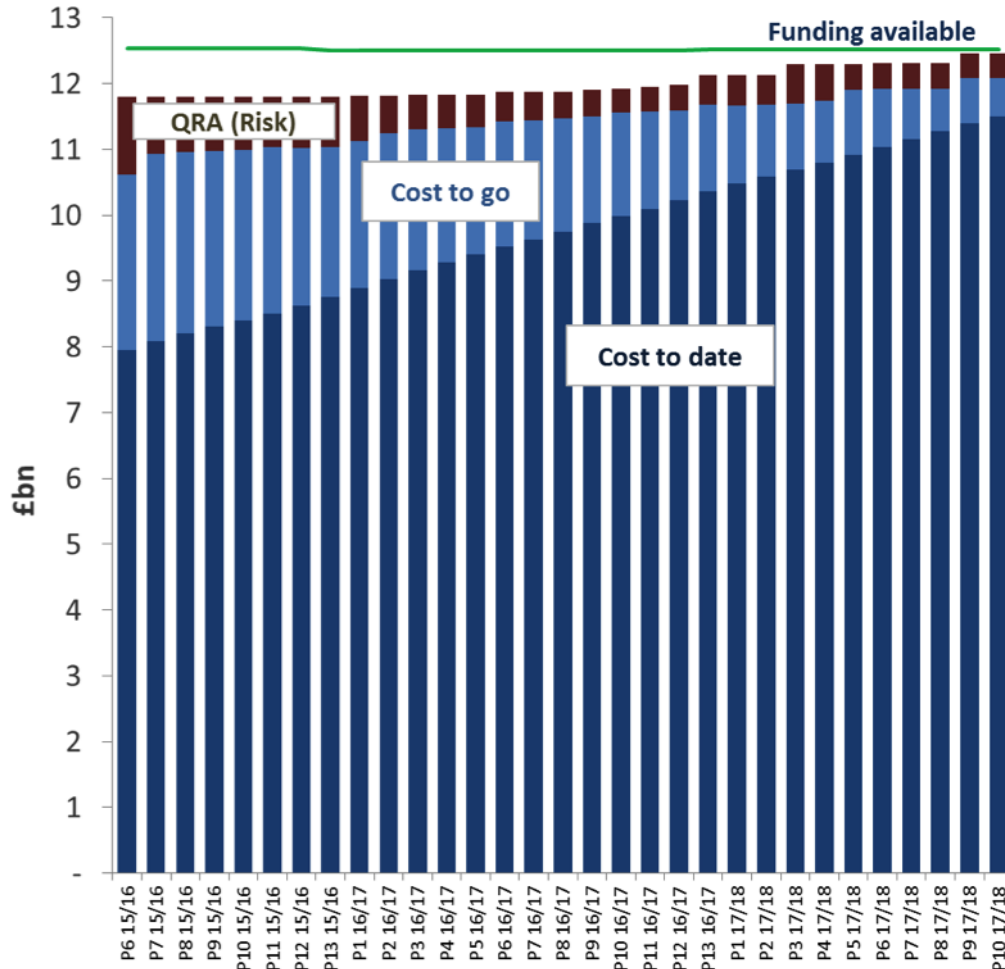


# ARE WE WITHIN FUNDING?



## Central Section Works

There is just 10% of works yet to complete.



## How can we all help?

Keep to  
schedule

+

Ensure efficient  
spend

+

Minimise  
Change

- ▶ Has to come in 'on Time'
- ▶ On 'Budget'
- ▶ Has to be 'safe'
- ▶ Has to be 'reliable'
  
- ▶ **Any Questions?**



# End to End

