

TRANSPORT FOR LONDON

BRIEFING NOTE

Subject: Weekly Mayoral update on Crossrail / Elizabeth line

Date: 15 May 2018

Manifesto commitment(s)

Not applicable

Mayor's Transport Strategy (MTS)

A good public transport experience

Proposal 57: The Mayor, through TfL, will work with the DfT to open the Elizabeth line in 2019, with services initially providing 24 trains per hour through central London and increasing in frequency during the 2020s as demand requires.

1 Purpose

- 1.1 Weekly update to the Mayor outlining progress and challenges ahead of the launch of the Elizabeth line.
- 1.2 The Mayor is asked to **NOTE** this briefing.

2 Headlines

- 2.1 The latest three-day testing period took place in the tunnels between Canary Wharf and Woolwich on 11 – 13 May. Specific tests included platform screen door/train interfaces, Driver Only Operation CCTV images from the platforms to the trains and radio coverage, mileage accumulation and line speed operation.
- 2.2 Several tests were successfully completed, including further full speed automatic operation. This is to be expected at this stage in a project, but will require careful management of the remaining programme of tests. A number of tests were deferred or will need to be repeated in the next testing window which is in two weeks time.
- 2.3 TfL Rail remains on schedule to take over the existing Heathrow Connect services from 20 May 2018, using the existing rolling stock to the airport and the new Class 345 trains between Paddington and Hayes & Harlington. Final submissions are now being made to the safety review bodies that need to approve the operation.
- 2.4 On the Crossrail tunnel fit-out activities including overhead conducting rail and cabling installation continued last week. The tunnel fit-out activities between Paddington and Whitechapel are being prioritised to ensure those needed for train testing in that section of the tunnel can start in the testing window between 7 and 12 June. There has been a small delay to the “power on” sequence from Westbourne Park but it will not delay the start of testing in the June testing window.
- 2.5 At stations, a range of work continues including:
 - The installation of mechanical and electrical equipment at Paddington



- At Bond Street, lift installation on the western ticket hall
 - At Tottenham Court Road and Whitechapel, readiness for tunnel ventilation fan and overhead line power
 - At Farringdon, completing platform tiling
 - At Liverpool Street, installation of an incline lift
 - At Woolwich, the completion of escalator and lift installation
- 2.6 The provision of asset data, operation and maintenance manuals and training materials by contractors remains challenging. This is needed to support the handover and bringing into use of the railway for Paddington to Abbey Wood services. Crossrail Ltd (CRL) is applying pressure on contractors to provide materials to meet training and handover plans, and working with TfL to prioritise the production schedule.
- 2.7 There is a significant volume of safety assurance and approvals required in order to support increasingly complex aspects of dynamic testing and ultimately bring the railway into safe operation. The rate of submissions to the safety assurance bodies needs to increase and CRL has secured additional resource to assist with this as well as establishing new weekly metrics and a daily focus on required deliverables.
- 2.8 CRL, working with the future Infrastructure Managers (IMS), maintainers and operators has agreed the approach to evaluating each area's readiness for trial running, trial operations and passenger service in December 2018. A detailed tracker containing all the activities needed for these three major milestones has been agreed as well as three formal checkpoints in June, July and October to assess readiness.

3 Costs

- 3.1 CRL's costs are reported on a periodic basis and are available up to the end of Period 13 (up to 31 March 2018). The forecast for the delivery of the central section has increased at the end of Period 13 to £12,723m, from £12,467m in Period 12. This follows a review to incorporate the implications of the revised Master Operational Handover programme, previously reported delays to energisation and lower than expected levels of productivity on the systemwide and stations contracts.
- 3.2 At the end of Period 13, the forecast cost to complete the Crossrail works exceeds the £600m TfL contingency by £211m. A breach in funding will be reported formally in the Crossrail semi-annual construction report that will be made available to TfL and DfT officials (Sponsors) following the CRL Board meeting on 24 May.
- 3.3 The forecast cost for Network Rail's delivery of the On Network Works (ONW) remains unchanged at £2,530m, against the original budget of £2,300m. The DfT has already secured funding to support this increased cost. NR has indicated further risks in the range of [REDACTED] with a funding request of [REDACTED] to be funded from NR contingency.
- 3.4 We are working with the DfT to agree how to jointly resolve the funding shortfall. The Sponsors anticipate the increase in costs above currently agreed funding will be made public in the annual Written Ministerial Statement that is being prepared for Parliament the week commencing 25 June 2018. At this time, we anticipate that details of any



funding agreements can also be shared. In addition, TfL, DfT, and CRL will coordinate the release of press statements with the Written Ministerial Statement.

4 Programme and Schedule




- 4.1 The key commitments and dates in Crossrail's Master Operational Handover Schedule (MOHS) 2018 with key issues are provided in the appendix A.



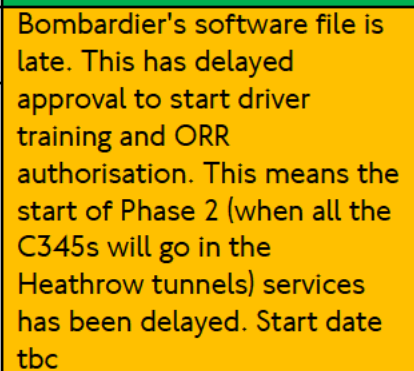
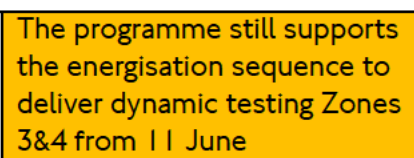
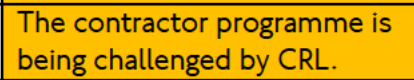
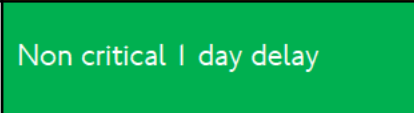

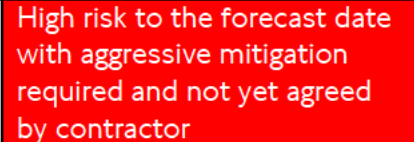
5 Appendix

- **Appendix A:** Key milestones from MOHS 2018 schedule with key issues
- **Appendix B:** List of Acronyms
- **Appendix C:** Joint TfL and Bombardier Weekly Report



Appendix A: Key milestones from MOHS 2018 schedule by Stage and key issues including change since last period. The latest available dates are from Period 01 (up to 28 April 2018).

Key: On track 
 Behind target but not impacting on critical path to Stage 3 
 Behind target and at risk of impacting critical path to Stage 3 services 

Elizabeth Line Readiness Key Milestones	Target	Forecast	Variance	Critical path RAG	Periodic Trend
Stage 2 Phase 1 – Paddington to Heathrow					
Opening of Stage 2 - Heathrow to Paddington High Level @T/T Change 20 May 18	20-May-18	20-May-18	0		↔
Stage 2 Phase 2 - Paddington to Heathrow					
ETCS Ready for Formal Heathrow Testing	24-Aug-18	24-Aug-18	0		↔
ETCS Approval to Operate for Driver Training	24-Aug-18	12-Oct-18	-49	 Bombardier's software file is late. This has delayed approval to start driver training and ORR authorisation. This means the start of Phase 2 (when all the C345s will go in the Heathrow tunnels) services has been delayed. Start date tbc	↔
ORR Authorisation for On-board Signalling	28-Sep-18	19-Nov-18	-52		
Commence Stage 2 Phase 2 with ETCS functionality	28-Oct-18	TBC	<i>(Dependent on Unit Availability for Driver Training)</i>		
Stage 3 - Paddington to Abbey Wood					
Dynamic Testing					
WBP ATFS Energised	31-Mar-18	17-May-18	-47	 The programme still supports the energisation sequence to deliver dynamic testing Zones 3&4 from 11 June	↓
PSD Ready for Dynamic Testing in Zone 1	09-Apr-18	28-May-18	-49	 The contractor programme is being challenged by CRL.	↓
Provide all Trains to Systemwide for Dynamic Testing (3rd & 4th FLUs)	14-May-18	07-Jun-18	-24	 Non critical 1 day delay	↓
Linewide SCADA available in Zones 3 & 4	30-May-18	31-May-18	-1		↔
Signalling infrastructure ready for DT in Zones 3 & 4	07-Jun-18	07-Jul-18	-30	 High risk to the forecast date with aggressive mitigation required and not yet agreed by contractor	↓



GSM-R infrastructure ready for DT in Zones 1 to 4	08-Jun-18	29-Jun-18	-21	Medium risk based on update from Siemens	↓
Permanently energise OHLE Zones 3 & 4	10-Jun-18	10-Jun-18	0		↔
Start Dynamic Testing (Zones 3 & 4)	11-Jun-18	11-Jun-18	0		↔
Start Dynamic Testing (Zones 1,2,3 & 4)	30-Jun-18	17-Jul-18	-17	Knock on impact from delay in signalling infrastructure readiness in Z3&4	↓
Trial Running					
All 11 kV S,S&P locations energized	15-Apr-18	19-May-18	-34	Forecast date has now moved to 13 May. Consequences of delayed permanent power to stations, shafts and portals are being mitigated	↓
ORR Issue Safety Authorisation to RfLI	07-Jun-18	07-Jun-18	0		↔
Commence Transition Testing @ GEML	30-Jun-18	15-Jul-18	-15	Confirmation of NR possessions required. Infrastructure and transition software low risk	↓
All 22 kV S,S&P locations energized	30-Jun-18	28-Jul-18	-28	Fault with voltage transformers is leading to further delay. Response plan in development	↓
ORR Issue Amended Safety Cert. & Authorisation to MTRC	04-Jul-18	04-Jul-18	0		↔
Training completed for RFL in support of Handover of Routeway	05-Jul-18	03-Aug-18	-29	Production of training materials is being prioritised to ensure RfL can train the maintenance and station staff first as they are the most urgent people	↔
Commence Transition Testing @ GWML	14-Jul-18	12-Aug-18	-29	Securing NR possessions not yet achieved. Discussions continuing to finalise.	↓
Delivery Yellow Plant (RPM, ET01, ET02)	27-Jul-18	04-Aug-18	-8		↓
Sufficient RFLI Ops & Maintenance. Staff Trained and Competent as IM	03-Aug-18	03-Aug-18	0		↔
Training Delivered to allow the Introduction of the RFLI Rule Book	03-Aug-18	03-Aug-18	0		↔
Handover - Railway Systems	05-Aug-18	05-Aug-18	0	Delays in the installation, testing and commissioning of the signalling system	↔



				introduces a knock on risk to commencement of trial running	
CBTC Authorised for FLU for Trial Running	05-Aug-18	26-Jun-18	40		↔
Handover to Operator / Commencement of Trial Running	05-Aug-18	05-Aug-18	0	Delays in the installation, testing and commissioning of the signalling system introduces a knock on risk to commencement of trial running	↔
22no. Cl.345 FLUs Available for Trial Running	13-Aug-18	29-Jun-18	45		↑
Stage 3 - Paddington to Abbey Wood					
Trial Operations					
All Stations 'Staged Completion' - for RFLI/LU/MTR Familiarisation and Trial Ops.	<i>Refer to detailed Station Table</i>				
Final COS safety case updated and submitted to RABC	31-Aug-18	31-Aug-18	0		↔
Commence Trial Operations	09-Sep-18	09-Sep-18	0	Potential knock on to this milestone if trial running is delayed	↔
Passenger Service					
Submit Technical File to ORR	17-Sep-18	17-Sep-18	0		↔
CBTC Authorised for Passenger Service	10-Oct-18	02-Aug-18	69		↑
PML ATS Re-energised including NR feed	15-Oct-18	15-Oct-18	0		↓
Temporary services recovery complete	09-Nov-18	30-Nov-18	-21	CRL continuing to challenge contractor programme and discuss with RfL whether some services could be removed later by maintenance team	↑
Opening of Stage 3 - Central Section Paddington L/L to Abbey Wood	09-Dec-18	09-Dec-18	0		↔
Substantial Completion of Stage 3					
Plumstead Maintenance	21-	21-	0		↓



Facility Completion (Initial IM access)	Nov-18	Nov-18			
Final Handover of all Stations, Shafts and Portals	28-Nov-18	28-Nov-18	0		↔
Plumstead Stabling Sidings Completion	29-Mar-19	29-Mar-19	0		↔
Stage 3 - Paddington to Abbey Wood					
LU Stations 'Staged Completion' - for LU Familiarisation and Trial Ops.					
Whitechapel Station	16-Aug-18	16-Aug-18	0		↔
Bond Street Station	31-Oct-18	31-Oct-18	0		↔
Liverpool Street Station	02-Sep-18	02-Sep-18	0		↔
Tottenham Court Road Station	02-Aug-18	02-Aug-18	0		↔
Farringdon Station	17-Aug-18	17-Aug-18	0		↔
RFLI Stations 'Staged Completion' - for RFLI/MTR Familiarisation and Trial Ops.					
Paddington Station	29-Jul-18	29-Jul-18	0		↔
Custom House Station	28-Jul-18*	28-Jul-18	0		↔
Woolwich Station	09-Sep-18	09-Sep-18	0		↔
Canary Wharf Station	05-Jul-18	05-Jul-18	0		↔
Date with * = Final Handover date not Staged Completion					
Stage 4 - Paddington to Abbey Wood & Shenfield					
Required no. units available for Stage 4 (55 FLU & 5 RLU)	17-May-19	8-May-19	9		↓
Opening of Stage 4 - Paddington L/L to Abbey	19-May-19	19-May-	0		↔



Wood and Shenfield		19			
Stage 5 - Full Crossrail Service					
70 Trains Delivered for Stage 5. (Including RLU to FLU Reconfiguration)	13-Dec-19	16-Oct-19	58		↔
Opening of Stage 5 - Reading & Heathrow to Abbey Wood and Shenfield	15-Dec-19	15-Dec-19	0		↔



Appendix B: List of Acronyms

Acronym	Description
APIS	Authorisation for Placing Into Service
ATC	Alstom, TSO, Costain joint venture
ATFS	Auto Transformer Feeder Station
BT	Bombardier Transportation
CBTC	Communications Based Train Control
CRL	Crossrail Limited
DfT	Department for Transport
ET01/02	Engineering Train
ETCS	European Train Control System
FLU	Full Length Unit
GEML	Great Eastern Mainline
GSM-R	Global System for Mobile Communications – Railway
GWML	Great Western Mainline
LU	London Underground
MNO	Mobile Network Operators
MOHS	Master Operating Handover Schedule
MTRC	Mass Transit Railway - Crossrail
MTS	Mayor's Transport Strategy
ORR	Office of Rail & Road
PML	Pudding Mill Lane
PSD	Platform Screen Door
RAB (C)	RfL Assurance Board for Crossrail
RfL	Rail for London
RPM	Railway Profiling Machine
S, S&P	Station Shafts and Portals
TBC	to be confirmed
TCMS	Train Control Management System
TfL	Transport for London
TPH	Trains per hour
WBP	Westbourne Park



Appendix C: Joint TfL and Bombardier Weekly Report

Elizabeth line - Bombardier Weekly Report 14 May 2018

Note No: 11

Key Activities and Issues

- 45 trains have been completed in Derby by Bombardier, which is in line with the plan.
- Of the 15 Class 345 7-Car Trains, 5 are now based at Old Oak Common Depot ready for Stage 2 services between Paddington and Hayes & Harlington from 20 May. The remaining 10 7-Car trains remain at Ilford Depot and are available for passenger service on the Liverpool Street to Shenfield line.
- Bombardier is focused on delivering its reliability growth plan. This targets a mean distance between service affecting failures (the standard industry measure) of 10,000 miles by 26th June 2018. It is based on 15 modifications and software updates that will reduce or eliminate current faults. Last week zero failure days were recorded for the fleet.
- Three 9-Car trains are being used for driver training on the Great Western route (between Paddington and Heathrow / Reading) and three 9-Car trains are being used for testing, two in the Elizabeth line central tunnel section between Whitechapel and Abbey Wood (Dynamic Testing) and one for pre-testing in the Heathrow tunnels.
- Dynamic testing in the tunnels between Canary Wharf and Woolwich recommenced on 11 May, as planned. Tests for this period include train and signalling testing, the drivers CCTV system and platform screen door interfaces. Some of these tests repeat activities that were scheduled to take place in the last testing window but not completed due to faults with other (non train) equipment in the tunnel.
- Tunnel testing is currently taking place using release 7.1 of the train control management software. This release resolves a number of issues with earlier versions. It has improved the efficiency of testing, however a number of further issues will be resolved by release 7.2.
- Release 7.2 of the train control management software is being tested on the rigs at Derby. A bug was found that affects the start-up of the system. We believe this has now been resolved and approvals are now being progressed to use 7.2 on the train at the Melton test track from 15 May. This is 10 days behind the original plan. Bombardier is looking at how it mitigates this delay to ensure that it does not affect planned dates for testing in the tunnels or approval for trial operations.
- The forecast date for safety approval of the European Train Control System element necessary for Stage 3 has changed from 22 May to 11 June. This is to accommodate a further release (MR2.1) which improves performance. Version MR2.1 software is already



being used for testing and Bombardier confirm this has no knock on impact on the overall programme.

- Bombardier is producing a plan and programme for assurance activities. With the amount of testing and the number of releases ahead, this is a key area of focus. A meeting with the safety regulator (the Office of Rail and Road) has been arranged for 21 May at which they will be briefed on Bombardier's approach to securing the necessary approvals. Bombardier continues to review the resources assigned to this crucial activity.
- Some issues discovered in testing of the Siemens signalling software where they relate to the Siemens part of the system will need to be addressed in future releases. Weekly meetings continue between Bombardier, Siemens, Crossrail and TfL, to improve joint testing, coordination of software release programmes and bug fixing. These meetings are productive and time devoted to them is being increased.
- Progress in bringing Old Oak Common Depot in to full use continues, and a media event was held at the Depot on 10 May. As previously reported, the planned signalling commissioning on 7 May was deferred to 17 May as the necessary testing had not been completed by Atkins, the signalling supplier. Senior Atkins representatives have restated their commitment to their revised programme and this is now being monitored on a daily basis.
- TfL Rail remains on schedule to take over the Heathrow Connect services from 20 May 2018, using the existing rolling stock to the airport and the Class 345 trains between Paddington and Hayes & Harlington. Final submissions are now being made to the safety review bodies that need to approve the operation.
- Further pre-testing of the European Train Control System ('ETCS') in the Heathrow tunnels took place 4 May and will now be scheduled fortnightly using the more up to date Release 7 series software.



Key Programme Milestones – Changes to previous forecast dates shown in red

Stage 2	P80 Programme (V3_5_1) 11 th Jan	Current Forecast
Approval for driver training on Great Western routes excluding European Train Control System	27 Feb	Completed - submitted 5 March
Commence build of TCMS release 7.3 (the Stage 2 passenger service software)	26 June	26 June
Independent Safety Assessment body ('ISA') approval for European Train Control System MR3 software necessary for Stage 2	6 August	6 August
Independent Safety Assessment body ('ISA') approval for TCMS release 7.3	18 September	18 September
Approval for European Train Control System driver training on Great Western	24 Aug	12 Oct
Approvals for European Train Control System Passenger Service	28 Sept	19 Nov
Stage 3		
Completion of Transition testing at Melton ready for Central Operating Section Dynamic Testing	29 Jan	Completed
Commence build of TCMS release 7.2 (the Stage 3 passenger service software)	24 April	Completed on 20 April
Independent Safety Assessment body ('ISA') approval for European Train Control System MR2 software necessary for Stage 3	22 May	11 June
Approval of CBTC signalling for Central Operating Section Trial Operations	22 Jun	22 Jun
Availability of 22 trains for Trial Running in the Central Operating Section	13 Aug	13 Aug
Approval of Class 345 for Stage 3 Passenger Service	10 Oct	10 Oct
Start of Stage 3 Passenger Service	9 Dec	9 Dec
Old Oak Common Depot		
Section A Brought into Use	1 Mar	Completed
Section B1 Brought into Use	11 Apr	Completed
Section C Brought into Use	30 May	11 June

