



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 111

Period 1 FY2018-19

01 April 2018 – 28 April 2018

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24 May 2018

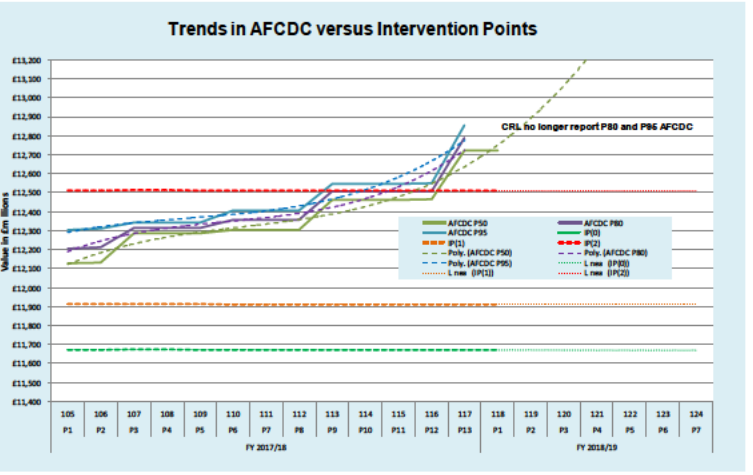
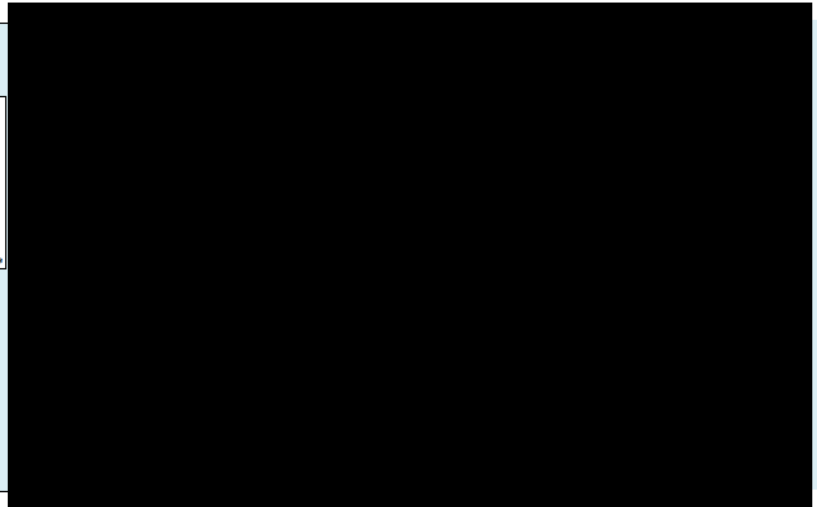
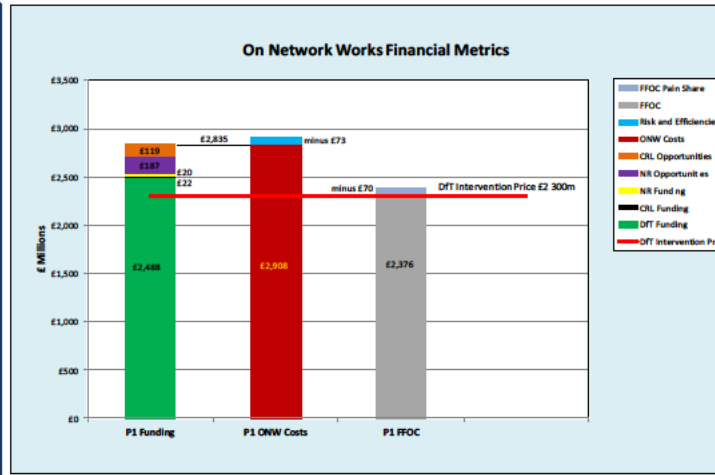
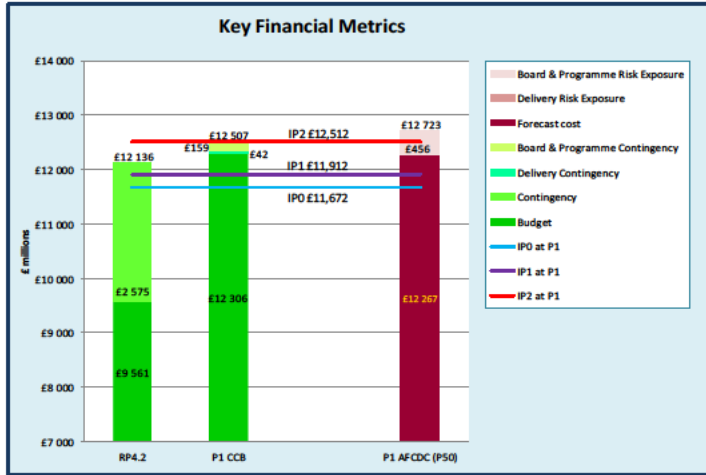


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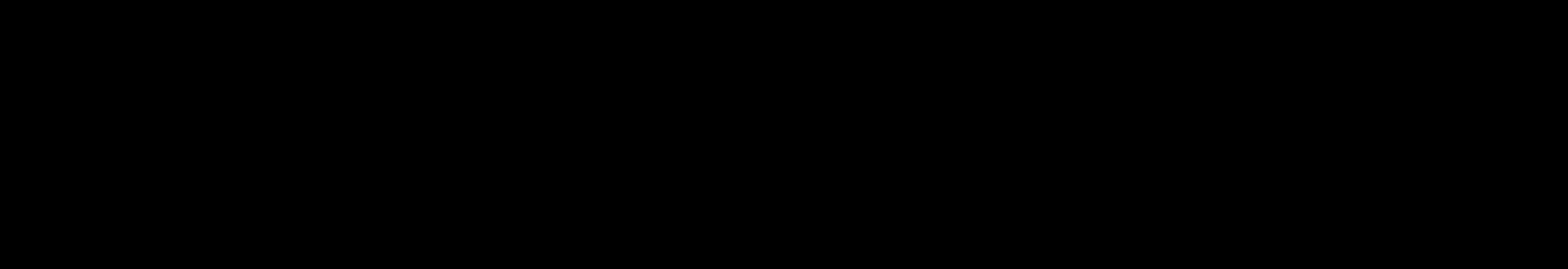
Cost and Schedule Dashboard (Period 1 FY2018/19)

SACR18 (as at April 2017):
 AFDCD (P50) ~ £12.303bn. AFDCD (P80) ~ £12.356bn
 AFC: (£12.303bn AFDCD (P50) + £2.482bn ONW etc) = £14.785bn

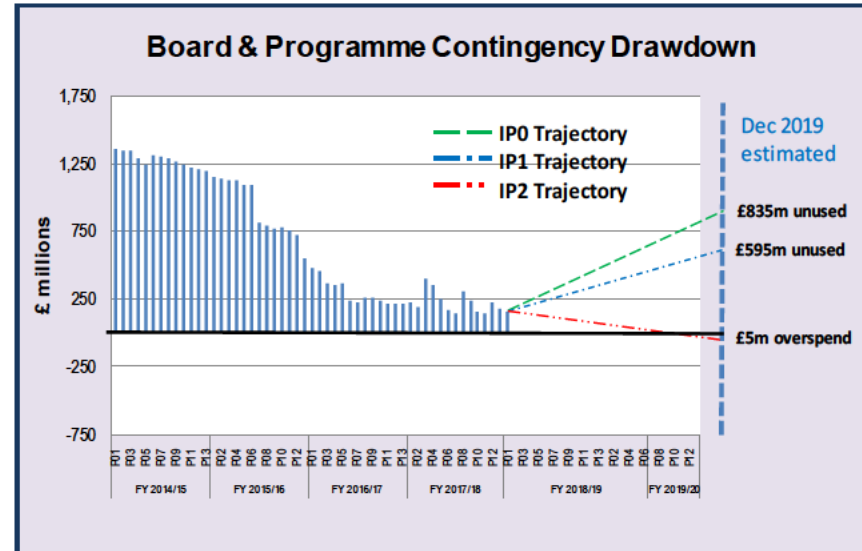
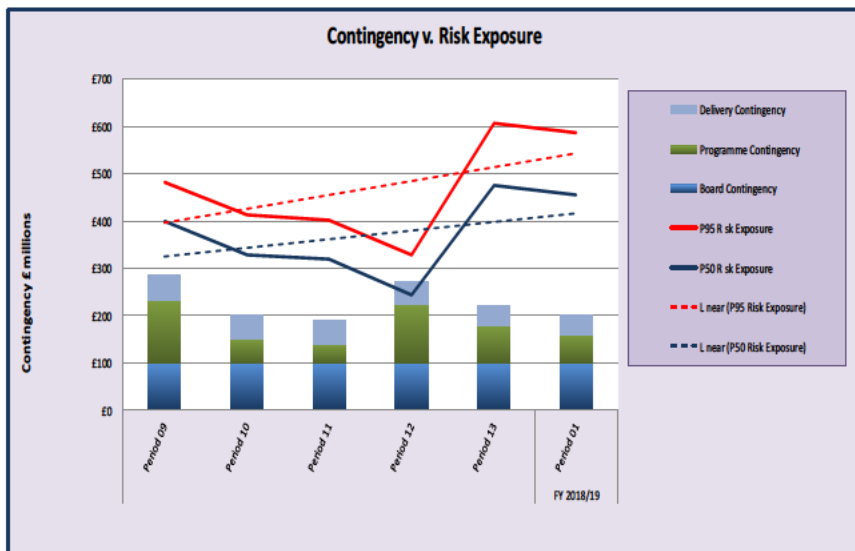
Cost:



Schedule:



Risk, Contingency & Change:



Project Representative's Summary:

Cost: IP0, IP1 and IP2 have not changed in Period 1. The AFDCD (P50) has also not changed in Period 1 and remains at £12,723m, exceeding IP2 by £211m. The Period 1 Finance Current Control Budget also remains at £12,507m. The AFDCD (P50) exceeds the reported financial budget by £216m and the RP4.2 Baseline funding of £12,136m by £587m. From Period 1, CRL is discontinuing reporting AFDCD to P80 and P95 and will be reporting a single AFDCD to P50. The Period 1 CRL ONW AFC (excluding VNs) and NR FFOC remains at £2,376m, both of which exceed the DfT Intervention Price by £76m.

Schedule & Progress: The MOHS remains highly ambitious. Overall period performance has struggled to match that required to deliver MOHS, and there have been further slippages in milestone dates. CRL has recently advised that Trial Running and Trial Operations target dates will be delayed, and that a checkpoint system will be implemented to manage progress. There remains a high risk that Stage 3 Opening will not be achieved.

Risk, Contingency & Change: In Period 1, there was a £19m decrease in P50 risk to £456m predominantly due to changes for Systemwide Main Works, LU Signalling Immunisation and Earthing, and Operations staff costs to support MOHS. The overall revised contingency budget of £201m is currently insufficient to cover the P50 risk exposure of £456m by £255m (a £1m minor improvement on Period 13). The centrally controlled Delivery contingency remains at £42m in Period 1.

Cost and Schedule Dashboard

(Quick Reference Guide)

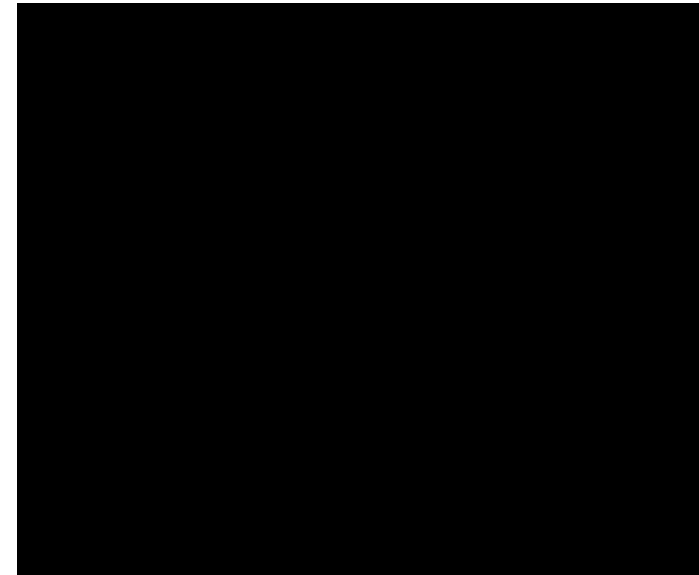
Cost

Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFDCDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

On Network Works Financial Metrics

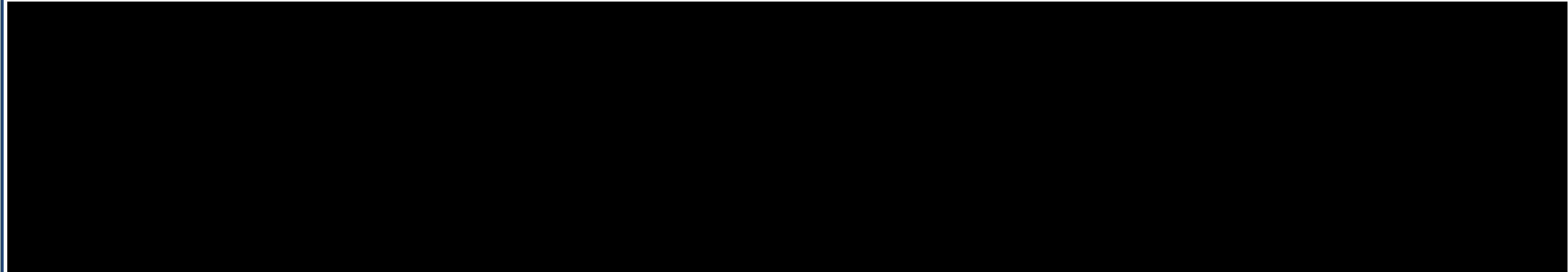
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



Trends in AFDCDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFDCDC at P50, P80 and P95 and forecasts the respective future AFDCDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2. From Period 1, CRL no longer report P80 and P95 AFDCDC.

Schedule & Float



Risk, Contingency & Change

Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

Project Status Report 111

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Note: This report relies on the information set out in CRL's Period 1 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 28 April 2018. Note that information emerging after the close of Period 1 is subject to formal confirmation by CRL in its Period 2 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

Document history and status

Revision	Date	Description	By	Review	Approved
1	17 May 2018	PSR 111 Period 1 FY 2018-19 v1.10.docx ~ Draft	PRep Core Team		
2	24 May 2018	PSR 111 Period 1 FY 2018-19 v1.18.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and ahead of CRL targets.

Financial:

The Intervention Points have not changed in Period 1. The AFCDC at P50 remains at £12,723m. The AFCDC at P50 continues to exceed IP2 by £211m, so we expect CRL to confirm a formal breach of IP2 at SACR19. The P95 AFCDC is £12,855m. Period 1 has again seen cost increases to both CRL assessments and Contractors' estimates for Target Costs and Defined Costs.

CRL is preparing a new cost to complete scenario which considers the impact of a completion tail extending into Trial Running and Trial Operations, with some construction work extending post Stage 3 Opening. Jacobs has reviewed the approach taken by CRL and is currently completing a final peer assessment as part of the overall cost scenario review work.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains at £2,530m, but we expect this to increase to reflect the £54m additional NR funding. The ONW final forecast outturn cost (FFOC) remains at £2,376m.

Schedule and Progress:

The Master Operational Handover Schedule (MOHS) remains highly ambitious. There is little or no float available ahead of Zones 3 & 4 dynamic testing, or to allow sufficient completion of works ahead of Trial Running. The introduction by CRL of blockade working on 26 April 2018, which alternates 11 days of construction with 3 days of dynamic testing in two-weekly cycles up to Trial Running, has delivered some schedule improvement to route-wide tunnel installation. However, this improvement is not so evident in the installation, testing and commissioning works associated with Stations, Portals and Shafts, where significant completion and integration challenges remain. There have been technical difficulties and poor progress in the completion of other rail systems.

CRL has recently advised that Trial Running and Trial Operations target dates will be delayed, and that a checkpoint system will be implemented to manage progress.

Stage 2 Opening:

Stage 2 Phase 1 started as planned on 20 May 2018. There are a number of snagging items that remain for both BT and NR, and these will be carried within their programmed works.

Preparations continue for ETCS testing to support Stage 2 Phase 2 services. BT/Alstom signalling functional testing has been completed in Charleroi. There has been slippage in the TCMS software programme, but there has been no change by RfL to achieving approval for driver training in October 2018. Time required for training ahead of service introduction is under review, with RfL and MTR-C investigating the minimum requirements. Completion of sufficient driver training along with avoidance of a commissioning clash with Stage 3 are likely to be the determining issues which drive the Phase 2 opening date.

Stage 3 Opening:

Considerable effort has been made in the period by all contractors to complete installation in line with MOHS. Delivery performance has varied across the rail systems and concerns remain with general progress at Central Section stations to support Phase 3 testing; there are particular concerns with the completion of [REDACTED].

[REDACTED] completed OLE installation on the Central Section and at Westbourne Park allowing Zones 3 & 4 first energisation on 22 May 2018; the start of dynamic testing remains on target for 11 June 2018. Prioritisation of OLE works has introduced delay to tunnel cable installation, and timely completion of signalling and GSM-R is under threat.

Delivery of High Voltage (HV) Non-Traction Power has suffered delay due to a Voltage Transformer (VT) failure. Ongoing investigation is highlighting a manufacturing defect as the likely cause and, while replacement availability will reduce delay, some schedule impact appears unavoidable. Further HV energisation has been placed on hold pending VT replacement, although installations already commissioned are able to remain live, albeit with safe working restrictions in place; this is allowing localised Phase 3 testing to continue.

Rail systems testing has proceeded more slowly than expected, despite the introduction of dynamic testing "windows". A total of 36 tests has been completed so far, of which 22 will need to be repeated. Important lessons have been learned, but with a grand total of 509 tests to be carried out, more dynamic testing windows will be required.

Dynamic testing progress has been restricted by limitations in pre-tested train-borne signalling functionality, incomplete infrastructure and the availability of specialist resourcing support. While expected during the testing process, the emergence of defects and non-compliances and the need for rectification and re-testing, applies further schedule pressure. There is uncertainty as to whether or not signalling installations can be completed in time and approvals secured to meet NR possessions in June, July and August for signalling transition testing.

[REDACTED]
[REDACTED]
[REDACTED]

Tunnel ventilation remains the most significant of the rail systems to extend beyond the start of Trial Running, which in principle must be completed before Trial Operations; however, further slippage at [REDACTED] threatens this ideal and a practical resolution must be agreed between CRL and RfL in order for Stage 3 Opening to be achieved. More generally, the accumulation of delay across all areas of delivery continues to threaten the start of Trial Running and Trial Operations, and the start date for Stage 3 Operations is becoming more vulnerable.

The Infrastructure Managers (IMs) remain extremely concerned at the delays and ongoing slow progress in CRL's provision of training materials, asset information, [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED].

Stage 4 and 5 Openings:

The scope of Ilford Depot wire height works may reduce, which CRL is re-investigating following recent surveys; its findings are expected in Period 2. The Supplemental Agreement for delivery of the Stabling Sidings (under [REDACTED]) has been signed-off by [REDACTED], allowing ATC to formally act as contractor for the works.

1 Schedule and Progress

1.1 Summary

Progress during Period 1 reinforces our view that there is a high risk that the scheduled start dates for Trial Running and Trial Operations will not be achieved, and that Stage 3 Opening may be delayed. See details below and in Sections 2 and 3. CRL has recently advised that Trial Running and Trial Operations target dates will be delayed, and that a checkpoint system will be implemented to manage project progress.

CRL has selected eighteen milestones which have been approved by the CRL Board as Corporate Milestones for FY 2018/19. Ten relate to delivery and eight to operational readiness. Figure 1 - 1 indicates¹ the new Corporate Milestones (shown as Period 1 Baseline) alongside the relevant dates from MOHS 2018 and the latest Period 1 forecasts. Four are already forecast to be later than the baseline and we expect further delays over the next few months. Detailed commentary on these is given in the following Sections.

Corp Mstone	Description	Period 1 Baseline	MOHS 2018 EDBL	Period 1 Forecast
1	All 11KV SS&P Non-Traction Power Locations Energised	April	15-Apr-18	19-May-18
2	CBTC Auto Reverse and Isolated ETCS Testing Complete at Melton	April	06-Apr-18	27-Apr-18
3	Stage 2 Phase 1 Service Introduction PAD to Heathrow	May	20-May-18	20-May-18
4	West Enhanced Stations contract award	June	08-Apr-18	20-Jul-18
5	Start Dynamic Testing in Zones 3 & 4	June	11-Jun-18	11-Jun-18
6	CBTC Authorised for FLU for Trial Running	June	22-Jun-18	26-Jun-18
7	ESS - ECHR Complete for Handover to Infrastructure Manager	July	03-Jul-18	17-Aug-18
8	Commence Trial Running	Aug	05-Aug-18	05-Aug-18
9	22no. CI.345 FLUs Available for Trial Running	Aug	13-Aug-18	29-Jun-18
10	CRL central section Safety Case updated and submitted to RABC	Sept	31-Aug-18	31-Aug-18
11	PAD - ECHR Complete for Handover to Infrastructure Managers	Sept	07-Sep-18	14-Sep-18
12	Submit APIS for Central Section to ORR	Sept	17-Sep-18	17-Sep-18
13	Commence Trial Operations - Stage 3 Central Section PAD to ABW	Sept	09-Sep-18	09-Sep-18
14	Class 345 CBTC Signalling auth for Passenger Service by ORR	Oct	10-Oct-18	02-Aug-18
15	LIS - ECHR Complete for Handover to Ms	Nov	24-Oct-18	24-Oct-18
16	Opening of Stage 3 - Central Section PAD to ABW	Dec	09-Dec-18	09-Dec-18
17	Plumstead - First Stage Maintenance Sidings and connection to COS	Dec	21-Nov-18	21-Nov-18
18	Plumstead Stabling Sidings - ECHR Complete for Handover to IMs	Feb	29-Mar-19	29-Mar-19
	Forecast later than Period 1 Baseline			
	Forecast earlier than Period 1 Baseline			

Figure 1 - 1 ~ Corporate Milestones

1.2 Central Section

The new Anchor Milestones data at Period 1 for actuals and forecasts has revealed that more productivity and milestone targets have not been met so that the actual/forecast curve now touches the [redacted] date baseline curve. Figure B - 1 in Appendix B indicates the overall cumulative progress. This is also illustrated by the actual/forecast curve moving towards the [redacted] date curves on the individual project charts in Appendix B and Appendix C.

¹ SS&P = Stations Shafts and Portals, FLU = Full Length Unit, ESS = Eleanor Street Shaft, ECHR = Element Completion Handover Report, ABW = Abbey Wood.

Figure B - 3 in Appendix B indicates 44 Anchor Milestones (21 in Period 13) which are forecast to be delivered later than the MOHS baseline [REDACTED] date. Many feature significant in-period delays. In some cases, these delays are minor and not critical, but others bring further stress to the overall programme. To date, CRL has only delivered 19 of the 28 due in MOHS 2018. Detail regarding progress of individual projects is included later in this report; see Sections 2 and 3.

The key issues are now:

- [REDACTED]
- [REDACTED]
- Installation and testing of ventilation systems has not been accelerated as planned by CRL, and has been further delayed, see Section 3.5;
- Energisation of non-traction power systems remains delayed following further problems at Limmo, see Section 3.5;
- Phase 3² integration testing continues under threat, mainly due to delays to communications software implementation, to installation of permanent ventilation, and to power-on dates, see Section 3.5;
- Delays to the GSM-R system continue to add risk to start of Trial Running, see Section 3.5;
- Draft handover Execution Plans have been submitted but these need to be urgently agreed by the IMs, see Section 3.4;
- [REDACTED];
- The completion of all Final Design Overview certificates and the production of Installation Release Notes are not being accelerated back to the original forecast and further delays are bringing significant risk to the Handover and safety approval process, see Sections 3.4 and 3.7;
- Competing demands for access to the Trace for dynamic testing and completion of installation continues to be critical with CRL now implementing blockade working, see Section 3.5;
- Tunnel walkways etc. cannot be installed before Trial Operations, see Section 3.5;
- CRL may not be able to agree, transition testing dates with NR on the GWML, see Section 3.6.3;
- [REDACTED];
- [REDACTED]

There remains a high risk that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018.

² The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

1.3 NR ONW

CRL and NR report that the ONW is 95% complete (previous 94%) based on expenditure of forecast cost, rather than actual physical progress.

On Crossrail West, the Kensal Green North compound was handed back to the developer, Ballymore, the Royal Oak OLE achieved Entry into Service (EiS), the West Enhanced Stations Package 3 tender submissions were returned to NR and are currently being assessed and the signalling works associated with the Hayes & Harlington bay platform were completed.

In the east, the platform 2 extension at Romford was handed over to RfL. Construction has commenced at the Shenfield Auto transformer site following the recent receipt of planning permission from Brentwood Borough Council.

At Abbey Wood, the station's car park, western and central interchange footbridges, mechanical and electrical fit out, Elizabeth line ticket hall and platform works are progressing for completion in June 2018.

At Period 1, NR reports that all works are on schedule to achieve Key Dates and Key Outputs, with the exception of the following. None of these represent any current critical risk and we will continue to track progress.

Stage 3; KD33 (Enable energisation of COS from Kensal Green as pre-requisite for dynamic testing in advance of Stage 3 introduction of Crossrail services (30 March 2018):

- The primary feed into Westbourne Park ATS was completed on 15 May 2018. The Central Operating Section (COS) was energised from Kensal Green on 22 May 2018, generally in line with the agreed schedule between CRL and NR.

Stage 5; KO5A (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) and KD22 (Route clearance & all other infrastructure, including stabling & sidings updates, complete to support Stage 4 Dynamic Testing) (10 September 2018):

- [REDACTED]
[REDACTED]
[REDACTED] We will monitor progress and mitigation proposals.
- In the KO5A area, the platforms have been lengthened, new lifts and new station SISS (exc. Ilford) have been installed and NR communications systems reconfigured to the RCC, however there remain outstanding issues for:
 - DOO Stratford & Shenfield;
 - Goodmayes Platform 1 lift;
 - Harold Wood ticket Hall;
 - Delays to finishing works at Manor Park and Maryland that are sequenced for commissioning post ONSIP Completion.

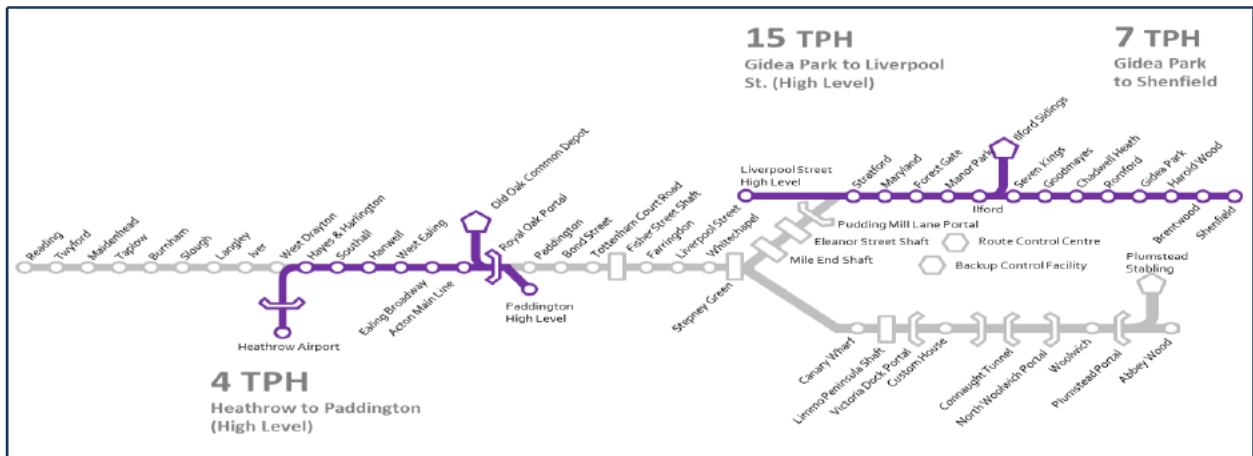
Stage 5; KO5B (Full Infrastructure Capability from Reading to the Central Core Area at Westbourne Park to support the operation of new Crossrail trains across the full Crossrail Network) and KD24 (Infrastructure complete to support Stage 5 Dynamic Testing) (10 September 2018):

- Construction of the Traction Switching Station at Paddington can only be achieved during the prospective Christmas 2018 possession. NR is investigating the available options, but KO5B remains at risk. However, works are progressing to the current delivery plan with the outer area AT system available to commission from May 2018 and

the inner area AT system available to commission from July 2018. The actual dates are constrained by the completion of the 12kA resilience work. The conversion to AT power on the western route is forecast for December 2018, the later date as a result of the separate NR 12kA power resilience works which requires either additional access prior to, or delivery at, Christmas 2018. NR is carrying out access work streams in parallel with modelling the September 2018 – January 2019 timetable demands on power draw, although NR has already confirmed that the power upgrade is not required prior to September 2018.

Refer to Sections 2, 4 and 5 for further information regarding NR works required for each Stage completion.

2 Stage 2: Phase 1; 20 May 2018. Phase 2; [Date TBC]



2.1 Summary

Stage 2 Phase 1 commenced on 20 May 2018. Stage 2 Phase 2 does not have a confirmed start date, however Sponsors have requested this is achieved by the end of February 2019.

Phase 1 started as planned on 20 May 2018.
Key challenges for achieving Phase 2 in February 2019 are the train’s software development, which is at risk, and minimising the length of the driver training programme.

2.2 Operational Readiness Assessment

Stage 2-1 opening was achieved on 20 May 2018, so we will no longer discuss its dashboard.

CRL’s Stage 2-2 dashboard categorised one issue as ‘red’ for Phase 2. This was ‘Train Readiness’; see below.

2.3 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In our last report we described two interim activities that are required before formal ETCS testing can start in August 2018. They were:

1. Software code freeze – 15 May 2018.
2. Type testing of software on the train – 23 June 2018.

We understand that activity 1 is at risk, and is being investigated. Activity 2 is now forecast for 10 July 2018. The key milestone ‘Approval to Operate ETCS for Driver Training’ has been held

at 12 October 2018. This implies that schedule contingency has been eroded, which increases the risk that the date may slip.

The functional testing in the Alstom laboratory has been completed. All 20 planned tests were completed, and only one failed. The CRL project team is content that the exercise was useful, and shown that there is a reasonable basis for achieving compatibility between the BT and Alstom systems.

Operations

The key operational issue to delivering Phase 2 is the period required for driver training. This is because drivers do not have long periods to train in, due to the limited length and access arrangements of the Heathrow spur. RfL and MTR-C are working to address the issue during workshops in June, such as identifying the minimum number of drivers required, maximising the use of the simulator and deferring elements of the courses.

The project teams understand that they should be planning to start services by the end of February 2019, and are currently seeking to understand what are the key impediments to that objective. An example would be the availability of resource which is also required for Stage 3 planning.

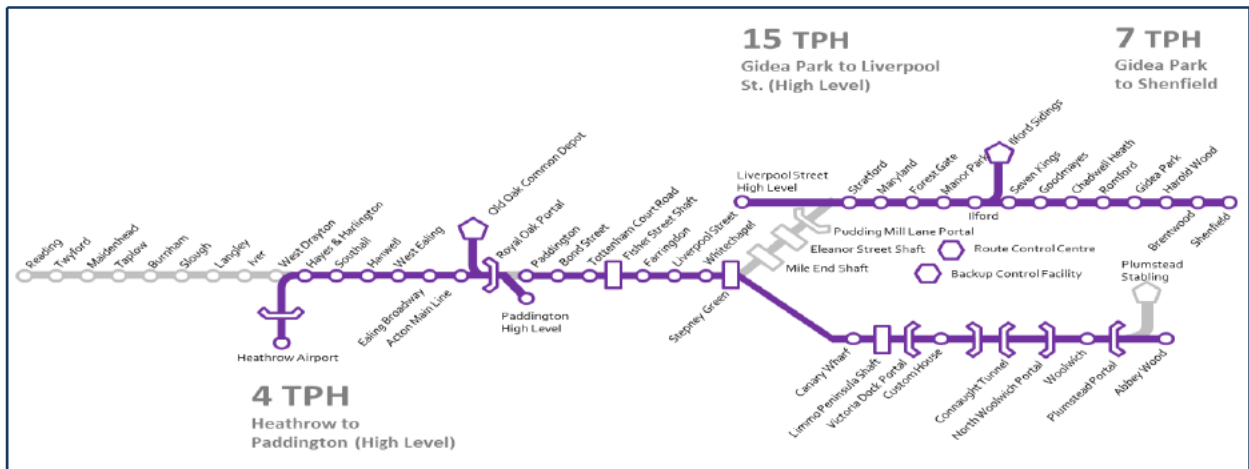
Regulatory Approvals

There are three key approvals for Phase 2 issued by the ORR:

- APIS GSM-R data to NR (achieved in this period);
- APIS ETCS trackside to be issued to NR;
- APIS ETCS on-board to be issued to BT.

APIS ETCS trackside is scheduled to be submitted in early June, and is considered to be at low risk. The APIS ETCS on-board schedule, culminating in a submission to ORR by 15 October 2018, is linked to the development of the signalling programme, and so must be considered as 'amber'.

3 Stage 3: Paddington to Abbey Wood; 9 December 2018³



3.1 Summary

There remain significant challenges on all fronts, and there remains a high risk that one or more stations will not be ready, and that Stage 3 Opening will not be achieved on the planned date. CRL has recently advised that Trial Running and Trial Operations target dates will be delayed, and that a checkpoint system will be implemented to manage progress.

Trial Running and Trial Operations target dates will be delayed.

Sixteen Readiness Tasks have been given a “Red” by the ELRSG.

Train software programme has undergone some slippage, eroding float.

Continued schedule pressures and further delays at Stations, Shafts and Portals.

Completion of IRNs still remains significantly behind the rate required to support MOHS.

Systemwide schedule pressure is building as delays occur.

Concern continues to grow over the readiness of some Stations, Shafts and Portal sites to start Phase 3 testing.

[REDACTED]

Completion of the permanent ventilation system remains the most difficult challenge to resolve.

Handover materials continue to make slow progress, likely to impact upon Trial Running, Handover and Trial Operations

Slow progress with submissions to RAB-C has made key regulatory approvals become ‘red’.

³ Stage 3 Completion of Trial Running is currently 9 September 2018; Stage 3 Opening is 9 December 2018.

3.2 Operational Readiness Assessment

We have recently been made aware that CRL is planning a change to the Trial Running and Trial Operations dates. This is not unexpected and we will report on the detailed proposals in our next report.

There are sixteen Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)⁴, a decrease of four from the previous report. Those Tasks that improved, or have closed, are shaded grey and will be removed in our next report.

Five of the tasks are rated as ‘medium’ impact, but have a cumulative impact upon RfL-I maintenance and LU Handover, which is rated as ‘high’ impact. The sixteen Readiness Tasks can be attributed to three categories, and are the same issues as last period:

- [REDACTED] This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway;
- COS infrastructure and interfaces not being in a position to support dynamic testing;
- Train software not being in a position to support dynamic testing.

These Tasks map across to MOHS18 and its key milestones which are discussed later in this Section.

	Readiness Task	Issue
Dynamic Testing Zones 1-2		
	Delivery of FLU with functioning CBTC	MOHS dates are being exceeded, and the testing windows have not been efficient, increasing the pressure upon the more limited time for testing. See Section 3.8.
	MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material continues to be in delay. See Section 3.9.
	RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	FDO certificate dates continue to be delayed. See Section 3.7.1.
	Possessions & isolations agreed and booked	There has been progress in the booking of required possessions and isolations
Dynamic Testing All Zones		
	Interfaces commissioned & operational for Trial Running	There is more certainty concerning asset readiness which allows for plans to be developed.
	NEW All Technical training delivered to MTR-C trainers	MTR-C is now raising similar issues to RFL-I concerning delayed training programmes. See Section 3.9
	LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material continues to be in delay. See Section 3.9.

⁴ Meeting held 4 May 2018.

	Readiness Task	Issue
	Compliance Achieved (FDO signed without caveat)	Issue raised in 'RfL-I acceptance of FDO (for interfacing assets). See Section 3.7.1.
	O&M manuals in place for 5 LU stations <i>Medium impact</i>	[REDACTED]
	LU maintenance in place for Handover <i>Medium impact</i>	There has been progress with regard to provision of asset data and spares information. [REDACTED]
	All tech training delivery to RfL-I trainers	[REDACTED] See Section 3.9.
	O&M manuals for RfL-I completed	[REDACTED]
	System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	[REDACTED]
	Systemwide approvals and agreements in place for DT	This reflects the delay associated with Zones 3 & 4 readiness.
Trial Running		
	Sufficient 345 units available to support 24tph tests	FLU's have been manufactured, but there may be issues with sufficient numbers meeting the acceptance criteria for the start of Trial Running. See Section 3.8
	MTR-C Station Handover	Grading reflects the late completion of Paddington and Woolwich stations.
	Element Completion Handover Certificate signed by LU	LU has down graded the task to amber. Considering the status of O&M manuals, and that 'LU handover achieved' is red we think this should remain red.
	RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.9.
	RfL-I Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] Simulator software 'drops' at the RCC have affected the Traffic Manager training programmes. Some will not be trained until after Handover. In addition delays to the start of Trial Running/Trial Operations will reduce the time for the staff to familiarise themselves with the railway.
Trial Operations		
	LU Handover achieved	This task is Red due to the items listed above.
Stage Three Service		
	LU Staff Ready to Open for Revenue Service	LU has reviewed the task, and believes it will have staff recruited and in place at the point the station is able to enter service.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 3 - 1 ~ Readiness Tasks with "Red" Status

3.3 Tunnels

CRL is targeting completion of all certification activities, for the remaining () tunnelling contract, by the end of May 2018. Backfilling of Access Shaft AS1, above the central concourse tunnel at Finsbury Circus (Liverpool Street), by the station contractor () is now forecast for completion by 24 September 2018.

3.4 Stations, Shafts and Portals

Continued schedule pressures and further delays are becoming apparent, following the recent re-baselining of MOHS in February 2018. The delays are evident in CRL’s performance from; the percentage progress, schedule performance curves, progress milestones and IRN completion reports across all of the station contracts.

The cumulative plan and actual percentage completions, reported for stations, now clearly show increasing signs of delay. What were minor differences between the planned and actual percentage completions, reported in Period 13, have now started to become widening variances in Period 1. We are concerned at the rate of deterioration that appears to have occurred in only one period. Refer to Appendix C, Figure C - 1, a summary of the Period 1 percentage completions against the re-baselined plan.

The developing gaps, between planned and actual percentage completions at the stations, are also evident in the deterioration in the station schedule performance curves; where nearly all of the “actual” curves have moved towards the “ Date” profile curve. While the actual/forecast curves still remain within the re-baselined MOHS Date envelope, the delays incurred will make achievement of the MOHS even more challenging. Actual and forecast schedule performance curves for MOHS 2018 can be found in Appendix C, Figure C - 2 to Figure C - 8 inclusive.

Increasing schedule pressure and lower than planned levels of progress at the stations can also be seen in the number of milestones missed during Period 1; suggesting that additional key Anchor Milestones are coming under increasing risk of being missed. All of the stations failed to achieve the milestones planned for the period and a number still forecast that further milestones will be missed in Period 2. CRL has not reported a cumulative station milestone performance this period; although individual station’s performance, reflecting further delays, can be seen in the Sections below. Last period we were able to report that a number of the missed milestones were a result of a failure to achieve the submission of documentation by the targeted date. This period, it appears that many of the missed milestones were associated with the targeted delivery of physical works.

CRL delivered 3 out of 7 key Anchor Milestones for stations during the period. This is a cumulative 19 against a planned 28 to date. CRL has stated that many of these missed Anchor Milestones do not affect MOHS or the start of trial running.

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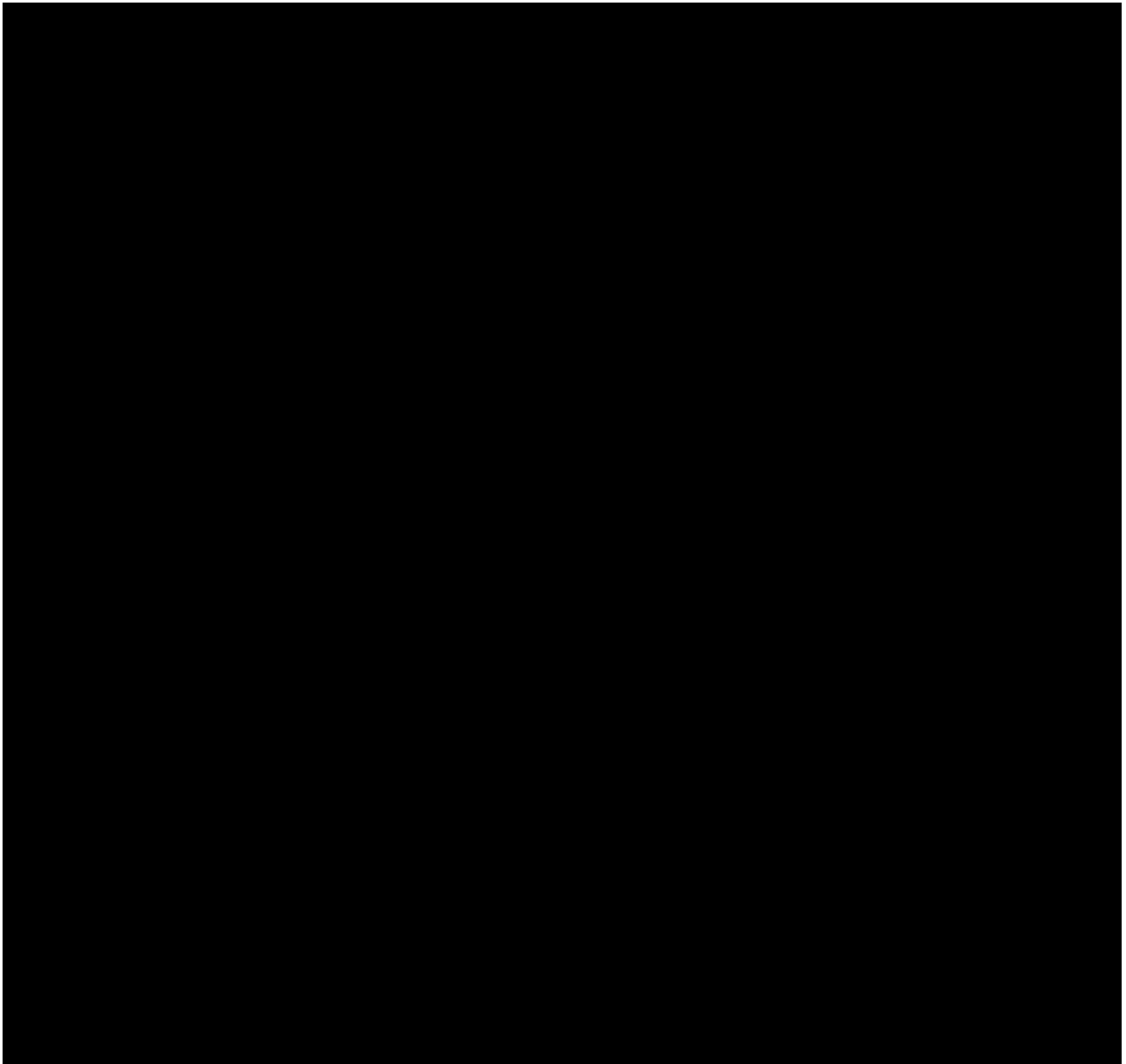


Figure 3 - 2 ~ Summary of Forecast Central Section Station Completion Dates

The general progress of the station works, in readiness for Testing and Commissioning, is being measured by the various Tier 1 contractors' production of Installation Release Notices (IRNs).

There are now an estimated 3,953 IRNs required for the Stations, Shafts and Portals (SSPs). By the close of Period 1, only 1,280 IRNs had been signed-off. This represents an increasingly negative variance against plan of 883 IRNs (719 in Period 13). These figures show that CRL has completed 32% of the IRNs against a planned 55% for the stations, portals and shafts.

The actual rate of completion of IRNs achieved are noted by station in the Sections below.

The evolution of Handover Execution Plans (HEPs) has continued during the period, with most including arrangements for Staged Completion. All SSP sites had submitted their HEPs to CRL, and their respective IMs (LUL/RfL) for review, by the close of Period 13. Comments are now being fed back from the IMs and amended HEP submissions, addressing the comments, are to be completed for re-submission and approval by the end of May 2018.

Tottenham Court Road Station

[Redacted]

[Redacted]

[Redacted]

- | [Redacted]
- | [Redacted]
- | [Redacted]

Farringdon Station

[Redacted]

- | [Redacted]
- | [Redacted]
- | [Redacted]

[Redacted]

Liverpool Street Station

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

Whitechapel Station

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

[Redacted]

Woolwich Station

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

[Redacted]

[Redacted]

Canary Wharf Station

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

Intermediate Shafts

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]



3.5 Completion and Handover of Integrated Systems

Achievement of MOHS 2018 remains highly reliant upon the performance of the [REDACTED] main works contractor, ATC, as the principal enabler for delivery of the Central Section. There is significant pressure upon the other Systemwide contractors to complete their own work scope at the same time, and it remains CRL’s challenge to work closely and collaboratively with all, to meet the key MOHS milestones of Trial Running, Trial Operations and Stage 3 Opening. Prioritisation of works is allowing these milestones to be held, at least for the time being, but schedule pressure is building as delays occur, as the time remaining reduces, and as the detailed scope and timescales for completion become clearer.

Last period we described CRL proposals to implement “blockade working”. This was a fundamental change in delivery approach, which sought to address the constraining effects and inefficiencies of Systemwide delivery and dynamic testing in a tunnel environment, inherent in a day/night access cycle. The basic working pattern is for each two week period up to Trial Running to be split between 11 days of construction and 3 days of dynamic testing, with the objective of completing Central Section Railway Systems installation before the start of Trial Running. The dynamic testing windows are set out in Section 3.6.1.

Key dates in the dynamic testing phase through to Trial Operations are shown in Figure 3 - 3, with Systemwide progress forecasts to completion illustrated in the charts in Appendix B. These curves are necessarily simplified but actual performance has slipped from plan. We provide more detail on the key period achievements and areas of risk below.

Key Dates	MOHS 2018	P13 Actual / Forecast	P1 Actual / Forecast	
Traction Power Energisation	01-Feb-18	01-Feb-18	01-Feb-18	
Commence DT in Z1&2	25-Feb-18	25-Feb-18	25-Feb-18	
ONW KD33 Power from KG	28-Feb-18	21-May-18	21-May-18	
4 Trains ready for DT Z3&4	23-Mar-18	15-May-18	07-Jun-18	*
Fibre Backbone complete	07-May-18	07-May-18	15-May-18	*
ATS at WBP energised	07-Apr-18	27-Apr-18	17-May-18	*
Traction Power on Z3&4	10-May-18	21-May-18	21-May-18	
Linewide SCADA available	30-May-18	30-May-18	31-May-18	*
Commence DT in Z3&4	11-Jun-18	11-Jun-18	11-Jun-18	
HV Non Traction Power on	01-Jul-18	29-Jul-18	29-Jul-18	
Commence DT All Zones	02-Jul-18	02-Jul-18	02-Jul-18	
Commence Trial Running	05-Aug-18	05-Aug-18	05-Aug-18	
Commence Trial Operations	09-Sep-18	09-Sep-18	09-Sep-18	

* In-period delay

Completed on time

Forecast later than MOHS

A557 - MOHS baseline date changed from 27/3/18 to 7/5/18 under change control 103

Figure 3 - 3 ~ Key Dates to Trial Operations

Blockade working was implemented for the first time on 26 April 2018, with one construction blockade and two Dynamic Testing windows completed to date. Progress in the period indicates that improved efficiencies necessary to sustain the MOHS dates for Rail Systems installation in the tunnels may be achievable in the longer periods being made available. Performance to date suggests that blockade working provides the most robust schedule basis for final delivery.

While a Supplemental Agreement has now been executed⁵ which commits [REDACTED] to MOHS 2018, a delivery schedule which demonstrates schedule alignment throughout has yet to be produced. Forecast completion of certain workstreams extends beyond their respective MOHS milestones⁶ and work continues to identify mitigating measures; we have summarised these workstreams below. In practice, the non-negotiable Railway Systems delivery pre-requisites to Trial Running, and to key milestones such as traction power energisation and dynamic testing in Zones 3 & 4 (listed in Figure 3 - 3), are well recognised. They are prominent in all Systemwide contractor working schedules and remain significant interim completion targets.

A notable period achievement has been [REDACTED]'s completion on 15 May 2018 of all Overhead Catenary System (OCS) works, including assurance documentation, in Central Section Zones 3 & 4 and at Westbourne Park. Success has been driven by lessons learned from Zones 1 & 2, with particular management focus on right-first-time completion. Appropriate resource levels have been applied, allowing the delivery of all IRNs with minimal snags. This completion was critical to first OCS energisation in Zones 3 & 4, achieved on 22 May 2018, which in turn provides just enough time for progressive energisation and short circuit testing ahead of dynamic testing on 11 June 2018.

NR achieved a number of critical sequential activities ahead of OCS energisation, including the energisation of WBP ATFS on 17 May 2018 and the installation of the last of three Permanent Earthed Sections (PES) at Westbourne Park on 20 May 2018.

C660 has achieved the completion of integration of the Zones 1 & 2 and Zones 3 & 4 elements of the Crossrail Data Network on 7 May 2018; as a result, all network switches are “visible” from the RCC. All fibre links to support Zones 3 & 4 energisation are available and C660 is on target to deliver line-wide SCADA on the MOHS date of 30 May 2018.

[REDACTED] software development is now under better [REDACTED] management control, and is seen as less of a risk than in previous periods⁷. While the software delivery schedule is not fully aligned with MOHS, Trial Running is fully supported. Intermediate software drops synchronised with localised Phase 3 testing site requirements continue, allowing late-running Stations completion workstreams to continue without further delay. [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]. Further details are provided in Section 3.4.

We have previously described the critical “daisy-chain” sequence of HV sub-station energisations (i.e. both 11kV and 22kV) across the Central Section. We reported last period how readiness issues with [REDACTED] installations at Limmo had resulted in an irrecoverable 4 week delay to the sequence, but that a stable revised schedule leading to completion on 29 July 2018 had been prepared. Unfortunately, a Voltage Transformer (VT) failure on 17 April 2018 at Limmo has resulted in detailed site and factory investigations into all such equipment, leading to

⁵ Confirmed at the CRL C610 Period 1 PDB held on 9 May 2018.
⁶ CRL MOHS Period 1 Review held on 11 May 2018.
⁷ Confirmed at the CRL C660 Period 1 PDB held on 9 May 2018.

the identification of a manufacturing defect affecting both 11kV and 22kV installations. Further energisations involving the original VTs have been postponed pending replacement; a safety justification has been developed and agreement has been reached that those VTs already energised can remain so, albeit with restrictions upon staff access and proximity. The schedule impact of this latest failure is being established by [REDACTED] and CRL, although there is some confidence that it will be limited because a supply of replacements (with the defect already corrected) is available.

Platform Screen Door installation in the Central Section is nearing completion. The last module was recently installed at Whitechapel and doors at Canary Wharf have been operated under power. RAB(C) approval for the integration of PSD, signalling and train control systems through dynamic testing in Zones 1 & 2 has been approved, and while the [REDACTED] schedule does not align fully with MOHS, completion works are being prioritised to support the dynamic testing programme.

GSM-R delivery has responded well to increased management focus in the period, and all of the Zones 1 & 2 Base Stations have now been successfully integrated into the NR GSM-R national network; however, concerns remain with progress in Zones 3 & 4, with only 25% of the tunnel radiating cables installed by C610. As a consequence, Trial Running is at risk. CRL works closely with C610 to raise GSM-R priority, and continues discussion with NR to secure its support to future testing.

[REDACTED]

The workstreams which are unable to be accelerated sufficiently to meet MOHS, and will therefore extend beyond the current start date for Trial Running (and possibly Trial Operations) are as follows:

- [REDACTED] non-dynamic testing critical works (e.g. walkways, lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system completion and testing;
- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

Of these, the completion of the [REDACTED] permanent ventilation system remains the most significant and difficult challenge to resolve. The current forecast completion date for Phase 3 testing has moved out to 28 September 2018, driven by delays at [REDACTED], and this is beyond the deadline of 9 September 2018 for start of Trial Operations. Investigations are taking place into the feasibility and acceptability of completing all necessary testing which will allow Trial Operations to start, but with reduced or no ventilation functionality at [REDACTED]. Ventilation system completion is strictly not required ahead of Trial Running. We will report further on this critical issue next period.

Working arrangements continue to be developed between CRL and RfL that will allow the completion of these known late activities, from the time of Handover and into the Trial Running and Trial Operations periods. A balance must be reached between readiness of assets for handover to RfL, the nature and extent of the outstanding works, and the actual start of the Trial Running period. At this point, RfL becomes the IM and the RfL Rule Book applies, imposing a fundamental change of safety regime and delivery approach upon CRL's contractors. This will

effectively remove CRL’s relative “freedom” to deliver when it needs to, and instead constrain CRL to complete under RfL safety rules, and at times to suit RfL’s operational readiness workstreams⁸. Opportunities and options for Trial Running, Trial Operations and Stage 3 Opening must continue to be jointly explored.

3.6 Dynamic Testing

3.6.1 Dynamic Testing Management

Dynamic testing started on 25 February 2018, alternating in a day/night cycle with construction activities. Principally for reasons of poor efficiency and productivity, this was abandoned in favour of a “blockade approach” in which more substantial blocks of time are allocated to construction and testing activities within 14 day periods up to Trial Running. Blockade working started on 26 April 2018, with dynamic testing windows planned as follows:

1. 26 – 30 April 2018 (Zones 1 & 2);
2. 10 – 14 May 2018 (Zones 1 & 2);
3. 22 – 26 May 2018 (Zones 1 & 2);
4. 7 – 12 June 2018 (Zones 1 - 4);
5. 21 – 26 June 2018 (Zones 1 - 4);
6. 5 – 10 July 2018 (Zones 1 - 4);
7. 19 – 24 July 2018 (Zones 1 - 4).

Lessons from each dynamic testing window are being transferred to subsequent windows. In practice, and as anticipated, the balance between construction and dynamic testing within the 14 day cycle is being adjusted according to progress on site, and in order to prioritise works at the NR interfaces. We anticipate further and more substantial adjustments to allow longer periods of dynamic testing in June and July 2018, assuming good general progress with signalling testing.

[REDACTED] Testing in the Central Section is being complemented by off-site testing at BT’s facilities at Derby, and at Melton Test Track. Satisfactory initial integration testing at Derby allows software to be released to Melton. See Section 3.8 for a summary of BT software delivery progress.

Further integration support is provided through the use of the two Crossrail Integration Facilities (CIFs) located at Westferry Circus and at the [REDACTED] offices in Chippenham. CRL has recently decided to relocate the Westferry Circus CIF to Chippenham, to allow the two facilities to be operated in close proximity to one another. This will introduce significant efficiencies, simplifying in practice the process of comparing test results between what will remain independent facilities, and through the better use of scarce testing resources.

The dynamic testing sequence has two principal elements:

- Zones 1 & 2 (EDT);
- All Zones (i.e. Zones 1 - 4).

⁸ Re-affirmed by RfL at the CRL MOHS Period 1 Review held on 11 May 2018.

3.7 Approvals, Assurance and Agreements

3.7.1 Final Design Overview (FDO) Performance

Progress on the closure of FDO “Red” issues associated with the stations and shafts has already been noted in the Section 3.4.

The close-out of FDO “Red” issues continues to frustrate CRL and the forecast dates for FDO certification continue to slip month on month. CRL is now targeting the close-out of all outstanding “Red” issues by the end of May 2018, although this is very unlikely.

An FDO certificate is a prerequisite for Interim Acceptance and Handover of the new assets to the IMs:

- 25 “Red” issues have now been closed or downgraded to “Amber” (45 in Period 13);
- 36 “Ambers” were closed in Period 1 (72 in Period 13);
- This leaves a total of 102 (127 in Period 13) “Red” issues open;
- Reports and Certificates were finalised and issued to RfL for Acceptance. Mile End shaft, Victoria Dock portal, Whitechapel, Limmo shaft, North Woolwich portal, Tottenham Court Road and Fisher Street shaft now have zero “Red” issues;
- FDOs were also held for Westbourne Park and Plumstead sub station;
- IAs were held for Canary Wharf and Farringdon stations, Eleanor Street shaft and Royal Oak portal.

3.7.2 Interoperability

A NoBo Workshop was held on 24 April 2018 to build an overview of the remaining Interim Safety Verification evidence, Testing & Commissioning and Site Visits. With the general overview of the evidence documentation status, Ricardo Rail (RR) is now able to build a comprehensive Programme identifying the activities to be progressed. Whilst the majority of dates have been built in a collaborative manner, a number of activities have been set by RR to identify the inter dependencies and to cover all the deliverables for the targeted 17 September 2018 submission.

RR acknowledges that evidence information will be released after the 17 September 2018. While there is an agreement in principle with the ORR, it is understood that CRL will provide greater clarity on the progressive release of information at the next planned ORR Executive meeting on the 8 June 2018.

The NoBo remains concerned at being able to provide a fully supportive Technical File/SAR; but, with the current focus on programming and defining the missing evidence, building a supportive Technical File submission is being de-risked progressively around known deliverables.

The Interim Safety Verification for Abbey Wood station cannot be concluded until NR supplies the remaining PRM TSI evidence. In a recent DfT/ORR liaison meeting, NR stated that evidence would be provided before Easter, but nothing has been delivered yet. This needs to be delivered by September.

An AsBo/CRL workshop was held on 18 April 2018. Working relations were discussed and dates developed for evidence release. A commitment was made by CRL to close the currently open Assessment Records within 30 days from 19 April 2018. This gives a planned closure end date of 19 May 2018. We await RR’s Period 2 report for confirmation.

The AsBo’s major concerns in the context of finalising the SAR in 3 months are:

- The development of a resource loaded programme, now that a key workshop has been held. This will be needed to confirm viability of an on-time delivery of the SAR;
- Adequate detail of the CRL processes for confirmation of compliance for the safety requirements;
- Finalisation of the System Definition, System Safety Plan and contractor plans. The AsBo has been advised by CRL, that the majority of main contractor plans detailing the build, validate and integrate stages of their contractual commitments are now being updated. This is extremely late; nevertheless, the AsBo will endeavour to update its own planning based on this available information;
- The need for a clear approach to managing evidence, outstanding at submission, for APIS.

The AsBo’s Period 1 report summary remains largely unchanged from that in the previous period. The AsBo concludes, in respect of progress to a supportive SAR, that:

- The SAR is not supportive;
- CRL has postponed the SAR and the AsBo awaits redefinition of a programme that de-risks the final SAR submission;
- There is an increasing risk that the Final SAR will also be unable to support APIS. CRL has advised the AsBo that it does not expect to have all evidence available by the time that the AsBo has indicated it must commence production of the final CRL SAR. The workshop agreed that it was necessary to establish adequate detailing to confirm viability. The intention was to present the SAR to the ORR in early June 2018, however CRL now propose a submission in September 2018.

The AsBo continues to urge CRL to commit to the required actions identified for each of the concerns summarised above. The time to address these issues is running out.

The AsBo has completed its assessment of CRL’s Engineering Safety Manual. There remain outstanding concerns that are pertinent to future activities, including finalisation of the CRL justification of safety and compliance.

3.7.3 RAB(C)

RAB(C) has continued to prioritise CRL submissions which support dynamic testing progression ahead of others.

Following concerns reported last period, there have been improvements in submission development by CRL resulting in RAB(C) acceptance of the Safety Case for Zones 3 & 4 Energisation. This was a significant pre-requisite to the Go/No-Go meeting on 17 May 2018, at which readiness for OCS energisation was reviewed. See also Section 3.5.

However, the situation for the Safety Case for Zones 1 & 2 Dynamic Testing with Signalling Protection is less promising. We reported last period that a version of the submission was accepted by RAB(C) on 12 April 2018, allowing testing with a single train only. [REDACTED]

[REDACTED]

[REDACTED] Lack of this evidence and the inability to integrate it into the overarching argument prevents dynamic testing moving on to multiple train operation, risking delay to the dynamic testing schedule. Further information is provided in Section 3.8.

In the meantime, a large workload of late and deferred submissions remains, and there have been no significant improvements in the production by the Contractors of the documents that

underpin the various Safety Cases. Performance is only around 50% of that required to meet MOHS. CRL concern remains with contractor resource de-mobilisation before work has been completed. The forecast date for securing the APIS for Central Section assets has slipped from mid-September to mid-October 2018.

The key Engineering Safety Management submissions for the Stage 3 Safety Case are shown in Figure 3 - 4. These documents are critical to the achievement of Stage 3 Opening and, while recovery efforts are being made, it is becoming increasingly difficult to contain the schedule impacts.

No	Key Dates	MOHS 2018	Period 13 actual / forecast	Period 1 actual / forecast
1	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18	23-May-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	31-Mar-18	30-Jul-18
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	30-Apr-18	10-May-18
4	Contractors submit final ESJs to CRL	30-May-18	30-May-18	30-May-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	07-Jun-18	07-Jun-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Jun-18	30-Jun-18
7	Final COS Safety Case updated and submitted to RAB-C	31-Aug-18	31-Aug-18	31-Aug-18
8	Submit Technical File to ORR	17-Sep-18	17-Sep-18	17-Sep-18

Figure 3 - 4 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

3.7.4 Regulatory Approvals

CRL has continued to judge the overall rating of Stage 3 as ‘amber’, but there has been a deterioration in one of the 9 approvals being tracked. This is ‘ORR issues APIS for Central Section’, which is now assessed by the regulatory approvals team as ‘red’. The change from amber is due to the delay in providing submissions to RAB-C for approval.

The other approval that is rated ‘red’ is ‘Safety Approval Bodies Final sign-off’. This is also primarily due to the RAB-C submission schedule being behind plan. For instance, 35 submissions are planned for May 2018, but there is an expectation by the regulatory team that only 12 will be achieved.

An overall rating of ‘amber’ does not reflect the task required to complete CRL’s safety deliverables, and a ‘red’ rating would be more appropriate.

3.7.5 Agreements

There are five agreements that are adjudged to be amber:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- IM Interface manual between NR and RfL-I;
- Development Service Agreement, as above;
- Co-operation Agreement, as above.

The Umbrella Property Agreement was beginning to make progress since its profile was raised by CRL’s Managing Director. However, difficulties are still being reported. Fortnightly meetings are now taking place to try and provide some momentum.

The focus must now be upon the other amber items, of which the majority concern RfL-I establishing its relationship with NR as an IM. There is little float left to resolve these issues. See charts in Appendix D.1.

3.8 Rolling Stock and Depot

Rolling Stock

BT has now signed the Deed of Amendment that confirms its programme will prioritise Stage 3 activities. BT has already been working to the revised programme since Period 11.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

OOC

Section C BIU has incurred a delay of approximately 10 days from P13, and is now scheduled for 11 June 2018. RfL is likely to require Section C by mid-July 2018, so at the moment the risk to capacity is manageable.

Both Sections B and C will not be signalled until 23 August 2018. Route setting agents will need to be deployed until that point, and MTR-C, RfL and BT are engaged with devising operating procedures that minimise risks to safety and performance. This is essential, as the depot will be carrying out Stage 2 services and Trail Running activities during this period.

3.9 Handover

The rate of progression of the key Handover tasks does not align with IM readiness for Trial Running. This has been highlighted during the recently completed Completion Readiness Assessment Framework (CRAF) workshops between CRL and its contractors. The executives of the Tier 1 contractors have agreed to accelerate production⁹, but this will be a difficult task.

We are concerned that the large mass of data concerning Handover material is acting as an impediment to identifying solutions to the situation.

Training

[Redacted]

⁹ Crossrail Industry Group – 11 May 2018.

[Redacted]

O&M Manuals

[Redacted]

Spares

RfL remains concerned, as it has a number of open queries with CRL. Nevertheless, the Operational Readiness dashboard no longer has any spares tasks graded as 'red'.

Asset Information

CRL has advanced in providing the number of assets (asset information drop 1). There has been slow progress in developing the location of assets (asset drop 2). The other drops are equipment type (drop 3) and attributes (drop 4). So far RfL-I's position is:

Drop	Content	% accepted
1	Number of assets	87
2	Equipment	31
3	Location	6
4	Attributes	38

The lack of information, particularly concerning drop 2, could make it difficult for RfL to demonstrate that it has robust plans for maintaining the railway at the start of Trial Running.

3.10 Trial Running and Trial Operations

There are three areas that we highlight.

[Redacted]

[Redacted]

[Redacted]

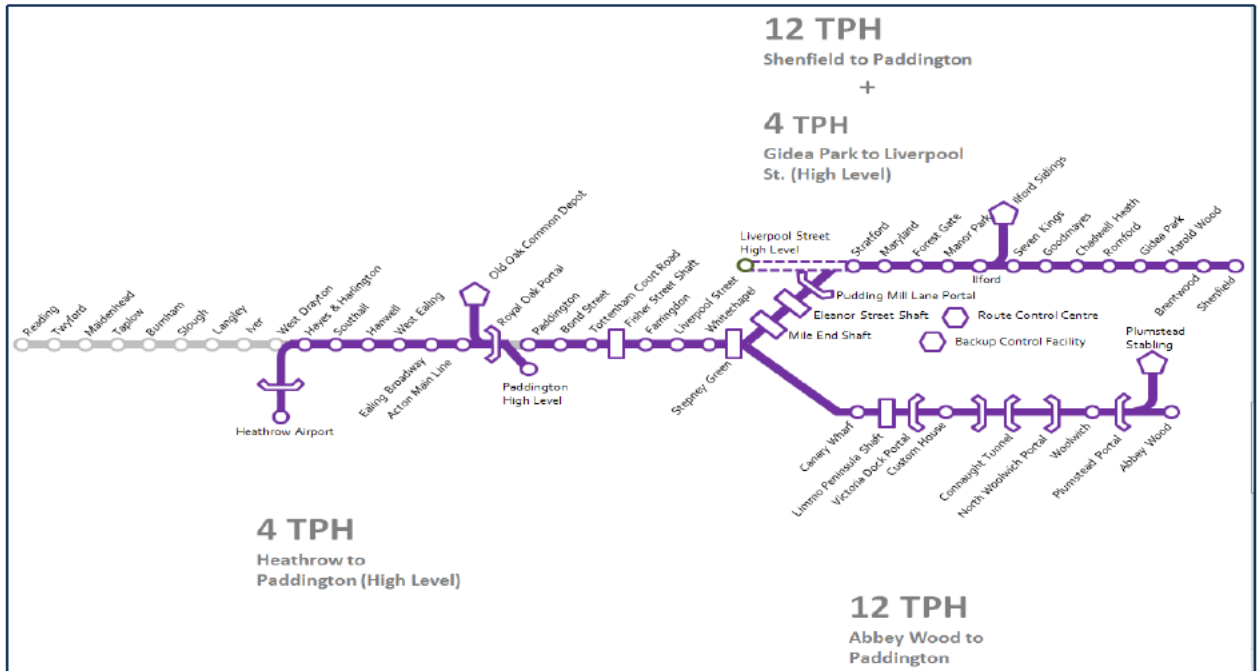


3.11 Plumstead Depot

Modifications to Plumstead Old Coal Yard are well in hand and the transfer of construction support facilities will be timed to suit Central Section completion and the land requirements of C695 Maintenance Facility.

The FDO for Plumstead Maintenance Facility and Stabling Sidings took place on 29 March 2018 with no significant issues revealed. 5 Red issues remain to be closed-out by the end of May 2018, with 4 closed in the period.

4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.



4.1 Summary

The main risk to Stage 4 Opening is the power upgrade works by NR.

4.2 Operational Readiness Assessment

There are four Readiness Tasks that have been given a “Red” status by the ORSG¹⁰, no change from our last report.

Readiness Task	Issue
Wire height alignment corrected to standard in Ilford Depot	Surveys are underway, and the results being assessed. CRL is seeking to minimise the scope. MTR-C want to stable 4 vehicles in Ilford to support Stage 3 services.
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The programme remains forecast to complete on 29 March 2019, but there are significant risks to that date. CRL and RfL are planning for a scenario where there is insufficient power to operate the planned timetable.
Ilford Station Redevelopment	As noted in Section 4.4 below.

¹⁰ 23 April 2018.

	Readiness Task	Issue
	DOO CCTV installed and operational Stratford and Shenfield stations	<p>There has been agreement in principle with AGA concerning Shenfield station.</p> <p>Stratford is proving problematic. NR stress it is very difficult to site cameras without recourse to adjusting station infrastructure (eg. canopies). MTR-C stress use of cameras is vital for performance (ensures efficient despatch).</p> <p>Discussions continue.</p>

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

4.3 Ilford Depot Line Speed Enhancement and Wire Heights

The scope of work for Ilford wire heights is reducing, although arrangements need to be agreed with AGA. Following recent surveys of the existing depot OLE, CRL is reinvestigating the requirements for wire heights and is expected to report its findings in Period 2.

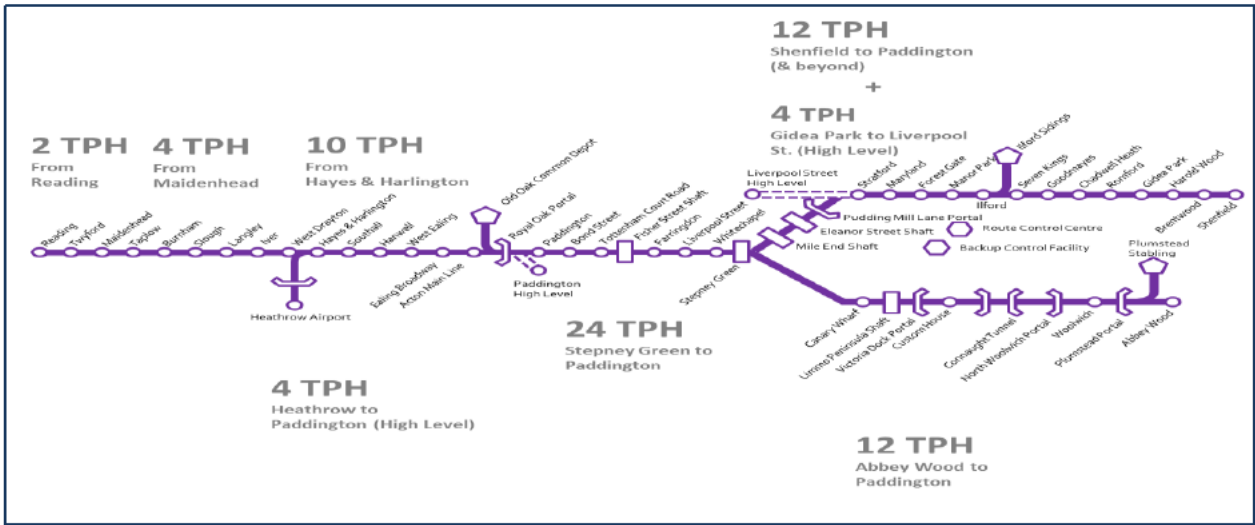
4.4 Ilford Station

NR continues to report that the GRIP5 design and GRIP6 delivery procurement for Ilford station remain on schedule with no changes to the forecast dates confirmed in Period 13 and that it remains committed to station opening for December 2019.

4.5 Plumstead Stabling Sidings

The Supplemental Agreement for delivery of the Stabling Sidings (under C696) has been signed-off by C610, allowing ATC to formally act as contractor for the works.

5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.



5.1 Summary

There are a number of concerns, but these are being mitigated. [REDACTED]

5.2 Operational Readiness Assessment

There are four Stage 5 Readiness Tasks that have been reported as a “Red” status to the PDB on 8 May 2018.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	If ETCS is not available then there is a technical solution that will enable CBTC to TPWS transition. Siemens have been instructed to provide a quote for this work, and BT will also need to carry out some work. See Section 5.3.2.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. See Section 5.3.1.
M Maidenhead Sidings staff accommodation	The accommodation is required by April 2019, and the GRIP 4 design has been delayed by 4 months to July 2018. The procurement methodology is not clear.
ORR issue APIS for ETCS (Stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task. The issue is whether ORR would extend the derogation (which would remove the ‘red’ status) if NR provide sufficient justification.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with "Red" Status

5.3 Network Rail Works

5.3.1 Platforms and Stations

NR, CRL and Great Western Railways are due to meet and formally accept that the additional stairs at Maidenhead station are not required in order to meet 2026 passenger demands as indicated by the NR GRIP 4 design pedestrian flow analysis.

NR has agreed the handover of DOO to CRL/RfL, subject to completion of the outstanding works by Amey. We presently await confirmation for the agreed date.

For the West enhanced stations, NR is reporting at Period 1:

- Completion of the NR GRIP 5 detail design by the end of May 2018;
- Package 3, for Southall, Hayes & Harlington and West Drayton, tenders were returned on 23 March 2018 and submissions are being reviewed and assessed by NR with the view to award the GRIP6 Contract on 14 June 2018;
- Package 6, for Acton, Ealing Broadway and West Ealing, tenders were received on 16 April 2018 with NR assessment in progress to award the GRIP6 Contract on 20 July 2018.

NR continues to report to be on schedule for all stations to be open by December 2019.

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):



The target is now 15 June 2018, following the approval at Safety Review Panel (SRP) on 10 May 2018.

The Maintainer has been accepted to be competent to work on ETCS assets and arrangements are currently being made for the RBC to be permanently connected to the interlocking.

Stages B & C (Stockley-Acton & Acton-Paddington):

The commencement of B/C testing at Charleroi was delayed to support CRL Stage A testing. The laboratory is now being reconfigured to support the NR Stage B/C programme. Stage C infrastructure data surveys are continuing and are due to be completed in Period 2. NR has engaged 'Sotera', an independent provider of Risk Assessment Report used in original drafting of the Exemption, to review options for managing delay to the Exemption expiry.

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI increased again during Period 1 remaining well above target, with all 11 Principal Contractors (PC's) scoring over 2.20. The RIDDOR and the lost time case (LTC) AFR prevail as before with both measures remaining well within target.

H&S KPI	Target	Period 13	Period 1
HSPI	2.20	2.59	2.63
PCs scoring over 2.20	11	11	11
RIDDOR AFR	0.15	0.09	0.09
LTC AFR	0.23	0.17	0.17

Figure 6 - 1 ~ Health and Safety Performance COS

During Period 1, there were 3 significant incidents including 1 RIDDOR, 1 LTC and 1 High Potential Near Miss.

CRL and its PC's have acknowledged that more effort is needed in order to reduce the number of incidents and related frequency rates. A number of presentations have been made by senior CRL staff to SHELTL, and a group exercise was held to identify new and emerging risks.

CDM assurance and verification continues, with 6 amber actions from 10 returns completed recently.

6.2 Health & Safety Performance ONW (NR)

During Period 1, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) has decreased to 0.1792. NR had no lost time incidents in Period 1, but suffered two minor injuries. The Programme's overall All Injury Rate has continued its downward trend and is currently 0.71 injuries per 100,000 hours worked.

7 Cost

7.1 Summary

The Intervention Points have not changed, and the P50 AFCDC remains as £12,723m, which exceeds IP2 by £211m.

IP0, IP1 and IP2 have not changed in Period 1.

The AFCDC at P50 remains as £12,723m.

The AFCDC at P50 exceeds IP2 by £211m.

The P95 AFCDC remains as £12,855m which exceeds IP2 by £343m.

The AFCDC at P50 exceeds the reported financial budget by £216m.

CRL is preparing a new cost to complete scenario.

██

██

The CRL ONW AFC, including VNs, remains at £2,530m.

The ONW FFOC remains at £2,376m.

7.2 AFCDC and Intervention Points

From Period 1, CRL has reduced the level of detail for commercial and contract administration reporting. CRL has discontinued to report the AFCDC to P80 or P95 as a planned consequence of CRL’s demobilisation of risk management and the curtailment of all future QRA analysis. Under the PDA, CRL is not obliged to provide P80 or P95 forecasts save for Schedule 7, Financial Model, Part 1, Clause 1. CRL is required to review and update the Financial Models as at 31 March and 30 September in each calendar year following the Effective Date and if requested by the Sponsors, CRL will also provide the Sponsors with copies of the Financial Models which are based on P80 and/or P95 forecast costs assumptions. From Period 1 onwards, CRL is reporting a single P50 AFCDC forecast.

IP0, IP1 and IP2 have not changed in Period 1. At Period 1, CRL is continuing to report the P50 AFCDC as £12,723m. The CRL Period 1 P50 AFCDC exceeds IP2 by £211m. However, CRL is still reporting P95 risk which is £132m more than P50 risk, therefore AFCDC at P95 may be regarded to be £12,855m. CRL and Sponsors are currently resolving the required funding of the programme above IP2. Sponsors, with the support of PRep, are in discussion with HM Treasury to clarify and validate the cause and effect of the additional funding requirements. Progress of the funding requirements will be reported in Period 2.

CRL is preparing a new cost to complete scenario which considers the impact of a completion tail extending into Trial Running and Trial Operations, with some construction work extending post Stage 3 opening. Jacobs has reviewed the approach taken by CRL and is currently completing a final peer assessment as part of the overall cost scenario review work.

(£ millions)	Period 13	Period 1	Delta	Movement
Forecast	12,247	12,267	20	up
Delivery Risk	0	0	0	same
Programme Risk	472	452	-20	down
Board Risk	4	4	0	same
AFDCDC total	12,723	12,723	0	same
IP0	11,672	11,672	0	same
IP0 Headroom	-1,051	-1,051	0	same
IP1	11,912	11,912	0	same
IP1 Headroom	-811	-811	0	same
IP2	12,512	12,512	0	same
IP2 Headroom	-211	-211	0	same

Figure 7 - 1 ~ AFDCDC (P50) Headroom to Intervention Points

Our review of the Period 13 QCRA indicates CRL has carried out a comprehensive assessment of risk and cost pressures for the ultimate completion of the programme. The independent Jacobs commercial review team attended the CRL Period 13 QCRA completion meeting on the 9 April 2018 and has also carried out its separate review. The CRL risk management team has fully co-operated, providing information to us to check that the QCRA processes are appropriate and in accordance with their procedures. We conclude from our investigations that the outputs from the Central Section QCRA models are representative of the programme and have been produced in a manner consistent with previous QCRA's. The CRL Risk Manager has advised that a comprehensive detailed contract review has been carried out and we are confident that the CRL QCRA is robust and within the bounds of accuracy normally associated with this type of forecast. In summary, CRL has undertaken a full QCRA review in which known issues have been identified and allowances included.

We will check the QCRA expected to be included in the CRL SACR19 Report and closely monitor developments, as we expect costs may increase later in 2018 due to continuing cost pressures on Systemwide activities, and at some stations such as Bond Street and Paddington.

CRL continues to seek cost efficiencies and to challenge contractors costs in its attempt to remain within funding, but we continue to note the following:

- The analysis of defined cost continues to follow the established trend of increase in CRL assessments of defined costs rising towards the contractors estimates. See Section 7.3;
- CRL is reporting that the programme is nearly 93% complete and engaging in the safety critical stages of testing and commissioning. Therefore, realistic prospects for major cost savings by reviewing the remaining scope at such a late stage, without compromising the necessary safety and procedural requirements of many complex interactive interfaces, may be difficult to realise. However, opportunities may exist in CRL's attempts to drive programme delivery efficiencies (such as from its implementation of the revised construction and testing strategy);
- We are of the opinion that the preparation by CRL of the 2017/2018 Financial Statements for audit may not necessarily bring any benefit to funding management.

Figure 7 - 2 indicates the cumulative delivery overspend at each period.

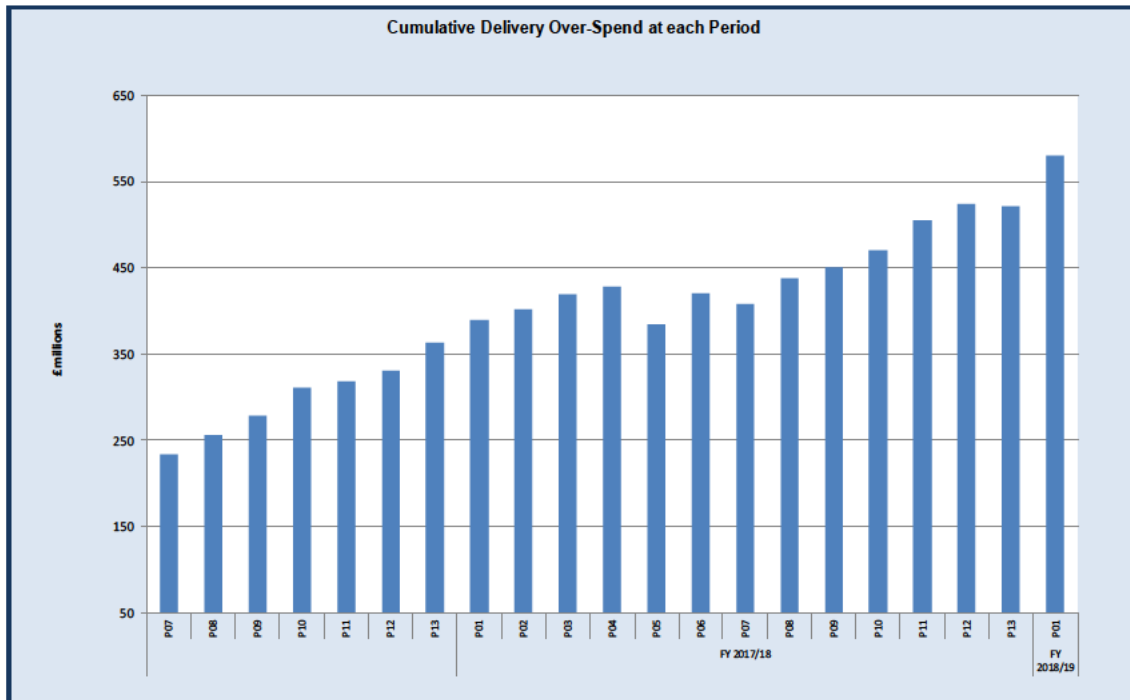


Figure 7 - 2 ~ Cumulative Delivery Overspend at each Period

The cumulative delivery overspend has increased in Period 1 by £58m to £580m (Period 13, £522m). CRL reports that spend and performance in Period 1 continues to be dominated by Stations and Systemwide Sectors, which together accounted for 82% of Delivery’s Cost of Work Done.

CRL reports that, in Period 1, it spent £46.3m above the 2018/19 Business Plan. This is mainly due to:

- Lower than expected productivity, additional scope; access delays; and cost increases for construction and logistics as a result of delays to energisation and dynamic testing for [REDACTED] (£18.6m);
- Delayed MEP and external work, prolongation, and incentives which were established after the Business Plan was set at [REDACTED] (£9.4m);
- Prolongation and ongoing architectural and MEP fit-out works which had been forecast to be complete at [REDACTED] (£8.3m);
- other net overspends (£24.3m).

This expenditure was offset by £14.3m of apparent unspent Programme risk due to cost being reported in the Sectors.

7.3 Cost: Central Operating Section (COS)

As a part of its period report restructuring, CRL has removed Target and Defined Costs for completed contracts and has restated the contract elemental breakdown. Contracts C300, C305 and C828 have been removed, whilst Contracts C510 and C350 have been collectively included within the ‘Others’ package. Consequently, the CRL Period 1 report shows a significant fall (circa £1.5bn) in both cumulative Target and Defined Costs. Figure 7 - 3 shows

the reconciliation of the adjusted Target and Defined Costs¹¹ to include removed values and avoid duplication of costs included within the 'Others' category in order to provide ongoing continuity for consistent trend analysis reporting. Period 1 has again seen cost increases to both CRL assessments and Contractors' estimates for Target Costs and Defined Costs.

Contract	Target £m		Defined Cost £m	
	P1		P1	
	CRL	CON	CRL	CON
C300				
C305				
C610				
C512				
C510				
C435				
C405				
C412				
C360				
C502				
C422				
C350				
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,257	£5,632	£5,543	£5,723
Others	£863	£923	£972	£983
Total	£6,120	£6,555	£6,515	£6,706

Figure 7 - 3 ~ P1 Adjusted Defined Cost and Target Cost¹²

[REDACTED]

- [REDACTED]
- [REDACTED]

[REDACTED]

¹¹ Figure 7-3 subject to arithmetical rounding errors.

¹² Figure 7-3 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments highlighted in paragraph before the table.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

7.4 Cost: On Network Works (ONW)

The CRL ONW AFC, excluding VNs, and the NR FFOC remain at £2,376m in Period 1.

The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,305.6m, which exceeds the DfT Invention Price of £2.3bn by £5.6m.

Figure 7 - 5 indicates the relevant breakdown.

Description	Period 13 £m	Period 1 £m
CRL AFC Excluding VNs	2,376	2,376
VN Funding	154	154
CRL AFC Including VN's	2,530	2,530
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
FFOC	2,376	2,376
Pain/gain share	-70	-70
Forecast to RAB	2,306	2,306

Figure 7 - 5 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

7.4.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is unchanged and remains at £2,530m for Period 1. NR reports a Total Secured Funding for NR ONW is £2,835.4m, as shown in Figure 7 - 6. In Period 1, NR received approval in principle from the NR Portfolio Board (CP5 contingency) for additional funding (£54m) to address the cost risk associated with [REDACTED] programme, demobilisation, access, and recoveries. Although due on 26 April 2018, the formal process for the additional funding is ongoing but is not causing any concern with regard to granting approval nor progress of the ONW schedule.

Description	P1 Source of Funding				P13
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	217.0	-	-	217.0	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,488.0	22.0	20.0	2,530.0	2,530.0
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
Sub Total	-	118.9	186.5	305.4	305.4
TOTAL SECURED FUNDING	2,488.0	140.9	206.5	2,835.4	2,835.4

Figure 7 - 6 ~ NR ONW Secured Funding



7.4.2 ONW Cost

CRL reports that the Grand Total Cost remains static in Period 1 at £2,835.4m, but with an increased mid-point sensitivity of plus £89.3m (a £22.8m deterioration from Period 13), as shown in Figure 7 - 7. NR is currently reconciling its costs as part of the Interim Final Account and the launch of its Paddington to Reading (P2R) Programme.

Description Funding	Period 13 £m	Period 1 £m	Delta £m	P1 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,901.6	2,907.9	6.3	2,901.5	2,957.4	3,022.5
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	-24.3	-26.8	-2.5	-24.1	-10.7	0.0
Recoveries (Residual)	-18.1	-16.4	1.7	-11.4	-10.3	-8.2
Targeted Savings	-23.8	-29.3	-5.5	-26.4	-11.7	0.0
Cost Grand Total	2,835.4	2,835.4	0.0	2,839.6	2,924.7	3,014.3
Total Secured Funding	2,835.4	2,835.4	0.0	2,835.4	2,835.4	2,835.4
Funding Gap	0.0	0.0	0.0	4.2	89.3	178.9

Figure 7 - 7 ~ NR ONW Cost Summary

NR continues to focus on cost control; however, in CRL’s view, the most significant cost risks to the ONW are in respect of:

- NR’s ability to achieve the required £26.8m of planned Efficiencies and £16.4m of Recoveries;
- Anglia [REDACTED]
- Closeout risk associated with upward pressure on the reported AFC for [REDACTED] now that the Contract is cost reimbursable;
- Closeout risk associated with final outturn cost with respect to [REDACTED] 1;
- Prioritisation of access and historic claims are impacting the confidence of achieving the reported AFC.

NR has received Tenders for West Outer enhanced stations package 3 and is currently progressing with tender reviews and has not released any data in respect of the tender values. Until NR declare the confirmed tender prices, there remains the risk that they may be higher than the amounts budgeted for the works.

CRL has collated the effects of these risks in its SPOT AFC cost sensitivity analysis as shown in Figure 7 - 7 above.

7.5 Contingency

The Finance Current Control Budget remains at £12,507m for Period 1. The £12,723m AFCDC (P50) exceeds the financial budget by £216m, and exceeds the RP4.2 Baseline funding of £12,136m by £587m. CRL intends to increase its FCCB to a value above IP2.

CRL is reporting that the overall Period 1 contingency budget of £201m is insufficient to cover the P50 risk exposure of £456m by £255m (a £1m small improvement from Period 13). The centrally controlled Delivery contingency at Period 1 remains at £42m.

Figure 7 - 8 shows the trend of the decrease in the Board and Programme Contingency and compares the higher Risk Exposure at P50 and P95 with the remaining contingency.

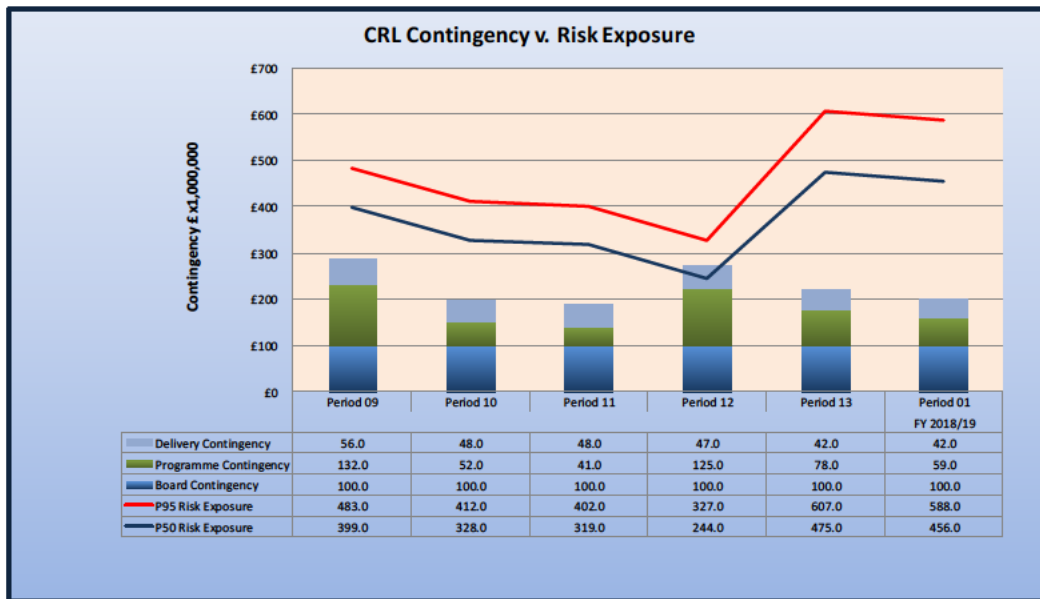
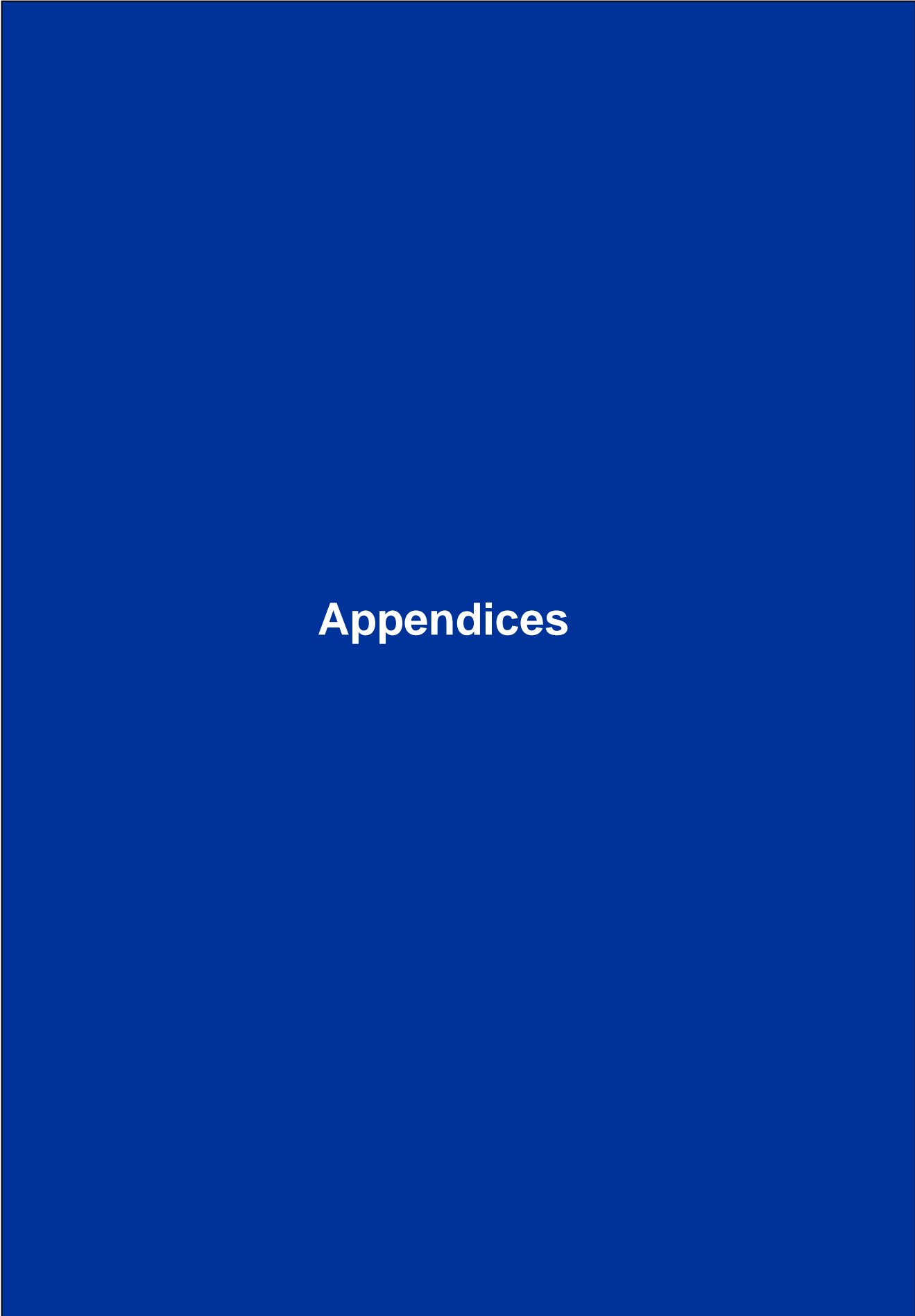


Figure 7 - 8 ~ Risk Exposure versus Contingency



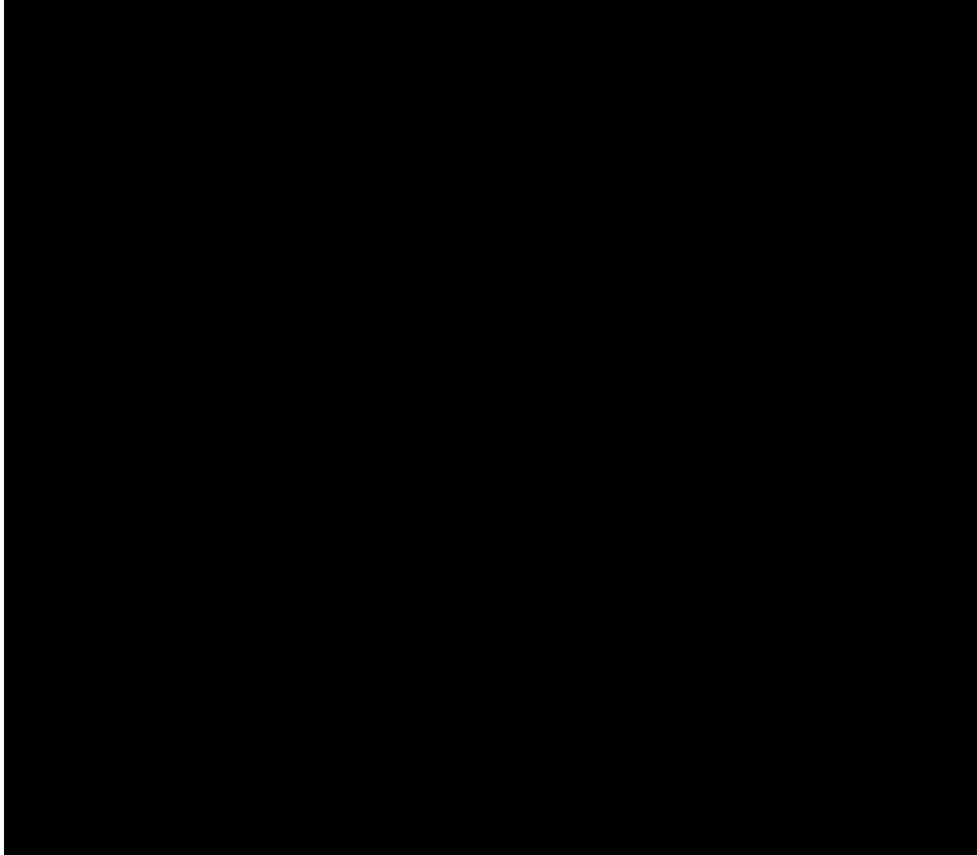
Appendices

Appendix A Contract Administration

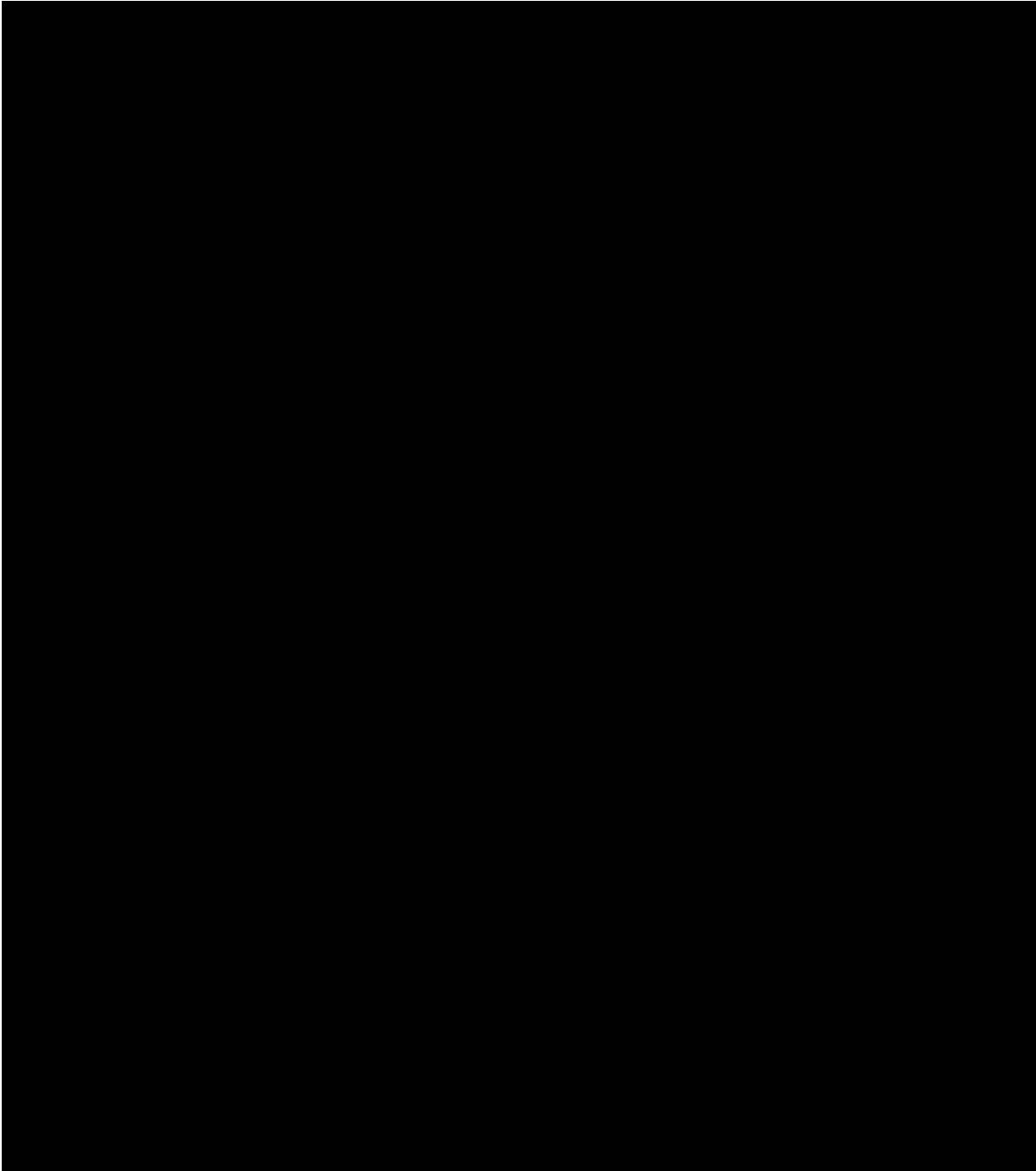
Appendix A Contract Administration, is deleted from Period 1 onwards, as CRL has discontinued reporting compensation events progress as part of its planned demobilisation. CRL has not provided any updated data for the Period 1 Board Report.

Appendix B Schedule & Performance

Figure B - 1 indicates the status of Anchor Milestones cumulative progress at Period 1.



The charts at Figure B - 2 indicate cumulative progress of each Systemwide contract based on data received from CRL.

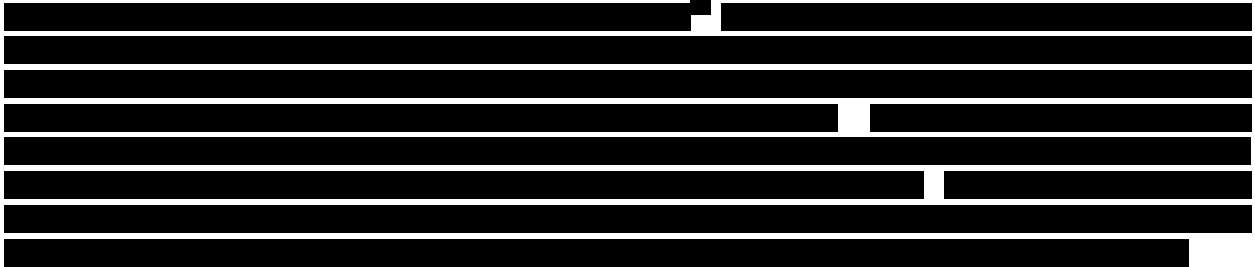
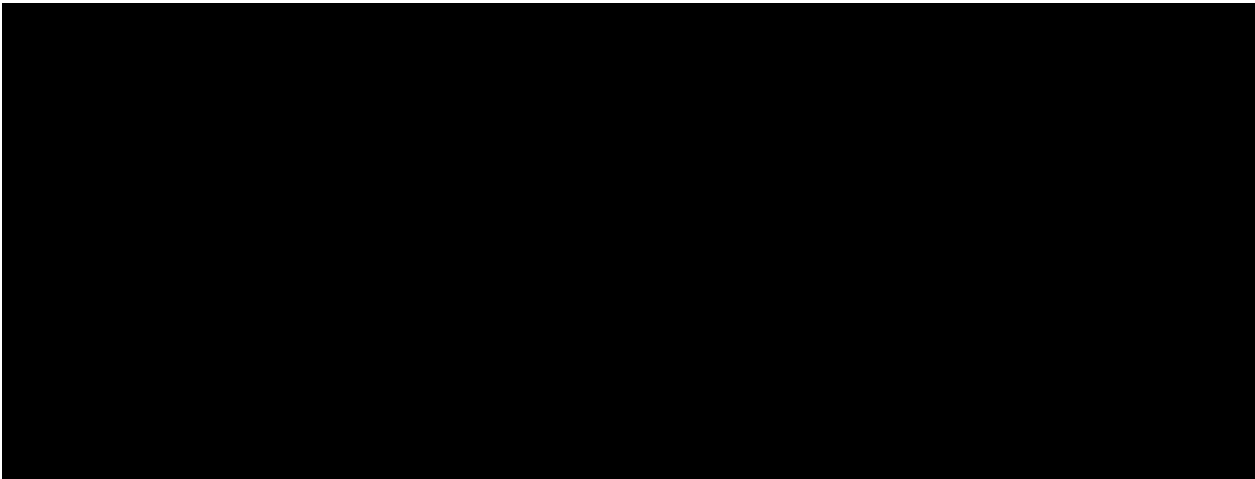
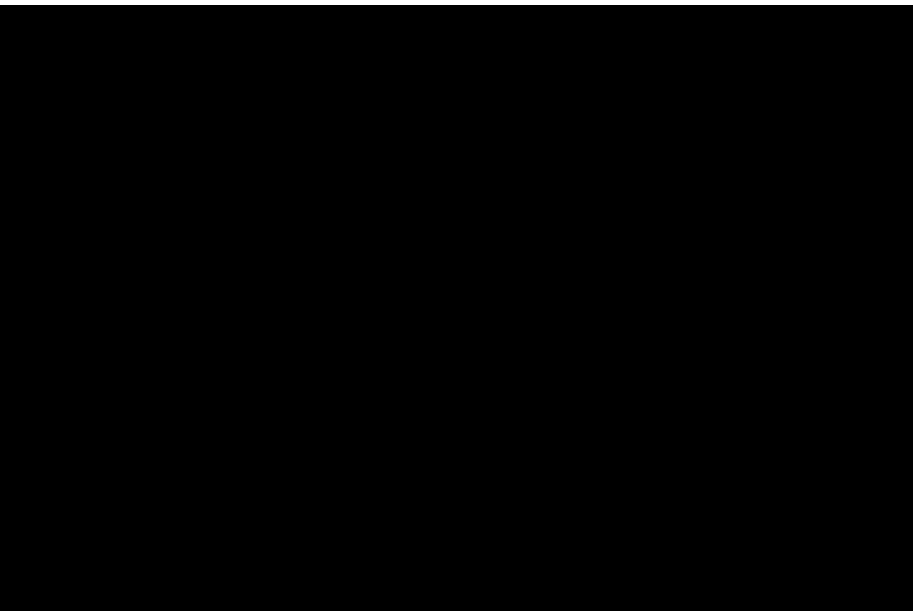


Anchor Milestone	MOHS	MOHS	Actual /	Actual /	Period	MOHS
	Baseline	Baseline	Forecast	Forecast		
	Date	Date	Period 13	Period 1	delay in	delay in
					days	days
C610- A726 Traction E&B complete in Zones 3 & 4	13-Apr-18	13-Apr-18	30-Apr-18	08-May-18	8	25
Draft COS Safety Case + results from Dynamic Testing Z 1 and 2	30-Apr-18	30-Apr-18	30-Apr-18	10-May-18	10	10
Sys - A698 Start PSD Platform Train Interface Test (DT) in Zone 1	10-Apr-18	10-Apr-18	10-May-18	11-May-18	1	31
C660 -A715 OFN re-configuration for All Zones complete	15-Apr-18	07-May-18	15-Apr-18	15-May-18	30	8
C660 - A557 Dark Fibre Handover to C6XX (Zones 3 & 4)	07-May-18	07-May-18	07-May-18	15-May-18	8	8
C644 -A693 WBP ATFS energised	31-Mar-18	31-Mar-18	27-Apr-18	17-May-18	20	47
C650 -A710 All 11 kV,S&P locations energized	15-Apr-18	15-Apr-18	21-Apr-18	19-May-18	28	34
ONW - OOC - KD33 Traction Power Infra etc KG ATFS to WBP ATS	28-Feb-18	28-Feb-18	21-May-18	21-May-18	0	82
Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18	31-Mar-18	23-May-18	53	53
C631-A711 PSD Ready for Dynamic Testing in Zone 1	31-Mar-18	09-Apr-18	09-May-18	28-May-18	19	49
C660 -A564 Linewide SCADA available in Zones 3 & 4	30-May-18	30-May-18	30-May-18	31-May-18	1	1
Provide all Trains to Systemwide for DT (3rd & 4th FLUs)	23-Mar-18	14-May-18	15-May-18	07-Jun-18	23	24
Training completed for MTR in support of Handover	30-May-18	30-May-18	30-May-18	30-Jun-18	31	31
Training completed for LU in support of Handover	30-May-18	30-May-18	30-Jun-18	30-Jun-18	0	31
Training material submitted in readiness for training delivery	05-May-18	05-May-18	30-Jun-18	30-Jun-18	0	56
C620 -A719 Signalling infrastructure ready for DT in Zones 3 & 4	07-Jun-18	07-Jun-18	07-Jun-18	07-Jul-18	30	30
C631 -A700 PSD Ready for Dynamic Testing in Zones 3 & 4	20-Jun-18	30-Jun-18	11-Jul-18	13-Jul-18	2	13
C620 - A621 Ready to Commence Transition Testing @ GEML	30-Jun-18	30-Jun-18	30-Jun-18	15-Jul-18	15	15
C610 -A590 Start Dynamic Testing (Zones 1,2,3 & 4)	30-Jun-18	30-Jun-18	30-Jun-18	17-Jul-18	17	17
C660 -A712 CIS ready Phase 3 in Zones 1 to 4	06-Jul-18	06-Jul-18	06-Jul-18	26-Jul-18	20	20
C650-A709 All 22 kV,S&P locations energized	30-Jun-18	30-Jun-18	30-Jun-18	28-Jul-18	28	28
Safety Assessment Report substantially complete (AsBo)	31-Mar-18	31-Mar-18	31-Mar-18	30-Jul-18	121	121
Sys - A691 Start PSD Platform Train Interface Test (DT) in Z 3 & 4	23-Jul-18	23-Jul-18	23-Jul-18	30-Jul-18	7	7
C350 - PML - Stage 3 Scenario Testing With C6xx to AC Completed	12-May-18	05-Jul-18	26-May-18	31-Jul-18	66	26
Training completed for RFL in support of Handover	05-Jul-18	05-Jul-18	03-Aug-18	03-Aug-18	0	29
C360 - L M - Ready for Handover to Infrastructure Manager (IM)	29-Jun-18	03-Aug-18	29-Jun-18	04-Aug-18	36	1
C360 - FSS - Ph 3 Integration Testing to Shaft iAC Completed	05-Jul-18	03-Aug-18	05-Jul-18	06-Aug-18	32	3
C360 - STG - Final Handover to Infrastructure Manager (M)	31-Jul-18	03-Aug-18	31-Jul-18	07-Aug-18	7	4
C360 - MEP - Ready for Handover to Infrastructure Manager (M)	29-Jun-18	03-Aug-18	29-Jun-18	09-Aug-18	41	6
C620 - A622 Ready to Commence Transition Testing @ GWML	14-Jul-18	14-Jul-18	14-Jul-18	12-Aug-18	29	29
C360 - ESS - Handover to Infrastructure Manager (M)	03-Jul-18	03-Aug-18	03-Jul-18	17-Aug-18	45	14
C405-PAD-A673 Completion of Phase 3 Testing	28-Jul-18	28-Jul-18	28-Jul-18	17-Aug-18	20	20
C412-BOS-A276 ETH PDA Milestone 11 Eastern Ticket Hall OSD	11-Jun-18	12-Jul-18	27-Jun-18	20-Aug-18	54	39
C350 - PML - Ready for Final Handover to Infrastructure Manager	25-Jun-18	05-Jul-18	25-Jun-18	28-Aug-18	64	54
Sys - A722TVS Status Mon test (DT) complete in Z 1 CWG (E&W)	13-Aug-18	13-Aug-18	13-Aug-18	29-Aug-18	16	16
C360 - FSS - Handover to Infrastructure Manager (IM)	03-Aug-18	03-Aug-18	02-Aug-18	31-Aug-18	29	28
C610 -A724 VCS Fully Operational (Phase 3)	24-Aug-18	24-Aug-18	24-Aug-18	07-Sep-18	14	14
GRIP 6 - Traction Power - New Substations in AT Mode - West	27-Apr-18	27-Apr-18	26-Sep-18	08-Sep-18	-18	134
C405-PAD-A267 All Fit-Out, etc, Tested & Commissioned	09-Aug-18	08-Sep-18	09-Aug-18	10-Sep-18	32	2
C405-PAD-A667 Handover to Infrastructure Managers	07-Sep-18	08-Sep-18	07-Sep-18	14-Sep-18	7	6
C422-TCR-A676 Handover to Infrastructure Managers	10-Aug-18	08-Sep-18	10-Aug-18	14-Sep-18	35	6
CWG-CWG-A608 Handover Station to Infrastructure Manager	05-Jul-18	03-Aug-18	05-Jul-18	28-Sep-18	85	56
2 Driver Training Units Available to MTR for Stage 2 (inc ETCS)	24-Aug-18	24-Aug-18	12-Oct-18	12-Oct-18	0	49
C610 -A720 Temporary services recovery complete	09-Nov-18	09-Nov-18	05-Dec-18	30-Nov-18	-5	21

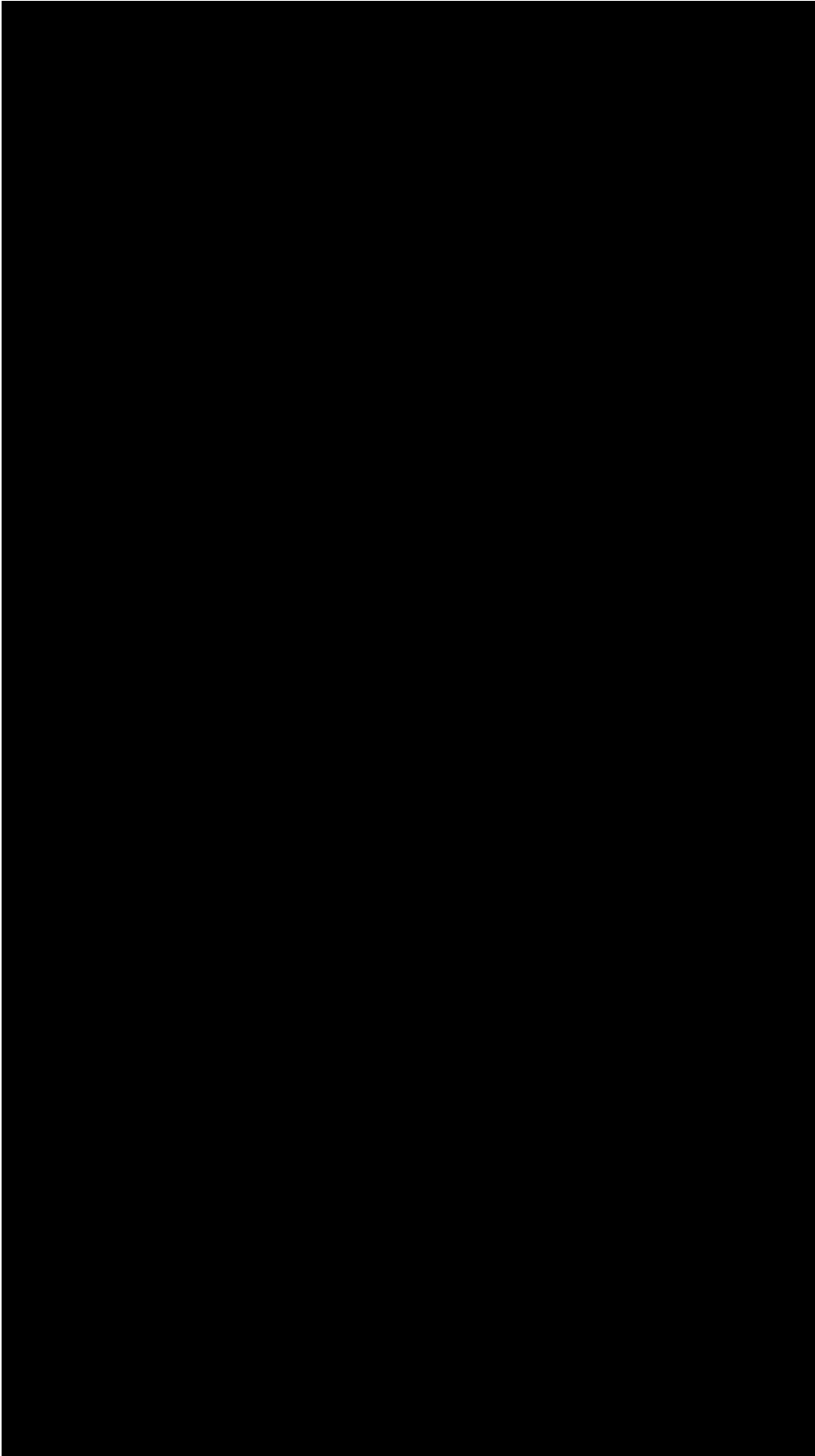
Figure B - 3 ~ Anchor Milestones forecast to be later than MOHS late date

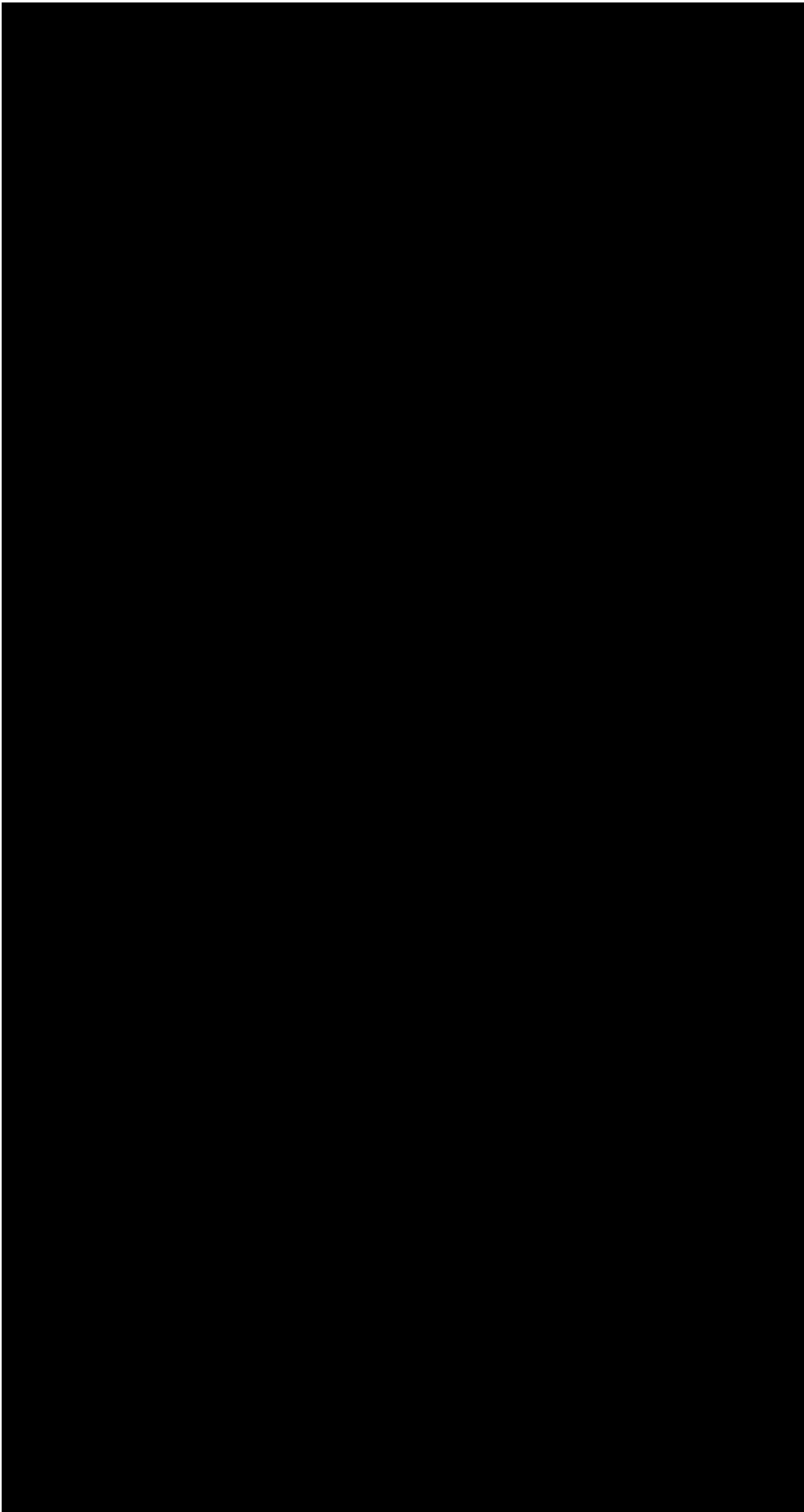
Appendix C Stations

C.1 Stations in the Central Section

A table with multiple rows and columns, all of which are completely redacted with black bars.A large rectangular area that is completely redacted with a solid black block.A table with multiple rows and columns, all of which are completely redacted with black bars.A large rectangular area that is completely redacted with a solid black block.

¹³ Data has been abstracted from the CRL Period 1 (2018/19) station dashboards.





C.2 Interface Works and Handovers

The “SLDs to go” report, for Period 1, has not been issued by CRL. Monitoring the delivery progress of the final 9 room/route handovers will now be undertaken as a part of the IRN trackers, for each of the stations, portals and shafts.

Appendix D Compliance and Assurance

D.1 Agreements

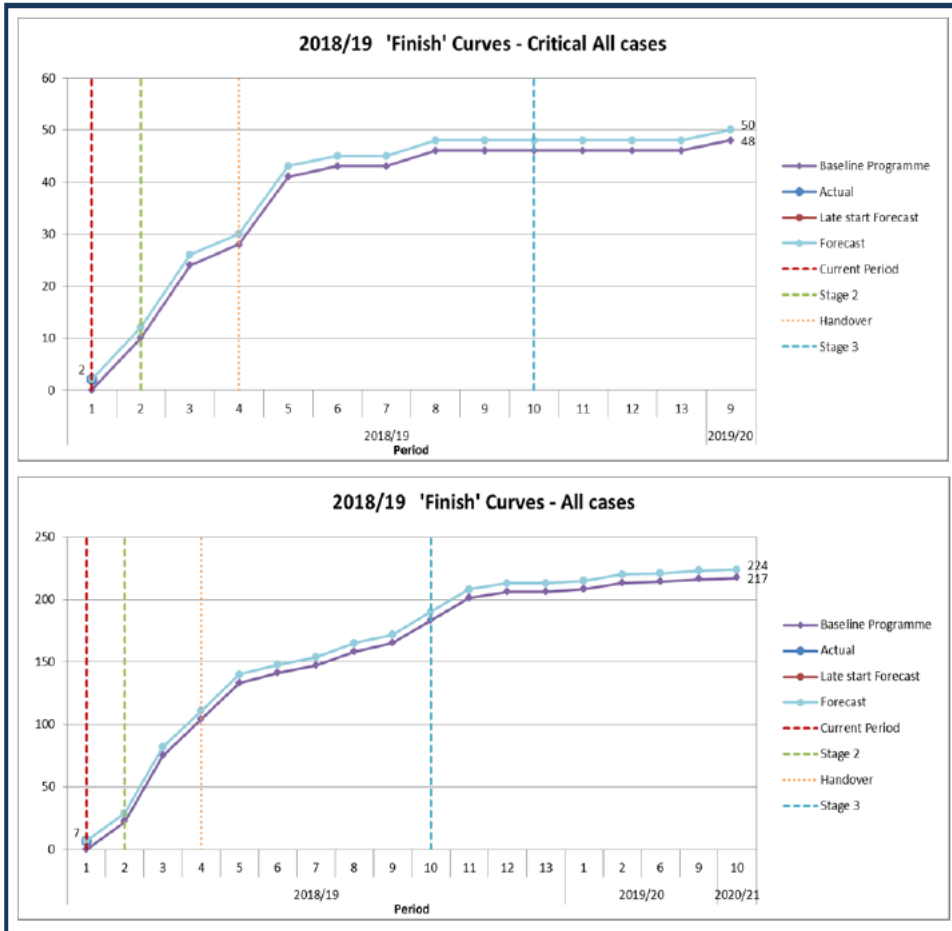


Figure D - 1 ~ 2017/18 Start, Finish & Close Curves

The Agreements programme has been re-baselined to align with the MOHS 2018 programme. This resulted in a reduction of critically required agreements, giving a figure of 50 overall. Operational agreements dominate the critical list, with RfL-I requiring 31 and LU 11.

D.2 Quality

D.2.1 Right First Time (RFT) and World Class (WC) Metrics

The results for the quality metrics for the first period of 2018/19 are shown in tabular form below. Quality metric RFT3 continues to perform below standard.

Metric	YTD	Target
RFT1 – ITPs	1	0
RFT2 – Partial re-work	0.32%	2%
RFT3 – Observation reports	74%	90%
RFT4 - NCRs	92%	95%

Figure D - 2 ~ RFT & WC Metrics

PSR 111 Period 1 FY 2018-19 v1.18.docx

We have discussed the performance of RFT3 with the CRL quality manager and we have 2 comments to make:

- The number of observations being carried out is above the target, and the number of faults being found demonstrates that the field engineers are performing in their roles.
- The rise in unsatisfactory faults is often an unfortunate by-product of schedule pressure at this point in the programme. There is some recourse, in that the IMs are requiring the faults raised in the reports to be closed as part of the Handover process.

Acceptance of certification packages was again disappointing, with 126 of 338 packages accepted. So far, CRL has accepted 5,300 of circa 15,000 packages. It is clear that there will be packages outstanding after Stage 3 Opening, which could impede Handover and Substantial Completion.

D.2.2 Quality Performance Index

No contractors received a “Red” status for their quality performance in Period 1. The overall index for the period was 1.89. CRL’s target is to be above 2.00.

D.2.3 Quality Issues

There was one Category 1 NCR reported in this period;

- C512 – Whitechapel Station. The roof light is compliant with the design, however the specification is not compliant to LU standards. The lowest layer of glass should be toughened, but in this case is heat strengthened.

D.2.4 Audit Monitoring

No audits were adjudged to be ‘poorly controlled’ in this period.

D.3 Land & Property (L&P)

CRL’s Land & Property functions have now transitioned into TfL.

D.4 Over Site Development (OSD) and Urban Realm (UR)

Accountability for all Over Site Developments has transferred from CRL’s Land & Property team to TfL’s Commercial Development team. TfL will report income receipts, from OSDs, periodically to CRL.

There have been some minor changes to CRL’s forecast MOHS OSD handover date for Bond Street (East). There have also been changes to the forecast developer start dates for Tottenham Court Road (West), Farringdon (East) and Liverpool Street (East) OSDs. A number of OSD developer start dates have also been updated, together with some of estimated OSD completion of construction (Shell & Core) works dates.

Figure D - 3 provides a summary¹⁴ of the current forecast Key Dates for Completion and handover¹⁵ of the CRL deck slabs at each station to the OSD contractors¹⁶, as well as the OSD

¹⁴ Summary of OSD dates has been abstracted from the CRL Board Report, the MOHS and Key Dates progress summary.

¹⁵ The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

forecast start, duration and completion dates¹⁷. Completed handovers are shown against a green shaded background. The changes to forecast dates have been highlighted in bold text in the table.

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.



OSD Sites linked to CRL Stations - Key Dates							
Station	Location	CRL Anchor Milestone	PDA Milestone	CRL's Forecast (MOHS) Handover Date to Station OSD Developer	Forecast Developer Start Date on Site**	Estimated Construction Duration (m)	Est. Shell & Core Completion
Bond Street	West - Davies Street	A275	10	31-Oct-18	Feb-19	20	Oct-20
	East - Hanover	A276	11	28-Aug-18	28-Aug-18	15	Dec-19
Tottenham Court Road	West - Dean Street	A279	15	30-Nov-18	Dec-18	22	Oct-20
	East - Astoria	A277	12	06-Sep-17	Jan-18	36	Jan-21
	East - Goslett Yard	N/A	N/A	06-Sep-17	May-19	14	Oct-20
Farringdon	West - Cardinal House	A278	13	30-Jun-18	Jan-19	18	Jun-20
	East - Lindsey Street	A280	16	29-Mar-18	Jul-18	21	Mar-20
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18	Apr-19	21	Jan-21
	East - Blomfield Street	A284	18	28-Feb-18	Aug-19	21	May-21
OSD Sites <u>NOT</u> linked to CRL Stations - Key Dates							
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast Sectional Completion Date	Forecast Developer Start Date on Site	Construction Duration (m)	Shell & Core Completion
Paddington	PIP Triangle	N/A	N/A	Available	Aug-19	17	Jan-22
	Fisher Street	N/A	N/A	Jul-18	Jul-18	16	Nov-19
	Limmo Peninsula	N/A	N/A	Jul-19	Jul-19	24	Jul-21
	Woolwich	N/A	N/A	Jun-19	Jun-19	52	Oct-24
<p>Notes</p> <ol style="list-style-type: none"> ** Proposed OSD start dates will be confirmed as the Developers programme evolves CRL Forecast Sectional Completion Dates are abstracted from The CRL MOHS Baseline Early schedule TBC = To be confirmed Dates abstracted from L&P OSD Project Dashboard and Anchor Milestones are shaded thus:  Forecast dates that have now been achieved (with actual dates shown) are shaded thus:  Developer start dates at Bond Street precede station forecast handover dates, due to earlier phased handovers. 							

Figure D - 3 ~ Summary of OSD forecast Key Dates

Paddington (PIP Triangle)

[Redacted text block]

Variation of the existing OSD agreement for Great Portland Estates (GPE) **Bond Street (East)** Hanover Square Office consent was approved by TfL and phased handover of the site has been instructed by CRL. The main handover of the ETH +1 roof slab (triggering payment) has been delayed until August 2018. Work to resolve the noise and vibration concern continues. The report on noise & vibration mitigation enclosure (design and cost) is expected in June 2018. The handover date for the vent shaft remains a risk and is being monitored closely by both teams. [Redacted text block]

¹⁶ The developers' start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL's Anchor Milestone summary.

¹⁷ The estimated shell & core completion dates will be validated when the OSD contractors' schedules become available.

Agreement of the target handover date for the OSD for **Bond Street (West)**, is still proving to be difficult, as a result of continued station schedule delays. CRL's forecast handover date to the OSD developer remains 31 October 2018. Handover review sessions with OSD and LUL starting to take place. Plans for acoustic testing, to prove the Tunnel Ventilation System's impact on OSD are being developed. The testing is planned for August 2018, during C610's phase 2.3 testing of the vent fan system.

The OSD for residential development at **Tottenham Court Road (West)** will be offered to the open market in early 2018. Retail areas will be retained for in-house (TfL) management. The site is being used for site office accommodation by CRL's delivery team until November 2018. The OSD development will not, therefore, be able to start until 2019.

The developer for **Fisher Street** OSD has put forward a new offer for the site, reflecting a new mixed use hotel and residential scheme. A decision will be taken next period, as whether to extend and revise the development agreement or to re-market the site.

The DA for the **Farringdon West** (Cardinal House) office consent has been signed. The cycle Super Highway issue has now resolved.

The DA and Lease for Lindsey Street **Farringdon (East)** has been signed and completed. The site was successfully handed over on 4 April 2018.

The DA for **Liverpool Street (West)** office consent has been approved by TfL and Commissioner. Development Agreements being finalised on Cardinal House (FAR-W) to enable exchange in April/May 2018. Handover of the Moorgate Shaft site to the developer has been re-scheduled for the end of May 2018, as the DA has not been completed.

The DA and Lease for the **Liverpool Street (East)** Office and Retail OSD in Blomfield Street has been agreed and exchange was anticipated in April/May 2018. It is hoped that these issues can be resolved in the coming weeks, to enable an exchange of the documentation.

The **Limmo** masterplan has yet to be agreed with London Borough of Newham. Approval has been obtained to market the site through the TfL Property Partnership Framework (PPF). A JV partner selection process will be launched via the PPF in Q1 2018.

TfL wish to delay marketing of the **Woolwich** residential site, in order to review the potential for an alternative private rented sector disposal structure, to increase long term income. The judicial review hearing for the OSD has completed, with a legal decision determined in CRL's favour.

D.5 Undertakings & Assurances and Commitments - Central Section

Six of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Commitments Compliance Plans (CCP). has caught up on pending evidence, reported in Period 13. has an outstanding piece of evidence to upload into the CDT during Period 2.

D.5.1 Farringdon Station (East Ticket Hall) D25 Assurances

RfL agreed to the reduced operation of the ventilation fans at a key hour of the morning when background noise levels are low. Under this control scenario the modelling predicts that -4dB will be achieved for the ETH and that this would represent the exercise of reasonable endeavours and a report setting out that case is to be submitted to the local authority (City of London).

However, in the event that noise levels associated with tunnel ventilation, draught relief and operation of plant and equipment at a particular location are expected to be above the -5 dB level, IP D25 requires that CRL will, prior to commencement of procurement of equipment, provide the local planning authority with the following information:

- Calculated rating levels at the most sensitive receivers under the range of operational modes anticipated, including noise from the mechanical fan operation and draught relief;
- For tunnel ventilation, the frequency and duration of use of the fans expected as a result of possible congestion and train headway simulations;
- Details of the performance of noise mitigation incorporated into the deep level station, ventilation shaft and head house structures; and
- A description of the limitations to any or further mitigation being practicable.

There is no further definition around the timing of when this information is to be provided; but logically the reference to “procurement of equipment” is intended to refer to any equipment which contributes to, or potentially mitigates, the overall noise level, such that the local authority has a chance to comment on the proposed equipment prior to the commitment to purchase being made by CRL.

RfL accepted the operational constraint toward the end of October 2017. The fans responsible for the -4dB rating prediction were procured two years ago and were due to be installed in February this year. The requisite report has not been issued to the City. A level 1 PIR was raised accordingly.

D.5.2 C660/C520 Custom House PA/VA (D25) Assurance 465

Assurance 465 is drawn from Information Paper D25 and requires CRL to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and carrying out the detailed design of that system. The C660 PA design at Custom House station is complete but, following an email communication from the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria had not been reached. The meeting with LB Newham took place on 20 February, where the findings of the noise survey were presented and criteria discussed. The draft criteria, which were sent by CRL to LB Newham, were agreed on 8 March 2018. The process for closing this PIR has begun.

D.6 Undertakings & Assurances and Commitments - Surface Section

The CDT is used to generate reports each period setting out the actual upload of compliance evidence against what was planned and the information is presented in the Technical Director’s Report. The matching of actual evidence against what was planned is used as a lead indicator for the risk of potential non-compliance. Contracts that meet their plans are considered to represent a lower risk of non-compliance than any that do not. There has been a growing concern regarding the upload of evidence from NR contractors.

Two of the live Surface Section contracts, planned to upload compliance evidence into the Commitments Delivery Tracker (CDT) in Period 1, in accordance with their Compliance Matrices.

[REDACTED]
 [REDACTED]
 [REDACTED] This evidence continues to be outstanding.

There has been no other change, with regard to what was previously reported in Period 13. The long term outstanding items are as follows:

- [REDACTED] has four outstanding pieces of evidence from the seven planned in Period 8 and did not upload evidence into CDT in Period 11.
- The D26 report that [REDACTED] was due to upload in Period 6 remains outstanding. Also the planned upload of evidence of consultation with Thames Water remains outstanding since Period 10.
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.

No Surface Section PIRs were raised in Period 1.

Project Representative Team

D.7 Project Team

██████████: Project Representative, Safety, Progress, Risk, Governance;
██████████: Signalling, Railway Systems, Integration, T&C;
██████████: Engineering, Stations, OSD, U&As, Assurance;
██████████: Compliance & Change, Operations, RSD;
██████████: Commercial, Cost Control, Financial, ONW;
██████████: Administration Manager.

Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LoNo	Letter of No Objection
ABB	ASEA Brown Boverly	LoR	Line of Route
ACJV	Alstom Costain Joint Venture	LTC	Lost Time Case
ACWP	Actual Cost of Work Performed	LTIFR	Lost Time Incident Frequency Rate
AEA	Abellio East Anglia	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFC	Approved for Construction status	LV	Low Voltage
AFCDC	Anticipated Final Crossrail Direct Cost	M&E	Mechanical & Electrical
AFR	Accident Frequency Rate	MAID	Mandatory Asset Information Deliverables
AGA	Abellio Greater Anglia (now known as 'GA')	MCR	Material Control Requirement
AHU	Air Handling Units	MCS	Master Control Schedule
AIP	Approved in Principle	MENTOR	Mobile Electrical Network Testing, Observation and Recording
AIP	Approval in Principal	MEP	Mechanical Electrical & Public Health
AMS	Agreements Management System	MEPA	Mechanical, Electrical, Public Health, Architecture
APIS	Authorisation to Place into Service	MES	Mile End Shaft
ARS	Automatic Route Setting	MIRP	Maintenance Integration Review Panel
AsBo	Assurance Body - Ricardo Rail	MML	Mott MacDonald Ltd
ASLEF	Associated Society of Locomotive Engineers and Firemen	MOHS	Master Operational Handover Schedule
ATC	Automatic Train Control	MOS	Member of Staff
ATFS	Autotransformer Feeder System	MPS	Master Plan Shaft
ATO	Automatic Train Operation	MTIN	Miles Per Technical Incident Number
ATP	Automatic Train Protection	MTIN	Miles Technical Incident Number
ATS	Automatic Train Supervision	MTR SMS	MTR Safety Management System.
ATS	Auto Transformer Station	MTR-C	Mass Transit Railway - Crossrail
AWS	Automatic Warning System	MV	Medium Voltage
B&PC	Board & Programme Contingency	NCE	Notified Compensation Event
BBMV	Balfour Beatty Morgan Vinci	NCR	Non Conformance Report
BCA	Bilateral Connection Agreement	NG	National Grid
BCWP	Budgeted Cost of Work Performed (Earned Value)	NGET	National Grid Electricity Transmission
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NKL	North Kent Line
BFK	Bam Ferrovial Kier	NoBo	Notified Body
BH	Berkeley Homes	NOW	North Woolwich
BIU	Bringing Into Use	NR	Network Rail
BLL	Bakerloo Line Link	NSACS	New Sector Area Cost Summary
BMS	Building Management Systems	O&M	Operations and Maintenance
BOS	Bond Street Station	OCS	Overhead Catenary Systems
BP	Business Plan	OLE	Overhead Line Equipment
BREEAM	Building Research Establishment Environmental Assessment Methodology	OMC Building	Operations Maintenance Centre
BSP	Bulk Power Supply Point	OME	Order of Magnitude Estimate
BT	Bombardier Transportation	ONFR	On Network Functional Requirements
BT / PC	Bombardier Transportation / Prime Contractor	ONSIP	On Network Station Improvements Programme
BTH	Blomfield Ticket Hall	ONW	On Network Works
BUF	Bottom Up Forecast	OOC	Old Oak Common
C&CSC	Commercial and Change Sub-committee	OOCPA	Old Oak Common Paddington Approaches
CAR	Corrective Action Report	OPEX	Operational Expenditure
CARE	Crossrail Assurance Reporting Environment	Ops	Operations

CBTC	Communications Based Train Control	ORAT	Operational Readiness & Transfer Group
CCB	Current Control Budget	ORR	Office of Rail & Road
CCP	Commitments Compliance Plans	ORSG	Operational Readiness Steering Group
CCRB	Construction and Commissioning Rulebook	OSD	Over Site Development
CCRRB	Crossrail Construction Railway Rule Book	OSP	Operations Safety Procedures
CCSA	Contract Commercial Status Analysis	OTIS	OTIS escalators (company)
CCSC	Commercial & Change Sub-Committee	OTP	Overall Target Price
CCTV	Closed Circuit Television	PA	Public Address
CD/RA	Closed Door / Right Away	PAD	Paddington station
CDG	Competence Design Group	PCs	Principal Contractors
CDL	Central Door Locking	PDA	Project Development Agreement
CDM	Construction Design & Management Regulations	PDB	Network Rail Programme Delivery Board
CDN	Crossrail Data Network	PES	Platform Edge Screen
CDT	Commitments Delivery Tracker	PES	Permanent Earthed Sections
CE	Compensation Events	PIP	Paddington Integration Project
CEC	Chief Engineer's Communications	PIR	Potential Incident Report
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PLU	Plumstead
CEG	Central Engineering Group	PM	Project Manager
CEO	Chief Executive Officer	PMI	Project Manager Instruction
CFCCB	Contingency Finance Current Control Budget	PML	Pudding Mill Lane
CFO	Chief Financial Officer	PMO	Project Management Office NR
CIF	Crossrail Integration Facility	PNY	Paddington New Yard
CIS	Customer Information System	PPE	Personal Protective Equipment
CMR	Crossrail Managed Risk	PPF	Property Partnership Framework
CMS	Crossrail Management System	PPM	Passenger Performance Measurement
CoL	City of London	PRep	Project Representative
COS	Central Operating Section	PRISM	Cost Management Software
CPFR	Crossrail Programme Functional Requirements	PRM	Persons of Reduced Mobility
CPI	Cost Performance Index	PSD	Platform Screen Door
CPO	Compulsory Purchase Order	PSG	Performance Steering Group
CRAF	Completion Readiness Assessment Framework	PSR	Project Status Report
CRL	Crossrail Limited	PTYSC	Property Sub-Committee
CRV	Crossrail Requirements Variation	PWay	Permanent Way
CSCS	Construction Skills Certification Scheme	QBR	Quarterly Baseline Review
CSJV	Costain Skanska Joint Venture	QCRA	Quantified Cost Risk Assessment
CSM	Construction Safety Management	QRA	Quantified Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	QSRA	Quantified Schedule Risk Assessment
CT	Computerized Tomography	RAB	Regulatory Asset Base
CTOC	Crossrail Train Operating Concession	RAB (C)	RfL Assurance Board for Crossrail
CUH / CHS	Custom House Station	RAG	Red, Amber, Green Matrix
CW	Canary Wharf	RAM	Route Asset Manage.
CWG	Canary Wharf Group	RBC	Remote Block Computer
CWS	Canary Wharf Station	RCA	Risk Control Actions
D&A	Drugs and Alcohol	RCC	Route Control Centre
DA	Development Agreement	RfL	Rail for London
DeBo	Designated body	RfL-I	Rail for London - Infrastructure
DfT	Department for Transport	RFT	Right First Time
DLO	Direct Labour Organisation	RIA	Railway Integration Authority
DLR	Docklands Light Railway	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DOO	Driver Only Operation	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DPS	Depot Protection System	RIRP	Railway Integration Review Point
DT	Dynamic Testing	RLU	Restricted Length Unit
Dwall	Diaphragm wall	ROC	Rigid Overhead Conductor

DWWP	Delivery of Works Within Possession	ROC	Regional Operational Centre
E&B	Earthing & Bonding	ROP	Royal Oak Portal
EA	Environment Agency	RP4.2	Review Point 4.2
EAC	Estimate at Completion	RR	Ricardo Rail
EB	Eastbound	RRV	Road / Rail Vehicles
ECP	Employers Completion Process	RS	Rolling Stock
ECS	Empty Coach Stock	RSC	Return Screen Conductor
EDBL		RSD	Rolling Stock & Depot
EDT	Early Dynamic Testing	RSSB	Rail Safety & Standards Board
EED	Emergency Exit Door	RTU	Remote Telemetry Unit
EFC	Estimated Final Cost	S&C	Switches & Crossings
EiS	Entry into Service	SA	Supplementary Agreement
ELRSG	Elizabeth Line Readiness Steering Group	SACR	Semi Annual Construction Report
EMC	Electromagnetic Compatibility	SAP	System Applications Products
EMU	Electrical Multiple Unit	SAR	Safety Assessment Report
ERTMS	European Rail Traffic Management Systems	SAT	Site Acceptance Test
ESJ	Engineering Safety Justification	SCADA	Supervisory Control and Data Acquisition
ESM	Engineering Safety Management	SCL	Sprayed Concrete Lining
ETCS	European Train Control System	SCN	Sponsor Change Notice
ETH	Eastern Ticket Hall	SDG	Signalling Design Group
EVM	Earned Value Management	SDO	Selective Door Operation
FAR	Farringdon	SDS	Scheme Design Specification
FCCB	Finance Current Control Budget	SER	Signalling Equipment Room
FDC	Framework Design Consultant	SES	South East Service
FDO	Final Design Overview	SESR	South East Signalling Room
FDS	Final Design Statements	SFA	Sponsor Funding Account
FFOC	Final Forecast Outturn Cost	SHELT	Safety and Health Leadership Team
FGW	First Great Western	SIRP	Systems Integration Review Panel
FIS	Fisher Street Shaft	SISS	Station Information and Security System
FLU	Full Length Unit	SJR	Safety Justification Report
FoI	Freedom of Information	SLD	Single Line Diagrams
FRAG	Fraud Risk Assurance Group	SMS	Safety Management System
FTS	Floating Track Slab	SMTA	Smithfield Market Traders Association
GAF	Greater Anglia Franchisee	SOC	Statement of Compatibility
GE	Great Eastern	SONIA	Sterling Overnight Index Average
GEBR	Guaranteed Emergency Brake Rate	SOR	Systems Operation Room
GEFF	Great Eastern Furrer & Frey	SORBA	Shaping Architecture Company (sub cladding contractor)
GEML	Great Eastern Main Line	SPI	Schedule Performance Index
GFRC	Glassfibre Reinforced Concrete	SPS	Secondary Part Steel
GLA	Greater London Authority	SR	Sponsors Requirement
GPE	Great Portland Estates	SRP	Safety Review Panel
GRC	Glass Reinforced Concrete	SSE	Scottish & Southern Electricity
GRIP	Governance for Railway Investment Projects	SSP	Stations, Shafts, Portals
GSM-R	Global System for Mobile Communication - Railway	STG	Stepney Green
GW	Great Western	STS	Standard Track Slab
GWML	Great Western Main Line	SVP	Safety Verification Panel
GWR	Great Western Railway	T&C	Testing & Commissioning
H&S	Health & Safety	TAP	Technical Assurance Plan
HAL	Heathrow Airport Limited	TBM	Tunnel Boring Machine
HALARP	Heathrow Airport Limited Assurance Review Panel	TC&HSG	Testing, Commissioning and Handover Steering Group
HAS	High Attenuation Sleeper	TCMS	Train Control Management System
HAVS	Hand Arm Vibration Syndrome	TCR	Tottenham Court Road
HEP	Handover Execution Plans	TCRW	Tottenham Court Road West
HIA	Heathrow Implementation Agreement	TDY	Tunnel Drive Y
HM	Her Majesty	TfL	Transport for London

HMDL	Handover Master Deliverable List	TOC	Train Operating Company
HRW	Heathrow Airport	TPA	Tunnel Planning Authority
HSPI	Health & Safety Performance Indicator	TPH	Trains Per Hour
HV	High Voltage	TPS	Train Protection System
HVAC	Heating Ventilation & Air Conditioning	TPWS	Train Protection & Warning System
IA	Interim Acceptance	TRAIL	Transport Reliability Availability Integrated Logistics
ICD	Interface Control Document	TRH	Temporary Rehousing
IECC	Integrated Electronic Control Centre	TSI	Technical Standard for Interoperability
IEP	Intercity Express Programme	TTVS	Temporary Tunnel Ventilation System
IFC	Issued For Construction	TUCA	Tunnelling & Underground Construction Academy
IFD	Ilford Yard	TWAO	Transport & Works Act Order
IM	Infrastructure Manager	TXM	TXM Plant
IOSH	Institution of Occupational Safety and Health	U&A	Undertakings & Assurances
IP	Intervention Point (0, 1, & 2)	UKPN	UK Power Networks
IR35	Inland Revenue Taxation Regulation 35	UR	Urban Realm
IRN	Installation Release Note	URT	Unresolved Trends
IRSG	International Regulatory Strategy Group	UTX	Under Track Crossings
ISJ	Interim Safety Justification	VDP	Victoria Dock Portal
ISV	Intermediate Statements of Verification	VERP	Value Engineering Review Panel
ITP	Inspection & Test Plan	VFL	Vo ker Fitz Patrick
ITT	Invitation to Tender	VN	Variation Notice
JST	Joint Sponsor Team	VT	Voltage Transformer
KBR	Knorr-Bremse Rail	WAD	Works Authorisation Document
KD	Key Deliverable	WBP	Westbourne Park
KE	Kinematic Envelope	WBS	Work Breakdown Structure
KG	Kensal Green	WC	World Class
KO	Key Output	WCC	Westminster City Council
KPI	Key Performance Indicator	WCCC	Whole Contract Construction Certificate
L&P	Land and Property	WHI	Whitechapel
LB	London Borough	WITI	Western Inner Track Infrastructure
LBTH	London Borough of Tower Hamlets	WOE	Western Outer Electrification
LDBL	██████████	WOO	Woolwich Station
LFB	London Fire Brigade	WOTI	Western Outer Track Infrastructure
LIV	Liverpool Street	WTH	Western Ticket Hall
LMU	London Metropolitan University	YC	Yard Control
LO	London Over ground		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 112

Period 2 FY2018-19

29 April 2018 – 26 May 2018

Document No. B2111500/112/1.18

21 June 2018



Official ~ Sensitive Commercial

Project Status Report 112

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Note: This report relies on the information set out in CRL's Period 2 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 26 May 2018. Note that information emerging after the close of Period 2 is subject to formal confirmation by CRL in its Period 3 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan.

Document history and status

Revision	Date	Description	By	Review	Approved
1	14 June 2018	PSR 112 Period 2 FY 2018-19 v1.11.docx ~ Draft	PRep Core Team		
2	21 June 2018	PSR 112 Period 2 FY 2018-19 v1.18.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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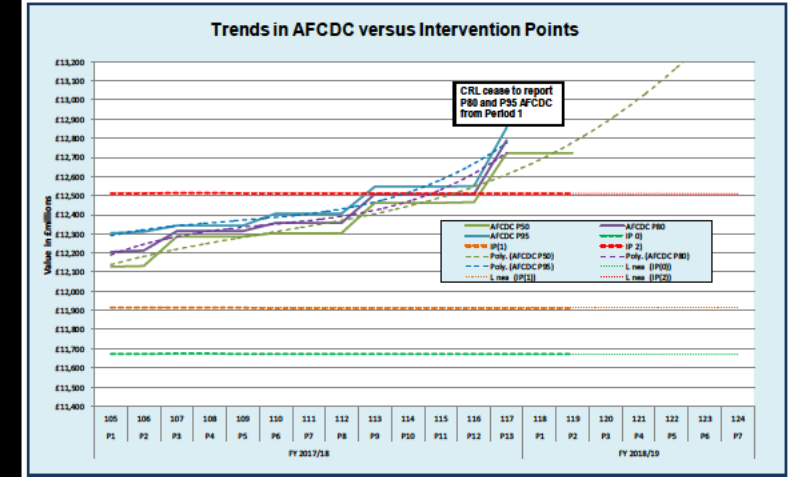
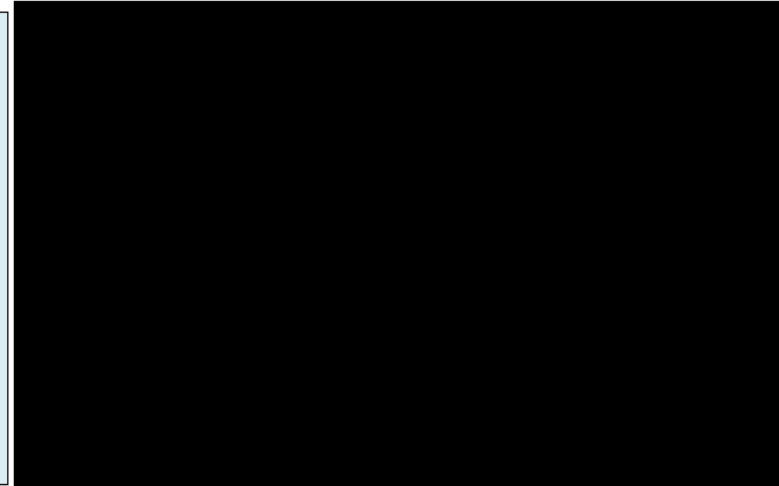
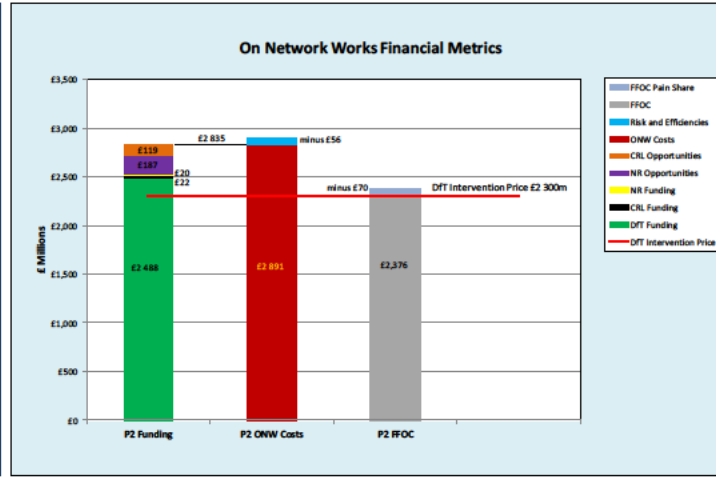
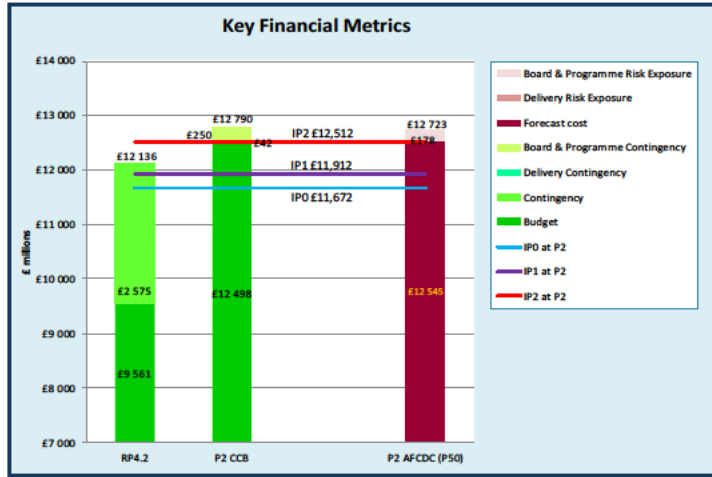
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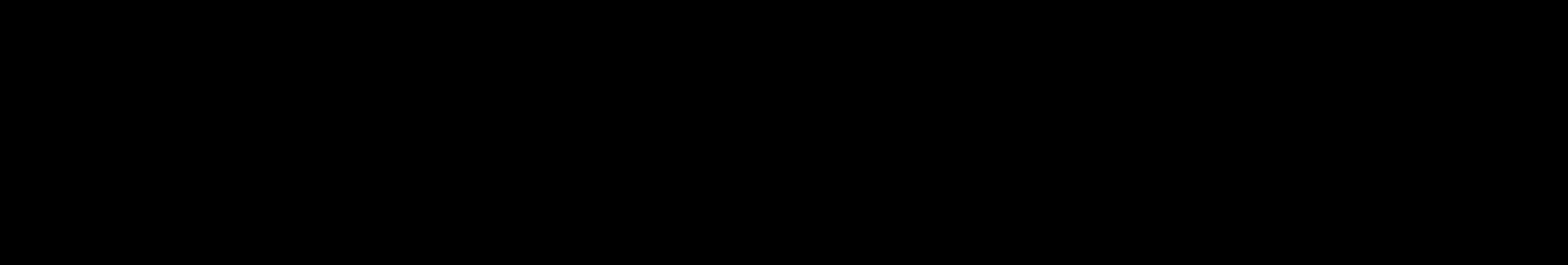
Cost and Schedule Dashboard (Period 2 FY2018/19)

SACR19 (as at April 2018):
 AFCDC (P50) ~ £12.723bn. AFCDC (P80) ~ £12.790bn
 AFC: (£12.723bn AFCDC (P50) + £2.408bn ONW etc) = £15.131bn

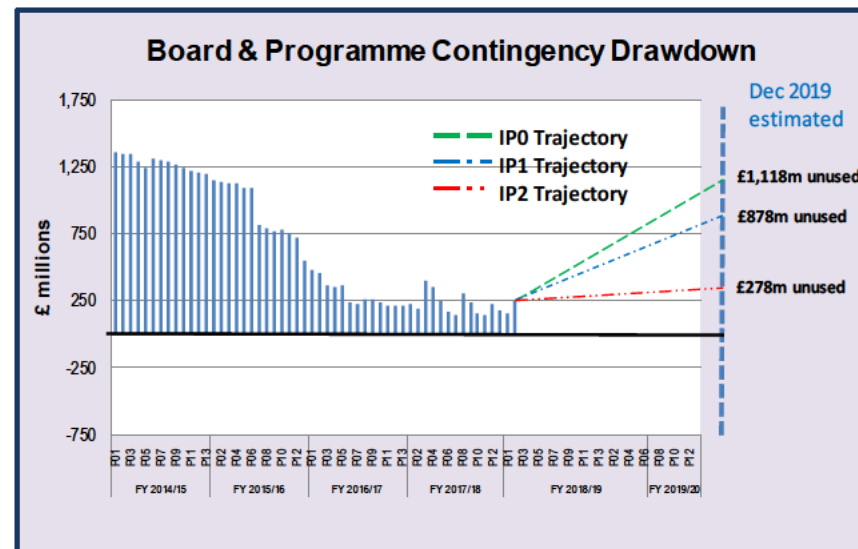
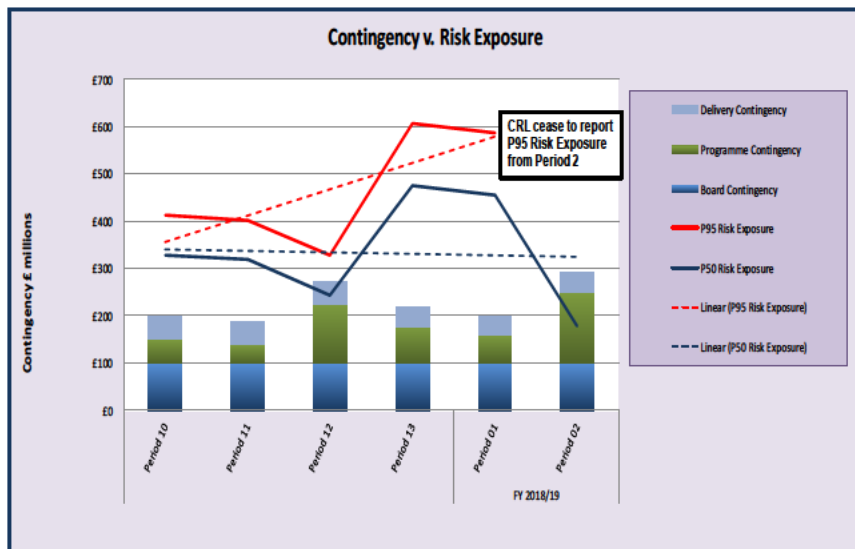
Cost:



Schedule:



Risk, Contingency & Change:



Project Representative's Summary:

Cost: IP0, IP1 and IP2 have not changed in Period 2. The AFCDC has also not changed in Period 2 and remains at £12,723m, exceeding IP2 by £211m. The Period 2 Finance Current Control Budget has increased to £12,790m to reflect the Period 13 (SACR19) P80 AFCDC. The AFCDC is below the reported financial budget by £67m but exceeds the RP4.2 Baseline funding of £12,136m by £587m. The Period 2 CRL ONW AFC (excluding VNs) and NR FFOC remains at £2,376m, both of which exceed the DfT Intervention Price by £76m.

Schedule & Progress: CRL face a number of significant challenges during the next few months; there remains a high risk that Stage 3 Opening may be delayed or the opening will be sub-optimal. CRL has advised that Trial Running and Trial Operations target dates have been delayed and merged into 'Combined Trials' which are scheduled to commence on 1 October 2018, thus reducing the time for Trial Operations from 13 to 10 weeks. Prior to this, a new 'Pre-Trial Running' period is due to commence on 11 September 2018 for 3 weeks.

Risk, Contingency & Change: In Period 2, there was a £278m decrease in P50 risk to £178m predominantly due to drawdown of risk to fund Delivery level cost increases which CRL previously identified in its Q4/Period 13 QCRA. As a consequence of the increase to the FCCB, the overall revised contingency budget of £292m is sufficient to cover the risk exposure of £178m by £114m (a £369m improvement from Period 1). The centrally controlled Delivery contingency remains at £42m in Period 2.

Cost and Schedule Dashboard

(Quick Reference Guide)

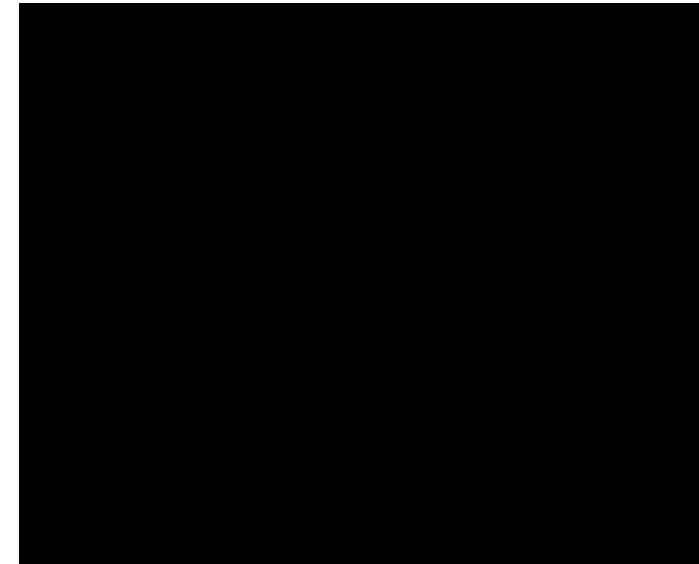
Cost

Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFCDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

On Network Works Financial Metrics

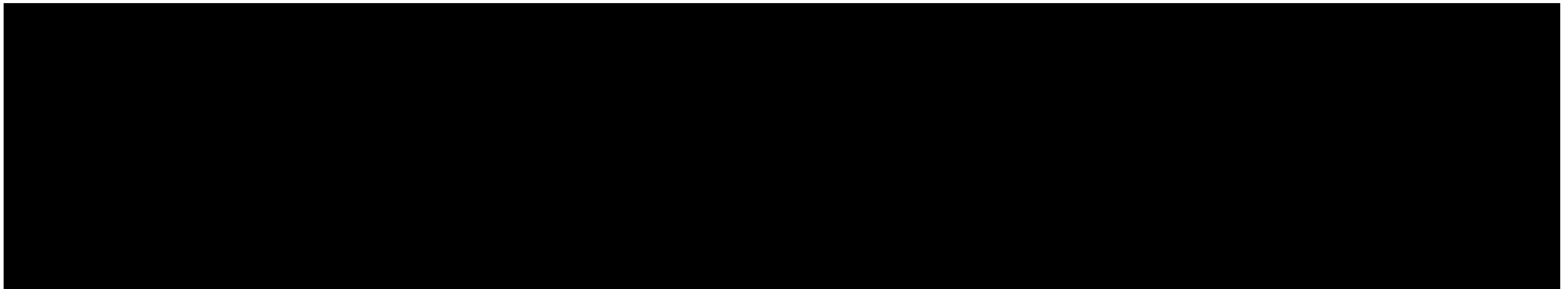
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



Trends in AFCDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFCDC at P50, P80 and P95 and forecasts the respective future AFCDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2. From Period 1, CRL no longer report P80 and P95 AFCDC.

Schedule & Float



Risk, Contingency & Change

Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets, although CRL now aim to achieve improved rates.

Financial:

The Intervention Points have not changed in Period 2, and the AFCDC at remains at £12,723m, resulting in a breach of IP2 by £211m. Costs continue to increase so we expect an increased forecast in Period 3. The independent Jacobs commercial team has reviewed the scenarios costings prepared by CRL and has issued its final report.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains at £2,530m, but we expect this to increase to reflect the £54m additional NR funding. The ONW final forecast outturn cost (FFOC) remains at £2,376m. CRL assess there are cost risks to the ONW forecasts.

Stage 2 Opening:

RfL is provisionally planning to swap the Reduced Length Units, currently running between Paddington and Hayes & Harlington, with Full Length Units (FLU) in August 2018. This is dependent upon development of TCMS v7.2 software, but would give tangible benefit in driving up FLU performance prior to Stage 3.

Stage 2 Phase 2 is encountering two issues that could affect the target opening date of 24 February 2019. The first is the slippage (continued from Period 1) in the developmental phases of TCMS v7.3. [REDACTED]

Stage 3 Opening - Infrastructure and Systems:

CRL has advised that Trial Running and Trial Operations target dates have been delayed and merged into 'Combined Trials' which are scheduled to commence on 1 October 2018. Prior to this, a new 'Pre-Trial Running' period is due to commence on 11 September 2018 for 3 weeks.

Key achievements in the period have included the completion of the traction power energisation sequence, allowing a test train to run through Zones 3 & 4 to Westbourne Park on time on 11 June 2018. Readiness for dynamic testing through the prioritisation of energisation critical works has been achieved by delaying other rail systems installations. Completion of previously non-critical works, such as the GSM-R tunnel cable infrastructure, is proving challenging.

The forecast completion date for the High Voltage (HV) Non-Traction Power system has remained stable at 29 July 2018, following the delayed start at Limmo Shaft and Voltage Transformer (VT) failures. However, [REDACTED]

Following completion of line-wide SCADA delivery on 31 May 2018, [REDACTED] continues to support Stations, Shafts and Portals Phase 3 testing demands with interim software drops. However, [REDACTED]

[REDACTED]
CRL has approached RfL and LU for possible temporary support from their own projects.

[REDACTED]
[REDACTED] Investigations continue into the feasibility and acceptability of completing sufficient testing for Trial Operations to start, but with reduced or no ventilation functionality at [REDACTED]. CRL is also investigating a possible opportunity to carry out airflow performance testing within the Thames Tunnel, in order to provide some schedule relief.

CRL has continued with the delivery strategy of Blockade Working in the period and four Dynamic Testing Windows have now been completed. Despite the greater functionality now available for testing as a result of increased software maturity and the fixing of software baselines for trains and infrastructure, the results have been mixed. There are concerns with the general readiness of [REDACTED] to take advantage of the testing opportunity being made available by the latest iterations of [REDACTED] software and CRL is liaising with [REDACTED] at corporate level to address the issue.

It has been confirmed from recent detailed review that seven testing Windows provide insufficient time for signalling integration testing on the Central Section. The simultaneous operation of a number of single-train test tracks offers some possible mitigation and is being investigated. CRL intends to extend the dynamic testing period to accommodate a further three Windows up to the start of Pre-Trial Running. However, [REDACTED] [REDACTED]. The extended period will also allow the critical completion and testing of the NR signalling interfaces at Pudding Mill Lane and Westbourne Park, although agreement with NR on possessions has yet to be reached. The remaining schedule period will be used to complete training and the delivery of documentary support to the IMs, as well as to strike a balance between asset completion, IM readiness and railway reliability, in readiness for passenger service.

CRL face a number of significant challenges during the next few months. The time available for completion of work and the opportunities for delay mitigation in order to achieve Stage 3 Opening are reducing. Therefore there remains a high risk that Stage 3 Opening may be delayed or the opening will be sub-optimal.

Stage 3 Opening - Handover and Operational Readiness:

The combining of Trial Running and Trial Operations means there is less time for the trains to be 'sweated' to identify and rectify faults, or O&M staff to become familiarised with the railway. This will have an impact upon performance at the start of passenger service.

[REDACTED]
[REDACTED]
[REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Stage 4 and 5 Openings:

NR reports that the Class 345 RLUs will have the pantograph over-height protection deactivated. This mitigation closes the Ilford Yard wire heights issue. The main risk to Stage 4 continues to be the power upgrade works by NR.

NR has received tenders and carried out initial assessment for the West Enhanced stations for both Package 2 (Acton, Ealing and West Ealing) and Package 3 (Southall, Hayes & Harlington and West Drayton), but further clarification is required. There are concerns that an extended procurement process and delayed award will impact upon booked possessions at Christmas 2018 and the securing of weekend possessions between December 2018 and May 2019. This could affect the planned opening dates of the stations. Concerns regarding ETCS and the related derogation continue.

1 Cost

1.1 Summary

The Intervention Points have not changed and the AFCDC¹ continues to breach IP2 by £211m. We expect the breach to increase in Period 3. ONW forecasts are as before.

IP0, IP1 and IP2 have not changed in Period 2;
The AFCDC remains as £12,723m;
The AFCDC breaches IP2 by £211m;
[REDACTED]
We expect the AFCDC to increase at Period 3;
The independent Jacobs commercial review team has reviewed the CRL costed scenarios;
Following an increase to Contingency, the AFCDC is now below the financial budget;
The CRL ONW AFC, including VNs, remains at £2,530m;
The ONW FFOC remains at £2,376m;
CRL assess there are significant cost risks to the ONW forecasts.

1.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 2. At Period 2, CRL continues to report the AFCDC as £12,723m, but further reports that it has increased marginally by £0.2m in Period 2. The CRL Period 2 AFCDC continues to exceed IP2 by £211m, as shown in Figure 1 - 1. Resolution of the required funding of the programme above IP2 continues with discussions ongoing between CRL and Sponsors with HM Treasury to clarify and validate the cause and effect of the additional funding requirements.

We expect the AFCDC to increase due to continuing evidence of further cost pressures at [REDACTED], [REDACTED] and [REDACTED] stations with CRL reporting increases in cost forecasts as a result of continued pressure to complete works in time for the combined Elizabeth line Trials in October 2018. There is also the likelihood that [REDACTED] station may not be available until post Stage 3 creating further potential cost pressure. [REDACTED]
[REDACTED]
[REDACTED]. CRL reports that the full requirement needs to be reviewed, assessed and managed through the trend process. CRL intends to carry out an internal review of costs to go, URTs, risk, etc in late June as part of its AFCDC review for Period 3; we expect the AFCDC to increase following this review.

¹ Although CRL does not refer to P50 in its Period 2 report, the PDA defines all costs at P50. THE AFCDC at Period 2 is based upon that created at Period 13 which was at P50. CRL has advised that there will be no QCRA or Probability calculations at Period 3.

CRL has advised that the AFDCDC includes cost or risk allowances for all items of scope currently instructed in the COS; although we believe the risk allowances may be insufficient. CRL will need to carefully examine the costs of the new Combined Trials strategy, as well as its risk allowances, as part of its Period 3 cost review. The only two items which are specifically excluded are the costs of the OOC second link, and [REDACTED]

Programme risk reduced by £278m in Period 2 due to risk allowances being utilised to fund Delivery, Indirect and Property cost increases which have been previously identified in the Q4/Period 13 QCRA.

(£ millions)	Period 1	Period 2	Delta	Movement
Forecast	12,267	12,545	278	up
Delivery Risk	0	0	0	same
Subtotal	12,267	12,545	278	up
Programme Risk	452	174	-278	down
Board Risk	4	4	0	same
AFDCDC total	12,723	12,723	0	same
IP0	11,672	11,672	0	same
IP0 Headroom	-1,051	-1,051	0	same
IP1	11,912	11,912	0	same
IP1 Headroom	-811	-811	0	same
IP2	12,512	12,512	0	same
IP2 Headroom	-211	-211	0	same

Figure 1 - 1 ~ AFDCDC Headroom to Intervention Points

CRL continues to seek cost efficiencies and to challenge contractors costs in its attempt to mitigate cost escalation above IP2, but we continue to note the following:

- The analysis of defined cost continues to follow the established trend of increase in CRL assessments of defined costs rising towards the contractors estimates and the gap is not closing, see Section 1.3;
- CRL is reporting that the programme is just over 93% complete and engaging in the safety critical stages of testing and commissioning and is modifying its plan to deliver Stage 3. Therefore, realistic prospects for major cost savings at such a late stage will be difficult to realise. However, opportunities may exist in CRL’s implementation of the revised construction and testing strategy.

Figure 1 - 2 indicates the cumulative delivery overspend at each period.

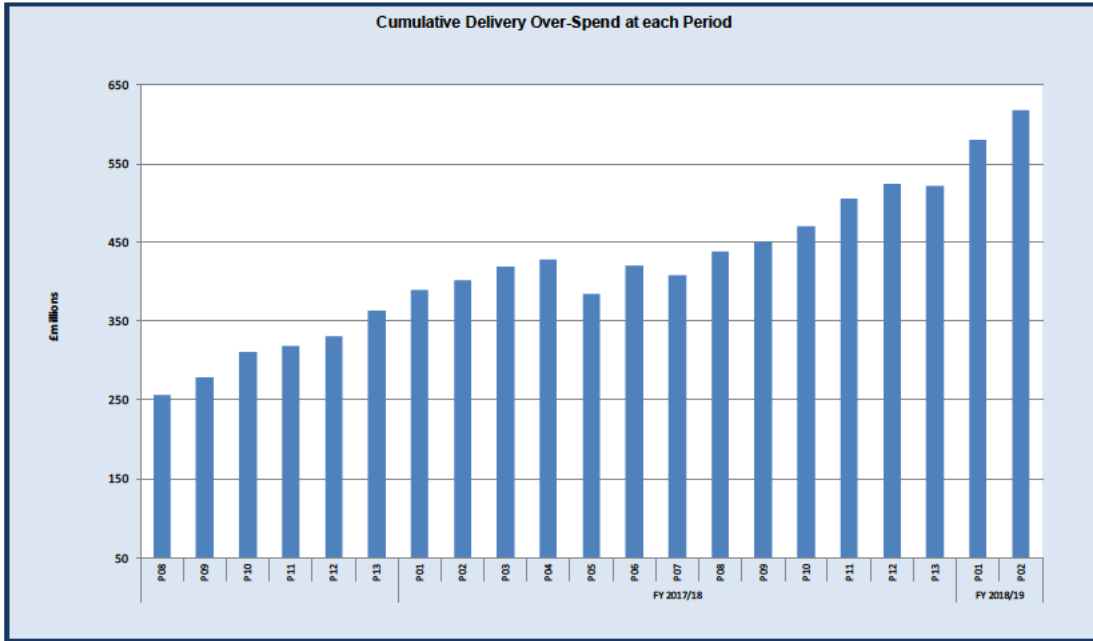


Figure 1 - 2 ~ Cumulative Delivery Overspend at each Period

The cumulative delivery overspend has increased in Period 2 by £38m to £618m (Period 1, £580m). This overspend is included in the AFCDC.

CRL reports that, in Period 2, it spent £52.2m above the 2018/19 Business Plan, continuing the trend of growing overspend. The Business Plan for Direct Costs was set in Period 6 2017/18 and the subsequent impacts of cost escalation and delays to MOHS dates for the key contracts has a consequential effect to the Business Plan. The CRL Period 2 Board Report provides the details of the overspend which, in summary, are predominantly due to prolongation and delays. These costs are included in the AFCDC.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 2 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package.



² Figure 1-3 subject to arithmetical rounding errors.

Contract	Target £m		Defined Cost £m	
	P2		P2	
	CRL	CON	CRL	CON
C300				
C305				
C610				
C512				
C510				
C435				
C405				
C412				
C360				
C502				
C422				
C350	others	others	others	others
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,318	£5,515	£5,607	£5,804
Others	£912	£923	£971	£982
Total	£6,230	£6,438	£6,578	£6,786

Figure 1 - 3 ~ P1 Adjusted Defined Cost and Target Cost³

[Redacted text block]

[Redacted text block]

[Redacted text block]

³ Figure 1-3 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.

[Redacted]

[Redacted]

[Redacted]

1.4 Scenario costs

CRL has prepared its cost to complete scenarios which consider the impact of a completion tail extending into Trial Running and Trial Operations, with some non-critical construction work extending post Stage 3 opening. The independent Jacobs commercial review team appointed by the JST has reviewed the approach taken by CRL, and has completed the final report to be presented to the Crossrail Sponsor Board on 25 June 2018, as well as providing on-going support to JST regarding actual cost performance compared to the cost scenarios and review conclusions.

1.5 Contingency

The Finance Current Control Budget has been increased at Period 2 by £283m to £12,790m to align with the P13 2017/2018 P80 AF CDC. The CRL Board meeting on 25 May 2018 approved this budget which is in excess of approved funding and IP2. The £12,723m AF CDC (P50) is now below the financial budget by £67m, but exceeds the RP4.2 Baseline funding of £12,136m by £587m.

CRL is reporting that the overall Period 2 contingency budget of £292m is now sufficient to cover the P50 risk exposure of £178m by £114m (a £369m improvement from Period 1). The centrally controlled Delivery contingency at Period 2 remains at £42m.

From Period 2, CRL is no longer reporting risk exposure at P95. Consequently, Figure 1 - 5 shows the trend of the decrease in the Board and Programme Contingency and compares the lower Risk Exposure at P50 only with the remaining contingency.

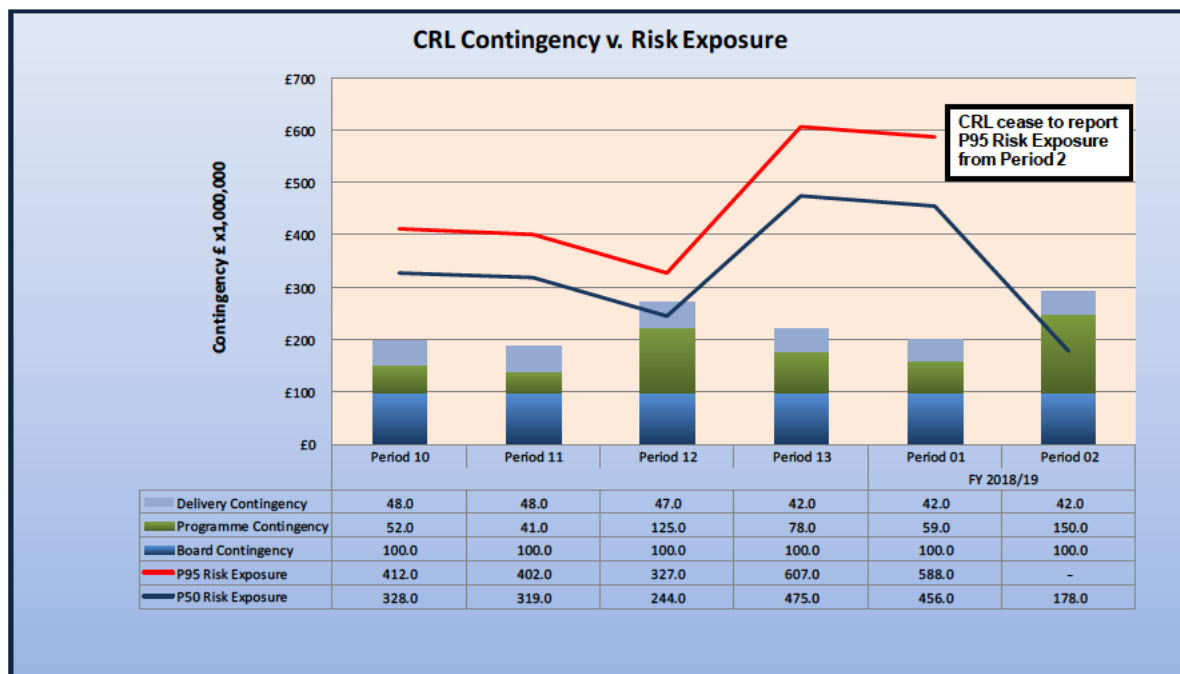


Figure 1 - 5 ~ Risk Exposure versus Contingency

1.6 Cost: On Network Works (ONW)

CRL reports that the ONW are 95% complete, which offers greater certainty around the cost performance of the Project. However, CRL has concern in respect of the cost risk associated with [redacted] Programme Demobilisation, Access, and Recoveries. The CRL ONW AFC, excluding VNs, and the NR FFOC remains at £2,376m in Period 2.

The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,305.6m, which exceeds the DfT Invention Price of £2.3bn by £5.6m. This has been stable for several periods. Figure 1 - 6 indicates the relevant breakdown.

Description	Period 1 £m	Period 2 £m
Cost Grand Total	2,835	2,835
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
CRL/NR Funding:		
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
Total CRL/NR Secured Funding	305	305
FFOC	2,376	2,376
Pain/gain share	-70	-70
Forecast to RAB	2,306	2,306

Figure 1 - 6 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

1.6.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is unchanged and remains at £2,530m for Period 2. NR reports a Total Secured Funding for NR ONW is £2,835.4m, as shown in Figure 1 - 7.

The ONW funding is expected to increase in Period 3 following NR seeking to secure a further £9.8m of Recoveries in relation to other NR projects and tax/insurance recoveries; these amounts are currently included in the 'Recoveries (Residual)' tabulated in Figure 1 - 8 NR ONW Cost Summary.

[REDACTED]

Description	P2 Source of Funding				P1
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	217.0	-	-	217.0	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,488.0	22.0	20.0	2,530.0	2,530.0
Sub Total	-	118.9	186.5	305.4	305.4
TOTAL SECURED FUNDING	2,488.0	140.9	206.5	2,835.4	2,835.4

Figure 1 - 7 ~ NR ONW Secured Funding

1.6.2 ONW Cost

CRL reports that the Grand Total Cost remains static in Period 2 at £2,835.4m, but with a reduced mid-point sensitivity of plus £73.5m (a £15.8m improvement from Period 1), as shown in Figure 1 - 8.

Description	Period 1 £m	Period 2 £m	Delta £m	P2 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,907.9	2,891.8	-16.1	2,887.4	2,931.9	2,978.5
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	-26.8	0.0	26.8	0.0	0.0	0.0
Recoveries (Residual)	-16.4	-9.8	6.6	-4.8	-4.3	-4.9
Targeted Savings	-29.3	-46.6	-17.3	-42.0	-18.7	0.0
Cost Grand Total	2,835.4	2,835.4	0.0	2,840.6	2,908.9	2,973.6
Total Secured Funding	2,835.4	2,835.4	0.0	2,835.4	2,835.4	2,835.4
Funding Gap	0.0	0.0	0.0	5.2	73.5	138.2

Figure 1 - 8 ~ NR ONW Cost Summary

NR continues to focus on cost control; however, in CRL’s view, the most significant cost risks to the ONW are in respect of:

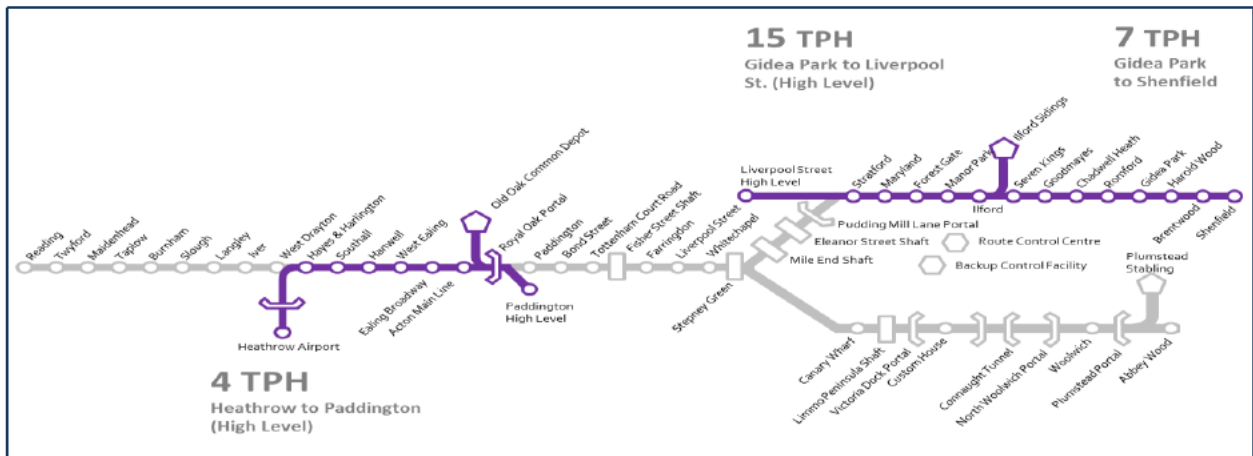
- NR’s ability to achieve the required £9.8m of Recoveries;
- Anglia [REDACTED];
- Closeout risk associated with upward pressure on the reported AFC for [REDACTED] now that the Contract is cost reimbursable;
- Closeout risk associated with final outturn cost with respect to [REDACTED];
- Prioritisation of access and historic claims are impacting the confidence of achieving the reported AFC.

NR has received tenders for West Outer enhanced stations Packages 2 & 3 and is currently progressing with tender reviews but has not released any data in respect of the tender values and there still remains the risk that [REDACTED]

■■■■ NR has reported that, whilst tenders are largely compliant in respect of safety and technical requirements, there are ■■■■■ and, at present, NR is unable to proceed with awarding these packages. CRL is working closely with NR to ensure all options are considered to ensure major activity planned during Christmas possessions can be undertaken and the December 2019 delivery achieved. In the meantime, the enabling works packages continue and, to further mitigate potential schedule delay, NR has commenced procurement of essential long-lead items which will be 'free-issued' to suppliers upon Contract award.

CRL has collated the effects of known Period 2 risks in its SPOT AFC cost sensitivity analysis as shown in Figure 1 - 8 above.

2 Stage 2: Phase 2; [Target Date 24 February 2019]



2.1 Summary

CRL and RfL are in the process of preparing plans for Stage 2 Phase 2 opening. The target date for this is 24 February 2019; to be confirmed.

An interim phase, swapping out RLUs with FLUs, is provisionally planned for August; Slippage to the train's on board ETCS programme continues;

2.2 Operational Readiness Assessment

The CRL team that has been responsible for programme integration of Stages 2, 4 and 5 is disbanding in August 2018. RfL and the CRL close-out organisation⁴ will need to ensure they have the capacity to fulfil those functions. We note that both Stage 1 and 2-1 took considerable effort to be implemented, and we would expect Stage 2-2 (to be shortly followed by Stage 4) to be no different.

CRL's Stage 2-2 dashboard categorised one issue as 'red' for Phase 2. This is the same number as Period 1, but in Period 1 it was 'Train Readiness'. In Period 2 it is 'Driver training & Ops proving'. The risk relates to the lack of clarity concerning the driver training programme; see Section 2.4.

2.3 Interim phase

A further interim phase between Stage 2-1 and 2-2 is provisionally planned, which involves 'swapping out' the RLU's currently in service in the west with FLU's prior to Stage 2-2. This has the benefit of increasing the mileage and hence performance of the FLU's. It also means the RLU's can be repatriated to the east, releasing C315 stock to their owner. A number of

⁴ Stage 4&5 were identified as CRL Close-out organisational responsibilities in SB 93B-01, not Stage 2-2.

activities and infrastructure alterations are required for this to be achieved, but these are all things that Stage 2-2 would require anyway. RfL want to implement this change by 12 August 2018. A key decision trigger to that date is confirmation that development of TCMS v7.2 has reached a developmental milestone by late June 2018. This initiative should be pursued for the reasons listed above, as long as it remains an achievable target and does not become a burden.

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In our Period 13 report, we described two interim activities that are required before formal ETCS testing, using TCMS v7.3, can start in August 2018. They were:

1. Software code freeze – 15 May 2018.
2. Type testing of software on the train – 23 June 2018.

CRL’s Period 2 report revised the forecast completion of Activity 1 to 29 May 2018. It had not been achieved by 20 June 2018. We repeat our comment from our Period 1 report where we said that this implies schedule contingency has been eroded, increasing the risk that the following key milestone will slip. Activity 2 is now forecast for 16 July 2018. The key milestone ‘Approval to Operate ETCS for Driver Training’ remains held by CRL at 12 October 2018.

[REDACTED]

Operations

As stated in our P1 report, the key operational issue to delivering Phase 2 is the period required for driver training. [REDACTED]

[REDACTED] As described above, BT’s agreement with RfL is that the train will be ready to start driver training by 12 October 2018. MTR-C would like to work up proposals that start driver training at the beginning of January 2019, but still meet a late February start to service. This is driven by MTR-C’s wish to avoid preparations for Stage 2-2 and Stage 3 coinciding.

[REDACTED]

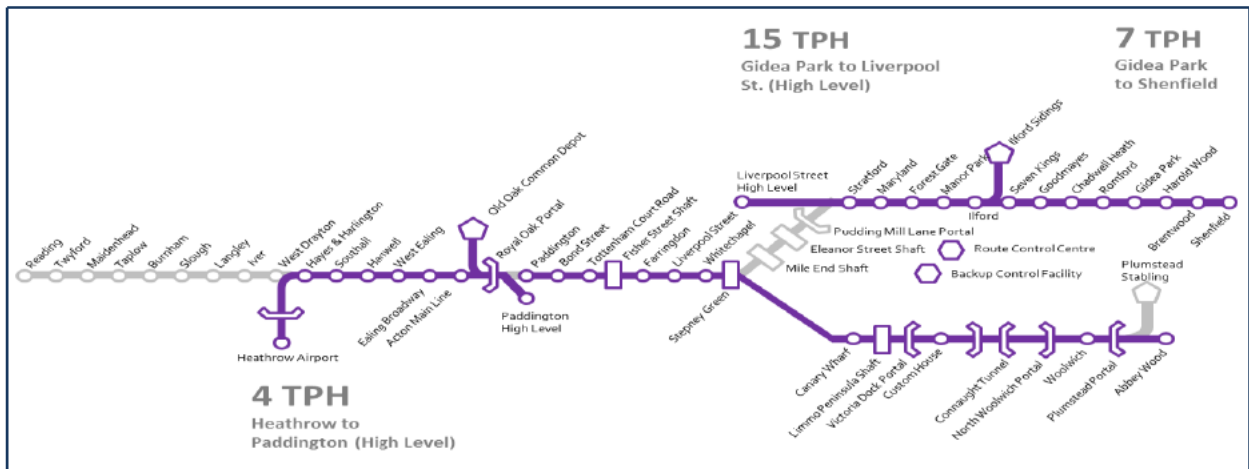
Regulatory Approvals

There are now two key approvals for Phase 2-2 to be issued by the ORR:

- APIS ETCS trackside to be issued to NR;
- APIS ETCS on-board to be issued to BT.

APIS ETCS trackside was submitted 19 June 2018, with a positive response expected back from the ORR by 13 July 2018. It is considered by CRL to be at low risk. The APIS ETCS on-board schedule, forecast to provide a submission to ORR by 15 October 2018, is linked to the development of the BT signalling programme. It must therefore be considered as ‘amber’.

3 Stage 3: Paddington to Abbey Wood; 9 December 2018⁵.



3.1 Summary

CRL face a number of significant challenges during the next few months; see details in the following Sub-Sections and in CRL’s Board Report. The time available for completion of work and the opportunities for delay mitigation in order to achieve Stage 3 Opening are reducing. Therefore, there remains a high risk that Stage 3 Opening may be delayed or the opening will be sub-optimal.

CRL has advised that Trial Running and Trial Operations target dates have been delayed and merged into ‘Combined Trials’ which are scheduled to commence on 1 October 2018, thus further reducing the time for Trial Running and Operations from 18 to 8 weeks⁶. Prior to this, a new ‘Pre-Trial Running’ period is due to commence on 11 September 2018 for 3 weeks. These revised dates will allow more time for construction blockades and additional dynamic testing windows. The revisions will also take account of new dates for transition testing at NR interfaces.

- High risk that Stage 3 Opening may be delayed or the opening will be sub-optimal;*
- Trial Running and Trial Operations target dates have been delayed;*
- CRL has created three target Interim Milestones to be tracked;*
- More Anchor Milestones have been missed;*
- Potential for [REDACTED] Station opening to be late;*
- Further delays to the installation and testing of permanent tunnel ventilation systems;*
- Further delays to HV Non Traction Power energisation at Stations;*
- System delays at some stations for the completion of Phase 3 Integration Testing;*
- Insufficient dynamic testing windows for testing and re-tests;*
- Uncertainty regarding possessions for signalling transition testing;*
- Late production and agreement of Engineering Safety Justifications;*
- Delays in the production of Handover deliverables and training;*

RfL and CRL have jointly created an Elizabeth Line Countdown Board Tracker (ELCBT) which sets out the readiness tests and related criteria for management of tasks leading to Interim Milestones. These are supported by Deep Dive meetings to review specific concerns, and T-meetings to review matters outstanding at each IM review. The first Tracker was presented to the PDB meeting on 5 June 2018, although this was a draft and more data needed to be added. An updated version was issued at the Interim PDB on 20 June 2018. We believe this is a good step forward, focussing all parties on the issues and risks to be resolved leading up to each target date. Nevertheless, this tool does not resolve the issues and we believe all milestones are at risk.

The three target Interim Milestones are:

- IM1 - 30 August 2018 – Dynamic Testing under CCRB⁷ (to deliver Pre-Trial Running);
- IM2 - 24 September 2018 – Pre-Trial Running (to enable Combined Trials);
- IM3 - 3 December 2018 – Combined Trials (for Stage 3 Opening Revenue Service).

Figure A - 1 in Appendix A sets out the eighteen Corporate (Key) Milestones recently approved by the CRL Board, alongside the latest forecasts. Eight (previous four) are forecast to be later than the baseline and we expect further delays over the next few months. Milestone 1 for non-traction power energisation is likely to be re-forecast from June to July 2018; see Section 3.6. Milestone 4 for the contract award for West Enhanced Stations is likely to be delayed; see Section 5.3.1. Milestones 8 and 13 have been renamed and given new dates to reflect the new Trial Operations strategy.

The MOHS Anchor Milestones data at Period 2 for actuals and forecasts has revealed that yet more milestone targets have been missed so that the actual/forecast curve now overlaps the ■■■ date baseline curve in Period 6 (August/September). Figure A - 2 in Appendix A indicates the overall cumulative progress.

Figure A - 3 in Appendix A indicates 53 Anchor Milestones (44 in Period 1), from a total remaining of 115, which are forecast to be delivered later than the MOHS baseline ■■■ date. Many feature significant in-period delays. In some cases, these delays are minor and not critical, but others bring further stress to the overall programme. Detail regarding progress of individual projects is included later in this Section.

The key issues which are bringing schedule risk to Stage 3 Opening are listed below and expanded later in this Section:

- IMs unable to agree Handover Execution Plans (HEP), see Section 3.4;
- Potential for ■■■ Station to be late opening, see Section 3.4;
- Poor production of Installation Release Notes (IRN), see Section 3.4;
- Further delays to the installation and testing of permanent tunnel ventilation systems, see Section 3.6;
- Further delays to HV Non Traction Power energisation at Stations, see Section 3.6;
- System delays are forecast at some stations for the completion of Phase 3 Integration Testing, see Section 3.6;
- Critical tunnel equipment cannot be installed before Trial Operations, see Section 3.6;
- Late delivery of ■■■ software, see Section 3.6;
- Issues with ■■■, see Section 3.6;
- Insufficient dynamic testing windows for testing and re-tests, see Section 3.7;

⁷ Construction and Commissioning Rulebook governing access to the Trace under CRL management.

- [REDACTED];
- [REDACTED];
- Completion of all FDOs, see Section 3.8.1.
- Overload of submissions to RAB(C), see Section 3.8.3;
- Late production and agreement of Engineering Safety Justifications (ESJ), see Section 3.8.3;
- [REDACTED];
- Delays in the production of Handover deliverables and training affecting IM readiness, see Section 3.10;
- [REDACTED]

3.2 Operational Readiness Assessment

Change to Trial Running and Trial Operations

CRL has recently announced a change to the Trial Running and Trial Operation dates. The plan is to continue test windows, interspersed with construction, until 11 September. At that point it will start a Pre-Trial Running period for the train and Trace infrastructure. During this period the number of trains being utilised is likely to be between 6 – 10, and CRL will retain control. On 1 October 2018 the system will enter Combined Trials (Running & Operations) when control of train operations changes to RfL-I.

[REDACTED]

[REDACTED]

Elizabeth Line Dashboard

There remain sixteen Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)⁸, the same number as our previous report.

There has been an improvement with the provision of technical training to trainers, but other factors have mitigated against this improvement. The sixteen Readiness Tasks can be attributed to three categories, and are the same issues as last period:

- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. This period has also seen a delay to the installation of training equipment in TUCA. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway;

⁸ Meeting held 1 June 2018.

- COS infrastructure and interfaces not being in a position to support dynamic testing. This is also affecting the readiness of NR signallers and maintainers who need to be aware of the transition operation and infrastructure;
- Train software not being in a position to support dynamic testing.

3.3 Tunnels

CRL is now targeting completion of all certification activities, for the remaining () tunnelling contract, by the end of June 2018, against a target date in mid-February 2018. This is one month later than reported in our last report. The delay in contract closure has been attributed to the demobilisation of both the CRL and contractor’s site teams, and the lack of availability of CRL resource. Backfilling of Access Shaft AS1, above the central concourse tunnel at Finsbury Circus (Liverpool Street), by the station contractor () remains forecast for completion by 24 September 2018.

3.4 Stations, Shafts and Portals

Schedule and cost pressures continue across most of the main central section stations. Further delays are impacting on the completion of fit-out, subsequent testing & commissioning and the forecast IM handover dates.

The delays to CRL’s performance are evident from the reported percentage progress, missed progress milestones and delayed IRN completion reported across all of the station contracts. CRL has, in response, re-sequenced a number of activities before Stage 3 opening, to allow for more opportunities for construction and testing, to complete critical works.

The cumulative actual and planned percentage completions, reported for all but () and F () stations, show a continued increase in delays against planned levels of progress. We are concerned at the continuing rate of deterioration that appears to have occurred over the last two periods and the increasing risk to achieving the station opening dates. Refer to Appendix B, Figure B - 1, for a summary of the Period 2 percentage completions against the re-baselined MOHS 2018 plan.

The gaps, between planned and actual percentage completions at the stations, are still evident in the station schedule performance curves. While the actual/forecast curves still remain within the re-baselined MOHS () Date envelope, the delays incurred will make achievement of the MOHS even more challenging. Actual and forecast schedule performance curves can be found in Appendix B.

Lower than planned levels of progress at the stations can also be seen in the number of milestones missed during Period 2, adding to schedule pressures. Only 49 of the 76 planned project milestones were achieved in the period. While many of the missed milestones do not directly impact on the MOHS critical path, they still represent a developing bow wave of physical and documentary work that still has to be completed, prior to IM handover.

A summary of the Central Section station completion dates can be seen in (). This table reflects the forecast key dates and milestones, for each station at Period 2, against the MOHS 2018 target dates. There have been delays in the reported forecast dates for completion of fit-out, IM handover and station completion dates, at () and () stations during Period 2. These date changes are shown in Bold text on the table.

The general progress of the station works, in readiness for Testing and Commissioning (T&C), is being measured by the various Tier 1 contractors' production of Installation Release Notices (IRNs). Completion of IRNs still remains significantly behind the rate required to support MOHS.

Only 227 of the 438 IRNs planned, for the Stations, Shafts and Portals (SSPs), were achieved in Period 2. CRL has completed only 38% against a planned 60% of the 4,003 IRNs for all stations, portals and shafts. Delayed completion of physical works is delaying delivery of the IRNs. This adds further risk to the completion of integration testing in time for handover to the IMs, and the achievement of the MOHS programme. CRL forecasts the completion of a further 1,127 IRNs in Period 3. [REDACTED]

[REDACTED] The bow wave of IRN submission/completion continues to build and the required rate of closure per period is increasing to what has been demonstrated to be unachievable levels. [REDACTED]

CRL has extended the deadline for the completion and agreement of the Handover Execution Plans for all stations, shafts and portals with the IMs to late June 2018.

Bond Street Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Tottenham Court Road Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Farringdon Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Canary Wharf Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Intermediate Shafts: [REDACTED]
[REDACTED]

- [Redacted]
- [Redacted]
- [Redacted]

3.5 ONW

NR has confirmed⁹ that its works for Key Date 33 (KD33) to enable energisation of COS from Kensal Green as pre-requisite for dynamic testing in advance of Stage 3 introduction of Crossrail services are complete. The primary feed into Westbourne Park ATS was completed on 15 May 2018. The Central Operating Section (COS) was energised from Kensal Green on 22 May 2018.

At Abbey Wood, NR is reporting that the main station and lifts are complete and that progressive handover is underway through June 2018 for the NKL and CRL platforms, bridges and car park. The NR elements of the various communication links are complete and currently await CRL elements to enable splicing and final connection works.

3.6 Completion and Handover of Integrated Systems¹⁰

Blockade Working remains CRL’s core completion philosophy, built around a basic two-week working pattern split between 11 days of construction in “blockades” and 3 days of dynamic testing in “windows”. In practice, to date the balance has been tailored to suit the number of dynamic tests able to be carried out in any given window, constrained by upstream off-site testing and software maturity. The dates for the dynamic testing windows are set out in Section 3.7.1.

Key dates in the dynamic testing phase through to Trial Operations are shown in Figure 3 - 1, with Systemwide progress forecasts to completion illustrated in the charts in Figure A - 4 in Appendix A. It should be noted that CRL is currently reviewing in detail the schedule for completion beyond Dynamic Test Window No. 7 (19 July 2018).

⁹ CRL PDB 5 June 2018.

¹⁰ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

Key Dates	MOHS 2018	P1 Actual / Forecast	P2 Actual / Forecast
Traction Power Energisation	01-Feb-18	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18	25-Feb-18
ONW KD33 Power from KG	28-Feb-18	21-May-18	22-May-18
4 Trains ready for DT Z3&4	23-Mar-18	07-Jun-18	07-Jun-18
Fibre Backbone complete	07-May-18	15-May-18	15-May-18
ATS at WBP energised	07-Apr-18	17-May-18	15-May-18
Traction Power on Z3&4	10-May-18	21-May-18	21-May-18
Linewide SCADA available	30-May-18	31-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	11-Jun-18	11-Jun-18
HV Non Traction Power on	01-Jul-18	29-Jul-18	29-Jul-18
Commence DT All Zones	02-Jul-18	02-Jul-18	02-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18	10-Sep-18
Commence Trial Operations	09-Sep-18	09-Sep-18	01-Oct-18

* In-period delay

Completed on time

Forecast later than MOHS

A557 - MOHS baseline date changed from 27/3/18 to 7/5/18 under change control 103

Figure 3 - 1 ~ Key Dates to Trial Operations

The energisation sequence for Zones 3 & 4 was successfully completed on 8 June 2018, allowing dynamic testing to be extended to Westbourne Park from Zones 1 & 2 for the first time on 11 June 2018, and in line with the date in the MOHS 2018. This was a notable success, given the number and complexity of critical workstreams, delivered by a range of stakeholders, that had to be brought together.

achieved the completion of line-wide SCADA delivery on 31 May 2018 and software development and delivery is making sufficient progress to support Stations pre-Trial Running aspirations. However, there is now significant CRL concern over the readiness of some Stations, Shafts and Portal sites to start Phase 3 testing, and the completion of a substantial integration testing workload using the data management infrastructure. Continuing schedule compression is producing what might become an unsupportable demand for additional resources. The current testing resource is around 50, but levels in the order of double that number are required for July and into August. CRL has approached RfL and LU for possible temporary support from their own projects.

While replacement Voltage Transformers (VTs) are arriving on time to support programme requirements, the forecast completion date of 29 July 2018 (at) remains under threat unless productivity improves.

CRL concerns remain with the amount of outstanding work associated with GSM-R cable installation. Installation completion by is currently at 82% of 145 cables, but with no IRNs yet issued; has therefore started cable termination work at risk in order to mitigate delays, with 2.5% complete of a total of 166¹¹. Completion of GSM-R is necessary for Trial Running.

¹¹ CRL C660 Communications & Control Period 2 PDB held on 5 June 2018.

Forecast completion of certain workstreams extends beyond their respective MOHS milestones¹² and work continues to identify mitigating measures. These are:

- [REDACTED] non-dynamic testing critical works (e.g. walkways, lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system completion and testing;
- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

Of these, the completion of the [REDACTED] permanent ventilation system remains the most significant and difficult challenge to resolve. The current forecast completion date for Phase 3 testing has moved out to 8 October 2018, driven by further delays at [REDACTED]. Investigations continue into the feasibility and acceptability of completing all necessary testing for Trial Operations to start, but with reduced or no ventilation functionality at [REDACTED]. CRL is also investigating a possible opportunity to carry out airflow performance testing within the Thames Tunnel.

Working arrangements continue to be developed between CRL and RfL that will allow the completion of the known late activities into the Trial Running and Trial Operations periods. CRL has recently proposed to extend Blockade Working to 10 September 2018, in order to allow completion of installation and dynamic testing. This will include an additional three Dynamic Testing Windows; see Section 3.7.1 below. This is a direct response to the overwhelming challenge of accommodating all remaining scope before the MOHS 2018 Trial Running start of 5 August 2018, and to avoid for as long as possible the constraints of working under RfL safety rules, which would otherwise be applied from that point. The proposal includes the re-definition of the time beyond 10 September 2018, with the period up to 1 October 2018 being utilised for “Pre-Trial Running”, and thereafter, up to Stage 3 Opening, for “Combined Trials”. Precise details on how these schedule periods will be used in practice are being developed and agreed.

We have recognised for some time that “intrusion” into the schedule period previously set aside for Trials was inevitable, and through our past reports have encouraged CRL and RfL to engage on the possibilities. It is crucial that a schedule is devised and agreed soon, allowing a balance to be struck between asset completion, achievement of sufficient IM readiness and demonstration of railway reliability, in order for Stage 3 Opening to be achieved on 9 December 2018.

3.7 Dynamic Testing

3.7.1 Dynamic Testing Strategy

The current programme and latest dates¹³ for the dynamic testing windows are as follows:

1. 27 – 29 April 2018 (Zones 1 & 2) (COMPLETED);
2. 10 – 13 May 2018 (Zones 1 & 2) (COMPLETED);
3. 25 May 2018 (Zones 1 & 2) (COMPLETED);
4. 7 – 12 June 2018 (Zones 3 & 4) (COMPLETED);
5. 22 – 25 June 2018 (All Zones);
6. 5 – 10 July 2018 (All Zones);
7. 19 – 24 July 2018 (All Zones).

¹² CRL MOHS Period 2 Review held on 8 June 2018.

¹³ CRL MOHS Period 2 Review held 8 June 2018.

Lessons from each dynamic testing window are being transferred to subsequent windows. As anticipated, the balance between construction and dynamic testing within the 14 day cycle is being adjusted according to readiness and latest delivery requirements. However, of greater significance is CRL's identification of the need for a further three dynamic testing windows as follows:

8. 2 – 7 August 2018 (All Zones);
9. 16 – 21 August 2018 (All Zones);
10. 30 August – 4 September 2018 (All Zones).

Detailed review of the [REDACTED] scope of signalling tests, together with the practical constraints inherent in the current method of testing (i.e. with single trains only), has confirmed that significantly more testing time is required than can be provided in the 7 windows. The delivery by [REDACTED] of increasingly mature iterations of TCMS v7, each providing greater testing opportunity, has allowed the full extent of signalling integration testing to be better understood. [REDACTED]

[REDACTED]

The implementation of additional windows provides some additional time, but further measures will be necessary in order to avoid possible impact upon Stage 3 Opening. Options for splitting the Central Section into multiple test tracks, with each effectively supporting simultaneous single train tests, and potentially operating around-the-clock, are being developed by CRL and the contractors. To provide even greater flexibility, PML ATFS might be retained as a feeder station for a further limited period, instead of being released now for modification to its final designed state. A "multiple" test track approach will require a significant increase in specialist supporting resources and a careful assessment of the current rule book to ensure that such an approach can be managed safely and effectively. We expect CRL's plans to be finalised in the period, and we will provide an update in our next report.

3.7.2 Dynamic Testing Progress

Four dynamic testing windows have now been completed under blockade working, almost exclusively involving test train operations in Zones 1 & 2. However, dynamic testing was successfully extended into Zones 3 & 4 on 11 June 2018, late in Dynamic Testing Window No. 4, with initial low speed runs between Whitechapel and Westbourne Park.

A new C620 signalling baseline was installed during Window No. 3, matched with a compatible trains software baseline which was installed in the same period. This combination makes available to CRL for testing, a much-increased functionality set (effectively everything for Stage 3 operations, including Yellow Plant).

CRL has submitted to RAB(C) the follow-on safety argument for the Safety Case for Dynamic Testing with Signalling Protection, but dynamic testing remains restricted to the use of a single train, pending the delivery of supporting evidence by BT relating to the braking performance of the train; see Section 3.8.3.

Signalling transition testing at each of the NR GE and GWML interfaces is scheduled independently of the blockades, and is now targeted to take place as follows:

- GE – 11 and 25 August 2018;
- GW – 9 September 2018.

While good progress was made with signalling equipment installation on the GEML over the late May Bank Holiday weekend, and Westbourne Park works are well advanced, no site progress

has yet been made on the GWML¹⁴. Agreement has yet to be reached with NR on access for completion, and CRL has approached DfT to provide assistance. Train movements from the NR network (and particularly from the GWML) are critical to the performance of Stage 3 services and the transitions must be made operational in time to support Pre-Trial Running.

3.8 Approvals, Assurance and Agreements

Within the CRL Board report there is a 'Regulatory Approvals Stage 2 and 3 Roadmap'¹⁵ that graphically shows the organisations and activities engaged with regulatory approval. We describe the key issues within this section of the report.

FDO's (Section 3.8.1) and RAB-C (Section 3.8.3) are key components of the activity 'Crossrail Safety Case'. This activity feeds into the work of the NoBo and AsBo, named in the 'Central Operating Section' activity. We describe this activity within Section 3.8.2. Finally we provide an overall assessment within Section 3.8.4.

3.8.1 Final Design Overview (FDO) Performance

CRL's target for close-out of FDO "Red" issues and the forecast dates for FDO certification continue to slip month on month. CRL is now targeting the close-out of all outstanding "Red" issues by the end of June 2018. An FDO certificate is a prerequisite for Interim Acceptance and Handover of the new assets to the IMs:

- 30 "Red" issues have now been closed or downgraded to "Amber" (25 in Period 1);
- 36 "Ambers" were closed in Period 2 (36 in Period 1).

The FDO review meetings will be replaced by reviews of the Element Outstanding Works List (EOWL); see Section 3.10.

3.8.2 Interoperability

CRL's strategy for submission of the Technical File/Safety Assessment Report (SAR) on 17 September 2018 was shared with the ORR on 21 May 2018. The ORR accepted, in principle, the approach to the production of the Technical File. The ORR, however, wants to ensure that the structure showed a simple and clear navigation route through the documented evidence and the signed certificates, with 'limited' defined conditions. The AsBo believes that the Technical File will contain all of the design evidence; but the Testing and Commissioning (T&C) data will be missing, as the output will be late. Bond Street station's T&C information presents a particular challenge, as it is not expected to become available until mid-November 2018.

The ORR implied a preference to delay the submission by a month if this meant the Technical File would, by then, be 90 to 95% complete. CRL has proposed that the ORR attend a review meeting on the 11 July 2018, to be shown the proposed document structure, so any required changes could be introduced. It is therefore increasingly likely that the Technical File will not be submitted to the ORR until October 2018.

The AsBo continues to report that there remains no "demonstrably viable" programme for delivery of a supportive SAR and reiterates the following major concerns in the context of finalising the SAR in 2 months:

¹⁴ CRL C620 Signalling PDB held on 5 June 2018.

¹⁵ CRL Period 2 Board Report – P2 2018/19, page 27.

- The development of a resource loaded programme, now that a key workshop has been held. This will be needed to confirm viability of an on-time delivery of the SAR;
- Adequate detail of the CRL processes for confirmation of compliance for the safety requirements;
- Finalisation of the System Definition, System Safety Plan and contractor plans;
- The need for a clear approach to managing evidence, outstanding at submission, for APIS.

3.8.3 RAB(C)

RAB(C) continues to review formal submissions in line with CRL and RfL requirements. The submissions plan has undergone detailed review in the period and a new baseline created. This baseline requires submission production at rates well above that achieved to date, and completion of the process to support Stage 3 Opening remains challenging. For example, 86 submissions have been made so far out of a total of 142, at an average of 5 per month; the rate must be increased to 14 per month in order to support Stage 3 Opening.

CRL plans to carry out multiple train dynamic testing in Window No. 6 starting on 5 July 2018. This now provides sufficient time for BT’s Class 345 braking performance evidence to be finalised and approved by its AsBo, for incorporation into the relevant safety case. Further information is provided in Section 3.9.

The key Engineering Safety Management submissions for the Stage 3 Safety Case are shown in Figure 3 - 2. These deliverables are now being provided with some schedule relief through CRL’s implementation of the revised plan which provides for Pre-Trial Running and Combined Trials. We expect these dates to be further delayed. See also Section 3.6.

No	Key Dates	MOHS 2018	Period 1 actual / forecast	Period 2 actual / forecast
1	Contractors submit draft ESJs to CRL	31-Mar-18	23-May-18	30-Jun-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	30-Jul-18	30-Jul-18
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	10-May-18	10-May-18
4	Contractors submit final ESJs to CRL	30-May-18	30-May-18	30-Jul-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	07-Jun-18	30-Jul-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Jun-18	30-Jun-18
7	Final COS Safety Case updated and submitted to RAB-C	31-Aug-18	31-Aug-18	31-Aug-18
8	Submit Technical File to ORR	17-Sep-18	17-Sep-18	17-Sep-18
	* In-period delay			

Figure 3 - 2 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

3.8.4 Regulatory Approvals

CRL has continued to judge the overall rating of Stage 3 as ‘amber’ in its Board report. There has been a number of specific improvements in this period. The ORR issued Safety Authorisation to RFL-I, and agreed that BT was not required to formally submit an updated Technical File to it.

The two approvals that were red in Period 1 remain so (‘ORR issues APIS for Central Section’ and ‘Safety Approval Bodies Final sign-off’). One of the key determinants to these approvals is the rate of acceptance by RAB-C of assurance deliverables. There are 55 deliverables remaining, to be completed at circa 9 a month. The average in the last 6 months has been 5, hence we feel an overall rating of ‘amber’ does not reflect the task required to complete CRL’s safety deliverables, and a ‘red’ rating would be more appropriate.

3.8.5 Agreements

There are six agreements that are adjudged to be amber. The five from last period are:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- IM Interface manual between NR and RfL-I;
- Development Service Agreement, as above;
- Framework Project Services Agreement¹⁶, as above.

The additional item is the Connection Agreements at Abbey Wood, Pudding Mill Lane and Westbourne Park.

The progress of the Umbrella Property Agreement is reported by CRL as being slow. Some of this is because of commercial issues being conflated into the discussions, which CRL perceive to be unrelated.

It is frustrating that this and the other amber items are progressing slowly. We understand that it is in the nature of commercial agreements that they often remain unresolved until the deadline. Nevertheless, CRL should articulate to Sponsors if there is a genuine concern, rather than 'frustrating business as usual'.

The charts in Appendix C.1 indicate the progress of the critical operational agreements.

3.9 Rolling Stock and Depot

Rolling Stock

The authorisation of TCMS v7.2 for Trial Running is scheduled for 2 July 2018, a delay of one week from our last report. The key date for it to be ready is 5 July 2018. This is the start of test window 6 and multiple train operation. The software being used is adequate for Trial Running, but requires a revision to be suitable for passenger service. This is forecast to be completed by 2 August 2018. The testing programme will continue until and throughout the Pre-Trial Running Period. Solutions to problems found between the wayside and train borne equipment could suffer delays as they wait to be tested within the next test window. Signalling and train software will remain a critical activity throughout the life of the project.

There has been an improvement concerning the GEBR braking issue. BT has completed its testing, and provided the results to Siemens so that it can incorporate the data into its design.

We raised concerns in our last report about whether there would be enough trains to operate the Trial Running exercises. The delay to Trial Running means that this particular concern has receded. [REDACTED]

OOC

Section C BIU was achieved on 11 June 2018, and both Sections B and C are forecast to be signalled by 26 August 2018. There are concerns at the gaps in the assurance documentation necessary for project completion, but this will not affect the operational service.

¹⁶ Previously known as the Co-operation Agreement.

3.10 Handover

We feel that the issues concerning Handover are not progressing at the required rate to support the IMs ability to carry out Combined Trials. This takes into account the revised date to Combined Trials.

Training

RFLI and MTRC are continuing to report difficulties in training their staff. This is principally due to;

- TUCA has been unavailable due to delays with training equipment fit out. This impedes training efficiency as substitute facilities have to be found;
- The unreliability and lack of full functionality of the signalling and communications simulators is disrupting the training of the RFL-I controllers;
- [REDACTED]
- Training of equipment provided by [REDACTED] has now had to be programmed to finish by mid-September 2018.

O&M Manuals

[REDACTED]

Asset Information

There has been progress in almost all areas since Period 1. Unfortunately the rate of progress must increase for the IM to be able to construct robust maintenance plans in time to support Combined Trials.

Drop	Content	% accepted
1	Number of assets	84
2	Location	57
3	Equipment	13
4	Attributes	30
5	All drops for review	14
6	Accepted	0

Figure 3 - 3 ~ Content / Percentage

Handover Master Deliverable List

The HMDL includes items such as As-built drawings. So far RFL-I has accepted 5% of the 105,000 documents it is expecting to be submitted to it, and LU 10% of the expected 55,000 documents. It would be reasonable to expect this work stream to continue after Trial Running has started.

It is likely that some assets will remain under the care of the supplier until the IM is trained and has the relevant drawings/O&M manuals.

In all cases CRL and the IMs are seeking to prioritise the work streams, but the work can only be done by the Tier 1 contractors. If these items are not sufficiently completed then the IMs, principally RfL-I, will not be able to 'stand up' as a competent organisation to receive the railway.

CRL has recently created an Element Outstanding Works List (EOWL) which will be updated and monitored regularly.

3.11 Trial Running and Trial Operations

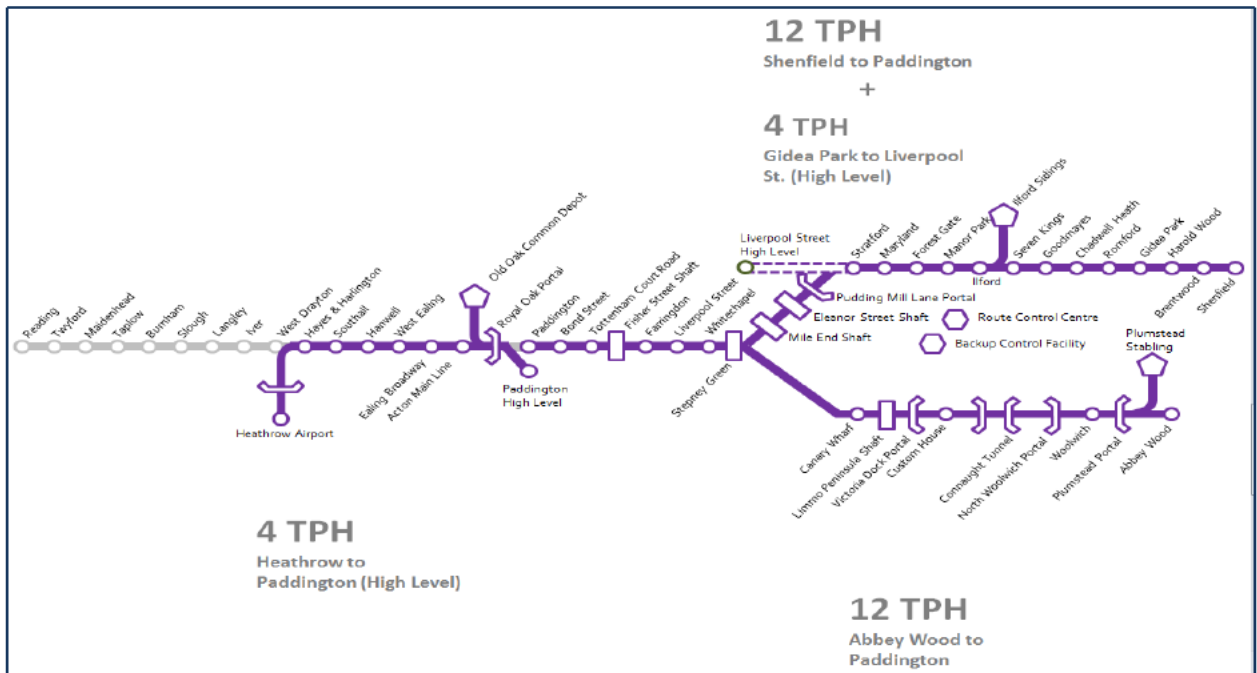
We have explained the possible impact of the change to Trial Running and Trial Operations dates in previous Sections. We would add that the new Combined Trials period will require a higher degree of coordination between RfL-I and CRL. Previously, whilst RfL-I would be in control of the railway during Trial Running, it would have been carrying out exercises set by CRL that would prove CRL had fulfilled its scope. Now these exercises could be carried out in conjunction with RfL-I's readiness exercises.

The delay to Trial Running may also lead to CRL reviewing its staffing demobilisation plan.

3.12 Plumstead Depot

Progress stands at 33% compared with a forecast of 35%. The concrete to the roof deck of the Accommodation Building was successfully poured in the period, and Maintenance Building steel erection was started.

4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.



4.1 Summary

The main risk to Stage 4 continues to be the power upgrade works by NR.

4.2 Operational Readiness Assessment

There are two Readiness Tasks that have been given a “Red” status by the ORSG¹⁷, two less than our last report.

	Readiness Task	Issue
	Wire height alignment corrected to standard in Ilford Depot	Surveys have shown that the works are limited in nature, and are likely to be completed or mitigated within the time allowed. See Section 4.3 below.
	KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	NR is forecasting the ATF distribution from PML to Shenfield for May 2019. CRL has notified NR of its March 2019 requirement and NR is working to bring the programme back in line. CRL and RfL are planning for a scenario where there is insufficient power to operate the planned timetable.
	Ilford Station Redevelopment	As noted in Section 4.4 below.

¹⁷ 21 May 2018.

	Readiness Task	Issue
	DOO CCTV installed and operational Stratford and Shenfield stations	Stratford platforms 5 & 8 remain problematic. NR stress it is very difficult to site cameras without recourse to adjusting station infrastructure (e.g. canopies). MTR-C stress use of cameras is vital for performance (ensures efficient despatch). Discussions continue.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

4.3 Ilford Depot Wire Heights

NR report that the Class 345 RLUs will have the pantograph overheight protection de-activated in mitigation for the wire heights issue within the yard and that this issue is now closed.

4.4 Ilford Station

NR continues to report that the GRIP5 design contract has been awarded and an ECI Contract is due to be let in June 2018 using an existing framework to accelerate the procurement timescales. The GRIP6 delivery procurement for Ilford station remains on schedule and NR remains committed to station opening for December 2019. The key dates we shall monitor to assure that progress remains on schedule are:

- GRIP 5 complete – August 2018;
- GRIP 6 tender return – August 2018;
- GRIP 6 Contract award – October 2018.

4.5 ONW

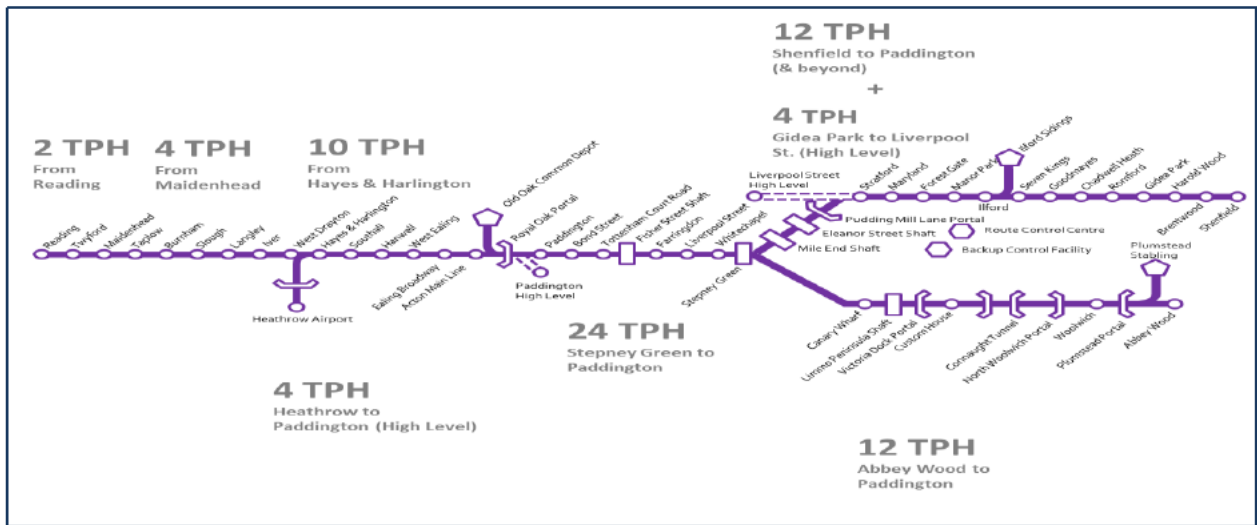
Stage 4; KO5A – 10 September 2018 (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) (10 September 2018).

[REDACTED]
[REDACTED]
[REDACTED] We will continue to monitor progress and mitigation proposals.

Key Date 22 (Route clearance & all other infrastructure, including stabling & sidings updates, complete to support Stage 4 Dynamic Testing) (31 August 2018); NR reports that all platforms have been lengthened, lifts installed, station SISS installed and NR communications reconfigured to Romford RCC, save for the following exceptions to be delivered after Key Date 22:

- Ilford station is not included and is treated separately;
- [REDACTED]
- [REDACTED]
- [REDACTED]

5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.



5.1 Summary

Concerns regarding ETCS and the related derogation continue. New risks have become apparent regarding procurement of the West Enhanced stations.

5.2 Operational Readiness Assessment

There are five Stage 5 Readiness Tasks that have been reported as a “Red” status to the PDB on 8 May 2018, an increase of one.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	If ETCS is not available then there is a technical solution that will enable CBTC to TPWS transition. See Section 5.3.2.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019. Current bid submissions are not acceptable to NR. See Section 5.3.1.
M Maidenhead Sidings staff accommodation	The accommodation is required by April 2019, and the GRIP 4 design has been delayed by 4 months to July 2018. Initial designs for both drivers' and cleaners' accommodation have been reviewed by NR and changes have been requested by CRL to reduce the footprint of both.
ORR issue APIS for ETCS (Stage B & C)	Linked to 'ETCS available and tested airport Jn' task. The issue is whether ORR would extend the derogation (which would remove the 'red' status) if NR provide sufficient justification. See 5.3.2 below.

	Readiness Task	Issue
	NEW DOO CCTV GWML outer stations	GRIP 5 design not procured. Installation will also require platform extensions to be built.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with "Red" Status

5.3 Network Rail Works

5.3.1 Platforms and Stations

NR has received tenders and carried out initial assessment for the West Enhanced stations for both Package 2 (Acton, Ealing and West Ealing) and Package 3 (Southall, Hayes & Harlington and West Drayton). NR has reported that the technical and safety elements of the tenders are acceptable but the [REDACTED]. NR is to carry out a clarification exercise that may require NR issuing further tender information, together with extension to time, with the intention to award Contracts at the end of August for the first package and at the end of September for the second package. [REDACTED]

Critical path activities are:

- Works at Christmas 2018;
- Securing weekend possessions from December 2018 to May 2019 – this access is subject to [REDACTED]

Commercial representatives from CRL and NR met on 12 June 2018 to examine and consider alternative procurement solutions that do not compromise NR governance compliance requirements. NR has yet to share the Tender prices and is withholding these until fully compliant and normalised tenders are available. DfT has emphasised to CRL the need to ensure that any alternative is the most cost-efficient and for costs to be kept within budget.

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):

NR has confirmed¹⁸ that the Radio Block Centre (RBC) was permanently connected to the Interlocking on 4 May 2018.

[REDACTED]

- [REDACTED]
- [REDACTED]

NR returned to SRP on 7 June 2018 with the view to complete APIS by mid-July 2018, which remains ahead of the scheduled APIS required date.

¹⁸ CRL PDB 5 June 2018.

Stages B & C (Stockley-Acton & Acton-Paddington):

[Redacted content]

NR reports that initial discussions have been held with stakeholders regarding the strategy for applying for a new exemption to the ORR which would commence in January 2020.

5.4 ONW

Stage 5; KO5B

Construction of the Traction Switching Station at Paddington can only be achieved during the prospective Christmas 2018 possession. NR is investigating the available options, but KO5B remains at risk. However, works are progressing to the current delivery plan with the outer area AT system available to commission from May 2018 and the inner area AT system available to commission from July 2018. NR is forecasting the conversion to AT power on the Western Route for December 2018. This later date is a consequence of separate NR 12kA power resilience works which requires either additional access prior to, or delivery at, Christmas 2018.

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI increased again during Period 2 remaining well above target, with all 11 Principal Contractors (PC's) again scoring over 2.20. The RIDDOR remained as before and the lost time case (LTC) AFR reduced slightly, with both measures remaining well within target, although CRL now aim to achieve rates of 0.06 and 0.15 respectively.

H&S KPI	Target	Aim	Period 1	Period 2
HSPI	2.20	-	2.63	2.64
PCs scoring over 2.20	11	-	11	11
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.17	0.16

Figure 6 - 1 ~ Health and Safety Performance COS

There were 3 significant incidents during Period 2; a RIDDOR (twisted ankle) and two High Potential Near Miss's (falling bolt and men in energised transformer room).

CRL has acknowledged¹⁹ that safety focus needs to be maintained due to a large influx of new part time and temporary workers at stations, caused by the ramp up of work across multiple trades to achieve completion. This in addition to energisation of transformer rooms within the stations. All attend a refreshed site induction but site supervisors need to take more care at daily site briefings to avoid miscommunications, which has become an ongoing problem.

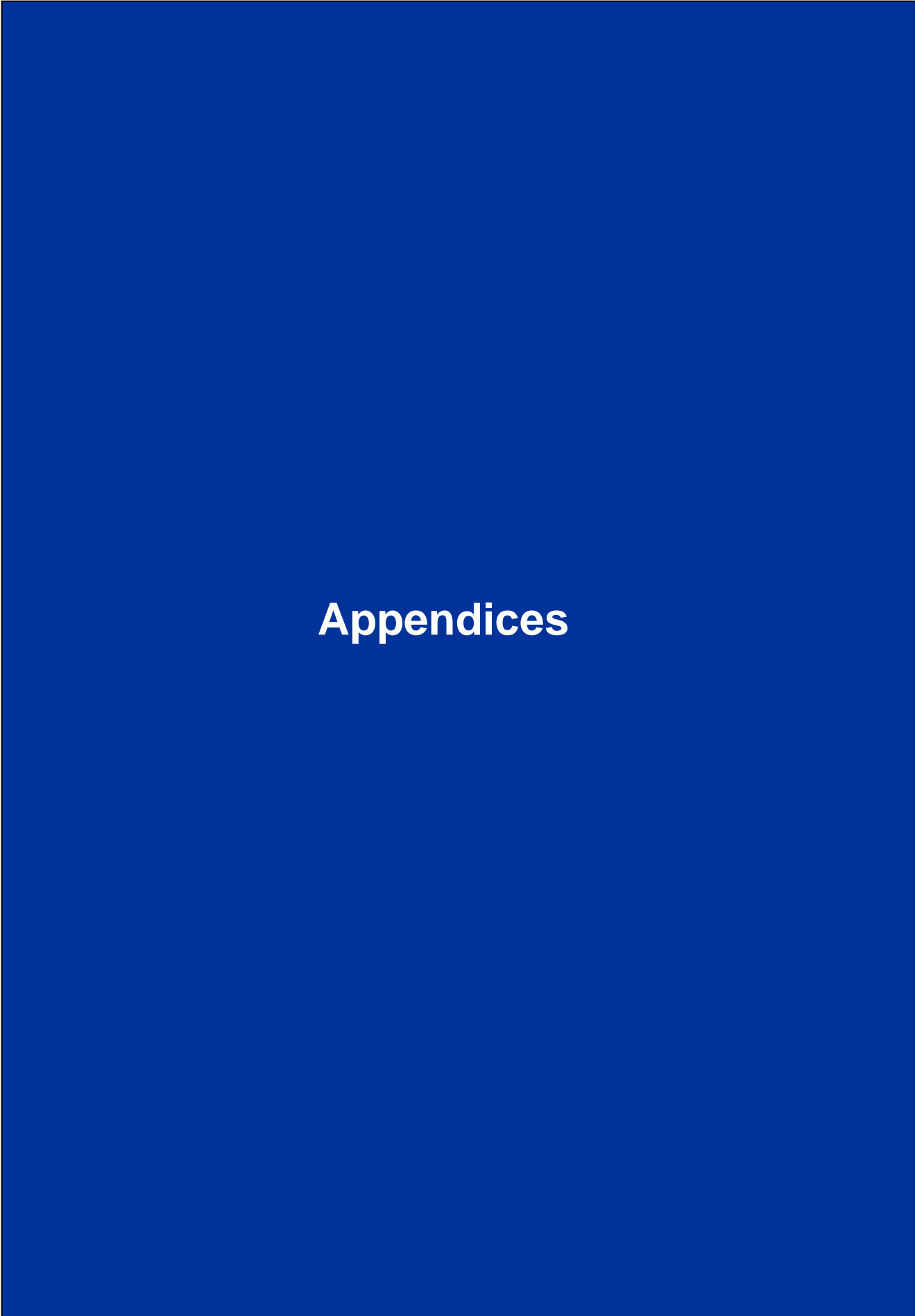
We continued to be concerned about safety arrangements at Canary Wharf station, where the PC is ATC (C610) but the work is being carried out by trade contractors directly engaged by CRL. This is not an ideal situation; however, a senior Bechtel project manager, with experience of other Crossrail sites, has now been brought onto the project. We expect safety will be his priority.

CRL continue to be supported by an embedded London Fire Brigade (LFB) Officer. We understand planning has commenced for LFB exercises at some stations.

6.2 Health & Safety Performance ONW (NR)

During Period 2, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) decreased to 0.1434. NR had no lost time incidents in Period 2, but suffered two minor injuries. The Programme's overall All Injury Rate increased marginally from 0.71 to 0.73 injuries per 100,000 hours worked.

¹⁹ Meeting with H&S Director 6 June 2018.



Appendices

Appendix A Schedule & Performance

Figure A - 1 indicates²⁰ the CRL Corporate Milestones (shown as Period 1 Baseline) alongside the relevant dates from MOHS 2018, the Period 1 forecasts and the latest Period 2 forecasts.

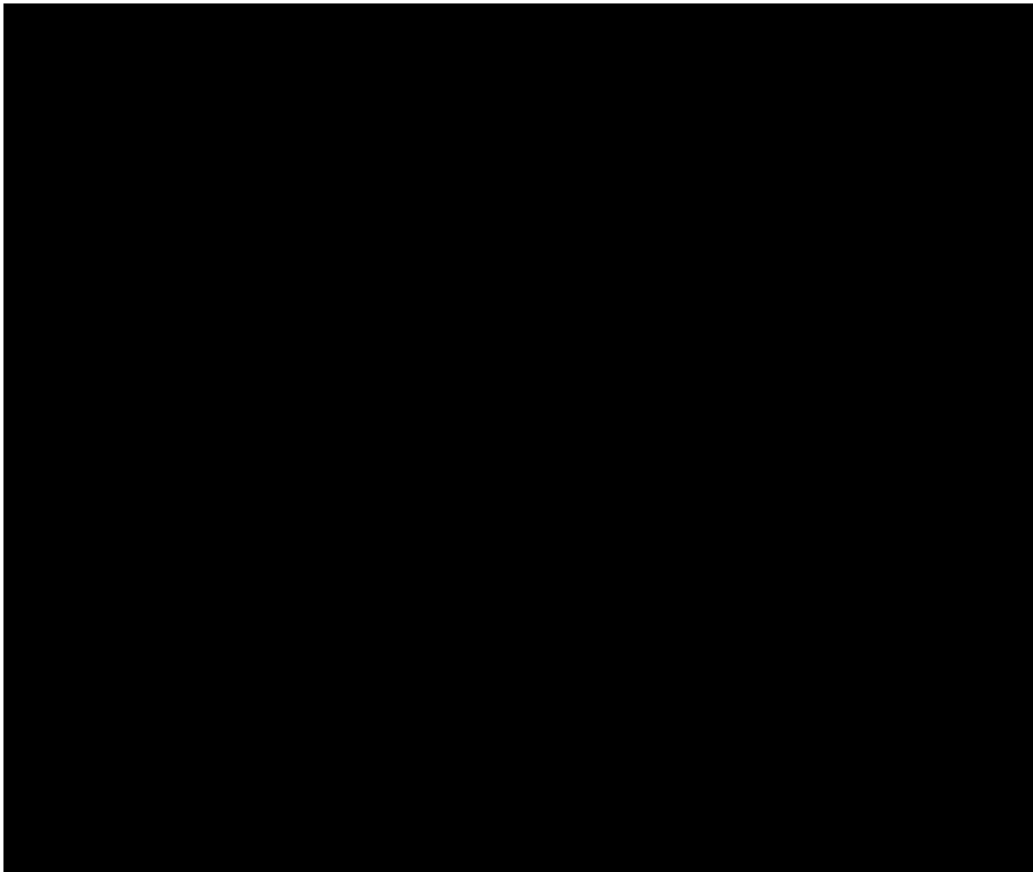
Milestone 1 for non-traction power energisation is likely to be re-forecast from June to July 2018. Milestone 4 for the contract award for West Enhanced Stations is likely to be delayed. Milestones 8 and 13 have been renamed and given new dates to reflect the new Trial Operations strategy.

Corp Mstone	Description	Period 1 Baseline	MOHS 2018 EDBL	Period 1 Forecast	Period 2 Forecast	
1	All 11KV SS&P Non-Traction Power Locations Energised	April	15-Apr-18	19-May-18	02-Jun-18	*
2	CBTC Auto Reverse and Isolated ETCS Testing Complete at Melton	April	06-Apr-18	27-Apr-18	27-Apr-18	
3	Stage 2 Phase 1 Service Introduction PAD to Heathrow	May	20-May-18	20-May-18	20-May-18	
4	West Enhanced Stations contract award	June	08-Apr-18	20-Jul-18	TBA	
5	Start Dynamic Testing in Zones 3 & 4	June	11-Jun-18	11-Jun-18	11-Jun-18	
6	CBTC Authorised for FLU for Trial Running	June	22-Jun-18	26-Jun-18	02-Jul-18	*
7	ESS - ECHR Complete for Handover to Infrastructure Manager	July	03-Jul-18	17-Aug-18	07-Aug-18	*
8	Commence Pre-Trial Running	Aug	05-Aug-18	05-Aug-18	10-Sep-18	*
9	22no. CI.345 FLUs Available for Trial Running	Aug	13-Aug-18	29-Jun-18	10-Aug-18	*
10	CRL central section Safety Case updated and submitted to RABC	Sept	31-Aug-18	31-Aug-18	31-Aug-18	
11	PAD - ECHR Complete for Handover to Infrastructure Managers	Sept	07-Sep-18	14-Sep-18	15-Oct-18	*
12	Submit APIS for Central Section to ORR	Sept	17-Sep-18	17-Sep-18	17-Sep-18	
13	Commence Trial Operations / Combined EL Trials	Sept	09-Sep-18	09-Sep-18	01-Oct-18	*
14	Class 345 CBTC Signalling auth for Passenger Service by ORR	Oct	10-Oct-18	02-Aug-18	02-Aug-18	
15	LIS - ECHR Complete for Handover to IMs	Nov	24-Oct-18	24-Oct-18	24-Oct-18	
16	Opening of Stage 3 - Central Section PAD to ABW	Dec	09-Dec-18	09-Dec-18	09-Dec-18	
17	Plumstead - First Stage Maintenance Sidings and connection to COS	Dec	21-Nov-18	21-Nov-18	21-Nov-18	
18	Plumstead Stabling Sidings - ECHR Complete for Handover to IMs	Feb	29-Mar-19	29-Mar-19	29-Mar-19	
	Forecast later than Period 1 Baseline					
	Forecast earlier than Period 1 Baseline					
	* In period movement					
	ECHR = Element Completion Handover Report					

Figure A - 1 ~ Corporate Milestones

Figure A - 2 indicates the status of Anchor Milestones cumulative progress at Period 2.

²⁰ SS&P = Stations Shafts and Portals, FLU = Full Length Unit, ESS = Eleanor Street Shaft, ECHR = Element Completion Handover Report, ABW = Abbey Wood.



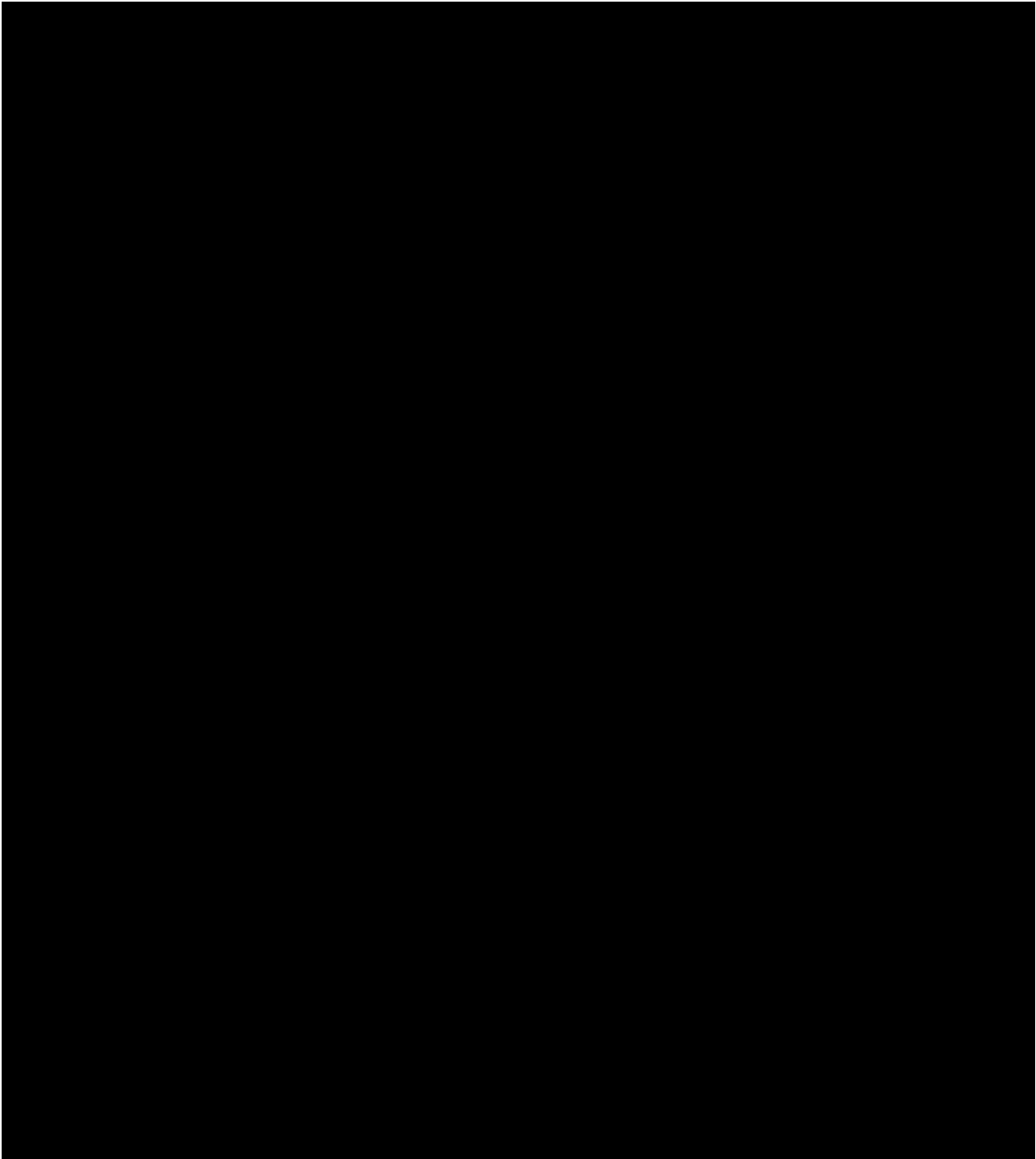
Delayed AMs from MOHS late dates

ID	Anchor Milestone	MOHS Baseline Date	MOHS Baseline Date	Actual / Forecast Period 1	Actual / Forecast Period 2	Period delay in days	MOHS delay in days
A710	C650 -A710 All 11 KV S,S&P locations energized	15-Apr-18	15-Apr-18	19-May-18	02-Jun-18	14	48
A711	C631-A711 PSD Ready for Dynamic Testing in Zone 1	31-Mar-18	09-Apr-18	29-May-18	05-Jun-18	8	57
A625	Provide all Trains to Systemwide for Dynamic Testing (3rd & 4th FLUs)	23-Mar-18	14-May-18	07-Jun-18	07-Jun-18	0	24
A698	Sys - A698 Start PSD Platform Train Interface Test (DT) in Zone 1	10-Apr-18	10-Apr-18	11-May-18	09-Jun-18	29	60
A742	Training completed for MTR in support of Handover	30-May-18	30-May-18	30-Jun-18	30-Jun-18	0	31
A743	Training material submitted in readiness for training delivery	05-May-18	05-May-18	30-Jun-18	30-Jun-18	0	56
A744	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18	23-May-18	30-Jun-18	38	91
A620	C696 - A620 Construction Works Commence	02-Jul-18	02-Jul-18	02-Jul-18	03-Jul-18	1	1
A723	C610 -A723 All walkway installation complete in Zone 1	29-Jun-18	29-Jun-18	29-Jun-18	04-Jul-18	5	5
A636	C350 - PML - Phase 3 Integration (Scenario) Testing Period to Shaft IAC Completed	12-May-18	05-Jul-18	31-Jul-18	11-Jul-18	-20	6
A700	C631 -A700 PSD Ready for Dynamic Testing in Zones 3 & 4	20-Jun-18	30-Jun-18	13-Jul-18	19-Jul-18	6	19
A719	C620 -A719 Signalling infrastructure ready for DT in Zones 3 & 4	07-Jun-18	07-Jun-18	07-Jul-18	19-Jul-18	12	42
A685	C435-FAR-A685 Completion of All Phase 3 Testing Enabling Removal of Hoarding	22-Jul-18	22-Jul-18	22-Jul-18	23-Jul-18	1	1
A709	C650-A709 All 22 KV S,S&P locations energized	30-Jun-18	30-Jun-18	28-Jul-18	29-Jul-18	1	29
A745	Safety Assessment Report substantially complete (AsBo)	31-Mar-18	31-Mar-18	30-Jul-18	30-Jul-18	0	121
A747	Tier 1s Submit Final ESJs to CRL	30-May-18	30-May-18	30-May-18	30-Jul-18	61	61
A748	CRL Submit S.Js to RABC	07-Jun-18	07-Jun-18	07-Jun-18	30-Jul-18	53	53
A712	C660 -A712 CIS ready Phase 3 in Zones 1 to 4	06-Jul-18	06-Jul-18	26-Jul-18	30-Jul-18	4	24
A741	Training completed for LU in support of Handover	30-May-18	30-May-18	30-Jun-18	31-Jul-18	31	62
A684	SS&P Fire Mains Ready for Integration Zones 3&4	05-Jul-18	15-Jul-18	05-Jul-18	01-Aug-18	27	17
A691	Sys - A691 Start PSD Platform Train Interface Test (DT) in Zones 3 & 4	23-Jul-18	23-Jul-18	30-Jul-18	03-Aug-18	4	11
A316	RIL Ready to commence Trial Running and Handover under ROGS to RIL's new (IM) Infrastructure Manager	05-Jul-18	04-Aug-18	04-Aug-18	06-Aug-18	2	2
A590	C610 -A590 Start Dynamic Testing (Zones 1,2,3 & 4)	30-Jun-18	30-Jun-18	17-Jul-18	06-Aug-18	20	37
A734	C360 - STG - Ready for Handover to Infrastructure Manager (IM)	31-Jul-18	03-Aug-18	07-Aug-18	07-Aug-18	0	4
A736	C360 - ESS - Ready for Handover to Infrastructure Manager (IM)	03-Jul-18	03-Aug-18	17-Aug-18	07-Aug-18	-10	4
A731	C350 - PML - Ready for Handover to Infrastructure Manager (IM)	25-Jun-18	05-Jul-18	28-Aug-18	08-Aug-18	-20	34

A621	C620 - A621 Ready to Commence Transition Testing @ GEML	30-Jun-18	30-Jun-18	15-Jul-18	11-Aug-18	27	42
A653	C360 - FSS - Phase 3 Integration (Scenario) Testing Period to Shaft IAC Completed	05-Jul-18	03-Aug-18	06-Aug-18	17-Aug-18	11	14
A664	C422-TCR-A664 Completion of All Phase 3 Testing Enabling Removal of Hoarding	05-Jul-18	12-Jul-18	05-Jul-18	17-Aug-18	43	36
A276	C412-BOS-A276 ETH PDA Milestone 11 Site available to commence Bond Street Station Eastern Ticket Hall OSD	11-Jun-18	12-Jul-18	20-Aug-18	28-Aug-18	8	47
A718	C620 -A718 All Signalling Dynamic Testing complete (Except Yellow Plant)	03-Aug-18	03-Aug-18	03-Aug-18	03-Sep-18	31	31
A673	C405-PAD-A673 Completion of Phase 3 Testing	28-Jul-18	28-Jul-18	17-Aug-18	08-Sep-18	22	42
A622	C620 - A622 Ready to Commence Transition Testing @ GWML	14-Jul-18	14-Jul-18	12-Aug-18	09-Sep-18	28	57
A592	A592 Handover to Operator / Commencement of Trial Running* / Commence Reliability Growth	05-Aug-18	05-Aug-18	05-Aug-18	10-Sep-18	36	36
A724	C610 -A724 VCS Fully Operational (Phase 3)	24-Aug-18	24-Aug-18	07-Sep-18	10-Sep-18	3	17
A738	C360 - FSS - Ready for Handover to Infrastructure Manager (IM)	03-Aug-18	03-Aug-18	31-Aug-18	14-Sep-18	14	42
A740	Training completed for RFL in support of Handover	05-Jul-18	05-Jul-18	03-Aug-18	14-Sep-18	42	71
A722	Sys - A722TVS Status Monitoring test (DT) complete in Zone 1 CWG (E&W)	13-Aug-18	13-Aug-18	29-Aug-18	17-Sep-18	19	35
A267	C405-PAD-A267 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	09-Aug-18	08-Sep-18	10-Sep-18	20-Sep-18	10	12
A608	CWG-CWG-A608 Handover Station to Infrastructure Manager	05-Jul-18	03-Aug-18	28-Sep-18	28-Sep-18	0	56
A269	C422-TCR-A269 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	13-Jul-18	19-Aug-18	17-Aug-18	28-Sep-18	42	40
A615	C610 -A615 *KD39 Complete Trial Running* / Complete Reliability Growth Period	08-Sep-18	08-Sep-18	08-Sep-18	30-Sep-18	22	22
A172	RfL Ready to Commence Trial Operations - Stage 3 Central Section Paddington L/L to Abbey Wood	05-Aug-18	08-Sep-18	05-Sep-18	01-Oct-18	26	23
A739	Commence Trial Operations	09-Sep-18	09-Sep-18	09-Sep-18	01-Oct-18	22	22
A623	2 Driver Training Units Available to MTR for Stage 2 (inc ETCS Functionality)	24-Aug-18	24-Aug-18	12-Oct-18	12-Oct-18	0	49
A676	C422-TCR-A676 Handover to Infrastructure Managers	10-Aug-18	08-Sep-18	14-Sep-18	12-Oct-18	28	34
A667	C405-PAD-A667 Handover to Infrastructure Managers	07-Sep-18	08-Sep-18	14-Sep-18	15-Oct-18	31	37
A166	C435-FAR-A166 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	17-Aug-18	12-Oct-18	17-Aug-18	19-Oct-18	63	7
A668	C435-FAR-A668 Handover to Infrastructure Managers	17-Aug-18	08-Sep-18	24-Aug-18	29-Oct-18	66	51
A178	ONW - NE Spur - KO5A Full Infra.Capability from Shenfield to Central Core Area at Pudding Mill Ln	10-Sep-18	10-Sep-18	31-Aug-18	29-Mar-19	210	200
A179	ONW - NE Spur - KD22 Route clearance & all infrastructure, incl. stabling and sidings updates compl.	31-Aug-18	31-Aug-18	31-Aug-18	29-Mar-19	210	210
A169	ONW - West - KO5B Full Infra.Capability Maidenhead to Central Core Area at WB Park to Support Op. of New Trains (OC18-2)	10-Sep-18	10-Sep-18	10-Sep-18	12-Sep-19	367	367
A535	GRIP 6 - Traction Power - New Substations in AT Mode - West	27-Apr-18	27-Apr-18	08-Sep-18	12-Sep-19	369	503

Figure A - 3 ~ Anchor Milestones forecast to be later than MOHS late date

The charts at Figure A - 4 indicate cumulative progress of each Systemwide contract based on data received from CRL. Following a review with the JST, it was agreed that PRep is no longer required to create progress graphs after Period 2, as their usefulness has declined towards completion of the projects.



Appendix B Stations

B.1 Stations in the Central Section

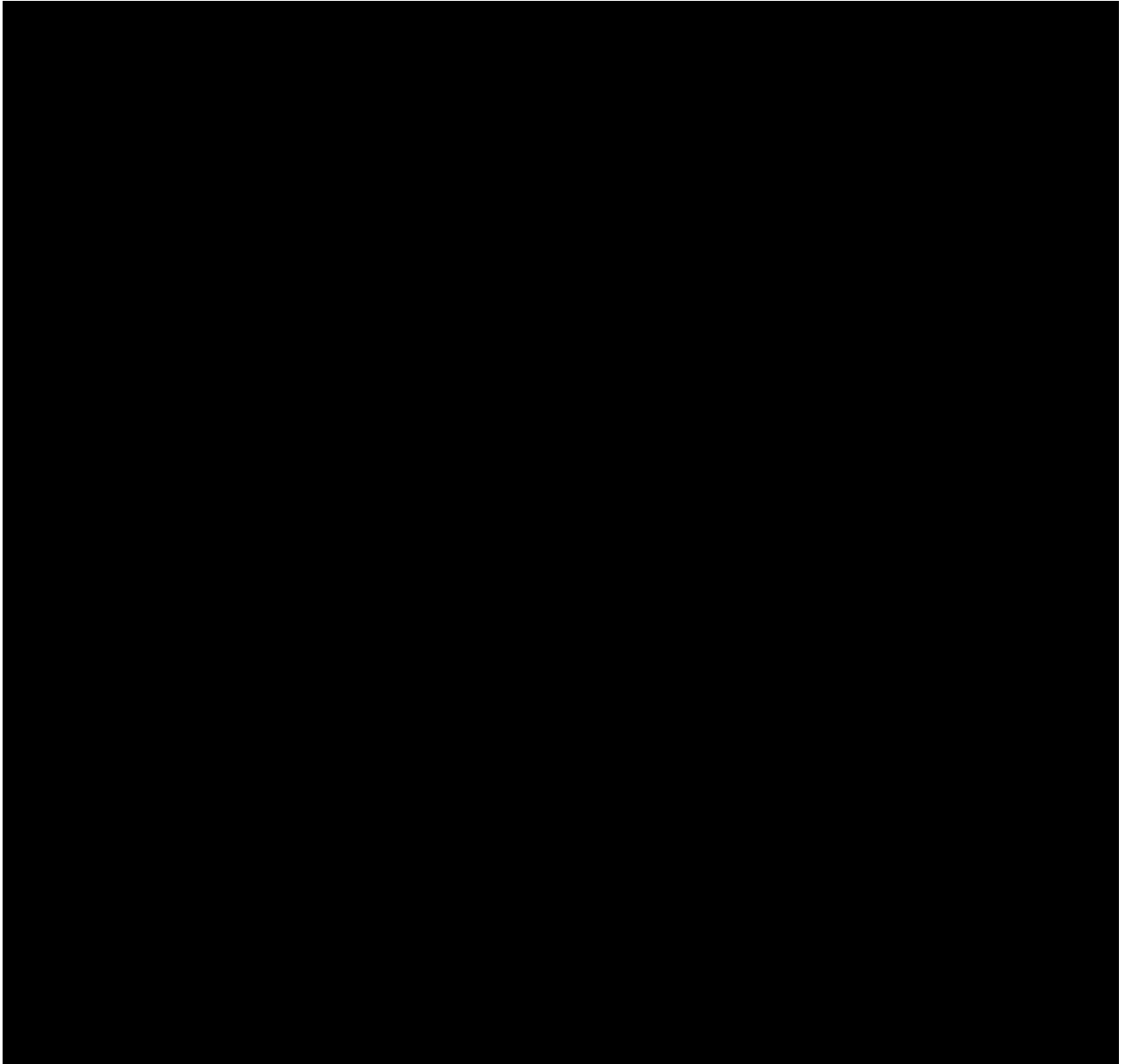
[Redacted]

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[Redacted]

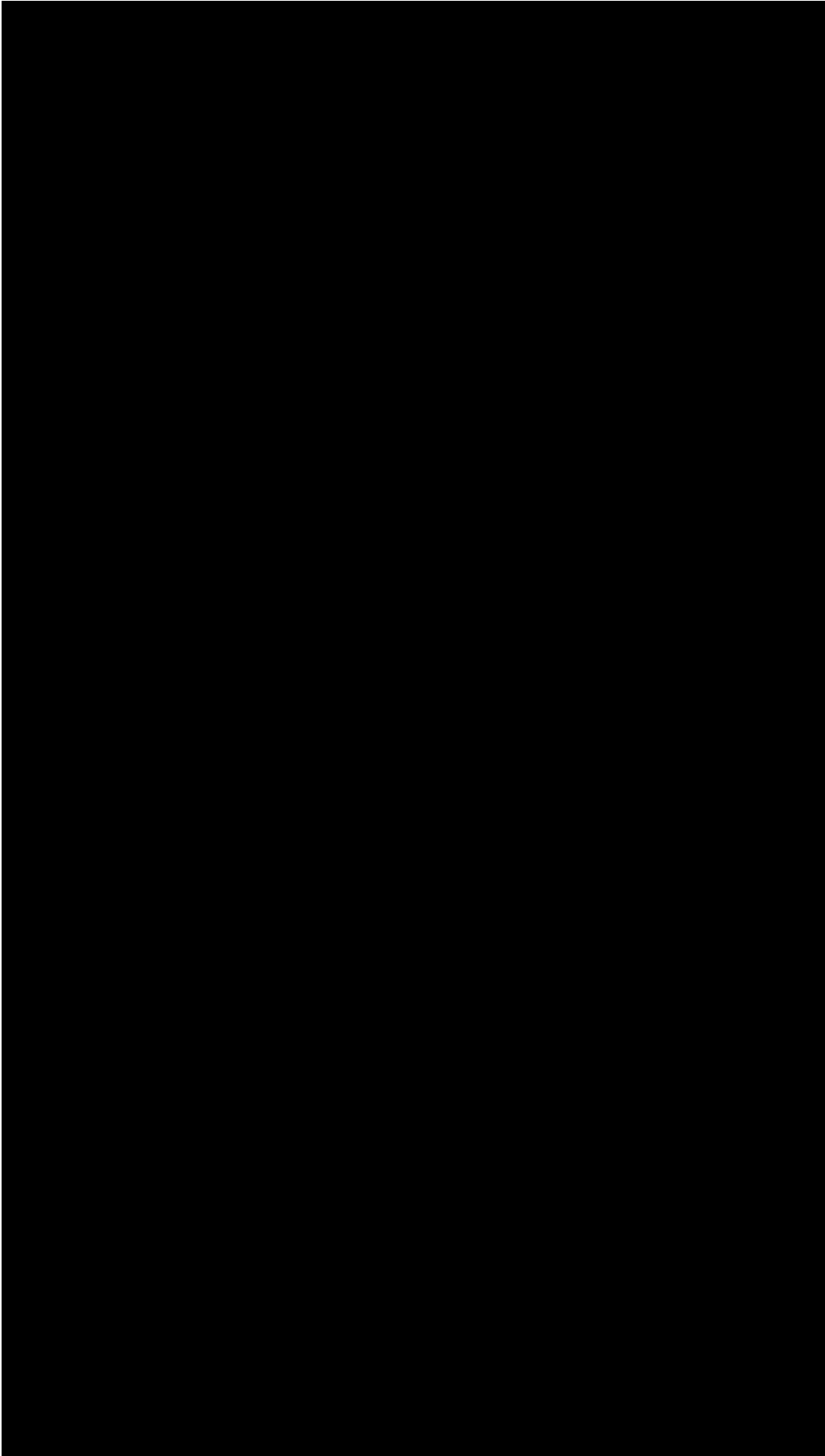
[Redacted]

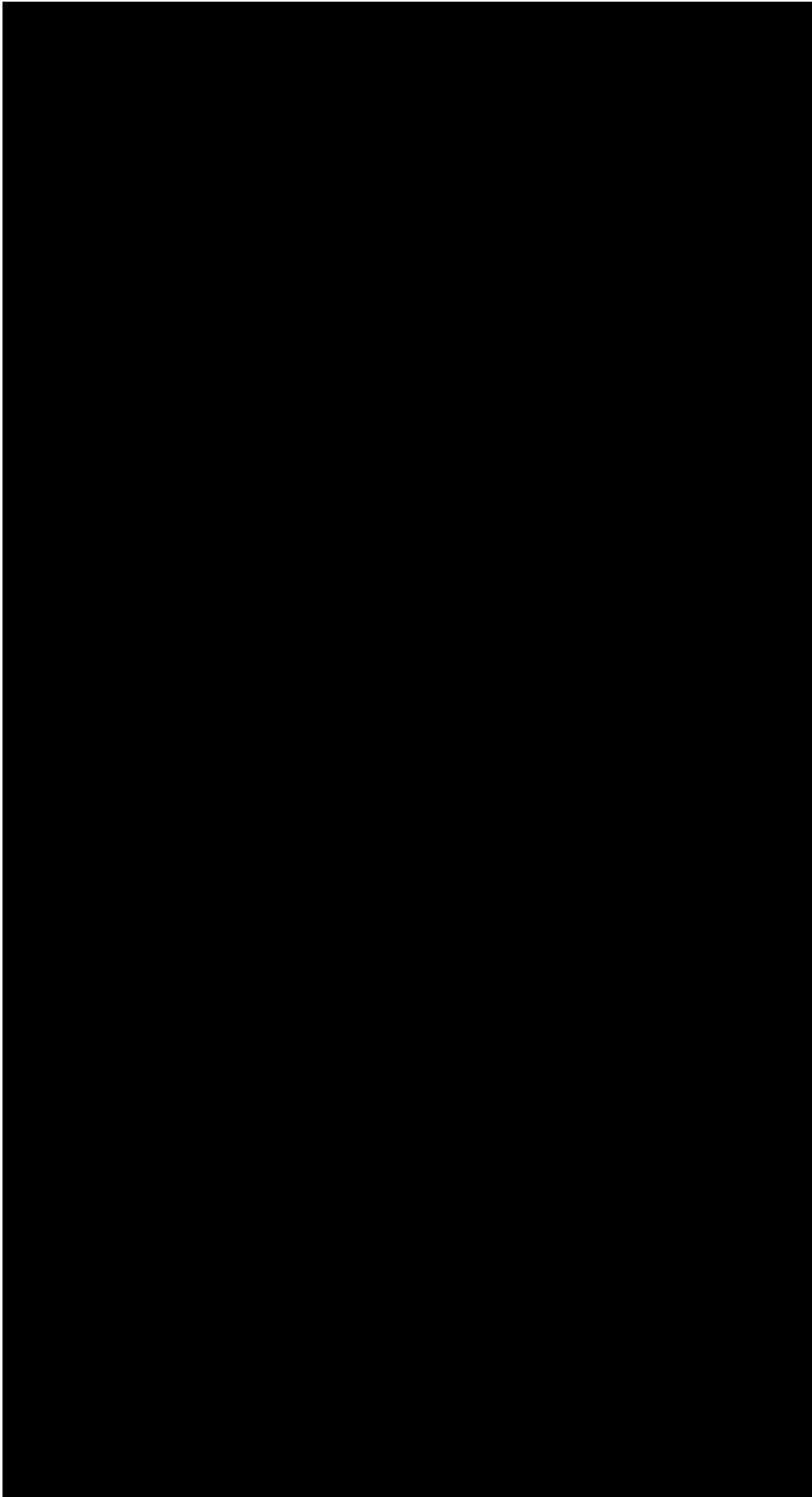
²¹ Data has been abstracted from the CRL Period 2 (2018/19) station dashboards.

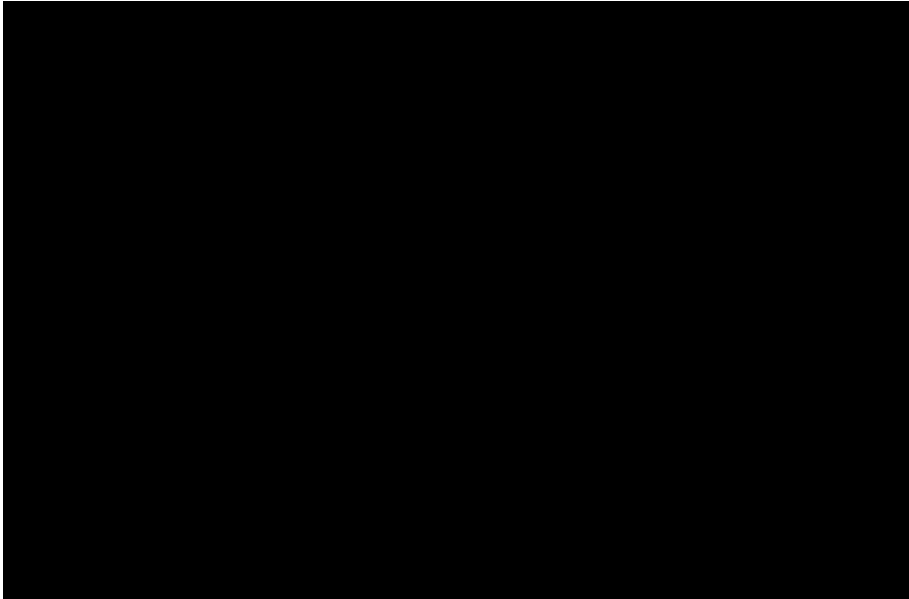


Station schedule performance graphs, based on Period 2 data received from CRL, are shown below. Refer Figure B - 4 to Figure B - 9 inclusive. These show revised forecast progress curves from Period 2 (2018/19) MOHS 2018 for each station.

Following a review with the JST, it was agreed that PRep is no longer required to create progress graphs after Period 2, as their usefulness has declined towards completion of the projects.







B.2 Interface Works and Handovers

CRL has issued a “SLDs to go” report for Period 2. By the close of the period, there were still 44 SLD room/route handovers still to be achieved; against the original 67 planned (MOHS 2018) target set in Period 11 (2017/18). However, 34 of the handovers are reported as “pending”, awaiting acceptance. Most of the remaining handovers are at [REDACTED] and [REDACTED] stations and within the Intermediate Shafts. Delivery progress of the final room/route handovers will be tracked in parallel with the completion of the IRNs, for each of the stations, portals and shafts.

Appendix C Compliance and Assurance

C.1 Agreements

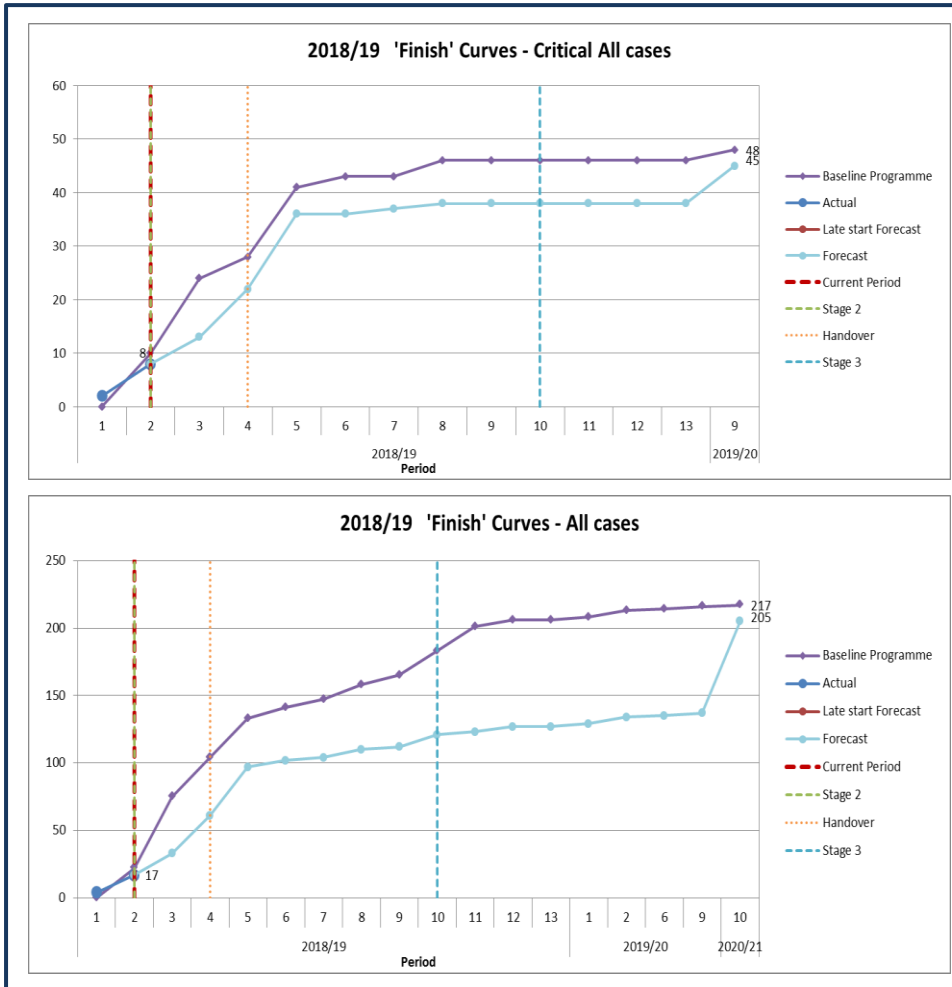


Figure C - 1 ~ 2017/18 Start, Finish & Close Curves

C.2 Quality

Following a review with the JST²², it was agreed that PRep is no longer required to report upon CRL’s quality functions from this Period 2 report.

C.3 Land & Property (L&P)

CRL’s Land & Property functions have now transitioned into TfL. Following a review with the JST, it was agreed that PRep is no longer required to report on L&P matters.

²² Broadway, 7 June 2018.

C.4 Over Site Development (OSD) and Urban Realm (UR)

Accountability for all Over Site Developments has transferred from CRL’s Land & Property team to TfL’s Commercial Development team. TfL will report income receipts, from OSDs, periodically to CRL. Following a review with the JST, it was agreed that PRep is no longer required to report on OSD and UR issues after Period 2.

CRL continues to report on forecast station OSD handover dates, as a part of station planning and performance monitoring; but it has ceased reporting on anticipate contractor start dates, anticipated OSD construction durations and forecast OSD completion dates. Figure C - 2 provides a summary²³ of the current forecast Key Dates for Completion and handover²⁴ of the CRL deck slabs at each station, to the OSD contractors. Completed handovers are shown against a green shaded background.

There has been one change to the forecast OSD handover dates during Period 2. Bond Street (West) handover has been delayed from 31 October 2018 (Period 1) to 27 November 2018 (Period 2). This reflects continued schedule pressure on the station’s completion and forecast date for opening.

OSD Sites linked to CRL Stations - Key Dates				
Station	Location	CRL Anchor Milestone	PDA Milestone	CRL's Forecast (MOHS) Handover Date to Station OSD Developer
Bond Street	West - Davies Street	A275	10	27-Nov-18
	East - Hanover	A276	11	28-Aug-18
Tottenham Court Road	West - Dean Street	A279	15	30-Nov-18
	East - Astoria	A277	12	06-Sep-17
	East - Goslett Yard	N/A	N/A	06-Sep-17
Farringdon	West - Cardinal House	A278	13	30-Jun-18
	East - Lindsey Street	A280	16	23-Mar-18
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18
	East - Blomfield Street	A284	18	28-Feb-18
OSD Sites <u>NOT</u> linked to CRL Stations - Key Dates				
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRLForecast Sectional Completion Date
Paddington	PIP Triangle	N/A	N/A	Available
	Fisher Street	N/A	N/A	Jul-18
	Limmo Peninsula	N/A	N/A	Jul-19
	Woolwich	N/A	N/A	Jun-19

Figure C - 2 ~ Summary of forecast OSD handover Key Dates

Bond Street (East) The main handover of the ETH +1 roof slab (triggering payment) has been delayed until 31 August 2018 (target date was 12 June 2018). Handover requires:

- Works to be complete;
- Handover documentation;
- Land Valuation to be agreed – credible solution to fan acoustic issue;

²³ Summary of OSD dates has been abstracted from the Level 1 MOHS and Anchor Milestone/Key Dates progress summary.

²⁴ The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

- Leases to be agreed;
- LONO to be in place for OSD works above CRL & operational station (logistics, fire, lifting, monitoring etc.).

Agreement of the target handover date for the OSD for **Bond Street (West)**, is still proving to be difficult, as a result of continued station schedule delays. CRL's forecast handover date to the OSD developer has been set at no earlier than 28 November 2018. Handover review sessions with OSD and LUL are being held. Plans for acoustic testing, to prove the Tunnel Ventilation System's impact on OSD are being developed. The testing is planned for early August 2018, during C610's phase 2.3 testing of the vent fan system.

The LBI has yet to approve the proposed render finish for the **Farringdon West** (Cardinal House) vent shaft that will eventually be incorporated into the proposed OSD.

The DAs for **Liverpool Street (West and East)** have not yet been signed. Arrangements for future caretaking of the OSD sites are being discussed with TfL.

The final Technical Interface Parameters (design document) for **Woolwich** station's OSD is awaited from the design consultant.

C.5 Undertakings & Assurances and Commitments - Central Section

Five of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Commitments Compliance Plans (CCP). [REDACTED] has not caught up on pending evidence reported in Period 1. [REDACTED] and [REDACTED] have outstanding evidence to upload in CDT this period but are expected to be complete by next period.

Following a review with the JST, it was agreed that PRep is no longer required to report on U&A issues after Period 2.

C.5.1 Farringdon Station (East Ticket Hall) D25 Assurances

RfL agreed to the reduced operation of the ventilation fans, at a key hour of the morning, when background noise levels are low. Under this control scenario the noise modelling predicted that -4dB would be achieved for the ETH and that this would represent the exercise of reasonable endeavours and a report setting out that case was to be submitted to the local authority (City of London).

RfL accepted the operational constraint toward the end of October 2017. The fans responsible for the -4dB rating prediction were procured two years ago and were due to be installed in February this year. The requisite report has not been issued to the City. A level 1 PIR was raised accordingly.

Further work has since confirmed there was a large amount of uncertainty built into the noise modelling and, given the result was within 0.03dB of achieving -5dB, CRL now reports achieving -5dB (when including the operational constraint). CRL is now compliant, as a report no longer needs to have been sent to City of London.

The PIR is now in the process of being closed out.

C.5.2 C660/C520 Custom House PA/VA (D25) Assurance 465

Assurance 465 is drawn from Information Paper D25 and requires CRL to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and carrying out the detailed design of that system. The C660 PA design at Custom House station is complete but, following an email communication from the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria had not been reached. The meeting with LB Newham took place on 20 February 2018, where the findings of the noise survey were presented and criteria discussed. The draft criteria, which were sent by CRL to LB Newham, were agreed on 8 March 2018. The process for closing this PIR has begun.

C.6 Undertakings & Assurances and Commitments - Surface Section

The CDT is used to generate reports each period setting out the actual upload of compliance evidence against what was planned and the information is presented in the Technical Director's Report. The matching of actual evidence against what was planned is used as a lead indicator for the risk of potential non-compliance. Contracts that meet their plans are considered to represent a lower risk of non-compliance than any that do not. There has been a growing concern regarding the upload of evidence from NR contractors.

One of the live Surface Section contracts, planned to upload compliance evidence into the Commitments Delivery Tracker (CDT) in Period 2, in accordance with their Compliance Matrices. The upload was achieved as planned.

It was reported in Period 13 that [REDACTED] and [REDACTED] had not uploaded all their evidence in accordance with what was planned. This evidence continues to be outstanding. There has been no other change, with regard to what was previously reported in Period 13.

The long term outstanding items are as follows:

- [REDACTED] (GRIP5-8) has four outstanding pieces of evidence from the seven planned in Period 8 and did not upload evidence into CDT in Period 11 2017/18.
- The D26 report that [REDACTED] was due to upload in Period 6 remains outstanding. Also the planned upload of evidence of consultation with Thames Water remains outstanding since Period 10 2017/18.
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4 2017/18.
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4 2017/18.

No Surface Section PIRs were raised in Period 2.

Following a review with the JST, it was agreed that PRep is no longer required to report on U&A issues after Period 2.

Project Representative Team

Project Team

██████████: Project Representative, Safety, Progress, Risk, Governance;
██████████y: Signalling, Railway Systems, Integration, T&C;
██████████: Engineering, Stations, OSD, U&As, Assurance;
██████████: Compliance & Change, Operations, RSD;
██████████: Commercial, Cost Control, Financial, ONW;
██████████: Administration Manager.

Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LoNo	Letter of No Objection
ABB	ASEA Brown Boverly	LO	London Over ground
ACJV	Alstom Costain Joint Venture	LoNo	Letter of No Objection
ACWP	Actual Cost of Work Performed	LoR	Line of Route
AEA	Abellio East Anglia	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AMS	Agreements Management System	MENTOR	Mobile Electrical Network Testing, Observation and Recording
APIS	Authorisation to Place into Service	MEP	Mechanical Electrical & Public Health
ARS	Automatic Route Setting	MEPA	Mechanical, Electrical, Public Health, Architecture
AsBo	Assurance Body - Ricardo Rail	MES	Mile End Shaft
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
ATC	Automatic Train Control	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
ATS	Auto Transformer Station	MTIN	Miles Technical Incident Number
AWS	Automatic Warning System	MTR SMS	MTR Safety Management System.
B&PC	Board & Programme Contingency	MTR-C	Mass Transit Railway - Crossrail
BBMV	Balfour Beatty Morgan Vinci	MV	Medium Voltage
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NG	National Grid
BFK	Bam Ferrovial Kier	NGET	National Grid Electricity Transmission
BH	Berkeley Homes	NKL	North Kent Line
BIU	Bringing Into Use	NoBo	Notified Body
BLL	Bakerloo Line Link	NOW	North Woolwich
BMS	Building Management Systems	NR	Network Rail
BOS	Bond Street Station	NSACS	New Sector Area Cost Summary
BP	Business Plan	O&M	Operations and Maintenance
BREEAM	Building Research Establishment Environmental Assessment Methodology	OCS	Overhead Catenary Systems
BSP	Bulk Power Supply Point	OLE	Overhead Line Equipment
BT	Bombardier Transportation	OMC Building	Operations Maintenance Centre
BT / PC	Bombardier Transportation / Prime Contractor	OME	Order of Magnitude Estimate
BTH	Blomfield Ticket Hall	ONFR	On Network Functional Requirements
BUF	Bottom Up Forecast	ONSIP	On Network Station Improvements Programme
C&CSC	Commercial and Change Sub-committee	ONW	On Network Works
CAR	Corrective Action Report	OOO	Old Oak Common

CARE	Crossrail Assurance Reporting Environment	OOCPA	Old Oak Common Paddington Approaches
CBTC	Communications Based Train Control	OPEX	Operational Expenditure
CCB	Current Control Budget	Ops	Operations
CCP	Commitments Compliance Plans	ORAT	Operational Readiness & Transfer Group
CCRB	Construction and Commissioning Rulebook	ORR	Office of Rail & Road
CCRRB	Crossrail Construction Railway Rule Book	ORSG	Operational Readiness Steering Group
CCSA	Contract Commercial Status Analysis	OSD	Over Site Development
CCSC	Commercial & Change Sub-Committee	OSP	Operations Safety Procedures
CCTV	Closed Circuit Television	OTIS	OTIS escalators (company)
CD/RA	Closed Door / Right Away	OTP	Overall Target Price
CDG	Competence Design Group	PA	Public Address
CDL	Central Door Locking	PAD	Paddington station
CDM	Construction Design & Management Regulations	PCs	Principal Contractors
CDN	Crossrail Data Network	PDA	Project Development Agreement
CDT	Commitments Delivery Tracker	PDB	Network Rail Programme Delivery Board
CE	Compensation Events	PES	Platform Edge Screen
CEC	Chief Engineer's Communications	PES	Permanent Earthed Sections
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIP	Paddington Integration Project
CEG	Central Engineering Group	PIR	Potential Incident Report
CEO	Chief Executive Officer	PLU	Plumstead
CFCCB	Contingency Finance Current Control Budget	PM	Project Manager
CFO	Chief Financial Officer	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CIS	Customer Information System	PMO	Project Management Office NR
CMR	Crossrail Managed Risk	PNY	Paddington New Yard
CMS	Crossrail Management System	PPE	Personal Protective Equipment
CoL	City of London	PPF	Property Partnership Framework
COS	Central Operating Section	PPM	Passenger Performance Measurement
CPFR	Crossrail Programme Functional Requirements	PRep	Project Representative
CPI	Cost Performance Index	PRISM	Cost Management Software
CPO	Compulsory Purchase Order	PRM	Persons of Reduced Mobility
CRAF	Completion Readiness Assessment Framework	PSD	Platform Screen Door
CRL	Crossrail Limited	PSG	Performance Steering Group
CRV	Crossrail Requirements Variation	PSR	Project Status Report
CSCS	Construction Skills Certification Scheme	PTYSC	Property Sub-Committee
CSDE	Correct Side Door Enabling	PWay	Permanent Way
CSJV	Costain Skanska Joint Venture	QBR	Quarterly Baseline Review
CSM	Construction Safety Management	QCRA	Quantified Cost Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	QRA	Quantified Risk Assessment
CT	Computerized Tomography	QSRA	Quantified Schedule Risk Assessment
CTOC	Crossrail Train Operating Concession	RAB	Regulatory Asset Base
CUH / CHS	Custom House Station	RAB (C)	RfL Assurance Board for Crossrail
CW	Canary Wharf	RAG	Red, Amber, Green Matrix
CWG	Canary Wharf Group	RAM	Route Asset Manage.
CWS	Canary Wharf Station	RBC	Remote Block Computer
D&A	Drugs and Alcohol	RCA	Risk Control Actions
DA	Development Agreement	RCC	Route Control Centre
DeBo	Designated body	RfL	Rail for London
DfT	Department for Transport	RfL-I	Rail for London - Infrastructure
DLO	Direct Labour Organisation	RFT	Right First Time
DLR	Docklands Light Railway	RIA	Railway Integration Authority
DOO	Driver Only Operation	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DPS	Depot Protection System	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995

DT	Dynamic Testing	RIRP	Railway Integration Review Point
Dwall	Diaphragm wall	RLU	Restricted Length Unit
DWWP	Delivery of Works Within Possession	ROC	Rigid Overhead Conductor
E&B	Earthing & Bonding	ROC	Regional Operational Centre
EA	Environment Agency	ROP	Royal Oak Portal
EAC	Estimate at Completion	RP4.2	Review Point 4.2
EB	Eastbound	RR	Ricardo Rail
ECP	Employers Completion Process	RRV	Road / Rail Vehicles
ECS	Empty Coach Stock	RS	Rolling Stock
EDBL		RSC	Return Screen Conductor
EDT	Early Dynamic Testing	RSD	Rolling Stock & Depot
EED	Emergency Exit Door	RSSB	Rail Safety & Standards Board
EFC	Estimated Final Cost	RTU	Remote Telemetry Unit
EFC	Economic and Financial Committee	S&C	Switches & Crossings
EiS	Entry into Service	SA	Supplementary Agreement
ELCBT	Elizabeth Line Countdown Board Tracker	SACR	Semi Annual Construction Report
ELRSG	Elizabeth Line Readiness Steering Group	SAP	System Applications Products
EMC	Electromagnetic Compatibility	SAR	Safety Assessment Report
EMU	Electrical Multiple Unit	SAT	Site Acceptance Test
ERTMS	European Rail Traffic Management Systems	SCADA	Supervisory Control and Data Acquisition
ESJ	Engineering Safety Justification	SCL	Sprayed Concrete Lining
ESM	Engineering Safety Management	SCN	Sponsor Change Notice
ETCS	European Train Control System	SDG	Signalling Design Group
ETH	Eastern Ticket Hall	SDO	Selective Door Operation
EVM	Earned Value Management	SDS	Scheme Design Specification
FAR	Farringdon	SER	Signalling Equipment Room
FCCB	Finance Current Control Budget	SES	South East Service
FDC	Framework Design Consultant	SESR	South East Signalling Room
FDO	Final Design Overview	SFA	Sponsor Funding Account
FDS	Final Design Statements	SHELT	Safety and Health Leadership Team
FFOC	Final Forecast Outturn Cost	SIRP	Systems Integration Review Panel
FGW	First Great Western	SISS	Station Information and Security System
FIS	Fisher Street Shaft	SJR	Safety Justification Report
FLU	Full Length Unit	SLD	Single Line Diagrams
FoI	Freedom of Information	SMS	Safety Management System
FRAG	Fraud Risk Assurance Group	SMTA	Smithfield Market Traders Association
FTS	Floating Track Slab	SOC	Statement of Compatibility
GAF	Greater Anglia Franchisee	SONIA	Sterling Overnight Index Average
GE	Great Eastern	SOR	Systems Operation Room
GEBR	Guaranteed Emergency Brake Rate	SORBA	Shaping Architecture Company (sub cladding contractor)
GEFF	Great Eastern Furrer & Frey	SPI	Schedule Performance Index
GEML	Great Eastern Main Line	SPS	Secondary Part Steel
GFRC	Glassfibre Reinforced Concrete	SR	Sponsors Requirement
GLA	Greater London Authority	SRP	Safety Review Panel
GPE	Great Portland Estates	SSE	Scottish & Southern Electricity
GRC	Glass Reinforced Concrete	SSP	Stations, Shafts, Portals
GRIP	Governance for Railway Investment Projects	STG	Stepney Green
GSM-R	Global System for Mobile Communication - Railway	STS	Standard Track Slab
GW	Great Western	SVP	Safety Verification Panel
GWML	Great Western Main Line	T&C	Testing & Commissioning
GWR	Great Western Railway	TAP	Technical Assurance Plan
H&S	Health & Safety	TBM	Tunnel Boring Machine
HAL	Heathrow Airport Limited	TC&HSG	Testing, Commissioning and Handover Steering Group
HALARP	Heathrow Airport Limited Assurance Review Panel	TCMS	Train Control Management System

HAS	High Attenuation Sleeper	TCR	Tottenham Court Road
HAVS	Hand Arm Vibration Syndrome	TCRW	Tottenham Court Road West
HEP	Handover Execution Plans	TDR	Technical Director's Report
HIA	Heathrow Implementation Agreement	TDY	Tunnel Drive Y
HM	Her Majesty	TfL	Transport for London
HMDL	Handover Master Deliverable List	TOC	Train Operating Company
HRW	Heathrow Airport	TPA	Tunnel Planning Authority
HSPI	Health & Safety Performance Indicator	TPH	Trains Per Hour
HV	High Voltage	TPS	Train Protection System
HVAC	Heating Ventilation & Air Conditioning	TPWS	Train Protection & Warning System
IA	Interim Acceptance	TRAIL	Transport Reliability Availability Integrated Logistics
ICD	Interface Control Document	TRH	Temporary Rehousing
IECC	Integrated Electronic Control Centre	TSI	Technical Standard for Interoperability
IEP	Intercity Express Programme	TTVS	Temporary Tunnel Ventilation System
IFC	Issued For Construction	TUCA	Tunnelling & Underground Construction Academy
IFD	Ilford Yard	TWAO	Transport & Works Act Order
IM	Infrastructure Manager	TXM	TXM Plant
IOSH	Institution of Occupational Safety and Health	U&A	Undertakings & Assurances
IP	Intervention Point (0, 1, & 2)	UKPN	UK Power Networks
IR35	Inland Revenue Taxation Regulation 35	UR	Urban Realm
IRN	Installation Release Note	URT	Unresolved Trends
IRSG	International Regulatory Strategy Group	UTX	Under Track Crossings
ISJ	Interim Safety Justification	VDP	Victoria Dock Portal
ISV	Intermediate Statements of Verification	VERP	Value Engineering Review Panel
ITP	Inspection & Test Plan	VFL	Volker Fitz Patrick
ITT	Invitation to Tender	VN	Variation Notice
JST	Joint Sponsor Team	VT	Voltage Transformer
KBR	Knorr-Bremse Rail	WAD	Works Authorisation Document
KD	Key Deliverable	WBP	Westbourne Park
KE	Kinematic Envelope	WBS	Work Breakdown Structure
KG	Kensal Green	WC	World Class
KO	Key Output	WCC	Westminster City Council
KPI	Key Performance Indicator	WCCC	Whole Contract Construction Certificate
L&P	Land and Property	WHI	Whitechapel
LB	London Borough	WITI	Western Inner Track Infrastructure
LBTH	London Borough of Tower Hamlets	WOE	Western Outer Electrification
LDBL	██████████	WOO	Woolwich Station
LFB	London Fire Brigade	WOTI	Western Outer Track Infrastructure
LIV	Liverpool Street	WTH	Western Ticket Hall
LMU	London Metropolitan University	YC	Yard Control

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 113

Period 3 FY2018-19

27 May 2018 – 23 June 2018

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Note: This report relies on the information set out in CRL's Period 3 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 23 June 2018. Note that information emerging after the close of Period 3 is subject to formal confirmation by CRL in its Period 4 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan.

Document history and status

Revision	Date	Description	By	Review	Approved
1	12 July 2018	PSR 113 Period 3 FY 2018-19 v1.13.docx ~ Draft	PRep Core Team		
2	19 July 2018	PSR 113 Period 3 FY 2018-19 v1.19.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets. CRL is currently in discussion with RfL, LUL, and MTR-C regarding access to work sites after The Railways and Other Guided Transport Systems (Safety) Regulations (ROGS) are implemented;

Financial:

The Intervention Points have not changed in Period 3 but CRL has increased the AFCDC by £87m to £12,810m, which exceeds IP2 by £298m. This increase consumes almost all of the increased funding made available by Sponsors. We are concerned that cost pressures remain across the programme that may cause the forecasts to be increased again before completion. The AFCDC is now £20m in excess of the financial budget and the contingency budget of £228m is not sufficient to cover the risk exposure of £249m.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains at £2,530m, but we expect this to increase soon to reflect the £54m additional NR funding. The ONW final forecast outturn cost (FFOC) remains at £2,376m. CRL assess that cost risks to the ONW forecasts remain.

Stage 2 Opening:

The Interim Phase (exchanging Reduced Length Units with Full Length Units) will not occur at the end of August, but possibly from November. This is due to the delays in TCMS v7.2 software, and a greater appreciation of the difficulties in carrying out timetabling changes to Paddington Station platforms. This will lessen the opportunity to build up mileage in the fleet.

Stage 2 Phase 2 has seen further slippage in the development of TCMS v7.3 software, [REDACTED]

[REDACTED] This increases the risk of delay to the start of services target date of 24 February 2019.

Stage 3 Opening - Infrastructure and Systems:

The programme still contains a large number of significant risks and we believe there is a very high risk that Stage 3 Opening will be delayed or the opening will be sub-optimal.

CRL remains committed to start Pre-Trial Running on 11 September 2018 and Combined Trials on 1 October 2018; continuing to balance the demands of construction completion against dynamic testing in order to achieve the best outcome for the Crossrail Programme. Poorer than expected dynamic testing progress, a large outstanding test workload and the significant financial benefits of completing installation prior to Combined Trials (thus avoiding the constraining effects of working under the RfL ROGS railway rule book) is leading CRL to target construction completion as a priority.

A detailed schedule analysis, supported by 'deep dives' on selected contracts, is being carried out by CRL. This analysis is intended to confirm what can be delivered in the time available, and by extension, the nature of the railway that could be opened to passenger service on 9 December 2018. A significant component of the analysis relates to the proof of signalling integration through dynamic testing, and CRL continues to review with Siemens the scope of tests to be completed on the Central Section. The workload significantly exceeds what is provided in the remaining dynamic testing windows and therefore impact upon Stage 3 Opening is inevitable.

Six Dynamic Testing Windows have been completed and the results have been mixed. Incomplete off-site testing and poor software maturity no longer constrain dynamic testing in the same way as before, and an increased number of tests are now available to be carried out. However, experience to date suggests that re-testing constitutes a significant workload. We remain concerned with the general readiness and flexibility of [REDACTED] resources to support an increasing testing opportunity.

Progress with GSM-R cabling, tunnel lighting, walkways, High Voltage power and tunnel ventilation is behind plan. [REDACTED] continues to work closely with the other rail systems contractors to progress integration with the SCADA system and to carry out Phase 3 testing whenever sites become available.

CRL remains extremely concerned at the readiness of Stations, Shafts and Portal (SSP) sites to start Phase 3 testing. Ongoing schedule drift is complicating what had already become an unsupportable demand for additional resources, and recruitment of specialist staff is proving difficult. [REDACTED]
[REDACTED]

Continued delays are impacting upon the stations' completion of fit-out, and slow progress of the physical work is delaying subsequent submission of documentation. Significant risks remain at [REDACTED] and [REDACTED] Stations.

CRL continues to face significant delivery challenges during the next few months, with the time available for completion of work and the opportunities for delay mitigation in order to achieve Stage 3 Opening reducing.

Stage 3 Opening - Handover and Operational Readiness:

There has been some positive feedback concerning the training received by MTR-C and LU, otherwise Handover remains problematic. Key components continue to be behind programme. The production of O&M manuals is in a particularly difficult position.

The status of Regulatory Approvals has now been adjudged 'red' by CRL, meaning there is a high risk that approvals will not be achieved in time to support Stage 3 Opening. This is due to the slow production and acceptance of safety assurance evidence, due in part to the late running testing phase. The outcome is that it makes formal Handover to RfL and LU in sufficient time for Stage 3 Opening, almost impossible to achieve.

Stage 4 and 5 Openings:

The key risk to Stage 4 continues to be the power upgrade works by NR. The full scope will not be completed by May 2019, and work is underway to understand how the timetable could be impacted.

There are two concerns with regard to Stage 5. The first is that, until NR has been successful in extending its ETCS exemption, there will be doubt as to whether Elizabeth Line services can operate as planned in December 2019. NR has been in discussions with the ORR, which it has described as positive. The second is that the western station upgrades project is at risk of not being completed by December 2019. This is primarily due to NR not being able to complete the procurement process. Work is underway to bridge the gap. NR is also not assured of having key access periods in 2019 available.

1 Cost

1.1 Summary

CRL has increased the AFCDC by £87m to £12,810m, which breaches IP2 by £298m. This increase consumes almost all of the increased funding made available by Sponsors. We are concerned that cost pressures remain across the programme that may cause the forecasts to be increased again before completion. ONW forecasts remain as before.

IP0, IP1 and IP2 have not changed in Period 3;

CRL has increased the AFCDC, by £87m to £12,810m;

The CRL AFCDC exceeds IP2 by £298m;

[REDACTED];

There is the likelihood that the AFCDC will continue to rise;

The AFCDC is now £20m in excess of the financial budget;

The contingency budget of £228m is not sufficient to cover the risk exposure of £249m;

The CRL ONW AFC, including VNs, remains at £2,530m;

The NR FFOC remains at £2,376m;

CRL continue to advise of significant cost risks to the NR ONW forecasts.

1.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 3. As we expected, CRL has increased the AFCDC, by £87m to £12,810m. CRL has stated that this increase is a consequence of an increase in risk of £71m for forecast cost increases at the major contracts following its Period 3 QRA¹ and a review of costs-to-go by senior CRL management.

The CRL Period 3 AFCDC exceeds IP2 by £298m, as shown in Figure 1 - 1, and is in excess of the Finance Current Control Budget (FCCB), of £12,790m, by £20m.

¹ Cost risk commercial assessment by CRL rather than a full QCRA with probabilities.

(£ millions)	Period 2	Period 3	Delta	Movement
Forecast	12,545	12,560	15	up
Delivery Risk	0	6	6	up
Subtotal	12,545	12,566	21	up
Programme Risk	174	240	66	up
Board Risk	4	4	0	same
AFDC total	12,723	12,810	87	up
IP0	11,672	11,672	0	same
IP0 Headroom	-1,051	-1,138	-87	down
IP1	11,912	11,912	0	same
IP1 Headroom	-811	-898	-87	down
IP2	12,512	12,512	0	same
IP2 Headroom	-211	-298	-87	down

Figure 1 - 1 ~ AFDC Headroom to Intervention Points

During the Period, CRL was allocated funding up to £211m above IP2, and Sponsors have committed to providing £300m. At the close of Period 3, there is only £2m headroom to this revised funding threshold and there are no signs that costs are abating. CRL reports that contractors continue to struggle to meet the demands of the schedule and that demobilisation from the project has been pushed back further, with labour, plant and staff all driving increases in defined cost. However, the full value of defined costs being pursued by the Contractors is not included in the current AFDC. The analysis of defined cost continues to follow the established trend of increase [REDACTED] g; see Section 1.3.

The rate of COWD has been steady through the life of the project, averaging approximately £120m per period, as shown in Figure 1 - 2. Together with the increasing rate of defined costs and the costs pressures at [REDACTED] and [REDACTED], there is the likelihood that the AFDC will continue to rise. Projecting linearly both the current rate of increase of AFDC and COWD to present a worse case scenario, they intersect at approximately £13bn in Period 10. The actual growth for both AFDC and COWD are unlikely to be a continuing linear expansion, but is expected to tail off as the works approach completion.

The cost review carried out by the independent Jacobs commercial team indicated that growth towards £400m above IP2 was based on contemporaneous cost performance and productivity circumstances at Period 13 and assumed all work will be complete in time for Stage 3 opening. Since Period 13, the AFDC has risen again, with a substantial step increase in Period 3, and the programme is still experiencing ongoing prolongation and disruption, compounding productivity and increasing costs. [REDACTED] CRL [REDACTED] Defined Cost forecasts are indicating a rising rate of increase that introduces risk of increase to the AFDC that is challenging to predict.

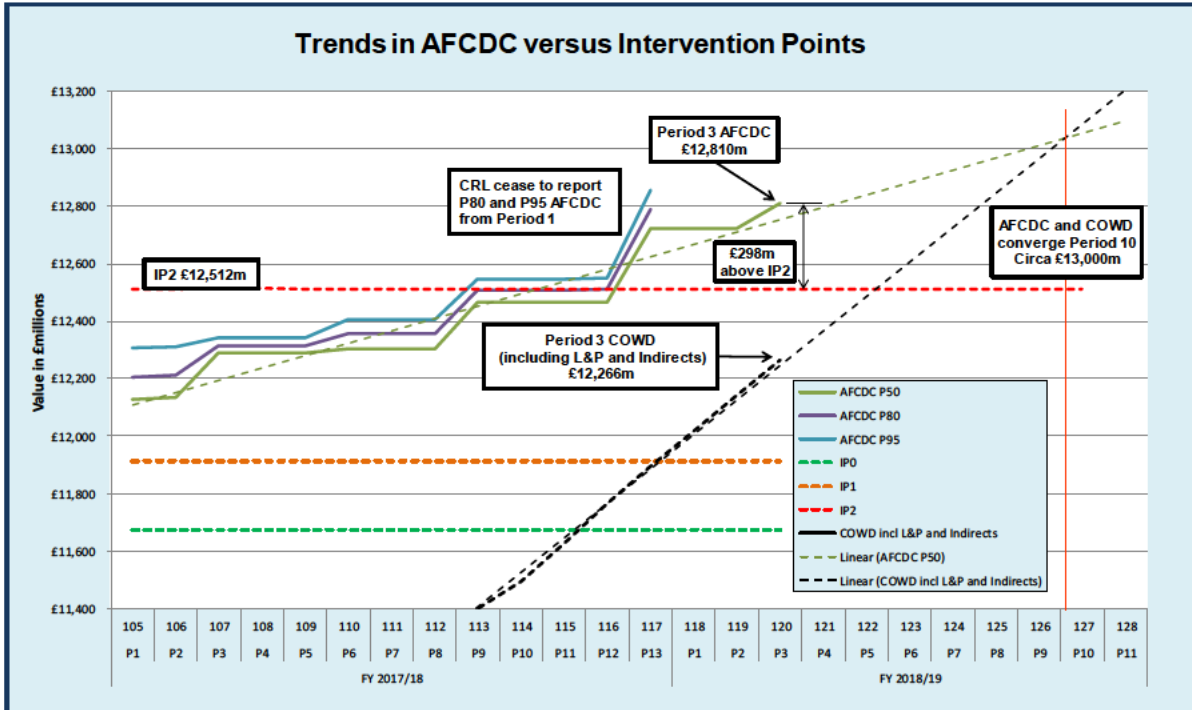


Figure 1 - 2 ~ AFDCD Headroom to Intervention Points

CRL has advised that the AFDCD includes cost or risk allowances for all items of scope currently instructed in the COS and provision for resolution of defined costs; although we believe the risk allowances may still be insufficient. The only item which is specifically excluded is the [REDACTED]. The cost of the OOC second link was excluded previously; however, CRL has now made a provision in its current AFDCD. [REDACTED]

Programme risk increased by £66m to £240m and £6m was added to Delivery Risk in Period 3, equating to an overall net increase in risk of £71m for forecast cost increases at the major contracts.

Figure 1 - 3 indicates the cumulative delivery overspend at each period.

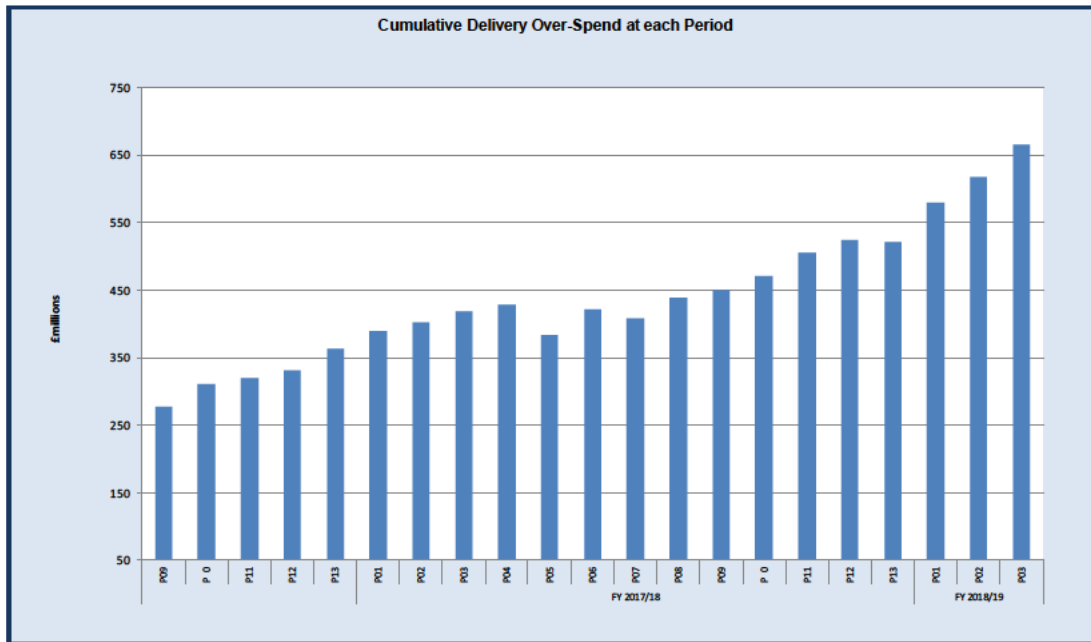


Figure 1 - 3 ~ Cumulative Delivery Overspend at each Period

The cumulative delivery overspend has increased in Period 3 by £48m to £666m (Period 2, £618m). This overspend is included in the AFCDC.

CRL reports that, in Period 3, it spent £51.2m above the 2018/19 Business Plan. The Business Plan for Direct Costs was set in Period 6 2017/18, and since then there has been a significant increase to the AFCDC (£0.5bn) and delays to MOHS dates for the key contracts and, as such, variances to the Business Plan are unavoidable. The CRL Period 3 Board Report provides the details of the overspend which, in summary, continue to be dominated by prolongation and delays. These costs are included in the AFCDC.

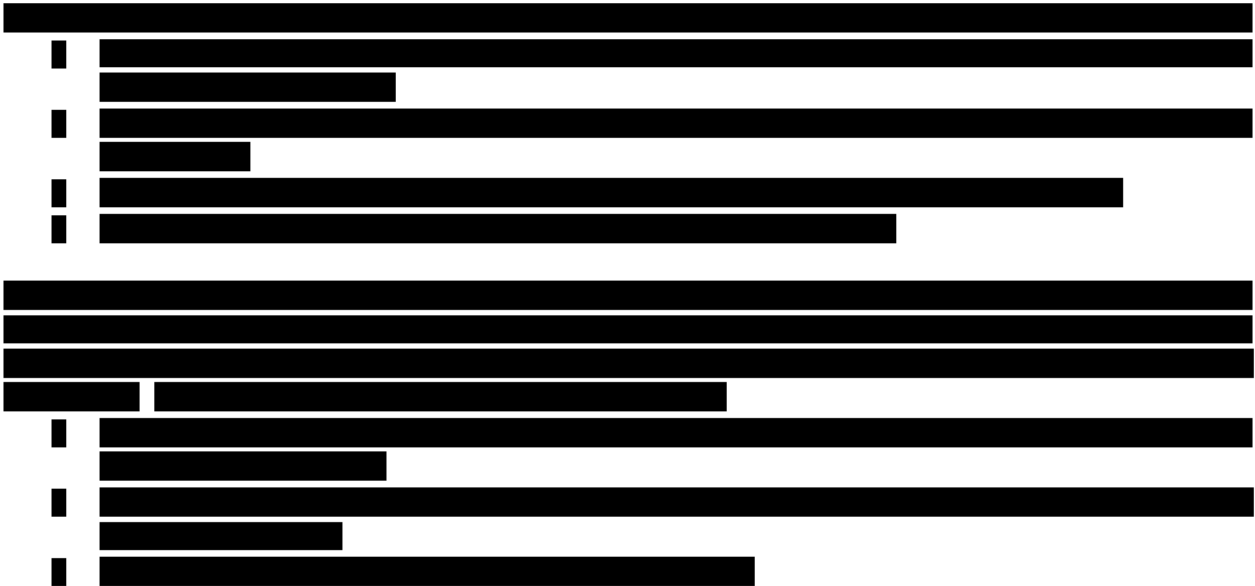
1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 3 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package.

Figure 1 - 4 shows the reconciliation of the adjusted Target and Defined Costs for Period 3 to include removed values and avoid duplication of costs included within the 'Others' category, in order to provide ongoing continuity for consistent trend analysis reporting.

Contract	Target £m		Defined Cost £m	
	P3		P3	
C300				
C305				
C610				
C512				
C510				
C435				
C405				
C412				
C360				
C502				
C422				
C350				
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,367	£5,604	£5,685	£5,895
Others	£912	£925	£971	£987
Total	£6,279	£6,529	£6,656	£6,882

Figure 1 - 4 ~ P1 Adjusted Defined Cost and Target Cost²



Although CRL has increased its AFDCD to take into consideration the increase of defined costs, the full value of the Contractors estimates has not been included. The rate of increase for defined costs is increasing and consequently the allowances within CRLs risk review appear to be insufficient.

² Figure 1-4 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

1.4 Scenario costs

The Crossrail Cost Scenario Review report issued by Jacobs on 19 June 2018 set out an analysis of CRL’s calculations for various scenarios presented in March 2018, using Period 10 data when AFCDC was at £12,464m. It also reviewed CRL’s completion tail scenarios based on Period 13 forecasts when AFCDC had increased to £12,723m, causing a £211m breach of IP2 (£12,512m). At that time, the expected final cost was £300m above IP2 or £400m as an upper bookend, assuming all essential construction work was finished on time and Stage 3 opened on 9 December 2018, or shortly thereafter.

Since then CRL has further increased the AFCDC to £12,810m with the breach of IP2 increasing to £298m. We are concerned that this additional increase, and delays noted

elsewhere in this report, may cause the bookend to increase. Figure 1 - 2 indicates straight-line extrapolations of the latest AFDCD and COWD numbers. These meet at Period 10 (December 2018) at approximately £13bn which is approximately £500m above IP2. As noted in Section 1.2 it is unlikely that the COWD will increase at a constant rate towards the end of 2018 and we would expect a tailing off of actual costs as the main construction works complete, possibly nearer the £400m breach.

As requested by Sponsors, we understand CRL is reviewing the MOHS and its confidence of opening Stage 3 on time in December 2018. Any major delays to this opening or station construction are likely to further increase costs. We would expect CRL to update its cost forecast once the schedule review has been completed.

1.5 Contingency and Risk

The Finance Current Control Budget remains at £12,790m at Period 3. The £12,810m AFDCD is now £20m in excess of the financial budget and also exceeds the RP4.2 Baseline funding of £12,136m by £674m.

CRL is reporting that the overall Period 3 contingency budget of £228m is not sufficient to cover the risk exposure of £249m by £22m (£136m deterioration from Period 2). The centrally controlled Delivery contingency at Period 3 has decreased by £3m to £39m.

Figure 1 - 6 shows the trend of the decrease in the Board and Programme Contingency and compares the lower Risk Exposure at P50 only with the remaining contingency.

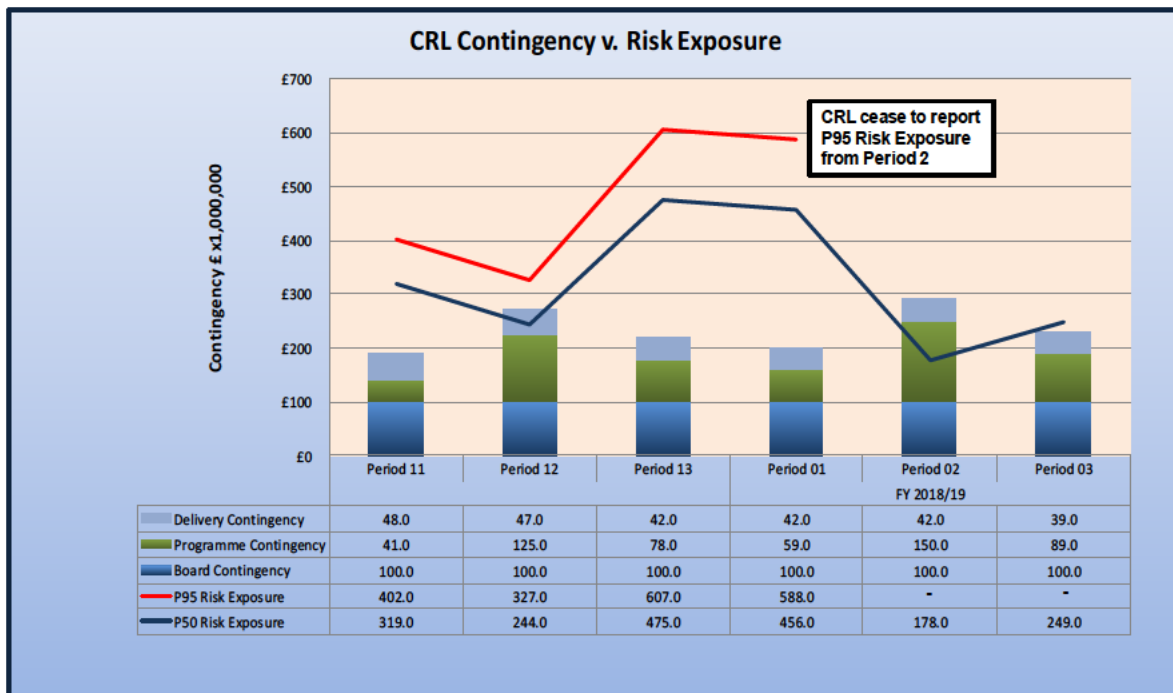


Figure 1 - 6 ~ Risk Exposure versus Contingency

The Crossrail Sponsor Board meeting on 25 June 2018 sought greater granularity and early warning for URT risk affecting AFDCD increases. A workshop was conducted with CRL to review the URT data and CRL has proposed to provide possible trend analysis for further discussion. The raw periodic URT data provides no reasonable forecast; the current best

forecasting tool is regarded to be a linear trend of AFCDC, as shown in Figure 1 - 6 above. CRL has confirmed³ that all trends are covered by URTs or risk in P3 AFCDC. Figure 1 - 7 shows the apportionment of Risk from Period 13 up to the CRL commercial risk review held in Period 3.

Period	QRA	URT's	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81

Figure 1 - 7 ~ Elemental Breakdown of Risk Allowances

1.6 Cost: On Network Works (ONW)

CRL reports that the ONW are 96% complete, offering greater certainty around the cost performance of the Project. The CRL ONW AFC, excluding VNs, and the NR FFOC remain at £2,376m in Period 3.

The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,305.6m, which exceeds the DfT Invention Price of £2.3bn by £5.6m. This has continued to be stable for several periods. Figure 1 - 8 indicates the relevant breakdown.

Description	Period 2 £m	Period 3 £m
Cost Grand Total	2,835	2,835
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
CRL/NR Funding:		
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
Total CRL/NR Secured Funding	305	305
FFOC	2,376	2,376
Pain/gain share	-70	-70
Forecast to RAB	2,306	2,306

Figure 1 - 8 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

³ C&CSC 10 July 2018.

1.6.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is unchanged and remains at £2,530m for Period 3. NR reports a Total Secured Funding for NR ONW is £2,835.4m, as shown in Figure 1 - 9.

The ONW funding is expected to increase in Period 4 following NR seeking to secure a further £9.8m of Recoveries in relation to other NR projects and tax/insurance recoveries; these amounts are currently included in the 'Recoveries (Residual)' tabulated in Figure 1 - 10, NR ONW Cost Summary. NR has received approval in principle for additional funding of £54m from the NR Portfolio Board (CP5 contingency) to address the cost risk associated with [REDACTED] programme demobilisation, access, and recoveries. CRL has reported that the funding changes will appear in the NR figures next period.

Description	P3 Source of Funding				P2
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	217.0	-	-	217.0	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,488.0	22.0	20.0	2,530.0	2,530.0
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
Sub Total	-	118.9	186.5	305.4	305.4
TOTAL SECURED FUNDING	2,488.0	140.9	206.5	2,835.4	2,835.4

Figure 1 - 9 ~ NR ONW Secured Funding

1.6.2 ONW Cost

CRL reports that the Grand Total Cost remains static in Period 3 at £2,835.4m, but with a reduced mid-point sensitivity of plus £78.4m (a £4.9m increase from Period 2), as shown in Figure 1 - 10.

Description	Period 2 £m	Period 3 £m	Delta £m	P3 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,891.8	2,902.1	10.3	2,886.1	2,940.9	2,997.9
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	0.0	0.0	0.0	0.0	0.0	0.0
Recoveries (Residual)	-9.8	-9.8	0.0	-4.8	-4.3	0.0
Targeted Savings	-46.6	-57.0	-10.4	-51.3	-22.8	0.0
Cost Grand Total	2,835.4	2,835.3	-0.1	2,830.0	2,913.8	2,997.9
Total Secured Funding	2,835.4	2,835.4	0.0	2,835.4	2,835.4	2,835.4
Funding Gap	0.0	-0.1	-0.1	-5.4	78.4	162.5

Figure 1 - 10 ~ NR ONW Cost Summary

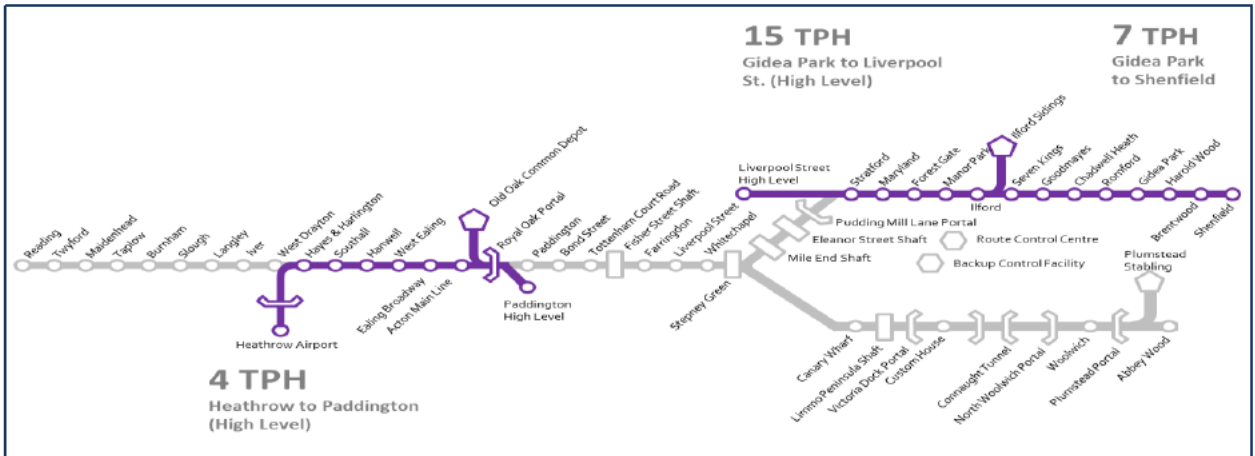
[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

[REDACTED]

CRL has collated the effects of known Period 3 risks in its SPOT AFC cost sensitivity analysis, as shown in Figure 1 - 10 above.

2 Stage 2: Phase 2; [Target Date 24 February 2019]



2.1 Summary

CRL and RfL continue to target 24 February 2019 for the completion of Stage 2; [REDACTED]. There has been no testing in Heathrow for several periods.

The interim phase, initially planned to be in place in August, could be delayed to November; Delays to TCMS v7.3 software; [REDACTED]; Growing risk of resource conflict between Stage 2-2 and any delay to Stage 3.

2.2 Operational Readiness Assessment

In our last report, we said that the CRL programme integration team responsible for Stages 2-2, 4 and 5 was due to be disbanded in August 2018. The majority of it will now be retained until February 2019.

CRL’s Stage 2-2 dashboard categorised one issue as ‘red’ for Period 3. [REDACTED]

2.3 Interim phase (Replace RLUs with FLUs)

The benefits of the interim phase have been described in our previous reports. We did state that RfL would like to have carried this out in mid-August 2018, but that will not be achieved due to the following:

- The key decision trigger, that the TCMS has met a developmental milestone by 26 June 2018 was not met, and is now expected to be achieved in early August. The passenger service version of TCMS (v 7.2.x) is expected at the end of August 2018.

- RfL need to give approximately 12 weeks⁴ formal notice to MTR-C to implement this phase. The length of the period is dictated by the timetable change required at Paddington station. This is because FLUs will need to use platform 14, which RLUs do not. That necessitates many other platform changes to other trains which will be displaced, at a time when NR timetabling resources are fully occupied in other issues. RfL is understandably wary at initiating this work when there is uncertainty as to whether the train will be ready.

In our opinion, the interim phase has clear benefits, and efforts should be made to pursue its implementation. Our concern is that some of the benefits (e.g. C345 FLU mileage) will be degraded if its implementation is delayed. We currently estimate the delay to be until November 2018.

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In our Period 13 report, we described two interim activities that are required before formal ETCS testing, using TCMS v7.3, can start in August 2018. They were:

1. Software code freeze – Forecast 15 May 2018;
2. Type testing of software on the train – Forecast 23 June 2018.

CRL is reporting that it has completed the first activity, and is now forecasting meeting the second activity in early August 2018. RfL believes this will impact the key milestone of ‘Approval to Operate ETCS for Driver Training’, forecast for 12 October 2018. Essentially, the delays to BT delivering TCMS v7.2 for Stage 3 are having an impact upon TCMS v7.3. This may not in itself delay the target opening of Stage 2-2 of 24 February 2019, because MTR-C is devising training options that start at the beginning of January 2019.

There has been no testing in Heathrow for a number of periods. A clear indication of progress can be made once BT/CRL have begun to carry out their integration tests and fault free running exercises.

Operations

An important aspect to be aware of is the proximity of Stage 2-2 and Stage 3. [REDACTED]
 [REDACTED]
 [REDACTED]
 [REDACTED]
 [REDACTED]

Regulatory Approvals

There are two key approvals for Phase 2-2 to be issued by the ORR:

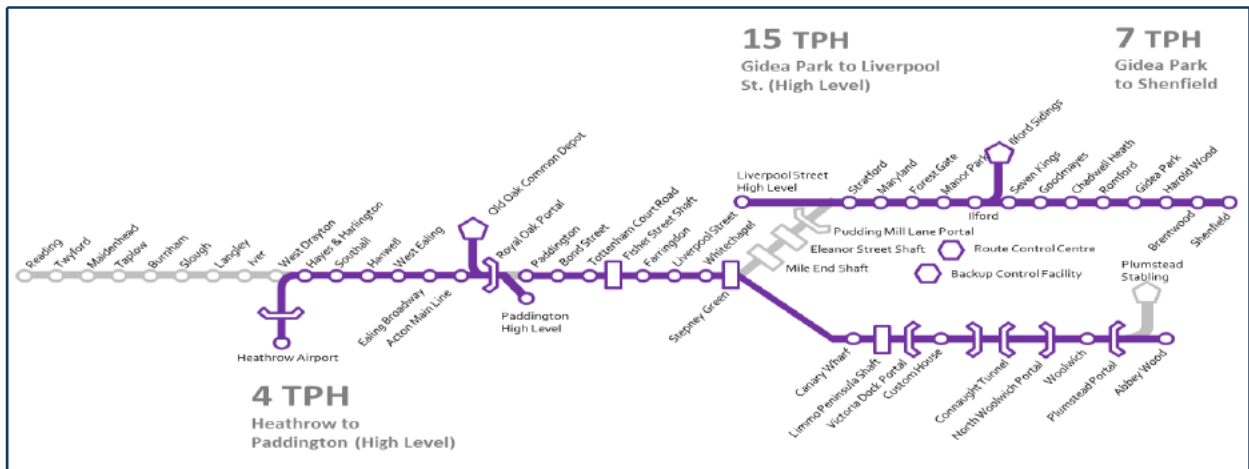
- APIS ETCS trackside to be issued to NR;
- APIS ETCS on-board to be issued to BT.

APIS ETCS trackside was expected to be issued by 13 July 2018, but has now been delayed to early August 2018. APIS ETCS on-board has moved from 19 November 2018 to 26 November 2018. We feel this is likely to slip further, due to the issues with train software development described in the Rolling Stock section above.

⁴ Period taken from Stage 2 Integration team programme.

[REDACTED]

3 Stage 3: Paddington to Abbey Wood; 9 December 2018.



3.1 Summary

Significant construction work, documentation and testing is to be completed over the next few months, subject to a range of risks as set out in the following Sub-Sections and in CRL’s Board Report. Therefore, we believe there is a very high risk that Stage 3 Opening will be delayed or the opening will be sub-optimal⁵.

CRL has developed its ‘Combined Trials’ strategy in more detail;
The programme still contains a large number of significant risks;
44 Anchor Milestones forecast to be later than the revised MOHS late date;
Twenty Readiness Tasks that have been given a ‘Red’ by ELRSG;
Continued delays are impacting upon the stations’ completion of fit-out, etc;
Slow progress of the physical work and subsequent submission of IRNs;
Significant risks at [redacted] and [redacted] Stations;
Concerns with Tunnel Ventilation and Phase 3 testing;
Concern with the general readiness and flexibility of [redacted] to support Dynamic Testing;
Handover, particularly O&M manuals, remains in delay causing significant issues for RfL-I;
Regulatory approvals now adjudged ‘red’ due to slow production of assurance evidence;
Critical Agreements between RfL and NR need to progress faster;
TCMS v7.2 is delayed by circa 4 weeks in this period.

⁵ Not in accordance with the PDA.

3.2 Schedule

Following its announcement in June that ‘Trial Running’ and ‘Trial Operations’ would be combined into ‘Combined Trials’ commencing 1 October 2018, CRL has developed its strategy in more detail. Twenty five Anchor Milestones (AM) have been adjusted and a further eleven have been deleted so that the revised MOHS reflects the new approach. The changes have been carried out within the Systemwide, Operations and Integration elements of the schedule. In addition, seven Surface AM dates are under review; see Section 3.6. The new strategy now includes a total of 11 dynamic testing windows plus 2 revised sets of transition testing periods on NR assets (GEML and GWML). Further details on dynamic testing are included in Section 3.8.

The table at Figure 3 - 1 indicates a selection of key Anchor Milestones that we intend to track over the next few months as important Key Dates, most of which have been re-baselined. The table gives the baseline dates in the latest adjusted MOHS, plus the CRL forecasts at Period 3. It shows that unadjusted Key Dates are forecast to be late but adjusted Key Dates are forecast to be on time, although most of them were running late against the original schedule. This reset of significant parts of the MOHS sets an updated baseline for the programme leading to Combined Trials due on 1 October 2018. Although the new baseline dates account for a range of late running activities, the programme still contains a large number of significant risks which are described below and elsewhere in Section 3.

Key Dates	Revised MOHS 2018	Period 3 Actual / Forecast
C650 - All 11 kV S,S&P locations energized	15-Apr-18	11-Jul-18
C650 - All 22 kV S,S&P locations energized	30-Jun-18	29-Jul-18
Training completed for MTR in support of Handover	30-Jun-18	31-Jul-18
COS safety Case submitted to RABC (to facilitate Handover)	30-Jun-18	30-Aug-18
C620 - Ready to Commence Transition Testing @ GEML	12-Aug-18	12-Aug-18
22no. CI.345 FLUs Available for Reliability Growth (Pre Trial Running)	13-Aug-18	13-Aug-18
Training completed for LU in support of Handover	31-Aug-18	31-Aug-18
C610 - Complete Pre-Trial Running	08-Sep-18	30-Sep-18
C660 - Train GSM-R Radio available to support Combined Trials	09-Sep-18	09-Sep-18
C610 - Ventilation Control System ready to support Combined Trials in normal mode	09-Sep-18	09-Sep-18
C620 - Ready to Commence Transition Testing @ GWML	10-Sep-18	09-Sep-18
RfLI Ready to commence Pre-Trial Running	11-Sep-18	11-Sep-18
Training completed for RFL in support of Handover	14-Sep-18	14-Sep-18
C620 - All Signalling Dynamic Testing complete (Except Yellow Plant)	17-Sep-18	17-Sep-18
Pre Trial Running starts	17-Sep-18	17-Sep-18
Final COS safety case updated and submitted to RABC	20-Sep-18	20-Sep-18
C660 - CIS ready to support commencement of Combined Trials	30-Sep-18	30-Sep-18
Commence Combined Elizabeth line Trials and Handover under ROGS to M	01-Oct-18	01-Oct-18
Forecast later than MOHS		
Forecast earlier than MOHS		
New or adjusted Anchor Milestones		

Figure 3 - 1 ~ Key Dates to Combined Trials

Figure A - 1 in Appendix A sets out the eighteen Corporate (Key) Milestones that were approved by the CRL Board, alongside CRL forecasts for Periods 2 and 3. Three Milestones have been adjusted to reflect the new strategy and eight have experienced further delays since Period 2. Milestone 6 (CBTC Authorised for FLU for Trial Running) is currently forecast as 4 July 2018, but we expect this will be re-forecast to August 2018. Milestone 14 (Class 345 CBTC Signalling authorised for Passenger Service by ORR) is forecast as 2 August 2018 (as

Anchor Milestone A706), but CRL have confirmed this will be in October as indicated in its Board Report.

Figure A - 2 in Appendix A indicates the overall cumulative progress of the completed Anchor Milestones. The graph is not very different to that shown at Period 2 because of the revised base lines as described above. However, the Actual/Forecast curve still remains on top of the Baseline [REDACTED] Date curve which indicates the critical nature of the schedule.

Figure A - 3 in Appendix A indicates 44 Anchor Milestones forecast to be later than the revised MOHS late date. Although this is less than 53 reported in Period 2, many have been reset and moved back. The accumulation of late completion of works and associated documentation has brought pressure on testing and commissioning, which in turn brings risk to approval processes. Details regarding late running activities are included in the remainder of Section 3.

The key issues which are bringing schedule risk to Stage 3 Opening are listed below and expanded later in this Section:

- Potential for Bond Street Station to be opened late, see Section 3.5;
- Additional works require at Canary Wharf Station, see Section 3.5;
- Stepney Green Shaft cannot be sufficiently advanced to support Combined Trials, see Section 3.5;
- Stage Completion dates agreed with the IMs cannot be achieved, see Section 3.5;
- Difficulties accelerating production of Installation Release Notes (IRN), see Section 3.5;
- Continued delays to the installation and testing of permanent tunnel ventilation systems, see Section 3.7;
- Further delays to HV Non Traction Power energisation at Stations, see Section 3.7;
- Delays to works and documentation causing delayed completion of Phase 3 Integration Testing, see Section 3.7;
- Critical tunnel equipment cannot be installed before Combined Trials, see Section 3.7;
- Late delivery of [REDACTED] software, see Section 3.7;
- Issues with GSM-R installation, see Section 3.7;
- Ongoing concerns regarding [REDACTED], see Section 3.7;
- Insufficient dynamic testing windows for testing and re-tests, see Section 3.8;
- Uncertainty regarding possessions for signalling transition testing on GEML and GWML, see Section 3.8;
- Overload of submissions to RAB(C), see Section 3.9;
- Late agreement of Engineering Safety Justifications (ESJ), see Section 3.9;
- Regulatory Approvals cannot be achieved in time, see Section 3.9;
- Testing and bug fixing of BT trains, see Section 3.10;
- Delays in the production of Handover deliverables and training affecting IM readiness, see Section 3.11;
- Risk that RfL/LUL/MTR-C have insufficient time to complete Trial Operations, see Section 3.12.

CRL is carrying out deep dive reviews on key aspects of the schedule (including QSRA's where required) for completion of Stage 3 Opening, following request by Sponsors at Sponsor Board on 25 June 2018 to provide further clarity on its confidence, as well as options for alternative opening strategies should they be required.

3.3 Operational Readiness Assessment

Elizabeth Line Dashboard

There are twenty Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)⁶, five more than in the previous period. The new entrants are:

- RCC training facilities, in particularly the signalling simulator, not having sufficient functionality;
- COS Handover to IMs in doubt due to delays in infrastructure;
- Incident Response Managers location at Paddington not complete;
- RfL-I interface principles with NR at the portals has not been agreed;
- RfL-I not satisfied with status of Initial Spares for the COS.

Overall, the twenty Readiness Tasks can be attributed to three categories and are the same issues as last period:

- [REDACTED]
- [REDACTED]
- [REDACTED]

3.4 Tunnels

CRL’s forecast date for completion of all certification activities, for the remaining (C510) tunnelling contract, has slipped to 16 July 2018, against an original target date in mid-February 2018. This is a further two weeks later than reported in our last report. [REDACTED]

[REDACTED]

[REDACTED] Backfilling of Access Shaft AS1, above the central concourse tunnel at Finsbury Circus (Liverpool Street), by the station contractor (C502) remains forecast for completion by 24 September 2018.

3.5 Stations, Shafts and Portals

Continued delays are impacting upon the stations’ completion of fit-out, subsequent testing & commissioning and the forecast IM Handover dates. The progress delays are evident from the reported percentage progress, missed progress milestones and delayed IRN completion reported across the station contracts. CRL has re-sequenced a number of activities before Stage 3 opening, to allow for more opportunities for construction and testing, to complete critical works.

The actual percentage progress, reported by CRL for Period 3 (2018/19), still shows a shortfall in progress against plan at all stations, increasing the risk to achieving the station opening dates. [REDACTED] and [REDACTED] stations have held

⁶ Meeting held 29 June 2018.

their percentage progress shortfalls, without further deterioration in the period. ██████████ has achieved a slight recovery; but ██████████ and ██████████ show an increasing deficit in percentage completion against plan. Refer to Appendix B, Figure B - 1, for a summary of the Period 3 percentage completions against the re-baselined MOHS 2018 plan.

Lower than planned levels of production at the stations are reflected in the number of milestones missed during Period 3; adding to schedule pressures as the stations progress towards their target dates for IM handover and completion. Only 15 of the planned 38 station milestones were achieved in the period. CRL maintains that many of the missed milestones do not directly impact on the MOHS critical path; but they still represent an increasing bow wave of physical work and documentary evidence that still has to be completed, prior to Testing & Commissioning, dynamic testing and eventual IM handover.

The increasing gap between planned and achieved milestones must be addressed by CRL, or the baseline revised, if the forecast MOHS dates are to be achieved. With less than six months to opening, it is unlikely that there is any further room to recover or mitigate the gap through a further re-baselining. Equally, the identification of new/alternative milestones will not necessarily help recover production to the required levels for a timely completion.

A summary of the Central Section station completion dates can be seen in Appendix B, Figure B - 2. This table reflects the forecast key dates and milestones, for each station at Period 3, against the MOHS 2018 target dates. There have been further delays reported in Period 3 on forecast dates for completion of fit-out at ██████████ and ██████████ stations; and for IM handover at ██████████ and ██████████. Forecast station completion dates, with the exception of ██████████, have been held in the period. Changes to the forecast dates are shown in Bold text on the table.

We note that the definition of IM Handover is being “softened” from the original objective to deliver a completed asset package, to a more phased asset transfer. This corresponds with similar discussions held, between CRL and the IMs, to assess what may be physically achievable and/or acceptable to the IMs as an absolute minimum, for station opening. There remains a strong risk that the IMs may not accept handover if the assets and the necessary certifications are not complete.

The general progress of the station works, towards Testing and Commissioning (T&C), can be measured by the various Tier 1 contractors’ production of Installation Release Notices (IRNs). The completion and submission of IRNs still remains significantly behind the rate required to support MOHS. CRL has completed 43% against a planned 74% of the 3,930 IRNs for all stations, portals and shafts⁷ in Period 3. Delayed completion of physical works is still delaying delivery of the IRNs. This adds further risk to the completion of integration testing in time for handover to the IMs, and the achievement of the MOHS programme.

We are concerned that the bow wave of IRN certification has been getting steeper each period, due to slow progress of the physical work and subsequent submission of the necessary documentation. We believe that the number of IRNs forecast for delivery in the coming periods, and any rapid recovery of those already missed, is unachievable given the contractor’s delivery performance to date. This will have an impact on the station and Systemwide forecast milestone dates.

⁷ IRN data sourced from the MOHS Review meeting held on 6 July 2018.

Bond Street Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Tottenham Court Road Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Whitechapel Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Canary Wharf Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]

Woolwich Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Intermediate Shafts: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

⁸ Latest completion date is shown by the Contractor as March 2019.

- [REDACTED]
- [REDACTED]

3.6 ONW

During the development of designs for certain elements, based on Crossrail’s On Network Functional Requirements (ONFR), CRL has identified alternative delivery routes that may provide more efficient use of funding, increase certainty of delivery, ensure stakeholder satisfaction and achieve a greater overall benefit. CRL is proposing to de-scope by Variation (under the Protocol) the following items from NR, and transfer the scope (including requirements) for delivery and completion by a separate organisation.

- MTR undertake the Staff Accommodation Facilities at Shenfield & Gidea Park and at Maidenhead;
- Station way-finding signage and branding and Romford Station lift to Platform 1 are carried out by TfL;
- Miscellaneous stations systems are jointly undertaken by MTR-C and TfL where appropriate;
- The local authority (London Borough of Bexley) to carry out the site restoration around Abbey Wood station;
- To confirm and change the ONFR that Ealing Platform 4 (the busiest platform on the west) as the only platform to have improvements for stepping distances on the Western section.

At Abbey Wood, CRL issued a variation to NR in Period 3 to move Key Output 2 from 30 June 2018 to 31 July 2018 to allow NR to implement CRL’s request to move the stop car position on Platform 4 and avoid NR undertaking redundant system testing on the DOO CCTV. NR is reporting that progressive handover is on schedule and the Crossrail platforms are on target for substantial completion.

3.7 Completion and Handover of Integrated Systems⁹

Blockade Working remains CRL’s core completion philosophy, built around a basic two-week working pattern split between 11 days of construction in “blockades” and 3 days of dynamic testing in “windows”. The original balance between “blockades” and “windows” was broadly devised to accommodate remaining installation work and the availability of dynamic test cases. However, poorer than expected dynamic testing progress, a large outstanding test workload and the significant benefits of completing installation prior to Combined Trials (thus avoiding the constraining effects of working under the RfL ROGS railway rule book), has caused CRL to target construction completion as a priority.

⁹ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

In practice, prioritisation of [REDACTED] construction has had little impact so far upon the timing of the remaining testing windows. However, there is an urgent need for [REDACTED] Signalling installation to be ready to support Zones 3 & 4 train testing during Dynamic Test Window No. 7, and a period of 11 days has been exclusively set aside for [REDACTED] for completion of track and trackside equipment installation. Given past performance, there are concerns with [REDACTED]' ability to make full use of this opportunity and CRL has initiated detailed planning sessions to ensure readiness.

Current key dates in the dynamic testing phase through to Combined Trials are shown in Figure 3 - 1 in Section 3.2. Current dates for dynamic testing windows are set out in Section 3.8.1.

Critical areas for rail systems completion are largely unchanged. CRL remains extremely concerned at the readiness of some Stations, Shafts and Portal (SSP) sites to start Phase 3 testing, and at the completion of a substantial integration testing workload using the C660 data management infrastructure. [REDACTED] continues to keep ahead of SSP testing priorities using intermediate drops of software, a consequence of close working between CRL project management teams. However, ongoing schedule drift is complicating what had already become an unsupportable demand for additional resources, as the bow-wave of remaining tests grows. RfL and LU are struggling to provide temporary support from their own projects, and while [REDACTED] has had some recruitment success, the late stages of Crossrail Programme delivery are proving unattractive to candidates looking for longer-term employment.

[REDACTED] continues to deliver the "daisy-chain" sequence of HV sub-station energisations necessary for the final non-traction power supply system. Some slippage into early August 2018 is forecast for [REDACTED] and [REDACTED]. Works at some SSP sites have been unable to keep pace with permanent HV power availability, and the original target of completion of LV distribution within a week of energisation is not being met. Downstream availability of LV power is necessary for [REDACTED] completion and commissioning of railway support systems such as tunnel lighting; CRL is working closely with contractors in an attempt to recover this situation. These late completions place further strain on the schedule for completion of Phase 3 testing back to the RCC using [REDACTED] SCADA.

[REDACTED] installation of GSM-R cables has made reasonable progress in the period, although some discrete locations in Zones 3 & 4 are not yet complete. Installation completion by [REDACTED]0 is currently at 93% of 145 cables, but still with no IRNs yet issued; [REDACTED] has continued cable termination work at risk in order to mitigate delays, with 34% complete of a total of 166¹⁰. Completion of GSM-R is necessary for the start of Combined Trials.

The completion of the [REDACTED] permanent ventilation system remains the most significant and difficult challenge to resolve. The current forecast completion date for Phase 3 testing has moved out to 2 November 2018, driven by further delays at [REDACTED]. Reviews have shown that testing of ventilation system functionality is possible without the need for running the fans up to full power. This approach would reduce the testing workload requiring permanent power, and provide some schedule relief to the final delivery of HV power systems.

Other mechanical rail systems interfaces between [REDACTED] and SSPs have been subject to detailed review in order to align schedules for completion, connection and integration testing. There is now much better co-ordination of activities to meet common interface deadlines for activities which have a railway-wide impact, such as testing for fire main and pumped drainage water flows; however, schedule difficulties remain.

¹⁰ CRL C660 Communications & Control Period 3 PDB held on 3 July 2018.

A detailed schedule analysis, supported by “deep dives” on selected contracts is being carried out by CRL. This analysis is intended to confirm what is able to be delivered in the time available, and by extension, the nature of the railway that could be opened to passenger service on 9 December 2018. It is possible that adjustments to dates for dynamic testing windows and key MOHS milestones will result, and we expect to report further next period.

3.8 Dynamic Testing

3.8.1 Dynamic Testing Strategy

The current programme and latest dates¹¹ for the dynamic testing windows are as follows:

1. 27 – 29 April 2018 (Zones 1 & 2) (COMPLETED);
2. 10 – 13 May 2018 (Zones 1 & 2) (COMPLETED);
3. 25 May 2018 (Zones 1 & 2) (COMPLETED);
- 4a&b. 7 – 12 June 2018 (Zones 3 & 4) (COMPLETED);
- 4x. 21 - 23 June 2018 (Zones 3 & 4) (COMPLETED);
5. 29 June – 4 July 2018 (All Zones) (COMPLETED);
6. 8 – 10 July 2018 (All Zones) (COMPLETED);
7. 27 – 31 July 2018 (All Zones);
8. 10 – 14 August 2018 (All Zones);
9. 24 – 28 August 2018 (All Zones);
10. 7 – 11 September 2018 (All Zones);
11. 21 – 25 September 2018 (All Zones).

There has been some movement of dates in the period in order to align Crossrail testing conditions with those at the NR interfaces. For example, to ensure that the need for the Central Section to be energised for dynamic testing does not conflict with booked NR isolations. Signalling transition testing at the NR GEML and GWML interfaces is scheduled to align with the testing windows as follows:

- GE (weeks 20 & 22; 11 & 25 August) – Dynamic Test Windows 8 and 9;
- GW (weeks 24 & 25; 9 & 16 September) – Dynamic Test Window 10 and 11.

The interface possession arrangements have yet to be formally confirmed by NR, but progress towards agreement has been made by CRL in the period. Train movements from the NR network (and particularly from the GWML) are critical to the performance of Stage 3 services and the transitions must be made operational in time to demonstrate correct operation during Pre-Trial Running.

The emerging prioritisation of construction over dynamic testing (see Section 3.7) acknowledges the slower than anticipated completion of test cases and the large number of tests still to be carried out. Incomplete off-site testing and poor software maturity do not constrain dynamic testing on the Central Section in the same way as before. Earliest completion of dynamic testing is now driven by the practicalities of executing the increasing number of test cases becoming available in the remaining testing windows.

The most significant step-change in productivity will be realised through multiple-train testing under signalling protection, currently scheduled to start during Dynamic Testing Window No. 7.

¹¹ CRL MOHS Period 3 Review held 6 July 2018.

The Safety Case for this mode of testing in Zone 1 was not approved by RAB(C)¹² and must be revised. This may delay the testing programme planned for Test Window 7. Once BT begins testing it will be limited to four trains under the current C610 Construction and Commissioning Railway Rule Book. CRL is working with C610 to obtain an ORR exemption for up to eight trains to operate, allowing the scope of dynamic testing prior to Combined Trials to be extended. This is sensible approach to maximising testing opportunity, but approval is by no means a foregone conclusion.

CRL continues to review with Siemens the scope of signalling tests to be completed on the Central Section. Among the several remaining critical workstreams (highlighted elsewhere in this report), signalling integration has the most significant schedule influence upon the outcome of the Crossrail Programme. It is understood that while some reductions in the overall time required have been identified, the workload still significantly exceeds what is provided in the remaining dynamic testing windows. [REDACTED]

[REDACTED]

3.8.2 Dynamic Testing Progress

Six dynamic testing windows have now been completed. Zone 1 is the most advanced in terms of tests completed and complexity of testing able to be carried out. This is line with the original strategy for delivery, with the south east leg being deliberately made available earlier, specifically to allow a “head start” to be made with train testing. It is possible that this strategy might inadvertently provide CRL with an opportunity for a restricted-route sub-optimal Stage 3 Opening, should that ultimately be seen as a benefit to the Crossrail Programme.

Train testing into Zones 3 & 4 is in its early stages, currently confined to track database correlation and platform / train interface clearance checks.

Dynamic testing across all Zones remains restricted to single-train running, pending approval by RAB(C) of the Safety Argument for Multiple Train Testing (see Section 3.9.3).

While testing progress can simplistically be estimated by numbers of tests completed, in practice there is a range of outcomes associated with the execution of individual test cases. Current experience is that outright failure is relatively rare, but that the numbers of tests which “pass” first time is approximately the same as those requiring follow-up work in the form of analysis and possible re-testing. This outcome profile will change as bugs are corrected in software and more tests are carried out.

¹² RAB-C meeting – 18 July 2018.

3.9 Approvals, Assurance and Agreements

3.9.1 Final Design Overview (FDO) Performance

CRL's target for close-out of FDO "Red" issues and the forecast dates for FDO certification continue to slip. An FDO certificate is a prerequisite for Interim Acceptance and Handover of the new assets to the IMs. The number of remaining Red (75) and Amber (168) conditions have reduced in the period, but not at a sufficient or consistent rate. CRL is now targeting the close-out of all outstanding "Red" issues by the end of August 2018. This will further delay Phase 2 testing.

3.9.2 Interoperability

CRL has requested a significant change in respect of the submission of the Technical File and structure of the Safety Assessment Report (SAR). Ricardo Rail (RR) has amended the AsBo's SAR structure to enable sectional submission to the ORR. Submission of the final complete Technical File is planned for 9 November 2018. The proposed new programme and target dates are, as follows:

Target Dates:

- 11 July 2018. Explain the revised structure to ORR;
- 30 July 2018. Submission of draft sections 1, 2 and 3;
- 17 September 2018. A full submission of the Energy and Infrastructure sections of the report. This will require sections 1, 2, 3, 4 and 5. Section 3 may still be incomplete as the full integration argument will still be evolving, and conclusions will be interim;
- October 2018. Submission of sections 6,7,8;
- 9 November 2018. The final submission of the Technical File, Safety Assessment Report and the Declaration of Control of Risk to the ORR.

Dates for test completion:

- 16 September 2018. Final test for signalling is GWML transition.

RR/CRL workshops have helped to develop a schedule of required activities, up to achieving final submission. Strong efforts will be required if CRL is to meet the dates committed to at these workshops. A re-baselining will be required to reflect revised ORR sectional submission dates. Bond Street station's T&C information presents a particular challenge, as it is not expected to become available until mid-November 2018.

3.9.3 RAB(C)

RAB(C) continues to review formal submissions in line with CRL and RfL requirements. However, CRL continues to miss forecasts for submissions, and completion of the process to support Stage 3 Opening remains challenging. This is evidenced by CRL plans for multiple train dynamic testing, see section 3.8.1.

These have slipped from Window No. 6 to Window No. 7, scheduled to start on 27 July 2018. This provides more time for BT's Class 345 braking performance evidence to be finalised and approved by its AsBo, for incorporation into the relevant safety case. Further information is provided in Section 3.10.

The key Engineering Safety Management submissions for the Stage 3 Safety Case are shown in Figure 3 - 2. The deadline for submission of all contractor ESJs to CRL of 13 July 2018 has been missed and a revised date has yet to be confirmed.

No	Key Dates	MOHS 2018	Period 2 actual / forecast	Period 3 actual / forecast	
1	Contractors submit draft ESJs to CRL	31-Mar-18	30-Jun-18	13-Jul-18	*
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	30-Jul-18	deleted	
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	10-May-18	deleted	
4	Contractors submit final ESJs to CRL	30-May-18	30-Jul-18	30-Jul-18	
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	30-Jul-18	30-Jul-18	
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Jun-18	30-Aug-18	*
7	Final COS Safety Case updated and submitted to RAB-C	20-Sep-18	31-Aug-18	20-Sep-18	*
8	Submit Technical File to ORR	09-Nov-18	17-Sep-18	09-Nov-18	*
	* In-period delay				
	Note - Key Dates 2 and 3 have been deleted				
	Note - Key Dates 7 and 8 Baseline dates have been adjusted				

Figure 3 - 2 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

As of 29 June 2018:

- Key Date 1 - Contractors submit draft ESJs to CRL – 33 of 56 had been submitted;
- Key date 4 - Contractors submit Final ESJs to CRL – 1 of 56 was accepted at code 1;
- Key Date 5 - CRL submit Safety Justifications to RAB-C – 0 of 23.

3.9.4 Regulatory Approvals

CRL has now judged the overall rating of Stage 3 with regard to Approvals as ‘red’. This is a position that we thought existed from Period 11, 2017/18. There are two areas that cause concern.

The first is whether safety assurance evidence, in the design and T&C phases can be produced in time for submission to the ORR. The progress of RAB-C submissions is an illustration of this. So far there have been 89 of a required 137 submissions to RAB-C. This means RAB-C will need to receive and accept 51 submissions before service opening, an average of 10 a month. This has increased from 9 submissions in Period 2. The average over the last 6 months has been 5 accepted submissions.

The other area of concern is Interoperability compliance. Demonstrating design compliance¹³ is nearly complete, but no evidence has been produced that shows the design has been implemented.

These issues will affect the quality of the Technical File (see Section 3.9.2) and the final sign-off of the safety approval bodies.

3.9.5 Agreements

There are six agreements that are adjudged to be amber. These were the same as last Period, and are:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- IM Interface manual between NR and RfL-I;
- Development Service Agreement between NR and RfL-I;
- Framework Project Services Agreement¹⁴ between NR and RfL-I;
- Connection Agreements at Abbey Wood, Pudding Mill Lane and Westbourne Park between NR and RfL-I.

¹³ There are 155 TSI requirements applicable to the Elizabeth Line.

¹⁴ Previously known as the Co-operation Agreement.

[REDACTED]

More positively CRL is reporting that the body of the Crossrail Umbrella Agreement is now agreed, and attachments are close to being finalised. RfL is reporting that 5 August 2018 is the deadline for its signing.

There are 38 Critical Agreements to be put in place to enable Handover and operations, the majority of which fall to RfL-I and LU. The charts in Appendix C indicate the slow progress in delivering these agreements.

3.10 Rolling Stock and Depot

Rolling Stock

In our last report, we said that TCMS v7.2 was scheduled to be authorised for Trial Running by 2 July 2018. This was not achieved, and TCMS v7.1.2.3 will be used for multi-train testing. This version is adequate for this activity, but it is disappointing that v7.2 was not ready so that it has a longer period for testing. The passenger service version of TCMS v7.2 is now forecast to be ready by the end of August 2018, a delay of approximately 4 weeks from last period. Further delays cannot be discounted.

A key issue is establishing reliability. The trains need to do as many miles as feasible to establish that they can operate reliably in service, but time and access is limited. [REDACTED]

[REDACTED]

OOC

The depot is progressing well; however, we are mindful of two activities that have the ability to affect operations.

- Signalling of Sections B&C is planned to proceed on 20 July, with any residual works planned for 25 August 2018. Good progress is currently being made. There is a manual mitigation if this is not successful, but obviously not favoured.
- The Back Line requires its third and final switch to be installed, and this would ideally be in place for Combined Trials, and certainly for passenger operations. The works are scheduled for completion by the beginning of August, so there should be little cause for concern. Nevertheless, we will continue to monitor the situation.

3.11 Handover

We feel that this period has shown some positive developments in training and Asset information, but there remain issues which are not progressing at the required rate to support the IMs ability to carry out Combined Trials.

Training

There has been an overall improvement in the training area in this Period. LU training and MTR-C station training has now started and both IMs appear satisfied with the progress being made. There has also been some progress with RfL-I technical training, in particular [REDACTED] (non-traction HV power) and [REDACTED] (signalling).

There are, however, key issues where the level of improvement must be increased in order to contribute to a successful Handover. As described in our last report these are the pace and quality of [REDACTED] training and the lack of functionality/reliability of control room simulators.

O&M Manuals

[REDACTED]

Asset Information

The progress that we reported in our last report has continued into Period 3, albeit not uniformly. [REDACTED], and [REDACTED] have now produced enough information to meet the threshold for IM readiness (with respect to Asset Information). [REDACTED] and [REDACTED] are imminent.

There remain difficulties with reaching the same condition for the [REDACTED] contracts. These must be resolved so that the impact upon Handover is minimised. [REDACTED]

[REDACTED]

Drop	Content	% received ¹⁵
1	Number of assets	92
2	Location	59
3	Equipment	46
4	Attributes	44
5	All drops for review	25
6	Accepted	0

Figure 3 - 3 ~ Content / Percentage

Handover Master Deliverable List

In our opinion, there will be a significant number of documents outstanding after Handover. CRL and the IMs will need to agree, and CRL then deliver those documents that are deemed critical for Handover and Passenger Service. The concern is that the majority of those type of documents are from the [REDACTED]

[REDACTED]

3.12 Combined Trials

[REDACTED]

The focus of the activities will naturally prioritise safety exercises, and opportunities for general familiarisation will be restricted.

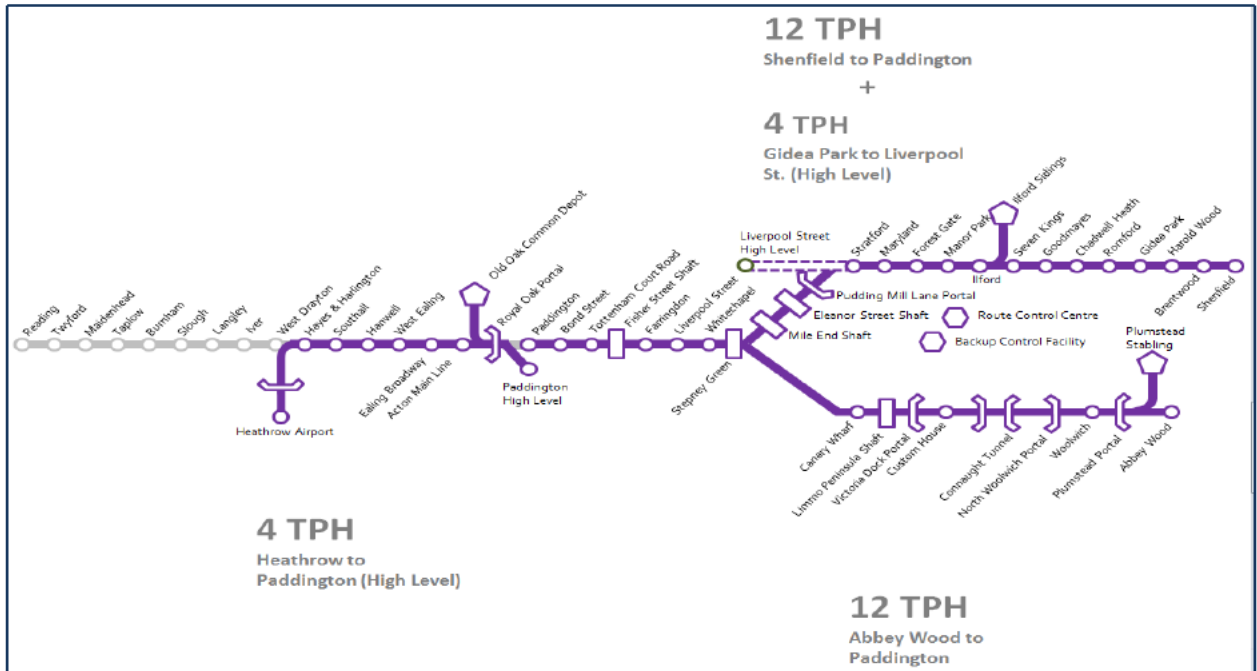
¹⁵ Figures taken from CRL Period 3 Board report – Operations Performance, page 30.

Operations staff from both RfL-I and MTR-C are on course to be ready for the start of Combined Trails. Maintenance staff, primarily from RfL-I, will need to progress the issues described in Section 3.11 to ensure they are ready.

3.13 Plumstead Depot

Maintenance Building steelwork erection was completed and the roof slab was poured. The Kalzip roof to the Accommodation Building was completed. Land handover from [REDACTED] remains a schedule risk which is being mitigated through close management attention.

4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.



4.1 Summary

Our principal concern for Stage 4 is the power upgrade works to be carried out by NR.

4.2 Operational Readiness Assessment

There are two Readiness Tasks that have been given a “Red” status by the ORSG¹⁶, the same as our last report.

Readiness Task	Issue
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	NR has confirmed that the full scope will not be complete by May 2019. Capacity modelling is being undertaken to confirm implications for timetable. MTR-C must submit a timetable in August based upon findings.
DOO CCTV installed and operational Stratford and Shenfield stations	Confirmation that cameras will be installed at Stratford platforms 5 & 8. Key risks in areas of design, access and CMS.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

¹⁶ 18 June 2018.

4.3 Ilford Station

NR reports that the GRIP5 design for Ilford & Romford Stations being carried out by Atkins is progressing to schedule. The ECI Contract was due to be let in June 2018 using an existing framework but has been deferred to Mid-July 2018 with the main works Contract award forecast for October 2018. The GRIP6 delivery procurement for Ilford Station remains on schedule and NR remains committed to station opening for December 2019. The key dates we shall continue to monitor to assure that progress remains on schedule are:

- GRIP 5 complete – August 2018;
- GRIP 6 tender return – August 2018;
- GRIP 6 Contract award – October 2018.

4.4 ONW

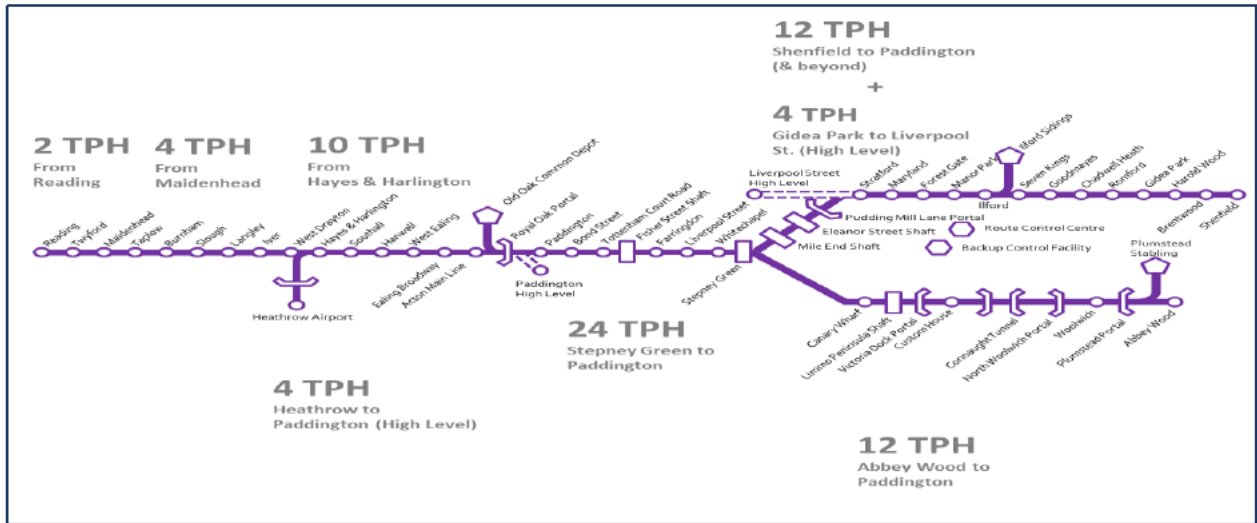
Stage 4; KO5A – (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) (10 September 2018).

NR has reported that the remaining telecoms immunisation works that were impacted by the concentrator programme, the auto transformer (ATF) and bonding scope have been removed from [REDACTED] will be procured under a separate Contract. These workscopes will be moved from KD22 and KO5A to the new KO6A. CRL has approved KO6A for 1 May 2019 at the C&CSC on 10 July 2018. As a consequence of [REDACTED] the remainder of the station refurbishments and lift installation may be extended. NR has [REDACTED] NR is currently forecasting the Traction Power upgrade to AT mode at risk of slipping beyond the planned date of May 2019. Consequently, NR is undertaking further traction power modelling to validate options to complete the infrastructure in stages.

Key Date 22 (Route clearance & all other infrastructure, including stabling & sidings updates, complete to support Stage 4 Dynamic Testing) (31 August 2018); NR reports that all platforms have been lengthened, lifts installed, station SISS installed and NR communications reconfigured to Romford RCC, save for the following exceptions to be delivered after Key Date 22:

- DOO CCTV at Stratford & Shenfield stations are ongoing but to delayed timescales. The CCTV at Shenfield and Gidea Park sidings has been impacted by the lack of a maintenance agreement for these assets between NR's Anglia Route and MTR-C.
- NR has identified funding and has agreed proposals to progress the works at Goodmayes station for Platform 1 lift;
- Delays to finishing works at Manor Park and Maryland that are sequenced for commissioning post ONSIP completion.

5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.



5.1 Summary

Our principal concern relates to ETCS and whether ORR will extend its derogation. In addition, although NR is working to mitigate problems, we are concerned about the risk that West Enhanced stations may not be delivered on time.

5.2 Operational Readiness Assessment

There are four Stage 5 Readiness Tasks that have been reported as a “Red” status to the PDB on 3 July 2018, a decrease of one.

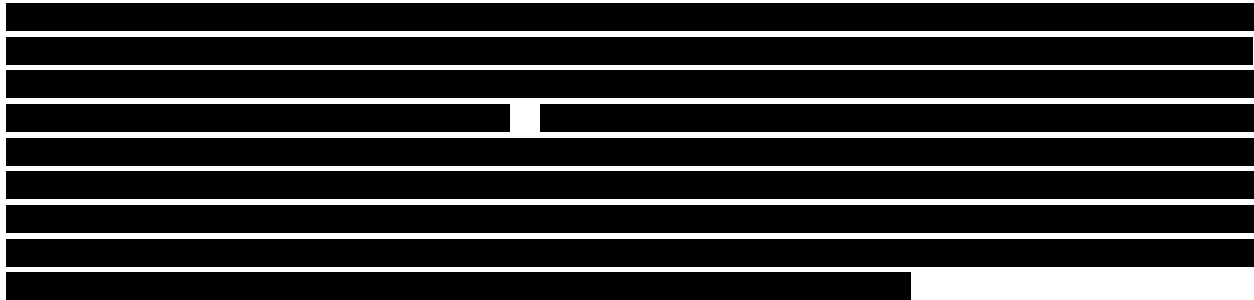
	Readiness Task	Issue
	ETCS available and tested Airport Jn to Paddington	ETCS will not be available, necessitating the implementation of the technical solution that enables CBTC to TPWS transition. See Section 5.3.2.
	ONFR Western station upgrades complete	[REDACTED]
	Maidenhead Sidings staff accommodation	MTR-C will now lead the procurement.
	ORR issue APIS for ETCS (Stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task. The issue is whether ORR would extend the derogation (which would remove the ‘red’ status) if NR provide sufficient justification. See Section 5.3.2.
	DOO CCTV GWML outer stations	Slow procurement, and installation will also require platform extensions to be built. (linked to station upgrades). See Section 5.3.1.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with "Red" Status

5.3 Network Rail Works

5.3.1 Platforms and Stations



The critical path activities are:

- Works at Christmas 2018;
- Securing weekend possessions from December 2018 to May 2019 – Great Western’s access dispute has been upheld but NR is not seeking an appeal. Instead, NR is reporting that it is working collaboratively with Great Western to agree possessions on a case by case basis.

During Period 3, NR undertook a value engineering exercise on the West Enhanced station Packages to mitigate risk to these critical possession requirements. CRL is working closely with NR to ensure all options are considered to ensure that the major activity planned during Christmas possessions can be undertaken and the December 2019 delivery achieved. In the meantime, the enabling works packages continue and, to further mitigate potential schedule delay, NR is procuring long-lead and standard proprietary items which will be ‘free-issued’ to suppliers upon Contract award.

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):

NR has confirmed that the Safety Review Panel (SRP) support for Authorisation to Place into Service (APIS) was granted on 7 June 2018. NR has progressed the application with the ORR, with an expectation that this process will be completed by mid-July 2018, which is ahead of the scheduled APIS required date. NR reports that it has shared the necessary actions for putting the system in to use with industry partners. These actions require completion prior to operating a timetabled service with a reliance on ETCS, expected mid-October 2018.

Stages B & C (Stockley-Acton & Acton-Paddington):

NR has confirmed that the Exemption Status meeting was held with the ORR and industry partners on 12 June 2018 and reports that the ORR is supportive of a new “Exemption” request. NR is engaging with Sotera (who undertook the original risk analysis work stream) to work on this new scope of works.

NR is reviewing options for recovery of the programme, which is currently showing an unmitigated delay of approximately three months to the Stage C commissioning following delays in the integrated laboratory testing and infrastructure data provision.

A GSM-R Hazop workshop was held on 28 June 2018, with major stakeholders reviewing “de-sectorisation”. Consequently, the GSM-R Network Change can be progressed and finalised. The GSM-R GRIP 5-8 Contract has been awarded to Siemens.

5.4 ONW

Stage 5; KO5B

NR has instructed works at West Outer stations (DOO CCTV, platform extension works) to Amey and reports that further instructions for Slough and Maidenhead works are expected to be issued in Period 4. NR has confirmed that the works for upgrading the traction power to AT mode have been completed to Crossrail’s requirements but the full completion of the system upgrade (for IEP trains) is contingent on electrical bonding works at Paddington that are presently forecast for February 2019.

NR reports that the scope contained in the OOCPA/IEP, WITI and stations contracts has been transferred from Crossrail West to the new Paddington to Reading (P2R) delivery vehicle. The remaining Traction Power Supply (TPS), Enhanced Stations and West Outer Stations scope will be transferred from KO5B and KD24 to the new KO6b. CRL has approved KO6b for 1 December 2019 at the C&CSC on 10 July 2018.

NR is continuing to investigate options to mitigate delay on KO5B for the construction of the Traction Switching Station at Paddington which can only be achieved during the prospective Christmas 2018 possession. The outer area AT system has been available to commission from May 2018 and the inner area AT system available to commission from July 2018. NR is forecasting the conversion to AT power on the Western Route for December 2018. This later date is a consequence of separate NR 12kA power resilience works which requires either additional access prior to, or delivery at, Christmas 2018.

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI fell slightly during Period 3 but remained well above target, with all 11 Principal Contractors (PCs) again scoring over 2.20. The RIDDOR and Lost Time Case (LTC) AFR's remained as before with both measures remaining well within target, although CRL now aim to achieve rates of 0.06 and 0.15 respectively.

CRL has added a new metric this period to measure the rolling average rate of High Performance Near Misses (HPNM). This is currently 0.20, which is less than the rate of 0.24 at Period 3 2017/18. This is not especially useful, as the number of near misses is not as important as the fact they are being reported and the relevant lessons are learned.

H&S KPI	Target	Aim	Period 2	Period 3
HSPI	2.20	-	2.64	2.59
PCs scoring over 2.20	11	11	11	11
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.16	0.16
HPNM Rate	na	na	0.20	0.20

Figure 6 - 1 ~ Health and Safety Performance COS

There were 5 significant incidents during Period 3; a RIDDOR (fractured foot bone), a LTC (sprained wrist) and 3 HPNMs (falling bolt, damaged draw pit lid and incorrect water gasket).

Contract C530 (Balfour Beatty at Woolwich) has achieved 977 days and over 2.5m hours since its last LTC. This is to be commended.

CRL is currently in discussion with the IMs regarding access to work sites after Staged Completions are achieved, and The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) are implemented; currently targeted for 1 October 2018. LU and MTR-C (via RfL-I) are developing access rules for the stations and shafts based on LU procedures used elsewhere on the tube system, and RfL-I is developing rules for access to the track based on NR procedures¹⁷. CRL expect that these rules will not be as much of an administrative burden as elsewhere on 'live' NR and LU sites, however they are likely to involve more restrictions than the current CRL rules.

6.2 Health & Safety Performance ONW (NR)

During Period 3, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) increased minimally from 0.1434 to 0.1467. NR had no lost time incidents in Period 3, but suffered one minor injury and one near miss in respect of OHLE construction earth bonds. The Programme's overall All Injury Rate decreased marginally from 0.73 to 0.72 injuries per 100,000 hours worked.

¹⁷ Confirmed by H&S Director at meeting on 9 July 2018.

Appendices

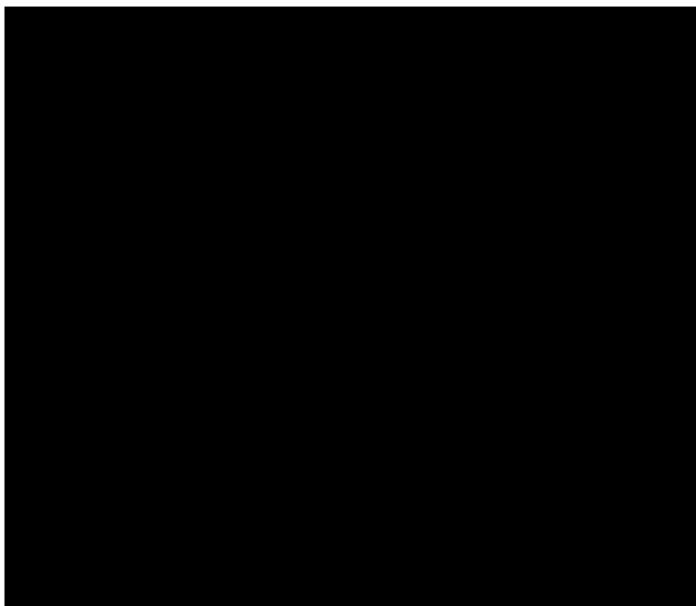
Appendix A Schedule & Performance

Figure A - 1 indicates¹⁸ the CRL Corporate Milestones (shown as Period 1 Baseline) alongside the relevant dates from MOHS 2018, the Period 2 forecasts and the latest Period 3 forecasts. Milestone 4 is currently forecast for September 2018, although this is to be confirmed. Milestones 10, 12 and 13 have been adjusted due to the new Combined Trials strategy.

Corp Mstone	Description	Period 1 Baseline	MOHS 2018 EDBL	Period 2 Forecast	Period 3 Forecast
1	All 11KV SS&P Non-Traction Power Locations Energised	April	15-Apr-18	02-Jun-18	11-Jul-18 *
2	CBTC Auto Reverse and Isolated ETCS Testing Complete at Melton	April	06-Apr-18	27-Apr-18	27-Apr-18
3	Stage 2 Phase 1 Service Introduction PAD to Heathrow	May	20-May-18	20-May-18	20-May-18
4	West Enhanced Stations contract award	June	08-Apr-18	TBA	SEPT ? *
5	Start Dynamic Testing in Zones 3 & 4	June	11-Jun-18	11-Jun-18	11-Jun-18
6	CBTC Authorised for FLU for Trial Running	June	22-Jun-18	02-Jul-18	04-Jul-18 *
7	ESS - ECHR Complete for Handover to Infrastructure Manager	July	03-Jul-18	07-Aug-18	31-Aug-18 *
8	Commence Pre-Trial Running	Aug	05-Aug-18	10-Sep-18	SEPT
9	22no. CI.345 FLUs Available for Trial Running	Aug	13-Aug-18	10-Aug-18	13-Aug-18 *
10	CRL central section Safety Case updated and submitted to RABC	Sept	20-Sep-18	31-Aug-18	20-Sep-18 *
11	PAD - ECHR Complete for Handover to Infrastructure Managers	Sept	07-Sep-18	15-Oct-18	15-Oct-18
12	Submit APIS for Central Section to ORR	Sept	17-Sep-18	17-Sep-18	09-Nov-18 *
13	Commence Combined EL Trials and HO under ROGS	Sept	01-Oct-18	01-Oct-18	01-Oct-18
14	Class 345 CBTC Signalling auth for Passenger Service by ORR	Oct	10-Oct-18	02-Aug-18	OCT *
15	LIS - ECHR Complete for Handover to Ms	Nov	24-Oct-18	24-Oct-18	24-Oct-18
16	Opening of Stage 3 - Central Section PAD to ABW	Dec	09-Dec-18	09-Dec-18	09-Dec-18
17	Plumstead - First Stage Maintenance Sidings and connection to COS	Dec	21-Nov-18	21-Nov-18	21-Nov-18
18	Plumstead Stabling Sidings - ECHR Complete for Handover to Ms	Feb	29-Mar-19	29-Mar-19	29-Mar-19
	Forecast later than Period 1 Baseline				
	Forecast earlier than Period 1 Baseline				
	* In period movement				
	ECHR = Element Completion Handover Report				
	Milestones 10, 12, and 13 have been adjusted due to new Combined Trials strategy				

Figure A - 1 ~ Corporate Milestones

A - 2 indicates the status of Anchor Milestones cumulative progress at Period 3.



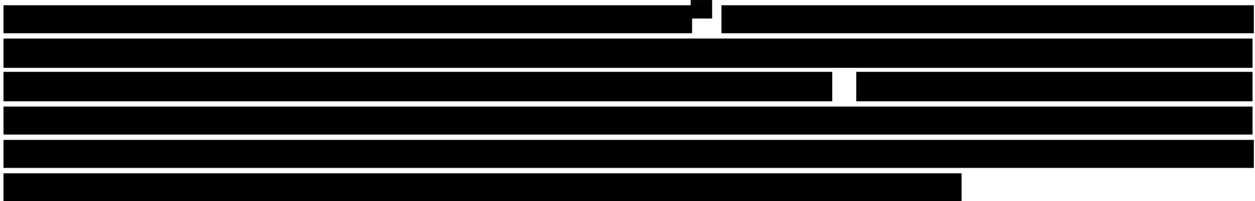
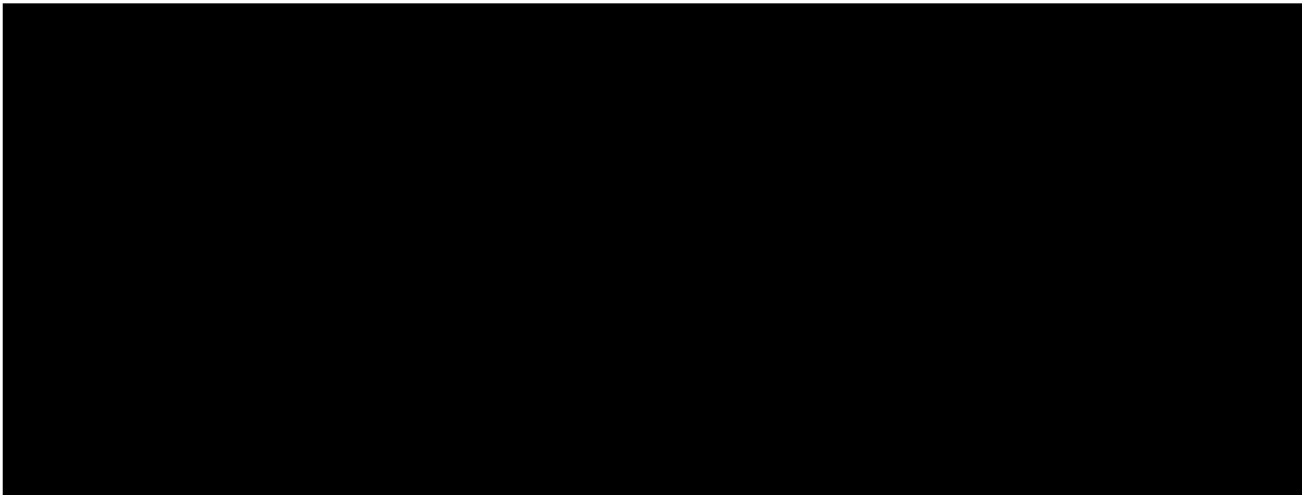
¹⁸ SS&P = Stations Shafts and Portals, FLU = Full Length Unit, ESS = Eleanor Street Shaft, ECHR = Element Completion Handover Report, ABW = Abbey Wood.

ID	Anchor Milestone	MOHS Baseline	MOHS Baseline	Actual / Forecast Period 2	Actual / Forecast Period 3	Period delay in days	MOHS (rev) delay in days
A698	Sys - A698 Start PSD Platform Train Interface Test (DT) in Zone 1	10-Apr-18	10-Apr-18	09-Jun-18	10-Jun-18	1	61
A711	C631-A711 PSD Ready for Dynamic Testing in Zone 1	31-Mar-18	09-Apr-18	05-Jun-18	16-Jun-18	11	68
A620	C696 - A620 Construction Works Commence	02-Jul-18	02-Jul-18	03-Jul-18	03-Jul-18	0	1
A710	C650 -A710 All 11 kV S,S&P locations energized	15-Apr-18	15-Apr-18	02-Jun-18	11-Jul-18	39	87
A744	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18	30-Jun-18	13-Jul-18	13	104
A660	SS&P Provision of DOO and Platform Finishes for Dynamic Testing in Zones 1, 2, 3, 4	15-May-18	10-Jun-18	06-Jun-18	15-Jul-18	39	35
A276	C412-BOS-A276 ETH PDA Milestone 11 Site available to commence Bond Street Station Eastern Ticket Hall OSD	11-Jun-18	12-Jul-18	28-Aug-18	19-Jul-18	-40	7
A682	SS&P Provision of GSMR Interface for Dynamic Testing in Zones 1, 2, 3, 4	29-Mar-18	10-Jun-18	06-Jun-18	24-Jul-18	48	44
A709	C650-A709 All 22 kV S,S&P locations energized	30-Jun-18	30-Jun-18	29-Jul-18	29-Jul-18	0	29
A747	Tier 1s Submit Final ESJs to CRL	30-May-18	30-May-18	30-Jul-18	30-Jul-18	0	61
A748	CRL Submit SJs to RABC	07-Jun-18	07-Jun-18	30-Jul-18	30-Jul-18	0	53
A743	Training material submitted in readiness for training delivery	05-May-18	05-May-18	30-Jun-18	31-Jul-18	31	87
A742	Training completed for MTR in support of Handover	30-Jun-18	30-Jun-18	30-Jun-18	31-Jul-18	31	31
A684	SS&P Fire Mains Ready for Integration Zones 3&4	05-Jul-18	15-Jul-18	01-Aug-18	01-Aug-18	0	17
A685	C435-FAR-A685 Completion of All Phase 3 Testing Enabling Removal of Hoarding	22-Jul-18	22-Jul-18	23-Jul-18	01-Aug-18	9	10
A636	C350 - PML - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed	12-May-18	05-Jul-18	11-Jul-18	15-Aug-18	35	41
A664	C422-TCR-A664 Completion of All Phase 3 Testing Enabling Removal of Hoarding	05-Jul-18	12-Jul-18	17-Aug-18	17-Aug-18	0	36
A749	COS safety Case submitted to RABC (to facilitate Handover)	30-Jun-18	30-Jun-18	30-Jun-18	30-Aug-18	61	61
A737	C360 - MEP - Ready for Handover to Infrastructure Manager (IM)	29-Jun-18	03-Aug-18	27-Jul-18	31-Aug-18	35	28
A640	C360 - LIM - Ready for Handover to Infrastructure Manager (IM)	29-Jun-18	03-Aug-18	25-Jul-18	31-Aug-18	37	28
A736	C360 - ESS - Ready for Handover to Infrastructure Manager (IM)	03-Jul-18	03-Aug-18	07-Aug-18	31-Aug-18	24	28
A653	C360 - FSS - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed	05-Jul-18	03-Aug-18	17-Aug-18	31-Aug-18	14	28
A673	C405-PAD-A673 Completion of Phase 3 Testing	28-Jul-18	28-Jul-18	08-Sep-18	08-Sep-18	0	42
A679	C530-PLU-A679 Handover to Infrastructure Managers	02-Aug-18	08-Sep-18	02-Aug-18	13-Sep-18	42	5
A731	C350 - PML - Ready for Handover to Infrastructure Manager (IM)	25-Jun-18	05-Jul-18	08-Aug-18	15-Sep-18	38	72
A738	C360 - FSS - Ready for Handover to Infrastructure Manager (IM)	03-Aug-18	03-Aug-18	14-Sep-18	21-Sep-18	7	49
A269	C422-TCR-A269 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	13-Jul-18	19-Aug-18	28-Sep-18	28-Sep-18	0	40
A615	C610 - A615 Complete Pre-Trial Running	08-Sep-18	08-Sep-18	30-Sep-18	30-Sep-18	0	22
A641	C360 - STG - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed	05-Jul-18	03-Aug-18	12-Jul-18	01-Oct-18	81	59
A267	C405-PAD-A267 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	09-Aug-18	08-Sep-18	20-Sep-18	03-Oct-18	13	25
A688	C530-WOO-A688 Completion of All Phase 3 Testing	30-Sep-18	02-Oct-18	30-Sep-18	12-Oct-18	12	10
A676	C422-TCR-A676 Handover to Infrastructure Managers	10-Aug-18	08-Sep-18	12-Oct-18	12-Oct-18	0	34
A667	C405-PAD-A667 Handover to Infrastructure Managers	07-Sep-18	08-Sep-18	15-Oct-18	15-Oct-18	0	37
A166	C435-FAR-A166 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	17-Aug-18	12-Oct-18	19-Oct-18	19-Oct-18	0	7
A675	C512-WHI-A675 Completion of All Phase 3 Testing	10-Sep-18	10-Sep-18	10-Sep-18	20-Oct-18	40	40
A668	C435-FAR-A668 Handover to Infrastructure Managers	17-Aug-18	08-Sep-18	29-Oct-18	29-Oct-18	0	51
A734	C360 - STG - Ready for Handover to Infrastructure Manager (IM)	31-Jul-18	03-Aug-18	07-Aug-18	31-Oct-18	85	89
A658	C530-WOO-A658 Handover to Infrastructure Managers	31-Oct-18	02-Nov-18	31-Oct-18	14-Nov-18	14	12
A672	C512-WHI-A672 Handover to Infrastructure Managers	08-Oct-18	08-Oct-18	08-Oct-18	16-Nov-18	39	39
A608	CWG-CWG-A608 Handover Station to Infrastructure Manager	05-Jul-18	03-Aug-18	28-Sep-18	08-Dec-18	71	127
A535	GRIP 6 - Traction Power - New Substations in AT Mode - West	27-Apr-18	27-Apr-18	12-Sep-18	30-Dec-18	109	247
A169	ONW - West - KO5B Full Infra.Capability Maidenhead to Central Core Area at WB Park to Support Op. of New Trains (OC18-2)	10-Sep-18	10-Sep-18	12-Sep-18	30-Dec-18	109	111
A179	ONW - NE Spur - KD22 Route clearance & all infrastructure, incl. stabling and sidings updates compl.	31-Aug-18	31-Aug-18	29-Mar-19	29-Mar-19	0	210
A178	ONW - NE Spur - KO5A Full Infra.Capability from Shenfield to Central Core Area at Pudding Mill Ln	10-Sep-18	10-Sep-18	29-Mar-19	29-Mar-19	0	200

Figure A - 3 ~ Anchor Milestones forecast to be later than MOHS [redacted] date

Appendix B Stations

B.1 Stations in the Central Section

A table with multiple rows and columns, all of which are completely redacted with black boxes.

A summary of the Central Section station completion dates can be seen in Figure B - 2 below. This table reflects the forecast key dates and milestones, for each station at Period 3, against the MOHS 2018. The table does not reflect the key dates that may be separately identified within specific 100 day "look ahead" plans developed by each station. There have been movements in the reported forecast dates for completion of fit-out ([redacted] stations), IM handover ([redacted]) and a station completion date at [redacted] station during Period 3. These date changes are shown as "Bold" text on the table below.

Revised dates have been agreed with LUL and RfL for certain IM Handover Anchor Milestones (marked with *) following LUL IM Review meeting on 28 June 2018 and RfL IM Review meeting on 29 June 2018. These revised dates are not, as yet, reflected in the Period 3 MOHS update.

¹⁹ Data has been abstracted from the CRL Period 3 (2018/19) station dashboards.

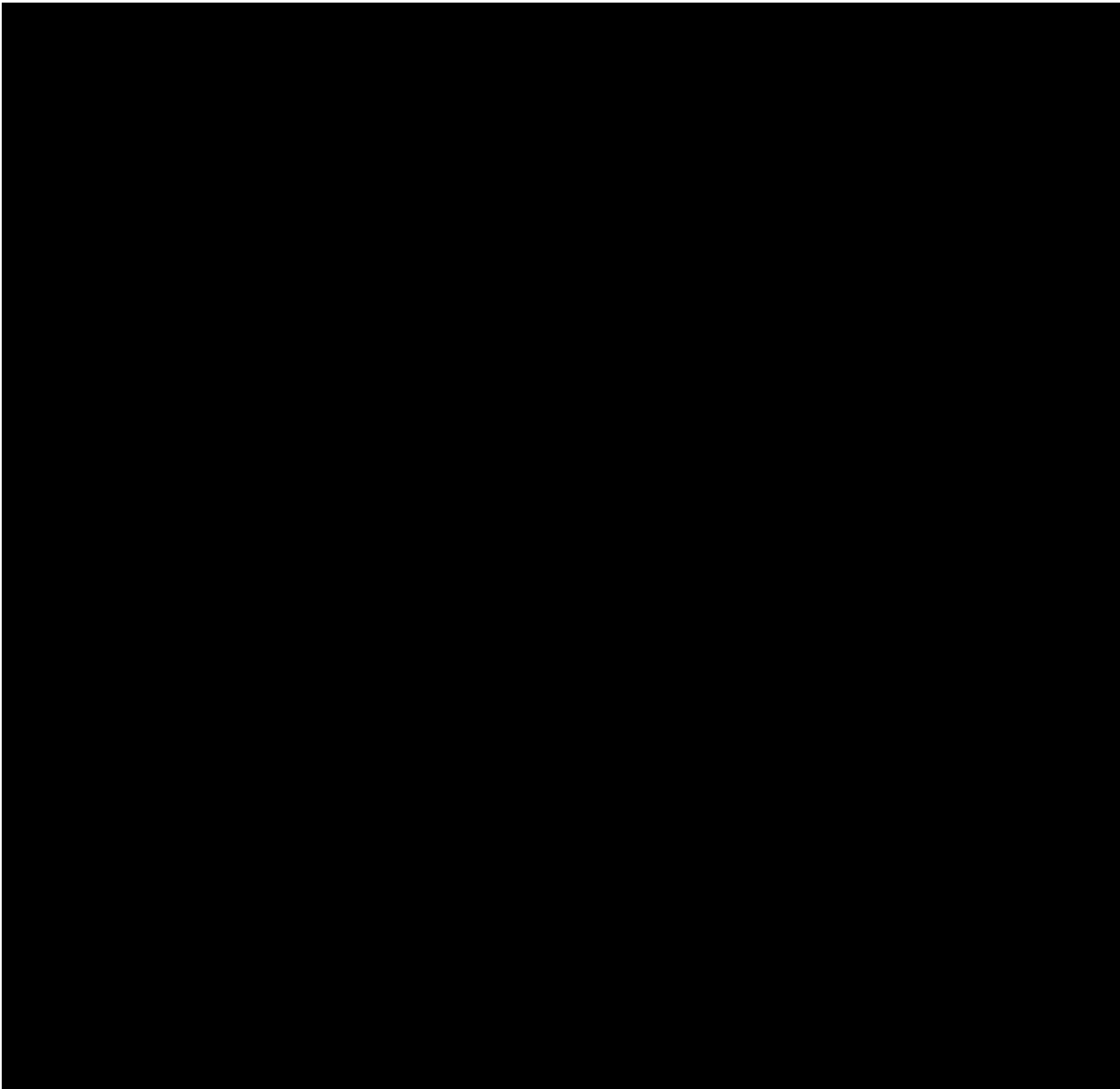


Figure B - 2 ~ Summary of Forecast Central Section Station Completion Dates

B.2 Interface Works and Handovers

CRL has not issued a “SLDs to go” report for Period 3. Most of the remaining handovers are at [REDACTED] stations and within the Intermediate Shafts. Delivery progress of the final room/route handovers will be monitored in parallel with the completion of the IRNs, for each of the stations, portals and shafts.

Appendix C Agreements

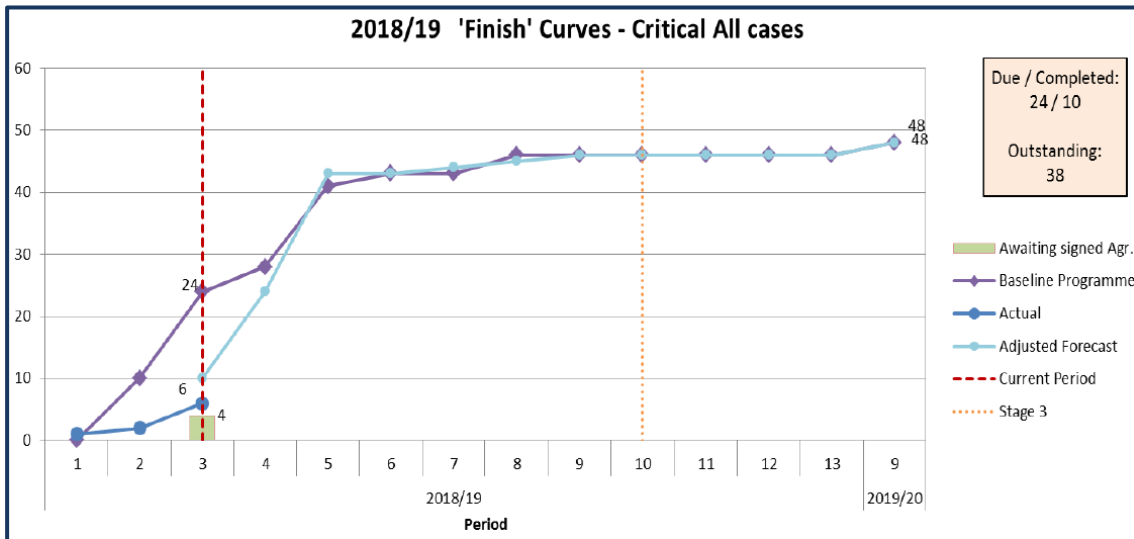


Figure C - 1 ~ 2018/19 Start, Finish & Close Curves²⁰

The diagram illustrates the slow pace in completing the agreements that are critical to Stage 3. CRL is forecasting a significant improvement in Periods 4 and 5, which we will be monitoring.

²⁰ Extract from C&CSC paper, 10 July 2018.

Project Representative Team

Project Team

██████████: Project Representative, Safety, Progress, Risk, Governance;
██████████: Signalling, Railway Systems, Integration, T&C;
██████████: Engineering, Stations, Assurance;
██████████: Compliance & Change, Operations, RSD;
██████████: Commercial, Cost Control, Financial, ONW;
██████████: Administration Manager.

Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LMU	London Metropolitan University
ABB	ASEA Brown Boveri	LO	London Over ground
ACJV	Alstom Costain Joint Venture	LoNo	Letter of No Objection
ACWP	Actual Cost of Work Performed	LoR	Line of Route
AEA	Abellio East Anglia	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AM	Anchor Milestones	MENTOR	Mobile Electrical Network Testing, Observation and Recording
AMS	Agreements Management System	MEP	Mechanical Electrical & Public Health
APIS	Authorisation to Place into Service	MEPA	Mechanical, Electrical, Public Health, Architecture
ARS	Automatic Route Setting	MES	Mile End Shaft
AsBo	Assurance Body - Ricardo Rail	MIRP	Maintenance Integration Review Panel
ASLEF	Associated Society of Locomotive Engineers and Firemen	MML	Mott MacDonald Ltd
ATC	Automatic Train Control	MOHS	Master Operational Handover Schedule
ATF	Auto Transformer	MOS	Member of Staff
ATFS	Autotransformer Feeder System	MPS	Master Plan Shaft
ATO	Automatic Train Operation	MTIN	Miles Per Technical Incident Number
ATP	Automatic Train Protection	MTIN	Miles Technical Incident Number
ATS	Automatic Train Supervision	MTR SMS	MTR Safety Management System.
ATS	Auto Transformer Station	MTR-C	Mass Transit Railway - Crossrail
AWS	Automatic Warning System	MV	Medium Voltage
B&PC	Board & Programme Contingency	NCE	Notified Compensation Event
BBMV	Balfour Beatty Morgan Vinci	NCR	Non Conformance Report
BCA	Bilateral Connection Agreement	NG	National Grid
BCWP	Budgeted Cost of Work Performed (Earned Value)	NGET	National Grid Electricity Transmission
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NKL	North Kent Line
BFK	Bam Ferrovial Kier	NoBo	Notified Body
BH	Berkeley Homes	NOW	North Woolwich
BIU	Bringing Into Use	NR	Network Rail
BLL	Bakerloo Line Link	NSACS	New Sector Area Cost Summary
BMS	Building Management Systems	O&M	Operations and Maintenance
BOS	Bond Street Station	OCS	Overhead Catenary Systems
BP	Business Plan	OLE	Overhead Line Equipment
BREEAM	Building Research Establishment Environmental Assessment Methodology	OMC Building	Operations Maintenance Centre
BSP	Bulk Power Supply Point	OME	Order of Magnitude Estimate
BT	Bombardier Transportation	ONFR	On Network Functional Requirements
BT / PC	Bombardier Transportation / Prime Contractor	ONSIP	On Network Station Improvements Programme
BTH	Blomfield Ticket Hall	ONW	On Network Works
BUF	Bottom Up Forecast	OOC	Old Oak Common
C&CSC	Commercial and Change Sub-committee	OOCPA	Old Oak Common Paddington Approaches

CAR	Corrective Action Report	OPEX	Operational Expenditure
CARE	Crossrail Assurance Reporting Environment	Ops	Operations
CBTC	Communications Based Train Control	ORAT	Operational Readiness & Transfer Group
CCB	Current Control Budget	ORR	Office of Rail & Road
CCP	Commitments Compliance Plans	ORSG	Operational Readiness Steering Group
CCRB	Construction and Commissioning Rulebook	OSD	Over Site Development
CCRRB	Crossrail Construction Railway Rule Book	OSP	Operations Safety Procedures
CCSA	Contract Commercial Status Analysis	OTIS	OTIS escalators (company)
CCSC	Commercial & Change Sub-Committee	OTP	Overall Target Price
CCTV	Closed Circuit Television	PA	Public Address
CD/RA	Closed Door / Right Away	PAD	Paddington station
CDG	Competence Design Group	PCs	Principal Contractors
CDL	Central Door Locking	PDA	Project Development Agreement
CDM	Construction Design & Management Regulations	PDB	Network Rail Programme Delivery Board
CDN	Crossrail Data Network	PES	Platform Edge Screen
CDT	Commitments Delivery Tracker	PES	Permanent Earthed Sections
CE	Compensation Events	PIP	Paddington Integration Project
CEC	Chief Engineer's Communications	PIR	Potential Incident Report
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PLU	Plumstead
CEG	Central Engineering Group	PM	Project Manager
CEO	Chief Executive Officer	PMI	Project Manager Instruction
CFCCB	Contingency Finance Current Control Budget	PML	Pudding Mill Lane
CFO	Chief Financial Officer	PMO	Project Management Office NR
CIF	Crossrail Integration Facility	PNY	Paddington New Yard
CIS	Customer Information System	PPE	Personal Protective Equipment
CMR	Crossrail Managed Risk	PPF	Property Partnership Framework
CMS	Crossrail Management System	PPM	Passenger Performance Measurement
CoL	City of London	PRep	Project Representative
COS	Central Operating Section	PRISM	Cost Management Software
CPFR	Crossrail Programme Functional Requirements	PRM	Persons of Reduced Mobility
CPI	Cost Performance Index	PSD	Platform Screen Door
CPO	Compulsory Purchase Order	PSG	Performance Steering Group
CRAF	Completion Readiness Assessment Framework	PSR	Project Status Report
CRL	Crossrail Limited	PTYSC	Property Sub-Committee
CRV	Crossrail Requirements Variation	PWay	Permanent Way
CSCS	Construction Skills Certification Scheme	QBR	Quarterly Baseline Review
CSDE	Correct Side Door Enabling	QCRA	Quantified Cost Risk Assessment
CSJV	Costain Skanska Joint Venture	QRA	Quantified Risk Assessment
CSM	Construction Safety Management	QSRA	Quantified Schedule Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	RAB	Regulatory Asset Base
CT	Computerized Tomography	RAB (C)	RfL Assurance Board for Crossrail
CTOC	Crossrail Train Operating Concession	RAG	Red, Amber, Green Matrix
CUH / CHS	Custom House Station	RAM	Route Asset Manage.
CW	Canary Wharf	RBC	Remote Block Computer
CWG	Canary Wharf Group	RCA	Risk Control Actions
CWS	Canary Wharf Station	RCC	Route Control Centre
D&A	Drugs and Alcohol	RfL	Rail for London
DA	Development Agreement	RfL-I	Rail for London - Infrastructure
DeBo	Designated body	RFT	Right First Time
DfT	Department for Transport	RIA	Railway Integration Authority
DLO	Direct Labour Organisation	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DLR	Docklands Light Railway	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DOO	Driver Only Operation	RIRP	Railway Integration Review Point

DPS	Depot Protection System	RLU	Restricted Length Unit
DT	Dynamic Testing	ROC	Rigid Overhead Conductor
Dwall	Diaphragm wall	ROC	Regional Operational Centre
DWWP	Delivery of Works Within Possession	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
E&B	Earthing & Bonding	ROP	Royal Oak Portal
EA	Environment Agency	RP4.2	Review Point 4.2
EAC	Estimate at Completion	RR	Ricardo Rail
EB	Eastbound	RRV	Road / Rail Vehicles
ECI	Early Contractor Involvement	RS	Rolling Stock
ECP	Employers Completion Process	RSC	Return Screen Conductor
ECS	Empty Coach Stock	RSD	Rolling Stock & Depot
EDBL		RSSB	Rail Safety & Standards Board
EDT	Early Dynamic Testing	RTU	Remote Telemetry Unit
EED	Emergency Exit Door	S&C	Switches & Crossings
EFC	Estimated Final Cost	SA	Supplementary Agreement
EFC	Economic and Financial Committee	SACR	Semi Annual Construction Report
EiS	Entry into Service	SAP	System Applications Products
ELCBT	Elizabeth Line Countdown Board Tracker	SAR	Safety Assessment Report
ELRSG	Elizabeth Line Readiness Steering Group	SAT	Site Acceptance Test
EMC	Electromagnetic Compatibility	SCADA	Supervisory Control and Data Acquisition
EMU	Electrical Multiple Unit	SCL	Sprayed Concrete Lining
ERTMS	European Rail Traffic Management Systems	SCN	Sponsor Change Notice
ESJ	Engineering Safety Justification	SDG	Signalling Design Group
ESM	Engineering Safety Management	SDO	Selective Door Operation
ETCS	European Train Control System	SDS	Scheme Design Specification
ETH	Eastern Ticket Hall	SER	Signalling Equipment Room
EVM	Earned Value Management	SES	South East Service
FAR	Farringdon	SESR	South East Signalling Room
FCCB	Finance Current Control Budget	SFA	Sponsor Funding Account
FDC	Framework Design Consultant	SHELT	Safety and Health Leadership Team
FDO	Final Design Overview	SIRP	Systems Integration Review Panel
FDS	Final Design Statements	SISS	Station Information and Security System
FFOC	Final Forecast Outturn Cost	SJR	Safety Justification Report
FGW	First Great Western	SLD	Single Line Diagrams
FIS	Fisher Street Shaft	SMS	Safety Management System
FLU	Full Length Unit	SMTA	Smithfield Market Traders Association
Fol	Freedom of Information	SOC	Statement of Compatibility
FRAG	Fraud Risk Assurance Group	SONIA	Sterling Overnight Index Average
FTS	Floating Track Slab	SOR	Systems Operation Room
GAF	Greater Anglia Franchisee	SORBA	Shaping Architecture Company (sub cladding contractor)
GE	Great Eastern	SPI	Schedule Performance Index
GEBR	Guaranteed Emergency Brake Rate	SPS	Secondary Part Steel
GEFF	Great Eastern Furrer & Frey	SR	Sponsors Requirement
GEML	Great Eastern Main Line	SRP	Safety Review Panel
GFRC	Glassfibre Reinforced Concrete	SSE	Scottish & Southern Electricity
GLA	Greater London Authority	SSP	Stations, Shafts, Portals
GPE	Great Portland Estates	STG	Stepney Green
GRC	Glass Reinforced Concrete	STS	Standard Track Slab
GRIP	Governance for Railway Investment Projects	SVP	Safety Verification Panel
GSM-R	Global System for Mobile Communication - Railway	T&C	Testing & Commissioning
GW	Great Western	TAP	Technical Assurance Plan
GWML	Great Western Main Line	TBM	Tunnel Boring Machine
GWR	Great Western Railway	TC&HSG	Testing, Commissioning and Handover Steering Group
H&S	Health & Safety	TCMS	Train Control Management System

HAL	Heathrow Airport Limited	TCR	Tottenham Court Road
HALARP	Heathrow Airport Limited Assurance Review Panel	TCRW	Tottenham Court Road West
HAS	High Attenuation Sleeper	TDR	Technical Director's Report
HAVS	Hand Arm Vibration Syndrome	TDY	Tunnel Drive Y
HEP	Handover Execution Plans	TfL	Transport for London
HIA	Heathrow Implementation Agreement	TOC	Train Operating Company
HM	Her Majesty	TPA	Tunnel Planning Authority
HMDL	Handover Master Deliverable List	TPH	Trains Per Hour
HPNM	High Performance Near Misses	TPS	Train Protection System
HRW	Heathrow Airport	TPWS	Train Protection & Warning System
HSPI	Health & Safety Performance Indicator	TRAIL	Transport Reliability Availability Integrated Logistics
HV	High Voltage	TRH	Temporary Rehousing
HVAC	Heating Ventilation & Air Conditioning	TSI	Technical Standard for Interoperability
IA	Interim Acceptance	TTVS	Temporary Tunnel Ventilation System
ICD	Interface Control Document	TUCA	Tunnelling & Underground Construction Academy
IECC	Integrated Electronic Control Centre	TWAO	Transport & Works Act Order
IEP	Intercity Express Programme	TXM	TXM Plant
IFC	Issued For Construction	U&A	Undertakings & Assurances
IFD	Ilford Yard	UKPN	UK Power Networks
IM	Infrastructure Manager	UR	Urban Realm
IOSH	Institution of Occupational Safety and Health	URT	Unresolved Trends
IP	Intervention Point (0, 1, & 2)	UTX	Under Track Crossings
IR35	Inland Revenue Taxation Regulation 35	VDP	Victoria Dock Portal
IRN	Installation Release Note	VERP	Value Engineering Review Panel
IRSG	International Regulatory Strategy Group	VFL	Vo ker Fitz Patrick
ISJ	Interim Safety Justification	VN	Variation Notice
ISV	Intermediate Statements of Verification	VT	Voltage Transformer
ITP	Inspection & Test Plan	WAD	Works Authorisation Document
ITT	Invitation to Tender	WBP	Westbourne Park
JST	Joint Sponsor Team	WBS	Work Breakdown Structure
KBR	Knorr-Bremse Rail	WC	World Class
KD	Key Deliverable	WCC	Westminster City Council
KE	Kinematic Envelope	WCCC	Whole Contract Construction Certificate
KG	Kensal Green	WHI	Whitechapel
KO	Key Output	WITI	Western Inner Track Infrastructure
KPI	Key Performance Indicator	WOE	Western Outer Electrification
L&P	Land and Property	WOO	Woolwich Station
LB	London Borough	WOTI	Western Outer Track Infrastructure
LBTH	London Borough of Tower Hamlets	WTH	Western Ticket Hall
LDBL	██████████	YC	Yard Control
LFB	London Fire Brigade		
LIV	Liverpool Street		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation

C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works
C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 114

Period 4 FY2018-19

24 June 2018 – 21 July 2018

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16 August 2018



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Note: This report relies on the information set out in CRL's Period 4 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 21 July 2018. Note that information emerging after the close of Period 4 is subject to formal confirmation by CRL in its Period 5 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan.

Document history and status

Revision	Date	Description	By	Review	Approved
1	9 August 2018	PSR 114 Period 4 FY 2018-19 v1.10.docx ~ Draft	PRep Core Team		
2	16 August 2018	PSR 114 Period 4 FY 2018-19 v1.14.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets. CRL continues discussions with relevant parties regarding access to sites once the Infrastructure Managers (IMs) and MTR-C have taken possession at Staged Completion.

Financial:

The Intervention Points have not changed in Period 4 and the AFCDC remains at £12,810m, which exceeds IP2 by £298m. We are concerned that cost pressures remain across the programme, which will cause the forecasts to increase substantially at Period 5 or Period 6. Separately, CRL is currently preparing a revised cost forecast to reflect the revised delivery strategy.

The total On Network Works (ONW) forecast cost (AFC plus VNs) has increased to £2,584m, to reflect the £54m additional NR funding. The ONW final forecast outturn cost (FFOC) has also increased to £2,430m. CRL assesses that cost risks to the ONW forecasts remain.

Stage 2 Opening:

The interim stage¹ has been further delayed, and is likely to start in December 2018. The primary reason is delay to the train's TCMS v7.2 software.

For Stage 2-2, BT is late in providing an updated programme that reflects the current situation with regard to software. [REDACTED]

[REDACTED] Should the planned opening be delayed, then it would be advantageous if elements of MTR-C and RfL are not tasked with contemporaneously implementing Stage 2-2 and Stage 3. This situation could also apply to Stages 4 and 5.

Stage 3 Opening - Infrastructure and Systems:

The evidence set out in this report leads us to the conclusion that Stage 3 Opening is highly unlikely to be achieved on 9 December 2018. CRL are reviewing the schedule and we believe they should present a revised delivery strategy at the next Sponsor Board.

CRL continues to prioritise earliest completion of construction over dynamic testing, and delivery proceeds using a fortnightly 11 day construction / 3 day dynamic testing working pattern. The installation workload in the Central Section is progressively reducing, with CRL targeting 22 October 2018 for the completion of linear rail system works. Thereafter, CRL intends to introduce a pattern of midweek dynamic testing combined with weekend construction, prioritising train testing on what is anticipated will be completed rail infrastructure.

Dynamic testing has continued using limited duration 'windows', with mixed success. [REDACTED]

[REDACTED] Progress is below forecast and impact upon Stage 3 Opening remains inevitable. Priority is shifting towards readiness for NR signalling interface testing in the coming periods.

Completion of Station, Shaft and Portal (SSP) works in a sequence which supports railway integration activities continues to prove challenging. CRL has consolidated all the principal

¹ Transition from reduced length units to full length units for services between Paddington and Hayes.

outstanding workstreams into nine critical paths, which model the progressive convergence of delivery through installation completion, Phase 2 static testing and Phase 3 integration testing.

[REDACTED]
[REDACTED]

Beyond Phase 4 dynamic testing of the Signalling/Rolling Stock interface, the integration of all systems back to the Route Control Centre using the [REDACTED] systems presents one of the greatest challenges to Stage 3 Opening. Delays to SSP works are driving an increasing 'bow wave' of testing later into the schedule, and the associated resource requirement is proving very difficult for [REDACTED] to service.

There is significant consequent impact of delay at all stations upon the production of assurance documentation. [REDACTED]

Stage 3 Opening - Handover and Operational Readiness:

The key concern for the Handover material, required by IMs, [REDACTED] [REDACTED] A positive sign is that there is now recognition by all parties that they need to contribute to resolving the problem. There also remain issues with delayed provision of Handover Master Deliverables, which is likely to creating a 'bow wave' effect for IMs.

Obtaining Regulatory Approvals from the ORR, as well as the IM safety bodies, has been delayed because of the Programme delays. Whilst the design evidence is essentially complete, there is little construction evidence to provide to RAB-C, NoBo or AsBo.

The level of concern for both Handover and Regulatory Approvals is in relation to the proximity of a Stage 3 Opening in December 2018.

Stage 4 and Stage 5 Openings:

[REDACTED]
[REDACTED] There is a risk that if sufficient power supplies are not provided in time, then all Operators' planned services on the Great Eastern would need to be adjusted.

[REDACTED]
[REDACTED]
[REDACTED]

CRL has identified a technical option to mitigate against ETCS not being installed between Paddington and Stockley Junction by December 2019. CRL is minded to begin reporting upon progress of this option, a move we would support.

1 Cost

1.1 Summary

CRL has kept the AFCDC at £12,810m for Period 4, which breaches IP2 by £298m. This consumes almost all of the increased funding made available by Sponsors. We expect that the cost pressures that remain across the programme, along with delays to station and Systemwide works, will cause the forecasts to be increased significantly again. The NR ONW forecast cost (AFC plus VNs) has increased to £2,584m, to reflect the £54m additional NR funding. The ONW FFOC forecast has increased similarly by £54m to £2,430m. Further increase is expected as a consequence of the West enhanced station tenders being above NR budgets.

The Intervention Points have not changed in Period 4;
The AFCDC remains at £12,810m;
The CRL AFCDC exceeds IP2 by £298m;
[REDACTED];
We expect the AFCDC to increase at Period 5 or Period 6;
The revised contingency budget is sufficient to cover the current risk exposure;
The CRL ONW AFC, including VNs, has increased to £2,584m;
The NR FFOC has increased to £2,430m;
[REDACTED]

1.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 4 and we do not expect any future changes to IP2 under the current circumstances, where the AFCDC exceeds IP2 and challenges current funding thresholds.

CRL has not changed the AFCDC at Period 4 and it remains at £12,810m. The CRL Period 4 AFCDC exceeds IP2 by £298m, as shown in Figure 1 - 1; but is equal to the revised Period 4 Finance Current Control Budget (FCCB), of £12,810m.

(£ millions)	Period 3	Period 4	Delta	Movement
Forecast	12,560	12,715	155	up
Delivery Risk	6	2	-4	down
Subtotal	12,566	12,717	151	up
Programme Risk	240	89	-151	down
Board Risk	4	4	0	same
AFCDC total	12,810	12,810	0	same
IP0	11,672	11,672	0	same
IP0 Headroom	-1,138	-1,138	0	same
IP1	11,912	11,912	0	same
IP1 Headroom	-898	-898	0	same
IP2	12,512	12,512	0	same
IP2 Headroom	-298	-298	0	same

Figure 1 - 1 ~ AFCDC Headroom to Intervention Points

At Period 4, there remains only £2m headroom to the Sponsors additional funding provision of £300m. CRL is holding defined cost reviews with key projects in its ongoing review of emerging costs. The project reviews commenced at the end of July, with meetings at [REDACTED] and Systemwide to further interrogate and validate the cost pressures reported in Period 3.

The full value of defined costs being pursued by the Contractors is not included in the current AFDCD. [REDACTED]

[REDACTED]. This indicates to us that the full value of the defined cost gap is not included in the AFDCD. In Period 4, the risk drawdown of £154m was in excess of the £116m reduction in URTs suggesting that £38m of the risk drawdown was not associated with URTs but other cost pressures across the programme. [REDACTED]

The indicators described above, together with the increasing rate of defined costs and cost pressures, lead us to expect the AFDCD to significantly rise in Period 5 or Period 6 before SACR20.

The rate of COWD has been steady through the life of the project, averaging approximately £120m per period. In Period 4, the Delivery COWD was £119m but this was offset by a one-off £62m land and property Off Site Development (OSD) income resulting in a net COWD of £57m. Projecting linearly both the current rate of increase of AFDCD and COWD to present a worse case scenario, they intersect above £13bn in Period 10, as shown in Figure 1 - 2. However, the actual growth for AFDCD and the progression of COWD are unlikely to be a continuing linear trend and both are expected to tail off as the works approach completion.

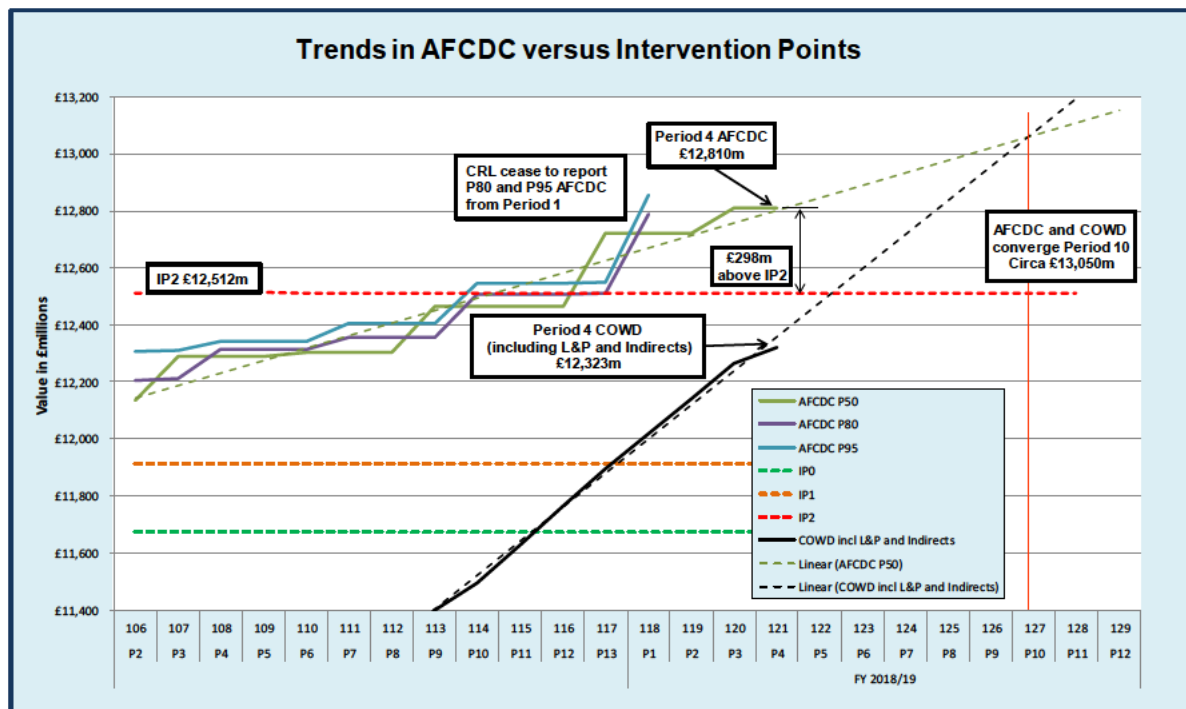


Figure 1 - 2 ~ AFDCD Headroom to Intervention Points

CRL advises that the AFDCD includes cost or risk allowances for all items of scope currently instructed in the COS and provision for resolution of defined costs; although, as described above, we believe the risk allowances are insufficient. The only item which is specifically excluded is [REDACTED]

There has been a sustained 70% increase in delivery overspend since Period 7. The cumulative delivery overspend, against the CRL internal budget at each period, has increased in Period 4 by £32m to £698m (Period 3, £666m) as shown in Figure 1 - 3.

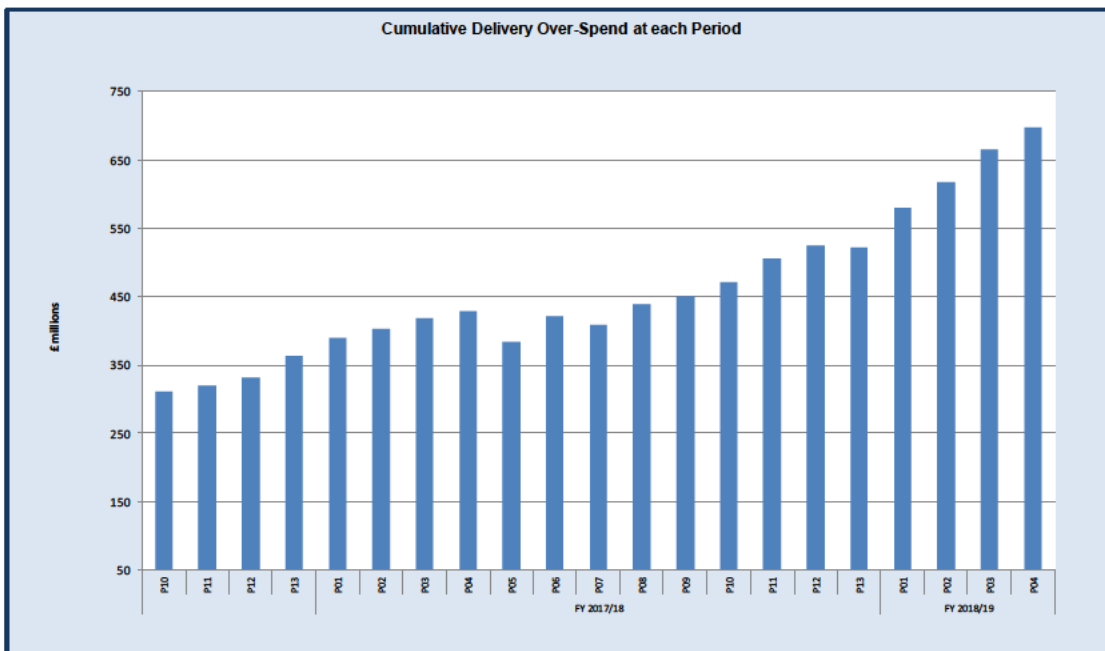


Figure 1 - 3 ~ Cumulative Delivery Overspend against CRL Budget at each Period

CRL reports that, in Period 4, it spent £0.1m below the 2018/19 Business Plan, mainly due to an underspend in Indirect Costs following the earlier than forecast receipt of OSD income offset by an overspend on Direct Costs. The CRL Period 4 Board Report provides the details of the overspend which, in summary, continues to be dominated by prolongation and delays. These costs are included in the AFDCD.

Programme risk has decreased by £151m to £89m and Delivery Risk reduced by £4m to £2m in Period 4, equating to an overall net decrease in risk of £155m², (from £249m to £95m) to fund Delivery level cost increases.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 4 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package.

² Rounding error, £154m reported by CRL.

Our trended assessment suggests that both Target and Defined cost gaps are still converging, such that:

- CRL assessment of Defined Costs continues to rise with the increasing Contractors' Defined Cost estimates;
- CRL Target Cost assessments continue to rise towards the increasing Contractors' Target Cost estimates.

Although the target gap is showing signs of closing, the convergence continues to be slow and the value also continues to grow at an increasing rate. Of growing concern to us is that the defined cost forecasts are showing no sign of convergence and the Period 4 gap is increasing, whilst both CRL and the Contractors view of defined costs continue to rise.

[REDACTED]

[REDACTED]

1.4 Scenario costs

CRL has reported⁴ that the AFCDC has exceeded the costs set out under scenarios A1 to A3 inclusive and B1. We are aware that CRL has concerns with Stage 3 opening and is currently reviewing its schedule. We await the outputs from the CRL review of its MOHS and its revised delivery strategy. Any major delays to Stage 3 opening or station construction will further increase costs. We would expect CRL to update its cost forecast once the schedule review has been completed.

⁴ Sponsor Board on 26 July 2018.

1.5 Contingency and Risk

The Finance Current Control Budget has increased in Period 4⁵ by £20m to £12,810m. The £12,810m AFCDC is equal to the revised financial budget, but exceeds the RP4.2 Baseline funding of £12,136m by £674m.

CRL is reporting that the overall Period 4 contingency budget of £99m is sufficient to cover the risk exposure of £95m by £4m (£26m improvement from Period 3). The centrally controlled Delivery contingency at Period 4 has decreased by £1m to £38m.

Figure 1 - 6 shows the trend of the decrease in the Board and Programme Contingency and compares the lower Risk Exposure at P50 only with the remaining contingency.

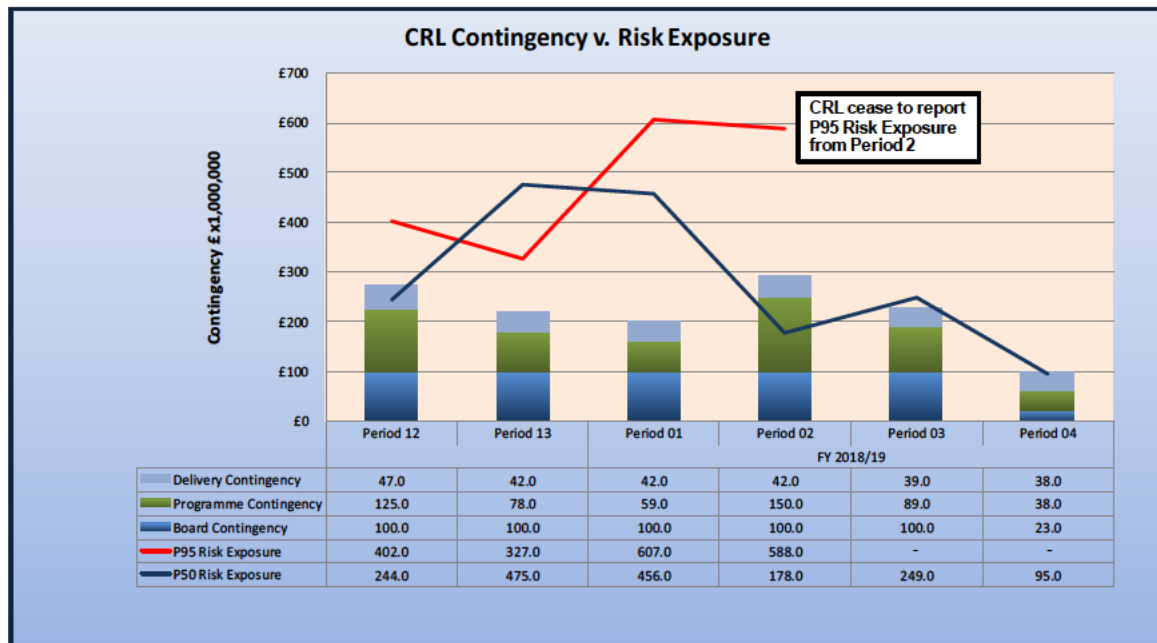


Figure 1 - 6 ~ Risk Exposure versus Contingency

CRL has confirmed that all trends are covered by URTs or risk in Period 4 AFCDC. Figure 1 - 7 shows the apportionment of Risk from Period 13 up to Period 4.

⁵ Approved by CRL Board 19 July 2018.

Period	QRA	URTs	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81
P4	95	46	2	87	6	43

Figure 1 - 7 ~ Elemental Breakdown of Risk Allowances

1.6 Cost: On Network Works (ONW)

The total On Network Works (ONW) forecast cost (AFC plus VNs) has increased to £2,584m, to reflect the £54m additional NR funding. The ONW are 91% complete (reduced from 96% due to an increase in the FFOC). CRL reports an increase to the FFOC, which now includes the additional £54m funding covered by the Portfolio Board, plus a CRL assessment for cost pressures and tender price risk associated with the Enhanced Stations. CRL remains confident with cost certainty improving on many of the projects as NR implements its programme closeout. However, it remains concerned with the final outturn cost, notably associated with the risks highlighted in Section 1.6.2 below.

The Forecast Final Outturn Cost (FFOC) at Period 4 has increased to £2,430.0m (in line with the £54m funding increase), which reflects a reported Grand Total Cost position of £2,889.4m less £154m for Variation Notices (Cash Funded) and £305.4m CRL/NR secured funding. CRL assesses the Grand Total Cost mid-point sensitivity to be +£50.8m.

Description	Period 3 £m	Period 4 £m
Cost Grand Total	2,835	2,889
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
CRL/NR Funding:		
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
Total CRL/NR Secured Funding	305	305
FFOC	2,376	2,430
Pain/gain share	-70	-70
Forecast to RAB	2,306	2,360

Figure 1 - 8 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

1.6.1 ONW Funding

CRL has reported that the total Period 4 AFC and Variations funding for NR ONW has increased to £2,889.4m; this is to include the £54m additional funding granted by NR Portfolio Board. NR reports a Total Secured Funding for NR ONW of £2,889.4m, as shown in Figure 1 - 9.

The ONW funding is expected to increase in future periods, as NR is currently discussing a further £22m application from the Portfolio Board to cover [REDACTED] cost pressures and non-achievement of planned recoveries. [REDACTED]

[REDACTED] these amounts are currently included in the 'Recoveries (Residual)' tabulated in Figure 1 - 10; NR ONW Cost Summary.

Description	P4 Source of Funding				P3
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	271.0	-	-	271.0	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,542.0	22.0	20.0	2,584.0	2,530.0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Sub Total	-	118.9	186.5	305.4	305.4
TOTAL SECURED FUNDING	2,542.0	140.9	206.5	2,889.4	2,835.4

Figure 1 - 9 ~ NR ONW Secured Funding

1.6.2 ONW Cost

CRL reports that the Grand Total Cost has increased by £54m in Period 4 to £2,889.4m, but with a reduced mid-point sensitivity of plus £50.8m (a £27.6m reduction from Period 3), as shown in Figure 1 - 10.

Description	Period 3 £m	Period 4 £m	Delta £m	P4 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,902.1	2,928.9	26.8	2,920.3	2,955.8	2,998.6
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	0.0	0.0	0.0	0.0	0.0	0.0
Recoveries (Residual)	-9.8	-8.6	1.2	-3.6	-3.2	0.0
Targeted Savings	-57.0	-30.9	26.1	-27.8	-12.4	0.0
Cost Grand Total	2,835.3	2,889.4	54.1	2,888.9	2,940.2	2,998.6
Total Secured Funding	2,835.4	2,889.4	54.0	2,889.4	2,889.4	2,889.4
Funding Gap	-0.1	0.0	0.1	-0.5	50.8	109.2

Figure 1 - 10 ~ NR ONW Cost Summary

CRL has collated the effects of known Period 4 risks in its SPOT⁶ AFC cost sensitivity analysis, as shown in Figure 1 - 10 above.

The most significant cost risks to the ONW continue to be:

- [REDACTED]
- Anglia [REDACTED]
[REDACTED]
[REDACTED]
- Closeout risk associated with upward pressure on the reported AFC for Kent ([REDACTED]
[REDACTED]) now that the Contract is cost reimbursable;
- Closeout risk associated with final outturn cost with respect to [REDACTED] claim for Stations KO4 Phase 1 Package 1;
- Prioritisation of access and historic claims are impacting the confidence of achieving the reported AFC;
- [REDACTED]

Further detail can be found under Section 5.3.1 of this report.

⁶ SPOT AFC – NR standard terminology - a spot check at a particular moment in time.

out a timetable change to allow FLUs to access Paddington platform 14. We understand NR has formally refused to consider a timetable platform change at Paddington before December. [REDACTED]

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In our Period 13 report, we described an interim activity that was required before formal ETCS testing, using TCMS v7.3, could start in August 2018. It was:

- Type testing of software on the train – Forecast 23 June 2018.

RfL is now forecasting it will start on 4 September 2018, and that formal Heathrow spur testing will start early November 2018. These dates require verification by BT, who needs to submit a revised programme. There is a reasonable possibility that its programme will show further delay to these dates. The primary reason for the slippage is that the variant required for Stage 2-2 (v7.3) builds upon the functionality of its predecessor, TCMS v7.2. As v7.2 is in delay, so is v7.3.

OOC

Signalling in Sections B&C was completed on 23 July 2018, removing the last major operational issue facing the depot.

The Back line connection has not been completed, but it is not required before the start of Stage 2-2. We do not believe the situation presents a risk to service.

Operations

[REDACTED]

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]

[REDACTED]

Regulatory Approvals

There are two key approvals for Stage 2-2, to be issued by the ORR:

- APIS ETCS trackside to be issued to NR;
- APIS ETCS on-board to be issued to BT.

APIS ETCS trackside is now further delayed to late August 2018 (was early August in Period 3). There has also been a new development. The NR SVP for Wales and Western regions requires evidence that the Operational Concepts described in the submission have been proved before it grants approval. These tests will be incorporated into the planned integration testing schedule, currently scheduled for one month starting from 14 September 2018.

APIS ETCS on-board has been further delayed to 4 December, but we feel this is likely to slip further, due to the issues with train software development described in the Rolling Stock section above.

3.2 Schedule

As reported previously, significant schedule pressures and poor productivity have built up over several months. These have resulted in an overwhelming set of issues bringing significant risk to the critical paths leading to Stage 3 Opening. At Period 3, we reported “we believe there is a very high risk that Stage 3 Opening will be delayed or the opening will be sub-optimal⁸”. The culmination of the evidence set out in this, and previous reports, leads us to the conclusion that Stage 3 Opening is highly unlikely to be achieved on 9 December 2018.

During Sponsor Board meeting on 26 July 2018, CRL described the challenges it faced and set out indicative scenarios it had developed and presented to its Board meeting on 19 July 2018. Each scenario targets station completion as early as possible to minimise costs. Further work is needed to develop the scenarios into a plan agreed with Partners and other stakeholders, and to assess the impacts on Stages 4 and 5. CRL has advised that it will present its recommendations to its Board meeting on 29 August 2018 and to Sponsor Board meeting on 3 September 2018.

The table at Figure 3 - 1 indicates a selection of key dates leading to Handover and Combined Trials currently due on 1 October 2018; many of which were re-baselined in June. The table gives the baseline dates in the latest adjusted MOHS, plus the CRL forecasts at Period 3 and 4. It can be seen that CRL’s own forecasts indicate that some of these have already been delayed. Our assessment is that almost all of the dates shown as forecast for September 2018 are ambitious and unlikely to be delivered on time. We expect CRL will produce new forecast dates in Period 5 or 6, once the new delivery strategy has been developed and agreed.

Key Dates	Revised MOHS 2018	Period 3 Actual / Forecast	Period 4 Actual / Forecast
C650 - All 11 kV S,S&P locations energized	15-Apr-18	11-Jul-18	11-Jul-18
C650 - All 22 kV S,S&P locations energized	30-Jun-18	29-Jul-18	18-Aug-18
Training completed for MTR in support of Handover	30-Jun-18	31-Jul-18	31-Aug-18
COS safety Case submitted to RABC (to facilitate Handover)	30-Jun-18	30-Aug-18	30-Aug-18
C620 - Ready to Commence Transition Testing @ GEML	12-Aug-18	12-Aug-18	12-Aug-18
22no. CI.345 FLUs Available for Reliability Growth (Pre Trial Running)	13-Aug-18	13-Aug-18	13-Aug-18
Training completed for LU in support of Handover	31-Aug-18	31-Aug-18	31-Aug-18
C610 - Complete Pre-Trial Running	08-Sep-18	30-Sep-18	30-Sep-18
C660 - Train GSM-R Radio available to support Combined Trials	09-Sep-18	09-Sep-18	09-Sep-18
C610 - Ventilation Control System ready to support Combined Trials in normal mode	09-Sep-18	09-Sep-18	09-Sep-18
C620 - Ready to Commence Transition Testing @ GWML	10-Sep-18	09-Sep-18	09-Sep-18
RfLI Ready to commence Pre-Trial Running	11-Sep-18	11-Sep-18	11-Sep-18
Training completed for RFL in support of Handover	14-Sep-18	14-Sep-18	30-Sep-18
C620 - All Signalling Dynamic Testing complete (Except Yellow Plant)	17-Sep-18	17-Sep-18	17-Sep-18
Pre Trial Running starts	17-Sep-18	17-Sep-18	17-Sep-18
Final COS safety case updated and submitted to RABC	20-Sep-18	20-Sep-18	20-Sep-18
C660 - CIS ready to support commencement of Combined Trials	30-Sep-18	30-Sep-18	30-Sep-18
Commence Combined Elizabeth line Trials and Handover under ROGS to IM	01-Oct-18	01-Oct-18	01-Oct-18
Forecast later than MOHS			
Forecast earlier than MOHS			
New or adjusted Anchor Milestones			
* In period movement			

Figure 3 - 1 ~ Key Dates to Combined Trials

⁸ Not in accordance with the PDA.

Figure A - 1 in Appendix A sets out the eighteen Corporate (Key) Milestones that were approved by the CRL Board, alongside CRL forecasts for Periods 3 and 4. Nine Milestones are now forecast to be late. Our comments on other Milestones are:

- Milestone 4 (West Enhanced Stations contract award) is likely to be October rather than September 2018;
- Milestone 8 (Commence Pre-Trial Running) is unlikely to commence in September 2018;
- Milestone 10 (CRL central section Safety Case updated and submitted to RABC) due on 20 September 2018 is at risk;
- Milestone 12 (Submit APIS for Central Section to ORR) is forecast by CRL as 9 November 2018 but is shown as September in its Board report. CRL has advised that the last safe moment for submission is November but the plan is to submit in September;
- Milestone 13 (Commence Combined EL Trials and HO under ROGS) is very unlikely to be achieved on 1 October 2018;
- Milestone 16 (Opening of Stage 3 - Central Section PAD to ABW) due 9 December 2018 is highly unlikely;
- The forecast dates for works at Plumstead are different from those shown in the CRL Board report, but these are under review.

We expect a new set of Corporate Milestones will be set once the new strategy is agreed.

Figure A - 2 in Appendix A indicates the overall cumulative progress of the completed Anchor Milestones (AM). The key feature of this chart is that many of the AMs have been delayed, resulting in a forecast cumulative curve later than the [REDACTED] Date Baseline curve. The table at Figure A - 3 in Appendix A indicates 52 Anchor Milestones, out of a total of 73 remaining, which are forecast to be later than the revised MOHS [REDACTED] date. Details regarding late running activities are included in the remainder of Section 3.

CRL has confirmed that nine critical paths lead through the Crossrail Stage 3 programme as follows:

1. Completion of Routeway ([REDACTED]);
2. Signalling ([REDACTED]);
3. Tunnel Ventilation ([REDACTED]);
4. Radio GSM-R for Dynamic testing ([REDACTED]);
5. Dynamic Testing ([REDACTED]);
6. HV Non Traction Power ([REDACTED]);
7. Traction Power PML ATFS ([REDACTED]);
8. SCADA and Communications ([REDACTED]);
9. Stations, Shafts and Portals Completion ([REDACTED]).

In addition to this list, we would add Rolling Stock ([REDACTED]). We would also stress the importance of the 'paper railway', such as IRNs, test certificates, O&M manuals, as built drawings, etc which are included within all critical paths. Details regarding the ongoing challenges and risks to each critical path are described in the following sub-sections and in CRL's Period 4 Board Report. We note that CRL has changed the target date for completion of routeway from 1 October 2018 to 22 October 2018, and removed Pre-Trial Running and Combined Trials activities⁹.

⁹ See CRL Period 4 Board Report pages 7 and 8.

3.3 Operational Readiness Assessment

Elizabeth Line Dashboard

There are nineteen Readiness Tasks that have been given a ‘Red’ by the Elizabeth Line Readiness Steering Group (ELRSG)¹⁰, one less than in the previous period. The change is:

- ‘Training and briefing of NR signalling and maintenance staff’ [at portal interfaces] was red and is now amber. This is due to further meetings and information between CRL and NR producing greater clarity.

Overall, the nineteen Readiness Tasks are attributable to three categories and are the same issues as last period:

- CRL not receiving Handover data, or it being below the necessary quality, from the [REDACTED]. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. There has been some improvement in this area (see Section 3.11), but there remains much to do.
- Central Section infrastructure and interfaces not being in a position to support dynamic testing and hence Combined Trials.
- Train software not being in a position to support dynamic testing.

We expect new Readiness target dates, which will affect their ‘red’ ratings, will be established once the revised opening strategy is approved.

3.4 Tunnels

Tunnelling works are now almost complete, apart from some snagging works, backfilling of central access shaft at Liverpool Street Station and completion of certification activities.

3.5 Stations, Shafts and Portals (SSP)

Schedule pressures continue on most Stations, Shafts and Portals (SSP) with cross-site issues, such as production of IRNs and Phase 3 testing, adding to specific problems at each site. CRL and the IMs have agreed Staged Completion¹¹ and Handover¹² target dates with a view to Combined Trials on 22 October 2018. As noted previously, inadequate production of the works and related paperwork across most SSPs has meant that the likelihood of this being achieved is very low. The review of Stage 3 Opening by CRL may reduce the pressure on ambitious targets. Nevertheless, CRL is pushing the Tier 1 Contractors hard to complete their works urgently in order to keep costs as low as possible at each location.

Actual progress at most SSPs has again deteriorated this period; details are shown later in this Section. We no longer report schedule percentage progress at each location, as they are all well over 90% and the key dates are now more important than assessed percentage completion. This percentage data is provided in the CRL Board Report. Refer to Appendix B, Figure B - 1 for the current forecast station completion and Handover dates.

The key issues affecting the SSPs are as follows:

¹⁰ Meeting held 27 July 2018.

¹¹ Staged Completion allows Tier 1 Contractors to ‘transfer’ station assets to allow safe commencement of familiarisation and Trial Operations by the IM and Operator.

¹² Handover of Element to relevant Operator as defined by the PDA.

- The [REDACTED] need to substantially complete their installation works so the IMs can take over the sites, and preliminary costs can be minimised;
- [REDACTED]
- [REDACTED] need to collaborate over the timing of, and resources for, Phase 3 integrated testing. 'Skyline' diagrams are being developed for each location to present a pictorial representation of the resources required for each set of tests. This is becoming a major challenge and Phase 3 testing is likely to take longer than currently forecast;
- CRL and its Contractors need to quickly energise SSP power systems following resolution of the circuit breakers latent defect issue;
- [REDACTED]
- Realistic Handover Execution Plans and Fire Plans need to be agreed at each location.

Paddington Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Bond Street Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Tottenham Court Road Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Farringdon Station: [REDACTED]
[REDACTED]
[REDACTED]

Liverpool Street Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Whitechapel Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

¹³ Actual 42% against plan of 73%. See CRL Board Report for additional details.

Canary Wharf Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Woolwich Station: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Intermediate Shafts and Portals: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

3.6 ONW

At Abbey Wood, the handover inspection was carried out on 31 July 2018. NR reports completion¹⁴ for the main station, lifts, North Kent Lines (NKL) and Crossrail platforms, bridges and car park, DOO CCTV and copier adjustments to support the relocation of the stop car marker. NR also reports completion of the dark fibre communications link to support Back-Up Control Facility (BU CF) and TUCA.

3.7 Completion and Handover of Integrated Systems¹⁵

We have noted in Section 3.2 CRL’s intention to formalise a revised delivery strategy. In practice, the schedule will retain the current completion philosophy of Blockade Working, built around a basic two-week working pattern split between 11 days of construction in ‘blockades’ and 3 days of dynamic testing in ‘windows’. CRL sees this as the optimum balance to deliver earliest completion of installation, while allowing meaningful progress with dynamic testing, commensurate with test case availability, software bug fixing and defect correction.

Completion of rail infrastructure remains CRL’s declared priority. This provides the significant benefit of avoiding the constraining effects of working under the RfL ROGS railway rulebook. CRL is targeting 22 October 2018 for the completion of linear rail system works. Thereafter, CRL intends to operate a weekly 5 weekday dynamic testing and a 2-day weekend construction cycle, handing over what is anticipated will be a completed rail infrastructure for extended periods of dynamic testing.

¹⁴ CRL confirmed substantial completion for Abbey Wood station at Sponsor Periodic Update - ONW Surface Works 9 August 2018.

¹⁵ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

We have reported on key areas of risk in past reports, and CRL has effectively distilled these into nine critical paths leading to Stage 3 Opening as noted in Section 3.2. We describe these paths and their key workstreams below.

1. Completion of Routeway (██████)

The principal outstanding linear activities are installation of lighting and LV power, drainage, fire mains; and the removal of temporary services (e.g. lighting, radio, fire main and power supplies). CRL intends to achieve all installations by 22 October 2018, but the removals are logistically difficult to complete and are not strictly a priority. For example, ██████ uses the construction radio to manage dynamic testing activities, and retention of the system, along with its associated temporary power supplies, is necessary until the end of the dynamic testing period. We understand that CRL has held encouraging discussions with RfL concerning the transfer of the scope of equipment removal to the IM. Completion of linear works remains largely within ██████ control; of greater concern is the need to interface with SSP installation, completion of which continues to slip.

2. Signalling (██████)

██
██
██
██
██
██

3. Tunnel Ventilation (██████)

The retention of temporary ventilation systems that support tunnel construction activities has frustrated progress with permanent tunnel ventilation installation. Delays at ██████████ and ██████████ in particular have the potential for greatest impact upon routewide completion of the permanent ventilation system. The planned progressive reduction in the use of diesel-hauled construction trains during August, September and October 2018 provides an opportunity for earliest staged removal of temporary works. CRL is satisfied that Phase 3 integration testing of the Tunnel Ventilation System is achievable prior to the completion of installations at Bond Street.

4. Radio (██████)

Completion of GSM-R remains a priority. It is a precursor to any formal asset handover to RfL (using it as an Operations and Maintenance Radio) as well as to any train operations once the ROGS rule book is in place on the trace. An additional workload for radio system testing arises from the different types of radio systems installed on the Central Section and the need to prioritise completion to align with different handover and operational requirements. Simplistically, were all radio installations complete in the SSPs, multiple radio systems testing could be undertaken in a single ‘sweep’. That will not be the case under the current schedule and ██████ must manage a similar resource peak to that associated with SCADA testing.

5. Dynamic Testing

See Section 3.8 below.

6. HV Non-Traction Power ██████████

Delivery of HV systems continues, although further slippage of the ‘daisy-chain’ sequence end date has occurred, with the final energisation now due to take place at Royal Oak Portal in mid-September 2018. Some SSP sites have continued to struggle with the completion of downstream LV networks, energisation of which is necessary for ██████ completion and commissioning of railway support systems such as tunnel lighting. The discovery outside Crossrail of faulty Air Circuit Breakers (ACBs), of the type being installed as part of Stations scope, has compounded these difficulties. Inspections of the 97 units installed on the Central

Section have been completed with no faults found, and previously halted LV energisation processes can resume. Late completions and unexpected faults further undermine CRL’s ability to deliver permanently energised and fully tested systems in support of Phase 3 testing.

7. Traction Power (████)

████ continues with a programme of equipment commissioning to complete the original scope of Traction Power Supply. Examples include those Section Switches that were not required to support first energisation or initial stages of dynamic testing. There is particular focus on the works necessary to re-configure PML ATFS to supply both the Central Section and the GEML.

8. SCADA and Communications (████)

Schedule drift continues to demand flexibility from █████ resources and to impose reactive short-term planning on █████ delivery. The still increasing bow-wave of Phase 3 tests has driven an industry-wide search for testing resources, yielding some, but only limited, success; CRL and █████ continue with their search efforts. The TCCRP¹⁶ has given approval to the uploading of Central Management System (CMS) software version 3.4.3 that releases much previously unavailable functionality. This release significantly increases the Phase 3 testing opportunity for installations that have been completed and certified.

9. Stations, Shafts and Portals (SSP) Completion

Delivery of all SSP Rail Systems related works is critical to overall railway completion and formal handover. There are many system ‘touch points’, including electrical, mechanical, data network (i.e. for SCADA connectivity), and much work remains to allow Phase 3 testing to be carried out in anything other than a piecemeal manner. While CRL/contractor co-ordination has improved over the planning of activities to meet common interface deadlines, we are concerned that the focus on dynamic testing is distracting attention from a potentially overwhelming workload at SSPs. This, in turn, brings with it a related assurance documentation workload that a reducing workforce will struggle to deliver as contractor and CRL resources are de-mobilised.

The table below summarises the progress to date with the production of test certification, and illustrates the size of the challenge facing CRL and the Contractors.

Test Phase	Phase Completion Certificate	Forecast %	Actual %
2.1 (Intermediate Static Test)	Installation Release Note (IRN)	79	45
2.2 (Pre-Commissioning Test)	Pre-Commissioning Certificate (PCC)	77	12
2.3 (System Static Test)	Partial Acceptance Certificate (PAC)		
3 (Static Integration Test)	Acceptance Certificate (AC)	72	5

Figure 3 - 2 ~ Progress to date with the Production of Test Certification

While the critical paths provide correct insight and focus onto delivery priorities, MOHS provides only a simplistic model of how the many complex workstreams will converge and integrate. It is important to retain a view across all aspects of delivery, drawing in the accompanying assurance documentation, training and safety approval workload. Actual progress has shown MOHS 2018 to be highly optimistic, with progressively increasing schedule compression finally unable to be absorbed without impact upon key milestones. It is essential that CRL applies the lessons learned to its revised strategic delivery schedule. Sufficient time provision must be

¹⁶ Testing & Commissioning Configuration Review Panel Meeting held on 2 August 2018.

made for the outstanding scope, including float to absorb imperfect delivery and unforeseen events. We expect to provide commentary on CRL’s revised plans next period.

3.8 Dynamic Testing

3.8.1 Dynamic Testing Strategy

CRL continues with dynamic testing in ‘windows’ which alternate with construction blockades. The timing of the windows is adjusted according to dynamic testing success, and CRL tends to make schedule changes to accommodate unfinished work or to maximise an opportunity with NR. The current programme and latest dates¹⁷ for the remaining dynamic testing windows are as follows:

9. 24 – 28 August 2018 (All Zones);
10. 7 – 11 September 2018 (All Zones);
11. 14 – 18 September 2018 (All Zones);
12. 28 September – 2 October 2018 (All Zones).

Planned signalling transition testing aligns with possessions at the NR GEML and GWML interfaces as follows:

- GEML 25 / 26 August (Dynamic Testing Window 9);
- GWML 8 / 9 September (Dynamic Testing Window 10);
- GWML 15 / 16 September (Dynamic Testing Window 11);
- GEML 29 / 30 September (Dynamic Testing Window 12);
- GWML 4 November 2018 (No corresponding Dynamic Testing Window).

Multiple-train testing under signalling protection was scheduled to start during Dynamic Testing Window 7 on 28/29 July, but RAB(C)¹⁸ was unable to approve the Safety Argument. CRL now plans for multiple train testing in Dynamic Testing Window 11. Dynamic testing will continue under the C610 Construction and Commissioning Railway Rule Book (CCRRB).

Agreement to extend the validity of the rule book is already being sought with the ORR. Further details on the approach to the ORR, including any requirement to increase the number of trains permitted to operate under multiple train testing, will become clearer once CRL’s schedule for dynamic testing and its strategy for test train management is known.

While CRL continues to review with [REDACTED] the full scope of signalling tests on the Central Section, CRL has acknowledged that the workload still significantly exceeds what is provided for in the remaining dynamic testing windows.

3.8.2 Dynamic Testing Progress

CRL has completed eight of the original dynamic testing windows, although a small number of short-length subsidiary windows have also been undertaken. It has not been possible to complete the full planned scope of tests for most of the testing windows, in many cases because of unresolved asset defects (e.g. broken track switches), temporary unavailability of rolling stock or insufficient asset maintenance leading to issues such as inadequate radio coverage. All parties to testing agree Action Plans for rectification at the end of each day of dynamic testing, but disruption to planned work remains at an unacceptably high level.

¹⁷ CRL MOHS Period 4 Review held on 3 August 2018.

¹⁸ RAB(C) Meeting held on 18 July 2018.

Test train running across the NR GEML interface was carried out for the first time during Dynamic Testing Window 8. CRL used the outputs from previous windows to tailor the testing scope, but as with the initial runs on the Central Section, the results were mixed. [REDACTED]

[REDACTED]

This is reflected in the latest testing statistics, which show a pass level of 34 against a cumulative revised total of 311 signalling test cases¹⁹. We understand that the increase in the total number of test cases is due to the inclusion of those associated with the NR interfaces. Availability of test cases ([REDACTED]) has become less of an issue over time, but absolute functional alignment of Rolling Stock and Signalling software releases which would simplify integration testing has yet to be achieved, and is a goal for future planning for dynamic testing.

3.9 Approvals, Assurance and Agreements

3.9.1 Final Design Overview (FDO) Performance

Outstanding FDO issues are now insignificant in the context of wider assurance issues described in the following Sections, therefore we no longer report on this. Further information, if required, is included in CRL’s Board Report.

3.9.2 Interoperability

This issue is now covered in Section 3.9.4.

3.9.3 RAB(C)

RAB(C) meets as required to review formal submissions in line with CRL and RfL requirements but CRL continues to miss its own submission deadlines.

CRL did not secure final acceptance of the Safety Argument for Multiple Train Testing because [REDACTED] supporting documentation did not align with the previously agreed principles for submission and acceptance. The delays in fully addressing this issue have caused signalling transition testing to become a greater priority, and with CRL attention focussed upon the completion of the relevant Safety Argument for the GEML interface, the document has now been accepted by RAB(C)²⁰.

RAB(C) continues to support the development of documentary processes for RfL-I in preparation for stepping-up as IM. It will consider submissions in the near future for the testing and commissioning of Yellow Plant during Dynamic Testing and Combined Trials, which facilitate the securing of operational licences for use under ROGS rules.

Figure 3 - 3 shows the key Engineering Safety Management submissions for the Stage 3 Safety Case with CRL forecasts. The deadline for submission of all contractor ESJs to CRL has been

¹⁹ Performance data confirmed in CRL Weekly Dynamic Testing Report Period 5 Week 2.

²⁰ Additional RAB(C) Meeting held on 8 August 2018.

re-scheduled to 1 November 2018, which is not credible in the context of Stage 3 Opening in December 2018. We expect these dates will be revised when the new delivery strategy is approved.

No	Key Dates	Revised MOHS 2018	Period 3 actual / forecast	Period 4 actual / forecast	
1	Contractors submit draft ESJs to CRL	31-Mar-18	13-Jul-18	31-Aug-18	*
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	deleted	deleted	
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	deleted	deleted	
4	Contractors submit final ESJs to CRL	30-May-18	30-Jul-18	01-Nov-18	*
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	30-Jul-18	20-Sep-18	*
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Aug-18	30-Aug-18	
7	Final COS Safety Case updated and submitted to RAB-C	20-Sep-18	20-Sep-18	20-Sep-18	
8	Submit Technical File to ORR	09-Nov-18	09-Nov-18	09-Nov-18	
	* In-period delay				
	Note - Key Dates 2 and 3 were deleted at Period 3				
	Note - Key Dates 7 and 8 Baseline dates were adjusted at Period 3				

Figure 3 - 3 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

3.9.4 Regulatory Approvals

CRL has continued to judge the overall rating of Stage 3 with regard to Approvals as ‘red’. We agree with this assessment. The primary reason for this ranking is the delay in providing evidence to RAB-C, AsBo, NoBo and hence the ORR.

The design element of the assurance process, as expected at this stage of the project, is nearly complete. For example, 21 from 25 Design Engineering Safety Justifications (DESJ), provided by Tier 1 contractors and 10 from 12 Safety Engineering Justifications (provided by CRL’s CEG) are accepted by RAB-C. The remaining key issues for design assurance are:

- [Redacted]
- [Redacted]
- [Redacted]

As we discussed in our last report, the AsBo has been requested by CRL to begin drafting chapters 1, 2, 3, 4 and 5 of the Safety Assessment Report (SAR), which cover Energy and Infrastructure. The aim was to complete these chapters by the end of September, and chapters 6 and 7 (Systems and PRM) by the end of October 2018. The AsBo is likely to make some progress based upon design evidence, but to complete the chapters will require physical evidence from the construction and Testing & Commissioning programmes. As described earlier, this is behind plan, to an extent that it makes it unlikely that the SAR is ready in time to support a December 2018 opening.

It is a similar situation with regard to Interoperability compliance. There has been some progress in this period in completing the outstanding design evidence, and many areas (e.g. [Redacted] station) are now 100%. However, the NoBo has so far been provided with virtually no evidence of construction or T&C compliance. As with the SAR, it is unlikely these will be ready in time.

21 [Redacted]

There are four agreements that are adjudged to be amber, two less than last period. These are:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- IM Interface manual between NR and RfL-I;
- Development Service Agreement between NR and RfL-I.

The two agreements that were amber and now adjudged to be 'green' are:

- Framework Project Services Agreement between NR and RfL-I;
- Connection Agreements at Abbey Wood, Pudding Mill Lane and Westbourne Park between NR and RfL-I.

Progress of the four agreements is laborious, but there continues to be dialogue between the parties involved. We believe that resolutions will be found as deadlines approach.

In our last report, we said that RfL was reporting that 5 August 2018 was the deadline for signing. This was because at that point, according to an earlier schedule, RfL was expecting to take control of the railway and start Trial Running. As that is now not scheduled at 1 October 2018, the date of 5 August 2018 has lost its significance.

There are 38 Critical Agreements to be put in place to enable Handover and operations, and Operational Agreements (22 RfL-I, 11 LU) account for the majority of the outstanding critical list (87%). The charts in Appendix C indicate the slow progress in delivering these agreements.

3.10 Rolling Stock

In our last report we said that the passenger services version of TCMS v7.2 was forecast to be ready by end of August 2018. It is now forecast to be ready by end of October 2018. RfL is waiting for a detailed plan from BT to confirm this forecast.

[Redacted]

The key milestones before Passenger service are transition and multi-train testing. The train now has the functionality and approval to carry out transition testing (see Section 3.8.1). Multi train testing is scheduled for 17 September 2018.

[Redacted]

3.11 Handover

There continue to be improvements in the delivery of training and asset information during this period. However, [Redacted]

22 [Redacted]

[REDACTED]

Training

Training delivery continues its overall improvement from last period. If courses are not being completed then it is normally due to the asset being unavailable, rather than a lack of a trainer or course materials. RfL-I is trying to mitigate the situation by seeking access to the same type of equipment at other locations on the trace.

O&M Manuals

There has been marginal progress with O&M acceptance (14 in Period 3, 21 in Period 4 from a total of 804). However, [REDACTED]

Workshops are now planned to resolve comments, circumnavigating the lengthy review process. We will be monitoring this approach to see if it bears fruit.

Asset Information

The flow of Asset Information to the IMs has continued to slowly improve in this period. The issues to resolve are:

- The quantity and quality of information from [REDACTED] is generally poor;
- [REDACTED] and [REDACTED] Asset Information has shown little improvement over a number of periods;
- RfL-I continues to have issues with receiving the information.

It is important to note that we have been reporting upon the information provided to IMs by CRL. There will be another exercise to carry out where IMs carry out VAPs (Verification Assurance Procedure) upon the information to assure themselves it is suitable.

Handover Master Deliverable List

So far RfL-I has accepted circa 4% of the HMDL allocated to it, and LU has received 12% of the HMDL allocated to it. There will be a challenge for IMs in receiving and reviewing the bow wave of documentation in the time allowed.

To mitigate the delays, CRL is seeking to agree with the [REDACTED] and the IMs as to when drawings, initially as red line, will be provided. It is likely to be more problematic for Systems than it will be for Stations, Shafts and Portals.

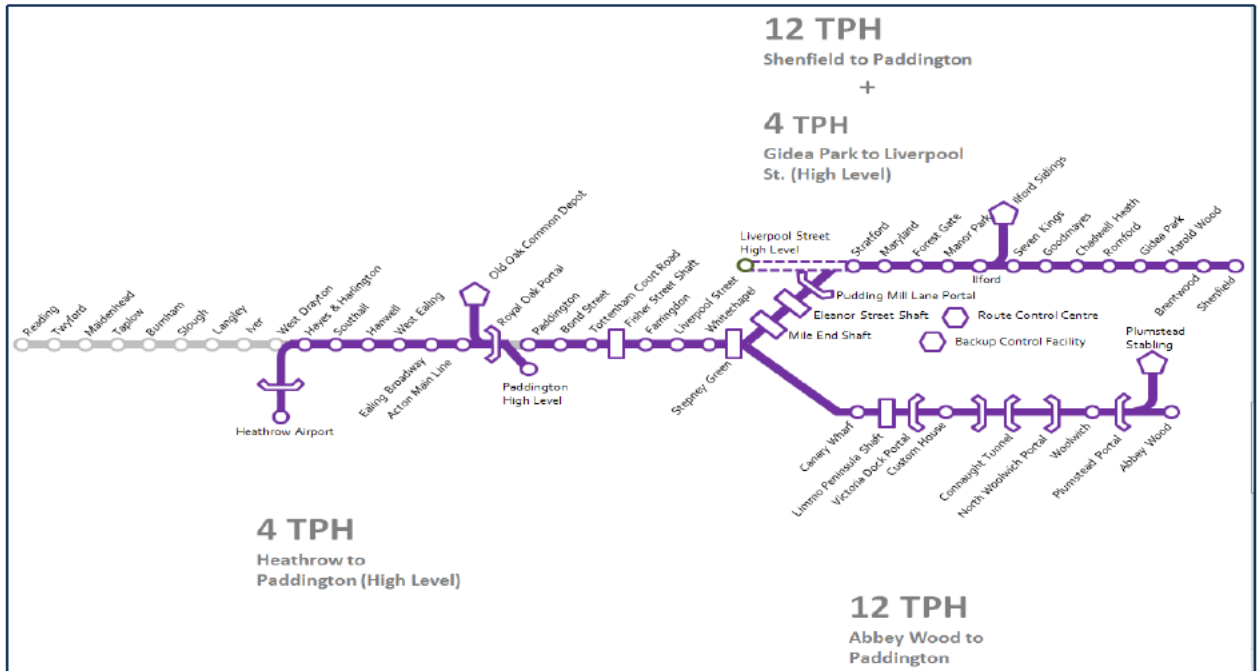
3.12 Combined Trials

CRL is undergoing work to evaluate the impact of schedule delays upon Stage 3. It intends to submit proposals to Sponsors, as noted in Section 3.2. We will evaluate what that means for Combined Trials, or Trial Running / Trial Operations, at that point.

3.13 Plumstead Depot

Window installation to the Accommodation Building and cladding of the Maintenance Building were started in the period. Land handover from C610 is a reducing schedule risk.

4 Stage 4: Paddington to Abbey Wood & Shenfield; Due 19 May 2019.



4.1 Summary

4.2 Operational Readiness Assessment

There are three Readiness Tasks that have been given a 'Red' status by the ORSG²³, one more than in our last report. The overall rating for Stage 4 is 'Red'.

Readiness Task	Issue
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	Capacity modelling to understand the implications for the degraded scope have been delayed by circa 4 weeks. MTR-C must submit a timetable in August based upon findings. NR also needs a plan to deliver such findings.
DOO CCTV installed and operational Stratford and Shenfield stations	Plans with contractors need to be agreed, and completion dates are very close (May 2019) to service opening.
NEW Station Information & Security System (SISS) stations and RCC	The interim solution (for opening) has been dropped due to the late delivery of NR's Control Room Equipment programme and the more advanced state of C660 works. The completion of NR's Communications Equipment Room (CER) is now the more critical element.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with 'Red' Status

²³ 16 July 2018.

4.3 Ilford & Romford Stations

NR reports that the GRIP 5 design for Ilford & Romford Stations being carried out by Atkins, due in August 2018, is now forecast for September 2018. NR has awarded an Early Contractor Involvement (ECI) contract to Volker Fitzpatrick under its Anglia Multi-Functional Framework (MFF) to commence pricing and planning of works. The ECI Contract was due to be let in June 2018 using an existing framework, but was deferred to mid-July 2018 with the main works Contract award forecast for October 2018. However, NR will now be issuing its main works tenders for return in October 2018 with the prospect to award contract in November 2018. To mitigate this one month delay, NR is assessing the options to carry out an advanced Works Package at Christmas 2018 in order to recover programme; NR remains committed to station opening for December 2019. The key dates we shall continue to monitor to assure that progress remains on schedule are:

- GRIP 5 complete – September 2018;
- GRIP 6 Tender return – October 2018;
- GRIP 6 Contract award – November 2018.

4.4 ONW

Stage 4, KO5A – (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) (10 September 2018).

At Period 4, the Anglia Traction Power Works required for Crossrail Stage 4 (ATF distribution to support Stage 4) is still being forecast by NR for May 2019. However, the Traction Power upgrade to AT mode is at risk of slipping beyond the planned date of May 2019. The initial traction power modelling report has been received by NR and the findings (yet to be verified) show that reinforcement of the current power supply as far as Gidea Park is likely to be necessary. The formal project schedule to demonstrate if the scheme can be delivered by start of Stage 4 will not be available until 17 August 2018. Consequently, a review of the NR study will be carried out to assess the impacts the service frequency in the event that the power upgrade is unavailable for Stage 4.

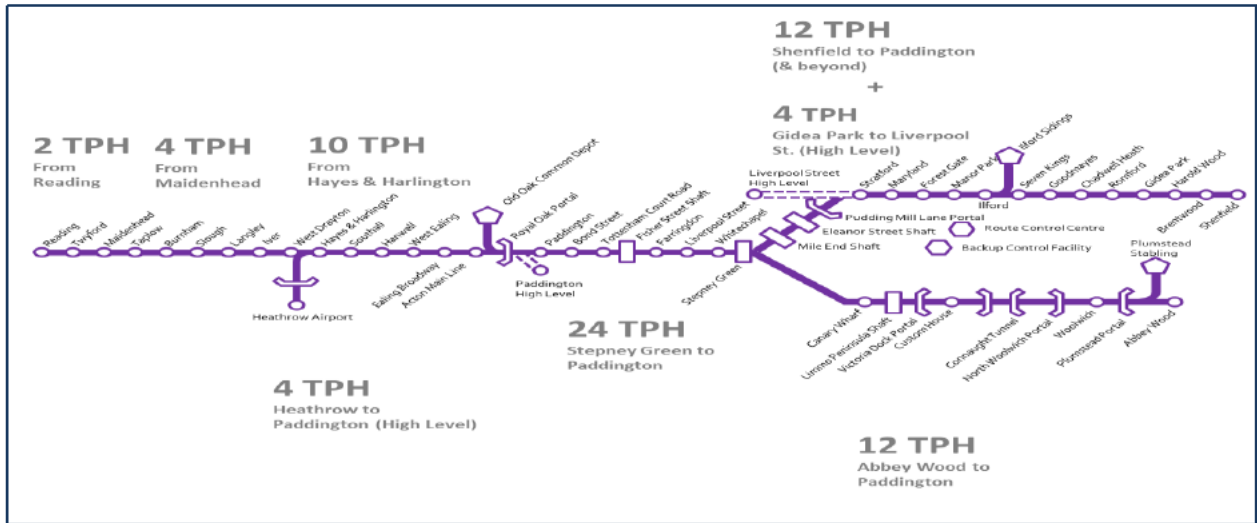
NR is reporting the traction power modelling status as:

- Inputs included – Crossrail Concept Train Plan, power loading requirements from BT;
- First outputs received for PML with further outputs due to follow shortly;
- Modelling continuing in parallel to delivery plan.

The remaining telecoms immunisation works that were impacted by the concentrator programme, the auto transformer (ATF) and bonding scope have been removed from the Costain contract and will be procured under a separate contract. [REDACTED]

[REDACTED] transfer remaining works to Keltbray – this is underway with Keltbray expected to be in contract imminently. A programme for these works will need to be agreed by NR. These worksopes have been moved from KD22 and KO5A to the new KO6A (May 2019).

5 Stage 5: Reading & Heathrow to Abbey Wood; Due 8 Dec 2019.



5.1 Summary

The key risk at this stage is the completion of the western stations upgrades.

5.2 Operational Readiness Assessment

There are three Stage 5 Readiness Tasks that have been reported as a 'Red' status to the PDB on 31 July 2018, a decrease of one from our Period 3 report.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	As ETCS will not be implemented by Dec 2019, CRL will now begin to report upon 'plan B', the implementation of a Stage 5 service dependent upon a CBTC/TPWS transition. Siemens has carried out preliminary works, and will need final instruction by November 2018.
ONFR Western station upgrades complete	The delay to the procurement schedule, and [REDACTED] remain unresolved. [REDACTED] [REDACTED] [REDACTED]
ORR issue APIS for ETCS (Stage B & C)	This is linked to 'ETCS available and tested airport Jn' task. It is no longer reported on the dashboard, but we are not unduly concerned. CRL has little influence over the matter and is trying to implement a 'plan B'. NR will report progress.
DOO CCTV GWML outer stations	Forecast to start on site October 2018, reviewing plan to new Key Date (KO6B – 1 Dec 2019).

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with 'Red' Status

5.3 Network Rail Works

5.3.1 Platforms and Stations

NR reports that bidders for the West Enhanced Stations Tender Packages 2 (Acton, Ealing, West Ealing) and 3 (Southall, Hayes & Harlington, West Drayton) have been granted a further two week extension of time for re-bidding using the completed GRIP 5 AFC status designs. Package 3 tender returns have been received by NR, and award is expected in late September 2018. Package 2 award is expected in early October 2018. NR has also identified a [REDACTED]

CRL reports that NR has not yet been able to provide sufficient information to CRL to validate such amounts.

The critical path activities are:

- Works at Christmas 2018 for which NR is engaging alternative framework suppliers to complete advanced works;
- Securing weekend possessions from December 2018 to May 2019 – NR has now secured the total access required with GW.

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):

NR reports that it continues to progress the application of the Authorisation to Place into Service (APIS) with the ORR, with a revised forecast that this process will be completed by August 2018 instead of the previous mid-July 2018 expectation. This short delay does not compromise the scheduled APIS required date. We will monitor a potential emerging issue where NR report that HAL require a full risk review on the End of Authority issue and commercial assurance prior to accepting the asset back into service. NR is working with CRL to dynamically prove the Operational Concept as part of the CRL '39 Tests' but it is still waiting on [REDACTED] acceptance of the transfer of hazards. This acceptance is required to close one of the gaps in Network Rail's Safety Justification Report (SJR) and progress to 'putting into use'.

Stages B & C (Stockley-Acton & Acton-Paddington):

NR has confirmed that the Exemption Status meeting was held with the ORR and industry partners on 12 June 2018 and reports that the ORR is supportive of a new Exemption request. NR is now commercially engaged with Sotera (who undertook the original risk analysis work stream) to work on this new scope of works and a contract 'kick-off' meeting is scheduled to take place during the course of Period 5.

NR continues to review the options for recovery of the programme, which is currently showing an unmitigated delay of approximately three months to the Stage C commissioning following delays in the integrated laboratory testing and infrastructure data provision.

The GSM-R GRIP 5-8 Contract has been awarded to Siemens and the Clause 14 Programme received by NR in Period 4 is currently under review.

5.4 ONW

NR has instructed advanced works at West Outer stations (DOO CCTV, platform extension works) to Amey. Further instructions for Slough and Maidenhead works are in progress. Although NR has confirmed that the Works for upgrading the traction power to AT mode have been completed to CRL's requirements, the full completion of the system upgrade (for IEP trains) is contingent on electrical bonding works at Paddington which are forecast to be completed for February 2019.

The remaining Traction Power Supply (TPS), Enhanced Stations and West Outer Stations scope has been transferred to the new Key Output 6B (KO6B), forecast completion due December 2019. All remaining scope for KO5B and KD24 is due to be completed by 10 September 2018. The outer area AT system has been available to commission from May 2018 and the inner area AT system available to commission from July 2018. NR is currently forecasting the conversion of the OHLE to AT power on Western Route for February 2019 to deliver full ATF for the planned February timetable change. [REDACTED]

[REDACTED]

[REDACTED]

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI decreased slightly²⁴ during Period 4 but remained well above target, with all 11 Principal Contractors (PCs) again scoring over 2.20. The RIDDOR and Lost Time Case (LTC) AFRs remained as before, with both measures remaining well within target. CRL and the PCs are aware of the usual peak in adverse safety performance on major projects nearing completion, so are looking to re-focus on this risk; known as the ‘Finish Safe’ campaign.

The High Performance Near Miss (HPNM) rate reduced slightly during Period 4. This is not of concern; however, the recent trend of falling H&S reporting levels is of concern. We are aware that this has been raised with the PCs, who are working to increase reporting to previous levels.

H&S KPI	Target	Aim	Period 3	Period 4
HSPI	2.20	-	2.61	2.60
PCs scoring over 2.20	11	11	11	11
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.16	0.16
HPNM Rate	na	na	0.20	0.19

Figure 6 - 1 ~ Health and Safety Performance COS

There were 5 significant incidents during Period 4; a RIDDOR (SiteStation storage box injured pelvis), 3 LTCs (cut leg, falling light fitting, SiteStation box injury) and 1 HPNM (diesel fumes at Canary Wharf Station). Many of the incidents over the last few periods have been the result of poor communications. Research has been carried out on this issue, and some changes will be made in future. CRL and the PCs have also focused on hazards due to buried services, especially as Urban Realm works increase outside the SSPs site footprints.

As noted in our previous report, CRL continues discussions with the IMs regarding access to work sites after Staged Completions, and ‘The Railways and Other Guided Transport Systems (Safety) Regulations 2006’ (ROGS) are implemented. The CRL H&S Director has confirmed²⁵ that he expects joint arrangements to be in place in good time for this key milestone; the date is currently under review.

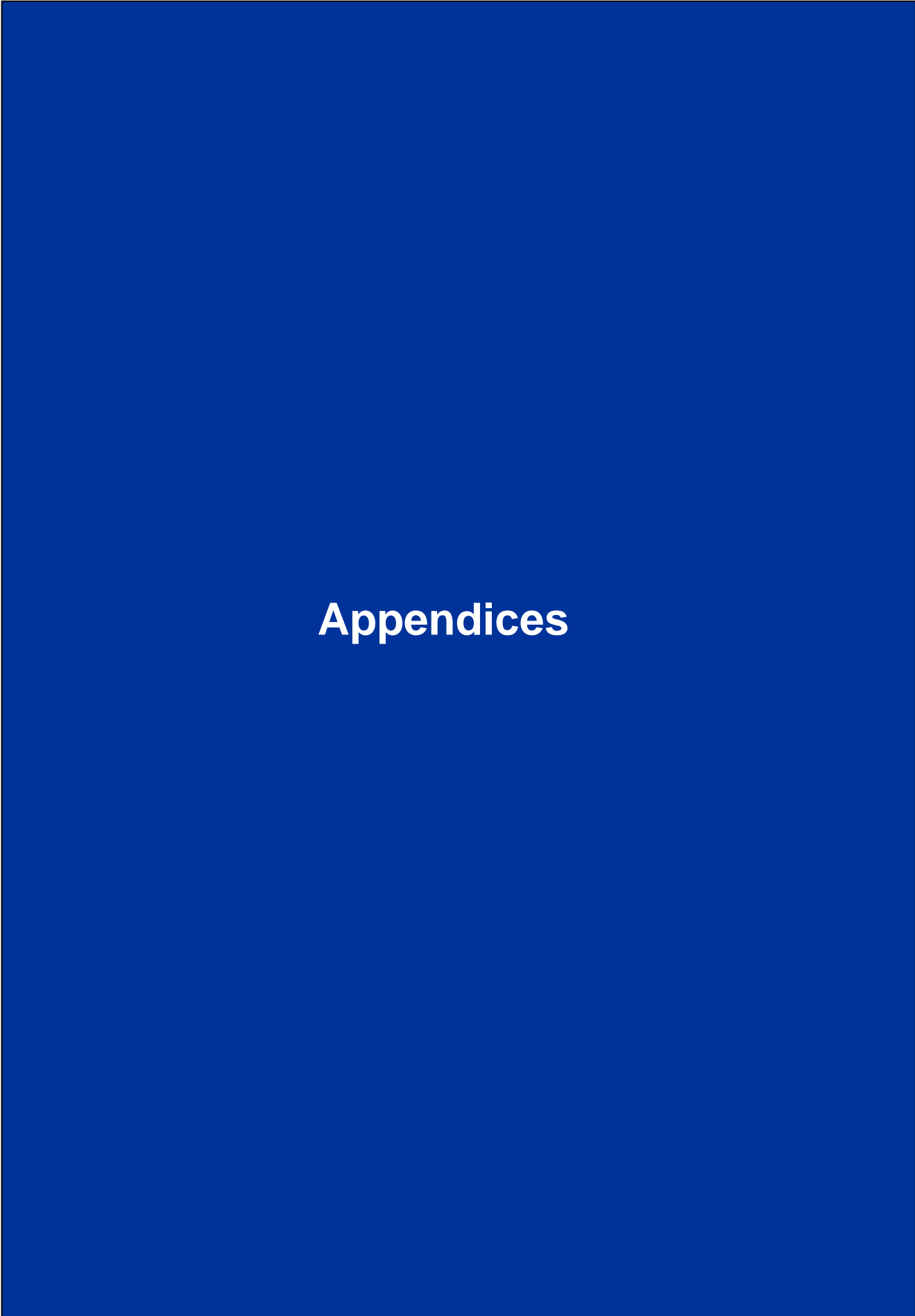
The London Fire Brigade (LFB) Officer has now left the project, but support is still available as required. Practical exercises have begun to allow local Commanders to become familiar with the new Crossrail facilities.

6.2 Health & Safety Performance ONW (NR)

During Period 4, NR’s rolling 13 period Lost Time Incident Frequency Rate (LTIFR) decreased from 0.1467 to 0.1368. NR had no lost time incidents in Period 4, but suffered one near miss in respect of a removed OHLE earth bond near Kensal Green. The Programme’s overall All Injury Rate decreased from 0.72 to 0.70 injuries per 100,000 hours worked.

²⁴ CRL revised the Period 3 HSPI from 2.59 to 2.61.

²⁵ Meeting 2 August 2018.



Appendices

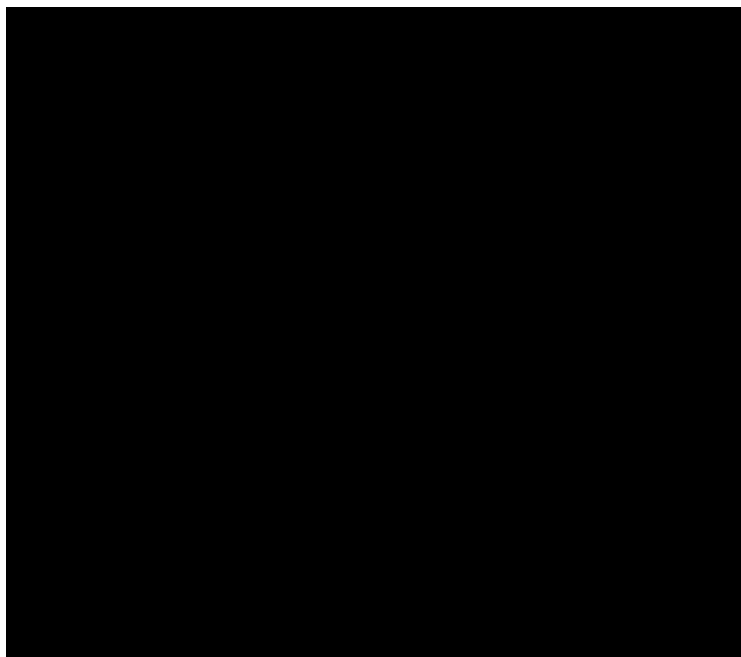
Appendix A Corporate Milestones & Anchor Milestone Progress

Figure A - 1 indicates²⁶ the CRL Corporate Milestones (shown as Period 1 Baseline) alongside the relevant dates from MOHS 2018 and latest CRL Period forecasts.

Corp Mstone	Description	Period 1 Baseline	MOHS 2018 EDBL	Period 3 Forecast	Period 4 Forecast
1	All 11KV SS&P Non-Traction Power Locations Energised	April	15-Apr-18	11-Jul-18	11-Jul-18
2	CBTC Auto Reverse and Isolated ETCS Testing Complete at Melton	April	06-Apr-18	27-Apr-18	27-Apr-18
3	Stage 2 Phase 1 Service Introduction PAD to Heathrow	May	20-May-18	20-May-18	20-May-18
4	West Enhanced Stations contract award	June	08-Apr-18	SEPT	SEPT
5	Start Dynamic Testing in Zones 3 & 4	June	11-Jun-18	11-Jun-18	11-Jun-18
6	CBTC Authorised for FLU for Trial Running	June	22-Jun-18	04-Jul-18	10-Aug-18 *
7	ESS - ECHR Complete for Handover to Infrastructure Manager	July	03-Jul-18	31-Aug-18	07-Sep-18 *
8	Commence Pre-Trial Running	Aug	05-Aug-18	SEPT	SEPT
9	22no. CI.345 FLUs Available for Trial Running	Aug	13-Aug-18	13-Aug-18	13-Aug-18
10	CRL central section Safety Case updated and submitted to RABC	Sept	20-Sep-18	20-Sep-18	20-Sep-18
11	PAD - ECHR Complete for Handover to Infrastructure Managers	Sept	07-Sep-18	15-Oct-18	26-Nov-18 *
12	Submit APIS for Central Section to ORR	Sept	17-Sep-18	09-Nov-18	09-Nov-18
13	Commence Combined EL Trials and HO under ROGS	Sept	01-Oct-18	01-Oct-18	01-Oct-18
14	Class 345 CBTC Signalling auth for Passenger Service by ORR	Oct	10-Oct-18	OCT	29-Oct-18 *
15	LIS - ECHR Complete for Handover to IMs	Nov	24-Oct-18	24-Oct-18	23-Nov-18 *
16	Opening of Stage 3 - Central Section PAD to ABW	Dec	09-Dec-18	09-Dec-18	09-Dec-18
17	Plumstead - First Stage Maintenance Sidings and connection to COS	Dec	21-Nov-18	21-Nov-18	21-Nov-18
18	Plumstead Stabling Sidings - ECHR Complete for Handover to IMs	Feb	29-Mar-19	29-Mar-19	29-Mar-19
	Forecast later than Period 1 Baseline				
	Forecast earlier than Period 1 Baseline				
	* In period movement				
	ECHR = Element Completion Handover Report				
	Milestones 10, 12, and 13 were adjusted due to Combined Trials strategy				

Figure A - 1 ~ Corporate Milestones

Figure A - 2 indicates the status of Anchor Milestones cumulative progress at Period 4.



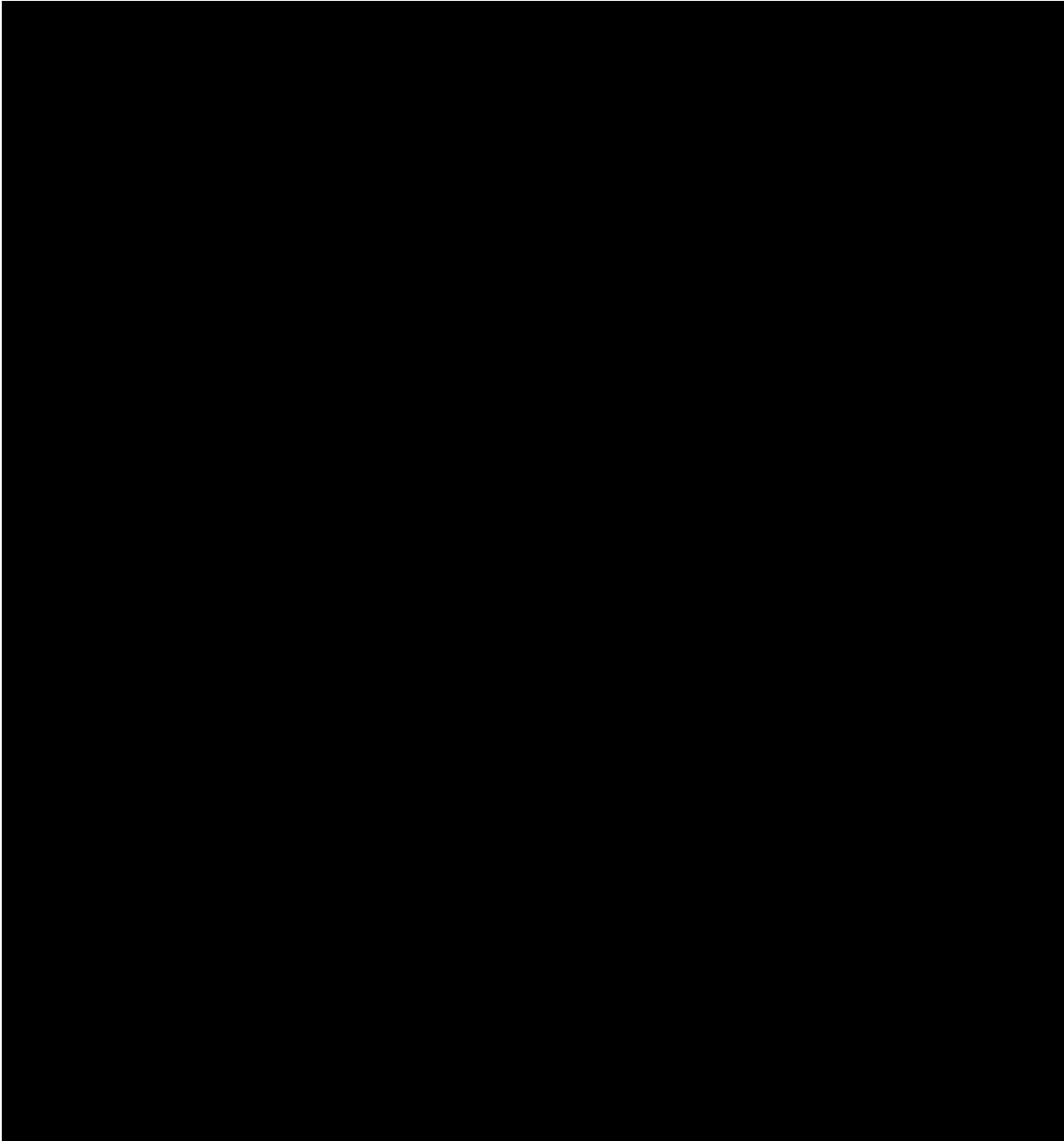
²⁶ SS&P = Stations Shafts and Portals, FLU = Full Length Unit, ESS = Eleanor Street Shaft, ECHR = Element Completion Handover Report, ABW = Abbey Wood.

ID	Anchor Milestone	MOHS Baseline Date	MOHS Baseline Date	Actual / Forecast Period 3	Actual / Forecast Period 4	Period delay in days	MOHS (rev) delay in days
A276	C412-BOS-A276 ETH PDA Milestone 11 Site available to commence Bond Street Station Eastern Ticket Hall OSD	11-Jun-18	12-Jul-18	19-Jul-18	23-Jul-18	4	11
A719	C820 -A719 Signalling infrastructure ready for DT in Zones 3 & 4	23-Jul-18	23-Jul-18	23-Jul-18	24-Jul-18	1	1
A160	ONW - RW - KO2 Infra.Capability Abbey Wood-Cent. Core Area at Plumstead Portal, Straford-Cent. Core Area, OOC-WB Park	30-Jun-18	30-Jun-18	30-Jun-18	31-Jul-18	31	31
A635	C360 - ESS - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	05-Jun-18	03-Aug-18	03-Aug-18	10-Aug-18	7	7
A743	Training material submitted in readiness for training delivery	05-May-18	05-May-18	31-Jul-18	10-Aug-18	10	97
A696	CBTC Authorised for Pre-Trial Ops (CBTC Integrated)	26-Jun-18	05-Aug-18	04-Jul-18	10-Aug-18	37	5
A645	C336 - ROP - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	31-May-18	03-Aug-18	04-Jul-18	13-Aug-18	40	10
A634	C360 - LIM - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	22-May-18	03-Aug-18	03-Aug-18	17-Aug-18	14	14
A684	SS&P Fire Mains Ready for Integration Zones 3&4	05-Jul-18	15-Jul-18	01-Aug-18	17-Aug-18	16	33
A709	C650-A709 All 22 kV S,S&P locations energized	30-Jun-18	30-Jun-18	29-Jul-18	18-Aug-18	20	49
A685	C435-FAR-A685 Completion of All Phase 3 Testing Enabling Removal of Hoarding	22-Jul-18	22-Jul-18	01-Aug-18	20-Aug-18	19	29
A636	C350 - PML - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	12-May-18	05-Jul-18	15-Aug-18	22-Aug-18	7	48
A749	COS safety Case submitted to RABC (to facilitate Handover)	30-Jun-18	30-Jun-18	30-Aug-18	30-Aug-18	0	61
A653	C360 - FIS - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	05-Jul-18	03-Aug-18	31-Aug-18	31-Aug-18	0	28
A737	C360 - MES - Ready for Handover to Infrastructure Manager (IM)**	29-Jun-18	03-Aug-18	31-Aug-18	31-Aug-18	0	28
A742	Training completed for MTR in support of Handover	30-Jun-18	30-Jun-18	31-Jul-18	31-Aug-18	31	62
A744	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18	13-Jul-18	31-Aug-18	49	153
A736	C360 - ESS - Ready for Handover to Infrastructure Manager (IM)**	03-Jul-18	03-Aug-18	31-Aug-18	07-Sep-18	7	35
A728	C360 - STG - Stage 5 Room Readiness for Key System Wide Rooms**	29-Jun-18	03-Aug-18	02-Aug-18	09-Sep-18	38	37
A684	C422-TCR-A684 Completion of All Phase 3 Testing Enabling Removal of Hoarding	05-Jul-18	12-Jul-18	17-Aug-18	10-Sep-18	24	60
A723	C810 -A723 All walkway installation complete in Zone 1	29-Jun-18	29-Jun-18	29-Jun-18	13-Sep-18	76	76
A640	C360 - LIM - Ready for Handover to Infrastructure Manager (IM)**	29-Jun-18	03-Aug-18	31-Aug-18	14-Sep-18	14	42
A748	CRL Submit SJs to RABC	07-Jun-18	07-Jun-18	30-Jul-18	20-Sep-18	52	105
A731	C350 - PML - Ready for Handover to Infrastructure Manager (IM)**	25-Jun-18	05-Jul-18	15-Sep-18	21-Sep-18	6	78
A738	C360 - FIS - Ready for Handover to Infrastructure Manager (IM)**	03-Aug-18	03-Aug-18	21-Sep-18	21-Sep-18	0	49
A679	C530-PLU-A679 Handover to Infrastructure Managers	02-Aug-18	08-Sep-18	13-Sep-18	21-Sep-18	8	13
A740	Training completed for RFL in support of Handover	14-Sep-18	14-Sep-18	14-Sep-18	30-Sep-18	16	16
A615	C810 - A615 Complete Pre-Trial Running	08-Sep-18	08-Sep-18	30-Sep-18	30-Sep-18	0	22
A641	C360 - STG - Phase 3 Integration (Scenario) Testing Period to Shaft iAC Completed**	05-Jul-18	03-Aug-18	01-Oct-18	01-Oct-18	0	59
A688	C530-WOO-A688 Completion of All Phase 3 Testing	30-Sep-18	02-Oct-18	12-Oct-18	12-Oct-18	0	10
A166	C435-FAR-A166 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	17-Aug-18	12-Oct-18	19-Oct-18	19-Oct-18	0	7
A675	C512-WHI-A675 Completion of All Phase 3 Testing	10-Sep-18	10-Sep-18	20-Oct-18	20-Oct-18	0	40
A267	C405-PAD-A267 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	09-Aug-18	08-Sep-18	03-Oct-18	26-Oct-18	23	48
A673	C405-PAD-A673 Completion of Phase 3 Testing	28-Jul-18	28-Jul-18	08-Sep-18	26-Oct-18	48	90
A269	C422-TCR-A269 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	13-Jul-18	19-Aug-18	28-Sep-18	28-Oct-18	28	68
A270	C502-LIS-A270 All Fit-Out, M&E, Public Health, Lifts & Escalators, Tested & Commissioned	05-Oct-18	24-Oct-18	05-Oct-18	26-Oct-18	21	2
A665	C502-LIS-A665 Completion of All Phase 3 Testing	05-Oct-18	09-Oct-18	05-Oct-18	26-Oct-18	21	17
A676	C422-TCR-A676 Handover to Infrastructure Managers	10-Aug-18	08-Sep-18	12-Oct-18	26-Oct-18	14	48
A706	CBTC Authorised for Passenger Service	10-Oct-18	10-Oct-18	02-Aug-18	29-Oct-18	88	19
A668	C435-FAR-A668 Handover to Infrastructure Managers	17-Aug-18	08-Sep-18	29-Oct-18	29-Oct-18	0	51
A623	2 Driver Training Units Available to MTR for Stage 2 (Phase 2 - incl. ETCS Functionality)	12-Oct-18	12-Oct-18	05-Oct-18	30-Oct-18	25	18
A734	C360 - STG - Ready for Handover to Infrastructure Manager (IM)**	31-Jul-18	03-Aug-18	31-Oct-18	31-Oct-18	0	89
A747	Tier 1s Submit Final ESJs to CRL	30-May-18	30-May-18	30-Jul-18	01-Nov-18	94	155
A658	C530-WOO-A658 Handover to Infrastructure Managers	31-Oct-18	02-Nov-18	14-Nov-18	14-Nov-18	0	12
A672	C512-WHI-A672 Handover to Infrastructure Managers	08-Oct-18	08-Oct-18	16-Nov-18	16-Nov-18	0	39
A670	C502-LIS-A670 Handover to Infrastructure Managers	24-Oct-18	24-Oct-18	24-Oct-18	23-Nov-18	30	30
A687	C405-PAD-A687 Handover to Infrastructure Managers	07-Sep-18	08-Sep-18	15-Oct-18	26-Nov-18	42	79
A608	CWG-CWG-A608 Handover Station to Infrastructure Manager	05-Jul-18	03-Aug-18	08-Dec-18	08-Dec-18	0	127
A169	ONW - West - KO5B Full Infra.Capability Maidenhead to Central Core Area at WB Park to Support Op. of New Trains (OC18-2)	10-Sep-18	10-Sep-18	30-Dec-18	30-Dec-18	0	111
A535	GRIP 6 - Traction Power - New Substations in AT Mode - West	27-Apr-18	27-Apr-18	30-Dec-18	30-Dec-18	0	247
A178	ONW - NE Spur - KO5A Full Infra.Capability from Shenfield to Central Core Area at Pudding Mill Ln	10-Sep-18	10-Sep-18	29-Mar-19	29-Mar-19	0	200
A179	ONW - NE Spur - KD22 Route clearance & all infrastructure, incl. stabling and sidings updates compl.	31-Aug-18	31-Aug-18	29-Mar-19	29-Mar-19	0	210

Figure A - 3 ~ Anchor Milestones forecast to be later than MOHS [redacted] date

Appendix B COS Stations Target Dates

A summary of the Central Section station completion and Handover dates can be seen in Figure B - 1 below. This table reflects the forecast key dates and milestones, for each station at Period 4, against the MOHS 2018. Date changes are shown as bold text. We expect dates will be revised once the new delivery strategy has been agreed.



Appendix C Agreements

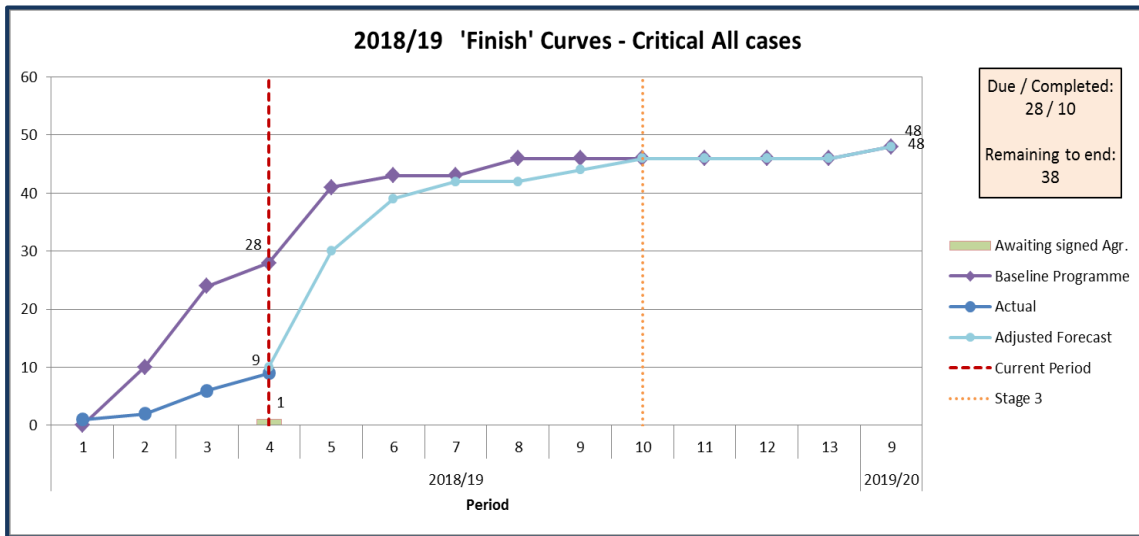


Figure C - 1 ~ 2018/19 Finish Curves – Critical All Cases²⁷

The diagram illustrates the slow pace in completing the agreements that are critical to Stage 3. CRL had been forecasting a significant improvement in Periods 4 and 5, but as can be seen this did not happen in Period 4.

²⁷ Extract from Period 4 CRL Agreements update programme.

Project Representative Team

Project Team

██████████ :
██████████ :
██████████ :
██████████ :
██████████

Project Representative, Safety, Progress, Risk, Stations;
Signalling, Railway Systems, Integration, T&C;
Compliance & Change, Operations, RSD, Assurance;
Commercial, Cost Control, Financial, ONW;
Administration Manager.

Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LIV	Liverpool Street
ABB	ASEA Brown Boverly	LMU	London Metropolitan University
ACBs	Air Circuit Breakers	LO	London Over ground
ACJV	Alstom Costain Joint Venture	LoNo	Letter of No Objection
ACWP	Actual Cost of Work Performed	LoR	Line of Route
AEA	Abellio East Anglia	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AM	Anchor Milestones	MENTOR	Mobile Electrical Network Testing, Observation and Recording
AMS	Agreements Management System	MEP	Mechanical Electrical & Public Health
APIS	Authorisation to Place into Service	MEPA	Mechanical, Electrical, Public Health, Architecture
ARS	Automatic Route Setting	MES	Mile End Shaft
AsBo	Assurance Body - Ricardo Rail	MFF	Multi-Functional Framework
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
ATC	Automatic Train Control	MML	Mott MacDonald Ltd
ATF	Auto Transformer	MOHS	Master Operational Handover Schedule
ATFS	Autotransformer Feeder System	MOS	Member of Staff
ATO	Automatic Train Operation	MPS	Master Plan Shaft
ATP	Automatic Train Protection	MTIN	Miles Per Technical Incident Number
ATS	Automatic Train Supervision	MTIN	Miles Technical Incident Number
ATS	Auto Transformer Station	MTR SMS	MTR Safety Management System.
AWS	Automatic Warning System	MTR-C	Mass Transit Railway - Crossrail
B&PC	Board & Programme Contingency	MV	Medium Voltage
BBMV	Balfour Beatty Morgan Vinci	NCE	Notified Compensation Event
BCA	Bilateral Connection Agreement	NCR	Non Conformance Report
BCWP	Budgeted Cost of Work Performed (Earned Value)	NG	National Grid
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NGET	National Grid Electricity Transmission
BFK	Bam Ferrovial Kier	NKL	North Kent Line
BH	Berkeley Homes	NoBo	Notified Body
BIU	Bringing Into Use	NOW	North Woolwich
BLL	Bakerloo Line Link	NR	Network Rail
BMS	Building Management Systems	NSACS	New Sector Area Cost Summary
BOS	Bond Street Station	O&M	Operations and Maintenance
BP	Business Plan	OCS	Overhead Catenary Systems
BREEAM	Building Research Establishment Environmental Assessment Methodology	OLE	Overhead Line Equipment
BSP	Bulk Power Supply Point	OMC Building	Operations Maintenance Centre
BT	Bombardier Transportation	OME	Order of Magnitude Estimate
BT / PC	Bombardier Transportation / Prime Contractor	ONFR	On Network Functional Requirements
BTH	Blomfield Ticket Hall	ONSIP	On Network Station Improvements Programme

BUCF	S	ONW	On Network Works
BUF	Bottom Up Forecast	OOC	Old Oak Common
C&CSC	Commercial and Change Sub-committee	OOCPA	Old Oak Common Paddington Approaches
CAR	Corrective Action Report	OPEX	Operational Expenditure
CARE	Crossrail Assurance Reporting Environment	Ops	Operations
CBTC	Communications Based Train Control	ORAT	Operational Readiness & Transfer Group
CCB	Current Control Budget	ORR	Office of Rail & Road
CCP	Commitments Compliance Plans	ORSG	Operational Readiness Steering Group
CCRB	Construction and Commissioning Rulebook	OSD	Over Site Development
CCRRB	Crossrail Construction Railway Rule Book	OSP	Operations Safety Procedures
CCSA	Contract Commercial Status Analysis	OTIS	OTIS escalators (company)
CCSC	Commercial & Change Sub-Committee	OTP	Overall Target Price
CCTV	Closed Circuit Television	P2R	Paddington to Reading
CD/RA	Closed Door / Right Away	PA	Public Address
CDG	Competence Design Group	PAD	Paddington station
CDL	Central Door Locking	PCs	Principal Contractors
CDM	Construction Design & Management Regulations	PDA	Project Development Agreement
CDN	Crossrail Data Network	PDB	Network Rail Programme Delivery Board
CDT	Commitments Delivery Tracker	PES	Platform Edge Screen
CE	Compensation Events	PES	Permanent Earthed Sections
CEC	Chief Engineer's Communications	PIP	Paddington Integration Project
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIR	Potential Incident Report
CEG	Central Engineering Group	PLU	Plumstead
CEO	Chief Executive Officer	PM	Project Manager
CER	Communications Equipment Room	PMI	Project Manager Instruction
CFCCB	Contingency Finance Current Control Budget	PML	Pudding Mill Lane
CFO	Chief Financial Officer	PMO	Project Management Office NR
CIF	Crossrail Integration Facility	PNY	Paddington New Yard
CIS	Customer Information System	PPE	Personal Protective Equipment
CMR	Crossrail Managed Risk	PPF	Property Partnership Framework
CMS	Central Management System	PPM	Passenger Performance Measurement
CoL	City of London	PRep	Project Representative
COS	Central Operating Section	PRISM	Cost Management Software
COS	Central Operating Section	PRM	Persons of Reduced Mobility
COWD	Cost of Work Done	PSD	Platform Screen Door
CPFR	Crossrail Programme Functional Requirements	PSG	Performance Steering Group
CPI	Cost Performance Index	PSR	Project Status Report
CPO	Compulsory Purchase Order	PTYSC	Property Sub-Committee
CRAF	Completion Readiness Assessment Framework	PWay	Permanent Way
CRL	Crossrail Limited	QBR	Quarterly Baseline Review
CRV	Crossrail Requirements Variation	QCRA	Quantified Cost Risk Assessment
CSCS	Construction Skills Certification Scheme	QRA	Quantified Risk Assessment
CSDE	Correct Side Door Enabling	QSRA	Quantified Schedule Risk Assessment
CSJV	Costain Skanska Joint Venture	RAB	Regulatory Asset Base
CSM	Construction Safety Management	RAB (C)	RfL Assurance Board for Crossrail
CSM-RA	Common Safety Method – Risk Assessment	RAG	Red, Amber, Green Matrix
CT	Computerized Tomography	RAM	Route Asset Manage.
CTOC	Crossrail Train Operating Concession	RBC	Remote Block Computer
CUH / CHS	Custom House Station	RCA	Risk Control Actions
CW	Canary Wharf	RCC	Route Control Centre
CWG	Canary Wharf Group	RfL	Rail for London
CWS	Canary Wharf Station	RfL-I	Rail for London - Infrastructure
D&A	Drugs and Alcohol	RFT	Right First Time
DA	Development Agreement	RIA	Railway Integration Authority

DeBo	Designated body	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DESJs	Design Engineering Safety Justifications	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DfT	Department for Transport	RIRP	Railway Integration Review Point
DLO	Direct Labour Organisation	RLU	Restricted Length Unit
DLR	Docklands Light Railway	ROC	Rigid Overhead Conductor
DOO	Driver Only Operation	ROC	Regional Operational Centre
DPS	Depot Protection System	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
DT	Dynamic Testing	ROP	Royal Oak Portal
Dwall	Diaphragm wall	RP4.2	Review Point 4.2
DWWP	Delivery of Works Within Possession	RR	Ricardo Rail
E&B	Earthing & Bonding	RRV	Road / Rail Vehicles
EA	Environment Agency	RS	Rolling Stock
EAC	Estimate at Completion	RSC	Return Screen Conductor
EB	Eastbound	RSD	Rolling Stock & Depot
ECI	Early Contractor Involvement	RSSB	Rail Safety & Standards Board
ECP	Employers Completion Process	RTU	Remote Telemetry Unit
ECS	Empty Coach Stock	S&C	Switches & Crossings
EDBL		SA	Supplementary Agreement
EDT	Early Dynamic Testing	SACR	Semi Annual Construction Report
EED	Emergency Exit Door	SAP	System Applications Products
EFC	Estimated Final Cost	SAR	Safety Assessment Report
EFC	Economic and Financial Committee	SAT	Site Acceptance Test
EiS	Entry into Service	SCADA	Supervisory Control and Data Acquisition
ELCBT	Elizabeth Line Countdown Board Tracker	SCL	Sprayed Concrete Lining
ELRSG	Elizabeth Line Readiness Steering Group	SCN	Sponsor Change Notice
EMC	Electromagnetic Compatibility	SDG	Signalling Design Group
EMU	Electrical Multiple Unit	SDO	Selective Door Operation
ERTMS	European Rail Traffic Management Systems	SDS	Scheme Design Specification
ESJ	Engineering Safety Justification	SER	Signalling Equipment Room
ESM	Engineering Safety Management	SES	South East Service
ETCS	European Train Control System	SESR	South East Signalling Room
ETH	Eastern Ticket Hall	SFA	Sponsor Funding Account
EVM	Earned Value Management	SGS	Stepney Green Shaft
FAR	Farringdon	SHELT	Safety and Health Leadership Team
FCCB	Finance Current Control Budget	SIRP	Systems Integration Review Panel
FDC	Framework Design Consultant	SISS	Station Information and Security System
FDO	Final Design Overview	SJR	Safety Justification Report
FDS	Final Design Statements	SLD	Single Line Diagrams
FFOC	Final Forecast Outturn Cost	SMS	Safety Management System
FGW	First Great Western	SMTA	Smithfield Market Traders Association
FIS	Fisher Street Shaft	SOC	Statement of Compatibility
FLU	Full Length Unit	SONIA	Sterling Overnight Index Average
Fol	Freedom of Information	SOR	Systems Operation Room
FRAG	Fraud Risk Assurance Group	SORBA	Shaping Architecture Company (sub cladding contractor)
FTS	Floating Track Slab	SPI	Schedule Performance Index
GAF	Greater Anglia Franchisee	SPS	Secondary Part Steel
GE	Great Eastern	SR	Sponsors Requirement
GEBR	Guaranteed Emergency Brake Rate	SRP	Safety Review Panel
GEFF	Great Eastern Furrer & Frey	SSE	Scottish & Southern Electricity
GEML	Great Eastern Main Line	SSP	Stations, Shafts, Portals
GFRC	Glassfibre Reinforced Concrete	STG	Stepney Green
GLA	Greater London Authority	STS	Standard Track Slab
GPE	Great Portland Estates	SVP	Safety Verification Panel
GRC	Glass Reinforced Concrete	T&C	Testing & Commissioning

GRIP	Governance for Railway Investment Projects	TAP	Technical Assurance Plan
GSM-R	Global System for Mobile Communication - Railway	TBM	Tunnel Boring Machine
GW	Great Western	TC&HSG	Testing, Commissioning and Handover Steering Group
GWML	Great Western Main Line	TCMS	Train Control Management System
GWR	Great Western Railway	TCR	Tottenham Court Road
H&S	Health & Safety	TCRW	Tottenham Court Road West
HAL	Heathrow Airport Limited	TDR	Technical Director's Report
HALARP	Heathrow Airport Limited Assurance Review Panel	TDY	Tunnel Drive Y
HAS	High Attenuation Sleeper	TfL	Transport for London
HAVS	Hand Arm Vibration Syndrome	TOC	Train Operating Company
HEP	Handover Execution Plans	TPA	Tunnel Planning Authority
HIA	Heathrow Implementation Agreement	TPH	Trains Per Hour
HM	Her Majesty	TPS	Train Protection System
HMDL	Handover Master Deliverable List	TPWS	Train Protection & Warning System
HPNM	High Performance Near Misses	TRAIL	Transport Reliability Availability Integrated Logistics
HRW	Heathrow Airport	TRH	Temporary Rehousing
HSPI	Health & Safety Performance Indicator	TSI	Technical Standard for Interoperability
HV	High Voltage	TTVS	Temporary Tunnel Ventilation System
HVAC	Heating Ventilation & Air Conditioning	TUCA	Tunnelling & Underground Construction Academy
IA	Interim Acceptance	TWAO	Transport & Works Act Order
ICD	Interface Control Document	TXM	TXM Plant
IECC	Integrated Electronic Control Centre	U&A	Undertakings & Assurances
IEP	Intercity Express Programme	UKPN	UK Power Networks
IFC	Issued For Construction	UR	Urban Realm
IFD	Ilford Yard	URT	Unresolved Trends
IM	Infrastructure Manager	UTX	Under Track Crossings
IOSH	Institution of Occupational Safety and Health	VAP	Verification Assurance Procedure
IP	Intervention Point (0, 1, & 2)	VDP	Victoria Dock Portal
IR35	Inland Revenue Taxation Regulation 35	VERP	Value Engineering Review Panel
IRN	Installation Release Note	VFL	Vo ker Fitz Patrick
IRSG	International Regulatory Strategy Group	VN	Variation Notice
ISJ	Interim Safety Justification	VT	Voltage Transformer
ISV	Intermediate Statements of Verification	WAD	Works Authorisation Document
ITP	Inspection & Test Plan	WBP	Westbourne Park
ITT	Invitation to Tender	WBS	Work Breakdown Structure
JST	Joint Sponsor Team	WC	World Class
KBR	Knorr-Bremse Rail	WCC	Westminster City Council
KD	Key Deliverable	WCCC	Whole Contract Construction Certificate
KE	Kinematic Envelope	WHI	Whitechapel
KG	Kensal Green	WITI	Western Inner Track Infrastructure
KO	Key Output	WOE	Western Outer Electrification
KPI	Key Performance Indicator	WOO	Woolwich Station
L&P	Land and Property	WOTI	Western Outer Track Infrastructure
LB	London Borough	WTH	Western Ticket Hall
LBTH	London Borough of Tower Hamlets	YC	Yard Control
LDBL			
LFB	London Fire Brigade		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 115

Period 5 FY2018-19

22 July 2018 – 18 August 2018

Document No. B2111500/115/1.21

13 September 2018



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Project Status Report 115

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Note: This report relies on the information set out in CRL's Period 5 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 18 August 2018. Note that information emerging after the close of Period 5 is subject to formal confirmation by CRL in its Period 6 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan.

Document history and status

Revision	Date	Description	By	Review	Approved
1	7 September 2018	PSR 115 Period 5 FY 2018-19 v1.15.docx ~ Draft	PRep Core Team		
2	13 September 2018	PSR 115 Period 5 FY 2018-19 v1.21.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets, although there are some concerns with the leading indicator trend. The 'Finish Safe' campaign for implementation during September aims to address this.

Financial:

The Intervention Points have not changed in Period 5 and the AFCDC remains at £12,810m, which exceeds IP2 by £298m. The AFCDC remains substantially understated with regard to increasing costs on most of the major projects due to delay and poor productivity. It also does not include costs caused by the delay of Stage 3 Opening. CRL has submitted indicative cost forecasts to Sponsors, which are under review. We expect the AFCDC to increase substantially at Period 6.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains as £2,584m. The ONW final forecast outturn cost (FFOC) remains as £2,430m. CRL continues to advise of significant cost risks to the NR ONW forecasts.

Stage 2 Opening:

The initiative to replace Reduced Length Units prior to Stage 2-2 remains likely to start in December 2018, but train software issues have raised the risk to that date.

[REDACTED]

Stage 3 Opening - Infrastructure and Systems:

CRL has determined that it is unable to deliver Stage 3 Opening in December 2018 and has notified Sponsors in an Adverse Event Notice (AEN) dated 30 August 2018. CRL has confirmed a new outline delivery plan and schedule for the completion of all fixed infrastructure, for the start of Trial Running on 15 April 2019. A new MOHS is under development and is expected to be made available in Period 7.

Delivery in April 2019 is predicated on the completion of all rail systems installation and the start of an intensive period of dynamic testing targeted at 22 October 2018, subject to readiness tests of rolling stock, signalling software and infrastructure being satisfied. Rail systems installation is currently forecast by CRL to be completed on 5 November 2018, and we expect completion of the other delivery elements also to be delayed; the start of the new regime of dynamic testing will be impacted as a consequence. Ultimately, the start date will be driven by actual progress, and the decision to commit will consider the extent to which any outstanding work inhibits ongoing strategic delivery progress. Nevertheless, a late start to what has already been presented by CRL as a challenging schedule is a concern, and we expect the impact, if any, upon the start of Trial Running to be made clear in the new MOHS.

CRL's short-term infrastructure completion and dynamic testing plans remain unchanged. While steady progress is being made with rail systems in the tunnels, connections into systems delivered by Stations, Shafts and Portals (e.g. Fire Main, LV Power, Radio) are proving difficult, and completion of these drive the 5 November 2018 forecast. The Phase 3 integration testing workload of remote equipment back to the Route Control Centre using SCADA remains critical,

compounded by poor resource availability. Resource shortages also affect radio systems commissioning.

Dynamic testing in limited duration 'windows' has continued on the Central Section and across the GEML interface for the first time. [REDACTED]

[REDACTED]. Investigation and rectification of faults discovered during testing windows are demanding increasing specialist attention and reliance upon the Crossrail Integration Facility and Melton Test Track. [REDACTED]

The general impact of delivery delay continues to affect the production of assurance documentation. [REDACTED]

Stage 3 Opening - Handover and Operational Readiness:

The delay to Stage 3 Opening will nominally remove the existing schedule constraints that are affecting delivery of Handover materials. As with completion of any other element of the Elizabeth Line, it is imperative that contractor performance is improved to ensure no slippage to any revised dates. [REDACTED]

Stage 4 and Stage 5 Openings:

The delay of Stage 3 Opening to Autumn 2019 will affect the Stage 4 and Stage 5 Opening dates. RfL, with CRL, is currently reviewing the impacts of this delay.

1 Cost

1.1 Summary

CRL has kept the AFCDC at £12,810m for Period 5, which breaches IP2 by £298m. This has consumed almost all of the increased funding made available by Sponsors. The AFCDC remains substantially understated with regard to increasing costs on most of the major projects due to delay and poor productivity. It also does not include costs caused by the delay of Stage 3 Opening; See Section 1.4. We have expressed our concern to JST¹ and DfT² regarding the potential further cost increases, and have provided order of magnitude estimates and trended trajectories of likely costs.

The NR ONW forecast cost (AFC plus VNs) is unchanged at £2,584m. The ONW FFOC forecast is also unchanged at £2,430m. Further increase is expected, for example as a consequence of the West enhanced station tenders being above NR budgets.

The Intervention Points have not changed in Period 5;

The AFCDC remains at £12,810m although this is understated;

The CRL AFCDC exceeds IP2 by £298m;

Risk allowances within the AFCDC are inadequate;

We expect the AFCDC to substantially increase at Period 6 due to increasing costs on major projects and delay to Stage 3 Opening;

The CRL ONW AFC, including VNs, remains at £2,584m;

The NR FFOC remains as £2,430m;

CRL continues to advise of significant cost risks to the NR ONW forecasts.

1.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 5 and we do not expect any future changes to IP2 under the current circumstances, where the AFCDC exceeds IP2 and challenges current funding thresholds.

CRL has not changed the AFCDC at Period 5 and it remains at £12,810m. The CRL Period 5 AFCDC exceeds IP2 by £298m, as shown in Figure 1 - 1; but is equal to the Finance Current Control Budget (FCCB), of £12,810m. However, at Period 5 the value of Unresolved Trends (URTs) is significantly greater than the overall Quantified Cost Risk Assessment (QCRA) provision and the URT value is increasing into Period 6. CRL has reported that the current risk allowances are inadequate, and hence we regard the AFCDC to be understated at Period 5. This understatement is due to the current complex situation affected by both extensions to schedule and related cost, compounded by cost pressures across the programme.

¹ Meetings with JST 12 July 2018, 19 July 2018, 2 August 2018 and 9 August 2018.

² Meetings with DfT 25 July 2018 and 22 August 2018.

(£ millions)	Period 4	Period 5	Delta	Movement
Forecast	12,715	12,717	2	up
Delivery Risk	2	1	-1	down
Subtotal	12,717	12,718	1	up
Programme Risk	89	88	-1	down
Board Risk	4	4	0	same
AFCDC total	12,810	12,810	0	same
IP0	11,672	11,672	0	same
IP0 Headroom	-1,138	-1,138	0	same
IP1	11,912	11,912	0	same
IP1 Headroom	-898	-898	0	same
IP2	12,512	12,512	0	same
IP2 Headroom	-298	-298	0	same

Figure 1 - 1 ~ AFCDC Headroom to Intervention Points

The full value of defined costs being pursued by the Contractors is not included in the current AFCDC. At Period 5, there is a defined cost [REDACTED]. But there is inadequate risk provision that leaves the QCRA exposed to an [REDACTED] l. There is no available pure risk allowance. Analysis of defined cost data continues to follow the established trend of [REDACTED]

The rate of Cost of Work Done (COWD) has been steady through the life of the project, averaging approximately £120m per period. In Period 5, the Delivery COWD³ was £104m and continues to follow the historical trend path. Projecting linearly both the current rate of increase of AFCDC and COWD to present a worse case scenario, they intersect above £13bn in Period 10, as shown in Figure 1 - 2. However, the actual growth of AFCDC and the progression of COWD are unlikely to be a continuing linear trend and both are expected to tail off as the works approach completion. But this is only representative of achieving Stage 3 opening in December 2018 and applying the CRL reported AFCDC of £12,810m, which we regard to be understated. These projections become exacerbated using data more appropriate to the current circumstances. CRL has presented⁴ its recommended revised Stage 3 opening plan, following the formal issue of its Adverse Event Notice, and order of magnitude costs of additional funding above the £300m already provided by Sponsors, see Section 1.4. These estimates are indicative and subject to review. Accurate assessment and projections are not possible until CRL provide us with details of its calculations.

Regardless of the extension to programme schedule and the associated costs, all the indicators described above, together with the increasing rate of defined costs and cost pressures, confirm our previously reported expectations of a substantial increase to the AFCDC in Period 5 or Period 6 before SACR20.

³ Excluding Land and Property (L&P).

⁴ Sponsor Board 3 September 2018.

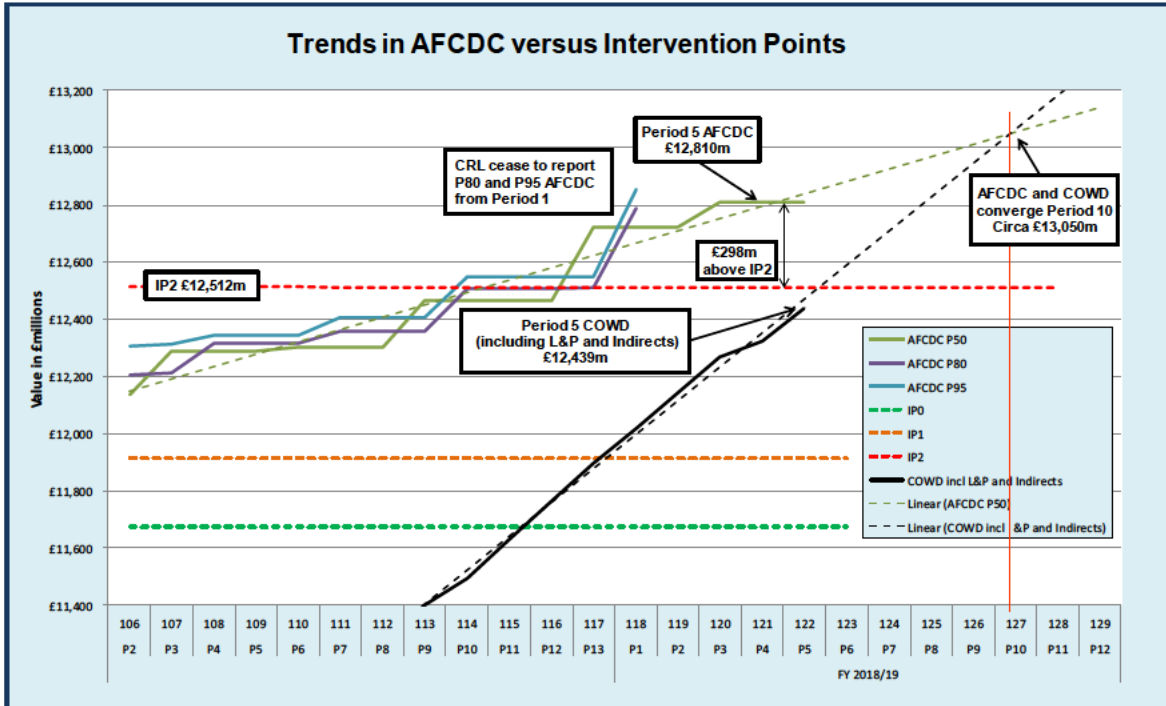


Figure 1 - 2 ~ AFDCD Headroom to Intervention Points

There has been a sustained 85% increase in delivery overspend from Period 7 (2017/18) to Period 5 (2018/19), an increase of 15% from Period 4, and trend projections shown in Figure 1 - 3 indicate the effects of this continued growth, which may be regarded as a consequence of the recent cost escalation experienced by the project. The cumulative delivery overspend, against the CRL internal budget at each period, has increased in Period 5 by £58m to £756m (Period 4, £698m) as shown in Figure 1 - 3.

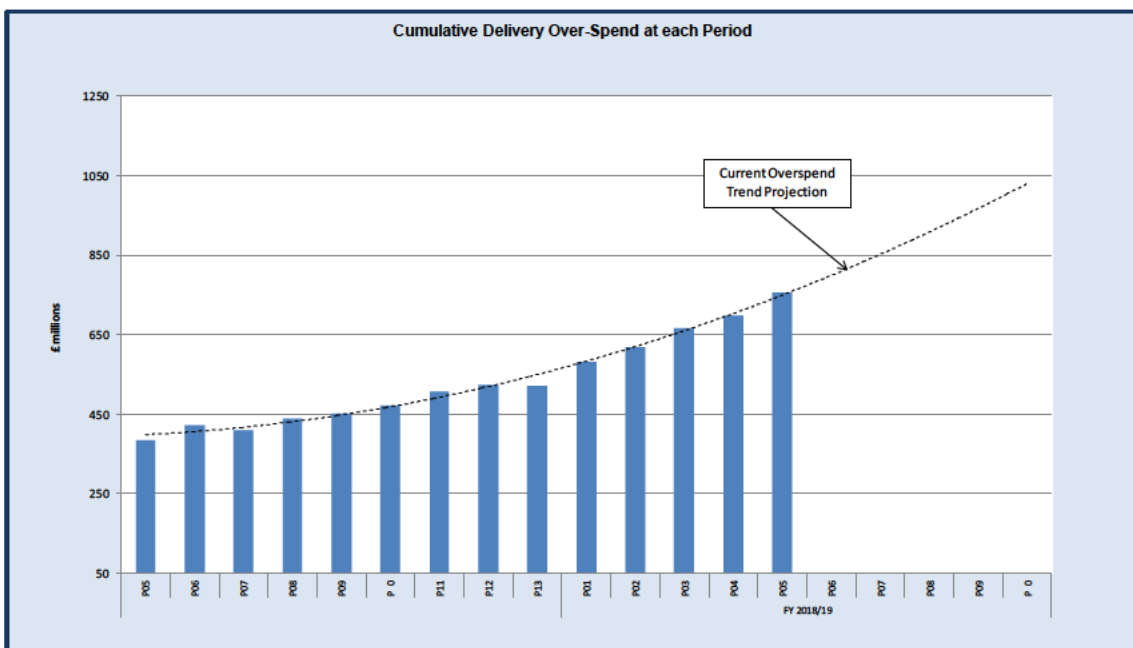


Figure 1 - 3 ~ Cumulative Delivery Overspend against CRL Budget at each Period

CRL reports that, in Period 5, it spent £66.1m above the 2018/19 Business Plan. The CRL Period 5 Board Report provides the details of the overspend which, in summary, continues to be dominated by low productivity, prolongation and delays.

Programme risk has decreased by £1m to £88m and Delivery Risk reduced by £1m to £1m in Period 5, equating to an overall net decrease in risk of £2m, (from £95m to £93m) to fund Delivery level cost increases.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 5 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package.

Figure 1 - 4 shows the reconciliation of the adjusted Target and Defined Costs for Period 5 to include removed values and avoid duplication of costs included within the 'Others' category, in order to provide ongoing continuity for consistent trend analysis reporting.

Contract	Target £m		Defined Cost £m	
	P5		P5	
	CRL	CON	CRL	CON
C300				
C305				
C610				
C512				
C510				
C435				
C405				
C412				
C360				
C502				
C422				
C350				
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,416	£5,704	£5,823	£6,053
Others	£912	£931	£977	£986
Total	£6,328	£6,635	£6,800	£7,039

Figure 1 - 4 ~ P4 Adjusted Defined Cost and Target Cost⁵



⁵ Figure 1-4 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.

[REDACTED]

Although CRL has advised that the AFDCDC makes allowances for the increase of defined costs, the full value of the Contractors' estimates has not been included. The rate of increase for defined costs is increasing, and consequently the allowances within CRL's risk review appear to be insufficient. At Period 5, [REDACTED]

[REDACTED]

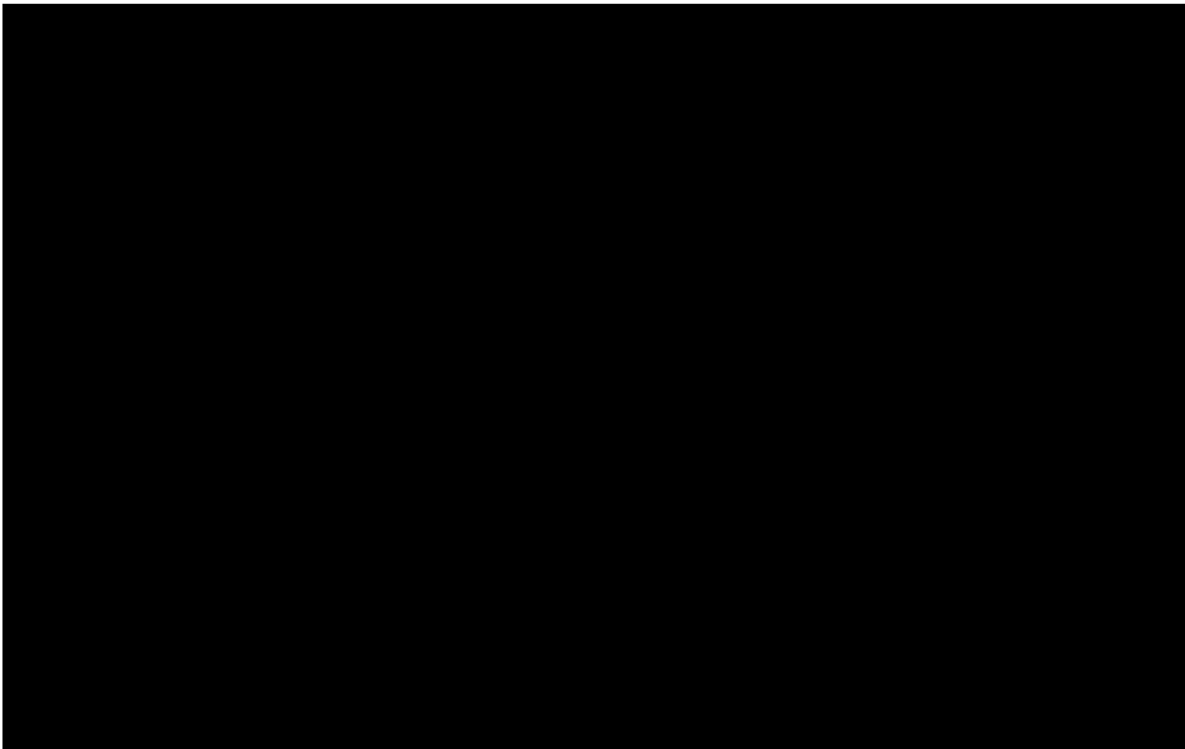
[REDACTED]

- [REDACTED]
- [REDACTED]

Although the target gap is showing signs of closing, the convergence is slowing further and the value continues to grow at an increasing rate. [REDACTED]

[REDACTED]

Figure 1 - 5 illustrates the comparisons and trends of CRL and Contractors' Forecast Defined Costs and Target Costs.



1.4 Stage Opening Delays – Cost Implications

The issue of an Adverse Event Notice by CRL, and the related revised Stage 3 opening plan, have very significant implications for forecast costs which will lead to an increase to the AF CDC, over and above that caused by increasing costs on major projects described earlier. CRL presented its initial estimates on the cost implications at Sponsor Board on 3 September 2018. These cover delays to Stage 3 opening, as well as residual increased costs across all projects over the last few periods. To this could be added cost to reflect the independent schedule review recommendations. CRL’s indicative outline calculations will need examination at a detailed level to ascertain if they are credible and to ensure all costs are covered, including Stages 4 and 5 .

1.5 Contingency and Risk

The Period 5 Finance Current Control Budget remains at £12,810m. The £12,810m AF CDC is equal to the revised financial budget, but exceeds the RP4.2 Baseline funding of £12,136m by £674m.

CRL is reporting that the overall Period 5 contingency budget of £87m is not sufficient to cover the risk exposure of £93m by £6m (£10m deterioration from Period 4). The centrally controlled Delivery contingency at Period 5 remains unchanged at £38m.

Figure 1 - 6 shows the trend of the decrease in the Board and Programme Contingency and compares the lower Risk Exposure at P50 only with the remaining contingency.

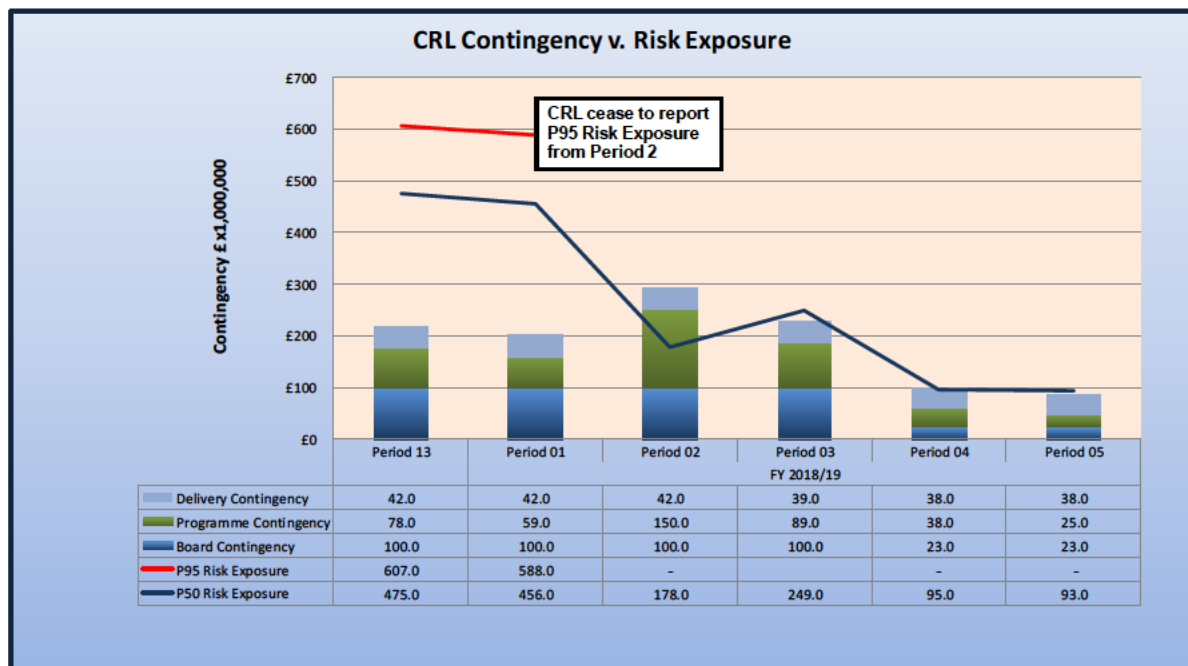


Figure 1 - 6 ~ Risk Exposure versus Contingency

CRL had confirmed that all trends are covered by URTs or risk in the Period 4 AF CDC. We believe this is now no longer the case, as URTs of £174m exceed available risk allowances by £87m. Figure 1 - 7 shows the apportionment of Risk from Period 13 up to Period 5.

Period	QRA	URT's	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81
P4	95	46	2	87	6	43
P5	93	174	1	86	6	-87

Figure 1 - 7 ~ Elemental Breakdown of Risk Allowances

1.6 Cost: On Network Works (ONW)

The Period 5 On Network Works (ONW) forecast cost (AFC plus VNs) has not changed from Period 4 and remains at £2,584m. The ONW are 91% complete (reduced marginally as the COWD in the period has been offset by Anglia (Other) costs which have been transferred out of ONW to NR Renewals). CRL remains concerned with the final outturn cost, notably associated with the risks highlighted in Section 1.6.2 below.

The Forecast Final Outturn Cost (FFOC) at Period 5 has not changed either and remains at £2,430.0m, which reflects a reported Grand Total Cost position of £2,889.4m, less £154m for Variation Notices (Cash Funded) and £305m CRL/NR secured funding, as shown in Figure 1 - 8.

Description	Period 4 £m	Period 5 £m
Cost Grand Total	2,889	2,889
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
CRL/NR Funding:		
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
Total CRL/NR Secured Funding	305	305
FFOC	2,430	2,430
Pain/gain share	-70	-70
Forecast to RAB	2,360	2,360

Figure 1 - 8 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

1.6.1 ONW Funding

CRL has reported that the total Period 5 AFC and Variations funding, and Secured Funding for NR ONW, remain at £2,889.4m as shown in Figure 1 - 9.

The ONW funding is expected to increase in future periods, as NR is currently discussing a further £22m application at the Portfolio Board⁶ to cover [REDACTED] cost pressures and non-achievement of planned recoveries. [REDACTED]; these amounts are currently included in the 'Recoveries (Residual)' tabulated in Figure 1 - 10; NR ONW Cost Summary.

Description	P5 Source of Funding				P4
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	271.0	-	-	271.0	271.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,542.0	22.0	20.0	2,584.0	2,584.0
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
[REDACTED]					
Sub Total	-	118.9	186.5	305.4	305.4
TOTAL SECURED FUNDING	2,542.0	140.9	206.5	2,889.4	2,889.4

Figure 1 - 9 ~ NR ONW Secured Funding

1.6.2 ONW Cost

CRL reports that the Grand Total Cost has not changed in Period 5 and remains at £2,889.4m, but with a reduced mid-point sensitivity of plus £35.1m (a £15.7m reduction from Period 4), as shown in Figure 1 - 10.

Description	Period 4 £m	Period 5 £m	Delta £m	P5 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,928.9	2,891.0	-37.9	2,888.4	2,928.4	2,968.8
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	0.0	0.0	0.0	0.0	0.0	0.0
Recoveries (Residual)	-8.6	-9.3	-0.7	-4.3	-3.9	0.0
Targeted Savings	-30.9	0.0	30.9	0.0	0.0	0.0
Cost Grand Total	2,889.4	2,881.7	-7.7	2,884.1	2,924.5	2,968.8
Total Secured Funding	2,889.4	2,889.4	0.0	2,889.4	2,889.4	2,889.4
Funding Gap	0.0	-7.7	-7.7	-5.3	35.1	79.4

Figure 1 - 10 ~ NR ONW Cost Summary

⁶ Date to be determined.

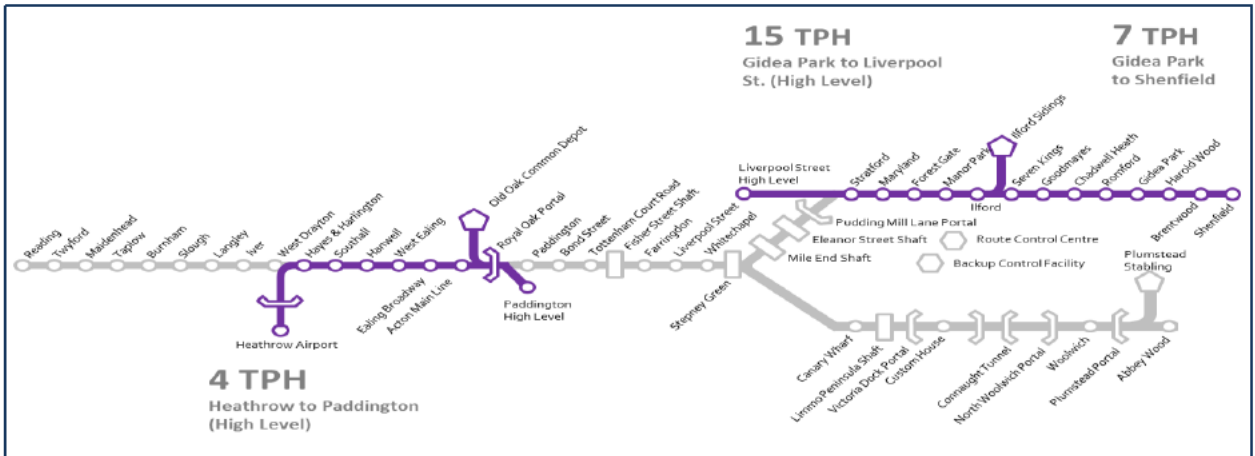
CRL has collated the effects of known Period 5 risks in its SPOT⁷ AFC cost sensitivity analysis, as shown in Figure 1 - 10 above.

The most significant cost risks to the ONW continue to be:

- [REDACTED]
- Anglia [REDACTED]
[REDACTED]
[REDACTED]
- Closeout risk associated with upward pressure on the reported AFC for [REDACTED] [REDACTED] now that the Contract is cost reimbursable;
- Closeout risk associated with final outturn cost with respect to [REDACTED] [REDACTED]
- The NR estimate, supported by the recent tender submissions received from the main works bidders, for the delivery of the GRIP 6-8 West Enhanced stations is [REDACTED] the current budget available to deliver this scope is [REDACTED].

⁷ SPOT AFC – NR standard terminology - a spot check at a particular moment in time.

2 Stage 2: Phase 2



2.1 Summary

The target date of 24 February 2019 cannot be met. This is because the delays to the overall train software programme, which includes the prioritisation of works required for Stage 3, have now been formalised and incorporated into the latest programme⁸. CRL is to advise a revised target date.

[REDACTED]

[REDACTED]

Target date of 24 February 2019 cannot be met, but any revised start date needs to avoid Stage 3 opening.

2.2 Operational Readiness Assessment

CRL’s Stage 2-2 dashboard categorised three issues as ‘red’ for Period 5. These are the same issues as reported in Period 4. They are ‘Train Readiness’, ‘CRL ETCS Integration testing’ and ‘Driver training & Ops proving’. See Section 2.4 for details.

2.3 Interim phase (Replace RLUs with FLUs)

This initiative⁹ has been further affected by delays of the passenger service version of TCMS v7.2.x, to be used for Stage 3. RfL is now forecasting approval for running on the GWML by early November 2018¹⁰. [REDACTED]

[REDACTED]

⁸ Stage 2 dashboard schedule – PDB 28 August 2018.
⁹ Primary purpose being to carry out mileage to increase reliability and find and address specific faults.
¹⁰ Rolling stock PDB Period 5 dashboard.

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In our Period 13 report, we described an interim activity that was required before formal ETCS testing, using TCMS v7.3, could start in August 2018. It was 'Type testing of software on the train – Forecast 23 June 2018'¹¹.

RfL is now forecasting it will start on 5 October 2018, a delay of almost 4 months¹². Formal Heathrow spur testing remains forecast to start in early November 2018. The primary reason for the slippage is that the variant required for Stage 2-2 (v7.3) builds upon the functionality of its predecessor, TCMS v7.2. As v7.2 is in delay, so is v7.3.

The period for Heathrow testing once type testing has been achieved has also increased. This is illustrated by the APIS date. In our Period 4 report, we stated that APIS ETCS on-board was forecast to be received by 4 December 2018, but that we felt this would slip, due to the issues with train software development described in the Rolling Stock section above. In Period 5, ORR approval is now anticipated by early February 2019. A [REDACTED].

OOC

The Depot is now fully open, with the exception of the Back line connection. These works are affected by delays to the associated NR works. RfL is considering options to minimise the commercial risk incurred by prolonging the works.

Operations

[REDACTED]

Regulatory Approvals

There are two key approvals for Stage 2-2, to be issued by the ORR:

- APIS ETCS trackside to be issued to NR;
- APIS ETCS on-board to be issued to BT. (see Rolling Stock section)

APIS ETCS trackside was received by NR on 30 August 2018.

¹¹ BT schedule in support of MOHS18.

¹² RSD PDB dashboard – 28 August 2018.

At Sponsor Board on 3 September 2018, CRL explained its recommended Stage 3 plan, based on Scenario 2 up to Trial Running, which it had already described to its Board meeting on 29 August 2018 and to the MOHS Review meeting with contractors on 31 August 2018. The schedule priorities are to finish routeway construction, satisfy entry criteria for 5/2 Dynamic Testing¹³ (DT), commence DT and software bug fixing, finish and handover stations, and commence Trial Running and Trial Operations.

At a strategic level, the plan features the following key targets:

- Target completion of majority of works in the tunnels by 22 October 2018;
- Readiness of [REDACTED] software for DT by 22 October 2018;
- Entry criteria achieved and full DT to commence 5 November 2018;
- All stations, except [REDACTED], to be substantially complete by 21 December 2018;
- All shafts and portals to be complete and handed over by April 2019;
- All stations, except [REDACTED], to reach Staged Completion by April 2019;
- Handover of all assets to IMs and transition to ROGS by 15 April 2019;
- Trial Running and Trial Operations to run through to Autumn 2019, or earlier if possible;
- Final full handover of all station contracts by mid-2019.

Additional information about these are included in the following text in Section 3. We understand CRL will be producing a revised MOHS at Period 7 with new Anchor Milestones and target dates. CRL will also arrange key go/no-go check point meetings well in advance of key milestones such as Commence DT and Commence Trial Running.

An independent review of the schedule, indicates that some of the key dates noted above are subject to significant risk. Another independent expert has been engaged for a further review of the plan. We will review the new MOHS upon receipt.

The table at Figure 3 - 1 indicates a selection of key dates as at Period 5, based on the old MOHS leading to Combined Trials, previously due on 1 October 2018. Many have been further delayed since Period 4 and we believe most are ambitious or not achievable. This table will be revised when we receive the new MOHS.

Key Dates	Revised MOHS 2018	Period 4 Actual / Forecast	Period 5 Actual / Forecast	
C650 - All 11 kV S,S&P locations energized	15-Apr-18	11-Jul-18	18-Jul-18	*
C650 - All 22 kV S,S&P locations energized	30-Jun-18	18-Aug-18	14-Sep-18	*
Training completed for MTR in support of Handover	30-Jun-18	31-Aug-18	28-Sep-18	*
COS safety Case submitted to RABC (to facilitate Handover)	30-Jun-18	30-Aug-18	30-Aug-18	
C620 - Ready to Commence Transition Testing @ GEML	12-Aug-18	12-Aug-18	12-Aug-18	
22no. CI.345 FLUs Available for Reliability Growth (Pre Trial Running)	13-Aug-18	13-Aug-18	30-Sep-18	*
Training completed for LU in support of Handover	31-Aug-18	31-Aug-18	28-Sep-18	*
C610 - Complete Pre-Trial Running	08-Sep-18	30-Sep-18	22-Oct-18	*
C660 - Train GSM-R Radio available to support Combined Trials	09-Sep-18	09-Sep-18	09-Sep-18	
C610 - Ventilation Control System ready to support Combined Trials in normal mode	09-Sep-18	09-Sep-18	02-Oct-18	*
C620 - Ready to Commence Transition Testing @ GWML	10-Sep-18	09-Sep-18	09-Sep-18	
RfLI Ready to commence Pre-Trial Running	11-Sep-18	11-Sep-18	26-Sep-18	*
Training completed for RFL in support of Handover	14-Sep-18	30-Sep-18	31-Oct-18	*
C620 - All Signalling Dynamic Testing complete (Except Yellow Plant)	17-Sep-18	17-Sep-18	16-Oct-18	*
Pre Trial Running starts	17-Sep-18	17-Sep-18	NA	
Final COS safety case updated and submitted to RABC	20-Sep-18	20-Sep-18	20-Sep-18	
C660 - CIS ready to support commencement of Combined Trials	30-Sep-18	30-Sep-18	30-Sep-18	
Commence Combined Elizabeth line Trials and Handover under ROGS to M	01-Oct-18	01-Oct-18	19-Oct-18	*
Forecast later than MOHS				
Forecast earlier than MOHS				
New or adjusted Anchor Milestones				
* In period movement				

Figure 3 - 1 ~ Key Dates to Combined Trials

¹³ Dynamic Testing five days per week 16 hours per day with night shift allocated to static testing. Two day weekends to be utilised for maintenance and outstanding works. Also known as Main Dynamic Testing Regime (MDTR).

Figure A - 1 in Appendix A sets out the eighteen Corporate (Key) Milestones that were approved by the CRL Board, alongside CRL forecasts for Period 5. We expect these will be revised once the new MOHS is approved and issued.

Figure A - 2 in Appendix A indicates the overall cumulative progress of the completed Anchor Milestones (AM) as at Period 5. The forecast line has moved even further to the right since Period 4, and many of these forecasts are ambitious or not achievable. The majority of the remaining Anchor Milestones are now forecast to be later than the MOHS [REDACTED] date base line. We have not added details here, as they will all be revised once the new MOHS is issued.

3.3 Operational Readiness Assessment

Elizabeth Line Dashboard

There are fifteen Readiness Tasks that have been given a 'Red' by the Elizabeth Line Readiness Steering Group (ELRSG)¹⁴, four less than in the previous period. The changes from red to amber are:

- 'RCC training facilities (SIM room) live and trainers training'. Sufficient progress has been made in developing the facilities, allowing training to proceed.
- 'Delivery of FLU with functioning CBTC'. We would have retained this Task at red, due to the issues described in Sections 3.7 and 3.9.
- 'RfLI interface principles verified and agreed with Network Rail'. An important operational issue that has generally been resolved.
- 'Incident Response Manager locations operationally ready'.

We expect new Readiness target dates, which will affect their 'red' ratings, will be established once the revised opening strategy is approved. However, the key red Tasks are associated with Handover assurance materials, and are likely to remain problematic.

3.4 Stations, Shafts and Portals (SSP)

The announcement of a delay to Stage 3 Opening has not changed CRL's resolve that Stations, Shafts and Portals (SSPs) need to be completed as soon as possible to minimise costs, so the MOHS target dates remain in place for the time being. Refer to Appendix B, Figure B - 1 for the current forecast completion dates as at Period 5.

The new MOHS will feature a change in strategy regarding stations. A new key date known as 'Tier One Substantially Demobilised' (TOSD) will be set for each station leading up to Christmas; except [REDACTED] which will probably be in February 2019. Although still under the control of the contractor, most construction work and paperwork should be complete, and a PPE free¹⁵ environment will be expected.

Staged Completion (SC) will be redefined to be ready for IM familiarisation following completion of all Phase 3 testing, and will be targeted during early 2019. All stations, with the possible exception of [REDACTED], are due to be ready for enactment of IM responsibility and implementation of ROGS on 15 April 2019. The delay of IM take-over of stations from various dates in late 2018 to new dates in March/April 2019 will remove potential access restrictions from the [REDACTED] [REDACTED] [REDACTED] and enable them to focus on works completion and demobilisation.

¹⁴ Meeting held 31 August 2018.

¹⁵ Also known as 'blue shoes environment' due to blue shoe covers worn to prevent dirt on new flooring.

Full Handover (HO) of the assets and related paperwork to the relevant IM will be targeted during mid-2019, although this milestone does not prevent passenger services. However, it is expected that shafts and portals, as well as the rail systems, will be handed over by 15 April 2019.

The following gives a brief status for each SSP, based on preliminary information issued at Sponsor Board. Progress information is included in the CRL Board Report. We expect new targets for TOSD, SC and HO to be included in the revised MOHS, along with definitions of what each milestone includes. We expect CRL will set aggressive TOSD targets to encourage contractors to demobilise and minimise costs. [REDACTED]

Paddington Station: [REDACTED]

Bond Street Station: [REDACTED]

Tottenham Court Road Station: [REDACTED]

Farringdon Station: [REDACTED]

Liverpool Street Station: [REDACTED]

Whitechapel Station: [REDACTED]

Canary Wharf Station: [REDACTED]

Woolwich Station: [REDACTED]

Custom House Station: [REDACTED]

Intermediate Shafts and Portals: [REDACTED]

3.5 ONW

NR reports that Key Output 2 achieved substantial completion of the Southeast section project on 31 July 2018.

3.6 Completion and Handover of Integrated Systems¹⁶

CRL's revised delivery strategy is summarised in Section 3.2. CRL's short-term infrastructure completion plans and objectives described in our recent reports remain unchanged. Completion of rail infrastructure continues to be prioritised and is being carried out using Blockade Working, a basic two-week working pattern split between 11 days of construction in 'blockades' and 3 days of dynamic testing in 'windows'. This remains CRL's preferred approach to installation completion, at the same time allowing dynamic testing progress to remain aligned with off-site testing activities, software bug fixing and defect correction.

The intention is then to switch to a new delivery regime known as '5/2 Dynamic Testing', subject to certain entry criteria being satisfied. This new approach effectively reverses the balance in schedule opportunity between construction and dynamic testing, and is based upon the assumption that reduced access will be required for the remaining construction-related works. In practice, what constitutes 'completion' and the date upon which it is achieved must be balanced against actual progress in delivering the other entry criteria. We consider the '5/2 Dynamic Testing' regime and the associated entry criteria further in Section 3.7.1.

We have updated below progress in delivery of the nine critical paths contained within MOHS which lead to Stage 3 Opening.

1. Completion of Routeway (██████)

The principal outstanding linear activities remain installation of lighting and LV power, drainage, fire mains; and the removal of temporary services (e.g. lighting, radio, fire main and power supplies). Steady progress has been made with the linear installations, particularly where only ██████ is involved, but significantly more effort is necessary to co-ordinate and implement the various tie-ins to works provided by other contractors at SSPs. This is likely to be the main source of delay in routeway completion.

██████ is prioritising works which rely upon rail plant in order to physically clear the tunnel environment and remove pollution sources as soon as possible. This, in turn, improves access for others and allows the earliest demobilisation of temporary tunnel ventilation systems. As noted in our last report, the infrastructure removals are logistically difficult to complete because certain later project activities will continue to rely upon temporary installations; removals might ultimately be transferred to RfL.

CRL considers the completion of the Routeway Rail Systems critical to the switch to the '5/2 Dynamic Testing' regime, and it is identified as one of the key entry criteria (see Section 3.7.1). Subject to final confirmation, CRL has indicated that this criterion will include the following activities:

¹⁶ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

1. Installation using rail-mounted plant complete;
2. [REDACTED] critical equipment installed and tested;
3. [REDACTED] ventilation control system operational;
4. [REDACTED] all PSDs operational with signalling interfaces;
5. [REDACTED] critical interfaces to PSDs, C620 and NR systems operational.

The target completion date is 22 October 2018, but we are already aware that slippage has occurred and CRL has most recently forecast completion on 5 November 2018; we believe this later date to be optimistic.

2. Signalling ([REDACTED])

With [REDACTED] installation nearing completion across the Central Section and across the NR interfaces, [REDACTED] is looking to provide greater support to integration and dynamic testing activities. Investigation and rectification of faults discovered during testing windows are demanding increasing specialist attention, and [REDACTED]
[REDACTED]

3. Tunnel Ventilation ([REDACTED])

Progress with permanent tunnel ventilation has largely aligned with forecast in the period. CRL has established that it is possible to carry out a significant proportion of the final airflow tests (effectively Phase 3 Static Integration Tests) before installations at [REDACTED] have been completed. Current proposals¹⁷ are for the sequence of location-specific tests to take place between 11 September and 23 October 2018, but success requires the completion of the preceding Phase 2.2 tests (currently standing at less than 50% complete) and upon sustained SSP support. The corresponding airflow tests associated with [REDACTED] are currently targeted at December 2018.

We believe that completion of the Permanent Ventilation System in the timescales proposed is at significant risk. Aside from the incomplete Phase 2.2 tests referred to above, the Phase 3 period of the schedule is tightly and intricately constructed, necessarily drawing together inputs from multiple contractors and with some tests requiring the use of a train. There is no specific float provision and limited scope for recovery should testing not proceed as planned. Given the complexity, we are concerned at level of optimism that the schedule suggests.

4. Radio ([REDACTED])

Completion of GSM-R remains a priority because it is a prerequisite to formal asset handover to RfL and to train operations once the ROGS rule book is in place on the trace (i.e. at the start of Trial Running). [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

5. Dynamic Testing

See Section 3.7 below.

6. HV Non-Traction Power [REDACTED]

Delivery of HV systems continues and the final transformer energisations are now due to take place on 16 September 2018, at [REDACTED] and [REDACTED]. Some SSP sites have continued to struggle with the completion of downstream LV networks, energisation of which is necessary for [REDACTED] completion and commissioning of railway support systems such as tunnel

¹⁷ Presented at the CRL Period 5 MOHS Review on 31 August 2018.

lighting. [REDACTED] CRL considers the downstream completion of permanent LV power critical to the switch to the '5/2 Dynamic Testing' regime, and it is identified as one of the key entry criteria (see Section 3.7.1).

7. Traction Power ([REDACTED])

[REDACTED] continues with a programme of equipment commissioning to complete the original scope of Traction Power Supply. Many Section Switches that were not required to support first energisation or initial stages of dynamic testing remain to be commissioned, and [REDACTED] only [REDACTED] has been completed so far. Taken against the other paths, Traction Power is considered to be one of the 'least critical'.

8. SCADA and Communications ([REDACTED])

[REDACTED] The proposed extension of Crossrail programme completion into 2019 offers some opportunity for resource profile smoothing, but even the most optimistic forecasts emerging from CRL suggest that critical challenges remain.

CRL is driving 'first in class' testing of asset types in order to gain testing experience as soon as possible, but SCADA I/O (Input/Output) schedules for many SSPs' sites have still not been finalised.

9. Stations, Shafts and Portals (SSP) Completion

Delivery of all SSP Rail Systems related works is critical to overall railway completion and formal handover. There are many system 'touch points', including electrical, mechanical, data network (i.e. for SCADA connectivity). A wide range of blocking issues remains and a significant effort is required across the whole of the Central Section to bring the infrastructure to a state of completion sufficient to allow meaningful progress to be made with Phase 3 Static Integration Testing. This situation in turn complicates testing resource planning and delays the preparation of assurance documentation.

The table below summarises the progress to date¹⁸ with the production of test certification, and illustrates the size of the challenge facing CRL and the Contractors. Note that 'actual' values marked with an asterisk (*) show a reduction from last period and are under review by CRL.

Test Phase	Phase Completion Certificate	Forecast %	Actual %
2.1 (Intermediate Static Test)	Installation Release Note (IRN)	89	42*
2.2 (Pre-Commissioning Test)	Pre-Commissioning Certificate (PCC)	86	12
2.3 (System Static Test)	Partial Acceptance Certificate (PAC)		
3 (Static Integration Test)	Acceptance Certificate (AC)	83	4*

Figure 3 - 2 ~ Progress to date with the Production of Test Certification

¹⁸ CRL MOHS Period 5 Review held on 31 August 2018.

3.7 Dynamic Testing

3.7.1 Dynamic Testing Strategy

CRL’s revised delivery strategy is summarised in Section 3.2. Success partly relies upon a switch in delivery approach to a ‘5/2 Dynamic Testing’ regime on 22 October 2018, the target date for Routeway Completion. CRL proposes not to initiate the switch until all of the following entry criteria have been satisfied:

- Railway Systems complete (Section 3.6);
- Planned releases of CBTC and TCMS on-board software installed (Section 3.7.2);
- Rolling Stock off-site completion of critical CBTC tests (Section 3.7.2);
- Permanent LV supplies in place at Stations (Section 3.6).

CRL intends to monitor and manage progress against the entry criteria, and will make a commitment to the new regime following a formal readiness review, four weeks ahead of the proposed switch date. It is vital that CRL remains realistic about its commitment to switch, since it is inevitable that the final timing will evolve with actual progress on site. We have already noted, above, difficulties with LV installations at Stations and with the general completion of Rail Systems in the Central Section which threaten the 22 October 2018 target date. Signalling software development and integration with rolling stock remain challenging and, despite CRL and [REDACTED] identification of aligned interim delivery milestones, there has been [REDACTED]

[REDACTED]

In the meantime, CRL continues with dynamic testing in ‘windows’ which alternate with construction ‘blockades’. The current programme and latest dates¹⁹ for the remaining dynamic testing windows are as follows:

11. 14 – 18 September 2018 (All Zones);
12. 28 September – 2 October 2018 (All Zones).

Planned signalling transition testing aligns with possessions at the NR GEML and GWML interfaces as follows:

- GWML 15/16 September 2018 (Dynamic Testing Window 11);
- GEML 30 September 2018 (Dynamic Testing Window 12);
- GWML 4 November 2018 (No corresponding Dynamic Testing Window).

Multiple-train testing under signalling protection was scheduled to start during Dynamic Testing Window 7 on 28/29 July, but RAB(C) was unable to approve the Safety Argument²⁰. CRL prioritised the completion of the transition testing Safety Arguments ahead of that for multiple-train testing in order to meet the interface possession dates; as a consequence, multiple-train testing is now planned to take place in Dynamic Testing Window 12.

Dynamic Testing will continue under the C610 Construction and Commissioning Railway Rule Book (CCRRB). ATC has submitted a new application to the ORR for a 6 month extension to its ROGS exemption. We understand ATC are now seeking a longer extension as a schedule risk mitigation measure.

¹⁹ CRL MOHS Period 5 Review held on 31 August 2018.

²⁰ RAB(C) Meeting held on 18 July 2018.

3.7.2 Dynamic Testing Progress

CRL has completed ten of the original dynamic testing windows, although a small number of short-length subsidiary windows have also been undertaken. Completion of the full planned scope of tests for most of the testing windows carried out to date has not been possible because of defects and performance problems with fixed assets, rolling stock and software. Issues remain with preparedness, co-ordination and levels of support by all parties, and disruption to planned work remains at an unacceptably high level. Particular problems have been experienced in the period with the initial set-up of rolling stock ahead of testing, with sometimes significant amounts of productive testing time lost to fault rectification.

While there have been some encouraging isolated successes, overall progress continues to be poor. The latest testing statistics (which do not yet include the results from Dynamic Testing Windows 9 or 10) still show a pass level of 34 against a cumulative total of 311 signalling test cases²¹. The most recent windows have revealed recurring fault types, but without obvious repeating patterns, which might allow the development of reliable software fixes. Work continues off site on the CIF and at Melton Test Track to investigate and rectify.

Test train running across the NR GEML interface was carried out for the second time during Dynamic Testing Window 9, allowing some issues first identified during Window 8 to be addressed. Trains operated successfully in Integrated Mode, but transitions between CBTC and TPWS did not all take place as planned.

Test train running across the NR GWML interface for the first time did not take place as planned during Dynamic Test Window 10 because critical NR OLE works had not been completed beforehand. CRL agreed to sole NR access at the interface because the OLE works are also critical to Dynamic Test Window 11; CRL instead carried out dynamic testing elsewhere on the Central Section.

We are aware that CRL has made positive steps to secure further possessions at both NR interfaces to allow the correct operation of the signalling interface designs to be demonstrated.

The inclusion of minimum requirements relating to rolling stock and software in the entry criteria for '5/2 Dynamic Testing' seeks to eliminate the impact of functionally misaligned software upon dynamic testing. However, we believe that the achievement of these particular entry criteria to match either the target date of 22 October 2018, or the forecast date of 5 November 2018 for the completion of rail systems installation, remains challenging. Further information is provided in Section 3.9.

3.8 Approvals, Assurance and Agreements

3.8.1 RAB(C)

RAB(C) meets as required to review formal submissions in line with CRL and RfL requirements, but CRL continues to miss its own submission deadlines.

CRL secured final RAB(C) acceptance²² of the Safety Argument for the GWML signalling transition testing in good time to meet the interface possession of 8/9 September 2018. The Safety Argument for Multiple Train Testing has yet to be re-submitted.

²¹ Performance data confirmed in CRL Weekly Dynamic Testing Report Period 6 Week 2.

²² RAB(C) Meeting held on 30 August 2018.

The Strategic Engineering Justification for the Earthing & Bonding System was approved by RAB(C) at the same meeting. This marks the successful completion of a technically and logistically difficult body of work, with complex design modelling forecasts verified by a range of site interface tests with neighbouring railways.

Figure 3 - 3 shows the key Engineering Safety Management submissions for the Stage 3 Safety Case with CRL forecasts at Period 5. Given CRL’s revised delivery strategy, the dates are no longer meaningful and commentary is unnecessary. We await revised dates in due course.

No	Key Dates	Revised MOHS 2018	Period 4 actual / forecast	Period 5 actual / forecast
1	Contractors submit draft ESJs to CRL	31-Mar-18	31-Aug-18	31-Aug-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	deleted	deleted
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	deleted	deleted
4	Contractors submit final ESJs to CRL	30-May-18	01-Nov-18	01-Nov-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	20-Sep-18	20-Sep-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Aug-18	30-Aug-18
7	Final COS Safety Case updated and submitted to RAB-C	20-Sep-18	20-Sep-18	20-Sep-18
8	Submit Technical File to ORR	09-Nov-18	09-Nov-18	09-Nov-18
	* In-period delay			
	Note - Key Dates 2 and 3 were deleted at Period 3			
	Note - Key Dates 7 and 8 Baseline dates were adjusted at Period 3			

Figure 3 - 3 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

3.8.2 Regulatory Approvals

We have been reporting²³ that CRL is unlikely to receive the necessary approvals to allow Stage 3 to start as planned on 9 December 2018. This has now been confirmed by the issue of the Adverse Event Notice. The regulatory approvals schedule will now need to be revised to ensure that adequate time and resources (both for CRL and contractors) are allowed to ensure the new opening date (to be advised) can be met.

With regard to progress in the period, the key issues during Period 5 remain very similar to Period 4. They are:

- [REDACTED]
- [REDACTED]
- [REDACTED];
- Project Wide Hazard Record closure is at 21%. The remaining open items require Test & Commissioning evidence from the contractors before they can be closed;
- Lack of TSI evidence to present to the NoBo.

3.8.3 Agreements

There are four agreements that are judged to be amber. These are the same ones from last period, and are:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- IM Interface manual between NR and RfL-I;
- Development Service Agreement between NR and RfL-I.

²³ PRep reports passim

²⁴ [REDACTED]

Progress is slow between the parties concerned, and this is being discussed at senior levels within the respective organisations.

There has been no change to the number of Critical Agreements that we reported open (38 in total) from our Period 4 report.

3.9 Rolling Stock

In our last report, we said that the passenger services version of TCMS v7.2 was forecast to be ready by end of October 2018. It is now forecast to be ready by mid-November 2018.

The key milestones before Passenger service are transition and multi-train testing. Transition testing has begun (see Section 3.7) on GEML. Multi-train testing has now to be carried out in DTW12, and the relevant software (TCMS v7.2.2.4) begun testing at Melton, and is scheduled to finish by 20 September 2018. This leaves little schedule float to cope with technical delays.

[REDACTED]

3.10 Handover

[REDACTED] It will be important to ensure that the impact of the Adverse Event Notice does not result in the dissipation of resources (both CRL and contractors') that are necessary to complete the work.

Training

The production of training materials, and delivery of training courses, has generally continued to plan in this period.

O&M Manuals

[REDACTED]

Asset Information

The flow of Asset Information to the IMs has continued to improve in this period, but the issues to resolve are the same as with Period 4. They are:

- The quantity and quality of information from [REDACTED] remains poor. CRL is concerned at the approach being taken by the Contractor, believing there are opportunities for some quick wins that are not being taken;
- [REDACTED] has shown little improvement over 5 periods, despite escalation;
- RfL-I continues to have issues with receiving the information.

Handover Master Deliverable List

RfL-I has now accepted circa 5%, and LU 10% of the HMDL allocated to it. As we explained in our last report, there will be a challenge for IMs in receiving and reviewing the bow wave of documentation, despite the change in schedule that will result from the Adverse Event Notice.

CRL has begun to report upon the situation concerning red line and as-built drawings, identifying progress and which ones are deemed important for Handover. This is a large task, and any opportunity to rationalise it should be sought.

3.11 Trial Running & Trial Operations [previously Combined Trials]

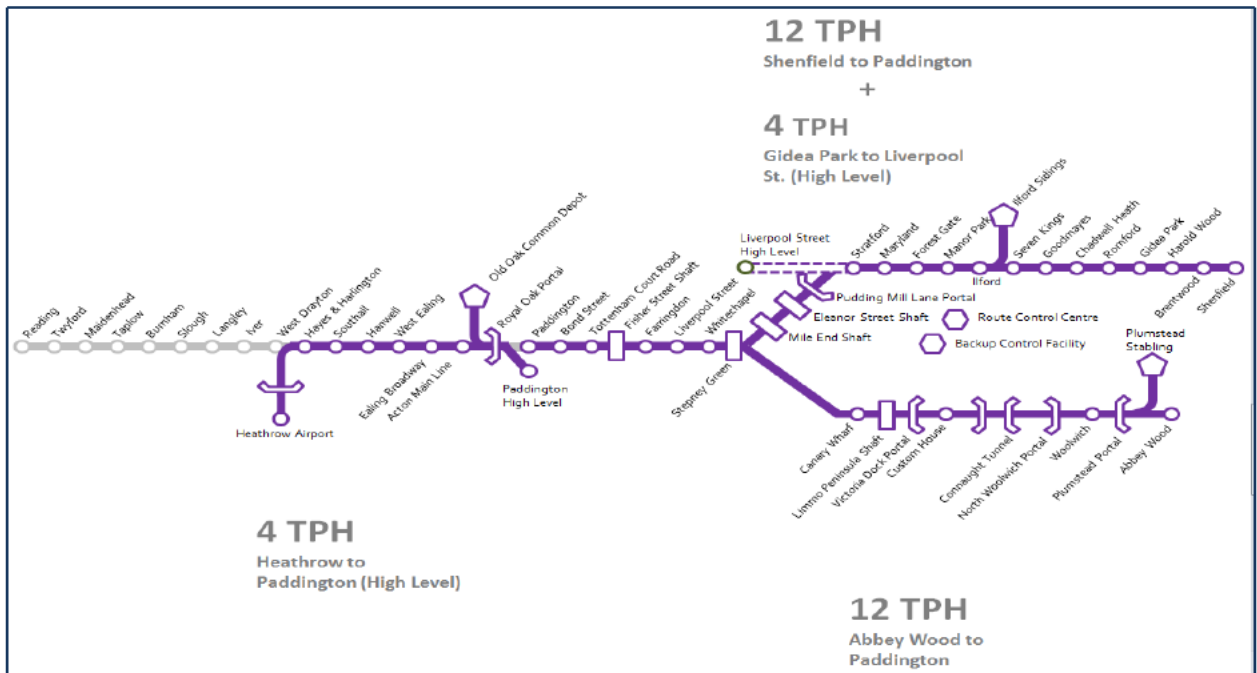
CRL is undertaking work to evaluate the impact of schedule delays upon Stage 3. We will evaluate what that means for Trial Running and and Trial Operations, when we have had the opportunity to review the detailed information.

One issue to highlight will be the impact of the Adverse Event Notice upon the RfL operations and maintenance staff. [REDACTED]

3.12 Plumstead Depot

Window installation to the Accommodation Building is 80% complete and cladding to the Maintenance Building is substantially complete. Land handover from C610 continues, but still needs to be carefully monitored to avoid schedule impact. C695 permanent works are not required to support Dynamic Testing.

4 Stage 4: Paddington to Abbey Wood & Shenfield



4.1 Summary

The delay of Stage 3 Opening to Autumn 2019 will affect the Stage 4 Opening date. RfL, with CRL, is currently reviewing the impacts of this delay.

4.2 Operational Readiness Assessment

There are three Readiness Tasks that have been given a 'Red' status by the PDB²⁵, the same as in our last report. The overall rating for Stage 4 is 'Red'.

Readiness Task	Issue
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The capacity model indicates that the degraded scope can support the timetable. Delivery remains challenging.
DOO CCTV installed and operational Stratford and Shenfield stations	Completion dates are very close (May 2019) to service opening.
Station Information & Security System (SISS) stations and RCC	Awaiting a completion schedule from the contractor.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with 'Red' Status

²⁵ 25 August 2018.

4.3 Ilford & Romford Stations

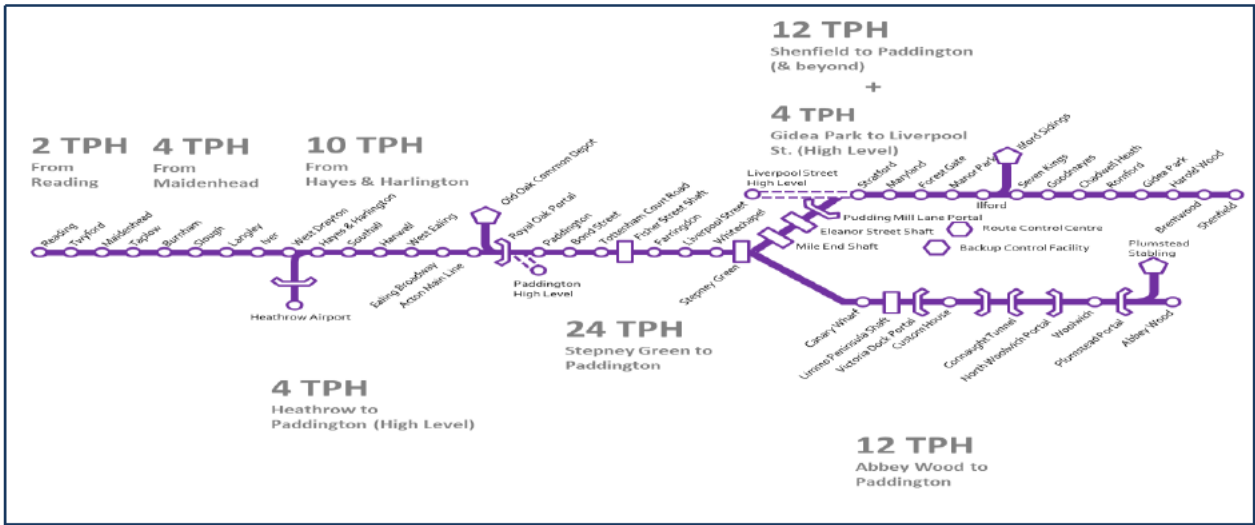
Volker Fitzpatrick is progressing with the pricing and planning of works for Crossrail East Enhanced Stations (Ilford and Romford) GRIP 6-8 following the award by NR of an ECI contract under the Anglia Multi-Functional Framework (MFF). NR has received internal governance approval for the continuation of this procurement strategy.

NR reports that the planned delivery target dates for Ilford & Romford Stations are being maintained. The key dates we shall continue to monitor to assure that progress remains on schedule are:

- GRIP 5 complete – September 2018;
- GRIP 6 Tender return – October 2018;
- GRIP 6 Contract award – November 2018.

NR is progressing with its assessment of the options to carry out an advanced Works Package at Christmas 2018 in order to recover programme; NR remains committed to station opening for December 2019.

5 Stage 5: Reading & Heathrow to Abbey Wood



5.1 Summary

The delay of Stage 3 Opening to Autumn 2019 will affect the Stage 5 Opening date. RfL, with CRL, is currently reviewing the impacts of this delay.

5.2 Operational Readiness Assessment

There are four Stage 5 Readiness Tasks that have been reported as a 'Red' status to the PDB on 25 August 2018, an increase of one from our Period 4 report.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	NR programme completion is now forecast for mid to late 2020.
NEW Exemption for enhanced TPWS	The ORR has been informed that an exemption will be required.
ONFR Western station upgrades complete	The delay to the procurement schedule, and [REDACTED], remain unresolved. [REDACTED]
DOO CCTV GWML outer stations	Forecast to start on site October 2018, reviewing plan to new Key Date (KO6B – 1 Dec 2019).

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with 'Red' Status

5.3 Network Rail Works

5.3.1 Platforms and Stations

NR reports that Tenders for the West Enhanced Stations Tender Packages 2 (Acton, Ealing, West Ealing) and 3 (Southall, Hayes & Harlington, West Drayton) have been received in Period 5. Contract award for Package 3 is expected in late September 2018 and Contract award for Package 2 is expected in October 2018. NR is undertaking parallel critical path activities and has awarded advanced works packages with its framework suppliers for the footbridges at West Ealing, Acton and Southall and the stairs at Ealing Broadway to be carried out during the Christmas 2018 possession. NR has confirmed that it has reached agreement with GWR and has secured the weekend possessions from December 2018 to May 2019.

CRL reports that NR has still not yet been able to provide sufficient information to validate the NR identified [REDACTED] in respect of the West enhanced stations [REDACTED].

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):

NR reports that Stage A key milestones are all complete. CRL confirmed²⁷ that NR received approval for the Authorisation to Place into Service (APIS) from the ORR at the end of August 2018.

The potential emerging issue where NR reported that HAL require a full risk review on the End of Authority issue and commercial assurance prior to accepting the asset back into service has been resolved.

Following the dynamic testing runs and a detailed review of the evidence, NR is reporting it believes that there is not a GSM-R network coverage problem and the previous theory of saturation of the train’s EDORs has been disproven. The issue has been identified around the ETCS train to track message sequence, and this needs investigation by BT.

Stages B & C (Stockley-Acton & Acton-Paddington):

NR reports that the Contract kick-off meeting to resolve the new Exemption request to the ORR has taken place with Sotera, who undertook the original risk analysis work stream, and that an outline delivery programme for the Exemption work stream has been produced.

NR continues to review with Alstom the options to rework Stage C delivery to attempt recovery of the programme, which is currently showing an unmitigated delay of approximately three months to the Stage C commissioning following delays in the integrated laboratory testing and infrastructure data provision.

²⁶ Crossrail Sponsor Board Paper SB96B-0,1 3 September 2018 Surface West Stations.

²⁷ ONW Sponsor Periodic Update meeting 6 September 2018.

5.4 ONW

NR reports that the critical path activities of GRIP 5 design, DOO CCTV installation and commissioning and platform extensions to West Drayton, Slough and Maidenhead were instructed to Ameyon 1 August 2018 under the existing contract, and site works have commenced at West Drayton. NR has confirmed that the route gauge clearance between Reading and West Drayton was achieved in Period 5.

NR continues to forecast the conversion of the OLE to AT power on Western Route for February 2019 to deliver full ATF for the planned February timetable change. NR reports that it has achieved 8 out of 25 access agreements with HEX and MTR-C to deliver the 12kA compatibility changes. NR is planning for the works to be undertaken during the four 1 day Christmas 2018 possessions.

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI decreased again in Period 5, which has been a trend since Period 2, and one Principal Contractor (PC) has failed to meet the target of 2.20 at Woolwich. A significant aspect of this decline is the falling rate of H&S inspections. CRL is aware of the issue and has encouraged all PCs to review the implementation of their basic processes.

H&S KPI	Target	Aim	Period 4	Period 5
HSPI	2.20	-	2.60	2.55
PCs scoring over 2.20	11	11	11	10
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.16	0.16

Figure 6 - 1 ~ Health and Safety Performance COS²⁸

The RIDDOR and Lost Time Case (LTC) AFRs remained stable in spite of an injury at Whitechapel. There was also a high potential near miss at Farringdon. Although the rates are still low compared to other projects, the falling HSPI trend is still of concern. CRL's 'Finish Safe' campaign for implementation during September aims to address this.

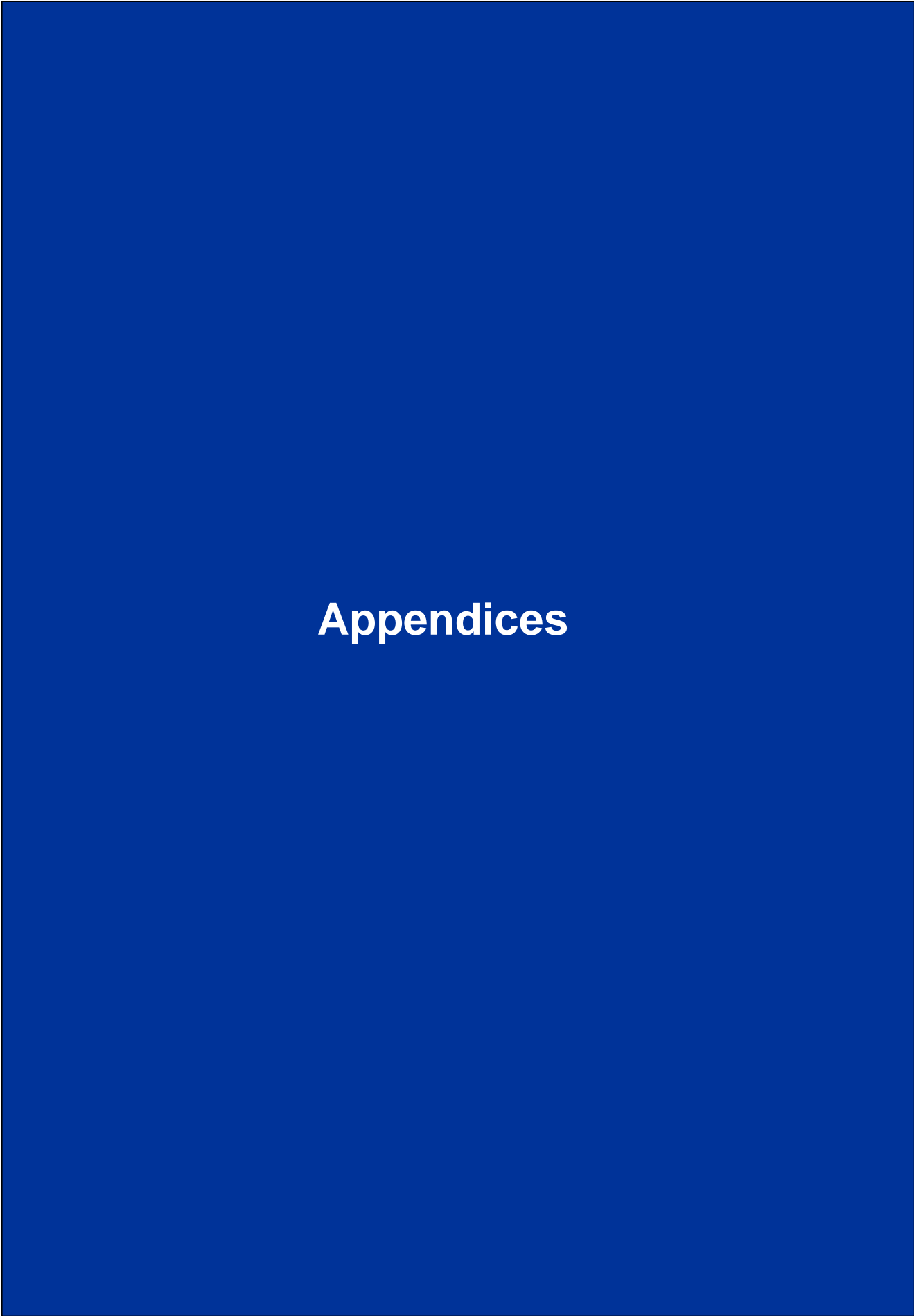
H&S issues related to Staged Completion, Handover, Railway Safety Regulations and HV traction power during the newly defined 'Main Dynamic Testing Regime' are all under review as part of the revised delivery strategy.

ATC (C610) has submitted a new application to the ORR for a 6 month extension to its ROGS exemption. We understand ATC are now seeking a longer extension as a schedule risk mitigation measure.

6.2 Health & Safety Performance ONW (NR)

During Period 5, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) increased slightly from 0.1368 to 0.1484. NR had no lost time incidents and no minor injuries in the period, but suffered an attempted theft of equipment and ATF cable at Chadwell Heath. The Programme's overall All Injury Rate for Period 5 is currently 0.72 injuries per 100,000 hours worked.

²⁸ High Potential Near Miss (HPNM) rate no longer reported by CRL.



Appendices

Appendix A Corporate Milestones & Anchor Milestone Progress

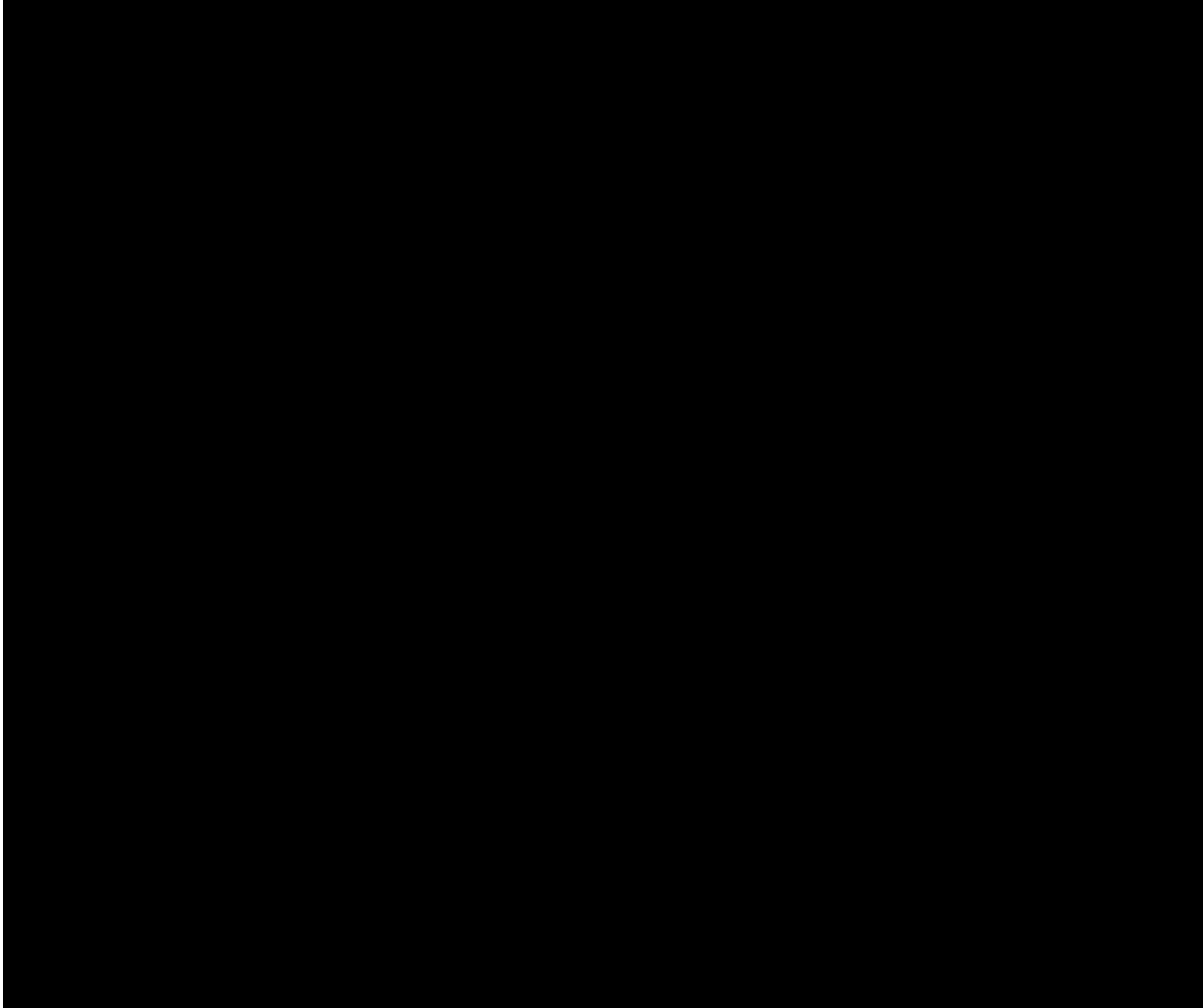
Figure A - 1 indicates²⁹ the CRL Corporate Milestones (shown as Period 1 Baseline) alongside the relevant dates from MOHS 2018 and latest CRL Period forecasts. We expect these milestones will be revised once the new MOHS is issued.

Corp Mstone	Description	Period 1 Baseline	MOHS 2018	Period 4 Forecast	Period 5 Forecast
1	All 11KV SS&P Non-Traction Power Locations Energised	April	15-Apr-18	11-Jul-18	18-Jul-18
2	CBTC Auto Reverse and Isolated ETCS Testing Complete at Melton	April	06-Apr-18	27-Apr-18	27-Apr-18
3	Stage 2 Phase 1 Service Introduction PAD to Heathrow	May	20-May-18	20-May-18	20-May-18
4	West Enhanced Stations contract award	June	08-Apr-18	SEPT	OCT
5	Start Dynamic Testing in Zones 3 & 4	June	11-Jun-18	11-Jun-18	11-Jun-18
6	CBTC Authorised for FLU for Trial Running	June	22-Jun-18	10-Aug-18	10-Aug-18
7	ESS - ECHR Complete for Handover to Infrastructure Manager	July	03-Jul-18	07-Sep-18	01-Oct-18 *
8	Commence Pre-Trial Running	Aug	05-Aug-18	SEPT	NA
9	22no. CI.345 FLUs Available for Trial Running	Aug	13-Aug-18	13-Aug-18	30-Sep-18 *
10	CRL central section Safety Case updated and submitted to RABC	Sept	20-Sep-18	20-Sep-18	20-Sep-18
11	PAD - ECHR Complete for Handover to Infrastructure Managers	Sept	07-Sep-18	26-Nov-18	26-Nov-18
12	Submit APIS for Central Section to ORR	Sept	17-Sep-18	09-Nov-18	09-Nov-18
13	Commence Combined EL Trials and HO under ROGS	Sept	01-Oct-18	01-Oct-18	19-Oct-18 *
14	Class 345 CBTC Signalling auth for Passenger Service by ORR	Oct	10-Oct-18	29-Oct-18	11-Dec-18 *
15	LIS - ECHR Complete for Handover to IMs	Nov	24-Oct-18	23-Nov-18	23-Nov-18
16	Opening of Stage 3 - Central Section PAD to ABW	Dec	09-Dec-18	09-Dec-18	09-Dec-18
17	Plumstead - First Stage Maintenance Sidings and connection to COS	Dec	21-Nov-18	21-Nov-18	19-Nov-18
18	Plumstead Stabling Sidings - ECHR Complete for Handover to IMs	Feb	29-Mar-19	29-Mar-19	29-Mar-19
	Forecast later than Period 1 Baseline				
	Forecast earlier than Period 1 Baseline				
	* In period movement				
	ECHR = Element Completion Handover Report				
	Milestones 10, 12, and 13 were adjusted due to Combined Trials strategy				

Figure A - 1 ~ Corporate Milestones

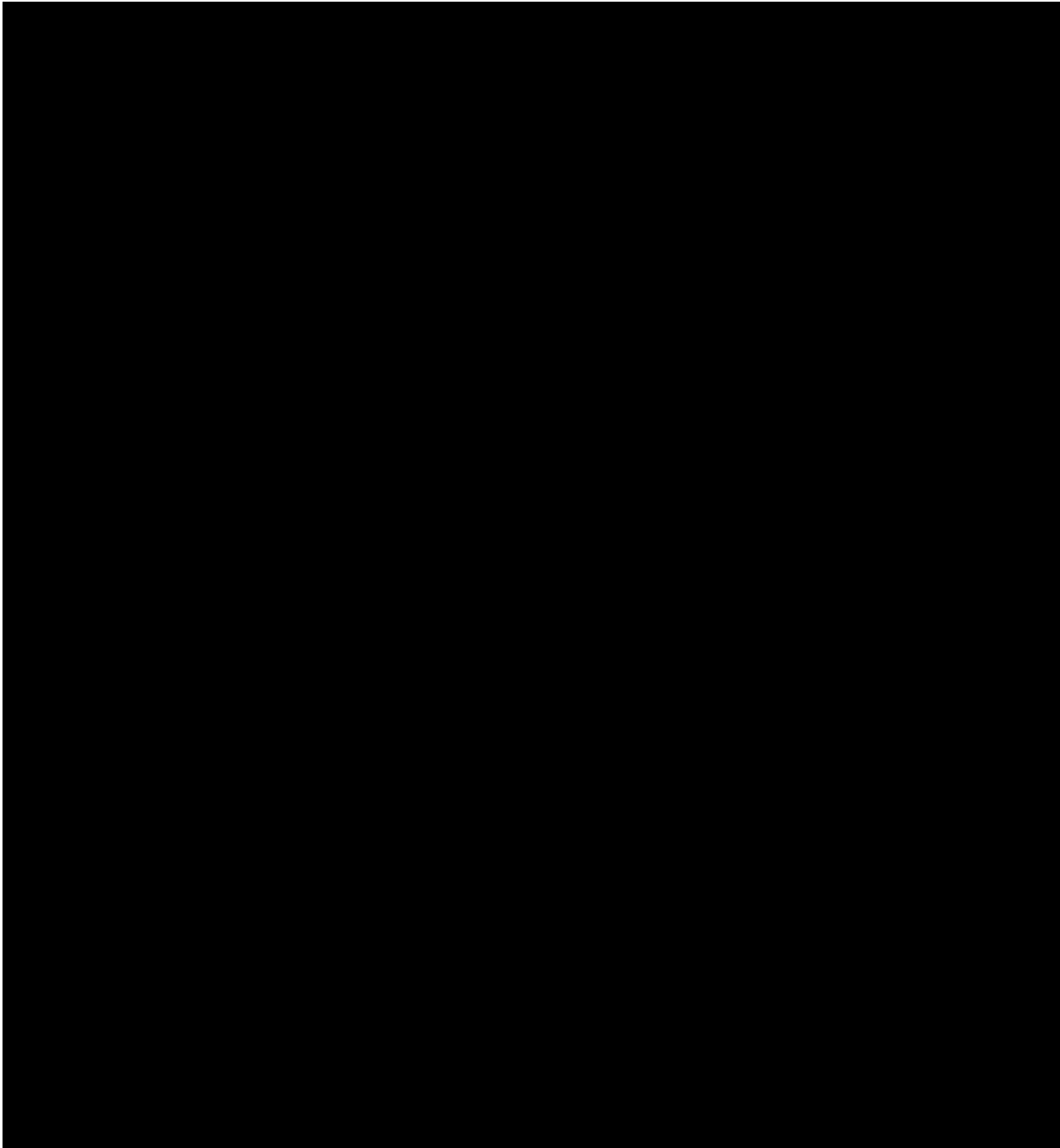
²⁹ SS&P = Stations Shafts and Portals, FLU = Full Length Unit, ESS = Eleanor Street Shaft, ECHR = Element Completion Handover Report, ABW = Abbey Wood.

Figure A - 2 indicates the status of Anchor Milestones cumulative progress at Period 5. The forecast line has moved even further to the right since Period 4. The majority of remaining Anchor Milestones are now forecast to be later than the MOHS [REDACTED] date base line. We have not added details here, as they will all be revised once the new MOHS is issued.



Appendix B COS Stations Target Dates

A summary of the Central Section station completion and Handover dates can be seen in Figure B - 1 below. This table reflects the forecast key dates and milestones, for each station at Period 5, against the current MOHS 2018. Date changes are shown as bold text. We expect all dates will be revised once the new MOHS has been issued.



Appendix C Agreements

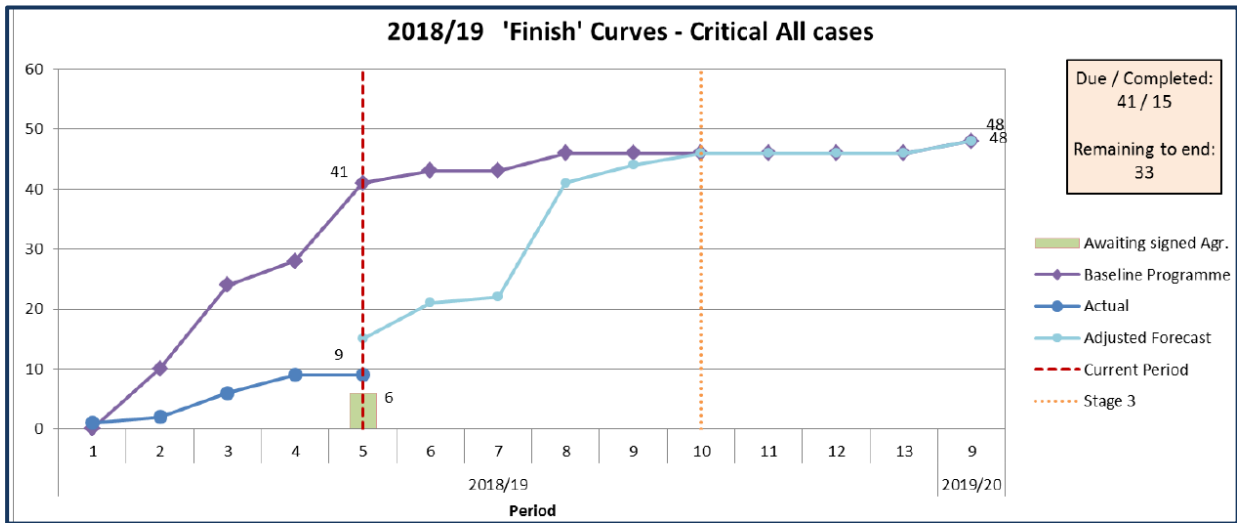


Figure C - 1 ~ 2018/19 Finish Curves – Critical All Cases³⁰

The diagram illustrates the slow pace in completing the Agreements that are critical to Stage 3. CRL had been forecasting a significant improvement in Periods 4 and 5 but, as can be seen, this did not happen in Period 5.

³⁰ Extract from Period 5 CRL Agreements update programme.

Project Representative Team

Project Team

██████████: Project Representative, Safety, Progress, Risk, Stations;
██████████: Signalling, Railway Systems, Integration, T&C;
██████████: Compliance & Change, Operations, RSD, Assurance;
██████████: Commercial, Cost Control, Financial, ONW;
██████████: Administration Manager.

Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LDBL	
ABB	ASEA Brown Boverly	LFB	London Fire Brigade
ABW	Abbey Wood	LIV	Liverpool Street
ACBs	Air Circuit Breakers	LMU	London Metropolitan University
ACJV	Alstom Costain Joint Venture	LO	London Over ground
ACWP	Actual Cost of Work Performed	LoNo	Letter of No Objection
AEA	Abellio East Anglia	LoR	Line of Route
AEN	Adverse Event Notice	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AM	Anchor Milestones	MDTR	Main Dynamic Testing Regime
AMS	Agreements Management System	MENTOR	Mobile Electrical Network Testing, Observation and Recording
APIS	Authorisation to Place into Service	MEP	Mechanical Electrical & Public Health
ARS	Automatic Route Setting	MEPA	Mechanical, Electrical, Public Health, Architecture
AsBo	Assurance Body - Ricardo Rail	MES	Mile End Shaft
ASLEF	Associated Society of Locomotive Engineers and Firemen	MFF	Multi-Functional Framework
ATC	Automatic Train Control	MIRP	Maintenance Integration Review Panel
ATF	Auto Transformer	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
ATS	Auto Transformer Station	MTIN	Miles Technical Incident Number
AWS	Automatic Warning System	MTR SMS	MTR Safety Management System.
B&PC	Board & Programme Contingency	MTR-C	Mass Transit Railway - Crossrail
BBMV	Balfour Beatty Morgan Vinci	MV	Medium Voltage
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NG	National Grid
BFK	Bam Ferrovial Kier	NGET	National Grid Electricity Transmission
BH	Berkeley Homes	NKL	North Kent Line
BIU	Bringing Into Use	NoBo	Notified Body
BLL	Bakerloo Line Link	NOW	North Woolwich
BMS	Building Management Systems	NR	Network Rail
BOS	Bond Street Station	NR PDB	Network Rail Programme Delivery Board
BP	Business Plan	NSACS	New Sector Area Cost Summary
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC Building	Operations Maintenance Centre

BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUCF	S	ONFR	On Network Functional Requirements
BUF	Bottom Up Forecast	ONSIP	On Network Station Improvements Programme
C&CSC	Commercial and Change Sub-committee	ONW	On Network Works
CAR	Corrective Action Report	OOC	Old Oak Common
CARE	Crossrail Assurance Reporting Environment	OOCPA	Old Oak Common Paddington Approaches
CBTC	Communications Based Train Control	OPEX	Operational Expenditure
CCB	Current Control Budget	Ops	Operations
CCP	Commitments Compliance Plans	ORAT	Operational Readiness & Transfer Group
CCRB	Construction and Commissioning Rulebook	ORR	Office of Rail & Road
CCRRB	Crossrail Construction Railway Rule Book	ORSG	Operational Readiness Steering Group
CCSA	Contract Commercial Status Analysis	OSD	Over Site Development
CCSC	Commercial & Change Sub-Committee	OSP	Operations Safety Procedures
CCTV	Closed Circuit Television	OTIS	OTIS escalators (company)
CD/RA	Closed Door / Right Away	OTP	Overall Target Price
CDG	Competence Design Group	P2R	Paddington to Reading
CDL	Central Door Locking	PA	Public Address
CDM	Construction Design & Management Regulations	PAD	Paddington station
CDN	Crossrail Data Network	PCs	Principal Contractors
CDT	Commitments Delivery Tracker	PDA	Project Development Agreement
CE	Compensation Events	PDB	Programme Delivery Board
CEC	Chief Engineer's Communications	PES	Platform Edge Screen
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PES	Permanent Earthed Sections
CEG	Central Engineering Group	PIP	Paddington Integration Project
CEO	Chief Executive Officer	PIR	Potential Incident Report
CER	Communications Equipment Room	PLU	Plumstead
CFCCB	Contingency Finance Current Control Budget	PM	Project Manager
CFO	Chief Financial Officer	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CIS	Customer Information System	PMO	Project Management Office NR
CMR	Crossrail Managed Risk	PNY	Paddington New Yard
CMS	Central Management System	PPE	Personal Protective Equipment
CoL	City of London	PPF	Property Partnership Framework
COS	Central Operating Section	PPM	Passenger Performance Measurement
COS	Central Operating Section	PRep	Project Representative
COWD	Cost of Work Done	PRISM	Cost Management Software
CPFR	Crossrail Programme Functional Requirements	PRM	Persons of Reduced Mobility
CPI	Cost Performance Index	PSD	Platform Screen Door
CPO	Compulsory Purchase Order	PSG	Performance Steering Group
CRAF	Completion Readiness Assessment Framework	PSR	Project Status Report
CRL	Crossrail Limited	PTYSC	Property Sub-Committee
CRV	Crossrail Requirements Variation	PWay	Permanent Way
CSCS	Construction Skills Certification Scheme	QBR	Quarterly Baseline Review
CSDE	Correct Side Door Enabling	QCRA	Quantified Cost Risk Assessment
CSJV	Costain Skanska Joint Venture	QRA	Quantified Risk Assessment
CSM	Construction Safety Management	QSRA	Quantified Schedule Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	RAB	Regulatory Asset Base
CT	Computerized Tomography	RAB (C)	RfL Assurance Board for Crossrail
CTOC	Crossrail Train Operating Concession	RAG	Red, Amber, Green Matrix
CUH / CHS	Custom House Station	RAM	Route Asset Manage.
CW	Canary Wharf	RBC	Remote Block Computer
CWG	Canary Wharf Group	RCA	Risk Control Actions
CWS	Canary Wharf Station	RCC	Route Control Centre
D&A	Drugs and Alcohol	RfL	Rail for London
DA	Development Agreement	RfL-I	Rail for London - Infrastructure

DeBo	Designated body	RFT	Right First Time
DESJs	Design Engineering Safety Justifications	RIA	Railway Integration Authority
DfT	Department for Transport	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DLO	Direct Labour Organisation	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DLR	Docklands Light Railway	RIRP	Railway Integration Review Point
DOO	Driver Only Operation	RLU	Restricted Length Unit
DPS	Depot Protection System	ROC	Rigid Overhead Conductor
DT	Dynamic Testing	ROC	Regional Operational Centre
Dwall	Diaphragm wall	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
DWWP	Delivery of Works Within Possession	ROP	Royal Oak Portal
E&B	Earthing & Bonding	RP4.2	Review Point 4.2
EA	Environment Agency	RR	Ricardo Rail
EAC	Estimate at Completion	RRV	Road / Rail Vehicles
EB	Eastbound	RS	Rolling Stock
ECHR	Element Completion Handover Report	RSC	Return Screen Conductor
ECI	Early Contractor Involvement	RSD	Rolling Stock & Depot
ECP	Employers Completion Process	RSSB	Rail Safety & Standards Board
ECS	Empty Coach Stock	RTU	Remote Telemetry Unit
EDBL		S&C	Switches & Crossings
EDORs	ETCS Data Only Radio	SA	Supplementary Agreement
EDT	Early Dynamic Testing	SACR	Semi Annual Construction Report
EED	Emergency Exit Door	SAP	System Applications Products
EFC	Estimated Final Cost	SAR	Safety Assessment Report
EFC	Economic and Financial Committee	SAT	Site Acceptance Test
EiS	Entry into Service	SC	Staged Completion
ELCBT	Elizabeth Line Countdown Board Tracker	SCADA	Supervisory Control and Data Acquisition
ELRSG	Elizabeth Line Readiness Steering Group	SCL	Sprayed Concrete Lining
EMC	Electromagnetic Compatibility	SCN	Sponsor Change Notice
EMU	Electrical Multiple Unit	SDG	Signalling Design Group
ERTMS	European Rail Traffic Management Systems	SDO	Selective Door Operation
ESJ	Engineering Safety Justification	SDS	Scheme Design Specification
ESM	Engineering Safety Management	SER	Signalling Equipment Room
ESS	Eleanor Street Shaft	SES	South East Service
ETCS	European Train Control System	SESR	South East Signalling Room
ETH	Eastern Ticket Hall	SFA	Sponsor Funding Account
EVM	Earned Value Management	SGS	Stepney Green Shaft
FAR	Farringdon	SHELT	Safety and Health Leadership Team
FCCB	Finance Current Control Budget	SIM	Simulation Room
FDC	Framework Design Consultant	SIRP	Systems Integration Review Panel
FDO	Final Design Overview	SISS	Station Information and Security System
FDS	Final Design Statements	SJR	Safety Justification Report
FFOC	Final Forecast Outturn Cost	SLD	Single Line Diagrams
FGW	First Great Western	SMS	Safety Management System
FIS	Fisher Street Shaft	SMTA	Smithfield Market Traders Association
FLU	Full Length Unit	SOC	Statement of Compatibility
Fol	Freedom of Information	SONIA	Sterling Overnight Index Average
FRAG	Fraud Risk Assurance Group	SOR	Systems Operation Room
FTS	Floating Track Slab	SORBA	Shaping Architecture Company (sub cladding contractor)
GAF	Greater Anglia Franchisee	SPI	Schedule Performance Index
GE	Great Eastern	SPS	Secondary Part Steel
GEBR	Guaranteed Emergency Brake Rate	SR	Sponsors Requirement
GEFF	Great Eastern Furrer & Frey	SRP	Safety Review Panel
GEML	Great Eastern Main Line	SSE	Scottish & Southern Electricity
GFRC	Glassfibre Reinforced Concrete	SSP	Stations, Shafts, Portals

GLA	Greater London Authority	STG	Stepney Green
GPE	Great Portland Estates	STS	Standard Track Slab
GRC	Glass Reinforced Concrete	SVP	Safety Verification Panel
GRIP	Governance for Railway Investment Projects	T&C	Testing & Commissioning
GSM-R	Global System for Mobile Communication - Railway	TAP	Technical Assurance Plan
GW	Great Western	TBM	Tunnel Boring Machine
GWML	Great Western Main Line	TC&HSG	Testing, Commissioning and Handover Steering Group
GWR	Great Western Railway	TCMS	Train Control Management System
H&S	Health & Safety	TCR	Tottenham Court Road
HAL	Heathrow Airport Limited	TCRW	Tottenham Court Road West
HALARP	Heathrow Airport Limited Assurance Review Panel	TDR	Technical Director's Report
HAS	High Attenuation Sleeper	TDY	Tunnel Drive Y
HAVS	Hand Arm Vibration Syndrome	TfL	Transport for London
HEP	Handover Execution Plans	TOC	Train Operating Company
HEX	Heathrow Express	TOSD	Tier One Substantially Demobilised
HIA	Heathrow Implementation Agreement	TPA	Tunnel Planning Authority
HM	Her Majesty	TPH	Trains Per Hour
HMDL	Handover Master Deliverable List	TPS	Train Protection System
HO	Handover	TPWS	Train Protection & Warning System
HPNM	High Performance Near Misses	TRAIL	Transport Reliability Availability Integrated Logistics
HRW	Heathrow Airport	TRH	Temporary Rehousing
HSPI	Health & Safety Performance Indicator	TSI	Technical Standard for Interoperability
HV	High Voltage	TTO	Temporary Ticket Office
HVAC	Heating Ventilation & Air Conditioning	TTVS	Temporary Tunnel Ventilation System
I/O	Input / Output	TUCA	Tunnelling & Underground Construction Academy
IA	Interim Acceptance	TWAO	Transport & Works Act Order
ICD	Interface Control Document	TXM	TXM Plant
IECC	Integrated Electronic Control Centre	U&A	Undertakings & Assurances
IEP	Intercity Express Programme	UKPN	UK Power Networks
IFC	Issued For Construction	UR	Urban Realm
IFD	Ilford Yard	URT	Unresolved Trends
IM	Infrastructure Manager	UTX	Under Track Crossings
IOSH	Institution of Occupational Safety and Health	VAP	Verification Assurance Procedure
IP	Intervention Point (0, 1, & 2)	VDP	Victoria Dock Portal
IR35	Inland Revenue Taxation Regulation 35	VERP	Value Engineering Review Panel
IRM	Incident Response Management	VFL	Volker Fitz Patrick
IRN	Installation Release Note	VN	Variation Notice
IRSG	International Regulatory Strategy Group	VT	Voltage Transformer
ISJ	Interim Safety Justification	WAD	Works Authorisation Document
ISV	Intermediate Statements of Verification	WBP	Westbourne Park
ITP	Inspection & Test Plan	WBS	Work Breakdown Structure
ITT	Invitation to Tender	WC	World Class
JST	Joint Sponsor Team	WCC	Westminster City Council
KBR	Knorr-Bremse Rail	WCCC	Whole Contract Construction Certificate
KD	Key Deliverable	WHI	Whitechapel
KE	Kinematic Envelope	WITI	Western Inner Track Infrastructure
KG	Kensal Green	WOE	Western Outer Electrification
KO	Key Output	WOO	Woolwich Station
KPI	Key Performance Indicator	WOTI	Western Outer Track Infrastructure
L&P	Land and Property	WTH	Western Ticket Hall
LB	London Borough	YC	Yard Control
LBTH	London Borough of Tower Hamlets		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 116

Period 6 FY2018-19

19 August 2018 – 15 September 2018

Document No. B2111500/116/1.16

11 October 2018



Official ~ Sensitive Commercial

Project Status Report 116

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Note: This report relies on the information set out in CRL's Period 6 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 15 September 2018. Note that information emerging after the close of Period 6 is subject to formal confirmation by CRL in its Period 7 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan.

Note: JST has confirmed that PRep will no longer formally report on On Network Works (ONW) in future periodic reports. PRep will continue to meet with CRL and NR, and will continue to advise JST of any key risks to Crossrail caused by NR.

Document history and status

Revision	Date	Description	By	Review	Approved
1	4 October 2018	PSR 116 Period 6 FY 2018-19 v1.11.docx ~ Draft	PRep Core Team		
2	11 October 2018	PSR 116 Period 6 FY 2018-19 v1.16.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets. The 'Finish Safe' campaign commenced during September.

Financial:

The Intervention Points have not changed in Period 6. Following a Quantified Cost Risk Analysis (QCRA), CRL has increased the AFDCD at P50 by £483m to £13,293m, which breaches IP2 by £781m. KPMG has commenced its reviews of the ongoing funding requirement, cash forecast and commercial and governance arrangements. The AFDCD remains understated and will increase again.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains as £2,584m. The ONW final forecast outturn cost (FFOC) remains as £2,430m. CRL continues to advise of significant cost risks to the NR ONW forecasts.

Stage 2 Opening:

The initiative to replace Reduced Length Units (RLU) prior to Stage 2-2 with Fixed Length Units (FLU) is planned for December 2018, but train software issues have further eroded schedule float. We believe there is a significant risk that the FLUs will not be ready by December. However, the RLUs can continue in service and be replaced as soon as the FLUs are ready. The impact of any delay will not be felt by passengers, but will result in reduced time to build reliability.

Readiness for Stage 2-2 remains intrinsically linked with the prioritised Stage 3. Until the Stage 3 train software development is significantly complete, any proposed dates for Stage 2-2 software (TCMS v7.3) are not secure. This then affects the start date for the driver training programme. Because of this, we believe there is a high risk that the revised target date of May 2019 will not be met. Any new target date is likely to need to avoid overlapping with preparations for Stage 3 opening. [REDACTED]

Stage 3 Opening – Infrastructure and Systems:

CRL presented its Remedial Action Plan (RAP) to the Sponsor Board on 20 September 2018; however, Sponsors have informed CRL that the RAP was not deemed adequate and requested additional information, to be submitted before the next Sponsor Board on 15 October 2018. The new MOHS is expected in late October 2018, which we expect will show significant delay against CRL's current target dates in MOHS 2018. CRL's outline delivery plan for the completion of all fixed infrastructure did target the start of Trial Running for 15 April 2019, although this is subject to review.

Delivery in April 2019 relied upon the completion of all rail systems installation and the start of an intensive period of '5/2 Dynamic Testing', previously targeted at 22 October 2018. However, 'entry criteria' devised to determine the readiness of rolling stock, signalling software and infrastructure have not been satisfied, so the start date needs to be reassessed. CRL has recently indicated that '5/2 Dynamic Testing' will not start until mid-December 2018.

Routeway installation is substantially complete, but large numbers of connections into systems remain to be delivered by Stations, Shafts and Portals (e.g. Fire Main, LV Power, Radio), and into cross-passages. These connections are proving difficult to complete, with consequent

impact upon the early achievement of '5/2 Dynamic Testing'. Delays to rolling stock and signalling software development further compound the situation.

Delays to Station Shaft and Portal works also impact Phase 3 integration testing of remote equipment back to the Route Control Centre using SCADA. All Phase 3 testing must be completed before Trial Running, and availability of specialist resources to achieve this remains a concern, in spite of CRL and [REDACTED] attempts to recruit and train more staff.

Dynamic testing in limited duration 'windows' has continued on the Central Section and test train runs across both NR interfaces have now been completed. [REDACTED]

[REDACTED] The number of signalling tests that have been successfully completed, requiring no follow-up, remains small. Concerns remain with [REDACTED] ability to provide sufficient supporting resources, as noted above.

Overall, contractor performance compared with MOHS 2018 remains very poor in the completion of Installation Release Notes and static test certification, and there are huge challenges in securing the necessary resources to maintain meaningful progress. Anticipated schedule adjustments in the new MOHS might provide some relief to current document delivery peaks.

Stage 3 Opening - Handover and Operational Readiness:

Our concerns currently centre upon the delivery of Handover and assurance evidence. The key Handover elements of O&M manuals, Handover Master Deliverables and some aspects of asset information could remain difficult to produce in time, based upon current performance rates. Equally, provision of assurance evidence to CRL's NoBo and AsBo is behind progress. This reflects the delay to completion of the infrastructure and systems, and will remain a challenge throughout the duration of the project.

The delay to Stage 3 Opening should result in the IMs having sufficiently trained and familiarised personnel for when service does start.

Stage 4 and Stage 5 Openings:

The key issue for Stage 4 is the Key Date 22 power upgrade works. At this point the scope has been confirmed, but the delivery plan and access (especially for Christmas 2018) has not yet been assured. [REDACTED]

The primary issue affecting Stage 5 is the western station upgrades. We understand NR is considering all [REDACTED] to resolve this. Another issue to be aware of is the delivery of DOO CCTV on western outer stations. These are part of NR's Key Output 6B works, scheduled for completion by 1 December 2019. This will need to be reviewed if the option of implementing an interim Paddington High level – Reading service¹ is to be pursued prior to this date.

We expect a new schedule for Stages 4 and 5 to form part of the new MOHS.

¹ Known as Stage 5A.

1 Cost

1.1 Summary

CRL has increased the AFDC by £483m to £13,293m for Period 6, which breaches IP2 by £781m. This consumes all of the increased £300m funding made available by Sponsors and has imposed commitment on Sponsors for further additional funding. The management and governance of the funding increase is critical for CRL to be able to meet its commitments. Cash availability is equally important to meet payment obligations to its suppliers. CRL has raised these issues as urgent matters with Sponsors.

The NR ONW forecast cost (AFC plus VNs) is unchanged at £2,584m. The ONW FFOC forecast is also unchanged at £2,430m. Further increase is expected; for example, as a consequence of the West enhanced station tenders being [REDACTED]

The Intervention Points have not changed in Period 6;
The AFDC has increased to £13,293m although this remains understated;
The CRL AFDC exceeds IP2 by £781m;
Risk allowances within the AFDC are inadequate;
The forecast gap between the Contractors' estimate and CRL's PM assessment of total defined cost has reduced by [REDACTED] to [REDACTED];
We expect the AFDC to increase again at Period 7;
The CRL ONW AFC, including VNs, remains at £2,584m;
The NR FFOC remains as £2,430m;
CRL continues to advise of significant cost risks to the NR ONW forecasts.

1.2 AFDC and Intervention Points

CRL has increased the AFDC at Period 6 by £483m to £13,293m. The CRL Period 6 AFDC exceeds IP2 by £781m, as shown in Figure 1 - 1; and also exceeds the Finance Current Control Budget (FCCB), of £12,810m by £483m.

(£ millions)	Period 5	Period 6	Delta	Movement
Forecast	12,717	12,719	2	up
Delivery Risk	1	6	5	up
Subtotal	12,718	12,725	7	up
Programme Risk	88	564	476	up
Board Risk	4	4	0	same
AFDC total	12,810	13,293	483	up
IP0	11,672	11,672	0	same
IP0 Headroom	-1,138	-1,621	-483	down
IP1	11,912	11,912	0	same
IP1 Headroom	-898	-1,381	-483	down
IP2	12,512	12,512	0	same
IP2 Headroom	-298	-781	-483	down

Figure 1 - 1 ~ AFDC Headroom to Intervention Points

The £483m AFCDC increase principally addresses the £228m of Unresolved Trends (URTs). CRL is reporting at Period 6 the provision of £154m to cover the CRL cost exposure set out in its Period 6 Consolidated Cost Report (CCR). The £154m provision is derived by CRL as the difference between each respective Contract AFC, which includes URT allowances, and its corresponding CRL adjusted Defined Cost. However, there is a significant [REDACTED] gap between CRLs Defined Cost assessment and the Contractors estimates.

Consequently, the full value of Defined Costs being pursued by the Contractors is not included in the current AFCDC. [REDACTED]

The rate of Cost of Work Done (COWD) continues to follow the consistent linear trend that has been steady through the life of the project. In Period 6, the Delivery COWD was £114m and continues to follow the historical trend path. However, as a consequence of the large AFCDC increase in Period 6, the trend projections for both the rate of increase of AFCDC and COWD offers no reasonable or accurate forecasting conclusion, as shown in Figure 1 - 2.

The announcement by CRL of the delay to Stage 3 has seen scrutiny of the project at two public GLA sessions and at the TfL Board meeting on 19 September 2018. Sponsors and TfL Executive have now commissioned KPMG to undertake two independent reviews of the project: one on governance and the other on financial and commercial management. An outcome from these reviews may be the determination of the costs to completion.

At Period 6, we are concerned that CRL reports an AFCDC increase of £14m above the P50 AFCDC presented to Sponsors on 20 September 2018. Of greater concern, CRL also gives notice of further increase following the review of the Remedial Action Plan (RAP).

We suggest that Sponsors should encourage CRL to settle urgently a fully inclusive and comprehensive Final Forecast Cost that is sustainable to completion. We would expect this to include the full risk entitlement for claims, contractors estimates and risk allowance. At Period 6, costs to go is reported as £383m, including URTs and QCRA. CRL has confirmed² that the QCRA includes allowances for the defined cost gap and disputes, but not to the full amount submitted by Contractors. Such an approach may avoid continuing incremental increase to the AFCDC through to Autumn 2019 and may mitigate the ongoing costs that are mainly around delays, prolongation and productivity issues.

² Meeting with CRL Commercial Director 9 October 2018.

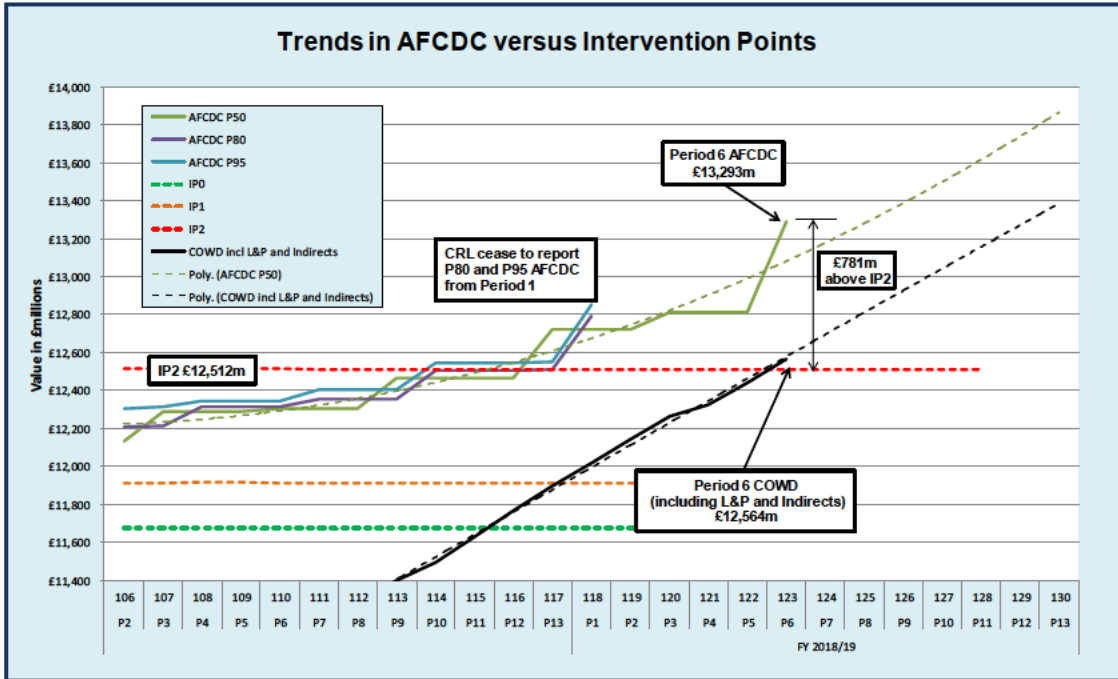


Figure 1 - 2 ~ AFDCD Headroom to Intervention Points

Delivery overspend continues to rise in Period 6 and trend projections shown in Figure 1 - 3 indicate the effects of this continued growth, which may be regarded as a consequence of the ongoing cost escalation experienced by the project. The cumulative delivery overspend, against the CRL internal budget at each period, has increased in Period 6 by £9m to £765m (Period 5, £756m) as shown in Figure 1 - 3.

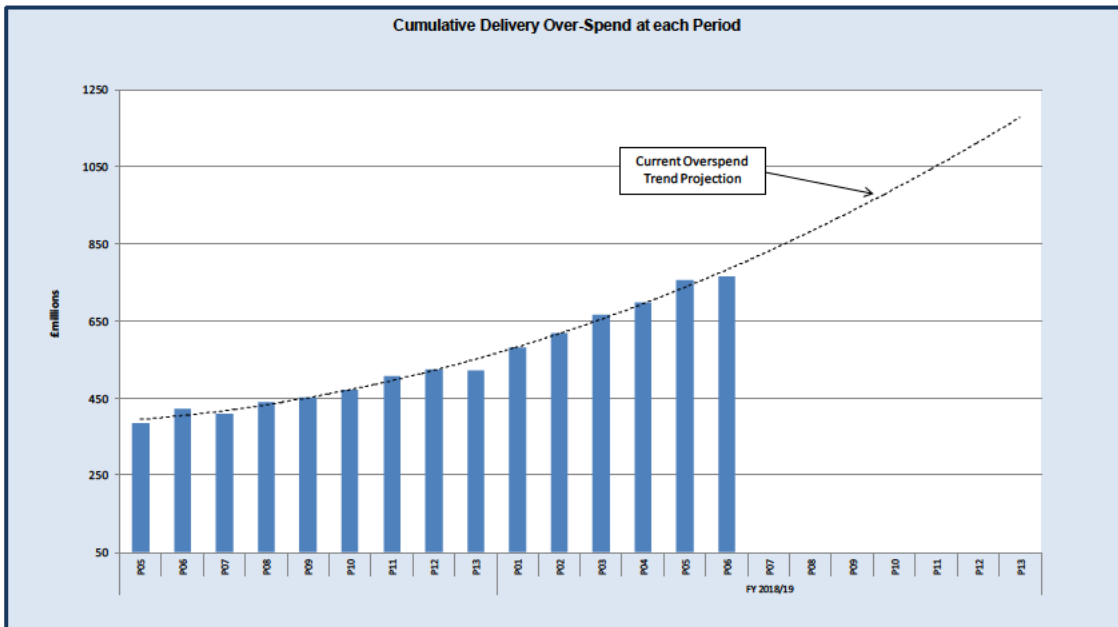


Figure 1 - 3 ~ Cumulative Delivery Overspend against CRL Budget at each Period

CRL reports that, in Period 6, it spent £84.8m above the 2018/19 Business Plan, an increase of £18.7m on Period 5. The CRL Period 6 Board Report provides the details of the overspend which, in summary, continues to be dominated by low productivity, prolongation and delays.

Programme risk has increased by £476m to £564m and Delivery Risk increased by £5m to £6m in Period 6, equating to an overall net increase in risk of £481m, (from £93m to £574m). This follows a QCRA carried out by CRL, which is subject to review by KPMG. We have recently received the breakdown of the QCRA and sought initial clarification³ with CRL. We will provide commentary on the completed review in our next report.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 6 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package. Figure 1 - 4 shows the reconciliation of the adjusted Target and Defined Costs for Period 6 to include removed values and avoid duplication of costs included within the 'Others' category, in order to provide ongoing continuity for consistent trend analysis reporting.

Contract	Target £m		Defined Cost £m	
	P6		P6	
C300				
C305				
C610				
C512				
C510				
C435				
C405				
C412				
C360				
C502				
C422				
C350				
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,484	£5,762	£5,892	£6,085
Others	£913	£931	£980	£989
Total	£6,397	£6,693	£6,872	£7,074

Figure 1 - 4 ~ P4 Adjusted Defined Cost and Target Cost⁴

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

³ Meeting with CRL Commercial Director 9 October 2018.

⁴ Figure 1-4 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.

[REDACTED]

Although CRL has advised that the AFCDC makes allowances for the increase of defined costs, the full value of the Contractors' estimates has not been included. The rate of increase for defined costs is increasing, and consequently the allowances within CRL's risk review appear to be insufficient. [REDACTED]

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

1.4 Stage Opening Delays – Cost Implications

The issue of the Adverse Event Notice by CRL, and the related revised Stage 3 opening plan, have very significant implications for forecast costs which has contributed to the increase to the AFCDC in Period 6. CRL is reporting that further AFCDC increases are expected to be added following the review of the RAP. CRL is ensuring that additional funding requests are supported by a realistic assessment of the schedule and risks. This will require examination at a detailed level to ascertain if they are credible, to ensure all costs are covered, including Stages 4 and 5, and sustainable to fund to completion.

1.5 Contingency and Risk

The Period 6 Finance Current Control Budget remains at £12,810m. The £13,293m AFCDC exceeds the financial budget by £483m, and exceeds the RP4.2 Baseline funding of £12,136m by £1.16bn.

CRL is reporting that the overall Period 6 contingency budget of £84m is not sufficient to cover the risk exposure of £574m by £490m (£484m deterioration from Period 5). The centrally controlled Delivery contingency and Board contingency at Period 6 both remain unchanged from Period 5 at £38m and £23m respectively.

Figure 1 - 6 shows the trend of the decrease in the Board and Programme Contingency and compares the lower Risk Exposure at P50 only⁵ with the remaining contingency.

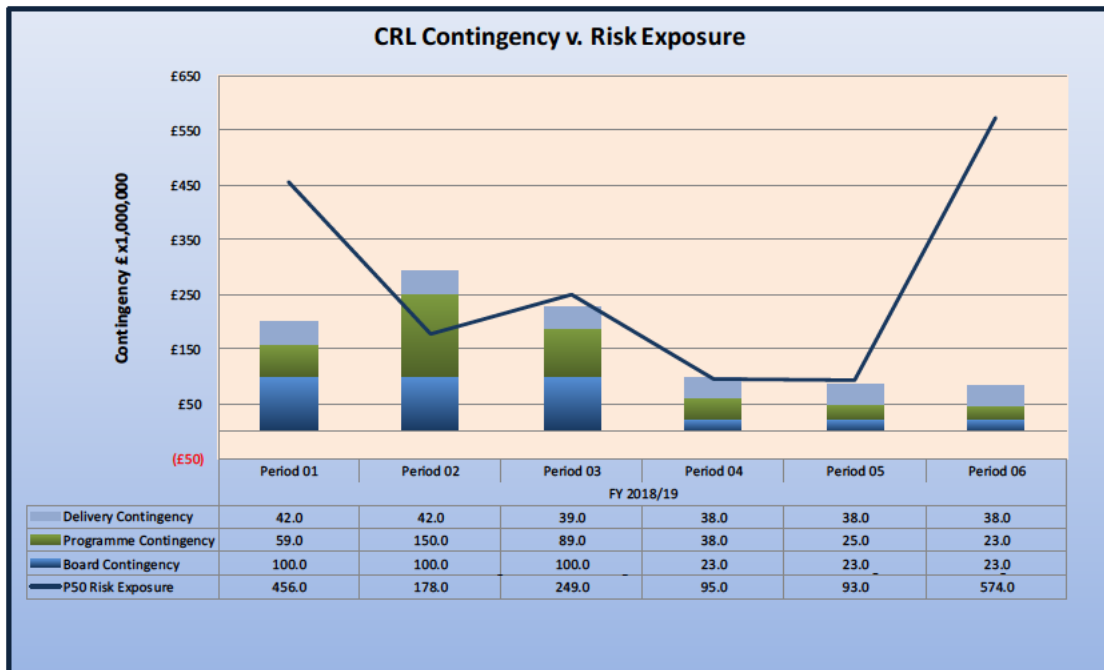


Figure 1 - 6 ~ Risk Exposure versus Contingency

CRL has confirmed that all trends are covered by URTs or risk in the Period 6 AFCDC. Figure 1 - 7 shows the apportionment of Risk from Period 13 up to Period 6.

⁵ CRL ceased to report P95 at Period 2.

Period	QRA	URTs	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81
P4	95	46	2	87	6	43
P5	93	174	1	86	6	-87
P6	574	228	6	530	38	308

Figure 1 - 7 ~ Elemental Breakdown of Risk Allowances

1.6 Cost: On Network Works (ONW)

The Period 6 On Network Works (ONW) forecast cost (AFC plus VNs) has not changed from Period 5 and remains at £2,584m. The ONW remain 91% complete⁶. CRL remains concerned with the final outturn cost, notably associated with the risks highlighted in Section 1.6.2 below.

The Forecast Final Outturn Cost (FFOC) at Period 6 has not changed either and remains at £2,430.0m, which reflects a reported Grand Total Cost position of £2,886m, less £154m for Variation Notices (Cash Funded) and £302m CRL/NR secured funding, as shown in Figure 1 - 8.

Description	Period 5 £m	Period 6 £m
Cost Grand Total	2,889	2,886
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	20	20
Total Cash Funding	154	154
CRL/NR Funding:		
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
[Redacted]	[Redacted]	[Redacted]
Total CRL/NR Secured Funding	305	302
FFOC	2,430	2,430
Pain/gain share	-70	-70
Forecast to RAB	2,360	2,360

Figure 1 - 8 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

⁶ ONW Percent complete is 91.0% and includes a forecast cost allowance for known cost pressures and Enhanced Stations (West).

1.6.1 ONW Funding

CRL has reported that the total Period 6 Secured Funding for NR ONW, has reduced slightly to £2,885.7m due to the effect of a small number of scope changes as shown in Figure 1 - 9.

The ONW funding is still expected to increase in future periods, as NR is currently discussing a further application for funding from the Portfolio Board to cover cost pressures relating to [REDACTED]. NR is seeking to secure a further £7.1m of Recoveries [REDACTED]. In relation to other NR projects and tax/insurance recoveries; [REDACTED] tabulated in Figure 1 - 10; NR ONW Cost Summary.

Description	P6 Source of Funding				P5
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	271.0	-	-	271.0	271.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
NR Current Funding	2,542.0	22.0	20.0	2,584.0	2,584.0
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Sub Total	-	118.9	182.8	301.7	305.4
TOTAL SECURED FUNDING	2,542.0	140.9	202.8	2,885.7	2,889.4

Figure 1 - 9 ~ NR ONW Secured Funding

1.6.2 ONW Cost

CRL reports that the Grand Total Cost has marginally increased by £4m in Period 6 from £2,881.7m to £2,885.7m, but with an increased mid-point sensitivity of £115m (a £80m increase from Period 5), as shown in Figure 1 - 10.

Description	Period 5 £m	Period 6 £m	Delta £m	P6 Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,891.0	2,907.7	16.7	2,943.1	3,010.0	3,070.9
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	0.0	0.0	0.0	0.0	0.0	0.0
Recoveries (Residual)	-9.3	-7.1	2.2	-2.1	-1.9	0.0
Targeted Savings	0.0	-14.9	-14.9	-11.9	-7.5	0.0
Cost Grand Total	2,881.7	2,885.7	4.0	2,929.1	3,000.6	3,070.9
Total Secured Funding	2,889.4	2,885.7	-3.7	2,885.7	2,885.7	2,885.7
Funding Gap	-7.7	0.0	7.7	43.4	114.9	185.2

Figure 1 - 10 ~ NR ONW Cost Summary

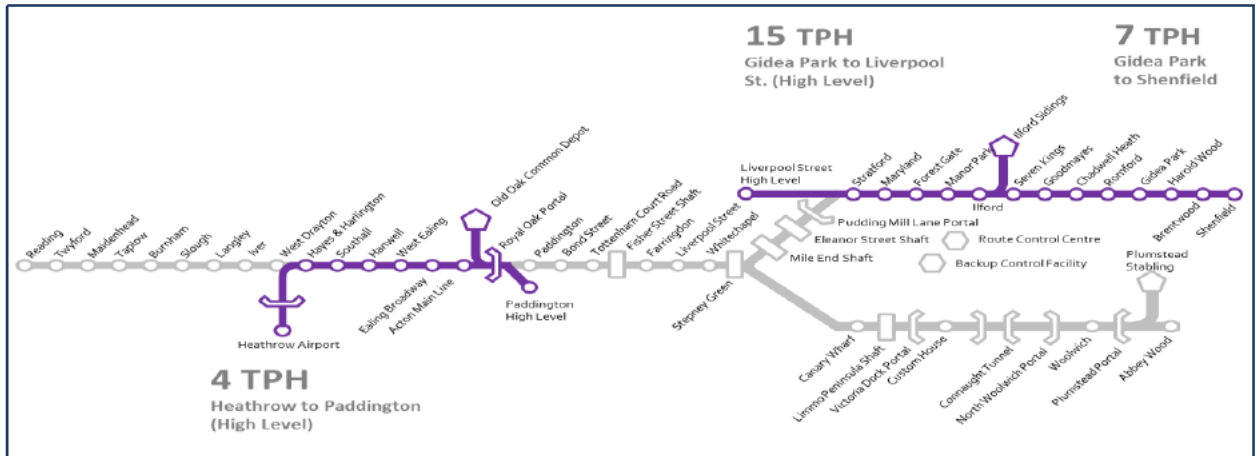
CRL has collated the effects of known Period 6 risks in its SPOT⁷ AFC cost sensitivity analysis, as shown in Figure 1 - 10 above.

The most significant cost risks to the ONW continue to be:

- NR's ability to achieve the required £7.1m of Recoveries;
- Anglia Civils – although NR is reporting that [REDACTED]
[REDACTED]
[REDACTED]
- Closeout risk associated with upward pressure on the reported AFC for [REDACTED]
[REDACTED] now that the Contract is cost reimbursable;
- Closeout risk associated with final outturn cost with respect to [REDACTED]
[REDACTED] 1;
- NR has yet to provide sufficient information to CRL to validate [REDACTED] for the delivery of the GRIP 6-8 West Enhanced stations; however, proposals are being put forward to Sponsors and NR's ExCom to request [REDACTED]

⁷ SPOT AFC – NR standard terminology - a spot check at a particular moment in time.

2 Stage 2: Phase 2



2.1 Summary

The target date for Stage 2 Phase 2 Opening is now May 2019, but there is a high risk that this will not be achieved.

Target date now May 2019, but there is a high risk that this will not be achieved;

2.2 Operational Readiness Assessment

CRL’s Stage 2-2 dashboard categorised three issues as ‘red’ for Period 6. These are the same issues as reported in Period 5. They are ‘Train Readiness’, ‘CRL ETCS Integration testing’ and ‘Driver training & Ops proving’. See Section 2.4 for details.

2.3 Interim phase (Replace RLUs with FLUs)

The approval of the software has been delayed by circa 3 weeks from Period 5 due to additional testing of the TCMS/CBTC configuration and associated assurance to allow a train to be driven with a failed AWS/TPWS system. We understand RfL is now aiming to implement the change in time for the new timetable introduction on 9 December 2018. There would be no detrimental impact upon passengers if that does not succeed, as RLUs could continue to operate. If this happens, then RfL does not need to wait until the next timetable change to make the swap. The negative impact is further delay in the opportunity to build reliability⁸.

⁸ The first provisional date for implementation was 12 August 2018. See PRep Period 2 status report.

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

The software development and approval dates have again been delayed in this period, by a week on average. However, we have little certainty as to whether these dates will be met by [redacted] due to the on-going demands of completing Stage 3 software development. Forecasting dates for completing TCMS v7.3 will be in doubt until that work is significantly complete. This is not likely to be until some point in November 2018.

The uncertainty surrounding the software means that the May 2019 service date is under significant threat. [redacted]

[redacted] RfL is also intending to extend the lease of the existing C360s, whose lease currently ends in May 2019. This is prudent.

[redacted]

[redacted]

OOC

The depot is now effectively operationally complete. We no longer intend to report upon it.

Operations

[redacted]

Regulatory Approvals

There is one remaining key approvals for Stage 2-2 APIS ETCS On-board to be issued by ORR to BT, currently forecast for 6 March 2019.

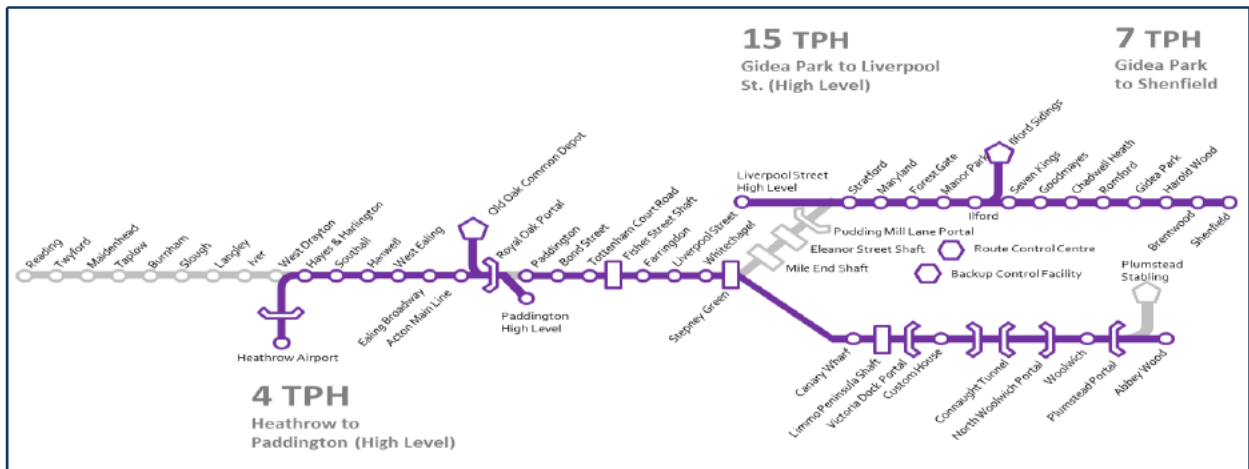
There are other approvals to obtain from the industry safety panels. NR's Wales and West SRP will approve putting ETCS wayside into use; MTR-C SVP will approve driver training and then passenger service; HALARP will approve reliability running, driver training and passenger service.

These approvals are dependent upon successful completion of the train's software and subsequent testing.

⁹ This includes W&W SRP ETCS, MTR-C SVP, HALARP and the ORR.

¹⁰ Stage 2 Phase 2 Period 6 PDB dashboard.

3 Stage 3: Paddington to Abbey Wood



3.1 Summary

CRL has presented its Remedial Action Plan (RAP) to the Sponsor Board; however, Sponsors have informed CRL that the RAP was not deemed adequate and requested additional information. The new MOHS is expected in late October 2018.

Remedial Action Plan to be revised;
Another independent schedule assurance review has been completed;
CRL continues to develop its new MOHS which will re-baseline most major contracts;
Progress continues to experience delays across all fronts;
Continued delays in production of IRNs;
Latest target for 5/2 Dynamic testing is mid-December 2018, subject to confirmation;
Handover materials are not progressing at the required rate;
Poor progress in completing assurance evidence necessary for regulatory approvals.

3.2 Schedule

Further to the Adverse Event Notice (AEN) issued by CRL on 30 August 2018, and following Sponsors request, CRL presented its Remedial Action Plan (RAP) to the Sponsor Board meeting on 20 September 2018. Sponsors informed CRL that the RAP was not adequate and requested additional information. The updated RAP is due to be discussed at the CRL Board meeting on 11 October 2018 and the Sponsor Board meeting on 15 October 2018.

The second part of the independent schedule assurance review of the proposed plan has been carried out by John Boss Consulting and a draft briefing note was also presented at the

Sponsor Board¹¹. This review broadly supports the conclusion of CRL that opening of Stage 3 in Autumn 2019 is achievable, although subject to risk. We issued our comments on the John Boss report to JST on 1 October 2018. We also submitted our suggestions regarding proposed 'flash reports' relating to cost, schedule and assurance.

CRL continues to develop its new Master Operational Handover Schedule (MOHS) which will re-baseline most major contracts. This was due to be ready in mid-October at the end of Period 7, but CRL has now advised it will be issued in late October, which is half way through Period 8. This allows for CRL Board and Sponsors review, as well as comments and feedback from all other stakeholders. The revised MOHS will include new baseline [REDACTED] key dates and new Anchor Milestones.

Progress continues to experience delays across all fronts with few project milestones being completed this Period; 184 are overdue. CRL report that progress was 0.2% against plan of 0.6%. Most of the remaining Anchor Milestones are forecast to be significantly later than the current MOHS 2018 baseline [REDACTED] dates; see chart at Figure A - 1 in Appendix A. In addition, as forecast, the start of 5/2 dynamic testing will not commence on 22 October 2018. Further details are included in the following sub-sections.

3.3 Operational Readiness Assessment

Elizabeth Line Dashboard

There are thirteen Readiness Tasks that have been given a 'Red' by the Elizabeth Line Readiness Steering Group (ELRSG)¹², two less than in the previous period. The changes from red to amber are:

- LU - 'MAID deliverables uploaded in Live Link'. Information is now being received from CRL.
- 'RfL Maintenance staff trained and competent'. Training programmes are now established, and the delay to the overall programme gives time to consolidate knowledge.

The reds that remain are predominately related to Handover material, due to the slow rate of progress and the lack of a MOHS to calibrate their status.

The ELRSG has now been disbanded and the Tasks will be tracked by either the Countdown Board or the Trial Operations Review Group. We will be reporting upon these forums from Period 7.

3.4 Stations, Shafts and Portals (SSP)

As noted earlier, CRL continue to develop the new MOHS which should be available in late October. This will feature newly defined target dates for SSP's:

- Tier One Substantial Demobilisation (TOSD);
- Phase 3 Complete (Ph3C);
- Staged Completion (SC);
- Handover (HO).

¹¹ Sponsor Board 20 September 2018.

¹² Meeting held 21 September 2018.

TOSD dates are important, as they indicate when costs will substantially reduce at each SSP, and Ph3C dates indicate when Phase 3 static integration testing is expected to be complete at each location. SC dates are targets when a SSP asset will be ready for takeover by the IM, and HO dates are target dates for completion of all paperwork in accordance with CRL's contract close out process. Completion of full HO paperwork should not prevent passenger services. We expect most of these dates, especially TOSD, will be ambitious targets as they will be based on [redacted] dates with minimal schedule float. A full definition of each of the key dates is expected with the new MOHS. We expect that most SSP's will be targeted to be ready for SC by the ROGS target date; currently 15 April 2019, although this is subject to review.

CRL continues to encourage the SSP Contractors to complete their works as soon as possible, with focus on those items of work which support the installation and testing of subsequent schedule critical works.

Production of IRNs, which are a prerequisite for testing, continues to be well behind plan, although some progress was made in Period 6. A total of 4,507 were planned, but only 2,115 (47%) have been produced to the end of the period. This delay continues to impact on subsequent testing and overall completion. We expect the new MOHS will include a realistic assessment of when the remaining IRNs are likely to be delivered.

The following gives a brief status for each SSP, based on information issued by CRL¹³. All dates are subject to confirmation. Schedule percentage progress information is included in the CRL Board Report, but these should be treated with caution as they are based on the outdated MOHS 2018 plan.

Paddington Station: [redacted]
[redacted]

Bond Street Station: [redacted]
[redacted] [redacted] [redacted]
[redacted]

Tottenham Court Road Station: [redacted]
[redacted]

Farringdon Station: [redacted]
[redacted]

Liverpool Street Station: [redacted]
[redacted]

Whitechapel Station: [redacted]
[redacted]

Canary Wharf Station: [redacted]
[redacted]
[redacted]

Custom House Station: [redacted]
[redacted]

¹³ Period 6 PDB report pack received 21 September 2018 and discussion with CRL Head of Planning.

Woolwich Station: [REDACTED]
[REDACTED]

Intermediate Shafts and Portals: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED].

Once the new MOHS dates are issued, we will meet with the CRL SSP Delivery Director to review progress and report our findings to JST, and in our Period 7 report.

3.5 Completion and Handover of Integrated Systems¹⁴

CRL’s current delivery strategy is summarised in Section 3.2. CRL’s short-term infrastructure completion plans and objectives described in our recent reports remain unchanged. Completion of rail infrastructure continues to be prioritised and is being carried out using Blockade Working. This remains CRL’s preferred approach to installation completion, at the same time allowing dynamic testing progress to remain aligned with off-site testing activities, software bug fixing and defect correction.

CRL’s intention is still to switch to the new delivery regime known as ‘5/2 Dynamic Testing’, subject to certain entry criteria being satisfied, and we consider this further in Section 3.6.1.

We have updated below progress in delivery of the nine critical paths contained within MOHS which lead to Stage 3 Opening.

1. Completion of Routeway [REDACTED]

The principal outstanding linear activities are associated with the installation of lighting and LV power, drainage and fire mains. The linear installations in the tunnels are now substantially complete but there has been poor progress in the completion of connections at cross-passages, caused in part by the logistical difficulties of placing and then operating up to 20 pieces of rail-mounted plant in each shift. The delays are being investigated by CRL and [REDACTED] to avoid further slippage to routeway completion.

A disproportionate amount of effort remains necessary to co-ordinate and implement the various tie-ins to works provided by other contractors at SSPs, despite improved co-ordination and detailed progress trackers.

There is a significant amount of equipment associated with the temporary services that are still in use (e.g. lighting, radio, fire main and power supplies). CRL’s requirement for temporary services will fall away as key project handover stages are reached during 2019, and the timing of removal varies with each one. CRL still intends for the removals to be transferred to RfL, although arrangements have yet to be formalised.

2. Signalling [REDACTED]

[REDACTED] installation is substantially complete across the Central Section and across the NR interfaces, with only items which are not critical to dynamic testing remaining outstanding (e.g. labels, signs and permanent marker boards). Provision by Siemens of sufficient resources to

¹⁴ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

support the '5/2 Dynamic Testing' period remains a serious concern. CRL and Siemens are in the process of recruiting and training additional workers to mitigate this risk.

Dynamic testing across the NR interfaces continues and is described further in Section 3.6.2.

3. Tunnel Ventilation [REDACTED]

There has been a significant drop-off in progress with permanent tunnel ventilation testing in the period¹⁵, in part because of a lack of LV power from SSPs. The objective remains to carry out a significant proportion of the final airflow tests throughout the Central Section before installations at Bond Street have been completed. However, the sequence of location-specific tests planned in Period 5 to be completed on 23 October 2018 has been re-sequenced and re-scheduled for completion on 20 November 2018. The corresponding airflow tests associated with Bond Street have been re-scheduled to take place during January 2019.

Progress in the last month has confirmed that the completion of the Permanent Ventilation System in the timescales originally proposed is challenging. Phase 2.2 tests have still not been completed and the Phase 3 period of the schedule remains tightly and intricately constructed, with no specific float provision. Given the complexity of the work and reliance upon other contractors, we do not believe that testing can be completed in the timescales proposed, and would expect that appropriate allowances are made in the new MOHS.

4. Radio [REDACTED]

GSM-R equipment installation continues in cross-passages. Availability of specialist resources remains a concern. CRL and [REDACTED] are in the process of recruiting and training additional workers to mitigate this risk. Gaps identified in detailed designs for above-ground sites continue to be rectified by [REDACTED]

5. Dynamic Testing

See Section 3.6 below.

6. HV Non-Traction Power (C650)

Delivery of HV systems is substantially complete, with the final transformer energisations scheduled to take place during October 2018 at Canary Wharf. This is a notable completion achievement and, given that the complexities and dependencies upon other contractors are analogous to those of the permanent ventilation system, there must be an opportunity for lessons to be transferred.

As before, some SSP sites have continued to struggle with the completion of downstream LV networks, energisation of which is necessary for [REDACTED] completion and commissioning of railway support systems such as tunnel lighting. These late completions undermine CRL's ability to deliver permanently energised and fully tested systems in support of Phase 3 testing. CRL considers the downstream completion of permanent LV power critical to the switch to the '5/2 Dynamic Testing' regime, and it is identified as one of the key entry criteria (see Section 3.6.1).

7. Traction Power [REDACTED]

[REDACTED] continues with a programme of equipment commissioning to complete the original scope of Traction Power Supply. Section Switches that were not required to support first energisation or initial stages of dynamic testing are being progressively commissioned, where completion of pre-requisite works at SSPs allows.

Modifications to PML ATFS continue.

¹⁵ Presented at the CRL Period 6 MOHS Review on 28 September 2018.

8. SCADA and Communications

The situation with SCADA and communications systems progress remains unchanged since last period. progress remains highly dependent upon a range of activity completions by others, and is subject to flexible working and reactive planning. Resource availability remains critical and identification and recruitment of further specialists for SCADA testing is an ongoing initiative.

CRL and continue to prioritise ‘first in class’ testing of asset types in order to gain testing experience as soon as possible. Late completion of SCADA I/O (Input/Output) schedules for many SSP sites remains a concern.

9. Stations, Shafts and Portals (SSP) Completion

Delivery of all SSP Rail Systems related works remains critical to overall railway completion and formal handover. This inter-dependence is reflected in the various cross-references to SSP works throughout this section of the report. There are many system ‘touch points’, including electrical, mechanical, data network (i.e. for SCADA connectivity). A wide range of blocking issues remains and a significant effort is required across the whole of the Central Section to bring the infrastructure to a state of completion sufficient to allow meaningful progress to be made with Phase 3 Static Integration Testing. This situation in turn complicates testing and witnessing resource planning and delays the preparation of assurance documentation.

The table below summarises the progress to date¹⁶ with the production of test certification, and illustrates the size of the challenge facing CRL and the Contractors.

Test Phase	Phase Completion Certificate	Forecast %	Actual %
2.1 (Intermediate Static Test)	Installation Release Note (IRN)	95	48
2.2 (Pre-Commissioning Test)	Pre-Commissioning Certificate (PCC)	93	15
2.3 (System Static Test)	Partial Acceptance Certificate (PAC)		
3 (Static Integration Test)	Acceptance Certificate (AC)	90	7

Figure 3 - 1 ~ Progress to date with the Production of Test Certification

3.6 Dynamic Testing

3.6.1 Dynamic Testing Strategy

CRL’s delivery strategy is summarised in Section 3.2, which was originally predicated upon a switch in delivery approach to a ‘5/2 Dynamic Testing’ regime on 22 October 2018. The switch would be made subject to documented¹⁷ ‘entry criteria’ being satisfied. These criteria are summarised below with cross-references to:

- Railway Systems complete (Section 3.5);
- Planned releases of CBTC and TCMS on-board software installed (Section 3.6.2);
- Rolling Stock off-site completion of critical CBTC tests (Section 3.6.2);
- Permanent LV supplies in place at Stations (Section 3.5).

A readiness review, chaired by an independent systems integration specialist, took place four weeks ahead of the target switch date¹⁸ to consider progress against the entry criteria. The

¹⁶ CRL Period 6 PDB Pack.

¹⁷ CRL document Entry Into Main Dynamic Testing Regime (CRL1-XLR-08-STP-CR001_Z-50003).

¹⁸ CRL meeting held on 21 September 2018.

review concluded that progress in all areas had fallen well short of what was necessary to achieve a switch on 22 October 2018, and commitment to that date was abandoned. Alternatives dates were discussed, but none was nominated as a new target, a situation that remains as of the date of this report. CRL advised at the most recent MOHS review¹⁹ that a new target switch date will only be confirmed once analysis supporting the development of the MOHS has been concluded and has since indicated a target of mid-December 2018. We also believe that consensus has yet to be reached on what constitutes ‘essential’ and ‘desirable’ entry criteria, and there is a risk that this will become a distraction in the identification of a revised target date.

We urge CRL to remain balanced and realistic rather than over-optimistic about what can be achieved, and to confirm and adhere to unambiguous entry criteria so far as possible. While the setting of challenging schedule milestones can bring benefits, we feel that CRL has spent a disproportionate amount of time and energy in the past on mitigation measures for delays which might have been avoided had a realistic schedule been developed in the first place. It is imperative that CRL produces a new MOHS which provides schedule confidence and delivery certainty.

In the meantime, CRL has now completed dynamic testing in ‘windows’, alternating with construction ‘blockades’. Multiple-train testing under signalling protection, originally scheduled to start during Dynamic Testing Window 7 on 28/29 July 2018, and re-scheduled to Dynamic Testing Window 12 on 14-18 September 2018, finally did not take place. The Safety Argument has not yet been approved and testing with more than one train will not now proceed until the ‘5/2 Dynamic Testing’ regime is in place.

Dynamic Testing will continue under the C610 Construction and Commissioning Railway Rule Book (CCRRB). [REDACTED] has submitted an application to the ORR for an extension to its Rule Book ROGS exemption until late 2019 as a schedule risk mitigation measure, but this has yet to be accepted.

CRL has indicated that it might plan more ‘windows’ for further dynamic testing during November and December 2018, but it is clear that these opportunities will be influenced by whatever revised target date for ‘5/2 Dynamic Testing’ is finally established.

3.6.2 Dynamic Testing Progress

CRL has completed twelve dynamic testing windows with two undertaken in the last period; a small number of short-length subsidiary windows have also been undertaken. In line with past performance, completion of the full planned scope of tests for the most recent windows has not been possible because of [REDACTED]

[REDACTED]

Test train running across the NR GEML interface was carried out for the third time during Dynamic Testing Window 12 (on 14-18 September 2018), allowing issues identified during Windows 8 and 9 to be addressed. There has been slow improvement in test results, with early issues being progressively resolved on repeated test runs.

Following the postponement of Dynamic Test Window 10 (on 7-9 September 2018) due to incomplete NR OLE works, test train running across the NR GWML interface took place for the first time during Dynamic Test Window 11 (on 15/16 September 2018). Some successful

¹⁹ CRL Period 6 MOHS Review held on 28 September 2018.

transitions from TPWS to CBTC were carried out, but runs in the reverse direction failed. These are under investigation.

Overall progress in achieving test success has stagnated. The latest testing statistics up to the completion of Dynamic Testing Window 11 still show a pass level of 34 against a cumulative total of 311 signalling test cases²⁰. Support investigations continue off site on the CIF and at Melton Test Track.

The ongoing repetition and emergence of new rail systems and rolling stock faults during dynamic testing support the case for ensuring that infrastructure sets are both complete and demonstrated reliable before the switch to '5/2 Dynamic Testing'.

3.7 Approvals, Assurance and Agreements

3.7.1 RAB(C)

RAB(C) meets as required to review formal submissions in line with CRL and RfL requirements, but CRL continues to miss its own submission deadlines. RAB(C) reviewed²¹ a revised programme of safety submissions aligned to CRL's latest schedule (targeting the start of Trial Running on 15 April 2019, although this is subject to review). A total of 52 submissions remain to be reviewed and approved before Stage 3 Opening, at a rate of approximately 5 per month. We expect the programme to require adjustment in due course, in order to match the revised MOHS.

The Safety Argument for Multiple Train Testing relies on the completion of the BT Consent to Test and ATC's revised submission on operational control of dynamic testing. CRL anticipates that the Safety Argument will be provided to RAB(C) in mid-October 2018, although with the planned sequence of 'windows' now completed, multiple-train testing will not now start until '5/2 Dynamic Testing' regime is in place.

New key dates for Engineering Safety Management submissions for the Stage 3 Safety Case are expected from CRL as part of the MOHS refresh.

3.7.2 Regulatory Approvals

There has been little progress to report upon since our Period 5 report. CRL states that there has been no change in the status of interoperability compliance for the three areas of design, NR deliverables and construction/dynamic testing.

A similar state exists with the production of the evidence required for the SAR, with one SEJ accepted by RAB-C in the period.

The key issues remain as before, and are joined by one more:

- *New* - [REDACTED] (Platform doors) Engineering Safety Management contract not in place, preventing closure of interface hazards;
- [REDACTED] continues to make slow progress in closing the open hazards allocated to it;
- [REDACTED] interface design with other signalling systems remains uncomplete;
- Lack of accepted O&M manuals prevents closure of system hazards²²;

²⁰ Performance data confirmed in the CRL Period 6 PDB Management Pack.

²¹ RAB(C) Meeting held on 12 September 2018.

²² This is because the mitigating action against many of the hazards is 'IM to follow the O&M manual'.

- Project Wide Hazard Record closure remains at 21%. The remaining open items require Test & Commissioning evidence from the contractors before they can be closed;
- Lack of TSI evidence to present to the NoBo.

We state the importance of Contractors completing the assurance evidence as well as the physical works. The Element is not deemed finished until the evidence is produced and accepted.

3.7.3 Agreements

There are four agreements that are judged to be amber. Three of these were described in our last report:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- Development Service Agreement between NR and RfL-I;
- GSM-R Network Services Agreement (new).

The IM Interface manual between NR and RfL-I is now adjudged green in Period 6.

We have been reporting that progress has been slow between the parties concerned, and fear that the delay to the programme will not provide much alleviation in delivering these Agreements in a timely manner.

There has been a change to the number of Critical Agreements that we reported open (38 in total) from our Period 4 and 5 reports. CRL states that the number is now 33, but this includes 5 or 6 agreements that are awaiting signed agreement.

3.8 Rolling Stock

The forecast dates for software development and assurance have slipped by circa 2 to 4 weeks from Period 5. The train is now forecast to receive an ISA for dynamic testing by 16 November. This is dependent upon its progress in passing the 29 tests that CRL and RfL have set for the Rolling Stock to prove it meets the essential requirements for dynamic testing.

By 28 September 2018, all 29 tests had been carried out, and 12 passed. What is not yet clear is whether any of the faults will require re-work of safety critical functionality, which would initiate the assurance process, with its consequential delay.

The time required to resolve the issues and pass the tests is not yet clear. This will emerge during the first 2 weeks of October. We would advise against any pressure to weaken the criteria for passing the 29 tests, as any issue will still require fixing, and could prejudice testing in the COS.



3.9 Handover

The progress of accepted O&M manuals, and delay of HMDL material, continues to remain a matter of concern. These items are an integral part of Handover to the IMs, and the delay to the overall programme does not necessarily mean there is adequate time to complete the work.

Training

The remaining issues for training centre upon Bond Street and Paddington stations due to their late running programmes, and C610 and C660 due in some cases to the lack of fitted equipment. We expect these to be resolved by time of opening for service.

O&M Manuals

We had hoped to see a change in results and behaviour by Period 6, but unfortunately there has been no significant change. A further 4 manuals were accepted in this period bringing the total to 34 of 779. Not all those manuals are critical for opening, but approximately half are expected to be. This is a large task.

The problems are a combination of behaviours, quality and the extended review process. CRL must quickly improve in this area of Handover.

Asset Information

With the exception of Bond Street station and C620 most asset data is in a position to be reviewed by the IMs. However, there appear to be on-going issues with loading into RfL's Maximo system due to quality issues. The extension of time should allow the contractors sufficient time to improve their performance, but pressure must continue to be applied to all parties.

Handover Master Deliverable List

In Period 6, the IMs accepted circa 4% of the HMDL total²³, bringing the total accepted to almost 14%. In the time available, there is likely to be a bow wave of documentation submitted to the IMs, and they need to be adequately resourced for this.

3.10 Trial Running & Trial Operations [previously Combined Trials]

As the revised MOHS has yet to be released, there has been little further progress in planning for Trial Running and Trial Operations. We do not believe there will be many issues, as by then (approximately summer 2019) operational and maintenance staff will have received the training and, hopefully, Handover materials that could have been lacking for a December 2018 opening.

We advise that the revised MOHS shows that the duration of Trial Operations returns to one of its previous incarnations of circa 13 weeks, and is not retained at circa 8 weeks as per the 'Combined Trials'. Those additional 5 weeks will be important in staff establishing familiarity with the equipment and systems, which is important for performance in the initial service period.

We repeat an issue facing RfL, and to a lesser extent LU, from our last report. The delay will mean these IMs will need to create initiatives that address issues of morale, retention and training competencies in the intervening period. The risk is that poor behaviours could become ingrained, influencing service delivery. We will monitor progress.

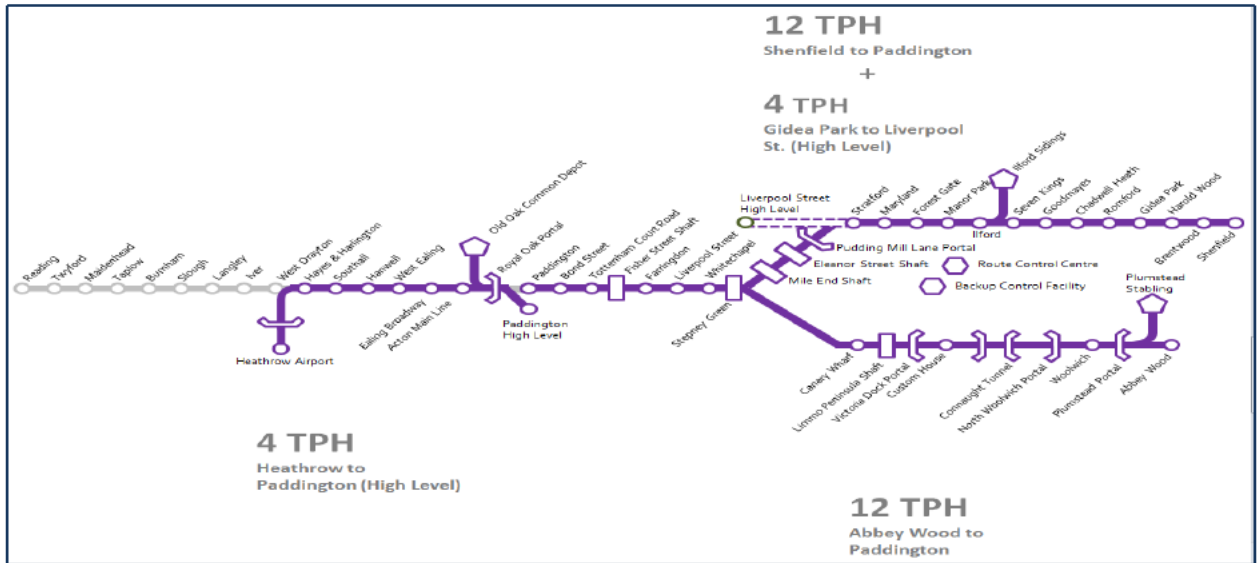
²³ Combined total estimated to be 183,600 documents.

3.11 Plumstead Depot

Window installation to the Accommodation Building is complete and cladding to the Maintenance Building is substantially complete. Electrical installation to both buildings has now started. Land handover from [REDACTED] continues, but still needs to be carefully monitored to avoid schedule impact. [REDACTED] permanent works are not required to support Dynamic Testing.

There is growing concern within RfL as to whether the signalling functionality matches the operational concepts that were developed. Areas of risk are the time taken to prepare the trains and limitation or complexity of moves within sidings. This is being investigated by CRL/RfL, and we will report accordingly.

4 Stage 4: Paddington to Abbey Wood & Shenfield



4.1 Summary

The delay of Stage 3 Opening will affect the Stage 4 Opening date. We await CRL’s recommendations as part of the revised MOHS. The key issue for Stage 4 is the KD22 power upgrade works.

4.2 Operational Readiness Assessment

There are three Readiness Tasks that have been given a ‘Red’ status by the PDB²⁴, the same ones as in our last report. The overall rating for Stage 4 is ‘Red’, based upon a May 2019 opening date.

	Readiness Task	Issue
	KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	Delivery remains challenging, as access at Christmas is not agreed and the Contractor’s programme is not completed or risk assessed.
	DOO CCTV installed and operational Stratford and Shenfield stations	Completion dates were very close (May 2019) to service opening, but as the opening date will certainly slip we would expect the works to have more time to be completed, unless momentum is lost. To be confirmed by the revised MOHS.
	Station Information & Security System (SISS) stations and RCC	The Contractor needs to provide a programme and [redacted] to accelerate its works. See comments above with regard to opening date.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with ‘Red’ Status

²⁴ 25 September 2018.

NR is constructing mainline platform extensions at Liverpool St high level station for the start of Stage 5; see Section 5.3.1.

4.3 Ilford & Romford Stations

NR is reporting that an advanced price for the Christmas enabling works for Crossrail East Enhanced Stations (Ilford and Romford) has been received from Volker Fitzpatrick, which is currently under review. NR is expecting the price for the full works to be available in November 2018. In the meantime, NR is currently discussing and reviewing the staging strategy and funding with CRL and expect to confirm its findings in Period 8.

NR reports that the planned delivery target dates for Ilford & Romford Stations are still being maintained. GRIP 5 detailed design was completed on schedule in Period 6. The key dates we shall continue to monitor to assure that progress remains on schedule are:

- GRIP 6 Tender return – October 2018;
- GRIP 6 Contract award – November 2018.

NR remains committed to station opening for December 2019.

4.4 ONW

Stage 4, KO5A – (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) (10 September 2018).

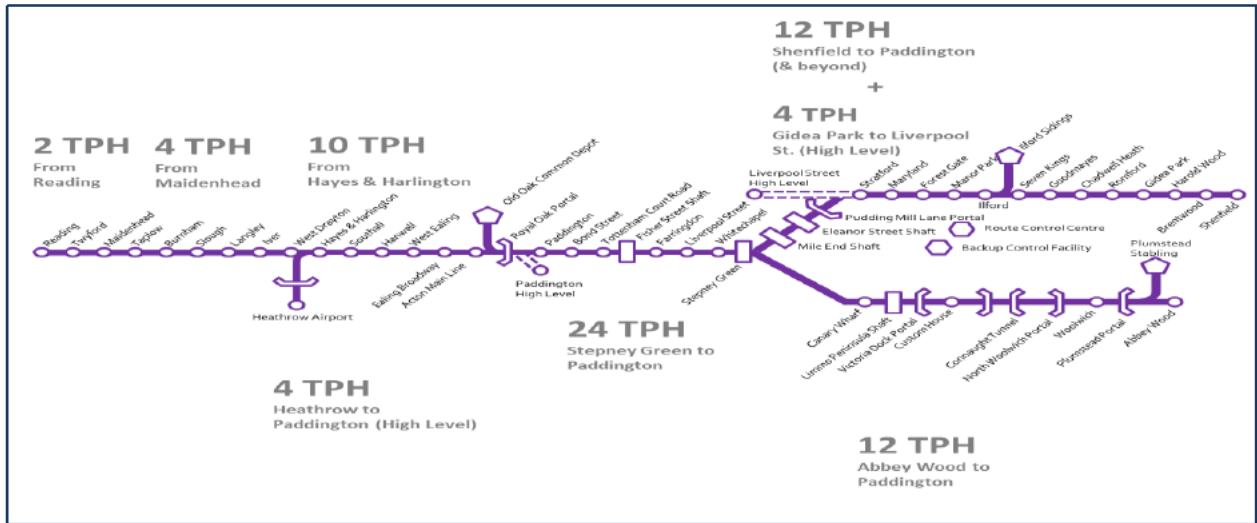
NR achieved two significant milestones during Period 6, with the achievement of Key Output 5a and Key Date 22 (Route clearance and all other infrastructure, including stabling & sidings updates, complete to support Stage 4 Dynamic Testing). Consequently, all of NR's original Key Dates and Key Outputs have now been achieved. NR and CRL continue to work together towards the two new Key Outputs 6a and 6b.

NR is reporting that progress for Key Output 6a, Full Infrastructure Capability to support Crossrail Stage 4 operations with sufficient time for testing and trials, is presently on schedule for 1 May 2019 forecast completion. The KO6a Anglia station key areas prior to Stage 4 opening in May 2019 include:

- At Period 6, the Anglia Traction Power Works required for Crossrail Stage 4 (ATF distribution to support Stage 4) is still being forecast by NR for May 2019;
- Access identified at Christmas 2018 for DOO CCTV on platforms 5 and 8 at Stratford;
- NR is currently awaiting GA to install temporary dispatch CCTV at Shenfield to enable the permanent DOO CCTV works to commence;
- NR has agreed the design solution for Goodmayes Station Platform 1 lift and currently seeking agreement for delivery;
- Manor Park and Maryland are planned for commissioning post ONSIP completion – all the achievable works have been concluded and are awaiting ONSIP completion. NR forecast to re-commence these works in January 2019 following demobilisation of the ONSIP team;
- Goodmayes ticket office is included under KO6a requirements due to water damage caused by failure of existing roof and drainage systems.

Key Output 6b covers the ONW required for Stage 5.

5 Stage 5: Reading & Heathrow to Abbey Wood



5.1 Summary

The delay of Stage 3 Opening will affect the Stage 5 Opening date. We await CRL’s recommendations as part of the revised MOHS. The primary issue affecting Stage 5 is the ONFR western station upgrades.

5.2 Operational Readiness Assessment

There are three Stage 5 Readiness Tasks that have been reported as a ‘Red’ status to the PDB on 30 September 2018, a decrease of one from our Period 5 report. The overall rating for Stage 5 is ‘Red’, based upon a December 2019 opening date.

	Readiness Task	Issue
	ETCS available and tested Airport Jn to Paddington	NR programme completion for ETCS is now forecast for mid to late 2020.
	Exemption for enhanced TPWS	The ORR has been informed, and CRL understand there is an acceptance of the situation.
	ONFR Western station upgrades complete	The delay to the procurement schedule, and [REDACTED] remain unresolved. [REDACTED]
	DOO CCTV GWML outer stations	This has been downgraded to red, but we believe the delivery plans are insufficiently mature to warrant the change. DOO CCTV will be required to operate any proposed Paddington High-level to Reading service.
	NEW Maidenhead Sidings accommodation	This Task was previously red, but it was thought sufficient progress had been made to downgrade it to amber. Concerns have since arisen to cause it to revert to red; the design is not optimal and there is [REDACTED] to support the works to be carried out by NR.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with ‘Red’ Status

5.3 Network Rail Works

5.3.1 ONW, Platforms and Stations

NR ONW for Stage 5 is included under NR Key Output 6b, Full Infrastructure Capability to support Crossrail Stage 5 operations (including Ilford and Romford Enhanced Stations) with sufficient time for testing and trials. NR is reporting that progress for Key Output 6b is presently on schedule for 1 December 2019 forecast completion.

NR continues to forecast the conversion of the OLE to AT power on Western Route for February 2019 to deliver full ATF for the planned February timetable change. NR is planning for the works to be undertaken during the four 1 day Christmas 2018 possessions. NR reports that the works for upgrading the traction power to AT mode have been completed to CRL’s requirements, but the full completion of the system upgrade for IEP trains is contingent on electrical bonding works at Paddington.

NR reports that Package 3 (Southall, Hayes & Harlington, West Drayton) tender returns have been assessed and tender recommendation made, although clarity is now being sought with respect to staging options so final recommendation is scheduled during Period 7 and Contract award expected in October 2018. Package 2 Tender returns (Acton, Ealing, West Ealing) have been received and are under review. [REDACTED]

NR is reporting that the critical path activities are progressing in parallel with advanced works over the Christmas 2018 period being undertaken by Bechtel and two tier 2 contractors for the manufacture and installation of footbridges at three stations.

NR is constructing mainline platform extensions at Liverpool St high level station for the start of Stage 5. A significant delay has emerged to the current GRIP 3-4 programme due to the following:

- Extended Track drainage investigations
- Discovery of a gas main
- Insufficient survey information
- Extended design approval process.

The key to the works is being able to make full use of the. We will monitor whether the current delay impacts upon the planned August 2019 possession. This is key for completing the works in time for Stage 5²⁵.

Another issue to be aware of is the delivery of DOO CCTV on western outer stations. These are part of NR’s Key Output 6b works, scheduled for completion by 1 December 2019. This will need to be reviewed if the option of implementing an interim Paddington High level – Reading service²⁶ is to be pursued prior to this date.

²⁵ December 2019 – MOHS 2018.

²⁶ Known as Stage 5A.

5.3.2 ETCS Delivery on the GWML

Stage A (Heathrow):

NR reports that Stage A key milestones are all complete. During Period 6, NR received its APIS from the ORR for ETCS (Heathrow) enabling the operation of passenger trains using the system infrastructure.

Stages B & C (Stockley-Acton & Acton-Paddington):

NR's revised plan for delivery of ETCS Stage B/C is under development but subject to a NR Route Review and also considers the effects from other projects, for example HS2. Consequently, the ETCS Stage B & C programme completion is delayed until mid to late 2020 with a delivery strategy not expected until Period 7. NR's application to the ORR for an exemption for enhanced TPWS, which is expected to be in excess of twelve months, is ongoing. The Sotera Risk Assessment was presented at the CRL Integration Meeting during the Period. Currently, CRL is not reporting any consequential effect to Stage 5 completion.

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI improved in Period 6, which has halted the falling trend. This is welcomed. Discussions with the Director of Health & Safety²⁷ indicate a renewed focus by CRL and the Principal Contractors (PCs) on leading indicators such as HSPI, inspections and near misses.

H&S KPI	Target	Aim	Period 5	Period 6
HSPI	2.20	-	2.55	2.57
PCs scoring over 2.20	11	11	10	11
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.16	0.15

Figure 6 - 1 ~ Health and Safety Performance COS²⁸

The RIDDOR rate remained at 0.09, in spite of incidents at Fisher Street Shaft and Paddington Station. The Lost Time Case (LTC) AFR improved to 0.15. There were also two high potential near misses on C610 Trace and Logistics.

CRL’s ‘Finish Safe’ campaign was launched during September. Amongst other matters, CRL and the PCs will focus on self-reviews, induction of new fit-out workers, exposure of services in Urban Realm, and the approaching winter weather.

ATC’s (C610) application to the ORR for an extension to its ROGS exemption is yet to be approved.

Lloyds Register Quality Assurance has recommended that CRL’s certification against ISO9001:2015 is continued.

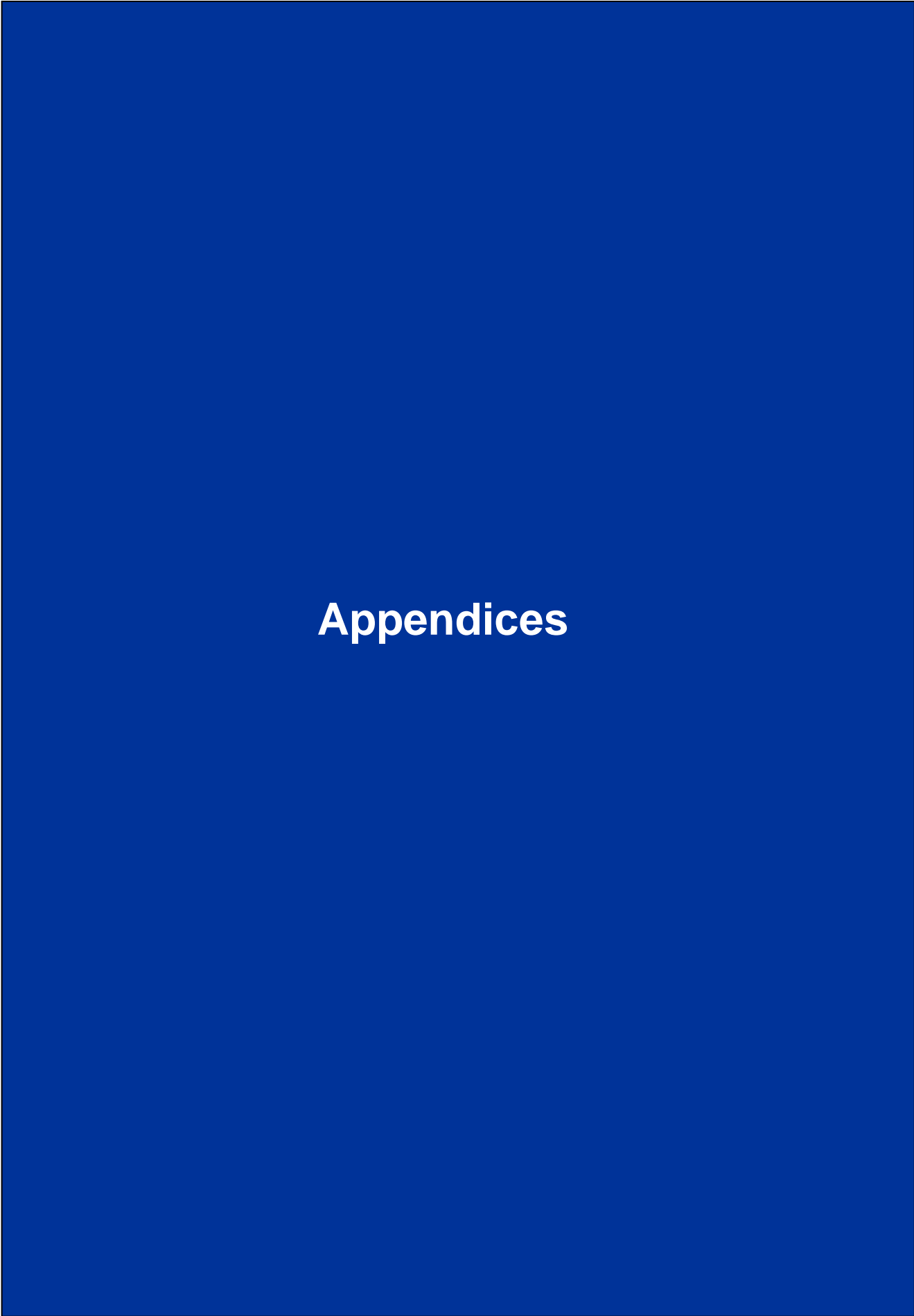
CRL is currently reviewing the resourcing required for its H&S team in accordance with the new schedule to completion.

6.2 Health & Safety Performance ONW (NR)

During Period 6, NR’s rolling 13 period Lost Time Incident Frequency Rate (LTIFR) increased slightly from 0.1484 to 0.16. NR had no lost time incidents but suffered one minor injury in the period. The Programme’s overall All Injury Rate for Period 5 is currently 0.76 injuries per 100,000 hours worked.

²⁷ Meeting on 1 October 2018.

²⁸ High Potential Near Miss (HPNM) rate no longer reported by CRL.



Appendices

Appendix A Corporate Milestones & Anchor Milestone Progress

We expect new Corporate Milestones will be approved by CRL once the new MOHS is issued. These will be reviewed upon receipt.

New Anchor Milestones will be generated by CRL as part of the development of the new MOHS. These will be reviewed upon receipt. The chart shown below indicates the forecasts at Period 6 based on MOHS 2018. Of the remaining 88 Anchor Milestones, 82 are forecast to be later than the MOHS 2018 late date base lines.

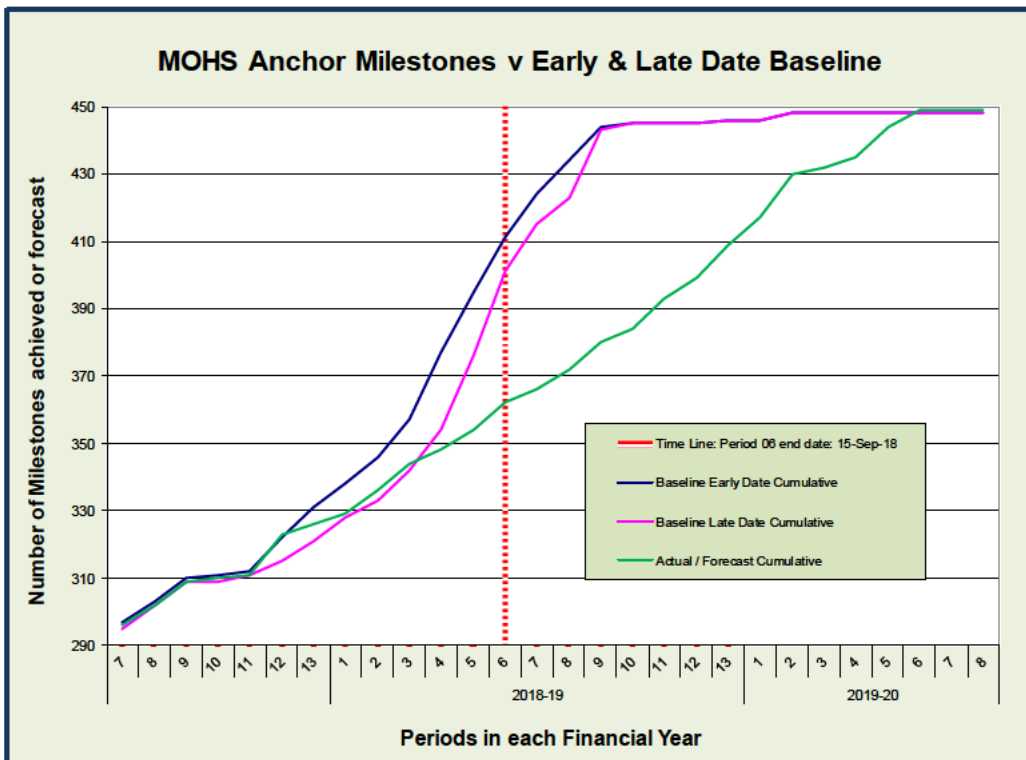


Figure A - 1 ~ Progress of Anchor Milestones

Appendix B COS Stations Target Dates

All baseline and forecast dates for Stations are currently under review pending development and approval of the new MOHS. These will be provided upon receipt and a new table created for our Period 7 report.

Appendix C Agreements

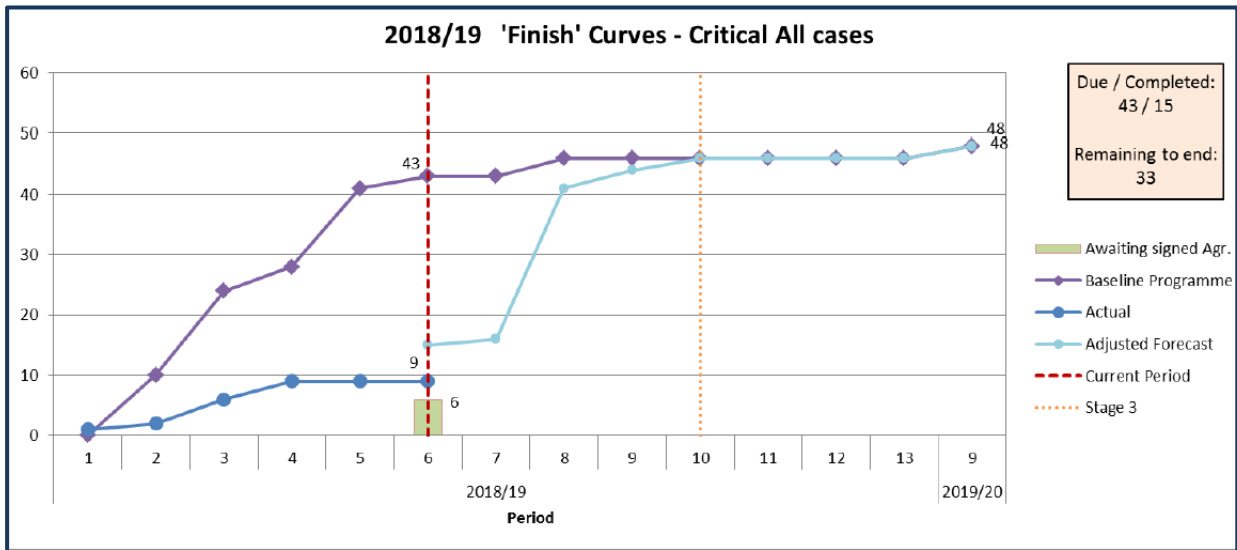


Figure C - 1 ~ 2018/19 Finish Curves – Critical All Cases²⁹

There remains much to do, but the Stage 3 Opening date shown here has now moved to Autumn 2019.

²⁹ Extract from Period 6 CRL Agreements update programme.

Project Representative Team

Project Team



Project Representative, Safety, Progress, Risk, Stations;
Signalling, Railway Systems, Integration, T&C;
Compliance & Change, Operations, RSD, Assurance;
Commercial, Cost Control, Financial, ONW;
Administration Manager.

Glossary of Terms and Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LBTH	London Borough of Tower Hamlets
ABB	ASEA Brown Boveri	LDBL	Baseline
ABW	Abbey Wood	LFB	London Fire Brigade
ACBs	Air Circuit Breakers	LIV	Liverpool Street
ACJV	Alstom Costain Joint Venture	LMU	London Metropolitan University
ACWP	Actual Cost of Work Performed	LO	London Over ground
AEA	Abellio East Anglia	LoNo	Letter of No Objection
AEN	Adverse Event Notice	LoR	Line of Route
AFC	Anticipated Final Cost	LTC	Lost Time Case
AFC	Approved for Construction status	LTIFR	Lost Time Incident Frequency Rate
AFCDC	Anticipated Final Crossrail Direct Cost	LU	London Underground
AFR	Accident Frequency Rate	LUL	London Underground Limited
AGA	Abellio Greater Anglia (now known as 'GA')	LV	Low Voltage
AHU	Air Handling Units	M&E	Mechanical & Electrical
AIP	Approved in Principle	MAID	Mandatory Asset Information Deliverables
AIP	Approval in Principal	MCR	Material Control Requirement
AM	Anchor Milestones	MCS	Master Control Schedule
AMS	Agreements Management System	MDTR	Main Dynamic Testing Regime
APIS	Authorisation to Place into Service	MENTOR	Mobile Electrical Network Testing, Observation and Recording
ARS	Automatic Route Setting	MEP	Mechanical Electrical & Public Health
AsBo	Assurance Body - Ricardo Rail	MEPA	Mechanical, Electrical, Public Health, Architecture
ASLEF	Associated Society of Locomotive Engineers and Firemen	MES	Mile End Shaft
AT	Autotransformer	MFF	Multi-Functional Framework
ATC	Automatic Train Control	MIRP	Maintenance Integration Review Panel
ATF	Auto Transformer	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
ATS	Auto Transformer Station	MTIN	Miles Technical Incident Number
AWS	Automatic Warning System	MTR SMS	MTR Safety Management System.
B&PC	Board & Programme Contingency	MTR-C	Mass Transit Railway - Crossrail
BBMV	Balfour Beatty Morgan Vinci	MV	Medium Voltage
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NG	National Grid
BFK	Bam Ferrovial Kier	NGET	National Grid Electricity Transmission
BH	Berkeley Homes	NKL	North Kent Line
BIU	Bringing Into Use	NoBo	Notified Body
BLL	Bakerloo Line Link	NOW	North Woolwich
BMS	Building Management Systems	NR	Network Rail
BOS	Bond Street Station	NR PDB	Network Rail Programme Delivery Board
BP	Business Plan	NSACS	New Sector Area Cost Summary
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems

BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC Building	Operations Maintenance Centre
BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUCF	S	ONFR	On Network Functional Requirements
BUF	Bottom Up Forecast	ONSIP	On Network Station Improvements Programme
C&CSC	Commercial and Change Sub-committee	ONW	On Network Works
CAR	Corrective Action Report	OOC	Old Oak Common
CARE	Crossrail Assurance Reporting Environment	OOCPA	Old Oak Common Paddington Approaches
CBTC	Communications Based Train Control	OPEX	Operational Expenditure
CCB	Current Control Budget	Ops	Operations
CCP	Commitments Compliance Plans	ORAT	Operational Readiness & Transfer Group
CCR	Consolidated Cost Report	ORR	Office of Rail & Road
CCRB	Construction and Commissioning Rulebook	ORSG	Operational Readiness Steering Group
CCRRB	Crossrail Construction Railway Rule Book	OSD	Over Site Development
CCSA	Contract Commercial Status Analysis	OSP	Operations Safety Procedures
CCSC	Commercial & Change Sub-Committee	OTIS	OTIS escalators (company)
CCTV	Closed Circuit Television	OTP	Overall Target Price
CD/RA	Closed Door / Right Away	P2R	Paddington to Reading
CDG	Competence Design Group	PA	Public Address
CDL	Central Door Locking	PAD	Paddington station
CDM	Construction Design & Management Regulations	PC	Principal Contractors
CDN	Crossrail Data Network	PDA	Project Development Agreement
CDT	Commitments Delivery Tracker	PDB	Programme Delivery Board
CE	Compensation Events	PES	Platform Edge Screen
CEC	Chief Engineer's Communications	PES	Permanent Earthed Sections
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	Ph3C	Phase 3 Complete
CEG	Central Engineering Group	PIP	Paddington Integration Project
CEO	Chief Executive Officer	PIR	Potential Incident Report
CER	Communications Equipment Room	PLU	Plumstead
CFCCB	Contingency Finance Current Control Budget	PM	Project Manager
CFO	Chief Financial Officer	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CIS	Customer Information System	PMO	Project Management Office NR
CMR	Crossrail Managed Risk	PNY	Paddington New Yard
CMS	Central Management System	PPE	Personal Protective Equipment
CoL	City of London	PPF	Property Partnership Framework
COS	Central Operating Section	PPM	Passenger Performance Measurement
COS	Central Operating Section	PRep	Project Representative
COWD	Cost of Work Done	PRISM	Cost Management Software
CPFR	Crossrail Programme Functional Requirements	PRM	Persons of Reduced Mobility
CPI	Cost Performance Index	PSD	Platform Screen Door
CPO	Compulsory Purchase Order	PSG	Performance Steering Group
CRAF	Completion Readiness Assessment Framework	PSR	Project Status Report
CRL	Crossrail Limited	PTYSC	Property Sub-Committee
CRV	Crossrail Requirements Variation	PWay	Permanent Way
CSCS	Construction Skills Certification Scheme	QBR	Quarterly Baseline Review
CSDE	Correct Side Door Enabling	QCRA	Quantified Cost Risk Assessment
CSJV	Costain Skanska Joint Venture	QRA	Quantified Risk Assessment
CSM	Construction Safety Management	QSRA	Quantified Schedule Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	RAB	Regulatory Asset Base
CT	Computerized Tomography	RAB (C)	RfL Assurance Board for Crossrail
CTOC	Crossrail Train Operating Concession	RAG	Red, Amber, Green Matrix
CUH / CHS	Custom House Station	RAM	Route Asset Manage.
CW	Canary Wharf	RAP	Remedial Action Plan
CWG	Canary Wharf Group	RBC	Remote Block Computer

CWS	Canary Wharf Station	RCA	Risk Control Actions
D&A	Drugs and Alcohol	RCC	Route Control Centre
DA	Development Agreement	RfL	Rail for London
DeBo	Designated body	RfL-I	Rail for London - Infrastructure
DESJs	Design Engineering Safety Justifications	RFT	Right First Time
DfT	Department for Transport	RIA	Railway Integration Authority
DLO	Direct Labour Organisation	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DLR	Docklands Light Railway	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DOO	Driver Only Operation	RIRP	Railway Integration Review Point
DPS	Depot Protection System	RLU	Restricted Length Unit
DT	Dynamic Testing	ROC	Rigid Overhead Conductor
Dwall	Diaphragm wall	ROC	Regional Operational Centre
DWWP	Delivery of Works Within Possession	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
E&B	Earthing & Bonding	ROP	Royal Oak Portal
EA	Environment Agency	RP4.2	Review Point 4.2
EAC	Estimate at Completion	RR	Ricardo Rail
EB	Eastbound	RRV	Road / Rail Vehicles
ECHR	Element Completion Handover Report	RS	Rolling Stock
ECI	Early Contractor Involvement	RSC	Return Screen Conductor
ECP	Employers Completion Process	RSD	Rolling Stock & Depot
ECS	Empty Coach Stock	RSSB	Rail Safety & Standards Board
EDBL	██████████ Baseline	RTU	Remote Telemetry Unit
EDORs	ETCS Data Only Radio	S&C	Switches & Crossings
EDT	Early Dynamic Testing	SA	Supplementary Agreement
EED	Emergency Exit Door	SACR	Semi Annual Construction Report
EFC	Estimated Final Cost	SAP	System Applications Products
EFC	Economic and Financial Committee	SAR	Safety Assessment Report
EiS	Entry into Service	SAT	Site Acceptance Test
ELCBT	Elizabeth Line Countdown Board Tracker	SC	Staged Completion
ELRSG	Elizabeth Line Readiness Steering Group	SCADA	Supervisory Control and Data Acquisition
EMC	Electromagnetic Compatibility	SCL	Sprayed Concrete Lining
EMU	Electrical Multiple Unit	SCN	Sponsor Change Notice
ERTMS	European Rail Traffic Management Systems	SDG	Signalling Design Group
ESJ	Engineering Safety Justification	SDO	Selective Door Operation
ESM	Engineering Safety Management	SDS	Scheme Design Specification
ESS	Eleanor Street Shaft	SEJ	Safety Engineering Justification
ETCS	European Train Control System	SER	Signalling Equipment Room
ETH	Eastern Ticket Hall	SES	South East Service
EVM	Earned Value Management	SESR	South East Signalling Room
FAR	Farringdon	SFA	Sponsor Funding Account
FCCB	Finance Current Control Budget	SGS	Stepney Green Shaft
FDC	Framework Design Consultant	SHELT	Safety and Health Leadership Team
FDO	Final Design Overview	SIM	Simulation Room
FDS	Final Design Statements	SIRP	Systems Integration Review Panel
FFOC	Final Forecast Outturn Cost	SISS	Station Information and Security System
FGW	First Great Western	SJR	Safety Justification Report
FHO	Full Handover	SLD	Single Line Diagrams
FIS	Fisher Street Shaft	SMS	Safety Management System
FLU	Full Length Unit	SMTA	Smithfield Market Traders Association
FoI	Freedom of Information	SOC	Statement of Compatibility
FRAG	Fraud Risk Assurance Group	SONIA	Sterling Overnight Index Average
FTS	Floating Track Slab	SOR	Systems Operation Room
GAF	Greater Anglia Franchisee	SORBA	Shaping Architecture Company (sub cladding contractor)

GE	Great Eastern	SPI	Schedule Performance Index
GEBR	Guaranteed Emergency Brake Rate	SPS	Secondary Part Steel
GEFF	Great Eastern Furrer & Frey	SR	Sponsors Requirement
GEML	Great Eastern Main Line	SRP	Safety Review Panel
GFRC	Glassfibre Reinforced Concrete	SSE	Scottish & Southern Electricity
GLA	Greater London Authority	SSP	Stations, Shafts, Portals
GPE	Great Portland Estates	STG	Stepney Green
GRC	Glass Reinforced Concrete	STS	Standard Track Slab
GRIP	Governance for Railway Investment Projects	SVP	Safety Verification Panel
GSM-R	Global System for Mobile Communication - Railway	T&C	Testing & Commissioning
GW	Great Western	TAP	Technical Assurance Plan
GWML	Great Western Main Line	TBM	Tunnel Boring Machine
GWR	Great Western Railway	TC&HSG	Testing, Commissioning and Handover Steering Group
H&S	Health & Safety	TCMS	Train Control Management System
HAL	Heathrow Airport Limited	TCR	Tottenham Court Road
HALARP	Heathrow Airport Limited Assurance Review Panel	TCRW	Tottenham Court Road West
HAS	High Attenuation Sleeper	TDR	Technical Director's Report
HAVS	Hand Arm Vibration Syndrome	TDY	Tunnel Drive Y
HEP	Handover Execution Plans	TfL	Transport for London
HEX	Heathrow Express	TOC	Train Operating Company
HIA	Heathrow Implementation Agreement	TOSD	Tier One Substantially Complete
HM	Her Majesty	TPA	Tunnel Planning Authority
HMDL	Handover Master Deliverable List	TPH	Trains Per Hour
HO	Handover	TPS	Train Protection System
HPNM	High Performance Near Misses	TPWS	Train Protection & Warning System
HRW	Heathrow Airport	TRAIL	Transport Reliability Availability Integrated Logistics
HSPI	Health & Safety Performance Indicator	TRH	Temporary Rehousing
HV	High Voltage	TSI	Technical Standard for Interoperability
HVAC	Heating Ventilation & Air Conditioning	TTO	Temporary Ticket Office
I/O	Input / Output	TTVS	Temporary Tunnel Ventilation System
IA	Interim Acceptance	TUCA	Tunnelling & Underground Construction Academy
ICD	Interface Control Document	TWAO	Transport & Works Act Order
IECC	Integrated Electronic Control Centre	TXM	TXM Plant
IEP	Intercity Express Programme	U&A	Undertakings & Assurances
IFC	Issued For Construction	UKPN	UK Power Networks
IFD	Ilford Yard	UR	Urban Realm
IM	Infrastructure Manager	URT	Unresolved Trends
IOSH	Institution of Occupational Safety and Health	UTX	Under Track Crossings
IP	Intervention Point (0, 1, & 2)	VAP	Verification Assurance Procedure
IR35	Inland Revenue Taxation Regulation 35	VDP	Victoria Dock Portal
IRM	Incident Response Management	VERP	Value Engineering Review Panel
IRN	Installation Release Note	VFL	Volker Fitz Patrick
IRSG	International Regulatory Strategy Group	VN	Variation Notice
ISA	Independent Safety Assessment	VT	Voltage Transformer
ISJ	Interim Safety Justification	W&W	Wales & West Utilities
ISV	Intermediate Statements of Verification	WAD	Works Authorisation Document
ITP	Inspection & Test Plan	WBP	Westbourne Park
ITT	Invitation to Tender	WBS	Work Breakdown Structure
JST	Joint Sponsor Team	WC	World Class
KBR	Knorr-Bremse Rail	WCC	Westminster City Council
KD	Key Deliverable	WCCC	Whole Contract Construction Certificate
KE	Kinematic Envelope	WHI	Whitechapel
KG	Kensal Green	WITI	Western Inner Track Infrastructure

KO	Key Output	WOE	Western Outer Electrification
KPI	Key Performance Indicator	WOO	Woolwich Station
L&P	Land and Property	WOTI	Western Outer Track Infrastructure
LB	London Borough	WTH	Western Ticket Hall
LBTH	London Borough of Tower Hamlets	YC	Yard Control

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 117

Period 7 FY2018-19

16 September 2018 – 13 October 2018

Document No. B2111500/117/1.17

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Note: This report relies on the information set out in CRL's Period 7 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 13 October 2018. Note that information emerging after the close of Period 7 is subject to formal confirmation by CRL in its Period 8 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan. JST has confirmed that PRep will no longer formally report on On Network Works (ONW) in future periodic reports. PRep will continue to meet with CRL and NR, and will continue to advise JST of any key risks to Crossrail caused by NR.

Document history and status

Revision	Date	Description	By	Review	Approved
1	1 November 2018	PSR 117 Period 7 FY 2018-19 v1.10.docx ~ Draft	PRep Core Team		
2	8 November 2018	PSR 117 Period 7 FY 2018-19 v1.17.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and Safety performance indicators remain stable and well within targets.

Financial:

The Intervention Points have not changed in Period 7. CRL has increased the AFCDC at P50 by £206m to £13,499m, which breaches IP2 by £987m. KPMG continues its independent financial and commercial review, and its independent governance review. The AFCDC remains understated and will increase again. DfT has arranged £350m of short term repayable financing to TfL for the Crossrail project.

Stage 2 Opening:

The initiative to replace Reduced Length Units (RLU) prior to Stage 2-2 with Fixed Length Units (FLU) remains planned for December 2018. The primary risk now is the timely submission of all the requisite assurance evidence. There will be no impact upon passengers if a delay to implementation should occur.

[REDACTED]

Stage 3 Opening – Infrastructure and Systems:

Completion of the new MOHS has been further delayed to 30 November 2018 (subject to approval of CRL Board on 5 December 2018) because of CRL’s need for more time to consider: options for alternating construction/dynamic testing for an interim period up to Main Dynamic Testing (MDT); schedules for the completion of Stations, Shafts and Portals (SSP); and an integrated programme for rolling stock and signalling. This latest delay to MOHS highlights the complex and highly integrated nature of the Crossrail railway. The delay is a major concern because CRL remains unable to demonstrate schedule certainty to stakeholders. The Sponsors have stressed to CRL the importance of a comprehensive, robust and stable MOHS in underpinning the cost projections, upon which the final financing arrangements will rely¹.

CRL now considers that the interim implementation of three or four 48 hour ‘schedule blocks’ between 10 December 2018 and 14 January 2019 best optimises the balance between construction and dynamic testing. This latest arrangement has yet to receive CRL Board support², but it will be subject to independent assessment and then further CRL Board consideration³ ahead of the next T-4 readiness review⁴.

¹ Sponsor Board letter to CRL dated 2 November 2018.
² The ‘schedule block’ proposal was not endorsed at the CRL Board Meeting held on 26 October 2018.
³ CRL Schedule Workshop planned on 7 November 2018 and CRL Board Meeting on 8 November 2018.
⁴ CRL T-4 Readiness Review scheduled for 9 November 2018.

Connections by the systemwide contractor (C610) of routeway systems into equipment delivered by SSP (e.g. Fire Main, LV Power, Radio), and into cross-passages continue to be difficult to implement because of Tier 1 completion delays. These delays further impact contractor demobilisation, planning and specialist resource availability for Phase 3 testing (principally by C660 Communications & Control) and the practical arrangements for formal handover. The true state of the works at the SSPs is not understood in sufficient detail to allow the outstanding scope to be assessed. Completion of the SSPs and the associated downstream railway systems works remains one of the most critical risks to handover and Trial Running. The current planned start of Trial Running is [REDACTED] with Trial Operations due to commence in [REDACTED], but these are yet to be confirmed in the new MOHS.

Concurrent delays to rolling stock and signalling software development cannot be accommodated within the revised date for MDT, so CRL has been forced to proceed by effectively 'eroding' the original Entry Criteria. It is vital that CRL takes a realistic view in MOHS of likely progress, given that dynamic testing will proceed using software and infrastructure that is not complete or not fully proven.

Overall, contractor performance remains very poor in the completion of assurance documentation and there are huge challenges in securing the necessary resources to maintain meaningful progress. Anticipated schedule adjustments in the new MOHS might provide some relief to current document delivery peaks. These challenges are also reflected in CRL's latest schedule of submissions to RAB(C) into 2019.

Stage 3 Opening - Handover and Operational Readiness:

Our concerns continue to be centred upon the delivery of Handover and assurance evidence. There has not been any significant increase in delivery during this period. A change in approach of processes and behaviours is required by Contractors, CRL and Infrastructure Managers to ensure this element of the Programme does not impede Handover and Opening.

Stage 4 and Stage 5 Openings:

RfL has proposed a Stage 5a, which introduces 4 trains per hour service between Paddington and Maidenhead/Reading, building on the Stage 2-2 between Paddington and Heathrow. The target date for this service is December 2019. The areas of risk to this date are as follows:

- Stage 2-2 will need to have been implemented;
- There is an overlap in the implementation of Stage 3 and this service, which could affect management focus;
- There are a number of industry regulatory issues to resolve, such as route capacity and the adjustment of platform works at Paddington.

The proposed opening date for Stage 4 is now May 2020, subject to the revised MOHS. This should allow sufficient time to complete the majority of at-risk items such as DOO CCTV at Stratford and Station Information Systems, but the NR Key Date 22 power upgrade works could remain an issue due to the limited access available after May 2019.

The proposed opening date for Stage 5 is now December 2020, subject to the revised MOHS. Outstanding issues remain Maidenhead Sidings accommodation, Western station upgrades and the signalling transition due to the delayed NR ETCS programme.

1 Cost

1.1 Summary

CRL has increased the AFDCD by £206m to £13,499m for Period 7, which breaches IP2 by £987m. The Period 7 AFDCD is, in our opinion, significantly understated. CRL has consumed all of the increased £300m funding made available by Sponsors and has imposed commitment on Sponsors for further additional funding. Discussions between TfL and DfT have progressed to determine how the additional funding will be provided, with London, as the primary beneficiary of Crossrail, bearing any additional costs via a financing arrangement. As an interim measure, DfT announced on 26 October 2018 that £350m of short term repayable financing will be made available to the Mayor of London and TfL in the current financial year to ensure that full momentum is maintained behind Crossrail.

Sponsors have commissioned KPMG to provide an independent review of Crossrail’s governance, and a separate independent review on CRL’s finance and commercial position.

The Intervention Points have not changed in Period 7;
The AFDCD has increased to £13,499m although this remains understated;
The CRL AFDCD exceeds IP2 by £987m;
The forecast gap between the Contractors’ estimate and CRL’s PM assessment of total defined cost has reduced by ██████ to ██████;
We expect the AFDCD to increase again at Period 8;
KPMG review of CRL’s finance and commercial position continues.

1.2 AFDCD and Intervention Points

CRL has increased the AFDCD at Period 7 by £206m to £13,499m. The CRL Period 7 AFDCD exceeds IP2 by £987m, as shown in Figure 1 - 1; and also exceeds the Finance Current Control Budget (FCCB), of £12,810m by £689m.

(£ millions)	Period 6	Period 7	Delta	Movement
Forecast	12,719	12,950	231	up
Delivery Risk	6	5	-1	down
Subtotal	12,725	12,955	230	up
Programme Risk	564	540	-24	down
Board Risk	4	4	0	same
AFDCD total	13,293	13,499	206	up
IP0	11,672	11,672	0	same
IP0 Headroom	-1,621	-1,827	-206	down
IP1	11,912	11,912	0	same
IP1 Headroom	-1,381	-1,587	-206	down
IP2	12,512	12,512	0	same
IP2 Headroom	-781	-987	-206	down

Figure 1 - 1 ~ AFDCD Headroom to Intervention Points

CRL reports that the increase in Period 7 is due to additional Programme risk allowances required to align with the revised dates as indicated in the RAP2⁵, in anticipation of the latest MOHS schedule which was due at the end of October 2018. From our discussions with CRL, we have learned that the revised MOHS will not be available for issue until after 30 November 2018 and that the dates in the RAP will be revised and reflected in the anticipated new MOHS. This correlates with our weekly report to the JST on 25 October 2018 wherein we reported⁶ that many of the stations would not be meeting the [REDACTED] dates set out in the RAP [REDACTED].

CRL reports that the Period 7 AFCDC has been revised in line with the updated RAP2 [REDACTED] dates cost forecast⁷. The RAP2 P50 AFCDC was £13,279m. CRL has based the [REDACTED] sequence of delivery dates on the principles of known current productivity rates from across all the Tier 1 contractors. CRL claims that the revised plan includes additional allowances for time, cost and risk to address all the remaining known challenges across the programme.

However, given that the issue of the revised MOHS is delayed and remains outstanding, is potentially unaccepted by the Contractors, that the [REDACTED] dates identified by the RAP are compromised and that stations continue to see cost increases in respect of delays, prolongation and productivity issues, we do not have confidence in the reported CRL AFCDC. The Period 7 AFCDC is, in our opinion, significantly understated.

The development of the AFCDC from Period 6 to Period 7, which incorporates the RAP and SACR20 forecasts, illustrated in Figure 1 - 2, lacks reasonable foundation and credibility. At SACR20, for instance, CRL reported that it had issued the RAP2 which included a revised P95 AFCDC of £13,831m, stating that this figure supersedes the position reported as at Period 6. Notwithstanding that the substantiation for the AFCDC is unsteady, there is no comparator as CRL did not report a P95 AFCDC at Period 6.

Probability Level	Period 6 £m	RAP2 £m	[REDACTED]	[REDACTED]	SACR20 £m	Period 7 £m
P50	£13,293	£13,279	[REDACTED]	[REDACTED]	-	£13,499
P80	-	£13,310	[REDACTED]	[REDACTED]	-	-
P95	-	£13,335	[REDACTED]	[REDACTED]	£13,831	-

Figure 1 - 2 ~ AFCDC Development between Period 6 and Period 7

At Period 6, CRL reported that it was seeking to reduce risk by agreeing fixed price arrangements with contractors to complete their works where appropriate. [REDACTED]

However, all stations are affected by ongoing cost pressures due to delays, prolongation and productivity issues which may be compounded by RAP dates not being achieved and a MOHS that is not accepted by Contractors.

We expect that there will be further AFCDC increases to be added following the KPMG review and the effect of the revised MOHS on the RAP. Assurance will be necessary from CRL that additional funding requests are supported by a realistic and tangible assessment of the

⁵ RAP2 – Remedial Action Plan, version 2, dated 2 October 2018.

⁶ Confirmed at CRL MOHS Review meeting 26 October 2018 and clarified by PRep email 30 October 2018.

⁷ CRL refer to this as P50 Early Dates.

⁸ We are currently awaiting confirmation and details of these negotiations.

schedule and risks. This will require examination at a detailed level to ascertain if they are credible, to ensure all costs are covered, including Stages 4 and 5, and sustainable to fund to completion.

The CRL Consolidated Cost Report (CCR) for Period 7 indicates a grand total Period 7 AFC increase of £103m from Period 6. The AFCDC 'QCRA' element includes allowances for URTs and Programme exposure; these were reported by CRL in its Period 6 CCR as £237.4m and £154.2m respectively. The Period 7 equivalents are £107.9m and £180.8m deriving a net overall reduction of £102.9m. Consequently, the Period 7 AFCDC has not been affected by these elements, confirming that URTs in the period have been covered by corresponding risk provisions.

The full value of Defined Costs being pursued by the Contractors is not included in the current AFCDC.

[REDACTED]

CRL will be carrying out Defined Cost reviews on all major projects in Periods 8 and 9.

The rate of Cost of Work Done (COWD) continues to follow the consistent linear trend that has been steady through the life of the project. In Period 7, the Delivery COWD was £114m and continues to follow the historical trend path. However, as a consequence of the large AFCDC increases in Periods 6 and 7 and the prospect of potentially future substantial increases, the trend projections for both the rate of increase of AFCDC and COWD offers no reasonable or accurate forecasting conclusion until such time as CRL state a tangible AFCDC, as shown in Figure 1 - 3.

We reiterate our recommendation that Sponsors encourage CRL to settle urgently a fully inclusive and comprehensive Final Forecast Cost that is sustainable and credible to completion. Such an approach may avoid the continuing incremental increase to the AFCDC through to Autumn 2019.

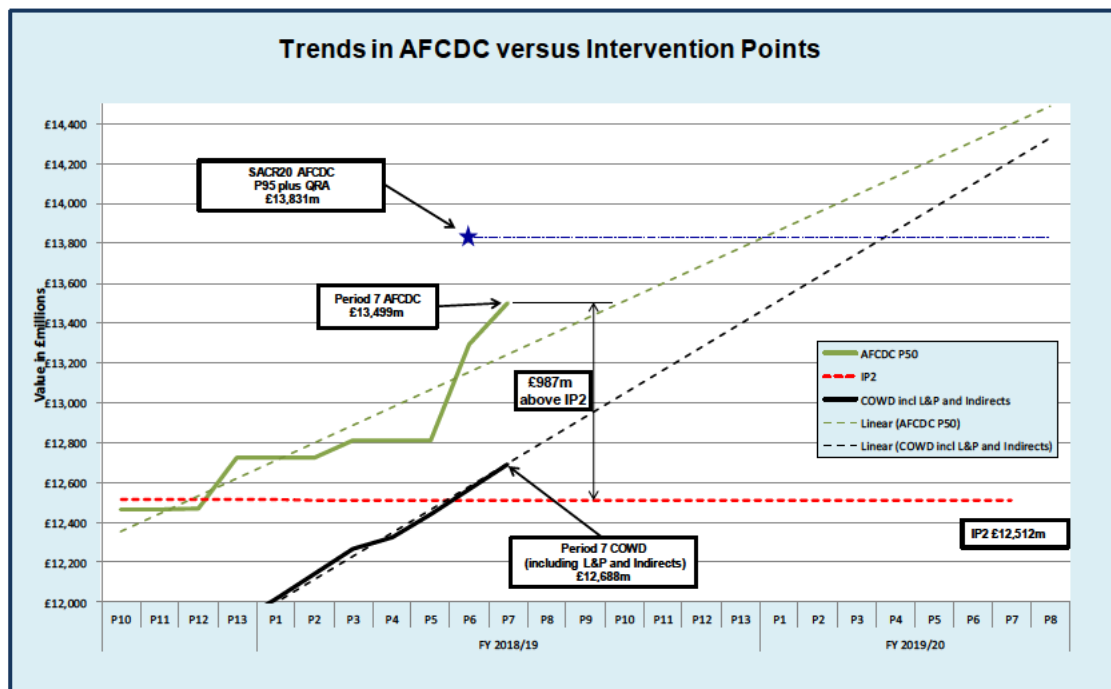


Figure 1 - 3 ~ AFCDC Headroom to Intervention Points

The cumulative delivery overspend, against the CRL internal budget at each period, has increased substantially in Period 7 by £119m to £884m (Period 6, £765m). Delivery overspend continues to rise in Period 7 and trend projections shown in Figure 1 - 4 indicate the effects of this continued growth, which may be regarded as a consequence of the ongoing cost escalation experienced by the project.

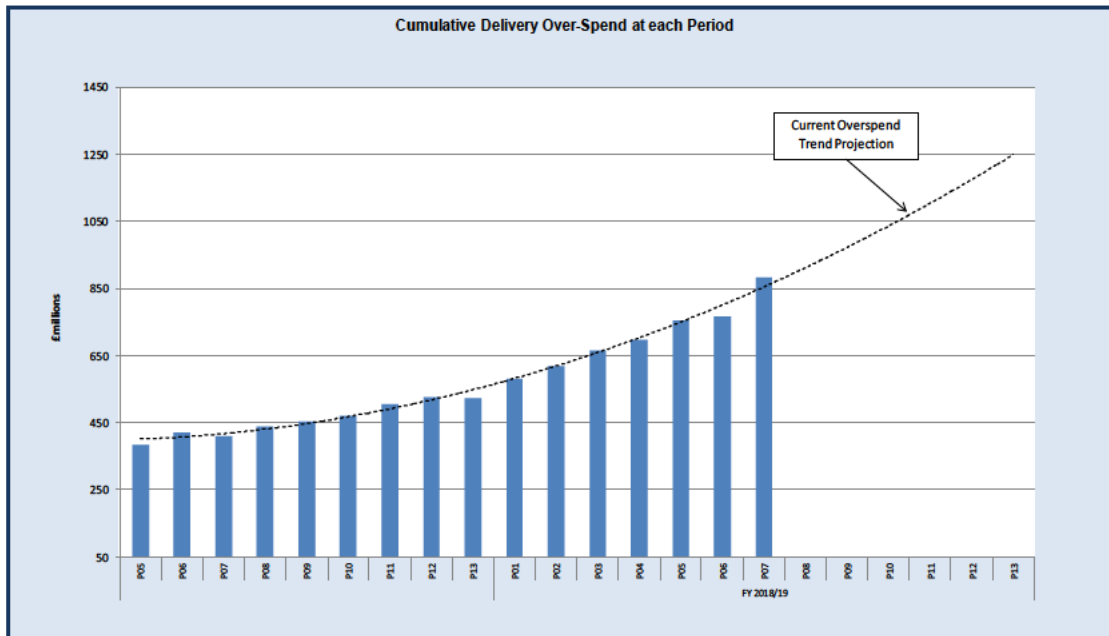


Figure 1 - 4 ~ Cumulative Delivery Overspend against CRL Budget at each Period

CRL reports that, in Period 7, it spent £91.9m above the 2018/19 Business Plan, an increase of £7.1m on Period 6. The CRL Period 7 Board Report provides the details of the overspend which, in summary, continues to be dominated by low productivity, prolongation and delays.

Programme risk has decreased by £24m to £540m and Delivery Risk decreased by £1m to £5m in Period 7, equating to an overall net reduction in risk of £26m⁹, (from £574m to £548m). We presently await receipt of the review by KPMG of the QCRA carried out by CRL for Period 6. We will provide commentary following the receipt of the completed review.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 7 for current contracts only, removing Contracts C300, C305 and C828, whilst Contracts C510 and C350 have been collectively included within the 'Others' package. Figure 1 - 5 shows the reconciliation of the adjusted Target and Defined Costs for Period 7 to include removed values and avoid duplication of costs included within the 'Others' category, in order to provide ongoing continuity for consistent trend analysis reporting.

⁹ Rounding error.

Contract	Target £m		Defined Cost £m	
	P7		P7	
C300				1
C305				
C610				
C512				
C510				
C435				
C405				
C412				3
C360				
C502				
C422				
C350				
C828				
C530				
C620				
C631				
C660				
Subtotal	£5,643	£5,812	£6,028	£6,180
Others	£914	£932	£983	£995
Total	£6,557	£6,744	£7,011	£7,175

Figure 1 - 5 ~ P4 Adjusted Defined Cost and Target Cost¹⁰

[REDACTED]

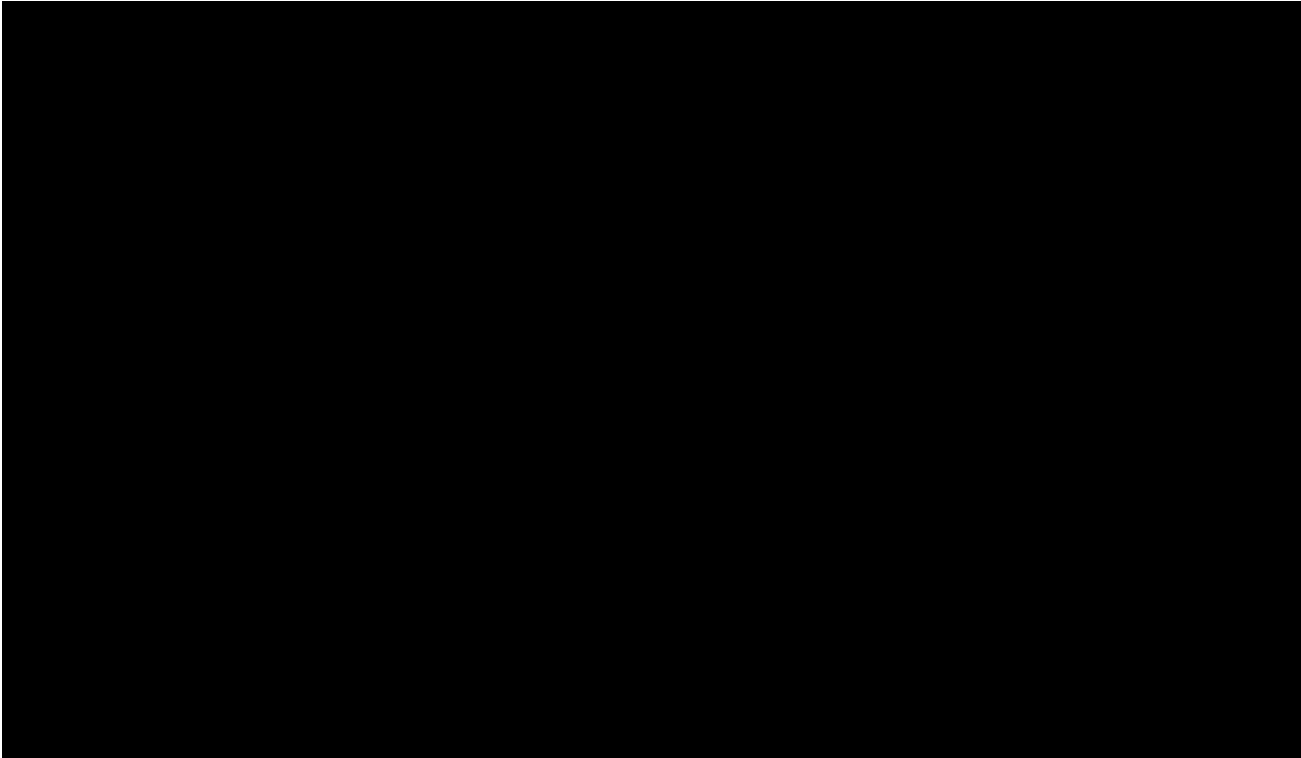
Although CRL has advised that the AFDCDC makes allowances for the increase of defined costs, the full value of the Contractors' estimates has not been included. The rate of increase for defined costs continues to rise and, consequently, the allowances within CRL's risk review appear to be insufficient.

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]

¹⁰ Figure 1-5 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.



1.4 Contingency and Risk

The Period 7 Finance Current Control Budget remains at £12,810m. The £13,499m AFCDC exceeds the financial budget by £689m, and exceeds the RP4.2 Baseline funding of £12,136m by £1.363bn.

CRL is reporting that the overall Period 7 contingency budget of £68m is not sufficient to cover the risk exposure of £548m by £480m (£10m deterioration from Period 6). The centrally controlled Delivery contingency has reduced by £7m to £31m during the reporting period, but the Board contingency remains unchanged from Period 6 at £23m.

Figure 1 - 7 shows the trend of the decline in Contingency and compares the lower Risk Exposure at P50 only¹¹ with the remaining contingency. This highlights the small and decreasing contingency available for significantly increased P50 risk allowances which become considerably exacerbated in the event that P95 AFCDC risks are applied.

¹¹ CRL ceased to report P95 at Period 2.

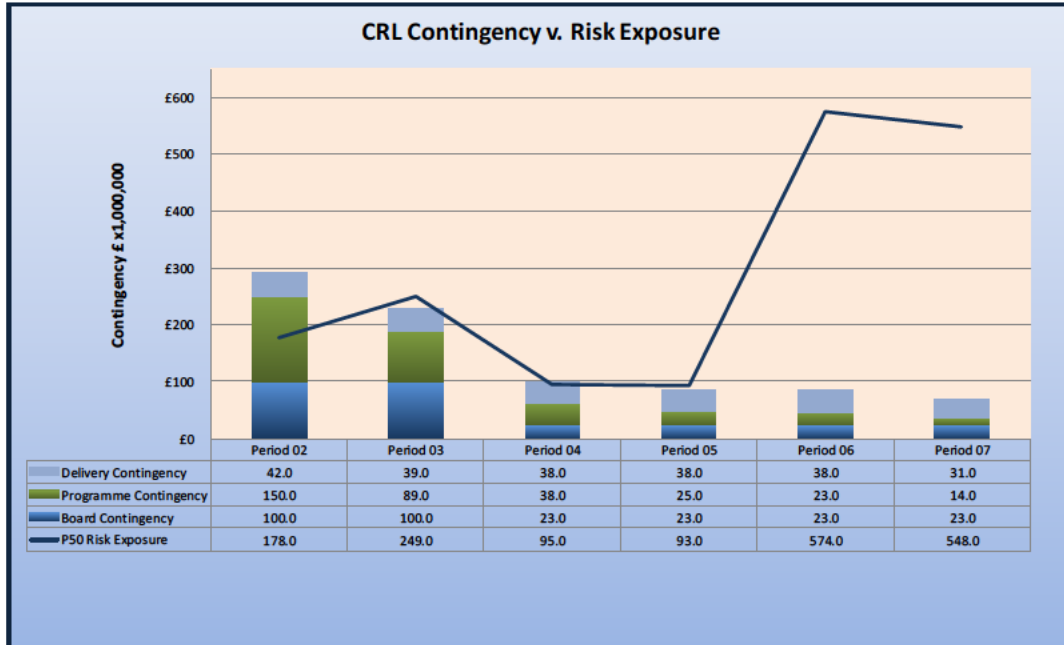


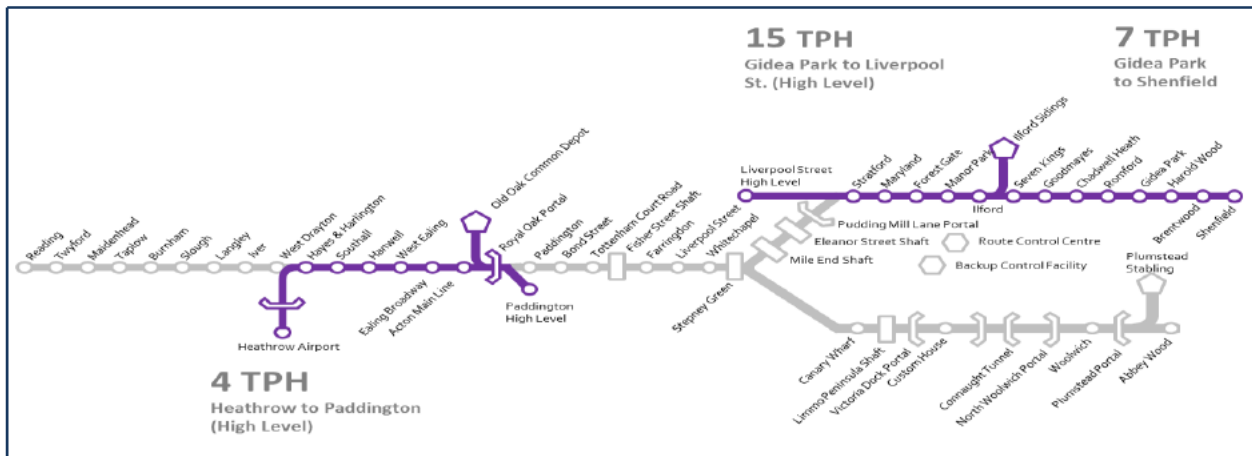
Figure 1 - 7 ~ Risk Exposure versus Contingency

CRL has confirmed that all trends are covered by URTs or risk in the Period 7 AFDCD. Figure 1 - 8 shows the apportionment of Risk from Period 13 up to Period 7.

Period	QRA	URT's	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81
P4	95	46	2	87	6	43
P5	93	174	1	86	6	-87
P6	574	228	6	530	38	308
P7	548	108	5	490	53	387

Figure 1 - 8 ~ Elemental Breakdown of Risk Allowances

2 Stage 2: Phase 2 – Target Date May 2019



2.1 Summary

The target date for Stage 2 Phase 2 Opening is now May 2019, but we do not believe this can be achieved due to the prioritisation of train software development for Stage 3. Any revised date for opening would need to take into account the following:

- Likely access to testing facilities and BT technical personnel;
- CRL and MTR-C preparations for Stage 3;
- CRL and MTR-C preparations for Stages 5a and Stage 4;
- Availability and stabling of the C360 fleet.

We believe target date of May 2019 for Stage 2-2 will not be achieved;

██

██

██

2.2 Operational Readiness Assessment

CRL’s Stage 2-2 dashboard categorised two issues as ‘red’ for Period 7. These were the same issues as reported in Period 6. They are ‘Train Readiness’ and ‘CRL ETCS Integration testing’. A third one, ‘Driver training & Ops proving’, was red and is now amber. This is because it is a known quantity (140 drivers trained over 10 weeks) and will start when the ‘red’ issues are complete. See Section 2.4 for details.

2.3 Interim phase (Replace RLUs with FLUs)

RfL is continuing to aim for implementation of the change in time for the new timetable on 9 December 2018. There are some risks to that date, but these are recognised and being managed. Essentially, they are whether all the requisite assurance evidence can be provided to the MTR-C SVP in time for its meeting in late November. We reiterate that there would be no

detrimental impact upon passengers if the change did not occur in early December, as RLUs could continue to operate. If this happens, then RfL does not need to wait until the next timetable change to make the swap. The negative impact would be further delay in the opportunity to build reliability¹².

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

The software development programme for TCMS 7.3 & ETCS has been delayed due to the prioritisation of TCMS 7.2 & CBTC for Stage 3. No formal ETCS testing (the '39 tests') is now expected in 2018. There are also issues between ETCS and the Driver Machine Interface (DMI) and GSM-R at Heathrow Terminal 4 that require resolution.

Until a plan is identified that enables TCMS 7.3 to access a test track and BT technical & assurance resources without undue hindrance, then the delay is likely to continue. RfL is aware of the need for such a plan, but it will be difficult to achieve. We therefore do not expect services to begin in May 2019, and it is difficult to forecast when Stage 2-2 will be ready under the current constraints. A backstop for implementation will be at some point between September and December 2019, the actual date being subject to agreement by various parties. The date will signify when the existing trains servicing Heathrow (C360 stock), are due to vacate the depot they are being operated from¹³.

An implementation date between May and December 2019 would overlap with the implementation stages of Stage 3, which MTR-C would be reluctant to carry out. In addition, MTR-C may also be preparing to implement stage 5a in December 2019 (see Section 5.2). We believe the MOHS must support a realistic Stage opening plan to ensure each Stage is adequately resourced.

Operations

There is little new information to add from our Period 6 report. [REDACTED]

Regulatory Approvals

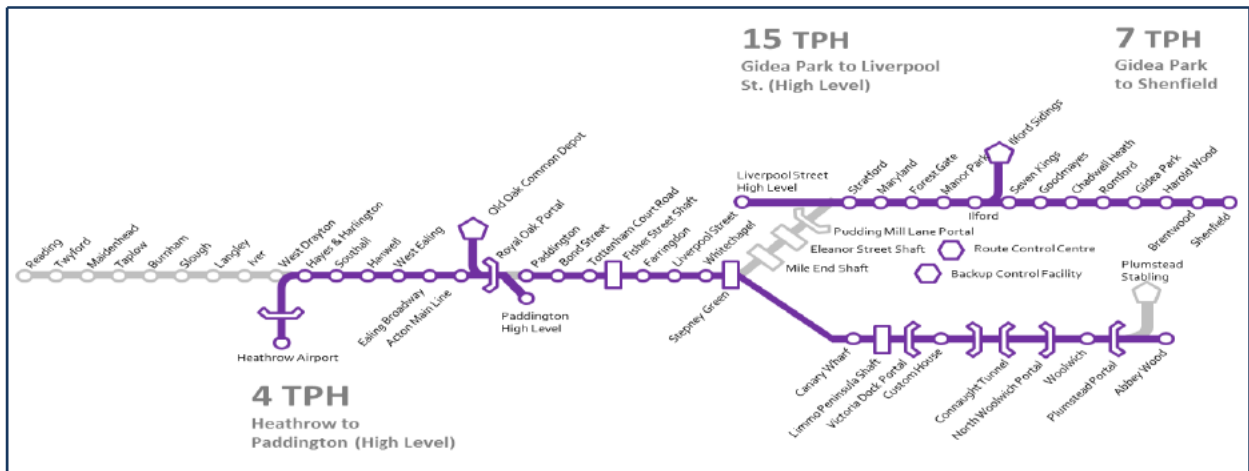
There is one remaining key approval for Stage 2-2 APIS ETCS On-board to be issued by ORR to BT.

There are other approvals to obtain from the industry safety panels. NR's Wales and West SRP will approve putting ETCS wayside into use; MTR-C SVP will approve driver training and then passenger service; HALARP will approve reliability running, driver training and passenger service. These approvals are dependent upon successful completion of the train's software and subsequent testing.

¹² The first provisional date for implementation was 12 August 2018. See PRep Period 2 status report.

¹³ To be demolished to allow other rail projects to progress.

3 Stage 3: Paddington to Abbey Wood



3.1 Summary

The Remedial Action Plan (RAP) has been revised. The new MOHS was expected in late October 2018, but this has been delayed until 30 November 2018, subject to approval at the CRL Board meeting on 5 December 2018.

Remedial Action Plan has been revised;
Issue of new MOHS has been delayed;
Production of IRNs is inadequate;
Many Stations Shafts & Portals [redacted] date targets in the RAP are already in delay;
Concurrent delays to rolling stock and signalling software development;
CRL is reviewing options for alternating construction and dynamic testing for an interim period up to Main Dynamic Testing;
Handover materials are not progressing at the required rate;
Poor progress in completing assurance evidence necessary for regulatory approvals.

3.2 Schedule

Following Sponsor Board on 20 September 2018, CRL issued a revised Remedial Action Plan (RAP2) on 2 October 2018 which was reviewed at the CRL Board meeting on 11 October 2018 and the Sponsor Board meeting on 15 October 2018. The [redacted] key dates set out in the RAP were based on CRL’s assessment of its top-level strategy. This is now under review as project workshops are completed to analyse the detailed activities which will form the new MOHS.

CRL’s Board Report for Period 7 includes the current strategy which indicates Interim Dynamic Testing (IDT) starting in December 2018, Dynamic Testing (DT) starting in January 2019, Phase 2 Static testing running through to April 2019, Phase 3 Integrated testing running through

to [REDACTED] and Trial Running starting in [REDACTED]. Stations Shafts and Portals (SSP) are shown completing during early to mid-2019. Our commentary on the risks to these dates is set out in the following Sections.

The new MOHS was due to be delivered in late October, but the development of the detailed analysis has revealed challenges on some dates in the RAP. This has led to a delay to the completion of the MOHS to 30 November 2018, subject to approval of CRL Board meeting on 5 December 2018. This is extremely disappointing.

Until then, CRL continues to base its forecasts against MOHS 2018 which was issued in February 2018. Unfortunately, the baseline dates are now so out of date that comparison is worthless. The chart at Figure A - 1 in Appendix A indicates the Period 7 Anchor Milestone forecasts set against the old MOHS baselines and it can be seen how fruitless any comparison can be. At the end of Period 7, 112 Anchor Milestones were due to be delivered; all of them substantially later than the current [REDACTED] baselines.

General progress is described by CRL as percentage completions in its Board report. These have also become ineffectual in monitoring progress because the outstanding work is a small percentage of the total to date, so we expect CRL to focus on the remaining works (including documentation) required to be done, rather than what has already been achieved.

3.3 Stations, Shafts and Portals (SSP)

General: CRL issue of the new MOHS due to more detailed information becoming available, and concern that some of the target dates are not achievable. The new MOHS will feature new milestone dates as described in our last report.

Whilst waiting for the new MOHS, we have examined the proposed Tier One Substantial Demobilisation (TOSD), Staged Completion (SC)¹⁴ and Handover (HO) dates as set out in the RAP and compared them with the draft dates presented at the CRL Programme Delivery Board (PDB) meeting on 23 October 2018. We were particularly concerned to learn¹⁵ that not one SSP had an integrated plan for works required between TOSD and SC dates. Our commentary is shown below. Note that these dates are work in progress and are subject to confirmation in the new MOHS; details are shown in Appendix B. We understand that CRL is currently negotiating with the Contractors to firm up these dates into commercial agreements. This is well advanced at [REDACTED] and [REDACTED], although it will be challenging at [REDACTED] due to the complexity of the takeover arrangements. [REDACTED]

As noted in previous reports, we reiterate our concern regarding the Contractors' ability to generate IRNs in sufficient quantity to support the testing and commissioning (T&C) programme. Progress has increased from 47% to 50% this period, but this is inadequate. This small periodic increase cannot continue, so CRL has established workshops with Contractors and their supply chain to assemble a detailed IRN delivery plan for each project.

Production of IRNs is a pre-condition to the progress of Phase 2 T&C and enormous amounts are required over the next 9 months with limited resources, [REDACTED]. CRL's forecasts are currently ambitious, so we look forward to CRL completing its SSP T&C plans up to Staged Completion (SC) at each location. This will provide a better insight into

¹⁴ Known as Take Over under the NEC Contract.

¹⁵ Reported at CRL PDB 23 October 2018.

CRL’s ability to deliver in accordance with its revised RAP and MOHS. There is risk that the stations SC forecasts dates will not enable commencement of Trial Operations as planned in [REDACTED]. Our comments regarding Phase 3 integrated T&C are in Section 3.4.

Shafts and Portals TOSD: The majority of these are likely to be delivered later than the [REDACTED] [REDACTED] dates, although most are currently forecast to remain within [REDACTED] [REDACTED]. [REDACTED] is at risk of being delivered late, but this is yet to be confirmed.

Shafts and Portals SC/HO: CRL plan to Handover shafts and portals at the same time as Staged Completion, although this is to be confirmed. The majority are likely to be delivered later than the [REDACTED] dates, although most are currently forecast to remain within [REDACTED]. [REDACTED] are at risk of being Handed Over late, but this is yet to be confirmed. The concern would be if this occurred after Transition to ROGS, currently targeted for [REDACTED].

LUL Stations TOSD: At this time, [REDACTED] stations are forecast to be delivered after [REDACTED] dates but before [REDACTED] [REDACTED]. [REDACTED] will probably be ready for the end of December, but [REDACTED] is at risk of slipping further into 2019 which is likely to impact on the forecast costs for this project.

LUL Stations SC: [REDACTED] [REDACTED] The concern is that [REDACTED] are at risk of achieving SC after Transition to ROGS. This will require detailed examination to ensure access, safety, etc are acceptable for Trial Running and Trial Operations. Another risk is that LUL may have insufficient time for station Trial Operations before passenger services.

LUL Stations HO: [REDACTED] [REDACTED] This may not prevent passenger services as long as LUL have the necessary approved documentation.

RfL Stations TOSD: At this time, [REDACTED] [REDACTED] are forecast to be delivered on or after [REDACTED] dates, but before [REDACTED]. If this is confirmed, the cost forecasts should have taken into account the forecast schedule position.

RfL Stations SC: At this time, all stations are forecast to reach Staged Completion by the [REDACTED] [REDACTED] dates. This is yet to be confirmed in the new MOHS.

RfL Stations HO: [REDACTED] stations are currently forecast to be Handed Over before the [REDACTED] [REDACTED] dates, subject to confirmation.

3.4 Completion and Handover of Integrated Systems¹⁶

CRL’s current delivery strategy is summarised in Section 3.2. CRL’s short-term infrastructure completion plans and objectives described in our recent reports remain unchanged, with the schedule balance still favouring the completion of installations in tunnels and cross-passages. Dynamic testing continues on the Central Section in ‘windows’, with the majority of the testing activity associated with the rolling stock occurring off-site at Derby and Melton.

¹⁶ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

It is still CRL's intention to migrate to the new delivery regime of '5/2 Dynamic Testing' sometime in the future, but the absolute nature and timing of the switch to what CRL now terms Main Dynamic Testing (MDT) has not been fixed or enshrined yet in a new MOHS. A target date of 14 January 2018 was identified in the period, but the schedule split between construction and testing leading up to that date is still subject to internal CRL review. It is also possible that the content of CRL's final plans will be influenced by the outcome of a review being carried out by PA Consulting. We describe the interim schedule options being considered by CRL in Section 3.5.1.

We have updated below progress in delivery of the nine workstreams considered to be critical to the delivery of Stage 3 Opening.

1. Completion of Routeway ()

The principal outstanding linear activities are associated with the installation of lighting and LV power, drainage and fire mains. The linear installations in the tunnels are now substantially complete and steady progress has been made in the completion of connections at cross-passages. However, significant effort remains necessary to co-ordinate and implement the various tie-ins to works provided by other contractors at SSPs.

CRL has reviewed the de-mobilisation of rail-mounted plant associated with the forecast completion of its works and has identified a requirement which extends to the end of December 2018. Thereafter, a minimal fleet of vehicles will be retained. Stabling of construction equipment must be carefully planned to avoid any conflict with Yellow Plant.

A range of temporary services continues to support construction completion and dynamic testing (e.g. lighting, radio, fire main and power supplies), and will be required into 2019. The principles for the transfer of temporary works removals from CRL to RfL have been agreed.

2. Signalling ()

installation is substantially complete across the Central Section and across the NR interfaces. Remaining items which are not critical to dynamic testing are being installed as opportunities become available (e.g. labels, signs and permanent marker boards). Though not yet fully addressed, is making more testing resource available in support of '5/2 Dynamic Testing'.

3. Tunnel Ventilation ()

Planning and implementation of the transition from temporary to permanent ventilation systems is extremely complex and is now managed by a full-time CRL co-ordinator/manager. System completion relies upon the completion of significant elements of civils works at SSPs prior to the installation by C610 of ventilation equipment. As a consequence, delays at individual locations brings risk to the whole programme.

While there have been some improvements, progress in the last month has once again confirmed that the completion of the Permanent Ventilation System in the timescales originally proposed only a couple of periods ago is challenging. There is now a particular focus on the completion of works at Eleanor Street Shaft, Whitechapel and Canary Wharf because this significantly reduces dependence upon temporary ventilation, and upon ventilation provision at Stepney Green Shaft ().

The current strategic objective is to carry out a significant proportion of the final airflow tests throughout the Central Section before installations at Bond Street and Stepney Green have been completed. The sequence of location-specific tests now extends into early December

the infrastructure to a state of completion sufficient to allow meaningful progress to be made with Phase 3 Static Integration Testing. This situation in turn complicates testing and witnessing resource planning and delays the preparation of assurance documentation.

CRL has delayed the release of the new MOHS largely because it has been unable yet to determine the true state of the works at each of the SSPs. It has therefore been unable to fully assess the workload to completion, and, given the integral nature of these sites, to properly determine the impact upon the completion of rail systems. Completion of the SSPs and the associated downstream railway systems works remains one of the most critical risks to handover and Trial Running.

3.5 Dynamic Testing

3.5.1 Dynamic Testing Strategy

While CRL remains committed to a '5/2 Dynamic Testing' regime, the working arrangements leading up to the switch have yet to be confirmed. In early October 2018, CRL indicated that it would implement a period of Interim Dynamic Testing on 10 December 2018, effectively introducing a 'reduced' form of the '5/2 Dynamic Testing' regime. The weekday element would contain daily 8 hour shifts for testing, alternating with 16 hours for construction. Thereafter, Main Dynamic Testing would provide for 16 hours of testing each day, with a target start date of 14 January 2018. These interim arrangements are attractive because they provide a 'stepped' change in the schedule balance between construction and dynamic testing, maximising the opportunity for construction completion and for off-site preparations for Main Dynamic Testing.

CRL has recently reviewed the form of these interim arrangements, preferring instead to implement three or four 48 hour 'schedule blocks' between 10 December 2018 and 14 January 2019. We understand that CRL considers that this is the approach which now best optimises the balance between construction and dynamic testing, given their current respective completion states. This appears to be nothing more than a slightly modified extension of the current 'windows' approach to dynamic testing, although the terminology used during presentation¹⁸ suggests that CRL believes this to be something notably different. This latest interim arrangement has yet to receive CRL Board support¹⁹, but it will be subject to independent assessment and then further CRL Board consideration ahead of the next T-4 readiness review²⁰.

There is a risk that a failure by CRL to make a schedule commitment soon to the start of '5/2 Dynamic Testing' will impact upon the contractors' ability to make firm resource plans, and also upon wider Crossrail completion. We urge CRL to resolve this issue as soon as possible, in order to re-build schedule confidence and provide delivery certainty.

There has been no change to the headline documented 'entry criteria'²¹ being satisfied, although it is unclear if these will be applied to the start of the interim arrangements on 10 December 2018 or to Main Dynamic Testing on 14 January 2018. These criteria are summarised below:

- Railway Systems complete (Section 3.4);
- Planned releases of CBTC and TCMS on-board software installed (Section 3.5.2);

¹⁸ CRL Period 7 MOHS Review held on 26 October 2018.

¹⁹ The 'schedule block' proposal was not endorsed at the CRL Board Meeting held on 26 October 2018.

²⁰ CRL T-4 Readiness Review scheduled for 9 November 2018.

²¹ CRL document Entry Into Main Dynamic Testing Regime (CRL1-XLR-08-STP-CR001_Z-50003).

- Rolling Stock off-site completion of critical CBTC tests (Section 3.5.2);
- Permanent LV supplies in place at Stations (Section 3.4).

Following the formal review on 21 September 2018, chaired by an independent systems integration specialist, internal interim progress reviews continue to be held by CRL. CRL's current plan to implement the interim dynamic testing arrangements described above on 10 December 2018 has fixed the date of the associated T-4 readiness review²². Given the current uncertainty around implementation, this date is subject to change.

We noted in our last report that CRL appeared not to have reached consensus on what constitutes 'essential' and 'desirable' entry criteria. Schedule drift since then, particularly with rolling stock (see Section 3.8), has effectively forced CRL to accept "an erosion" of the original entry criteria in order to maintain progress. Main Dynamic Testing will therefore start with an earlier than planned version of software, because the train on-board CBTC integration tests will not have been completed off-site. The fully-tested software is now forecast to be available for Central Section dynamic testing in mid-February 2018. Our concerns remain with CRL attempting out-of-sequence testing using assets which are incomplete and using unproven software.

CRL has re-evaluated when multiple-train dynamic testing might take place. It was originally scheduled for Dynamic Testing Window 7 on 28/29 July 2018, but was unable to proceed because of incomplete assurance documentation. It was then moved into the '5/2 Dynamic Testing' period when that was assumed to start during November 2018. However, the latest proposal targeting '5/2 Dynamic Testing' in January 2019 has caused multiple-train testing to be brought forward into new Dynamic Testing Window 14, scheduled for 17/18/19 November 2018.

3.5.2 Dynamic Testing Progress

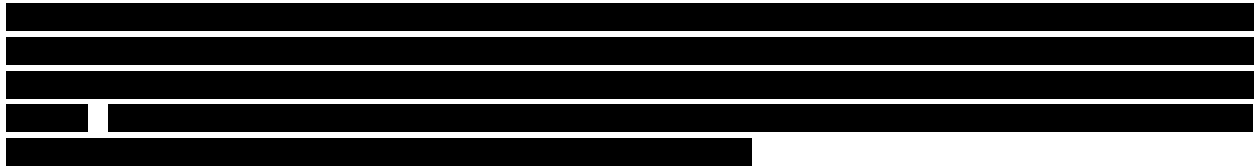
CRL has completed twelve dynamic testing windows with a small number of short-length subsidiary windows also undertaken. Dynamic Test Window 12X took place on 27/28 October 2018 in which a range of rolling stock, signalling and other rail systems tests were undertaken. The tests that were carried out were not particularly complex, but were at least largely successful.

[REDACTED]

Dynamic Testing Window 13 took place on 5 November 2018 and provided another opportunity for testing across the GWML interface. Successful TPWS / CBTC transitions were performed in the eastbound direction, although this has not yet been achieved westbound because of a known fault which is currently being addressed. Observations and interface tests with other rail systems were also carried out.

[REDACTED]

²² CRL T-4 Readiness Review scheduled for 9 November 2018.



3.6 Approvals, Assurance and Agreements

3.6.1 RAB(C)

CRL has re-worked its formal submissions schedule following review by RAB(C) last period. In the absence of firm dates pending the release of the revised MOHS, and for outline planning purposes only, CRL has targeted a railway opening in October 2019.

Around 60 documents are currently required to be processed by RAB(C) to allow opening, and with re-submissions inevitable, the review workload is substantial. The submission rate remains at approximately 5 per month, but the schedule is unavoidably back-loaded because many documents are unable to be finalised until testing has been completed. Communications systems submissions are a case in point, with final testing relying upon the completion of other major Crossrail elements which are in delay. Thus, the CRL submissions schedule shows, for example, that the final safety justifications for communications systems such as radio, public address, CCTV, telephony etc. will not be completed until June 2019, anticipating acceptance in July 2019.

Past experience has shown that the completion of relatively simple submissions, and particularly those relying upon the preparation of evidence or document components by multiple parties, requires a disproportionate amount of co-ordinating effort. The documents necessarily reflect the complexity of railway itself, and CRL must ensure that sufficient resources are in place to allow the already challenging timescales for RAB(C) approvals to be met.

New key dates for Engineering Safety Management submissions for the Stage 3 Safety Case are expected from CRL as part of the MOHS refresh.

3.6.2 Regulatory Approvals

There has been little progress to report upon since both our Period 5 and 6 reports.

CRL states that there has been no change in the status of interoperability compliance in the areas of design and construction/dynamic testing. There has been some small progress for NR design and construction evidence.

A similar state exists with the production of the evidence required for the SAR, with no Engineering Safety Justifications being completed this Period. This situation will not change until Testing and Commissioning (T&C) activities are completed.

The key issues remain as before:

- [REDACTED] continues to make slow progress in closing the open hazards allocated to it, as these need T&C evidence;
- [REDACTED] interface design with other signalling systems remains incomplete;
- Lack of accepted O&M manuals prevents closure of system hazards²³;

²³ This is because the mitigating action against many of the hazards is 'IM to follow the O&M manual'.

- Project Wide Hazard Record closure remains at 21%. The remaining open items require T&C evidence from the contractors before they can be closed;
- Lack of TSI evidence to present to the NoBo.

We continue to state the importance of Contractors and CRL completing the assurance evidence as well as the physical works. The Element will not be deemed completed until the evidence is produced and accepted. The new MOHS must adequately reflect these activities.

3.6.3 Agreements

There are five agreements that are judged to be amber. Four of these were described in our last report:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- Development Service Agreement between NR and RfL-I;
- GSM-R Network Services Agreement;
- Power Agreements between TfL and NR (new).

The Power Agreements are a proposal by RfL to lease ATFS units at Pudding Mill Lane and Kensal Green to NR, who would then re-charge RfL. NR has rejected the proposal. We believe a solution will be reached in due course. In any case, the current interim arrangements will continue, so the Programme will not be affected.

We believe the Agreements described above will be solved, but closure will simply be extended as the proposed Staged opening date has been extended.

There has been no change to the number of Critical Agreements that we reported open (38 in total) from our Period 4 - 6 reports. CRL states that the number is now 33, but this includes 5 or 6 agreements that are awaiting signed agreement.

3.7 Operational Readiness Assessment

The Elizabeth Line dashboard has been disbanded and open elements incorporated into a number of different forums, such as the RfL Readiness Board and Elizabeth Line Trial Operations Review Group. We are now reporting upon these forums.

Generally, the current issues facing the Operational elements of the IMs are, with the exception of Handover Material (see Section 3.9) and Plumstead (see Section 3.11), largely contained. Sufficient personnel have been recruited and trained, with the exception being some training modules of [REDACTED] and [REDACTED] that are proving difficult to close out. The primary focus of the IMs is now to move from a trained workforce to a competent one. This will require access to all the railway's systems and facilities that they are expecting to manage.

3.8 Rolling Stock

In this Period, BT and Siemens have produced a programme that manages the integration between the parties during the Dynamic Testing phase. The programme addresses the 29 tests, considered a pre-requisite by CRL in September 2018, to the start of Dynamic Testing.

The train will require various upgrades to its TCMS, CBTC, ETCS, TPWS and brakes software prior to it being placed into passenger service. The changes to software have been coordinated into different configurations as Dynamic Testing proceeds, and are as follows:

Configuration	Authorised for use ²⁴	Comment
Y 0.220 ²⁵	16/11/18	Necessary for Multi Train Testing, allowing TW14 & Interim Dynamic Testing to proceed.
Y 0.230	02/01/19 ²⁶	Necessary for Main Dynamic Testing to start, includes fixes to some of the failed 17 tests.
Y 0.240	18/02/19	Fixes to failed 17 tests effectively complete, essential entry criteria met ²⁷ .

Figure 3 - 1 ~ Dynamic Testing Proceeds



3.9 Handover

Handover materials has not progressed at the desired pace. We believe there needs to be a different approach to more timely processes and collaborative behaviours from Contractors, CRL and IMs if this element of the programme is to avoid being an impediment to opening. Clear metrics of what is required per period to facilitate Handover are required.

O&M Manuals

CRL is continuing with an O&M taskforce that is reviewing all aspects of the process, including relationships and behaviours. We reported on this initiative in our Period 4 report; however, progress has not markedly improved in Period 7. There is also no clear programme as to how many O&Ms are planned to be accepted on a period basis from now until Trial Running.

Asset Information

With the exception of [redacted] station and [redacted] most design asset data is in a position to be reviewed by the IMs. The Contractors are now labelling the assets that they have installed, prior to acceptance by the IMs. Currently stations, shafts and portals is reporting circa 30% completion from a total of approximately 122,000 assets²⁸. This is a large task to complete on time. There also appear to be on-going issues with loading into RfL's Maximo system due to quality issues, which could delay acceptance if not resolved.

Handover Master Deliverable List

²⁴ RS dashboard – PDB 24 October 2018.

²⁵ E.g. Y 0.220 will have TCMS 7.2.2.5, TPWS 2.5.2, ETCS PVI 5.6, CBTCA03-003, brakes 6.0 and propulsion 1.2.5.0. All these elements will be revised in later configurations.

²⁶ Assurance evidence is currently planned to be assessed between 19 December 2018 and 2 January 2019.

²⁷ One test relating to CBTC and PSD remaining until June 2019.

²⁸ Figures taken from Stations Steering Group meeting – 1 November 2018.

In Period 7, the IMs accepted circa 1% of the HMDL total²⁹, bringing the total accepted to just over 15%. In the time available, there may be a bow wave of documentation submitted to the IMs, and they need to be adequately resourced for this. We are uncertain whether this bow wave will occur, so encourage CRL and IMs to discuss the implications of that scenario with regard to Handover.

Training

As described in our last report, the remaining issues for training centre upon [REDACTED] [REDACTED] stations due to their late running programmes, and [REDACTED] and [REDACTED] due in some cases to the lack of fitted equipment. We expect these to be resolved by time of opening for service. CRL's training team is disbanding by the end of 2018, so the remaining responsibilities will need to be met by others within CRL or the IMs.

3.10 Trial Running & Trial Operations

In our Period 6 report, we raised a number of issues, and intended to comment more fully once the revised MOHS was released. The delay to the release means we reluctantly defer comment until Period 8.

3.11 Plumstead Depot

The planned completion date for the Maintenance Facility based on the [REDACTED] Period 7 schedule is [REDACTED]. The Period 8 schedule has not yet been submitted. The delay is due to late MEP design and installation, late site handovers and poor contractor performance. CRL is working closely with RfL in order to minimise the impact on RfL operations.

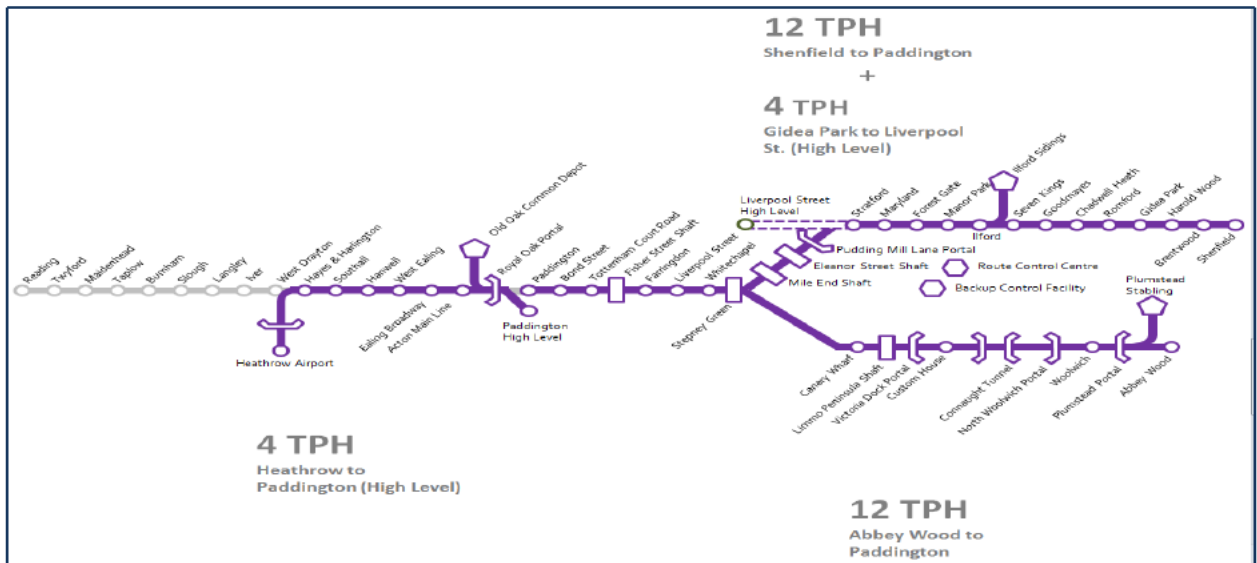
This delay has the potential to impact how the Yellow Plant will be used to maintain the railway from the start of Trial Running, [REDACTED], as well as support CRL prior to that. There will also be issues with bringing the C345 sidings into service within a working depot. RfL is investigating stabling the Yellow Plant in other depots that are in close proximity to Plumstead. A revised BIU strategy for the depot needs to be developed.

The review into whether the signalling functionality supports the Operational Concepts has been held³⁰, and a number of workstreams identified. We are due to meet the Stage 4 Operational Readiness Manager to understand the impacts.

²⁹ Combined total estimated to be 183,600 documents.

³⁰ 24 October 2018.

4 Stage 4: Paddington to Abbey Wood & Shenfield – May 2020 (tbc)



4.1 Summary

The proposed opening date for Stage 4 is now May 2020, subject to the revised MOHS. This should allow sufficient time to complete the at-risk items, but the NR KD22 power upgrade works will remain an issue due to the limited access available after May 2019.

4.2 Operational Readiness Assessment

There are three Readiness Tasks that have been given a 'Red' status by the PDB³¹, the same ones as in our last report. The overall rating for Stage 4 is 'Red'.

Readiness Task	Issue
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	No change from P6. Delivery remains challenging, as access not formally agreed and NR has not confirmed the Contractor's programme. There remains an imperative to complete the works by May 2019 due to the lack of access to the railway after that date.
DOO CCTV installed and operational Stratford and Shenfield stations	Little change from P6. NR is prioritising Platforms 5 and 8 at Stratford as these are used for normal running, and are planned for Christmas 2018. The Programme has not been confirmed, and there is a lack of clarity concerning the programme for Platforms 10 and 11, which would be used during perturbation.

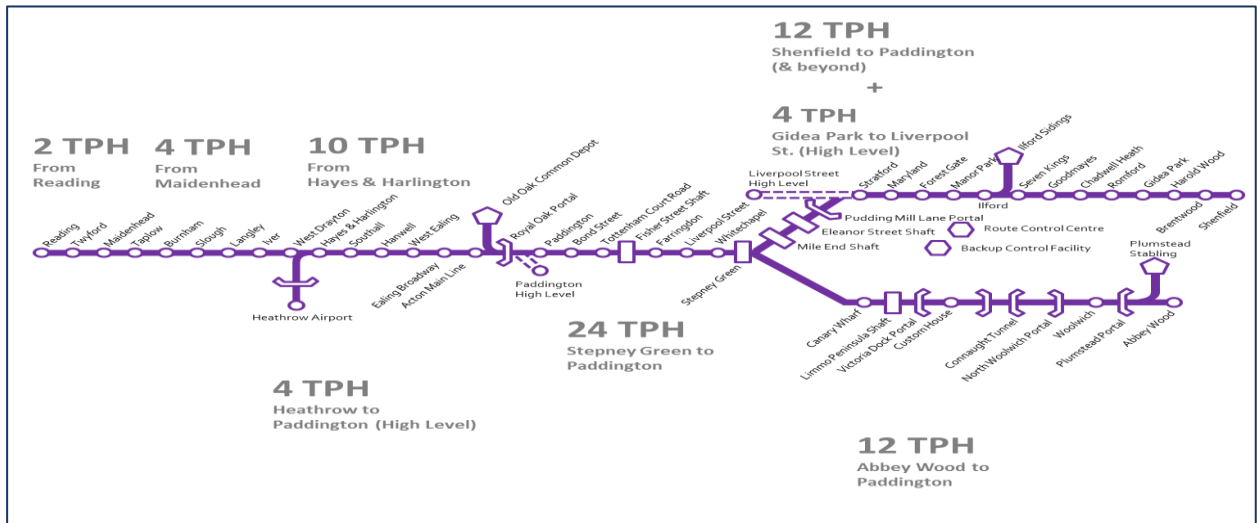
³¹ 24 October 2018.

	Readiness Task	Issue
	Station Information & Security System (SISS) stations and RCC	Both NR's Contractor (to provide a programme) and ██████ (to accelerate its works) are struggling to integrate their activities. This situation has been the case for a number of periods.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with 'Red' Status

5 Stage 5: Reading & Heathrow to Abbey Wood – Dec 2020 (tbc)



5.1 Summary

The proposed opening date for Stage 5 is now [redacted] [redacted] subject to the revised MOHS. A Stage 5a service has been proposed for starting in [redacted], but there are a number of risks that have to be taken into account.

5.2 Stage 5a

Stage 5a proposes to introduce a 4TPH service between Paddington and Maidenhead/Reading, building on the existing Stage 2-2 between Paddington and Heathrow. The target date for this service is [redacted]. The areas of risk to this date are as follows:

- Stage 2-2 will need to have been implemented, see Section 2;
- There is an overlap in the implementation of Stage 3 and this service, which could affect management focus;
- There are a number of industry regulatory issues to resolve, such as route capacity and the adjustment of platform workings at Paddington. These need to be agreed by 1 March 2019 for a formal submission to NR;
- The exemption certificate for enhanced TPWS will need to be extended, which is already being actioned.

5.3 Operational Readiness Assessment

There are four Stage 5 Readiness Tasks that have been reported as a ‘Red’ status to the PDB on 24 October 2018, an increase of one from our Period 6 report. The overall rating for Stage 5 is ‘Red’.

	Readiness Task	Issue
	ETCS available and tested Airport Jn to Paddington	NR programme completion for ETCS is now forecast for mid to late 2020. Siemens have provided a design and cost to install TPWS into the transition area, as that is the technology that will be required. It is awaiting instruction.
	ONFR Western station upgrades complete	A statement of intent regarding the inner stations is expected this week and the outer stations one month later if the December 2019 completion date is to be met. Any proposed delay should be impact assessed against the proposed Stage 5a service.
	NEW DOO CCTV & Platform lengthening GWML outer stations	This had been downgraded to amber, but we believed the delivery plans were insufficiently mature to warrant the change. DOO CCTV will be required to operate any proposed Paddington High-level to Reading service.
	Maidenhead Sidings accommodation	There are concerns that the GRIP 4 design is not optimal and there is insufficient budget to support the works to be carried out by NR.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with 'Red' Status

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI improved again in Period 7, from 2.57 to 2.59. The RIDDOR rate improved to 0.08, and the Lost Time Case (LTC) AFR improved to 0.13, in spite of two incidents on C610 Trace & Logistics.

There were also seven high potential near misses which is concerning. The CRL H&S Director has noted³² that the rolling average had increased from a low of 0.15 to 0.17, although this is still below the previous high of 0.22. He noted that CRL and the Principal Contractors (PCs) are focussing on this issue.

H&S KPI	Target	Aim	Period 6	Period 7
HSPI	2.20	-	2.57	2.59
PCs scoring over 2.20	11	11	11	11
RIDDOR AFR	0.15	0.06	0.09	0.08
LTC AFR	0.23	0.15	0.15	0.13

Figure 6 - 1 ~ Health and Safety Performance COS

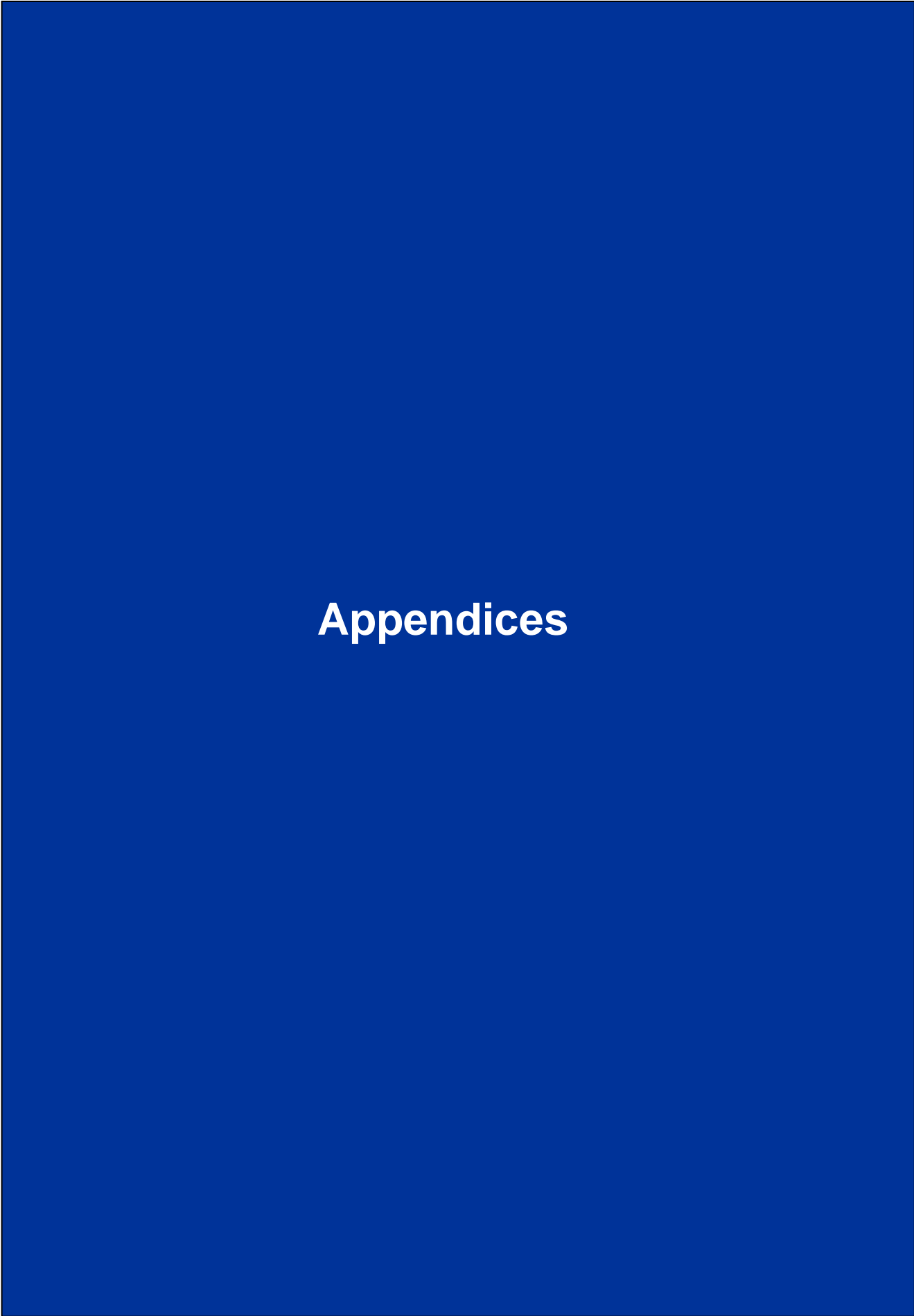
Stress, Fatigue and Mental Health were the subject of discussion at SHELTON on 28 October 2018. There is concern about the executives and managers within CRL and its Contractors during these difficult times.

CRL's 'Finish Safe' campaign was launched during September and continued into October. Various themes have been developed by the PCs at the various locations around the Programme. These focus on self-reviews, induction of new fit-out workers, exposure of services in Urban Realm, and the approaching winter weather.

██████████ application to the ORR for an extension to its ROGS exemption is yet to be approved.

CRL is currently reviewing the resourcing required for its H&S team in accordance with the new schedule to completion. The Director has been extended to Easter 2019.

³² Meeting with H&S Director on 29 October 2018.

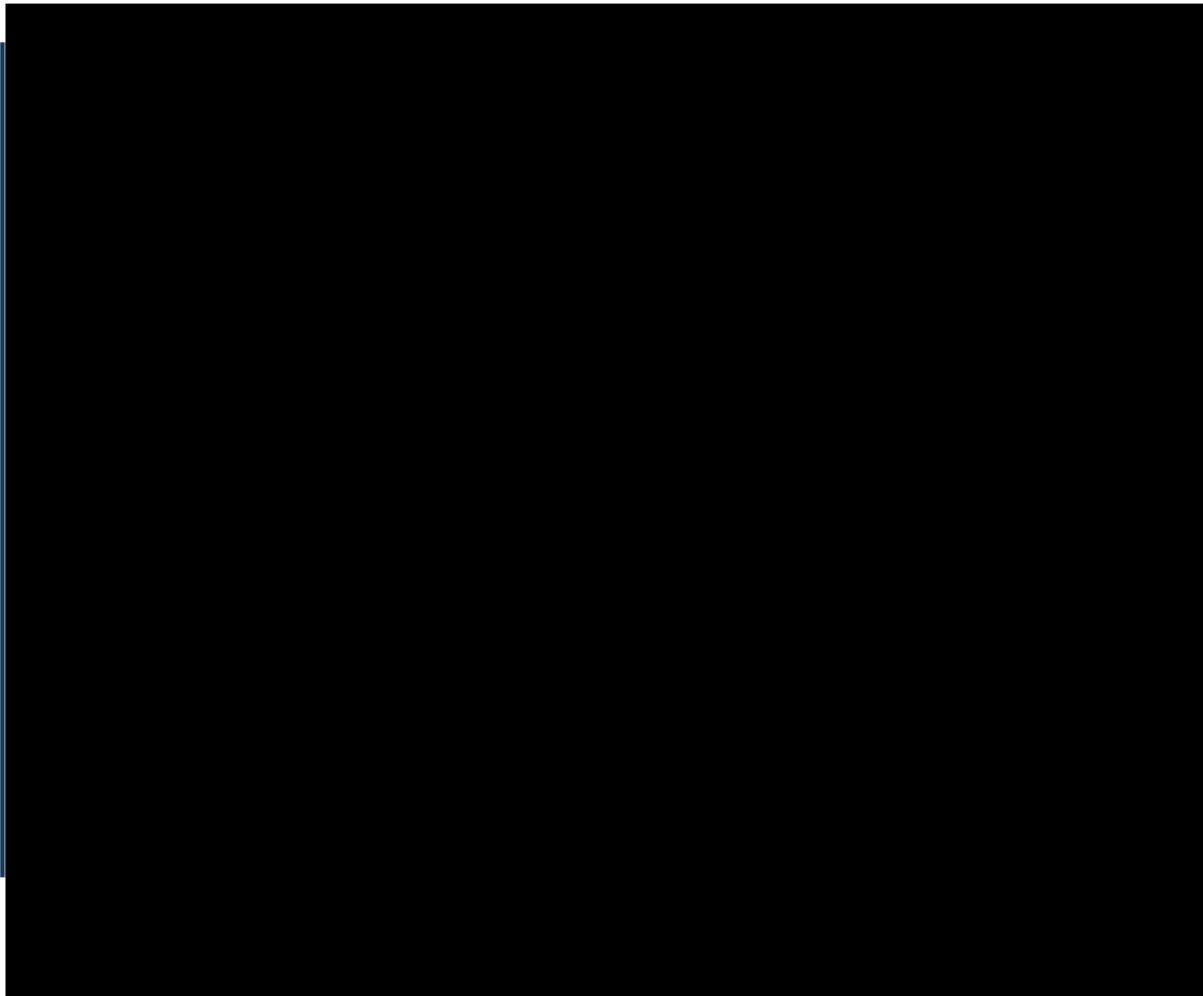


Appendices

Appendix A Corporate Milestones & Anchor Milestone Progress

We expect new Corporate Milestones will be approved by the CRL Board once the new MOHS is issued. These will be reviewed upon receipt.

New Anchor Milestones will be generated by CRL as part of the development of the new MOHS. These will be reviewed upon receipt. The chart shown below indicates the forecasts at Period 7 based on MOHS 2018. All of the remaining 112 Anchor Milestones are forecast to be later than the MOHS 2018 [REDACTED]

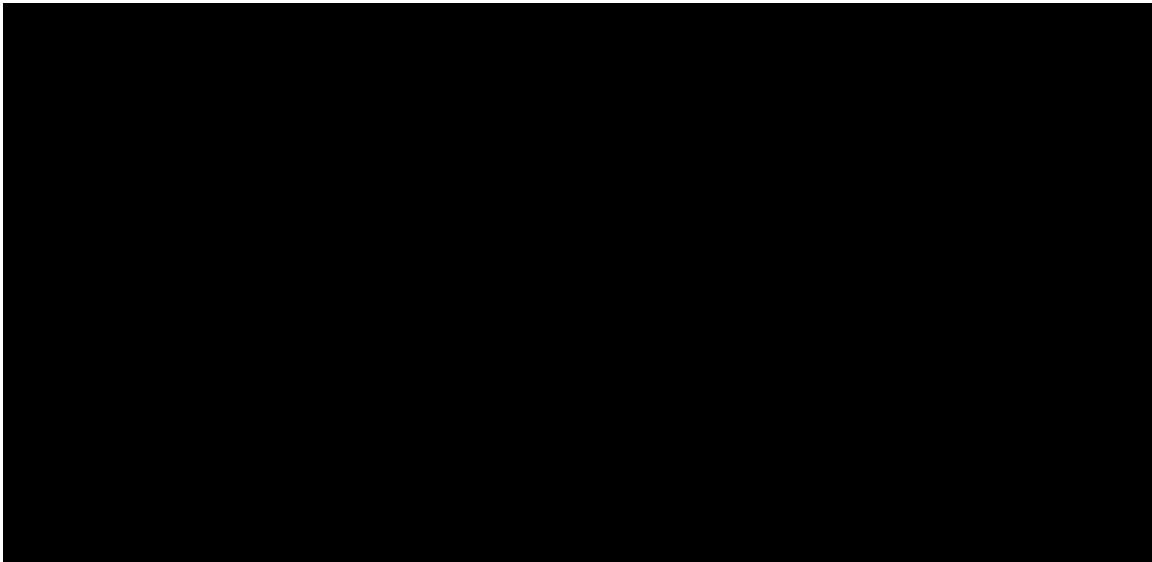
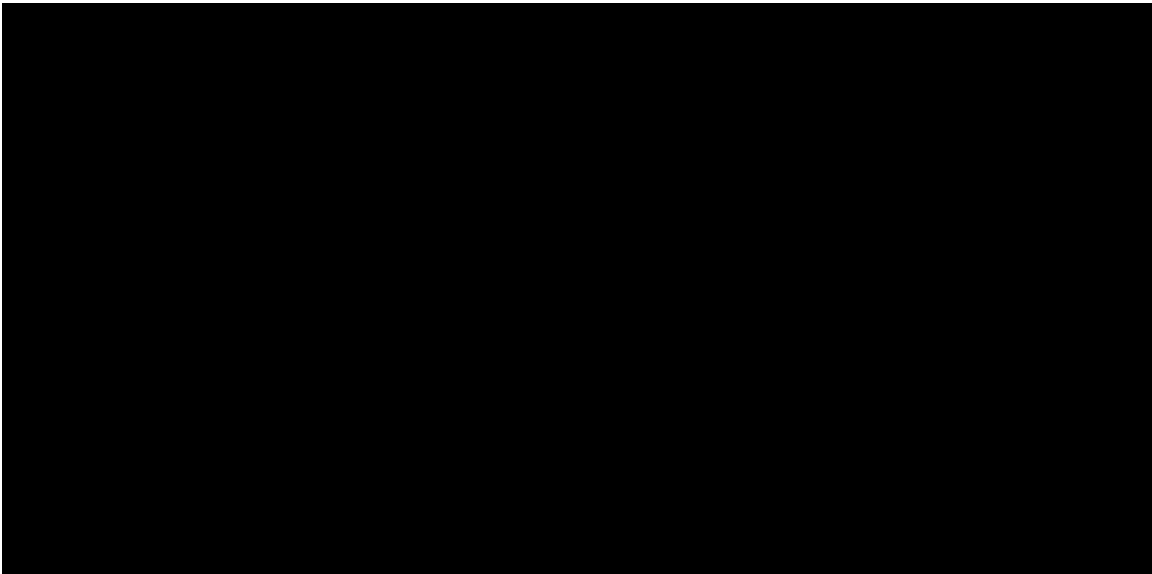


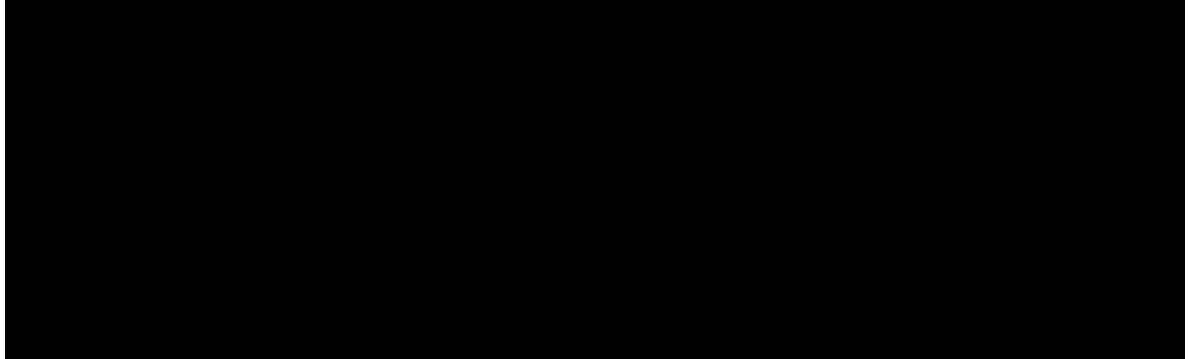
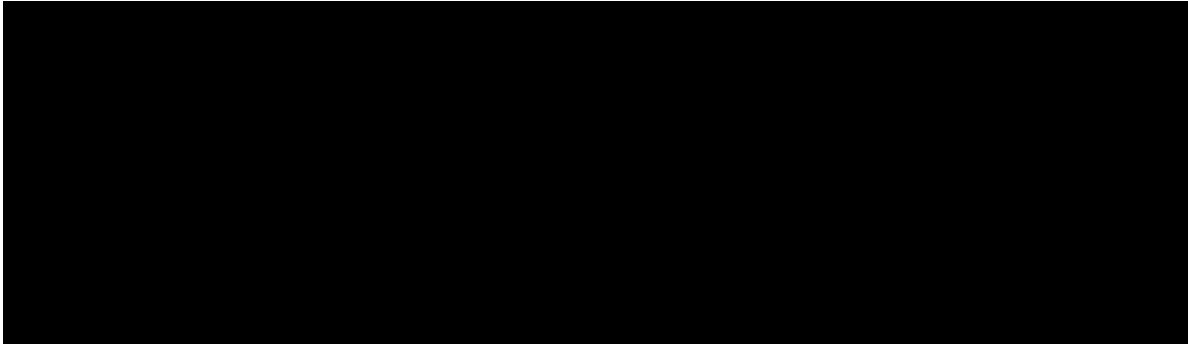
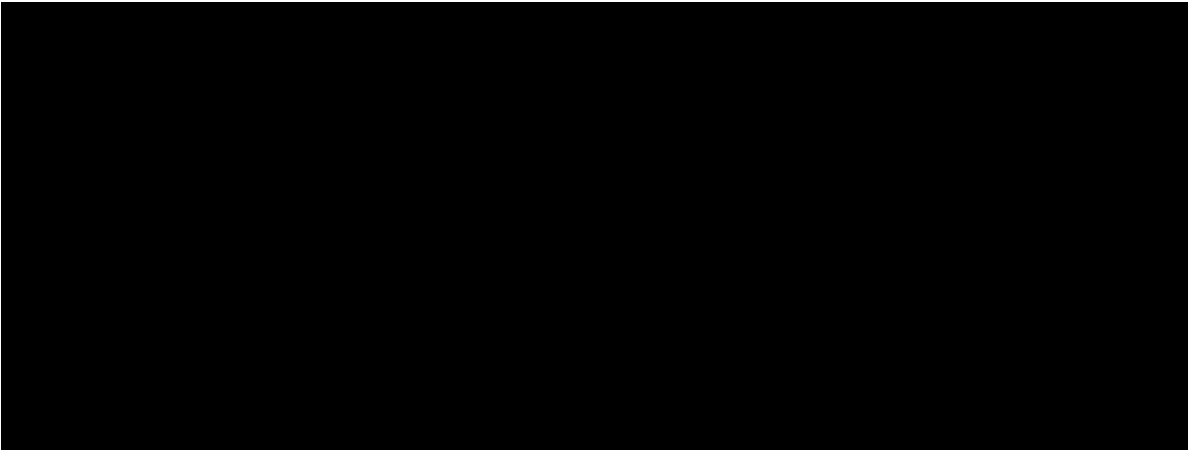
Appendix B COS SSP Target Dates

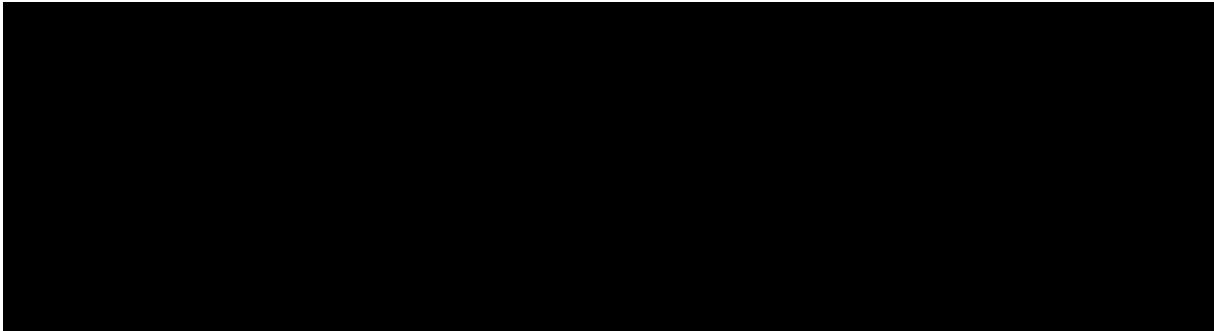
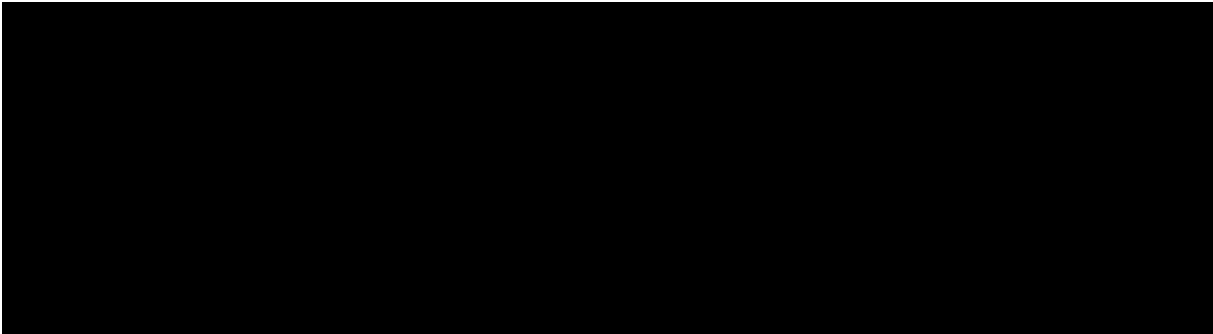
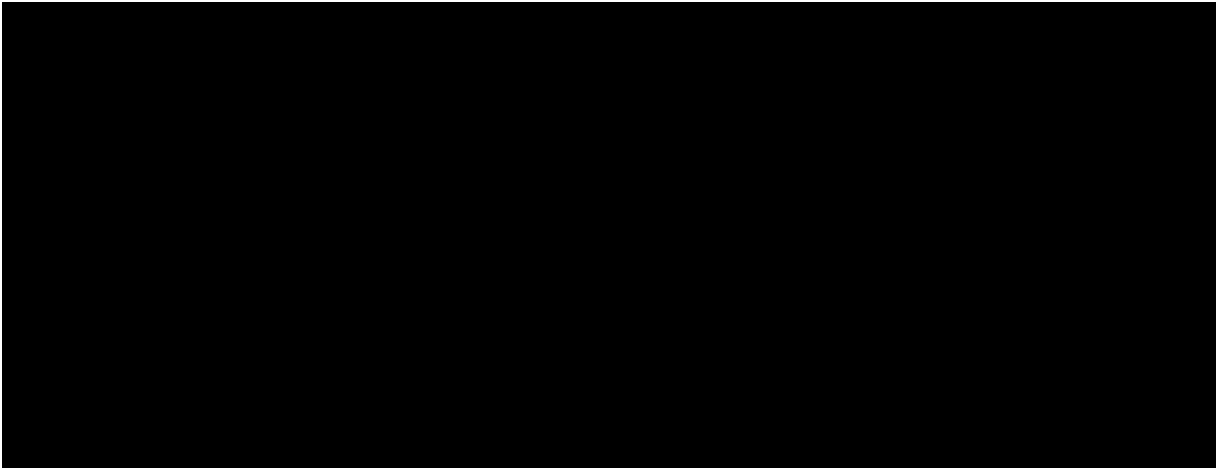
All baseline and forecast dates for Stations are currently under review pending development and approval of the new MOHS. These will be provided upon receipt and new tables created for our Period 8 report.

The following tables give approximate indications of possible forecast dates, as noted at CRL PDB on 23 October 2018, set against the [REDACTED] dates. The forecasts are draft dates subject to confirmation and issue of the new MOHS. Forecasts highlighted in amber show dates after [REDACTED] dates, and those highlighted in red show dates after [REDACTED] dates.

SHAFTS AND PORTALS

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Appendix C Agreements

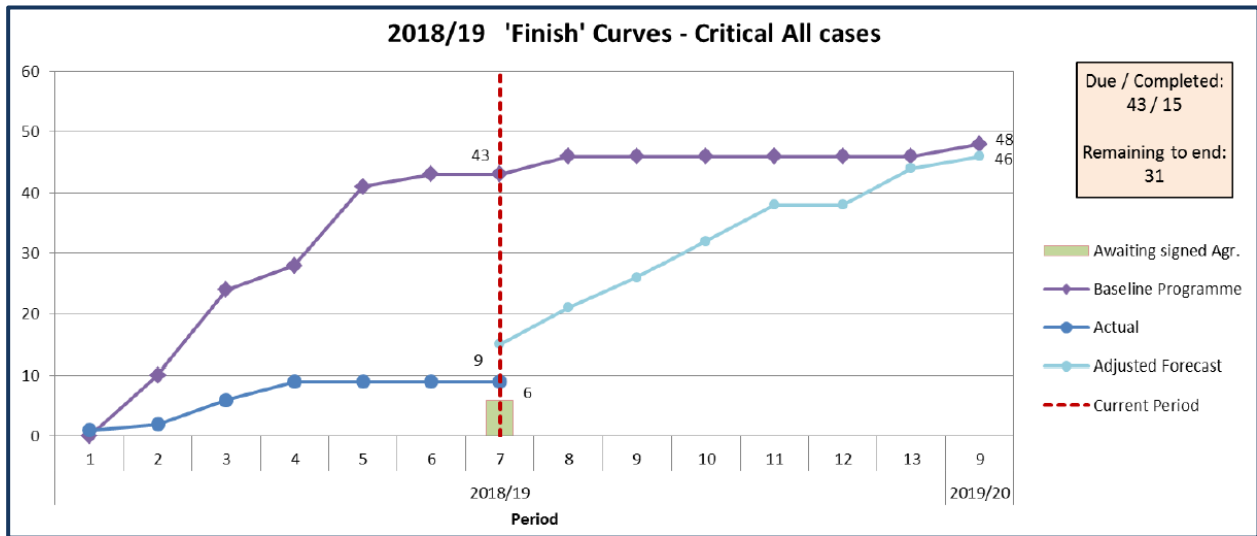


Figure C - 1 ~ 2018/19 Finish Curves – Critical All Cases³³

³³ Extract from Period 7 CRL Agreements update.

Project Representative Team

Project Team

██████████
██████████ :
██████████
██████████ :
██████████

Project Representative, Safety, Progress, Risk, Stations;
Signalling, Railway Systems, Integration, T&C;
Compliance & Change, Operations, RSD, Assurance;
Commercial, Cost Control, Financial;
Administration Manager.

Glossary of Terms and Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LDBL	Late Date Baseline
ABB	ASEA Brown Boverly	LFB	London Fire Brigade
ABW	Abbey Wood	LIS	Liverpool Street
ACBs	Air Circuit Breakers	LMU	London Metropolitan University
ACJV	Alstom Costain Joint Venture	LO	London Over ground
ACWP	Actual Cost of Work Performed	LoNo	Letter of No Objection
AEA	Abellio East Anglia	LoR	Line of Route
AEN	Adverse Event Notice	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AM	Anchor Milestones	MDT	Main Dynamic Testing
AMS	Agreements Management System	MDTR	Main Dynamic Testing Regime
APIS	Authorisation to Place into Service	MENTOR	Mobile Electrical Network Testing, Observation and Recording
ARS	Automatic Route Setting	MEP	Mechanical Electrical & Public Health
AsBo	Assurance Body - Ricardo Rail	MEPA	Mechanical, Electrical, Public Health, Architecture
ASLEF	Associated Society of Locomotive Engineers and Firemen	MES	Mile End Shaft
AT	Autotransformer	MFF	Multi-Functional Framework
ATC	Automatic Train Control	MIRP	Maintenance Integration Review Panel
ATF	Auto Transformer	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
ATS	Auto Transformer Station	MTIN	Miles Technical Incident Number
AWS	Automatic Warning System	MTR SMS	MTR Safety Management System.
B&PC	Board & Programme Contingency	MTR-C	Mass Transit Railway - Crossrail
BBMV	Balfour Beatty Morgan Vinci	MV	Medium Voltage
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NEC	New Engineering Contract
BFK	Bam Ferrovial Kier	NG	National Grid
BH	Berkeley Homes	NGET	National Grid Electricity Transmission
BIU	Bringing Into Use	NKL	North Kent Line
BLL	Bakerloo Line Link	NoBo	Notified Body
BMS	Building Management Systems	NOW	North Woolwich
BOS	Bond Street Station	NR	Network Rail
BP	Business Plan	NR PDB	Network Rail Programme Delivery Board
BREEAM	Building Research Establishment Environmental Assessment Methodology	NSACS	New Sector Area Cost Summary
BSP	Bulk Power Supply Point	O&M	Operations and Maintenance

BT	Bombardier Transportation	OCS	Overhead Catenary Systems
BT / PC	Bombardier Transportation / Prime Contractor	OLE	Overhead Line Equipment
BTH	Blomfield Ticket Hall	OMC Building	Operations Maintenance Centre
BUCF	S	OME	Order of Magnitude Estimate
BUF	Bottom Up Forecast	ONFR	On Network Functional Requirements
C&CSC	Commercial and Change Sub-committee	ONSIP	On Network Station Improvements Programme
CAR	Corrective Action Report	ONW	On Network Works
CARE	Crossrail Assurance Reporting Environment	OOC	Old Oak Common
CBTC	Communications Based Train Control	OOCPA	Old Oak Common Paddington Approaches
CCB	Current Control Budget	OPEX	Operational Expenditure
CCP	Commitments Compliance Plans	Ops	Operations
CCR	Consolidated Cost Report	ORAT	Operational Readiness & Transfer Group
CCRB	Construction and Commissioning Rulebook	ORR	Office of Rail & Road
CCRRB	Crossrail Construction Railway Rule Book	ORSG	Operational Readiness Steering Group
CCSA	Contract Commercial Status Analysis	OSD	Over Site Development
CCSC	Commercial & Change Sub-Committee	OSP	Operations Safety Procedures
CCTV	Closed Circuit Television	OTIS	OTIS escalators (company)
CD/RA	Closed Door / Right Away	OTP	Overall Target Price
CDG	Competence Design Group	P2R	Paddington to Reading
CDL	Central Door Locking	PA	Public Address
CDM	Construction Design & Management Regulations	PAD	Paddington station
CDN	Crossrail Data Network	PC	Principal Contractors
CDT	Commitments Delivery Tracker	PDA	Project Development Agreement
CE	Compensation Events	PDB	Programme Delivery Board
CEC	Chief Engineer's Communications	PES	Platform Edge Screen
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PES	Permanent Earthed Sections
CEG	Central Engineering Group	Ph3C	Phase 3 Complete
CEO	Chief Executive Officer	PIP	Paddington Integration Project
CER	Communications Equipment Room	PIR	Potential Incident Report
CFCCB	Contingency Finance Current Control Budget	PLU	Plumstead
CFO	Chief Financial Officer	PM	Project Manager
CIF	Crossrail Integration Facility	PMI	Project Manager Instruction
CIS	Customer Information System	PML	Pudding Mill Lane
CMR	Crossrail Managed Risk	PMO	Project Management Office NR
CMS	Central Management System	PNY	Paddington New Yard
CoL	City of London	PPE	Personal Protective Equipment
COS	Central Operating Section	PPF	Property Partnership Framework
COS	Central Operating Section	PPM	Passenger Performance Measurement
COWD	Cost of Work Done	PRep	Project Representative
CPFR	Crossrail Programme Functional Requirements	PRISM	Cost Management Software
CPI	Cost Performance Index	PRM	Persons of Reduced Mobility
CPO	Compulsory Purchase Order	PSD	Platform Screen Door
CRAF	Completion Readiness Assessment Framework	PSG	Performance Steering Group
CRL	Crossrail Limited	PSR	Project Status Report
CRV	Crossrail Requirements Variation	PTYSC	Property Sub-Committee
CSCS	Construction Skills Certification Scheme	PWay	Permanent Way
CSDE	Correct Side Door Enabling	QBR	Quarterly Baseline Review
CSJV	Costain Skanska Joint Venture	QCRA	Quantified Cost Risk Assessment
CSM	Construction Safety Management	QRA	Quantified Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	QSRA	Quantified Schedule Risk Assessment
CT	Computerized Tomography	RAB	Regulatory Asset Base
CTOC	Crossrail Train Operating Concession	RAB (C)	RfL Assurance Board for Crossrail
CUH / CHS	Custom House Station	RAG	Red, Amber, Green Matrix
CW	Canary Wharf	RAM	Route Asset Manage.
CWG	Canary Wharf Group	RAP	Remedial Action Plan

CWS	Canary Wharf Station	RBC	Remote Block Computer
D&A	Drugs and Alcohol	RCA	Risk Control Actions
DA	Development Agreement	RCC	Route Control Centre
DeBo	Designated body	RfL	Rail for London
DESJs	Design Engineering Safety Justifications	RfL-I	Rail for London - Infrastructure
DfT	Department for Transport	RFT	Right First Time
DLO	Direct Labour Organisation	RIA	Railway Integration Authority
DLR	Docklands Light Railway	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DOO	Driver Only Operation	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DPS	Depot Protection System	RIRP	Railway Integration Review Point
DT	Dynamic Testing	RLU	Restricted Length Unit
Dwall	Diaphragm wall	ROC	Rigid Overhead Conductor
DWWP	Delivery of Works Within Possession	ROC	Regional Operational Centre
E&B	Earthing & Bonding	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
EA	Environment Agency	ROP	Royal Oak Portal
EAC	Estimate at Completion	RP4.2	Review Point 4.2
EB	Eastbound	RR	Ricardo Rail
ECHR	Element Completion Handover Report	RRV	Road / Rail Vehicles
ECI	Early Contractor Involvement	RS	Rolling Stock
ECP	Employers Completion Process	RSC	Return Screen Conductor
ECS	Empty Coach Stock	RSD	Rolling Stock & Depot
EDBL	Early Date Baseline	RSSB	Rail Safety & Standards Board
EDORs	ETCS Data Only Radio	RTU	Remote Telemetry Unit
EDT	Early Dynamic Testing	S&C	Switches & Crossings
EED	Emergency Exit Door	SA	Supplementary Agreement
EFC	Estimated Final Cost	SACR	Semi Annual Construction Report
EFC	Economic and Financial Committee	SAP	System Applications Products
EiS	Entry into Service	SAR	Safety Assessment Report
ELCBT	Elizabeth Line Countdown Board Tracker	SAT	Site Acceptance Test
ELRSG	Elizabeth Line Readiness Steering Group	SC	Staged Completion
EMC	Electromagnetic Compatibility	SCADA	Supervisory Control and Data Acquisition
EMU	Electrical Multiple Unit	SCL	Sprayed Concrete Lining
ERTMS	European Rail Traffic Management Systems	SCN	Sponsor Change Notice
ESJ	Engineering Safety Justification	SDG	Signalling Design Group
ESM	Engineering Safety Management	SDO	Selective Door Operation
ESS	Eleanor Street Shaft	SDS	Scheme Design Specification
ETCS	European Train Control System	SEJ	Safety Engineering Justification
ETH	Eastern Ticket Hall	SER	Signalling Equipment Room
EVM	Earned Value Management	SES	South East Service
ExCom	Executive Committee	SESR	South East Signalling Room
FAR	Farringdon	SFA	Sponsor Funding Account
FCCB	Finance Current Control Budget	SGS	Stepney Green Shaft
FDC	Framework Design Consultant	SHELT	Safety and Health Leadership Team
FDO	Final Design Overview	SIM	Simulation Room
FDS	Final Design Statements	SIRP	Systems Integration Review Panel
FFOC	Final Forecast Outturn Cost	SISS	Station Information and Security System
FGW	First Great Western	SJR	Safety Justification Report
FHO	Full Handover	SLD	Single Line Diagrams
FIS	Fisher Street Shaft	SMS	Safety Management System
FLU	Full Length Unit	SMTA	Smithfield Market Traders Association
Fol	Freedom of Information	SOC	Statement of Compatibility
FRAG	Fraud Risk Assurance Group	SONIA	Sterling Overnight Index Average
FTS	Floating Track Slab	SOR	Systems Operation Room
GAF	Greater Anglia Franchisee	SORBA	Shaping Architecture Company (sub cladding contractor)

GE	Great Eastern	SPI	Schedule Performance Index
GEBR	Guaranteed Emergency Brake Rate	SPS	Secondary Part Steel
GEFF	Great Eastern Furrer & Frey	SR	Sponsors Requirement
GEML	Great Eastern Main Line	SRP	Safety Review Panel
GFRC	Glassfibre Reinforced Concrete	SSE	Scottish & Southern Electricity
GLA	Greater London Authority	SSP	Stations, Shafts, Portals
GPE	Great Portland Estates	STG	Stepney Green
GRC	Glass Reinforced Concrete	STS	Standard Track Slab
GRIP	Governance for Railway Investment Projects	SVP	Safety Verification Panel
GSM-R	Global System for Mobile Communication - Railway	T&C	Testing & Commissioning
GW	Great Western	TAP	Technical Assurance Plan
GWML	Great Western Main Line	TBM	Tunnel Boring Machine
GWR	Great Western Railway	TC&HSG	Testing, Commissioning and Handover Steering Group
H&S	Health & Safety	TCMS	Train Control Management System
HAL	Heathrow Airport Limited	TCR	Tottenham Court Road
HALARP	Heathrow Airport Limited Assurance Review Panel	TCRW	Tottenham Court Road West
HAS	High Attenuation Sleeper	TDR	Technical Director's Report
HAVS	Hand Arm Vibration Syndrome	TDY	Tunnel Drive Y
HEP	Handover Execution Plans	TfL	Transport for London
HEX	Heathrow Express	TO	Taken Over
HIA	Heathrow Implementation Agreement	TOC	Train Operating Company
HM	Her Majesty	TOSD	Tier One Substantially Complete
HMDL	Handover Master Deliverable List	TPA	Tunnel Planning Authority
HO	Handover	TPH	Trains Per Hour
HPNM	High Performance Near Misses	TPS	Train Protection System
HRW	Heathrow Airport	TPWS	Train Protection & Warning System
HSPI	Health & Safety Performance Indicator	TRAIL	Transport Reliability Availability Integrated Logistics
HV	High Voltage	TRH	Temporary Rehousing
HVAC	Heating Ventilation & Air Conditioning	TSI	Technical Standard for Interoperability
I/O	Input / Output	TTO	Temporary Ticket Office
IA	Interim Acceptance	TTVS	Temporary Tunnel Ventilation System
ICD	Interface Control Document	TUCA	Tunnelling & Underground Construction Academy
IDT	Interim Dynamic Testing	TWAO	Transport & Works Act Order
IECC	Integrated Electronic Control Centre	TXM	TXM Plant
IEP	Intercity Express Programme	U&A	Undertakings & Assurances
IFC	Issued For Construction	UKPN	UK Power Networks
IFD	Ilford Yard	UR	Urban Realm
IM	Infrastructure Manager	URT	Unresolved Trends
IOSH	Institution of Occupational Safety and Health	UTX	Under Track Crossings
IP	Intervention Point (0, 1, & 2)	VAP	Verification Assurance Procedure
IR35	Inland Revenue Taxation Regulation 35	VDP	Victoria Dock Portal
IRM	Incident Response Management	VERP	Value Engineering Review Panel
IRN	Installation Release Note	VFL	Volker Fitz Patrick
IRSG	International Regulatory Strategy Group	VN	Variation Notice
ISA	Independent Safety Assessment	VT	Voltage Transformer
ISJ	Interim Safety Justification	W&W	Wales & West Utilities
ISV	Intermediate Statements of Verification	WAD	Works Authorisation Document
ITP	Inspection & Test Plan	WBP	Westbourne Park
ITT	Invitation to Tender	WBS	Work Breakdown Structure
JST	Joint Sponsor Team	WC	World Class
KBR	Knorr-Bremse Rail	WCC	Westminster City Council
KD	Key Deliverable	WCCC	Whole Contract Construction Certificate
KE	Kinematic Envelope	WHI	Whitechapel
KG	Kensal Green	WiFi	Wireless Fidelity

KO	Key Output	WITI	Western Inner Track Infrastructure
KPI	Key Performance Indicator	WOE	Western Outer Electrification
KPMG	Klynveld Peat Marwick Goerdeler	WOO	Woolwich Station
L&P	Land and Property	WOTI	Western Outer Track Infrastructure
LB	London Borough	WTH	Western Ticket Hall
LBTH	London Borough of Tower Hamlets	YC	Yard Control

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 118

Period 8 FY2018-19

14 October 2018 – 10 November 2018

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6 December 2018



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Project Status Report 118

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Note: This report relies on the information set out in CRL's Period 8 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 10 November 2018. Note that information emerging after the close of Period 8 is subject to formal confirmation by CRL in its Period 9 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff. Changes to the format and content of this report have been agreed with JST. Removal of some Sections of the report has been agreed with JST as part of the PRep demobilisation plan. JST has confirmed that PRep will no longer formally report on On Network Works (ONW). PRep will continue to meet with CRL and NR, and will continue to advise JST of any key risks to Crossrail caused by NR.

Document history and status

Revision	Date	Description	By	Review	Approved
1	29 November 2018	PSR 118 Period 8 FY 2018-19 v1.11.docx ~ Draft	PRep Core Team		
2	6 December 2018	PSR 118 Period 8 FY 2018-19 v1.20.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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Executive Summary

Health and Safety:

Health and safety performance indicators continue to improve, however there are concerns regarding the increasing numbers of near misses.

Financial:

CRL has increased the AFDCD by £25m to £13,524m for Period 8, which breaches IP2 by £1.011bn. The AFDCD is, in our opinion, substantially understated. A significant AFDCD increase is expected in Period 9. Based on CRL reporting, we expect the AFDCD to potentially exceed £14bn which is higher than the SACR20 and Remedial Action Plan (RAP2) forecast of £13.83bn.

In respect of cash forecasting, CRL is reporting that the £300m funding made available by Sponsors will be exhausted by the beginning of Period 11 (January 2019) and it expects that an additional £314m will be drawn down in 2018/19 from the DfT £350m short term repayable financing.

Stage 2 Opening:

BT has submitted a programme that shows it will achieve Authorisation to Place Into Service (APIS) for its train borne ETCS in September 2019. [REDACTED]

[REDACTED]

We would expect the new MOHS to take the following into account:

- Realistic access to testing facilities and availability of BT technical and assurance personnel;
- CRL and MTR-C preparations for Stage 3 and 5a;
- Availability and stabling of the C360 fleet for a protracted period.

Stage 3 Opening – Infrastructure and Systems:

CRL has confirmed that the new MOHS was completed on 30 November 2018 for consideration by the CRL Board on 5 December 2018. Assessment of progress across the critical delivery workstreams has led CRL to commit to a Main Dynamic Testing (MDT) start on 14 January 2019. CRL has also planned for two further Dynamic Testing Windows (14 and 15) rather than implement any new interim delivery arrangements. [REDACTED]

[REDACTED]

The decision not to let MDT slip further has the effect of preserving schedule float until later in the dynamic testing period, when the need for float will be more critical. However, it is likely that not all MDT pre-requisites will be achieved, and further erosion of the Entry Criteria is inevitable. Our concerns remain with the risk of CRL attempting out-of-sequence testing using assets which are incomplete and using unproven software.

Ongoing Tier 1 delays frustrate the completion of routeway systems connections into Stations, Shafts and Portals (SSP) works. The initiative to confirm current status and completion schedules for SSP works will not be concluded for some time and it is crucial that CRL makes

realistic assumptions and allowances in the new MOHS, where insufficient information is available. Completion of the SSPs and the associated downstream railway systems works remains one of the most critical risks to Handover and Trial Running.

CRL has embarked on a detailed review of the [redacted] functionality necessary to support passenger service; the IMs are assisting in determining the [redacted] [redacted]. We understand that implementation of [redacted] is critical to the achievement of a Stage 3 Opening in 2019. CRL should take the opportunity to identify any [redacted] functionality which is surplus to railway operational requirements and remove it from the remaining scope.

Overall, contractor performance remains very poor in the completion of testing documentation and there are huge challenges in securing the necessary resources to maintain meaningful progress.

Stage 3 Opening - Handover and Operational Readiness:

Progress in delivering regulatory approvals necessary for CRL to achieve APIS in the Central Operating Section (COS) is significantly behind schedule. This is because in most cases, the assurance cycle cannot be finalised because testing and commissioning evidence has not been produced. These issues, and a lack of a MOHS, mean that the timely delivery of the CRL Safety Case is rated as 'red' by CRL.

With respect to Handover, all the deliverables (with the possible exception of training) are now in a position where the current approach will cause a future bow wave of submissions. Contractors, CRL and the IMs must be set up so that they can manage the situation in a timely manner.

Stage 5a, Stage 4 and Stage 5 full Openings:

Stage 5a

In our last report we described our concerns that Stage 3, 2-2 and 5a could all overlap, dissipating management focus and organisational resources. Alongside that concern we raise two more:

- The DOO CCTV and platform extension programme shows completion of platform extension works by end of September 2019 and DOO CCTV by 9 October 2019. MTR-C will then need to carry out its Operational proving and DOO CCTV sighting trials. There is little float in the programme to accommodate any delays.
- [redacted]

Stage 4

A significant development for Stage 4 has been the implications of operating Stage 5a (as well as Stage 2-2) from December 2019. This is because MTR-C believes Stage 5a and Stage 4 will jointly require 55 FLUs. [redacted]

[redacted]

Stage 5 Full

Outstanding issues are Western Stations upgrades, funding and schedule pressures putting a December 2019 service entry date at risk; and instructing the signalling transition due to the delayed NR ETCS programme.

1 Cost

1.1 Summary

CRL has increased the AFDCD by £25m to £13,524m for Period 8, which breaches IP2 by £1.011bn.

In respect of cash forecasting, CRL is reporting that the £300m funding made available by Sponsors will be exhausted by the beginning of Period 11 (January 2019) and it expects that an additional £314m will be drawn down in 2018/19. Consequently, additional Financial Budget will be required for CRL to pay Contractors beyond the Period 10 payment certificates (due w/c 21 January 2019). As an interim measure, DfT announced on 26 October 2018 that £350m of short term repayable financing will be made available to the Mayor of London and TfL in the current financial year to ensure that full momentum is maintained behind Crossrail.

The Period 8 AFDCD is, in our opinion, substantially understated. The Indirect Cost risk added in Period 8 is additional to the RAP2 and SACR20 forecast¹ and we expect further significant cost increases from the delayed issue of the revised MOHS. The [REDACTED] dates identified in the RAP are compromised and stations continue to see cost increases in respect of delays, prolongation and productivity issues. We also expect increases from the Defined Cost reviews CRL is conducting on key contracts and from the Period 9 QCRA.

The key points are:

- Period 8 AFDCD increased to £13,524m for Indirect Cost risk excluded from RAP;
- FCCB increased to £13,160m but £364m below Period 8 AFDCD;
- Contingency eroded to £10m servicing a £566m risk profile that excludes cost pressures from the revised MOHS and QCRA;
- AFDCD substantially understated, as it excludes revised MOHS impact, Period 9 QCRA, Direct Cost reviews and KPMG review impact;
- CRL will provide a new forecast after the MOHS is issued;
- Significant AFDCD increase expected in Period 9. Based on CRL reporting, we expect the AFDCD to potentially exceed £14bn which is higher than the RAP2 and SACR20 forecast of £13.83bn.

1.2 AFDCD and Intervention Points

IP2 increased by £1m at SACR20 to £12,513m. CRL has increased the AFDCD at Period 8 to £13,524m due to an additional £25m risk provision for Indirect Costs only. The CRL Period 8 AFDCD exceeds IP2 by £1,011m, as shown in Figure 1 - 1; and also exceeds the new FCCB by £364m.

¹ RAP2 forecast at P95 at late dates plus QCRA was £13,831m. Forecast also reported at SACR20.

(£ millions)	Period 7	Period 8	Delta	Movement
Forecast	12,950	12,957	7	up
Delivery Risk	5	5	0	same
Subtotal	12,955	12,962	7	up
Programme Risk	540	558	18	up
Board Risk	4	4	0	same
AFCDC total	13,499	13,524	25	up
IP0	11,672	11,673	1	up
IP0 Headroom	-1,827	-1,851	-24	down
IP1	11,912	11,913	1	up
IP1 Headroom	-1,587	-1,611	-24	down
IP2	12,512	12,513	1	up
IP2 Headroom	-987	-1,011	-24	down

Figure 1 - 1 ~ AFCDC Headroom to Intervention Points

As we mention above, the Period 8 AFCDC, in our opinion, continues to be significantly understated. The £25m increase in respect of Indirect cost risk in Period 8 is additional to the RAP AFCDC and we expect further significant cost increases. The issue of the revised MOHS continues to be delayed and remains outstanding and will impact on CRL cost forecasting. The [redacted] dates identified in the RAP are compromised and stations continue to see cost increases in respect of delays, prolongation and productivity issues. CRL is reporting at Period 8 that [redacted] stations will exceed their [redacted] forecast. In addition to the Defined Cost reviews CRL is conducting with key contracts during that last two weeks in November 2018, CRL intends to assess the impact of these cost pressures as part of its Period 9 QCRA which will be included in the corresponding AFCDC.

The full value of Defined Costs being pursued by the Contractors is not included in the current AFCDC. [redacted]

At the 15 November 2018 Sponsor Board meeting, CRL stated that the programme cannot be built for £13.5bn, although this will be its target, with an additional £300m held as CRL Board Contingency. CRL will give a new forecast after the revised MOHS is accepted.

Following the Sponsor Board meeting, CRL issued a paper setting out the key principles and status of Station Contractor Settlement Agreements that are being utilised to underpin the new MOHS to completion and provide as much cost certainty as possible. CRL reports positive progress to agree lump sum settlements for [redacted]

CRL is undertaking early discussions at [redacted] but is experiencing complex interfaces and issues. [redacted]

[redacted] On 21 November 2018, Sponsors noted the contents of this paper and raised no objections for CRL to progress the conclusion of the settlement agreements for the agreed Contracts. This partially mitigates cost escalation for a limited number of station contracts. However, all the Contractors have no contractual obligation to work or commit to MOHS, TOSD and Staged Completion dates and as such the mitigation is not assured. Furthermore, there remains cost escalation potential from the complex Systemwide contracts interfaces and [redacted] the Contractors at [redacted] and [redacted] stations.

We continue to expect further AFCDC increases following the KPMG review and the effect of the revised MOHS on the RAP. Assurance will be necessary from CRL that additional funding requests are supported by a realistic schedule and tangible assessment of risks. This will require examination at a detailed level to ascertain its credibility, to ensure that all costs and risks are fully covered, including Stages 4 and 5, and sustainable to fund through to completion.

We reiterate our recommendation that Sponsors encourage CRL to settle urgently a fully inclusive and comprehensive Final Forecast Cost that is sustainable and credible to completion. Such an approach may avoid the continuing incremental increase to the AFCDC.

The rate of Cost of Work Done (COWD) continues to follow the consistent linear trend that has been steady through the life of the project. In Period 8, the Delivery COWD was £94m and continues to follow the historical straight-line trend path. The perpetually consistent trend of COWD indicates neither a forthcoming reduction of period expenditure nor productivity improvement, but it remains a near constant churn. Our rudimentary linear forecast at Period 8, based on the past twelve periods, indicates that AFCDC and COWD become coincident at circa £16bn in Period 11, 2020/2021 (February 2021). It is highly unlikely that the AFCDC will escalate to this order of magnitude nor the schedule extend into 2021 but, based on CRL reporting detailed above, we expect the AFCDC to potentially exceed £14bn. Assuming a straight line forecast COWD, the point of coincidence of circa £14bn intersects around Period 6 2019/2020 (September 2019). However, the prospect of further substantial increase in the AFCDC and the steady rate of COWD offers no reasonable or accurate forecasting conclusion until such time as CRL state a credible AFCDC associated with a tangible schedule, as shown in Figure 1 - 2.

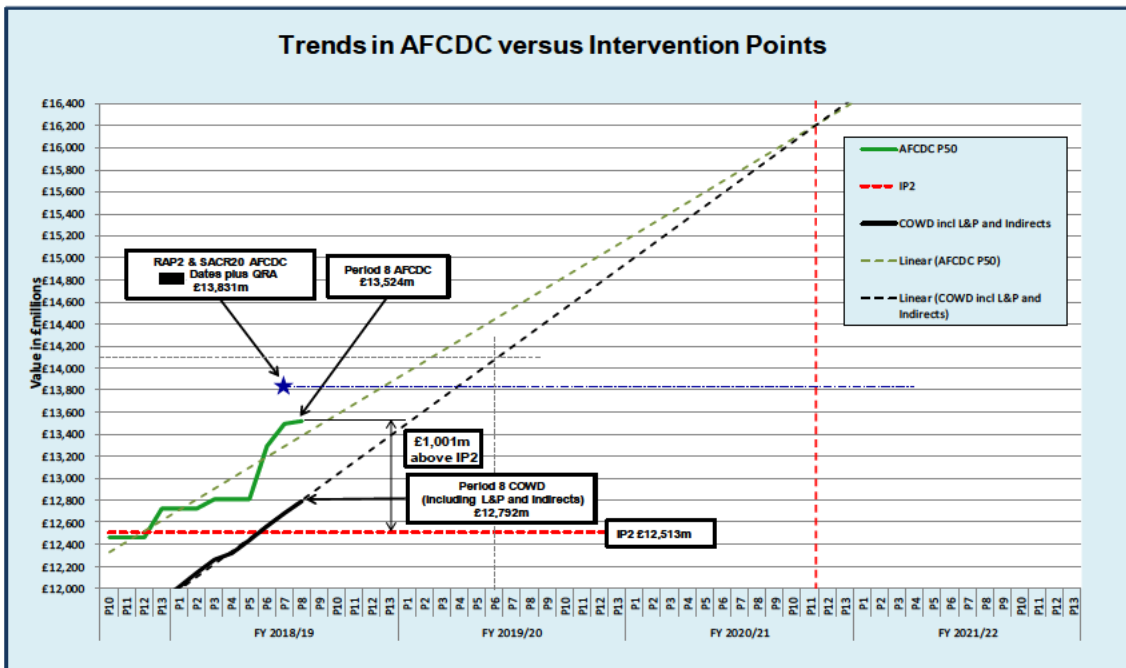


Figure 1 - 2 ~ AFCDC Headroom to Intervention Points

The cumulative delivery overspend, against the CRL internal budget at each period, has increased again but marginally in Period 8 by £18m to £902m (Period 7, £884m). Delivery overspend continues to rise in Period 8 and trend projections shown in Figure 1 - 3 indicate the effects of this continued growth, which may be regarded as a consequence of the ongoing cost escalation experienced by the project.

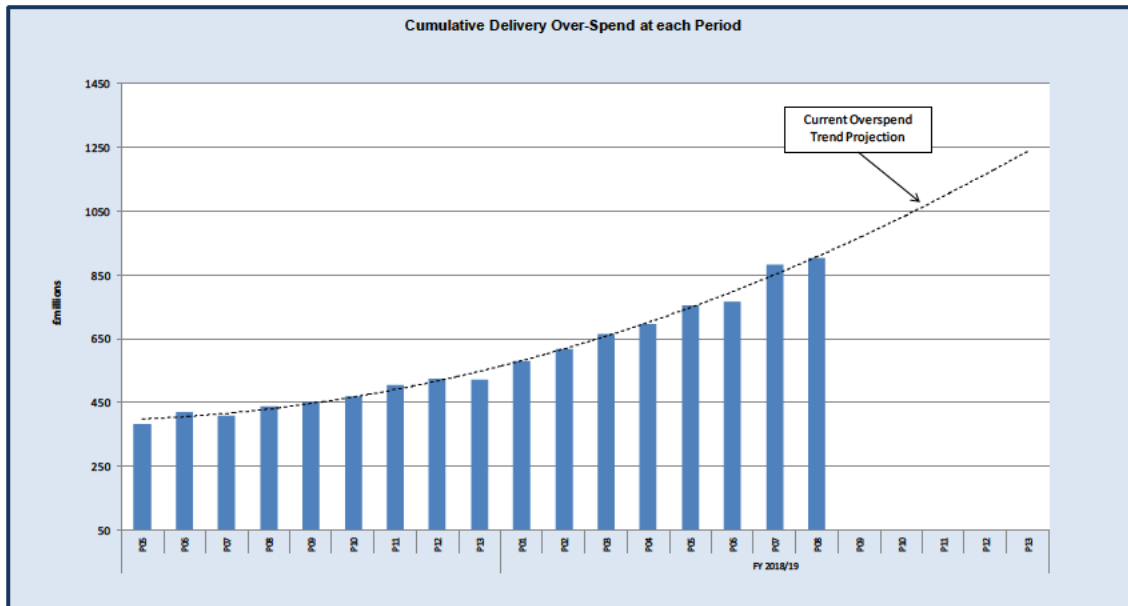


Figure 1 - 3 ~ Cumulative Delivery Overspend against CRL Budget at each Period

CRL reports that, in Period 8, it spent £65.8m above the 2018/19 Business Plan, a reduction of £26.1m on Period 7. The CRL Period 8 Board Report provides the details of the overspend which, in summary, continues to be dominated by low productivity, prolongation and delays.

Programme risk has increased by £18m to £558m and Delivery Risk remains at £5m in Period 8, equating to an overall net increase in risk of £18m, (from £548m to £566m). We still await receipt of the review by KPMG of the QCRA carried out by CRL for Period 6. CRL reports that it is preparing for the Period 9 QCRA. We will provide commentary following the receipt of the completed reviews.

1.3 Cost: Central Operating Section (COS)

CRL continues to report Target and Defined Costs in Period 8 for current contracts only; Contracts C300, C305 and C828 are omitted, whilst Contracts C510 and C350 are collectively included within the 'Others' package. Figure 1 - 4 shows the reconciliation of the adjusted Target and Defined Costs for Period 8 to include omitted values and avoid duplication of costs included within the 'Others' category, in order to provide ongoing continuity for consistent trend analysis reporting.

Contract	Target £m		Defined Cost £m	
	P8		P8	
				N
C300				
C305				
C610				
C512				
C510				s
C435				
C405				2
C412				
C360				
C502				
C422				
C350				
C828				0
C530				
C620				
C631				
C660				
Subtotal	£5,719	£5,921	£6,201	£6,321
Others	£914	£926	£991	£1,000
Total	£6,633	£6,847	£7,192	£7,321

Figure 1 - 4 ~ P4 Adjusted Defined Cost and Target Cost²

[REDACTED]

The forecast gap between the Contractors' estimate and CRL's PM assessment of total defined cost has reduced by [REDACTED] from [REDACTED] to [REDACTED]. The decrease in cost gap was mainly due to increases in CRL's forecast cost at [REDACTED] Station and [REDACTED].

Although CRL has advised that the AFDCDC makes allowances for the increase of defined costs, the full value of the Contractors' estimates has not been included. Defined Costs forecasts continue to rise and, [REDACTED].

[REDACTED]

- [REDACTED]
- [REDACTED]

² Figure 1-5 subject to arithmetical rounding errors. Light blue highlighted rows refer to omissions and amendments noted in the paragraph before the table.

³ Rounding error, CRL report [REDACTED] defined cost gap at Period 8.

[REDACTED]

[REDACTED]

1.4 Contingency and Risk

The Period 8 Finance Current Control Budget has increased to £13,160m to include the £350m interim short term repayable financing provided by DfT. The £13,524m AF CDC exceeds the financial budget by £364m, and exceeds the RP4.2 Baseline funding of £12,136m by £1.388bn.

CRL is reporting that the overall Period 8 contingency budget of £10m is not sufficient to cover the risk exposure of £566m by £556m (£76m deterioration from Period 7). The Period 7 centrally controlled Delivery contingency of £31m has been fully consumed and is reported by CRL at zero for Period 8. Similarly, the Period 7 Board contingency of £23m has been exhausted to zero in Period 8. We have serious concern with the incongruent relationship between the very low currently available contingency and the substantially increasing risk profile.

Figure 1 - 6 shows the trend of the decline in Contingency and compares the lower Risk Exposure at P50 only with the remaining contingency. This highlights the small and limited contingency available for significantly increased P50 risk allowances which become considerably exacerbated in the event that MOHS and P95 AF CDC risks are applied.

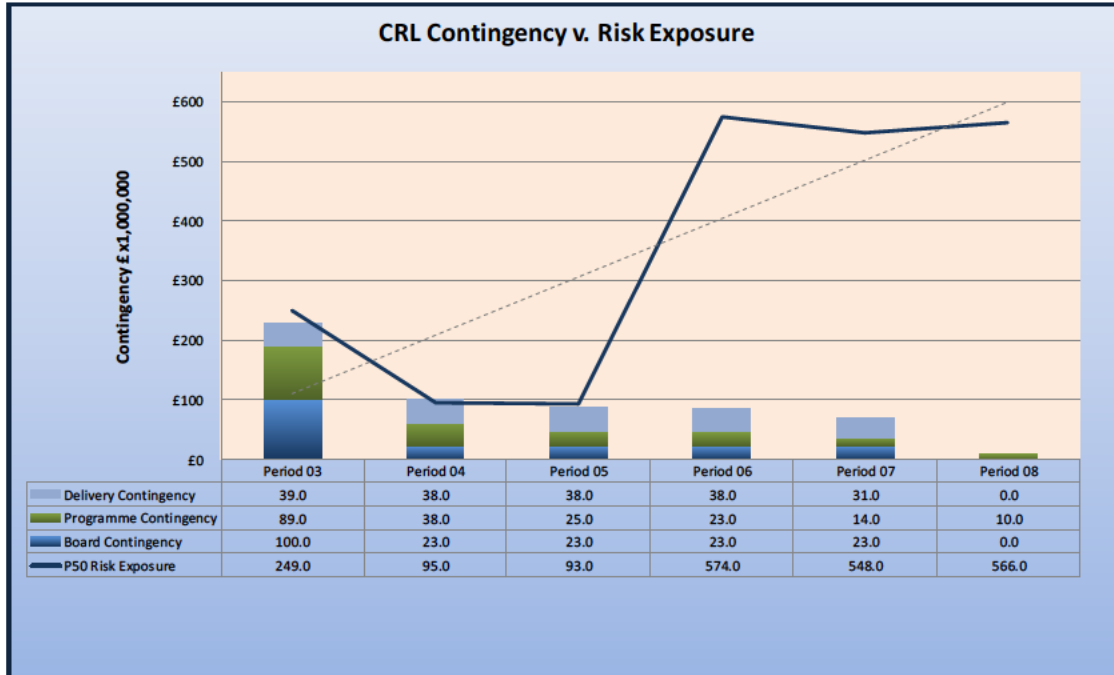


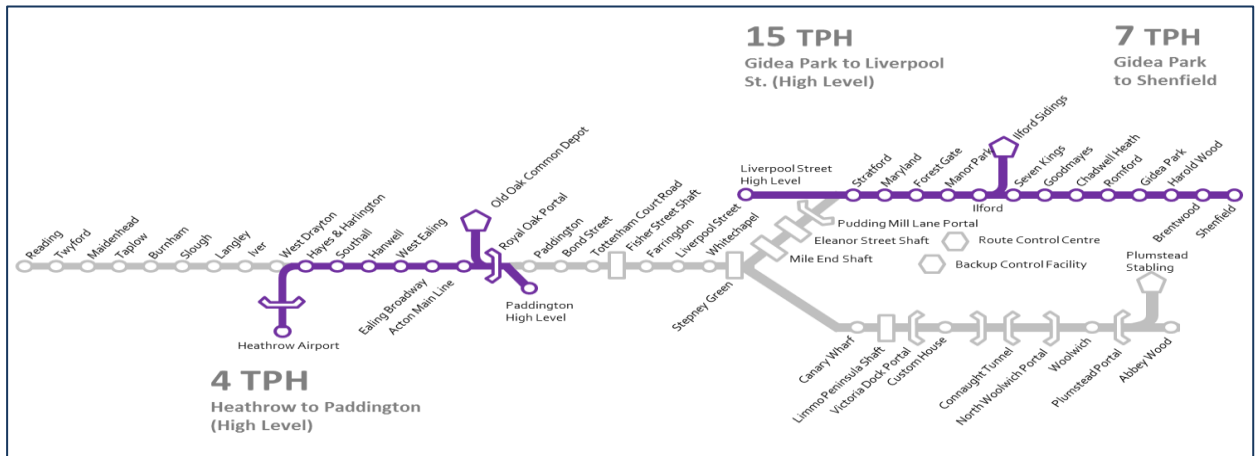
Figure 1 - 6 ~ Risk Exposure versus Contingency

CRL has confirmed that all trends are covered by URTs or risk in the Period 8 AFDCD. Figure 1 - 7 shows the apportionment of Risk from Period 13 up to Period 8.

Period	QRA	URT	Delivery Risk	Programme Risk Not Allocated	Programme Non-Delivery Risk	Pure Risk
	£m	£m	£m	£m	£m	£m
P13	475	340	0	450	25	110
P1	456	386	6	424	25	44
P2	178	106	6	165	7	65
P3	249	162	6	237	6	81
P4	95	46	2	87	6	43
P5	93	174	1	86	6	-87
P6	574	228	6	530	38	308
P7	548	108	5	490	53	387
P8	566	338	5	483	78	150

Figure 1 - 7 ~ Elemental Breakdown of Risk Allowances

2 Stage 2 Phase 2: Paddington to Heathrow– May 2019 tbc



2.1 Summary

The target date for Stage 2 Phase 2 Opening remains May 2019, but we continue to believe this cannot be achieved due to the prioritisation of train software development for Stage 3. Any revised date for opening, which we would expect to see in the MOHS, would need to take into account the following:

- Access to testing facilities and BT technical personnel;
- CRL and MTR-C preparations for Stage 3;
- CRL and MTR-C preparations for Stages 5a and Stage 4;
- Availability and stabling of the C360 fleet.

2.2 Operational Readiness Assessment

CRL’s Stage 2-2 dashboard categorised two issues as ‘red’ for Period 8. These are ‘Train Readiness’ and ‘RLU FLU⁴ swap out on GWML’. A third one ‘CRL ETCS integration testing’ has been removed from the dashboard, as it is now encompassed by ‘Train Readiness’.

2.3 Interim phase (Replace RLUs with FLUs)

The date for implementation has now been moved from 9 December 2018 to 17 December 2018, due to misaligned software packages [REDACTED]

There are 3 primary tasks to complete, these being:

- Completion of various assurance approvals;
- Driver familiarisation;
- FLUs to complete fault free running mileage test.

Taking the above into account, we believe there is a reasonable likelihood that implementation will be from January 2019.

⁴ RLU FLU – Restricted Length Unit, Full Length Unit.

There would be no detrimental impact upon passengers if the change did occur in January, as RLUs could continue to operate. The negative impact would be further delay in the opportunity to build reliability⁵.

2.4 Phase 2

The issues affecting Phase 2 are as follows:

Rolling Stock

In most respects, there has been little change from our Period 7 report. [REDACTED]
 [REDACTED]
 [REDACTED] BT's programme, which is not accepted by RfL, now shows achieving the train's APIS in September 2019.

This situation will remain, or further deteriorate, unless testing facilities and additional BT technical and assurance resources can be found. This is proving difficult [REDACTED]

RfL is investigating implementing other signalling modes that may allow FLUs to access Heathrow as an interim measure. These include fitting TPWS in the tunnel, or fitting ATP onto the trains. However, these could take similar time scales to implement as they bring their own technical and assurance challenges. It is also likely to delay the final version of TCMS 7.3.

We understand that the C360 fleet has been leased by RfL until December 2019. [REDACTED]
 [REDACTED]

Operations

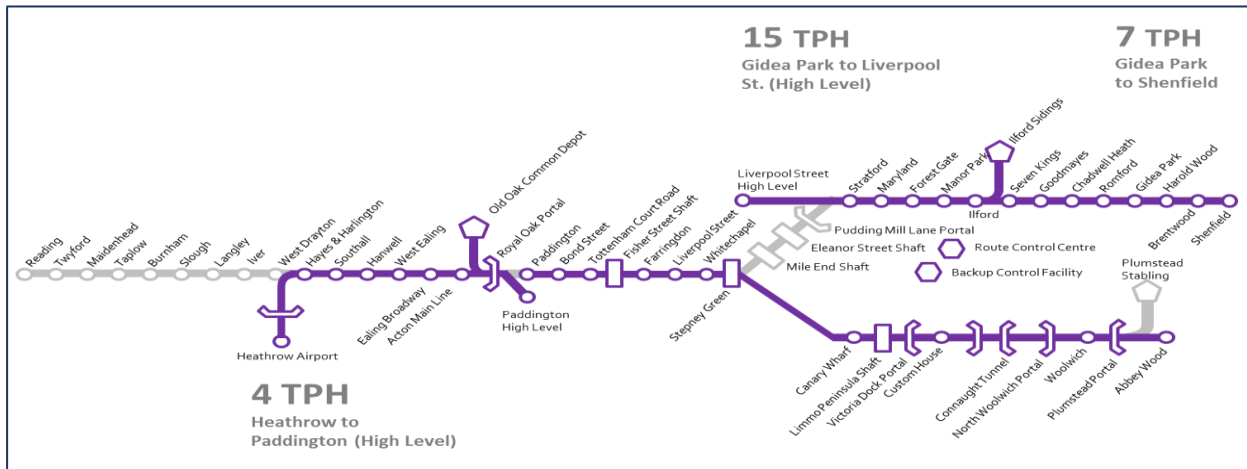
There is again little new information to add from our Period 7 report. [REDACTED]
 [REDACTED]
 [REDACTED]

Regulatory Approvals

There is no significant change from the situation described in our Period 7 report.

⁵ The first provisional date for implementation was 12 August 2018. See PRep Period 2 status report.

3 Stage 3: Paddington to Abbey Wood



3.1 Summary

The most important activity affecting Stage 3 Opening during Period 8 has been the development of the new Master Operational Handover Schedule which was completed on 30 November 2018 for issue to the CRL Board meeting on 5 December 2018. Other key issues are:

- We expect the new MOHS will be subject to a number of assumptions and caveats;
- CRL is reviewing the opportunity to defer some scope until after Stage 3 Opening;
- Tier One Substantial Demobilisation and Staged Completion dates to be confirmed;
- Ongoing delays with production of Installation Release Notes;
- Further delays at some Stations;
- Concerns with delivery of tunnel ventilation;
- Schedule challenges with Radio and SCADA testing & commissioning;
- Delays to achieving Multi-Train Testing;
- Handover materials not progressing at the required rate;
- Poor progress continues in completing assurance evidence necessary for regulatory approvals.

3.2 Schedule

CRL has been developing its new Level 0 & 1⁶ Master Operational Handover Schedule (MOHS) over the last two months. This was completed on 30 November 2018 for issue to its Board meeting on 5 December 2018. We will review the new MOHS in our Period 9 report and compare it to the key dates set out in CRL’s revised Remedial Action Plan (RAP) as discussed at Sponsor Board on 15 October 2018.

CRL’s Period 8 draft Anchor Milestone report⁷ includes the following key dates:

- Main Dynamic Testing commences – proposed and forecast 14 January 2019;
- Complete Dynamic Testing – proposed 20 June 2019, forecast 13 June 2019;

⁶ Level 0 is summary high level bar chart whereas Level 1 is detailed Primavera schedule.

⁷ CRL draft Period 8 Anchor Milestones report dated 14 November 2018.

- Changeover to ROGS/Commence Trial Running – proposed 22 July 2019, forecast 22 August 2019;
- Complete Trial Running – proposed 27 August 2019, forecast 26 September 2019;
- Stage 3 Opening – proposed 18 November 2019, forecast 20 December 2019.

Our commentary on the risks to these targets is set out in the following Sections. We should highlight that these target dates are provisional and subject to confirmation in the final approved MOHS. We expect the MOHS to feature the following three principal critical paths:

- Routeway integrated testing;
- Dynamic testing;
- Staged completions of Stations, Shafts and Portals.

During Period 8 CRL have been working to:

- Provide clarity on the meaning of [REDACTED] baseline dates;
- Confirm date and entry criteria for Main Dynamic Testing due in January 2019;
- Agree definitions with RfL/LUL/MTR-C for Staged Completion (SC), Handover (HO) and Authority to Use (ATU);
- Firm up TOSD and SC dates and definitions for stations, shafts and portals based on detailed investigations at Tottenham Court Road (TCR);
- Build confidence in the [REDACTED] schedule;
- Clarify timings for the integration of [REDACTED] train software;
- Progress detailed review of [REDACTED] [REDACTED] [REDACTED] [REDACTED] T&C scenarios and resources required;
- Understand the large variations in the estimates of durations for [REDACTED] T&C;
- Stabilise [REDACTED] schedule and clarify when temporary services are to be removed;
- Agree a communications plan so that the most appropriate schedule information is issued to any particular audience;
- Optimise the assurance regime needed when [REDACTED] provide software to [REDACTED];
- Identify a more ambitious approach to the assurance of future software releases;
- Clarify NR plans and confirm GE/GW transition tests;
- Complete QSRA's, where beneficial;
- Finalise risks and assumptions;
- Establish critical paths;
- Agree Anchor Milestones.

We expect that the new MOHS will be incomplete in that some of the dates will be provisional and subject to further investigation. A list of assumptions is expected when the MOHS is issued. Therefore, we expect CRL will issue a series of MOHS updates during 2019 when schedule knowledge becomes more mature.

Our understanding is that the new MOHS is based on delivery of 100% full functionality for Stage 3 Opening. [REDACTED]

[REDACTED]

3.3 Stations, Shafts and Portals (SSP)

3.3.1 General:

As noted above, CRL has been finalising the new MOHS. A key part of this has been the agreement of Tier One Substantial Demobilisation (TOSD) and Staged Completion (SC) dates for the SSPs. These are very important, because the TOSD dates commence the reduction of costs, and the SC dates indicate when the relevant IM will take over the asset. Precise definitions of TOSD and SC vary at each location and these will be set when the MOHS is approved.

As part of its Period 8 information, CRL has issued provisional draft Anchor Milestones, including TOSD and SC dates which are tabulated in Appendix B. These tables give approximate indications of possible MOHS and forecast dates, set against Period 7 forecasts and the Remedial Action Plan (RAP) dates. The forecasts are draft dates subject to confirmation and issue of the new MOHS. Our commentary regarding each location is set out below.

As noted in our previous reports, the slow progress of Installation Release Notes (IRN) has been a concern, as these certify the completion of the asset build as test Phase 2.1. Once an IRN is issued, the asset can move to Pre-Commissioning Certificate (PCC Phase 2.2) and Partial Acceptance Certificate (PAC Phase 2.3). These are required before the assets can move to an Acceptance Certificate (AC) and Phase 3 integrated testing. Our comments regarding Phase 3 integrated T&C are in Section 3.4. Details regarding certification progress are set out in CRLs Period 8 Board report; in summary IRNs 55%, and PCCs/PACs 14%. In some cases, CRL PMs are forecasting ambitious plans for future progress of certifications; we expect that these will be more realistic in the new MOHS.

CRL has recently commenced SSP period end programme review meetings⁸ focusing on work required to be completed leading up to take over by RfL and LUL at Staged Completion. We believe these will help refocus CRL PMs and the Contractors on the requirements of the IMs at Staged Completion.

3.3.2 Stations, Shafts and Portals – RfL

Shafts and Portals:

Most of the new MOHS dates for TOSD are likely to be within the RAP [REDACTED] dates except [REDACTED] and [REDACTED] [REDACTED] and [REDACTED] [REDACTED] are indicating late SC dates; CRL is reviewing mitigations to bring these back, but they are likely to be in June 2019. CRL is also reviewing the SC date for [REDACTED] [REDACTED] currently forecast for August 2019, as this needs to be ready for the Changeover to ROGS.

Some of the Shafts & Portals (e.g. Connaught Tunnel and Pudding Mill Lane Portal) have achieved TOSD, so lessons learned will be distributed to all other projects. Key issues across Shafts and Portals are:

- Replacement of temporary ventilation systems at [REDACTED]
- Final completion of all IRNs;
- Complete Phase 2 testing at all locations;
- Status of Authority to Use (ATU) dates to be agreed with RfL;
- Handover Plans to be agreed with RfL;

⁸ LU Transition to Revenue Service meeting 15 November and RfL Period End Review meeting 16 November.

- Agreement of care & custody, and maintenance plans.

Paddington station:

[Redacted text block for Paddington station]

Canary Wharf station:

[Redacted text block for Canary Wharf station]

Custom House station:

[Redacted text block for Custom House station]

Woolwich station:

[Redacted text block for Woolwich station]

3.3.3 Stations – LUL

Bond Street station:

[Redacted text block for Bond Street station]

⁹ Details discussed at C&CSC meeting 27 November 2018.

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

Tottenham Court Road station:

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

Farringdon station:

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

Liverpool Street station:

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

Whitechapel station:

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

3.4 Completion and Handover of Integrated Systems¹⁰

CRL's current delivery strategy is summarised in Section 3.2. While finalisation of the new MOHS continues and strategic programme key dates are as yet undeclared by CRL, short-term

¹⁰ The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

objectives are well understood. The completion of all infrastructure and the maintenance of momentum in dynamic testing on site remain CRL’s immediate priorities. However, the establishment and implementation of a strategy which best facilitates these objectives prior to Main Dynamic Testing (MDT) has proved troublesome, with options for the schedule split between construction and testing remaining open until late in the period. CRL has now concluded¹¹ that MDT will start on 14 January 2019, with two Dynamic Testing Windows (14 and 15) in the interim. Further details are provided in Section 3.5.1.

We have updated below progress in delivery of the nine workstreams considered to be critical to the delivery of Stage 3 Opening.

1. [REDACTED]

The principal outstanding linear activities are associated with the installation of lighting and LV power, drainage and fire mains, with forecast IRN [REDACTED] date completions as follows¹²:

- Fire Main: 22 December 2018;
- Walkways: 24 December 2018;
- Lighting and LV Systems: 15 February 2019;
- Drainage: 5 April 2019.

The linear installations in the tunnels are substantially complete and any outstanding works will not require the use of engineering trains. These dates support the CRL objective of withdrawing the “dirtiest” installation vehicles as soon as possible. Steady progress has been made in the completion of connections at cross-passages, but as before, significant effort remains to co-ordinate and implement the various tie-ins to works provided by other contractors at SSPs.

2. [REDACTED]

[REDACTED] installation is substantially complete across the Central Section and across the NR interfaces. Remaining items which are not critical to dynamic testing continue to be installed as opportunities become available (e.g. labels, signs and permanent Marker Boards). Visibility on site of signs and Marker Boards will ultimately be checked and signed-off by a formal Sighting Committee before Crossrail opens for passenger service, but this exercise cannot be completed until all permanent tunnel installations are in place.

Concerns remain with [REDACTED] general ability to fully resource MDT at multiple sites, although CRL commitment to MDT and interim schedule arrangements provides a firmer basis for resource planning. Good progress has been made in supporting the combined CRL/BT/Siemens “triage review” of dynamic testing outputs, with lead Siemens personnel identified and process “dry runs” already taking place.

3. [REDACTED]

Planning and implementation of the transition from temporary to permanent ventilation systems remains under the direction of a full-time CRL co-ordinator/manager. Although complex and protracted, steady progress has been made in the co-ordination of works at individual sites. CRL forecasts that 16 out of 18 sites will have fans commissioned and under local control by 17 December 2018. The “schedule outliers” are [REDACTED] and [REDACTED] the target completion date for the former is 21 February 2019 and the integration schedule for the latter is being finalised.

¹¹ Confirmed at the CRL Period 8 MOHS Review meeting held on 23 November 2018.

¹² CRL Period 8 C610 PDB held on 20 November 2018.

Works are on target for completion at [REDACTED] by Christmas 2018, and achievement will significantly reduce dependence upon temporary ventilation, and upon permanent ventilation provision at the late-running [REDACTED]. Thereafter CRL's focus will be on the completion of airflow tests throughout the Central Section. The sequence of location-specific tests now extends into early January 2019, but those requiring the use of a train remain scheduled before the end of January 2019. The corresponding airflow tests associated with [REDACTED] have been held and are scheduled to take place throughout February 2019.

4. [REDACTED]

Availability of specialist radio resources is a reducing concern, with sufficient numbers now recruited allowing varying demands to be met.

The emerging forecast date for the completion of GSM-R coverage testing is February 2019, but system completion and final application of NR operational rules is unlikely to be achieved until May 2019; GSM-R is one of the systems which drives the start dates for Trial Running and Trial Operations because of its requirement under the ROGS Rule Book. GSM-R resources will be progressively released to support the completion of other radio systems.

Similar risks and operational service dependencies as for GSM-R exist for the London Fire and Emergency Planning Authority (LFEPA) and Airwave testing. These will be integrated as extensions into existing operational radio systems at LU stations, or established as standalone radio systems at RfL stations.

In all cases, commissioning must be carefully phased to prevent disruption to existing operational radio (including the temporary tunnel radio system retained by [REDACTED] for dynamic testing). As noted in our last report, planning for the commissioning of all new CRL radio systems must take account of the distributed nature of radio equipment across various SSP and cross-passage sites.

5. Dynamic Testing

See Section 3.5 below.

6. [REDACTED]

The provision by SSP contractors of downstream LV works to allow final HV energisations by C650 is finally drawing to a close, although as with most SSP interfaces, a disproportionate amount of planning and co-ordination effort is required. Works are outstanding at [REDACTED]

[REDACTED]¹³. [REDACTED]
 [REDACTED]
 [REDACTED]
 [REDACTED]

CRL has established a planning forum for the management of electrical isolations once permanent power has been commissioned. This is in order to address the risk, already realised at some sites, of unplanned or unmanaged electrical disconnections affecting commissioned equipment.

7. [REDACTED]

Padding Mill Lane ATFS was successfully re-energised on 10 November 2018 with full control back to Romford RCC. Crossrail is now provided with two traction power feeds from NG at Padding Mill Lane, and two from NR at Westbourne Park.

¹³ CRL Period 8 C650 PDB held on 20 November 2018.

3.5 Dynamic Testing

3.5.1 Dynamic Testing Strategy

The start of MDT is anticipated as a significant step towards Crossrail opening, marking the completion of fixed infrastructure and transition into a railway fully under test. Initially termed '5/2 Dynamic Testing' by CRL, an ambitious target start date of 22 October 2018 was set in the September 2018 Remedial Action Plan. However, MDT has progressively slipped because the supporting infrastructure has been delivered late against over-optimistic forecasts. CRL's ability to commit to MDT (and also to deliver a robust and reliable MOHS) has been further undermined by an incomplete understanding of true delivery status across key critical areas.

CRL has recently re-affirmed that MDT will start on 14 January 2019. This decision is to be welcomed, not only because it provides an immediate basis for organisational readiness and supply chain commitment, but because it lays down a significant marker in the process of re-building schedule confidence. It also means that schedule float currently allocated to the dynamic testing period is retained for mitigation of future emerging testing issues, rather than given over "cheaply" for infrastructure completion.

Entry into MDT will be subject to Entry Criteria associated with the following areas being satisfied:

- Railway Systems complete (Section 3.4);
- Planned releases of CBTC and TCMS on-board software installed (Section 3.5.2);
- Rolling Stock off-site completion of critical CBTC tests (Section 3.5.2);
- Permanent LV supplies in place at Stations (Section 3.4).

The T-8 Readiness Review¹⁶ identified that a January start was unlikely on the basis of the progress towards the Entry Criteria at that time. Our concerns remain therefore with the further erosion of the Entry Criteria necessary to 'support' the January start and the associated risk of CRL attempting out-of-sequence testing using assets which are incomplete and using unproven software. However, we do acknowledge that, in keeping with the delivery of other major railway projects, CRL is in an extremely demanding situation and must make compromises for the strategic benefit of the Crossrail Programme. CRL must therefore strike a careful balance between the short and long-term impacts arising from its decision-making associated with the schedule.

In the meantime, CRL has finally resolved the issue of best schedule use up to MDT. Last period, we reported upon CRL's proposal to implement a period of Interim Dynamic Testing (IDT) on 10 December 2018 ahead of MDT, which was effectively a 'reduced' form of the '5/2 Dynamic Testing' regime with a schedule bias towards construction. This proposal then evolved into 'schedule blocks', a series of extended Test Windows with a schedule bias tending to dynamic testing. As of the date of this report, CRL has effectively abandoned IDT as originally conceived and its thinking has returned to Test Windows. Two further opportunities are now planned before MDT:

- Dynamic Test Window No. 14 - 7/10 December 2018;
- Dynamic Test Window No. 15 – 6/7 January 2019.

CRL's need to consider a range of schedule options up to MDT appears to illustrate the difficulties in understanding true delivery status across a range of complex interrelated systems.

¹⁶ CRL T-8 Readiness Review for MDT held on 9 November 2018.

While experience has shown that Test Windows do not allow the most efficient implementation of dynamic testing, with less than 2 months to MDT (and with Christmas reducing the amount of productive time available in practice), the retention of a proven delivery approach is pragmatic.

Multi-train testing is now scheduled to start during Dynamic Test Window No. 15. CRL plans to prove a fixed hardware and software configuration for both the train and the signalling system during DTW14, and then retain exactly the same set-up for DTW15. Confirmation of single train performance is a higher priority than starting multi-train testing, and this further delay is logical and justified for the longer-term benefit of dynamic testing.

The planned final rolling stock software configuration is not expected to be authorised until mid-July 2019, based upon the current test and assurance cycle programme. Given past performance this date remains at significant risk.

CRL is in the process of agreeing a range of GE and GWML transition testing possessions with NR during the first half of 2019. These will provide total testing times significantly in excess of those considered necessary in MOHS 2018, and far better represent the actual time required, taking into account recent experience with de-bugging and reliability.

Dynamic testing on the Central Section continues to be supported by off-site testing of rolling stock at Derby and Melton, and of the integrated systems by simulation on the CIF at Chippenham.

3.5.2 Dynamic Testing Progress

CRL has completed thirteen dynamic testing windows with a small number of short-length subsidiary windows also undertaken. We reported last period on the outputs from Dynamic Testing Window No. 13, which was the last to take place on 5 November 2018.

Dynamic Testing Window No. 14 was scheduled for late November 2018, but was recently deferred to early December in order to accommodate late delays in the [REDACTED]'s integrated software delivery schedule. Version Y0.220 was originally allocated to support DTW14 but technical and procedural issues identified during off-site pre-testing have required additional releases in order to deliver the fixes. As an example of the improving collaboration between the parties, fully-tested Y0.222 is now planned to be delivered to the Central Section at the end of November 2018, ahead of DTW14. See Section 3.8 for further details.

3.6 Approvals, Assurance and Agreements

3.6.1 RAB(C)

CRL's formal submissions schedule has been accepted in principle by RAB(C), but finalisation awaits completion of the MOHS review. Concerns remain with the rate of review and acceptance necessary to align with current completion targets. Confirmation of later MOHS milestones will provide some relief.

The current CRL initiative to explore [REDACTED] in order to secure earliest delivery (see Section 3.4) will require the safety arguments for the interim and final system states to be carefully constructed. Additional safety documents will be necessary to articulate the migration of safety critical functionality [REDACTED]. This is not necessarily an onerous exercise for CRL but, given the distributed and highly integrated nature of the [REDACTED] network, is one that will require care and attention to detail.

3.6.2 Regulatory Approvals

Progress in delivering regulatory approvals evidence reflects the overall status of the programme, as it relies upon completed designs and construction. In most cases the design element of assurance is completed but the assurance cycle cannot be finalised until testing and commissioning evidence is produced.

This is reflected in the key issues that CRL must manage in order to produce a Technical File that can be accepted by the ORR. The issues are:

- 74% of Project wide Hazard Records remain open, and require T&C evidence and O&M manuals to make significant progress;
- No T&C evidence of TSI compliance has been accepted;
- C660 continues to make slow progress in closing the open hazards allocated to it, as these need T&C evidence from circa 70 sites;
- The need for Contractors and CRL personnel to be sufficiently resourced and energised to complete this important assurance role.

These issues, and a lack of a MOHS, mean that the timely delivery of the CRL Safety Case¹⁷ is rated as 'red' by CRL¹⁸.

3.6.3 Agreements

There are five agreements that are judged to be amber. These are the same as were in our last report, and are:

- First Crossrail Track Access Agreement between NR and MTR-C;
- Umbrella Property Agreement between TfL and NR;
- Development Service Agreement between NR and RfL-I;
- GSM-R Network Services Agreement;
- Power Agreements between TfL and NR.

With regard to power agreements, CRL has now received a formal refusal [REDACTED] [REDACTED] In any case, the current interim arrangements can continue, so the Programme will not be affected.

There has been some positive change to the number of Critical Agreements that we reported open in Period 7, but there are still circa 30 to complete. CRL is trying to raise the profile of this activity, as it is currently only reported at the C&CSC on a periodic basis.

3.7 Operational Readiness Assessment

There has been little tangible activity in this section whilst the new MOHS, and access to the Elements, is being agreed. We will be reporting upon the IMs progress in meeting the new MOHS from Period 9.

3.8 Rolling Stock

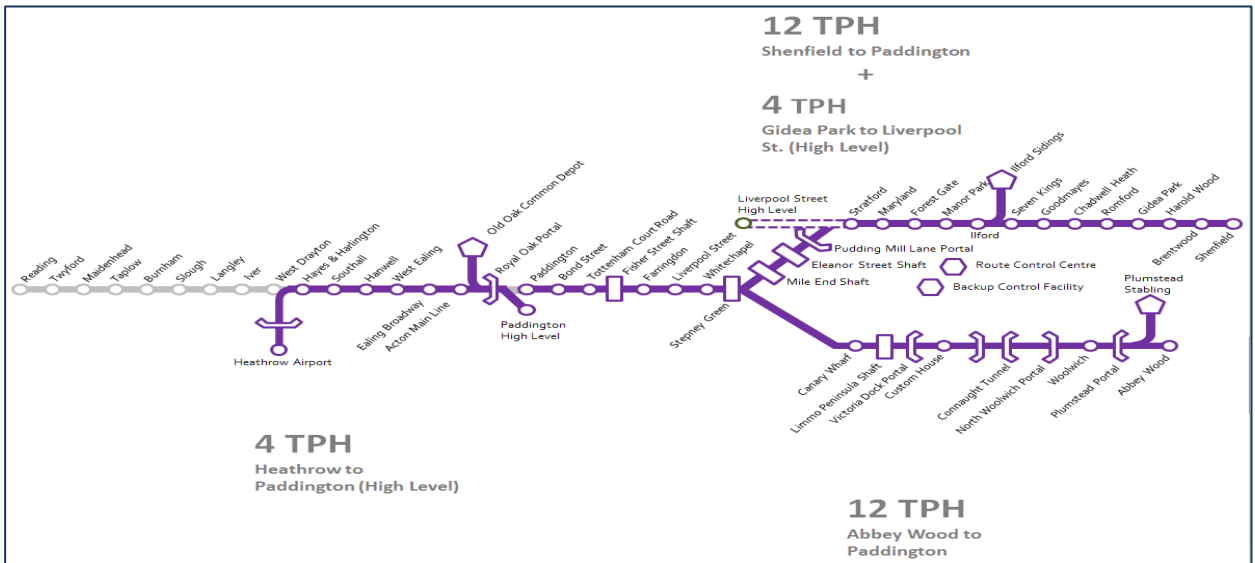
The various train system configurations, and their impact upon dynamic testing, have been discussed in sections 3.5.1 and 3.5.2.

¹⁷ CRL receiving an APIS for COS by mid October 2019.

¹⁸ Period 8 PDB day 1 pack.

There is still the issue of how the Yellow Plant can access the site (in order to maintain the COS) whilst the sidings are being constructed. We understand CRL and RfL are jointly working upon a solution that may entail out-stabling the Yellow Plant.

4 Stage 4: Paddington to Abbey Wood & Shenfield – May 2020 (tbc)



4.1 Summary

A new development has been the possible impact of Stage 5a

4.2 Operational Readiness Assessment

A significant development for Stage 4 has been the implications of operating Stage 5a (as well as Stage 2-2) from December 2019. This is because MTR-C believes Stage 5a and Stage 4 will concurrently require 55 FLUs.

[Redacted text block]

We would expect a detailed solution to be included in the MOHS.

In addition to the above there are two Readiness Tasks that have been given a 'Red' status by the PDB¹⁹, one less than in our last report. The overall rating for Stage 4 remains 'Red'.

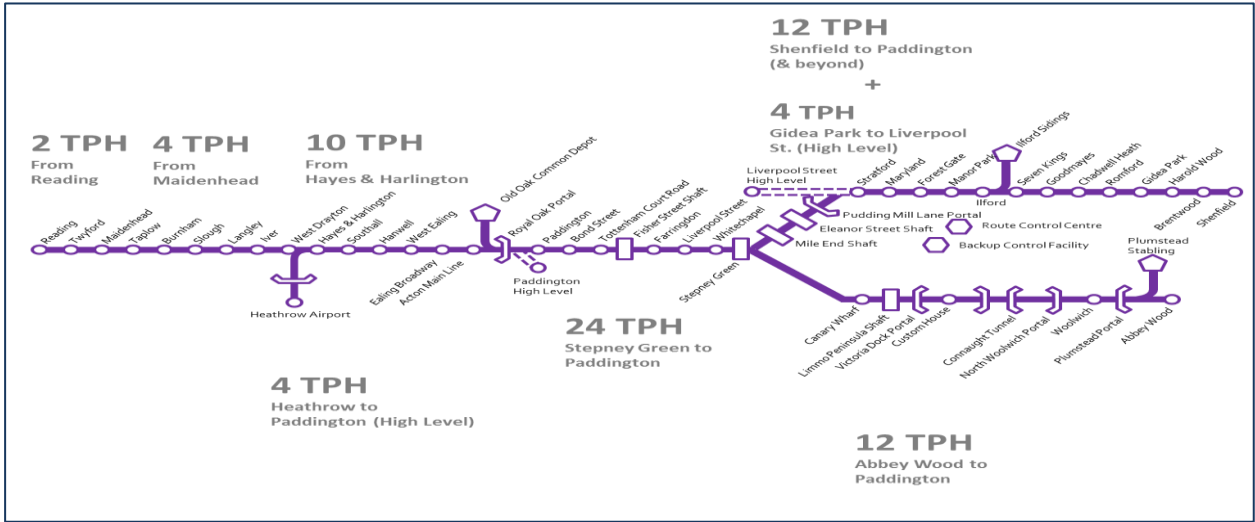
¹⁹ 21 November 2018.

	Readiness Task	Issue
	DOO CCTV installed and operational Stratford and Shenfield stations	<p>Little change from P6. NR is prioritising Platforms 5 and 8 at Stratford as these are used for normal running, and key works are planned for Christmas 2018. The Programme has not been confirmed after that date, when completion is forecast for May 2019. There is also a lack of clarity concerning the programme for Platforms 10 and 11, which would be used during perturbation.</p> <p>Temporary arrangements are planned to be installed at Shenfield, as no contractor has been appointed to carry out the works.</p>
	Station Information & Security System (SISS) stations and RCC	The impasse between NR's Contractor (to provide a programme) and [REDACTED] (to accelerate its works) is trying to be resolved by NR and CRL appointing new contractors.
	KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The works have been instructed to NR's contractors, but a programme has not been fully agreed. NR has applied a 'red' RAG status to the task. It should be pointed out that these works affect the route, not just Elizabeth line services.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with 'Red' Status

5 Stage 5: Reading & Heathrow to Abbey Wood – Dec 2020 (tbc)



(note – this graphic is subject to review)

5.1 Summary

We recognise the importance of achieving Stage 5a in December 2019, but there are a number of key issues to resolve. The primary concern for Stage 5a is the progress of the station enhancement programme, which Sponsors are familiar with.

5.2 Stage 5a

In our last report we described our concerns that Stage 3, 2-2 and 5a could all overlap, dissipating management focus and organisational resources. Alongside that concern and the others we raised are two more:

- The DOO CCTV and platform extension programme shows GRIP 5 designs completed by February 2019, platform works by end of September 2019 and DOO CCTV by 9 October 2019. MTR-C will then need to carry out its Operational proving and DOO CCTV sighting trials. MTR-C has noted that the characteristics of the route could mean that each station could take longer on average than previous occasions. Therefore, there is little float in the programme to accommodate any delays.
- [REDACTED]

5.3 Operational Readiness Assessment

There are four Stage 5 Readiness Tasks that have been reported as a ‘Red’ status to the PDB on 21 November 2018, the same as in our Period 7 report. The overall rating for Stage 5 is ‘Red’.

	Readiness Task	Issue
	ETCS available and tested Airport Jn to Paddington	NR programme completion for ETCS is now forecast for mid to late 2020. CRL will need to commission its alternative plan once the situation concerning programme and exemptions is clear.
	ONFR Western station upgrades complete	Pressure upon the programme could push completion into Q1 2020.
	DOO CCTV & Platform lengthening GWML outer stations	See Section 5.2
	Maidenhead Sidings accommodation	See Section 5.2

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with 'Red' Status

6 Health & Safety

6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. All KPIs improved again, with the AFR reaching very low rates, substantially below target. This reflects the safety culture which CRL has created over the last few years. The overall HSPI rate is 2.61 which is excellent when the highest score possible is 3.00. All 11 Principal Contractors (PCs) are beating the target with most above 2.50, and C405 achieving a score of 2.94.

H&S KPI	Target	Aim	Period 7	Period 8
HSPI	2.20	-	2.59	2.61
PCs scoring over 2.20	11	11	11	11
RIDDOR AFR	0.15	0.06	0.08	0.07
LTC AFR	0.23	0.15	0.13	0.11

Figure 6 - 1 ~ Health and Safety Performance COS

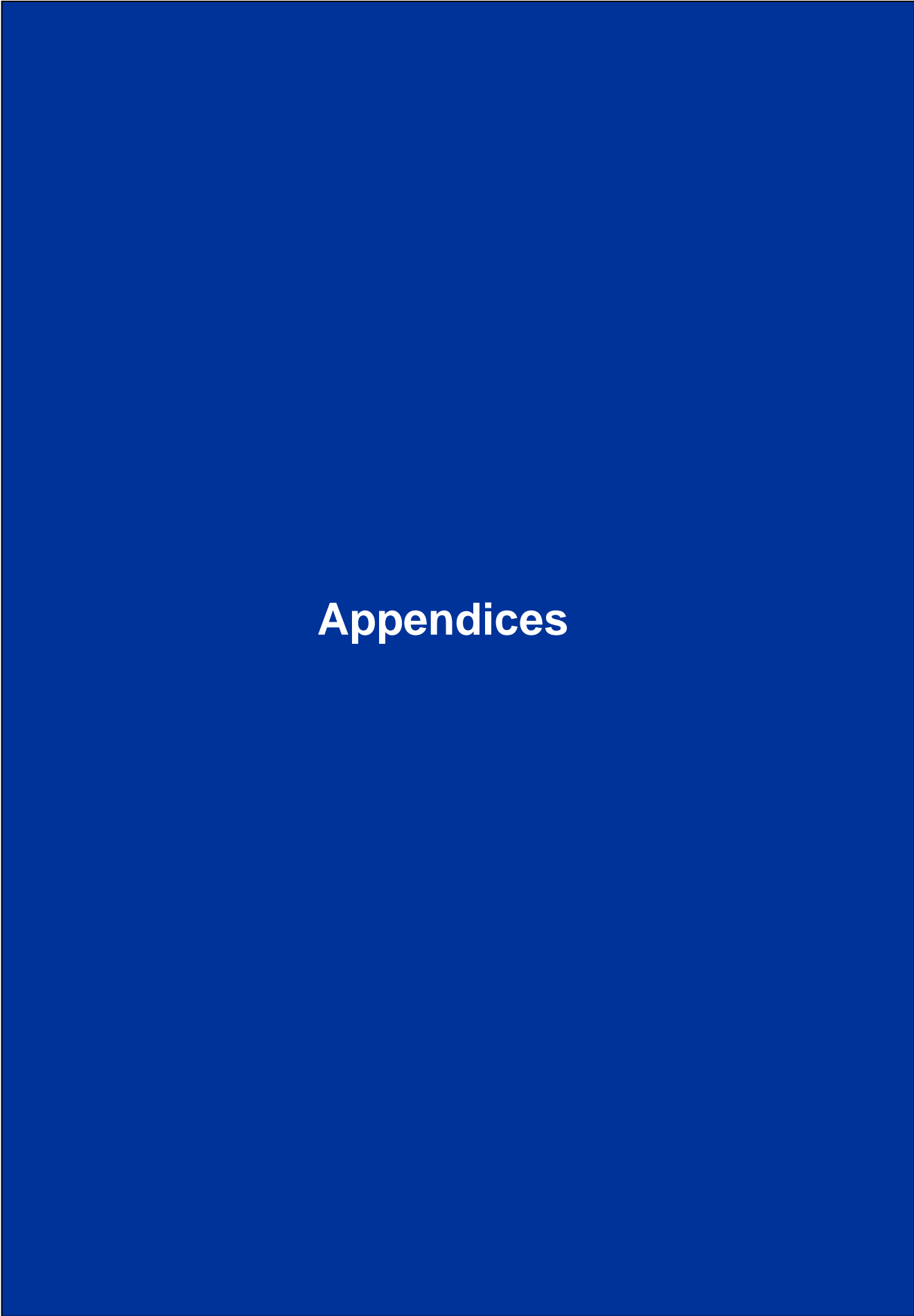
There were 6 new High Performance Near Misses (HPNM) during Period 8; all at the main station projects. Although it is encouraging that near misses are being reported, the large number of HPNM is concerning, especially when these are added to 7 reported during Period 7. CRL analysis indicates that many relate to the permit process for electrical works, so renewed focus has been applied on this and CRL are investigating if the procedures can be improved²⁰. We are also aware that the Stations Delivery Director has raised the profile of near misses and the increasing number of injuries at the SSP meetings.

The 'Finish Safe' campaign is currently being adapted to focus on autumn and winter weather conditions. Also, the known annual health and safety risks before and after the Christmas/New Year holiday period.

ATC's (C610) application to the ORR for an extension to its ROGS exemption has been approved but the end date is yet to be determined.

CRL has instructed all SSP Contractors to nominate a Dynamic Testing Coordinator at all sites and is implementing a new Dynamic Testing SSP Readiness Certificate. This will reduce safety hazards and reduce the risk that SSPs cause cancellation or disruption of DT.

²⁰ As confirmed by CRL Head of H&S 27 November 2018.



Appendices

Appendix A Corporate Milestones & Anchor Milestone Progress

We expect new Corporate Milestones will be approved by the CRL Board once the new MOHS is issued. These will be reviewed upon receipt.

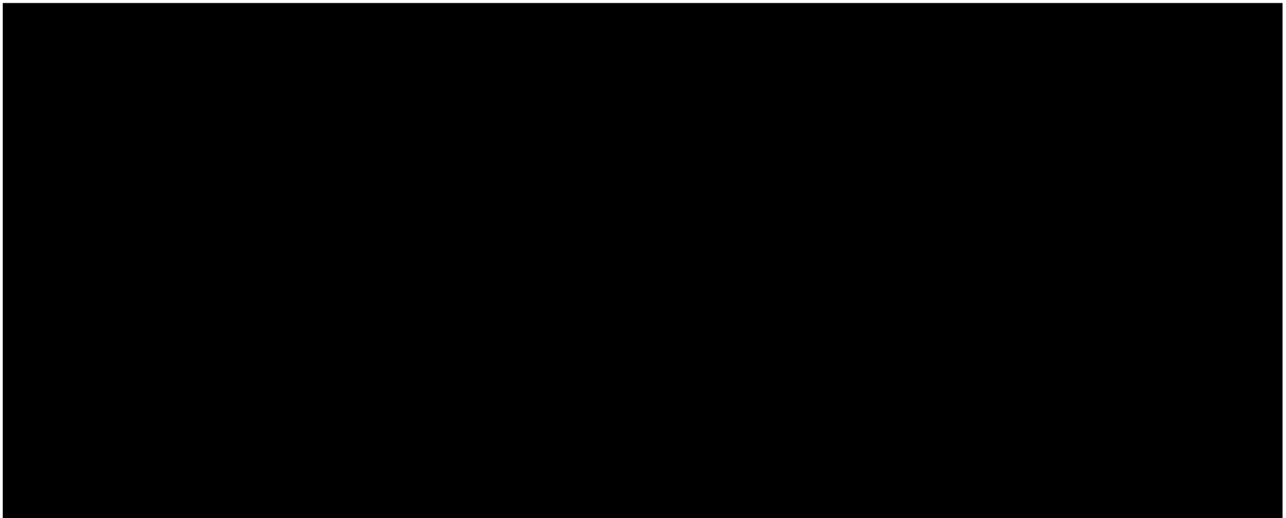
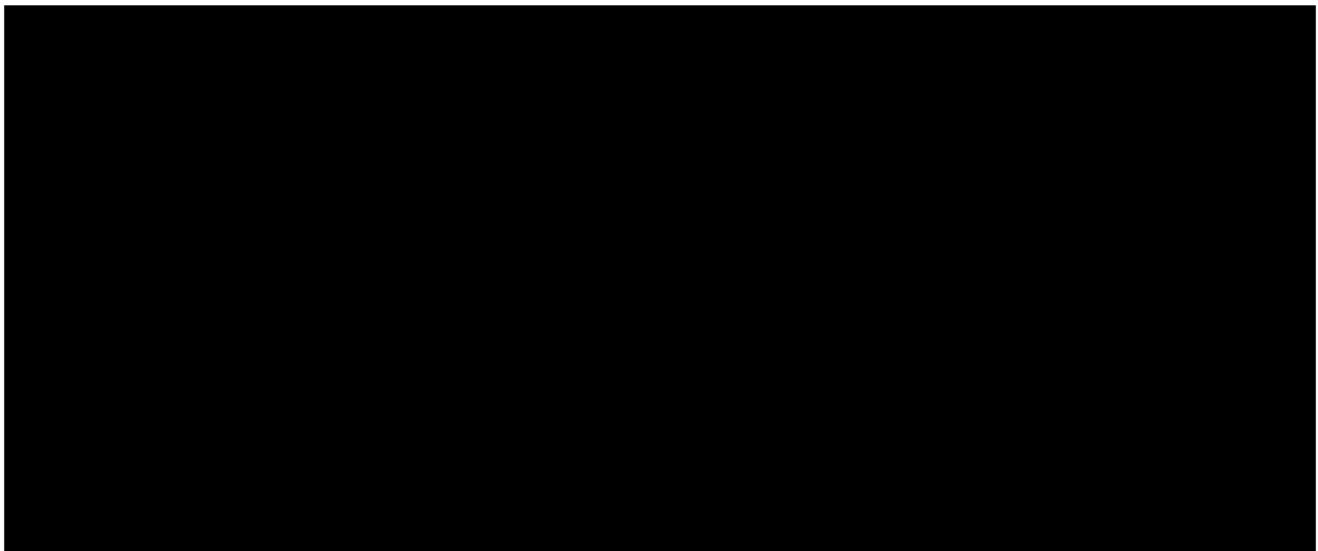
New Anchor Milestones will form part of the new MOHS. These will be reviewed upon receipt.

Appendix B COS SSP Target Dates

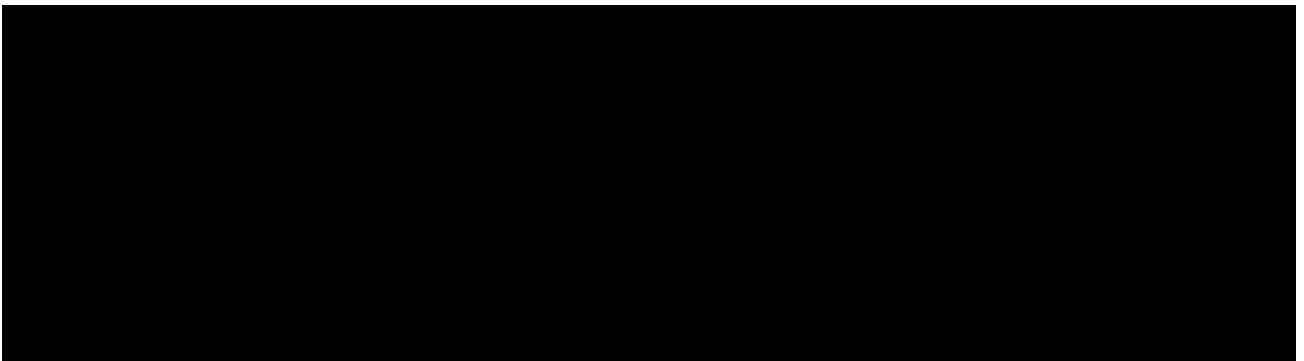
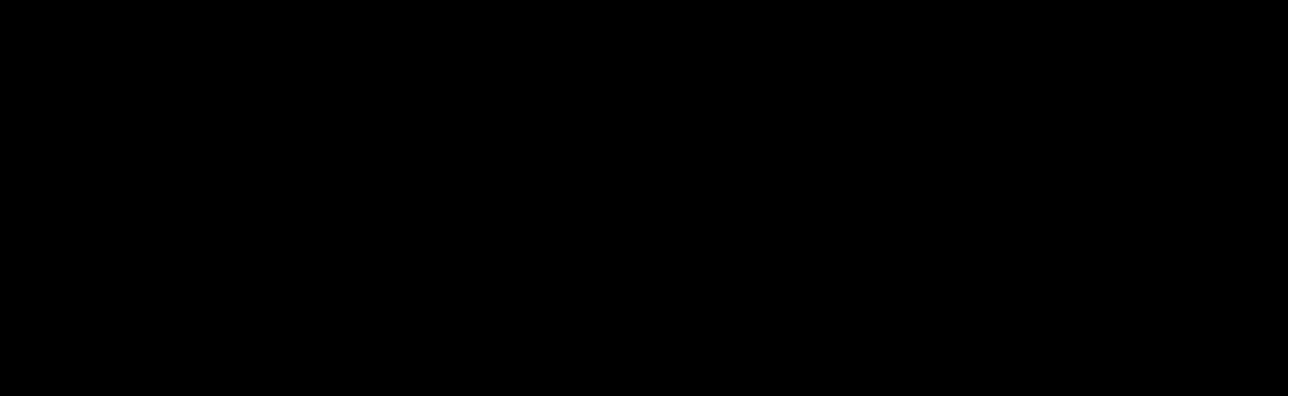
All baseline and forecast dates for Stations are currently under review pending development and approval of the new MOHS. These will be provided upon receipt and new tables created for our Period 9 report.

The following tables give approximate indications of possible MOHS and forecast dates, as noted in CRL Period 8 Anchor Milestones report dated 14 November 2018, set against Period 7 forecasts and the RAP dates. The forecasts are draft dates subject to confirmation and issue of the new MOHS. Forecasts highlighted in amber show dates after RAP [REDACTED] dates, and those highlighted in red show dates after [REDACTED]

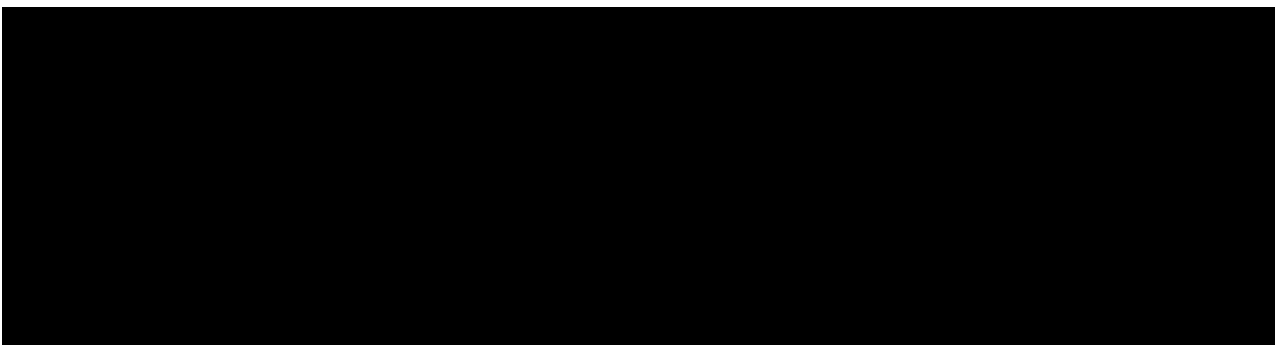
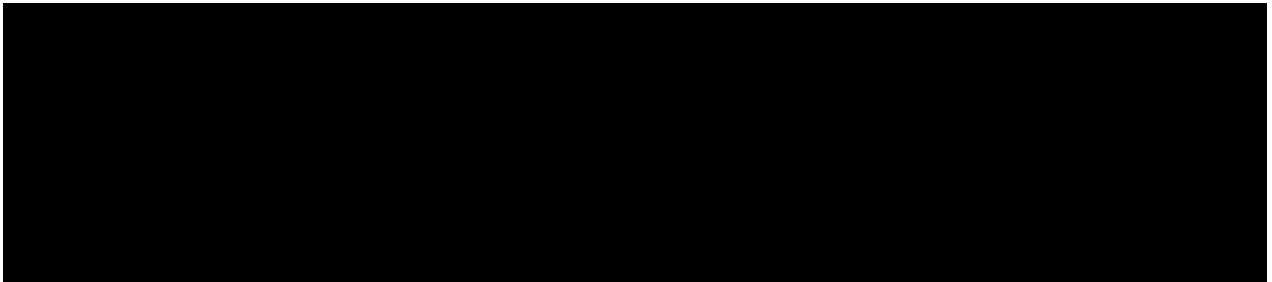
SHAFTS AND PORTALS

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LUL STATIONS



RfL STATIONS



Appendix C Agreements

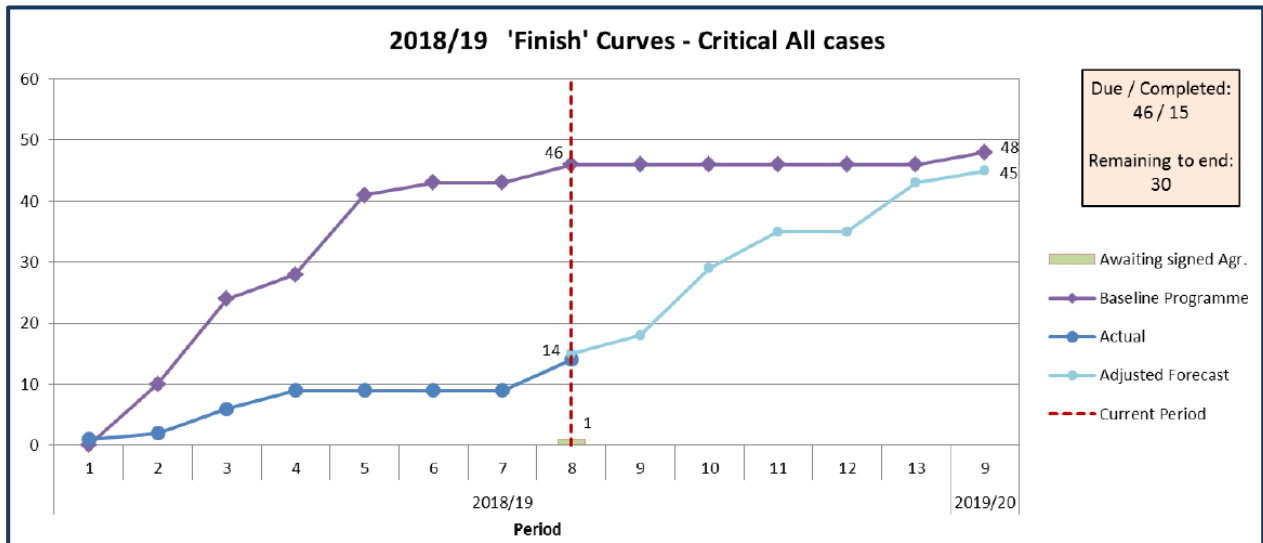


Figure C - 1 ~ 2018/19 Finish Curves – Critical All Cases²¹

²¹ Extract from Period 8 CRL Agreements update in C&CSC pack of 27 November 2018.

Project Representative Team

Project Team



Project Representative, Safety, Progress, Risk, Stations;
Signalling, Railway Systems, Integration, T&C;
Compliance & Change, Operations, RSD, Assurance;
Commercial, Cost Control, Financial;
Administration Manager.

Glossary of Terms and Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LFB	London Fire Brigade
ABB	ASEA Brown Boveri	LIS	Liverpool Street
ABW	Abbey Wood	LMU	London Metropolitan University
AC	Acceptance Certificate	LO	London Over ground
ACBs	Air Circuit Breakers	LoNo	Letter of No Objection
ACJV	Alstom Costain Joint Venture	LoR	Line of Route
ACWP	Actual Cost of Work Performed	LTC	Lost Time Case
AEA	Abellio East Anglia	LTIFR	Lost Time Incident Frequency Rate
AEN	Adverse Event Notice	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFC	Approved for Construction status	LV	Low Voltage
AFCDC	Anticipated Final Crossrail Direct Cost	M&E	Mechanical & Electrical
AFR	Accident Frequency Rate	MAID	Mandatory Asset Information Deliverables
AGA	Abellio Greater Anglia (now known as 'GA')	MCR	Material Control Requirement
AHU	Air Handling Units	MCS	Master Control Schedule
AIP	Approved in Principle	MDT	Main Dynamic Testing
AIP	Approval in Principal	MDTR	Main Dynamic Testing Regime
AM	Anchor Milestones	MENTOR	Mobile Electrical Network Testing, Observation and Recording
AMS	Agreements Management System	MEP	Mechanical Electrical & Public Health
APIS	Authorisation to Place into Service	MEPA	Mechanical, Electrical, Public Health, Architecture
ARS	Automatic Route Setting	MES	Mile End Shaft
AsBo	Assurance Body - Ricardo Rail	MFF	Multi-Functional Framework
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
AT	Autotransformer	MML	Mott MacDonald Ltd
ATC	Automatic Train Control	MOHS	Master Operational Handover Schedule
ATF	Auto Transformer	MOS	Member of Staff
ATFS	Autotransformer Feeder System	MPS	Master Plan Shaft
ATO	Automatic Train Operation	MTIN	Miles Per Technical Incident Number
ATP	Automatic Train Protection	MTIN	Miles Technical Incident Number
ATS	Automatic Train Supervision	MTR SMS	MTR Safety Management System.
ATS	Auto Transformer Station	MTR-C	Mass Transit Railway - Crossrail
ATU	Authority to Use	MTT	Multi Train Testing
AWS	Automatic Warning System	MV	Medium Voltage
B&PC	Board & Programme Contingency	NCE	Notified Compensation Event
BBMV	Balfour Beatty Morgan Vinci	NCR	Non Conformance Report
BCA	Bilateral Connection Agreement	NEC	New Engineering Contract
BCWP	Budgeted Cost of Work Performed (Earned Value)	NG	National Grid
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NGET	National Grid Electricity Transmission
BFK	Bam Ferrovial Kier	NKL	North Kent Line
BH	Berkeley Homes	NoBo	Notified Body
BIU	Bringing Into Use	NOW	North Woolwich
BLL	Bakerloo Line Link	NR	Network Rail
BMS	Building Management Systems	NR PDB	Network Rail Programme Delivery Board
BOS	Bond Street Station	NSACS	New Sector Area Cost Summary
BP	Business Plan	NWP	North Woolwich Portal

BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC Building	Operations Maintenance Centre
BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUCF	S	ONFR	On Network Functional Requirements
BUF	Bottom Up Forecast	ONSIP	On Network Station Improvements Programme
C&CSC	Commercial and Change Sub-committee	ONW	On Network Works
CAR	Corrective Action Report	OOC	Old Oak Common
CARE	Crossrail Assurance Reporting Environment	OOCPA	Old Oak Common Paddington Approaches
CBTC	Communications Based Train Control	OPEX	Operational Expenditure
CCB	Current Control Budget	Ops	Operations
CCP	Commitments Compliance Plans	ORAT	Operational Readiness & Transfer Group
CCR	Consolidated Cost Report	ORR	Office of Rail & Road
CCRB	Construction and Commissioning Rulebook	ORSG	Operational Readiness Steering Group
CCRRB	Crossrail Construction Railway Rule Book	OSD	Over Site Development
CCSA	Contract Commercial Status Analysis	OSP	Operations Safety Procedures
CCSC	Commercial & Change Sub-Committee	OTIS	OTIS escalators (company)
CCTV	Closed Circuit Television	OTP	Overall Target Price
CD/RA	Closed Door / Right Away	P2R	Paddington to Reading
CDG	Competence Design Group	PA	Public Address
CDL	Central Door Locking	PAC	Partial Acceptance Certificate
CDM	Construction Design & Management Regulations	PAD	Paddington station
CDN	Crossrail Data Network	PC	Principal Contractors
CDT	Commitments Delivery Tracker	PCC	Pre-Commissioning Certificate
CE	Compensation Events	PDA	Project Development Agreement
CEC	Chief Engineer's Communications	PDB	Programme Delivery Board
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PES	Platform Edge Screen
CEG	Central Engineering Group	PES	Permanent Earthed Sections
CEO	Chief Executive Officer	Ph3C	Phase 3 Complete
CER	Communications Equipment Room	PIP	Paddington Integration Project
CFCCB	Contingency Finance Current Control Budget	PIR	Potential Incident Report
CFO	Chief Financial Officer	PLU	Plumstead
CIF	Crossrail Integration Facility	PM	Project Manager
CIS	Customer Information System	PMI	Project Manager Instruction
CMR	Crossrail Managed Risk	PML	Pudding Mill Lane
CMS	Central Management System	PMO	Project Management Office NR
CoL	City of London	PNY	Paddington New Yard
COS	Central Operating Section	PPE	Personal Protective Equipment
COS	Central Operating Section	PPF	Property Partnership Framework
COWD	Cost of Work Done	PPM	Passenger Performance Measurement
CPFR	Crossrail Programme Functional Requirements	Prep	Project Representative
CPI	Cost Performance Index	PRISM	Cost Management Software
CPO	Compulsory Purchase Order	PRM	Persons of Reduced Mobility
CRAF	Completion Readiness Assessment Framework	PSD	Platform Screen Door
CRL	Crossrail Limited	PSG	Performance Steering Group
CRV	Crossrail Requirements Variation	PSR	Project Status Report
CSCS	Construction Skills Certification Scheme	PTYSC	Property Sub-Committee
CSDE	Correct Side Door Enabling	PWay	Permanent Way
CSJV	Costain Skanska Joint Venture	QBR	Quarterly Baseline Review
CSM	Construction Safety Management	QCRA	Quantified Cost Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	QRA	Quantified Risk Assessment
CT	Computerized Tomography	QSRA	Quantified Schedule Risk Assessment
CTOC	Crossrail Train Operating Concession	RAB	Regulatory Asset Base

CUH / CHS	Custom House Station	RAB (C)	RfL Assurance Board for Crossrail
CW	Canary Wharf	RAG	Red, Amber, Green Matrix
CWG	Canary Wharf Group	RAM	Route Asset Manage.
CWS	Canary Wharf Station	RAP	Remedial Action Plan
D&A	Drugs and Alcohol	RBC	Remote Block Computer
DA	Development Agreement	RCA	Risk Control Actions
DeBo	Designated body	RCC	Route Control Centre
DESJs	Design Engineering Safety Justifications	RfL	Rail for London
DfT	Department for Transport	RfL-I	Rail for London - Infrastructure
DLO	Direct Labour Organisation	RFT	Right First Time
DLR	Docklands Light Railway	RIA	Railway Integration Authority
DOO	Driver Only Operation	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DPS	Depot Protection System	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DT	Dynamic Testing	RIRP	Railway Integration Review Point
Dwall	Diaphragm wall	RLU	Restricted Length Unit
DWWP	Delivery of Works Within Possession	ROC	Rigid Overhead Conductor
E&B	Earthing & Bonding	ROC	Regional Operational Centre
EA	Environment Agency	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
EAC	Estimate at Completion	ROP	Royal Oak Portal
EB	Eastbound	ROP	Royal Oak Portal
ECHR	Element Completion Handover Report	RP4.2	Review Point 4.2
ECI	Early Contractor Involvement	RR	Ricardo Rail
ECP	Employers Completion Process	RRV	Road / Rail Vehicles
ECS	Empty Coach Stock	RS	Rolling Stock
EDBL	██████████ Baseline	RSC	Return Screen Conductor
EDORs	ETCS Data Only Radio	RSD	Rolling Stock & Depot
EDT	Early Dynamic Testing	RSSB	Rail Safety & Standards Board
EED	Emergency Exit Door	RTU	Remote Telemetry Unit
EFC	Estimated Final Cost	S&C	Switches & Crossings
EFC	Economic and Financial Committee	SA	Supplementary Agreement
EiS	Entry into Service	SACR	Semi Annual Construction Report
ELCBT	Elizabeth Line Countdown Board Tracker	SAP	System Applications Products
ELRSG	Elizabeth Line Readiness Steering Group	SAR	Safety Assessment Report
EMC	Electromagnetic Compatibility	SAT	Site Acceptance Test
EMU	Electrical Multiple Unit	SC	Staged Completion
EOWL	Element Outstanding Work List	SCADA	Supervisory Control and Data Acquisition
ERTMS	European Rail Traffic Management Systems	SCL	Sprayed Concrete Lining
ESJ	Engineering Safety Justification	SCN	Sponsor Change Notice
ESM	Engineering Safety Management	SDG	Signalling Design Group
ESS	Eleanor Street Shaft	SDO	Selective Door Operation
ETCS	European Train Control System	SDS	Scheme Design Specification
ETH	Eastern Ticket Hall	SEJ	Safety Engineering Justification
EVM	Earned Value Management	SER	Signalling Equipment Room
ExCom	Executive Committee	SES	South East Service
FAR	Farringdon	SESR	South East Signalling Room
FCCB	Finance Current Control Budget	SFA	Sponsor Funding Account
FDC	Framework Design Consultant	SHELT	Safety and Health Leadership Team
FDO	Final Design Overview	SIM	Simulation Room
FDS	Final Design Statements	SIRP	Systems Integration Review Panel
FFOC	Final Forecast Outturn Cost	SISS	Station Information and Security System
FGW	First Great Western	SJR	Safety Justification Report
FHO	Full Handover	SLD	Single Line Diagrams
FIS	Fisher Street Shaft	SMS	Safety Management System
FLU	Full Length Unit	SMTA	Smithfield Market Traders Association

FoI	Freedom of Information	SOC	Statement of Compatibility
FRAG	Fraud Risk Assurance Group	SONIA	Sterling Overnight Index Average
FTS	Floating Track Slab	SOR	Systems Operation Room
GAF	Greater Anglia Franchisee	SORBA	Shaping Architecture Company (sub cladding contractor)
GE	Great Eastern	SPI	Schedule Performance Index
GEBR	Guaranteed Emergency Brake Rate	SPS	Secondary Part Steel
GEFF	Great Eastern Furrer & Frey	SR	Sponsors Requirement
GEML	Great Eastern Main Line	SRP	Safety Review Panel
GFRC	Glassfibre Reinforced Concrete	SSE	Scottish & Southern Electricity
GLA	Greater London Authority	SSP	Stations, Shafts, Portals
GPE	Great Portland Estates	STG	Stepney Green Shaft
GRC	Glass Reinforced Concrete	STG	Stepney Green
GRIP	Governance for Railway Investment Projects	STS	Standard Track Slab
GSM-R	Global System for Mobile Communication - Railway	SVP	Safety Verification Panel
GW	Great Western	T&C	Testing & Commissioning
GWML	Great Western Main Line	TAP	Technical Assurance Plan
GWR	Great Western Railway	TBM	Tunnel Boring Machine
H&S	Health & Safety	TC&HSG	Testing, Commissioning and Handover Steering Group
HAL	Heathrow Airport Limited	TCMS	Train Control Management System
HALARP	Heathrow Airport Limited Assurance Review Panel	TCR	Tottenham Court Road
HAS	High Attenuation Sleeper	TCRW	Tottenham Court Road West
HAVS	Hand Arm Vibration Syndrome	TDR	Technical Director's Report
HEP	Handover Execution Plans	TDY	Tunnel Drive Y
HEX	Heathrow Express	TfL	Transport for London
HIA	Heathrow Implementation Agreement	TO	Taken Over
HM	Her Majesty	TOC	Train Operating Company
HMDL	Handover Master Deliverable List	TOSD	Tier One Substantially Complete
HO	Handover	TPA	Tunnel Planning Authority
HPNM	High Performance Near Misses	TPH	Trains Per Hour
HRW	Heathrow Airport	TPS	Train Protection System
HSPI	Health & Safety Performance Indicator	TPWS	Train Protection & Warning System
HV	High Voltage	TRAIL	Transport Reliability Availability Integrated Logistics
HVAC	Heating Ventilation & Air Conditioning	TRH	Temporary Rehousing
I/O	Input / Output	TSI	Technical Standard for Interoperability
IA	Interim Acceptance	TTO	Temporary Ticket Office
ICD	Interface Control Document	TTVS	Temporary Tunnel Ventilation System
IDT	Interim Dynamic Testing	TUCA	Tunnelling & Underground Construction Academy
IECC	Integrated Electronic Control Centre	TWAO	Transport & Works Act Order
IEP	Intercity Express Programme	TXM	TXM Plant
IFC	Issued For Construction	U&A	Undertakings & Assurances
IFD	Ilford Yard	UKPN	UK Power Networks
IM	Infrastructure Manager	UR	Urban Realm
IOSH	Institution of Occupational Safety and Health	URT	Unresolved Trends
IP	Intervention Point (0, 1, & 2)	UTX	Under Track Crossings
IR35	Inland Revenue Taxation Regulation 35	VAP	Verification Assurance Procedure
IRM	Incident Response Management	VDP	Victoria Dock Portal
IRN	Installation Release Note	VERP	Value Engineering Review Panel
IRSG	International Regulatory Strategy Group	VFL	Volker Fitz Patrick
ISA	Independent Safety Assessment	VN	Variation Notice
ISJ	Interim Safety Justification	VT	Voltage Transformer
ISV	Intermediate Statements of Verification	W&W	Wales & West Utilities
ITP	Inspection & Test Plan	WAD	Works Authorisation Document

ITT	Invitation to Tender	WBP	Westbourne Park
JST	Joint Sponsor Team	WBS	Work Breakdown Structure
KBR	Knorr-Bremse Rail	WC	World Class
KD	Key Deliverable	WCC	Westminster City Council
KE	Kinematic Envelope	WCCC	Whole Contract Construction Certificate
KG	Kensal Green	WHI	Whitechapel
KO	Key Output	WiFi	Wireless Fidelity
KPI	Key Performance Indicator	WITI	Western Inner Track Infrastructure
KPMG	Klynveld Peat Marwick Goerdeler	WOE	Western Outer Electrification
L&P	Land and Property	WOO	Woolwich Station
LB	London Borough	WOTI	Western Outer Track Infrastructure
LBTH	London Borough of Tower Hamlets	WTH	Western Ticket Hall
LDBL	██████████ Baseline	YC	Yard Control
LFEPA	London Fire and Emergency Planning Authority		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU