South East Route: Sussex Area Route Study

September 2015

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Foreword

I am delighted to present the Sussex Route Study, which sets out the strategic vision for the future of this vital part of the rail network over the next 30 years.

Each day this railway carries more than 60,000 people in the high peak hour alone into Central London, with many thousands more accessing key interchange points at East Croydon and Clapham Junction and travelling between regional centres on the route.

Working closely with industry stakeholders, Network Rail and train operators have delivered significantly expanded capacity for passengers in recent years on the route, with Control Period 4 (2009 - 2014) seeing many capacity improvements, most notably extensive train lengthening completed in the London suburban areas. More people are choosing to travel by train in both the peak and the off-peak across the area and high levels of growth are predicted to continue.

This success brings challenges. As this study sets out, maintaining and improving performance against a background of huge growth in passenger numbers over the last decade has been challenging for Network Rail and the train operators. The recent disruption during the improvement works at London Bridge has highlighted the difficulties in upgrading such a busy railway, whilst maintaining an acceptable service to passengers.

The Thameslink Programme which completes in 2018 brings significant investment to the London end of the route. The programme will unblock a key capacity bottleneck at London Bridge, and see the remaining few services extended on the Brighton Main Line that are not already operating at maximum length.

Development of this strategy has followed the new Long Term Planning Process with the Market Studies produced in 2013 forming the basis of the analysis. In this area those studies highlighted a number of key issues, not surprisingly the gap between peak capacity provision and expected future demand, but also a number of challenges around regional connectivity and access to airports.

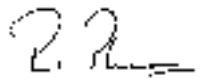
The Route Study has developed options to deliver against the key challenges, subject to value for money, deliverability and affordability. Options are set out against a long term planning horizon to 2043, allowing sets of long term interventions to be presented alongside and consistent with a prioritised set of options for Control Period 6 (2019 – 2024).

On this route, developing options that can make a particular contribution long term to improving performance as well as meeting the capacity challenge is particularly important. Alongside this, the study has also considered the growing challenges of peak passenger volumes at stations, with a view to setting priorities and options for investment in CP6.

This study was published for Consultation in October 2014. Chapter 4 sets out the key themes of the responses and how we have taken them into account in producing this final study.

Network Rail has led the production of this Route Study on behalf of the industry and as such it has been developed collaboratively with industry partners and wider stakeholders including passenger and freight operators, the Department for Transport, Transport for London, Local Authorities and Local Enterprise Partnerships. We thank them all for their contribution.

Paul Plummer



Group Strategy Director

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Executive Summary

Introduction

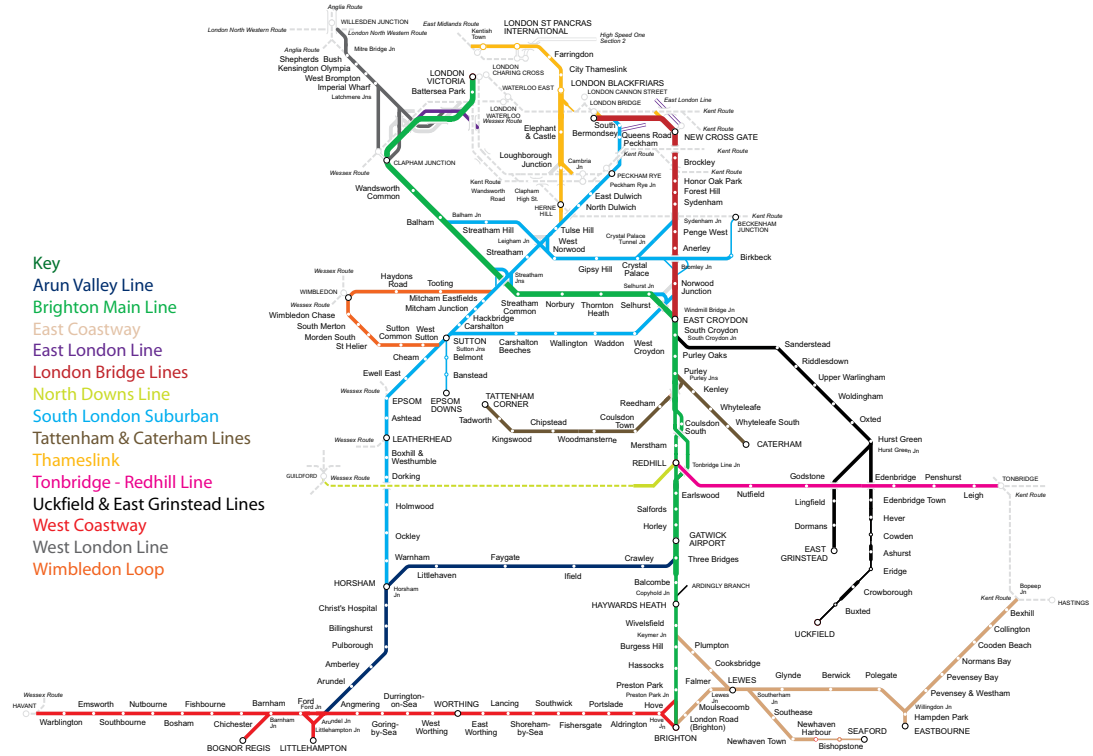
This Sussex Route Study seeks to establish the required future capacity and capability of the railway, from a systematic analysis of the future requirements of the network. It seeks to provide a strategy for meeting the growth outlined in the Long Term Planning Process (LTPP) Market Studies, whilst maintaining and where possible improving operational performance, and at a cost acceptable to funders and stakeholders. Network Rail, alongside the industry, is developing a programme of Route Studies, in conjunction with rail industry partners and other stakeholders.

Scope

The Sussex Route Study sets out a strategy for a particular part of the rail network. The scope of the Route Study covers the Brighton Main Line (BML) and connecting routes, the dense suburban network of radial routes in south central inner and outer London and the Orbital routes of the West and East London lines. Figure 1 sets out the study area.

The area covered by the Route Study is geographically relatively small when compared to other Route areas in the study programme,

Figure 1 - Sussex Route Study Geographical Scope



however the density of service operated through key nodes on this network – most notably the Croydon area and the London Bridge approaches is greater than in any other part of the UK. Figure 2 helps to put this point into context, comparing some service throughput statistics for the Croydon area with other often more well known railway locations in the UK.

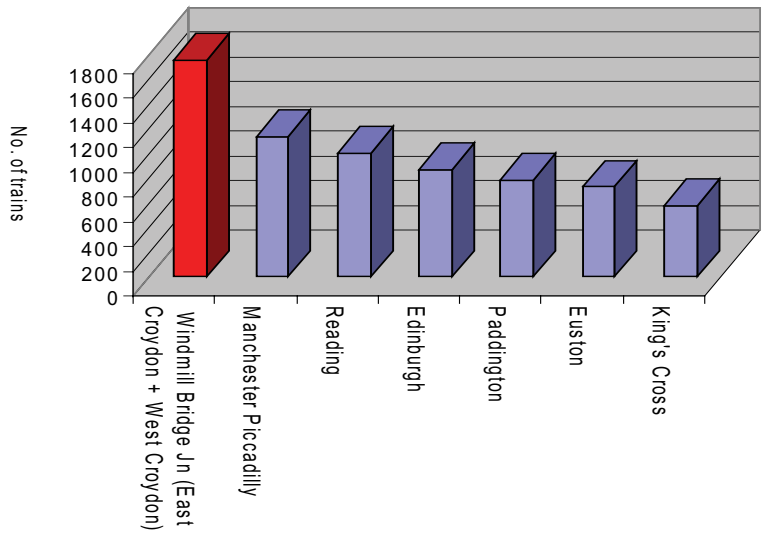
The lead TOC operating in the Route Area, Govia Thameslink Railway (GTR), is the largest Train Operating company in the UK and operates services that contribute approximately 16-17% of total national PPM.

The route is principally a commuter route to/from London with over 60,000 passengers delivered into Central London in the high-peak hour alone each weekday from the Route Study area. This figure does not include the large volumes of commuters who use the route to access key outer destinations and interchange points such as East Croydon and Clapham Junction and commute into other local and regional centres such as Brighton, Chichester, Lewes, Crawley and Horsham.

As well as the dense commuter operation, the Route Study area supports high levels of traffic to/from the UK's second largest airport at Gatwick as well as substantial volumes of off-peak leisure travel and travel between important regional centres.

Although principally a radial route to/from London, key inter regional services operate on connecting routes between Brighton and Hampshire/ the West Country, between Gatwick Airport / Redhill and the North Downs route to Guildford/ Reading/the West and between Brighton, East Sussex and Ashford in Kent. Freight traffic is focused on movements of building materials to/from several terminals on the BML, as well as large volumes of Channel Tunnel and other transit freight – mostly building materials also - using the West London Line (WLL).

Figure 2 - Sussex Route area key nodes, a national comparaison: Daily Train Movements



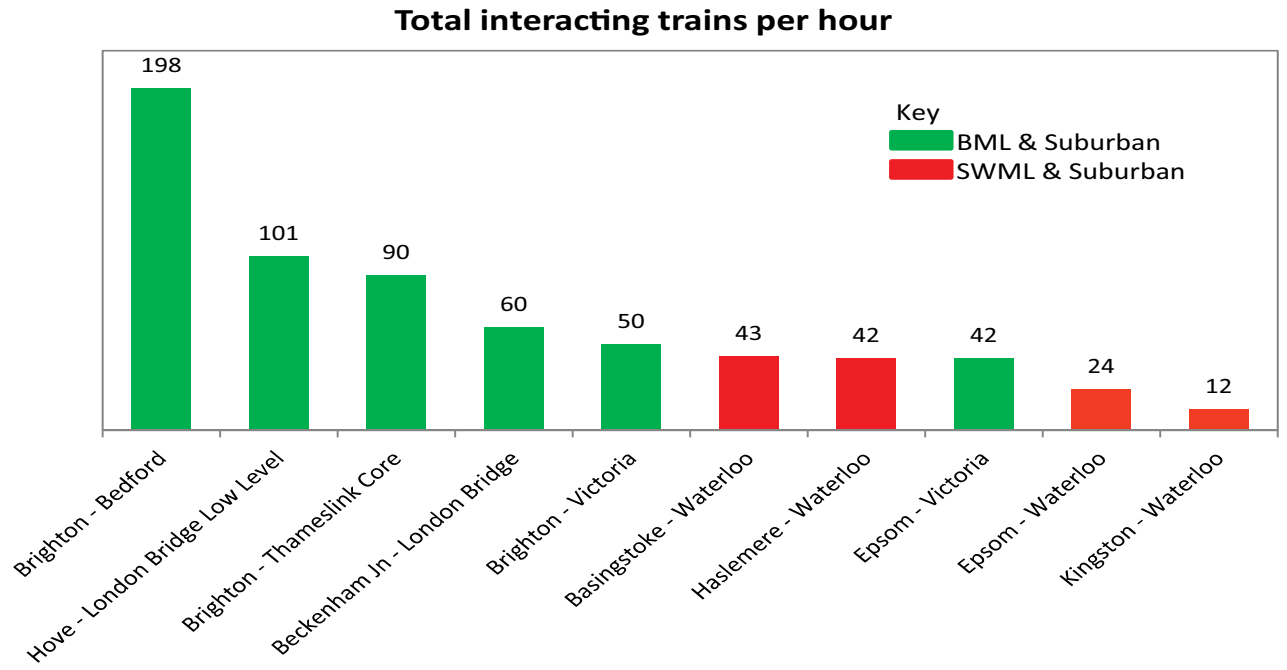
The Baseline Performance Challenge

The BML and connecting routes differ substantially in layout to most other main lines in the UK. The key difference is the proliferation of flat junctions as opposed to grade separated junctions. This combined with the particularly dense operation of services means the slightest delay in one service group can be quickly transferred – between Up (to London) and Down (from London) flows, between fast and slow line operations and critically between London Victoria and London Bridge/ Thameslink Core service groups.

To visually illustrate this point, Figure 3[1] below sets out the number of potential conflicting moves key service groups on the BML and connecting routes can encounter in the high peak hour (HPH, 08:00-08:59 arrivals at London terminal) versus more typical conditions on the Wessex Route (South West Main Line and South West suburban operations).

[1] For each service group, totals reflect the number of trains that cross the path of, reverse in front of or converge with the service group listed during the high peak hour.

Figure 3 - Comparaison of Conflicting Moves



The Public Performance Measure (PPM)[1] for 2014/15 was 83.1% for Southern, the main Train Operating Company (TOC) on the route, prior to its merger into GTR. This total was impacted by the disruption associated with London Bridge works for the Thameslink programme.

Despite considerable focus over the years on the performance challenge in the route area, the measure has never exceeded 90.7% annually and has generally been around the high 80's in recent years. Pre 2007 PPM levels were consistently lower than this – suggesting there are a number of fundamental factors at play.

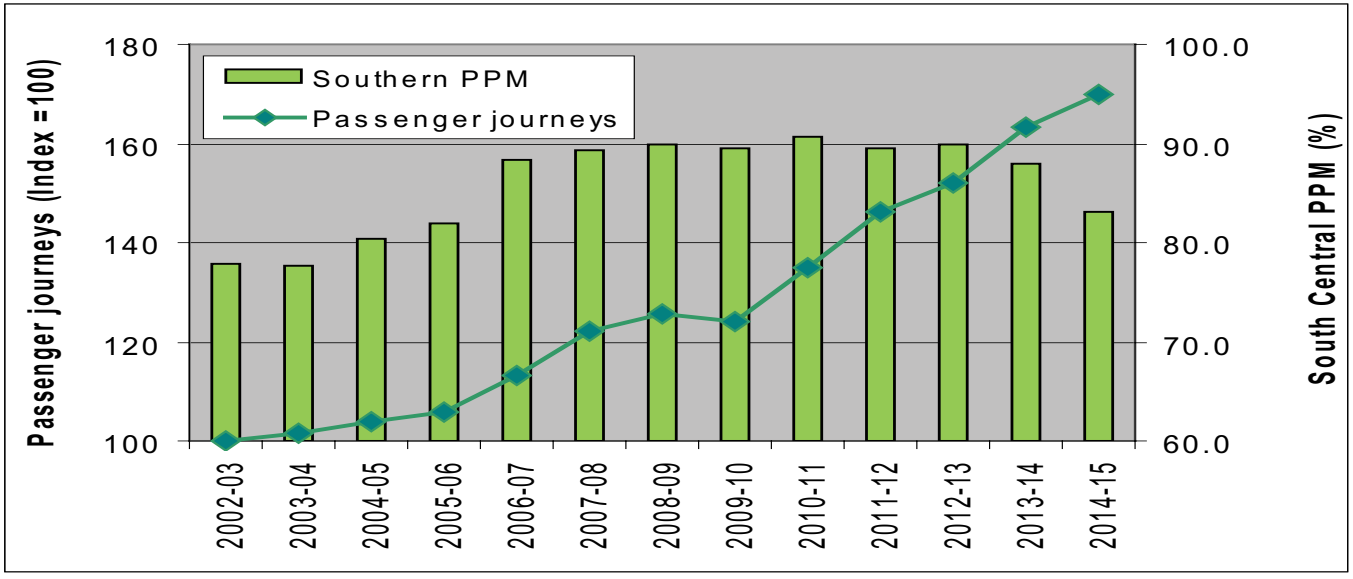
Figure 4 sets out historical PPM for the main route operator (was Southern is now GTR) mapped against the surge in demand for use of the railway in the south east over the last 12 years.

[1] This is a percentage measure of trains arriving at end destination within five minutes of booked arrival time

The challenge for Network Rail and the Train Operating Companies on the route, day to day, over the last ten years has been to maintain acceptable levels of performance as demand has surged, impacting key drivers of performance such as station dwell times and leading to the last remaining capacity headroom on the route being utilised as additional services and longer trains have been provided.

The December 2018 timetable change is likely to see further increased usage of the BML in the peak hours without any alteration to the infrastructure. Network Rail and GTR face a significant challenge therefore in maintaining current (pre London Bridge works) performance levels at the end of Control Period 5 (CP5) and into Control Period 6 (CP6). Recent work on the December 2018 timetable has again highlighted the performance risks of loading more services over the existing flat junctions on the route.

Figure 4 - Historical PPM in the Route Area



A number of workstreams are underway at Network Rail and with operators to address the performance challenge in the short, medium and long term. The investment options included in this study are aimed at forming part of the long term solution, by separating conflicting traffic flows and reducing the risk of knock on delays as well as meeting the core challenge of the Market Studies of generating much needed additional capacity.

On their own - the options in this study do not represent a single solution to all the performance challenges on the route, but they are an important building block in configuring the infrastructure appropriately for the train service that already operates over this railway today.

Timeframe and Baseline

The Sussex Route Study primarily focuses on CP6 (2019 to 2024), but has also considered the implications of growth in demand, and the increased role which the railway could play, over the next 30 years to 2043.

This document will allow identified "choices for funders" to feed into the Initial Industry Plan (IIP) for CP6 in September 2016 and ultimately inform the Department for Transport's (DfT) High Level Output Specification for CP6.

The period from 1 April 2014 to 31 March 2019 is Network Rail's current Control Period (CP5). All commitments to 2019 which are contained in the CP5 Delivery Plan have been included as part of the Route Study baseline. Key enhancement schemes that fall into this category are described further in Chapter 2.

It is recognised that the 2019 baseline used for the Route Study has the potential to change, with influences such as the Secretary of State for Transport announced review of the Control Period 5 enhancement programme.

As the options within the study represent a longer term view over the context of the next 30 years, the implications of any baseline revision are likely to be limited to the timing of the implementation of these options rather than the specific future choices themselves.

We are therefore publishing this strategy noting that it reflects a point in time which could change. Should any influences significantly change the outputs of, and options identified within the strategy, we will review and update accordingly as part of the ongoing process to maintain the validity of the strategy.'

Within the currently assumed baseline enhancements there are some significant improvements to some areas of route capacity, most notably the completion of the Thameslink Programme. During CP5 this will see the last set of main line peak services not already operating at maximum practical length, extended to 12-car operation.

Completion of the scheme will also see a new timetable in place from December 2018 that takes advantage of additional capacity released through upgrade of the Thameslink Core between London Bridge and London St Pancras International, but also leads to increased usage of the BML itself which will not have been subject to any upgrade.

Network Rail's draft December 2018 timetable has been taken as the baseline timetable for this study. This timetable has been constructed over a number of years with the input of incumbent operators on the route.

In May 2014 Govia Thameslink Railway (GTR) were announced as winning bidders for the Thameslink, Southern & Great Northern (TSGN) Franchise which commenced operation in September 2014 and runs until 2021 (two years into CP6). Although similar there are some differences in GTR's proposed timetable for December 2018 and the baseline Network Rail timetable. These differences are highlighted at a high level in Chapter 2. They do not alter the conclusions of this study. Access rights are yet to be granted for

December 2018 operations so both the study baseline and GTR's 2018 specification, can only be treated as working assumptions at this stage. Confirmation of the final timetable pattern will not be in place until a full integrated timetable with connecting routes north of the river has been completed and performance modelled/ if necessary altered accordingly.

Process

The starting point for this Route Study is the Market Studies published in October 2013, and established by the Office of Rail Regulation in December 2013. The Market Studies forecast demand

for passenger and freight traffic, and propose service level 'Conditional Outputs' for the industry to meet subject to feasibility, affordability and value for money.

Detailed demand analysis has been undertaken to ascertain the expected amount of growth over the next 10 and 30 years. The analysis identifies where supply and demand is mismatched over 10 and 30 year time horizons, and thus where train lengthening or more train services might be required in peak periods.

The conditional outputs for this study include:

- The level of rail capacity required to accommodate the demand for passenger journeys and freight services
- The level of rail connectivity between large towns and cities across the area (for example, the frequency of train services, journey times, and the provision of direct journeys which do not require an interchange)
- Providing adequate connectivity to Airports

This Sussex Route Study has been developed as a result of considerable analysis and close collaboration between Network Rail, the Department for Transport, Transport for London and the passenger and freight operators. The Office of Rail Regulation has acted as an observer. Productive meetings with Local Enterprise Partnerships and local authorities have also been held.

Choices for funders in Control Period 6 (2019-2024)

The choices identified and appraised as part of the Sussex Route Study are summarised below with a more detailed account in Chapter 5.

In all cases, where support exists from funders to progress a particular option, Network Rail will need to complete further engineering feasibility to ensure sufficiently detailed costings, output definitions and delivery plans can be submitted as part of the Business Plan for CP6. All costings published in this Study must be regarded as a high level guide only at this stage and are subject to change. In the case of the BML interventions outlined below, work is now well underway to provide GRIP2 costings by Summer 2016.

The Brighton Main Line (BML): Fast line services

This group of services comprise all trains operating on the fast lines to London Bridge and London Victoria inwards of Norwood Junction/ Selhurst. This effectively includes all services using the BML south of Croydon. Figure 5 sets out the relevant routes that have services that fall into this category.

For these service groups the London and South East Market Study (2013) predicts 64 per cent and 11 per cent growth into London Bridge and London Victoria respectively in the high-peak between 2011 and 2023. By 2043 115 per cent and 34 per cent growth respectively is predicted in the high growth scenario

The Capacity Gap

The Route Study has taken the South East Market study growth and calculated the number of additional services that would be required to operate on the Fast Lines to keep seat utilisation down to 100% on average during the high peak. This analysis indicates

- 4 -6 additional trains per hour are required by end CP6 – 2023/24 over and above the end CP5 2018 baseline[1]
- 6-8 additional trains per hour are required by 2043 over and above the end CP5 2018 baseline.

The Route Study has considered the alterations to the current railway that would be required to provide the additional peak capacity to meet both the end of CP6 and 2043 demand projections. Only interventions that would deliver clear capacity outputs in both a conventional signalling and a future European Train Control System (ETCS) signalling scenario have been put forward (see Digital Railway section). Chapter 5 of this Study

[1] The precise figure of additional trains per hour required above the end of CP5 base depends on the final 2018 Thameslink Key Output 2 timetable.

packages the individual BML interventions in a number of ways which would allow for the spreading of investment over two control periods depending on affordability.

Operational planning work for the study suggests if implemented a set of key Junction and station inventions along the BML would deliver an additional 6 trains per hour in the peak over and above the end of CP5 base. If achieved, this would meet the end of CP6 and end of 2043 Demand forecasts[1]

As Figure 6 indicates the interventions could be split over two Control Periods. The intervention at Windmill Bridge and East Croydon is the most significant single project and would on its own

1 Satisfying the 2023 demand forecast in this instance is defined as reaching a target of less than 85 per cent seat utilisation at the following stations on the BML: Hove, Haywards Heath, Redhill and East Croydon. For 2043 demand the target is less than 100 per cent seat utilisation as to maintain the 2023 target would result in an unrealistic quantum of trains, work completed for 2043 shows that in that timeframe significant standing would return to the route from as far out as Gatwick Airport in the high peak, so the less than 100 per cent target would not be met on every train.

Figure 5 - BML Fast line services

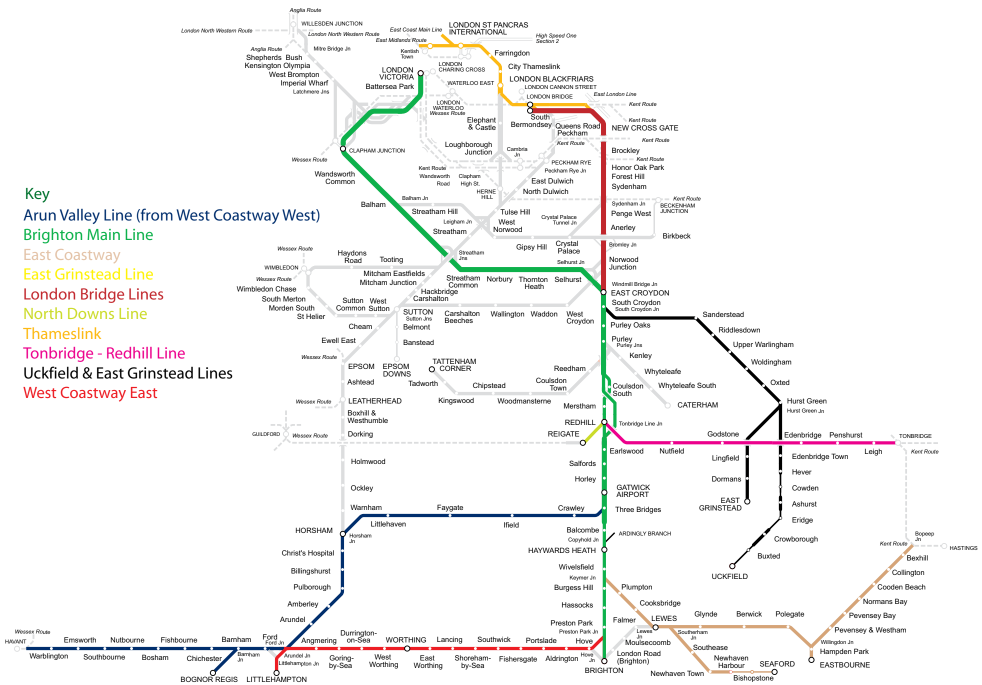


Figure 6 - Route Study Interventions on the Brighton Main Line

CP6 interventions: Core

C - Windmill Bridge Jn area grade separation and East Croydon remodelling
F - Reigate 12-car capability enhancements
G - Gatwick Airport Fast line capability enhancements
H - Haywards Heath London-end turnback enhancement

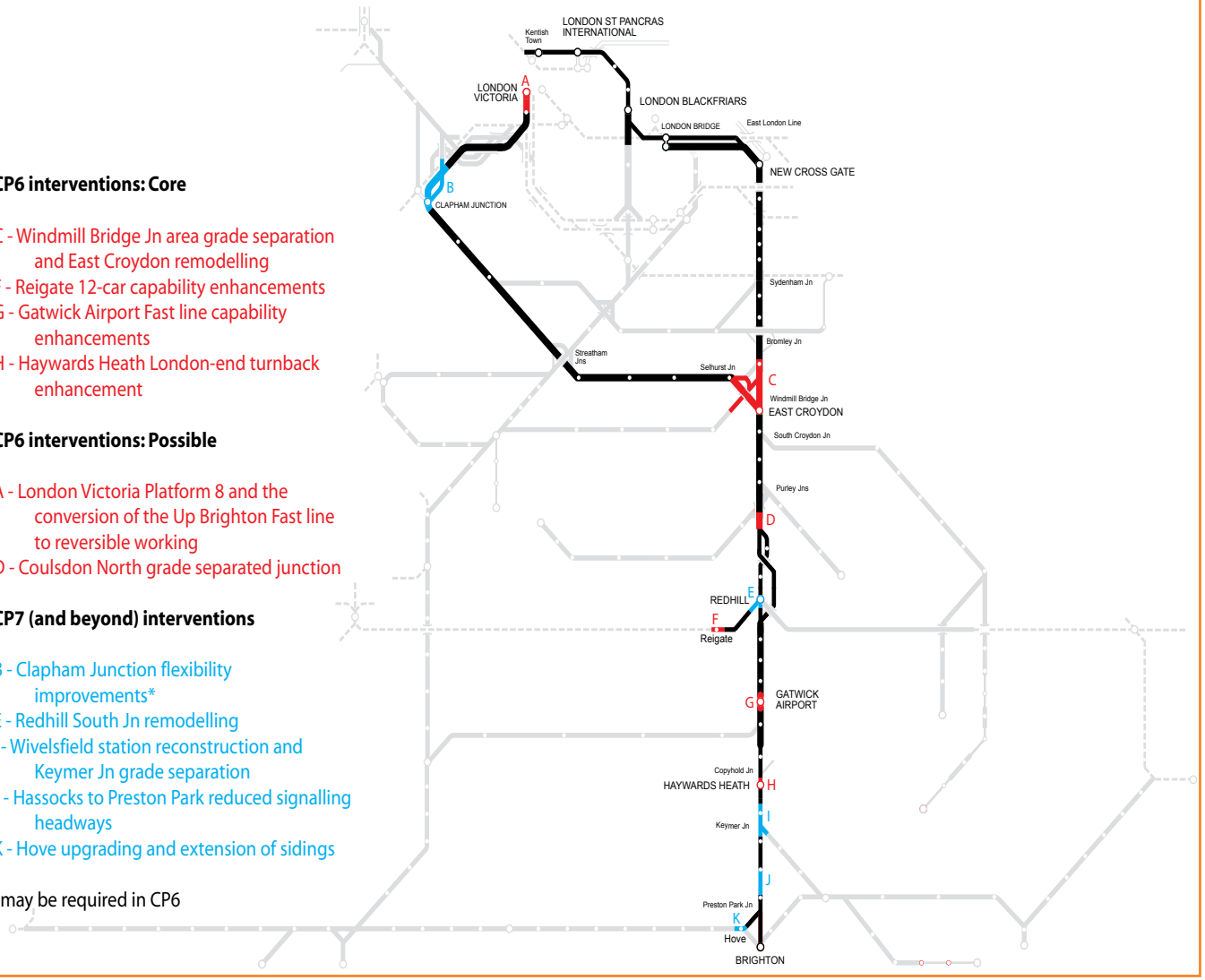
CP6 interventions: Possible

A - London Victoria Platform 8 and the conversion of the Up Brighton Fast line to reversible working
D - Coulsdon North grade separated junction

CP7 (and beyond) interventions

B - Clapham Junction flexibility improvements*
E - Redhill South Jn remodelling
I - Wivelsfield station reconstruction and Keymer Jn grade separation
J - Hassocks to Preston Park reduced signalling headways
K - Hove upgrading and extension of sidings

*may be required in CP6



be likely to release paths for an additional two to four trains per hour during the peak.

These interventions include:

Appraisals for six different option combinations of these infrastructure packages and their outputs are set out in detail in Chapter 5 and associated appendices. The more favourable option combinations offer a medium to high[1] business case at present, with performance and any wider benefits not yet added into the assessment and with cost estimates and engineering feasibility at an early stage.

As is always the case at an early stage, a number of challenges remain to be resolved in the early GRIP5[2] development phases of the above projects. For example alterations at Windmill Bridge Junction area are critical to the outputs of the programme, but solutions to grade separating the junction whilst maintaining and improving linespeed are still under development.

Timing of interventions to meet the Gap

Difficult choices now need to be made about the future development of the BML. A number of these decisions need to be made in time for implementation in Control Period 6 (2019-2024). There are three principal reasons for this.

- In CP6 – much of the main line signalling equipment is due for replacement, in particular the Norwood interlocking just north of Windmill Bridge. A one-off opportunity exists to combine improvements to layouts and signalling with these renewals.
- Demand forecasts show that by the end of CP6 demand on the route cannot be met without further interventions and crowding will be well beyond levels currently regarded as acceptable.
- Long term challenges in delivering acceptable performance on the route exist. It is no longer viable to continue to add incremental additional services to the route as it is currently configured.

The Digital Railway

The Digital Railway Programme is being developed by Network Rail and industry partners. The Programme is seeking to accelerate the introduction of new technology on the network nationally and in particular to accelerate the roll out of European Train Control Systems (ETCS) / Automatic Train Operation (ATO).

Work is still ongoing to determine a revised roll out strategy for this technology in the South East.

At this preliminary stage it is still possible however to draw some initial conclusions about the possible benefits of this technology to this particular area. These could be.

- Clapham Junction: This study has set out a complex and challenging infrastructure option to release main line capacity here in CP7, but implementation of ETCS/ATO could delay the need for such a scheme
- With ETCS/ATO delivered in the Thameslink Core (between London Blackfriars and London St Pancras International) from December 2018 and a substantial proportion of GTR's rolling stock being compatible with the systems, a logical opportunity exists to extend the technology south toward Norwood Junction and possibly beyond as part of an incremental plan.
- The Croydon area: Whilst ETCS/ATO cannot replicate the benefit of grade separation at Windmill Bridge Jn, depending on how the system develops in the future, it might provide a number of benefits in the wider Croydon area where numerous complex issues with conventional signalling lead to restrictions on speed and certain combinations of operational moves that restrict capacity.

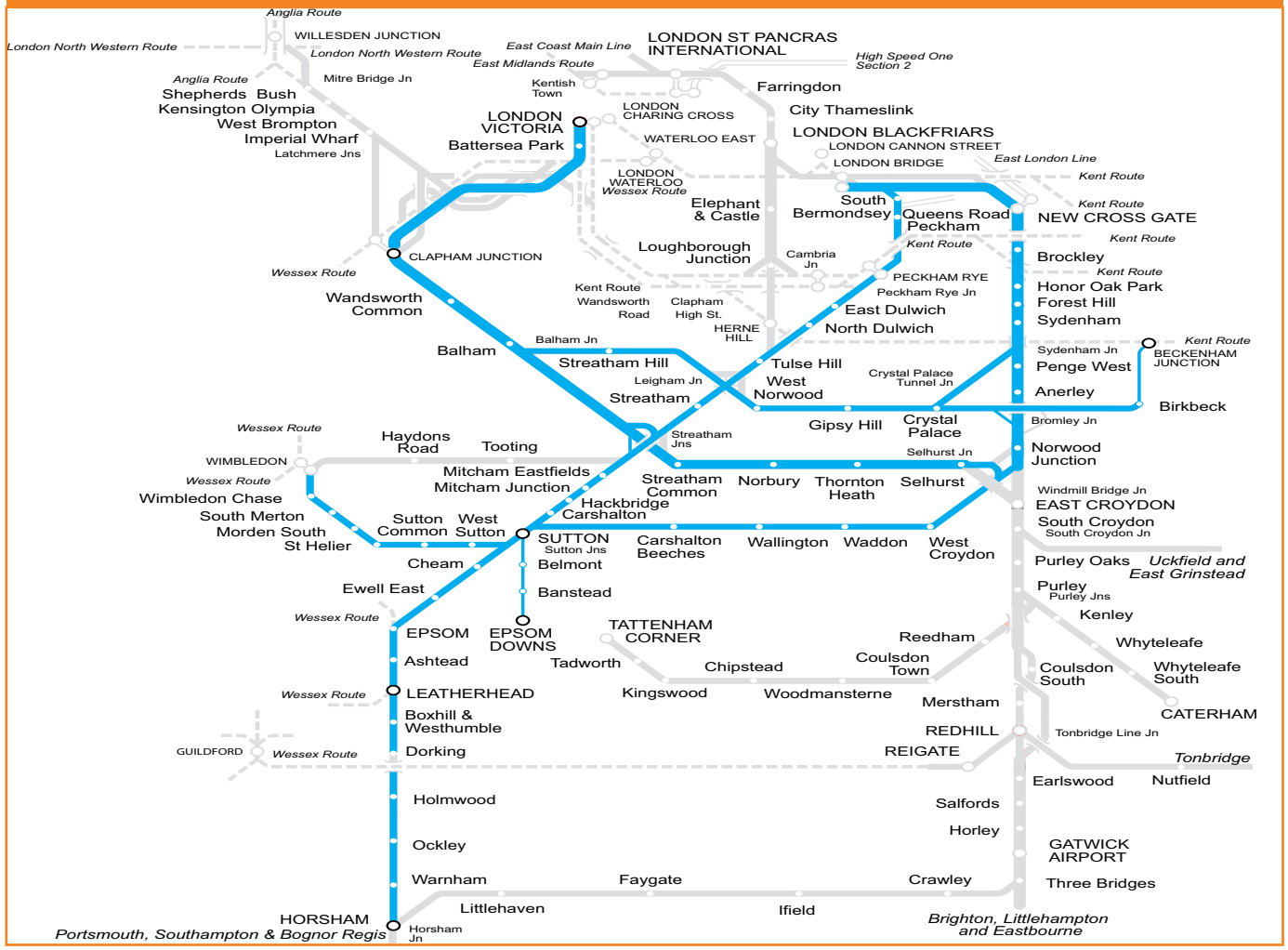
[1] Using DfT's VfM assessment guidance as at August 2012 (available www.gov.uk) a low value for money scheme has a Benefit Cost Ratio <1.5, a medium VfM scheme has a BCR of 1.5-2.0 and a high VfM scheme has a BCR of >2.0

[2] GRIP - Governance for Railway Investment Projects. This is the 8 stage process Network Rail uses to manage the development and delivery of projects.

Suburban services

The Route Study sets out the following options for the suburban area in CP6 and to 2043: Figure 7 shows the routes in question.

Figure 7 - Suburban services into London Victoria & London Bridge



London Bridge suburban routes (Tulse Hill and Sydenham corridors):

CP6 : 2019 – 2024

- 8- to 10-car operation of Tulse Hill Line services – the Route Study sets out a low business case due to the cost of platform extensions at Tulse Hill
- 4tph on the Wimbledon Loop (Tooting, Wimbledon, Sutton, Streatham services to/from Central London): Clockwise and anti-clockwise, peak and off peak with 2tph to London Bridge. This has a medium to high business case and would solve much of the Tulse Hill Line Crowding in the peak.
- If the 4tph option does not pass performance modelling tests, train lengthening is the only other option.

Beyond CP6: 2024-2043

- The analysis indicates that if both of the above interventions are implemented alongside changes to the interiors of suburban rolling stock 2043 demand can be met.

London Victoria suburban routes:

CP6: 2019 -2024

- The study notes extensions of all trains from 8 to 10-car operations during the peak has recently successfully been completed in December 2013
- The study proposes that for CP6, further capacity is likely to be best achieved via changes to seating configurations in Class 377 and 455 rolling stock rather than more infrastructure investment.

Beyond CP6: 2024-2043

- By Control Period 7 (2024-2029) it is recognised that a move from 10 to 12-car operation would be required on these services if demand is to be met. This would necessitate a further platform lengthening programme. In the meantime the Study recommends that renewals plans take into account the medium term aim of 12-car capability.
- An alternative hub based frequency enhancement option developed by Transport for London is also set out in Chapter 6. This option requires significant infrastructure but has some synergies with the CP6/CP7 BML options set out in section 2.1. Network Rail will be working closely with TfL to further develop this concept.

West London Line

The study notes the recent successful completion of 8-car platform extensions on the West London Line (WLL), the commencement of 8-car operation by Southern and the recent start of 5-car operation by London Overground Rail Operations Limited (LOROL)

CP6: 2019 -2024

- The study outlines that by the end of CP6 moving to a 10tph peak service frequency on the WLL is likely to be required if demand is to be met
- A number of interventions that would support resilience of operation when a 10tph peak timetable is in operation are set out including – reopening of Platform 0 and associated works at Clapham Junction

Beyond CP6: 2024-2043 –

- It is recognised that to meet background growth and the impact of connection of the WLL to Old Oak Common in CP7, a move to make further use of the 8-car capability delivered in 2014 will be definitely be required. This would ultimately involve LOROL services operating at 8- rather than 5-car and has implications for through running of services onto the North London Line (which is not yet 8-car capable).
- This requirement also has implications for the development of Platforms 0 & 1/2 at Clapham Junction, at least one and almost certainly two 8-car capable platforms will be required here. The CP6 scheme assessing the cost of re-opening Platform 0 will also provide costs for delivering Platform 0 as an 8 car Platform.
- Consideration is given to through operation of trains to the WLL from further south than Croydon, but the need for new grade separated access between the fast and slow/WLL lines in the Clapham area to achieve this means such an option would be very expensive and disruptive to deliver for peak services.

East London Line:

- The study notes the recent move from 4- to 5-car operation for LOROL services
- The study outlines that by end CP6 if demand is to be met two additional trains per hour would be required in the peak. West Croydon is ruled out as an origin point for these services for performance reasons. Paths are identified from Crystal Palace, although further work is required on empty stock pathing and performance issues before this option is regarded as feasible to implement.

Other key options and conclusions

North Downs Line (inter regional Reading – Guildford – Gatwick Airport route)

- The study sets out timetable options that would improve connectivity to Gatwick Airport. This includes consideration of a 3tph option on the North Downs (two Gatwick and one Redhill terminator) and the associated interventions that would be required to support this level of service. These include works at Redhill, Guildford and on level crossings.

Diversionary Routes for the BML

- The study sets out a costed option to build a short stretch of new line near Arundel to provide diversionary access to the BML. The business case calculated is low, primarily due to the small number of services that can be diverted at times of disruption due to the permanently limited number of west facing platforms at Brighton.
- Consideration is also given to the long term value of a reopened Lewes – Uckfield line as a diversionary route for the BML. The Study finds that like the Arundel Chord, only limited benefits would accrue at times of major disruption. As with the Arundel Chord this is due to the limited number of BML services that could actually be diverted via the route during a major incident.

Stations

A number of interventions to improve passenger capacity at stations are also identified as necessary in CP6, these locations include East Croydon (expansion of main concourse) and Tulse Hill (improvements to passenger flow on and between platforms and exits).

Acknowledgements and next steps

This Route Study has been developed through a process of wide industry collaboration, and the Route Study team wishes to acknowledge the considerable assistance provided by industry stakeholders and others in the development of this document. The consultation which ran from November 2014 to mid-January 2015 produced a wide set of responses and these are fully detailed in Chapter 4 of the Study. In some cases further pieces of work have been undertaken in response to specific questions and suggestions.

Network Rail has already begun more detailed engineering feasibility and further rounds of operational planning work on some of the key options set out in the study relating to the Brighton Main Line and also to some of the suburban/ orbital options. This means that by the time the IIP (Initial Industry Plan) for CP6 is published in September 2016, choices for funders in relation to capacity and performance on this route for CP6 will be set out in substantial detail.

1.0 Background

1.1Background

Since the late 1990s the national rail network has enjoyed a period of unprecedented growth. More passengers are using the network than ever before and the increase in the amount of goods transported by rail is considerable. The Department of Transport (DfT) recognises that the provision of attractive rail services is a significant driver of economic growth and this recognition is demonstrated by Governments' continuing desire to invest significantly in the provision of railway services, most recently through Network Rail's Control Period 5 (CP5, 2014 – 2019) Delivery Plan which proposes significant enhancements to the national network.

The Market Studies which form part of the overall Long Term Planning Process (LTPP), and which were published in 2013, suggest that demand for rail services is going to continue to grow strongly across all sectors. The studies also articulate the economic and demographic factors that continue to work in rail's favour before suggesting a number of service level conditional outputs that will deliver the DfT's strategic goals of:

- Encouraging economic growth
- Reducing environmental impact
- Improving the quality of life for communities and individuals.

It is against this background that the railway industry, working collaboratively, has developed this Route Study to present the case for further investment in the network for Control Period 6 (CP6, 2019 – 2024) and beyond to 2043.

1.2 The Long Term Planning Process

The LTPP was endorsed in April 2012 by the then Office of Rail Regulation (ORR - renamed the Office of Rail and Road in April 2015) to meet the requirements of Network Rail's network licence to use and develop the network so that it is consistent with funding that is, or is likely to become, available.

The LTPP is designed to enable the railway industry to take account, and advantage, of long term strategic investment being made in Great Britain's rail network. The planning horizon for the LTPP is 30 years and it is intended to adapt to potential structural changes in the economy and the approach to social and environmental responsibility, so that the rail industry can respond to change over the long-term life of the assets used to operate the rail network.

The LTPP will be an iterative process in which future planning cycles will enable an updated view to be taken of the changing context and requirements of the industry and economy. A key objective of the LTPP is to understand the longer term strategy whilst creating a prioritised view of requirements for the next Control Period (in this case CP6). In this planning cycle the prioritisation of requirements for CP6 will commence with the submission of the Initial Industry Plan (IIP) in September 2016. Future iterations of the LTPP will evolve, identifying requirements for future Control Periods as part of this on-going process.

The LTPP consists of a number of different elements, which, when taken together, seek to define the future capability of the rail network. These elements are:

- Market Studies, which forecast future rail demand, and develop conditional outputs for future rail services, based on stakeholders' views of how rail services can support delivery of the market's strategic goals
- Route Studies, which will develop options for future services and for development of the rail network, based on the conditional outputs and demand forecasts from the market studies, and assess those options against funders' appraisal criteria in each of Network Rail's devolved Routes
- Cross-boundary analysis, which will consider options for services that run across multiple routes to make consistent assumptions in respect of these services.

1.3 Market Studies

In October 2013, Network Rail published four Market Studies: Long Distance passenger, London and South East passenger, Regional Urban passenger and Freight. All four have been established by the ORR and are available on the Network Rail website, Network Rail Long Term Planning Process.

The three passenger Market Studies have clear connections to the three 'sectors' in which passenger train services are often divided. It

is important to emphasise that each Market Study considers a particular market, rather than a particular set of train services. The passenger Market Studies have three key outputs:

- Identification of the long term strategic goals which define the successful provision of rail services to each of the three passenger market sectors. These are based on the aspirations of current and likely future industry funders
- Demand forecasts for the sector, over a 10- and 30-year planning horizon. Scenarios are used to reflect key uncertainties, where appropriate
- Conditional outputs for the sector. The conditional outputs are aspired levels of service (in terms of, for example, frequency, journey time and/or passenger capacity on key flows in the sector).
- The conditional outputs reflect stakeholder views of how rail can support delivery of their strategic goals, and opportunities created by planned investments, as well as reflecting current service levels and forecast future demand. The aim of the market studies is to provide demand forecasts, and conditional outputs, that are consistent across the Route Studies.

For freight the conditional outputs are to meet the forecast level of freight set out in the Freight Market Study in 2023 and 2043. The Freight Market Study produced demand forecasts over a 10 and 30 year planning horizon, with preferred routeing of services and the implied requirements in terms of network capacity and capability. Further details on freight growth nationally, and within the Sussex Area, are included within Chapter 5.

Conditional outputs should be viewed as aspirations for the future rather than recommended investment decisions. It is also important to state that the conditional outputs are dependent on affordability, fundability, and a value for money business case. Equally the conditional outputs will need to be deliverable technologically, operationally and physically.

1.4 Route Studies

Building upon the Market Studies, the Route Studies develop and assess a series of choices that aim to meet the conditional outputs that were previously identified. The first step in developing these choices is to determine whether the conditional outputs can be accommodated on the existing rail network with enhancements that have already been committed for delivery.

Once this is determined it is important to assess the potential for train service options that would not require any infrastructure interventions. It is only when these two preliminary steps have been taken that the Route Study considers infrastructure based choices.

As previously stated the choices identified within this route study are intended to inform the development of proposals to consider within rail industry funding discussions for CP6. Equally, other potential rail industry funders, for instance Local Authorities or Local Enterprise Partnerships, may wish to consider the information this Route Study contains, when taking forward their own plans and proposals which may impact upon the rail network.

The Route Study takes account of a number of rail industry priorities and initiatives. These are:

Safety

Network Rail set out its vision for safety in its 'Transforming Safety & Wellbeing' vision and strategy through to 2024. Many of the choices for funders set out in this document are at an early stage of development and safety will be considered in depth as proposals are developed. It should be noted, however, that choices that involve proposals such as those to remove junction conflicts, eliminate level crossing movements or ease the flow of passengers at stations will improve the safe operation of trains for both passengers and freight.

Performance

The performance objectives for the rail industry in CP6 are not yet known. However, it has been assumed for the purposes of this Route Study that performance will continue to be an important consideration and trade-off when determining what choices will ultimately be taken forward to meet the identified conditional outputs.

Resilience

The resilience of the rail network has become an increasingly important strategic consideration. This is particularly the case in light of the winter storms of 2014 where lines were blocked or washed away causing significant delays and a number of line closures, not least at Dawlish on the Great Western Main Line south west of Exeter which resulted in the closure of the line to Plymouth, Paignton and Cornwall for eight weeks.

As part of this Route Study the rail industry has considered the outputs from work on resilience that Network Rail has undertaken. Each Network Rail Route has developed a Weather Resilience and Climate Change Adaptation Plan (WRCCA). For the Sussex Area the WRCCA was published at the end of September 2014. This document has set out a management plan for weather resilience and climate change supported by an evaluation of the resilience of rail infrastructure to historical weather events and an awareness of potential impacts from regional climate change projections.

The Digital Railway

The Digital Railway is an industry-wide programme designed to benefit Great Britain's economy by accelerating the digital enablement of the railway.

The programme sets out to build the industry business case to accelerate the digital-enablement of the railway in several key areas, including infrastructure, train operation, capacity allocation, ticketing and stations.

The output of the programme will be a business case to Government, presented through the Initial Industry Plan in September 2016. For the purpose of the Sussex Route Study, infrastructure assumptions on changes to signalling have been examined where the digital railway could help achieve conditional outputs.

Interoperability

The Railways (Interoperability) Regulations 2011 and associated Technical Specifications for Interoperability (TSI) apply to the entire UK rail network with the exception of the exclusions defined on the DfT website.

European and UK legislation defining objectives for Interoperability and the Trans European Transport Network (TEN-T) have been taken into account in the development of this Route Study.

For works being carried out on the UK component of the TEN-T network, European Union funding support is available for qualifying projects. Network Rail will work with the DfT to ensure that the UK takes maximum benefit from this opportunity.

Declarations of congested infrastructure

When Network Rail receives more requests for train paths to be included in the Working Timetable than can be accommodated on a section of line, the section of line concerned should be declared as 'Congested Infrastructure' under paragraph 23 of The Railways Infrastructure (Access and Management) Regulations 2005.

If infrastructure is declared as congested Network Rail will undertake and publish capacity analysis within six months under paragraph 23 of the regulations. Then Network Rail will also undertake a capacity enhancement study and publish that within a further six months under paragraph 24 of the regulations.

Accessibility and diversity

Network Rail's vision is to provide world-class facilities and services to everyone who uses the network. For the passenger interface this is particularly around stations where Network Rail seeks to make all stations:

- Safe
- Accessible and inclusive
- Efficient in the way we use natural resources and manage waste
- Focussed on the needs of all Network Rail customers
- Staffed by a competent, high quality team

Travelling by train should be as easy as possible for everyone who uses the railway network, irrespective of their age, disability, race, religion or belief, sex, or sexual orientation. This brings Network Rail in line with the Public Sector Equality Duty (PSED).

Network Rail receives specific funding for accessibility at stations through the Access for All (AfA) fund and will continue to design infrastructure that meets all accessibility legislation.

1.5 Cross-Boundary Analysis

Services that run across more than one Route Study area are considered in a separate cross-boundary workstream but form an integral part of the overall strategy for each route. This specific workstream has developed and assessed options for cross-boundary services (passenger and freight).

The output from the cross boundary analysis is a set of common assumptions that Route Studies should adopt regarding these services. Assumptions include the frequency and calling pattern of passenger services and the frequency and operating characteristics (e.g. gauge, speed, tonnage) of freight services.

1.6 LTPP Governance Arrangements

The LTPP is designed to be as inclusive as possible with contributions encouraged both from the rail industry and wider stakeholders. Overall governance responsibility for the process lies with the Rail Industry Planning Group (RIPG) whose membership comprises:

- Department for Transport (DfT)
- Freight Operating Companies (FOCs)
- London Travel Watch
- Network Rail
- Office of Rail and Road (ORR)
- Passenger Focus
- Passenger Transport Executive Group (PTEG)
- Rail Delivery Group
- Rail Freight Group
- Rail Freight Operators Association
- Railway Industry Association
- Rolling Stock Leasing Companies
- Train Operating Companies (TOCs)
- Transport for London (TfL)
- Transport Scotland
- Welsh Government

RIPG meets bi-monthly and provides strategic direction and endorsement of the constituent publications of the LTPP process.

1.7 Route Study Governance Arrangements

A three-tier structure for rail industry and wider stakeholder dialogue was established to oversee and help produce this Route Study.

A Programme Board, chaired by the Route Managing Director for Sussex with senior level representation from passenger and freight train operating companies, Rail Delivery Group, TfL, DfT and the ORR provided a high-level review function and a forum to resolve any significant issues which the Working Group remitted to the board for decision.

A Working Group, chaired by Network Rail, with a mandate to discuss the study on behalf of the rail industry. The Working Group determined how the conditional outputs from the Market Studies could be accommodated, including identification of service specifications and options with the aim of developing choices for CP6 and to 2043.

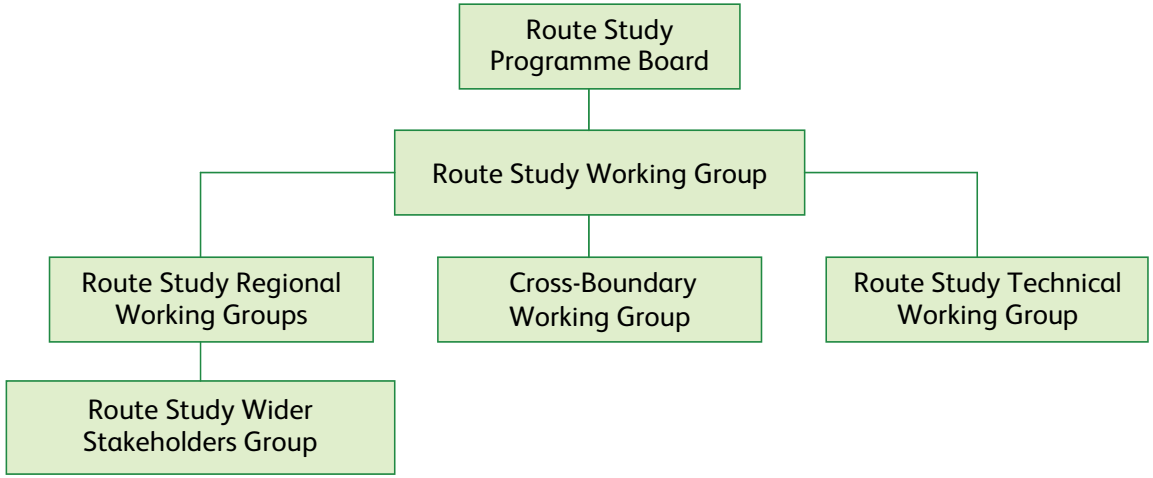
The working group comprised representatives from the current Operating Companies (both passenger and freight) who operate on the route, Rail Delivery Group, DfT, TfL, Network Rail, and the ORR as an observer.

A Regional Working Group, chaired by Network Rail, provided location specific oversight as well as an opportunity for collaboration outside the rail industry. The Regional group membership comprised Local Authorities, Local Enterprise Partnerships, Department for Transport, Airports and Freight stakeholders on the route.

Network Rail has managed the development of the work through an internal Technical Working Group to deliver the information necessary to support the deliberations of the Working Group, augmented as appropriate by discussions with rail industry stakeholders.

Wider stakeholders on the route, such as user groups, were consulted during the consultation process to ensure that specific local considerations were addressed or noted.

Figure 8 - Sussex Route Study Governance Structure



1.8 Document Structure

The remainder of this document, is structured as follows:

Chapter 2: Baseline including already planned changes to Infrastructure and services

Chapter 3: Future Demand and Resulting Conditional Ouputs

Chapter 4: Consultation Responses

Chapter 5: Control Period 6 – priorities for funders

Chapter 6: Accommodating the conditional outputs in 2043

Appendix A - Economic Appraisals

Appendix B - Summary schematic drawings of layout options in Chapter 5

The original Chapter 4 covering cross-boundary analysis in the Draft Route Study now forms **Appendix C**.

This document has been published on behalf of the Rail Industry exclusively on Network Rail's website.

2.0 Baseline

2.1 Geographic Scope

The Sussex Area Route Study covers the former Network Rail Sussex Route, which broadly reflects the former Southern Railway franchise area (the recently completed changes to franchise operators and the relevant dates of those changes are covered in Section 2.3).

The geographic scope covers most of East and West Sussex, as well as parts of Surrey, Kent, Hampshire and south London.

The railway operation is centred on the Brighton Main Line (BML), which forms a central spine between London and the south coast and towns such as Eastbourne, Brighton, Littlehampton and Bognor Regis. Several lines diverge from the BML along its length. The Arun Valley line connects to the BML south of Gatwick Airport, providing services to the coast via Horsham. The North Downs line provides services to/from Tonbridge to the east and services to/from Dorking, Guildford and Reading to the west. The East and West Coastway lines along the Sussex coast provide services which are centred on Brighton. These services extend to Havant in the west and Hastings in the east.

Additionally, the South London suburban network incorporates the branch lines to Tattenham Corner, Caterham, East Grinstead and Uckfield; and the inner suburban commuter routes. The West London Line provides orbital services from the Croydon and Clapham Junction areas to Shepherd's Bush, Willesden Junction and the North London Line. Freight services use the West London Line (WLL) to link destinations to the north, east and west of London with Kent, Sussex and the Continent through the Channel Tunnel. Likewise, to the east, suburban services from Clapham Junction, West Croydon and Crystal Palace provide orbital services via the East London Line (ELL).

Since the Long Term Planning Process (LTPP) started, the Network Rail previously devolved Sussex and Kent Routes have merged to form the South East Route with a central management team covering the day-to-day operational management of the newly established route. Given specific issues on the BML and in the former Sussex Route area, the Route Study Board , whose role it is to direct and oversee the study, agreed to produce a full Route Study dedicated to this specific geographical area. Figure 9 shows the geographical scope of the study.

The remainder of this chapter covers some of the key characteristics and issues facing the route today. Greater detail on the capability of the Route as it stands today can be found in the Sussex Network and Route Specifications.

2.2 Route Characteristics

2.2.1 Signalling and control

Trains are currently signalled from numerous signal boxes and area signalling centres across the Route. Signalling control is due to be centralised at Three Bridges Route Operating Centre (ROC) which opened in Control Period 4 (CP4, 2009-14) and is planned to be fully operational over successive control periods.

The consolidation of all the signalling into the ROC will see modern technology, such as traffic management systems, eventually offering improved control of the train movements. Figure 10 shows the intended resignalling and recontrol for Control Periods 5 (CP5, 2014-19), 6 (CP6, 2019-24) and beyond. As Chapter 1 notes, the industry is currently reviewing the programme for roll out of the European Rail Traffic Management System (ERTMS), the current plans would not see the full system in place in most of the Sussex Route area until the 2040's but this could change.

ERTMS is being introduced in parts of the UK presently and has two main components. The Global System for Mobile communications – Railway (GSM-R) has been installed across the network providing secure and reliable communications between train driver and signaller; and the European Train Control System (ETCS) will be deployed on a longer timescale. ETCS sees the signalling of trains move from the lineside to within the driver's cab.

ETCS Level 2, which provides a 'fixed block ' system of train detection (such as axle counters which count the number of axles entering and exiting a particular track section), will be installed as part of the Thameslink Programme through the core section between London St Pancras International and Blackfriars in 2018. This will be operated in conjunction with Automatic Train Operation (ATO) and traffic management systems with the aim of delivering the planned 24 trains per hour (tph) frequency through this section. Further deployment of this technology is anticipated in the future and is discussed in Chapters 5 and 6.

Figure 9 - South East Route: Sussex Area Route Study geographical scope

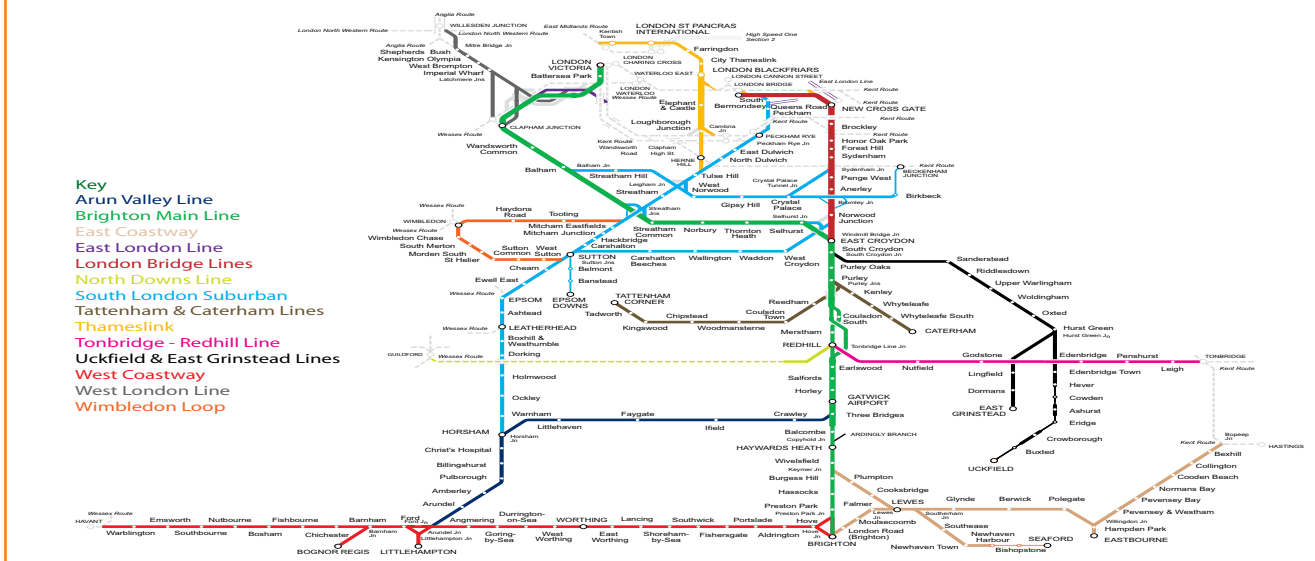
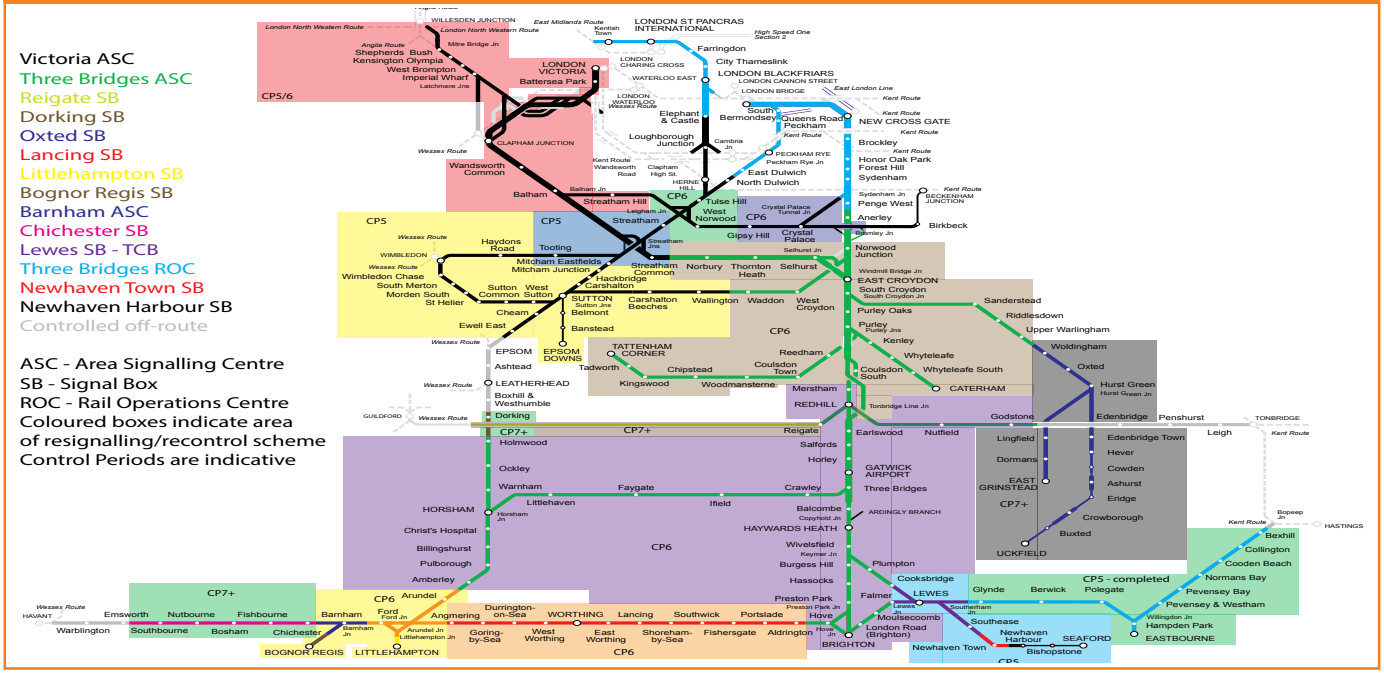


Figure 10 - Resignalling and recontrol



2.2.2 Electrification

The vast majority of the study area is electrified with 750V DC through a conductor (or third) rail. There are interfaces with adjacent routes that are electrified with 25kV AC overhead line equipment in addition to the conductor rail for a short section, such as between City Thameslink and Farringdon.

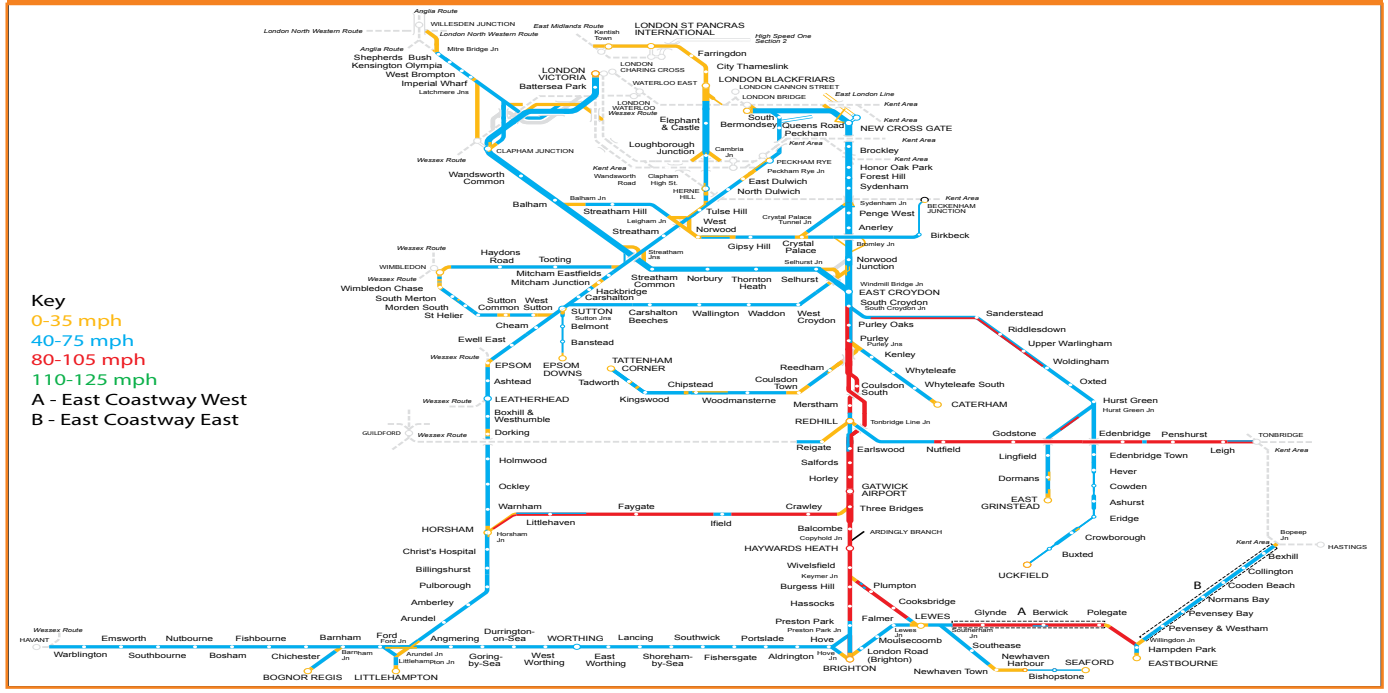
The North Downs Line between Redhill and Guildford, the Uckfield Line between Hurst Green and Uckfield and the East Coastway between Ore and Ashford International are non-electrified and operated by diesel multiple units. In the case of all three lines, diesel rolling stock also operates on adjacent electrified lines for significant parts of the journey. The Network RUS: Electrification is due to be published as a draft for consultation in 2015/16 and will review the case for in-fill electrification schemes.

2.2.3 Linespeeds

The BML south of South Croydon is generally 90mph to Preston Park as is Horsham to Three Bridges, Keymer Jn to Lewes Tunnel and South Croydon Jn to Woldingham. Generally, the maximum linespeed on the rest of the Sussex Area is 75mph, although many sections are faster or slower due to curvature, gradients, structures or density of traffic. Figure 11 shows the current linespeeds across the Sussex area.

Network Rail is working with the passenger and freight train operating companies to improve journey times where service level aspirations are higher than that of today. Increasing permitted linespeeds or removing speed restrictions usually requires improvements to each of the core elements of the infrastructure – track, signalling, gauging, geotechnical (civil engineering concerned

Figure 11 - Linespeeds on the Sussex area



with the engineering behaviour of earth materials, e.g. embankments), structures and power supply. Hence, opportunities to improve journey times at an acceptable cost are often linked to planned renewals whereby the overall cost to deliver the enhancement can be reduced as a consequence.

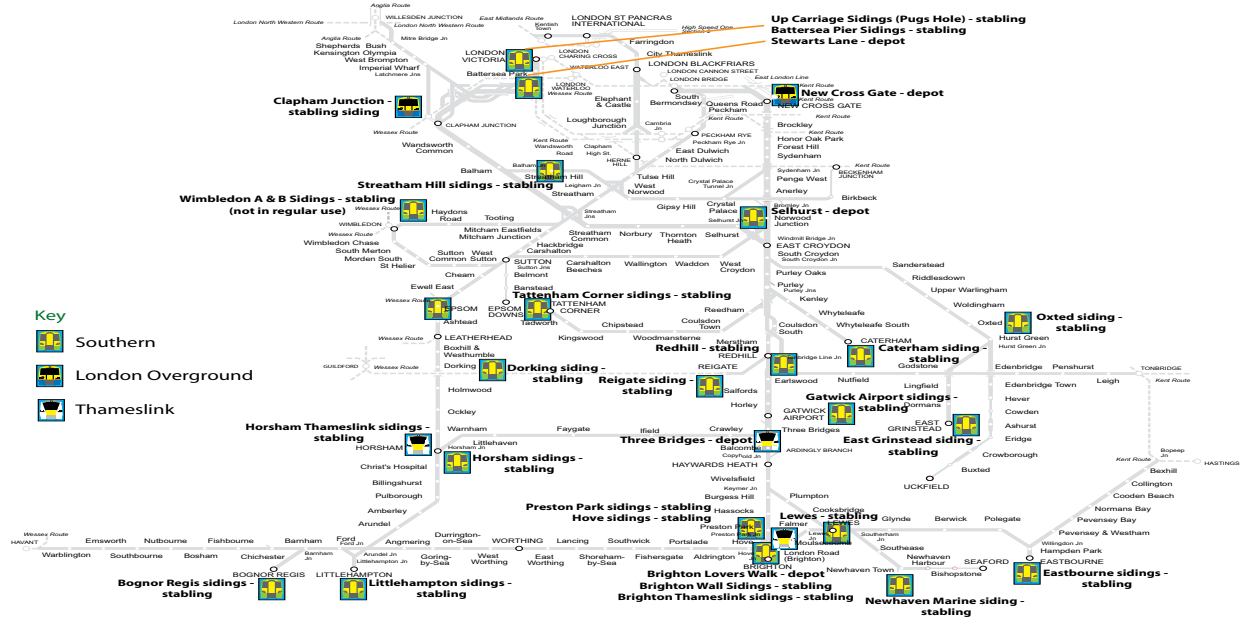
As part of the early phase of the East Sussex Coast Resignalling Scheme, the new signals have been positioned for 90mph operations. The East Coastway West section (labelled 'A' in Figure. 11) between Glynde and Hampden Park was raised to the increased linespeed soon after the new signalling had been commissioned. The eastern section (labelled 'B'), between Hampden Park and Bo-Peep Junction near Bexhill, will be upgraded in due course to allow the full potential of the new infrastructure, however timescales are yet to be finalised as the improvement is dependent on a number of non-signalling related issues.

2.2.4 Depots and Stabling

Trains are maintained at various depots in the Sussex area. Selhurst, Brighton Lovers Walk and Stewarts Lane are the major depots for the former South Central franchise, where heavy maintenance is carried out. In addition to the major depots, there are stabling and carriage servicing sidings across the study area, such as those at Streatham Hill, Littlehampton, Eastbourne, Leatherhead, Hove and Caterham.

The Thameslink Programme is delivering a new maintenance and cleaning depot south of Three Bridges station. This facility will be responsible for the cleaning and maintenance of part of the Class 700 fleet of trains. A similar depot is being constructed at Hornsey, in North London. New carriage servicing sidings have been constructed at Brighton, opposite Lovers Walk Depot, and are under construction at Horsham. Figure 12 shows the depots and stabling facilities across the Sussex area.

Figure 12 - Depots and stabling facilities



2.2.5 Performance

Figure 13 shows the Public Performance Measure (PPM) trend for the South Central franchise area since 2002/03 and compares it with the passenger demand trend across London and the South East during the same period. Although performance reached an historic high in 2010/11, train punctuality has subsequently reached a plateau.

During this period more people than ever before are using these services. This underlines the key challenges on this part of the network – providing capacity to meet burgeoning passenger demand; and ensuring that performance is maintained at an acceptable level.

The causes of the performance issues are varied. The route has endured many high impact events in recent years, including weather related incidents. Notwithstanding these, the track layouts and the particular nature of train movements on the route are such that the knock on impact of even minor incidents can be significant. The plethora of flat junctions and the many movements of trains between slow and fast lines are a key factor here.

Figure 13 - Sussex Route Study - Performance & Demand

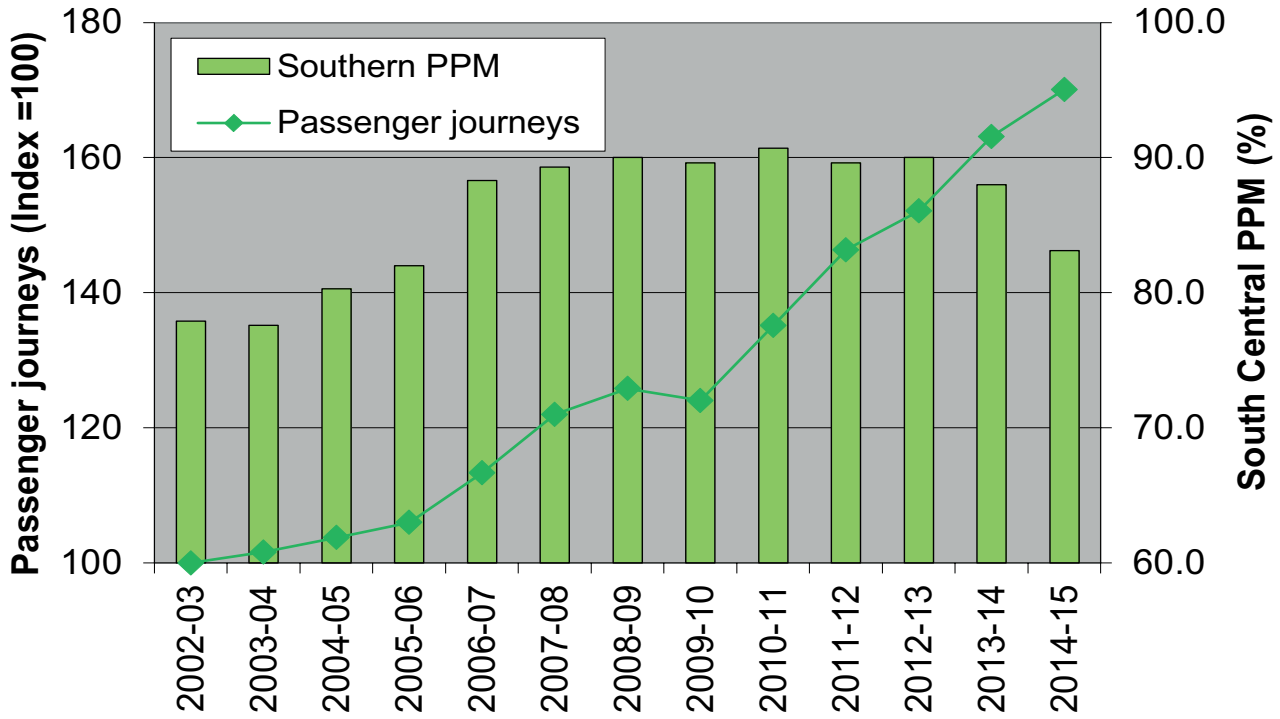
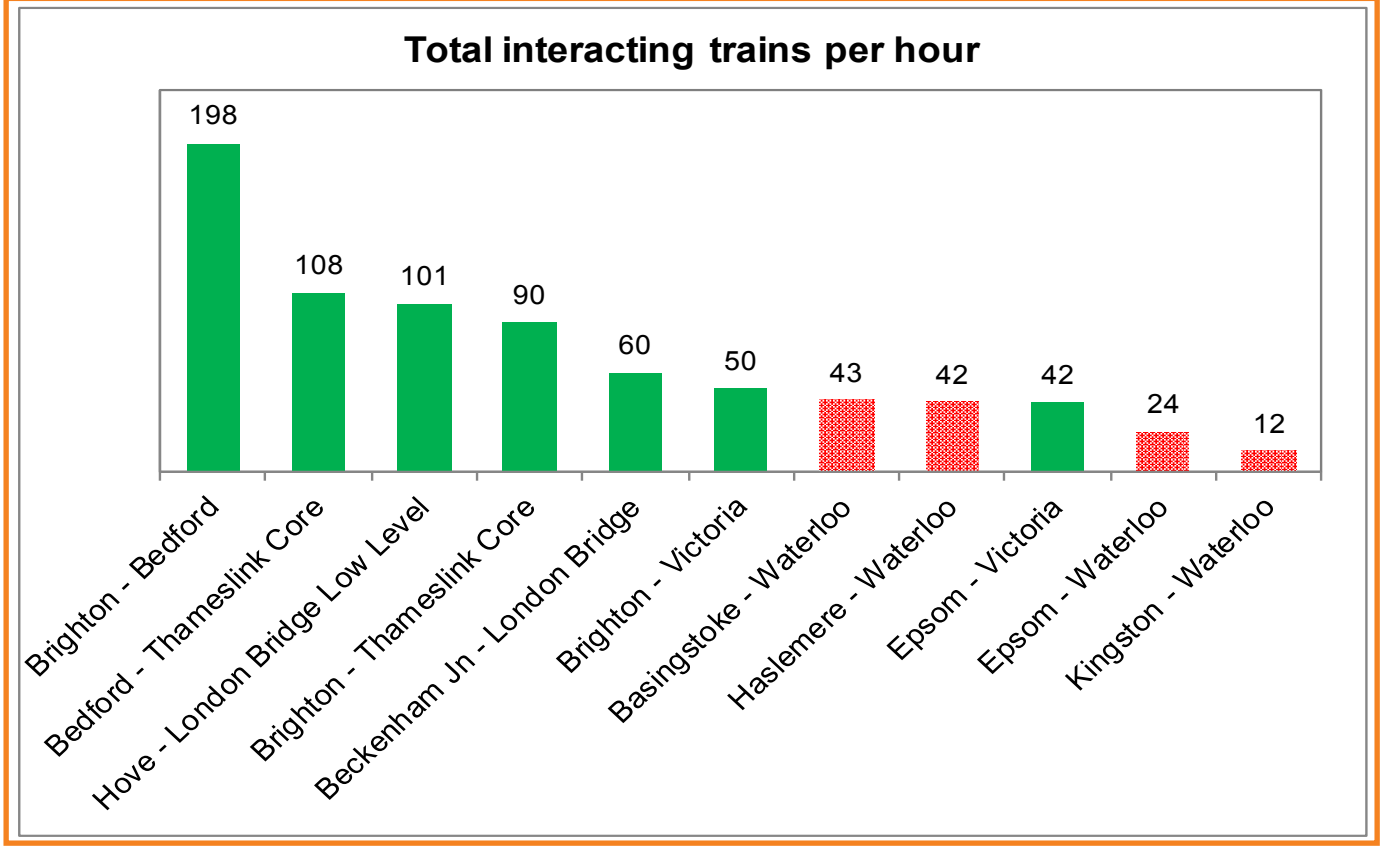


Figure 14 shows the number of potential conflicting moves different service groups on the BML and Sussex suburban routes have to contend with in a peak hour versus comparable similar distance service groups on the adjoining Wessex Route.

The intensive operation of the route and the current configuration of the infrastructure at key locations do have a daily impact on performance. The approaches to London Victoria via Balham and Clapham Junction; and the lines in and around East Croydon experience significant levels of reactionary (or knock-on) delays as a result of incidents elsewhere on the network.

Figure 14- Conflicting moves by train service group Sussex versus Wessex



Figures 15 & 16 shows the top ten Train Running System (TRUST) sections for weekday congestion delay for both Southern and Thameslink (formerly First Capital Connect) for the financial year 2014/15.

Congestion delay is typically where a train loses time when following, or regulated behind, a preceding/conflicting service. In this analysis, the use of weekday congestion delay serves to highlight locations where the route is utilised most intensively.

Recent Challenges at London Bridge

Recent performance has been a well-publicised challenge on Sussex Area. The Thameslink works to rebuild London Bridge have taken their toll on performance as the approaches to the Sussex-side platforms (10-15) have been reduced to 3-tracks from four over an extended distance. This will revert back to 4-tracks as further phases are completed.

Another key issue for the station has been the loss of the mid-platform link bridge which helped to split the flow of passengers alighting from the trains by taking those interchanging to the other platforms rather than forcing everyone to walk the length of the train to exit the platform at the buffer stop-end. This situation should improve in Summer 2016 when the Sussex section of the new concourse is opened, passengers will then be able to exit the station at street level to St Thomas Street. The platforms are narrow at the future entrance/exit escalators and lifts so most passengers have to alight before passengers are allowed to board the trains, affecting dwell times and causing delays during the peaks.

A plan has been developed to reduce the delay to services, details of which can be found on the Southern, Thameslink or Network Rail websites.

What has been highlighted by the various incidents is that even a minor incident can cause knock-on delay to other trains that spreads delay across the network. The sheer number of trains, particularly in the off-peak, has reduced the opportunity to recover the train service, this is exacerbated by the flat junctions across the Sussex Area which result in trains waiting for other trains to cross in front of them, similar to a phased traffic light controlled junction on the roads. Grade separated junctions, similar to motorway flyovers, see these trains traversing physically separated lines and, therefore, not affecting each other, but unfortunately unlike other main line routes in the UK the BML has few of these junctions currently in operation.

Figure 15 - Top 10 TRUST sections for weekday Southern congestion delay - financial year 2014/15

Rank	TRUST section	Delay (minutes)
1	Balham to Clapham Junction	17,068
2	London Victoria	15,577
3	Purley to East Croydon	15,301
4	Earlswood (Surrey) to Gatwick Airport	11,822
5	Balham to Selhurst	11,000
6	Selhurst to East Croydon	10,680
7	Clapham Junction to London Victoria	10,330
8	Selhurst to Balham	9.616
9	Battersea Park to London Victoria	9.446
10	East Croydon to Selhurst	8,800

Figure 16 - Top 10 TRUST sections for weekday First Capital Connect/ Thameslink congestion delay - financial year 2014/15

Rank	TRUST section	Delay (minutes)
1	Earlswood (Surrey) to Gatwick Airport	4,239
2	West Hampstead Thameslink to St Albans City	2,758
3	Norwood Junction to East Croydon	2,758
4	Bricklayers Arms Jn to London Bridge	2,009
5	Keymer Jn to Preston Park	1,957
6	Flitwick to Bedford	1,810
7	Three Bridges to Gatwick Airport	1,623
8	East Croydon	1,593
9	Haywards Heath to Balcombe Tunnel Jn	1,589
10	St Albans City to Luton	1,560

2.2.6 Enhanced infrastructure in CP4 and CP5

The Sussex RUS was published in January 2010 and its conclusions provided a clear set of capacity recommendations for CP5 for the BML. These are listed in Figure 17. This table also provides a reminder of the outputs of the Thameslink Programme which will upgrade and expand the Thameslink route across central London.

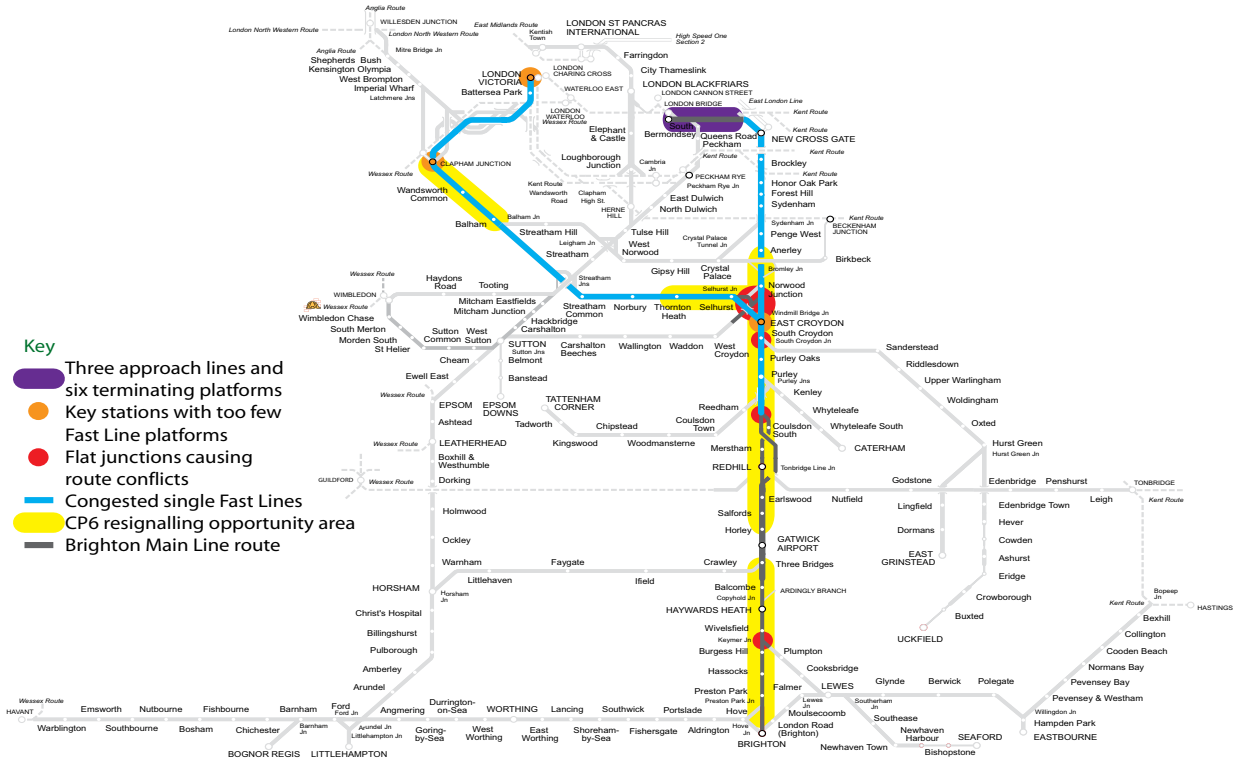
Figure 17 - Sussex RUS/ London and South East RUS conclusions and Thameslink Outputs impacting the Study area

Scheme	Output	Expected completion date
Thameslink Key Output 2	Extensive reconstruction of London Bridge station and approaching lines to deliver: • 4 tph Brighton to/from Thameslink Core via London Bridge 12-car in the peak (rather than current 3-4 tph predominantly via Elephant & Castle at 8-car) • Extension of some Brighton Main Line to London Bridge services to stations on London North Eastern and East Midlands Route (Midland Main Line and East Coast Main Line) and Anglia Route • Up to 24 tph through the Thameslink Core (London Blackfriars to London St Pancras International) • Full fleet introduction of Class 700 trains which have been purpose-built for high density traffic through the Thameslink Core and will replace all other rolling stock operated by Thameslink. • Introduction of European Train Control System Level 2 and Automatic Train Operation between London Bridge and Kentish Town	December 2018
CP5 infill train lengthening: West London Line	4- to 8-car operation on some peak West London Line services operated by Southern	Works brought forward from CP5. Delivered September 2014
Infill train lengthening CP5: Uckfield line 10-car	4-/6-/8- to 10-car operation on peak services to/from Uckfield	To be delivered in CP5
Purley train lengthening	8- to 10-car operation of Purley (ex-Caterham and Tattenham Corner) to London Bridge and London Victoria services	CP5 Output delivered early by Southern and Network Rail in December 2013
Redhill Platform 0	Additional platform at Redhill, to aid splitting and joining of 12-car length trains for London, allow some additional trains and a contributing scheme to increasing Reading/Guildford to Gatwick Airport frequency	December 2017
Battersea Park – London Victoria reversible line speed improvement	Increase in linespeed on Battersea Reversible line to 45 mph to reduce journey time and aid flow of services in and out of London Victoria in the peak	CP5/early-CP6
London Overground Capacity Improvement Programme	Conversion of London Overground Class 378 units from 4- to 5-car. This affects East London Services from West Croydon, Crystal Palace and Clapham Junction and West and North London Line services from Clapham Junction (via Kensington Olympia)	December 2015

This project is assumed as part of the baseline for the Route Study analysis, but it should be remembered that it potentially provides significant additional on-train capacity between the BML and London Bridge in the peak hours by the end of CP5, predominantly through train lengthening.

Network Rail has made good progress in identifying the funding needed for the projects in Figure 17 and in some cases has already delivered CP5 outputs early. For the purposes of the Route Study, it is assumed the recommendations in the table will be implemented during CP5 as planned with their consequential impact on crowding factored into the baseline of the analysis of this study.

Figure 18 – Brighton Main Line key capacity constraints



The interventions will help to relieve crowding in parts of the inner and outer suburban areas of the BML and also on main line services from Brighton and the Coastways to London Bridge/the Thameslink Core[1].

Figure 18 highlights the remaining key capacity constraints on the Route at the end of CP5, the baseline position for this Study.

2.3 Services

2.3.1 Passenger

By the start of the next Control Period, train services within the Route Study area will have undergone significant change triggered by the Thameslink Programme. The first changes have already been seen as, on 13 September 2014, Govia took over the first part of the Thameslink, Southern, Great Northern franchise (TSGN). Govia Thameslink Railway (GTR) is the name of the new operation, which has transferred control of Thameslink and Great Northern services, from First Capital Connect. Thameslink services, north of the Thameslink Core are covered by the East Midlands Route Study.

The South Central franchise, operated as Southern, was merged into GTR in July 2015. Gatwick Express will continue to operate under the GTR banner. The Great Northern routes, already operated by GTR from London King's Cross and Moorgate are out of the scope of this study.

Current Thameslink services in the Sussex area operate between Brighton & Bedford, Sutton/Wimbledon & Luton/St Albans and Sevenoaks & Kentish Town. During the reconstruction of London Bridge between 2015 and 2018, Thameslink services will operate via Tulse Hill, Herne Hill and Elephant & Castle.

On completion of the works at London Bridge, more services will operate across London via the Thameslink Core (between London Blackfriars and London St Pancras International). All Thameslink services to/from the BML will operate via London Bridge, reducing the overall peak journey time considerably between East Croydon and London Blackfriars.

As the refranchising was undertaken in parallel with the Route Study development, the December 2018 timetable is yet to be finalised. The Route Study Working Group established an agreed baseline timetable service specification using the Development Timetable devised in 2011. This sample timetable was developed by Network Rail with extensive input from the passenger train operating companies.

A summary of the agreed baseline service specification for the morning high peak hour (HPH, 08:00 to 08:59 arrivals at the London terminals) is provided in Figure 19. It should be noted that the service specification is indicative and track access rights are not yet in place for this specification. The final December 2018 timetable planned by GTR differs slightly from that in Figure 19.

The main differences in GTR's current 2018 plans are driven by a change in specification by the DfT that has rebalanced the number of services through the Thameslink Core in favour of additional services to/from the Sussex Route rather than Kent. The headline change is:

- additional 2tph BML to/from Thameslink core in the peak (Littlehampton gets a direct Thameslink service (note this effectively results in an additional 2tph over Windmill Bridge/ Cottage Junctions in the Croydon area above the Network Rail timetable))
- Wimbledon Loop[2] services to retain operation through the Thameslink core
- The Redhill corridor gets a lower service level to Victoria (minus 2ph) than in Figure 19.

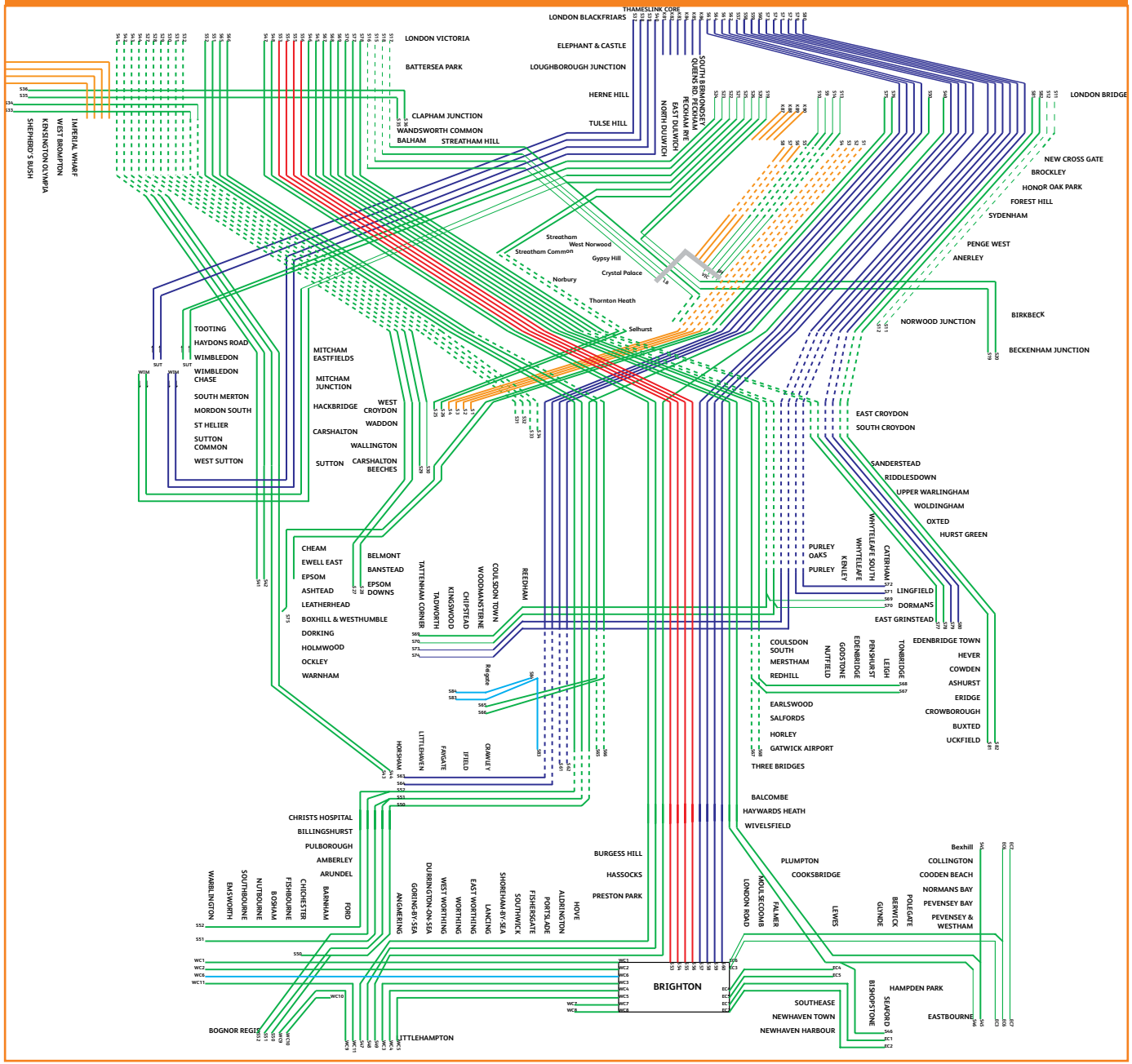
As with the baseline service assumption in Figure 19, Access Rights have yet to be agreed for these changes and will not be finalised until perofrmance modelling is completed.

In addition to GTR operated services, the First Great Western franchise historically included a commitment for a half-hourly Reading to Gatwick Airport service, but due to the congested network at Redhill and Gatwick Airport, this has not been possible to operate to date.

[1] Thameslink Core refers to the section of line through Central London between London Blackfriars and London St Pancras International

[2] Wimbledon Loop refers to services that operate between Tooting, Wimbledon, Sutton and Streatham

Figure 19 – Indicative weekday peak frequencies (08:00-08:59)



Key

Each line represents a train travelling in the peak direction arriving at its destination in the high peak hour (08:00-08:59). The colour of the line refers to the train operating company or GTR service group:

Southern

Gatwick Express

London Overground

Thameslink

First Great Western

(Based on DTT2011)

In CP4, an additional platform (Platform 7) was constructed at Gatwick Airport station, allowing Gatwick Express services into Platforms 5 & 6, reducing the requirement for crossing from the Fast Lines to Platforms 1 & 2. Redhill station will be enhanced with an additional platform (Platform 0) in CP5 which will also reduce the congestion and enable the extension of the Reading to Redhill service to Gatwick Airport in some hours. First Great Western have a franchise commitment to increase service levels overall on the North Downs Line to 3tph. Network Rail is currently reviewing what infrastructure, in addition to Redhill, may be required to achieve this.

2.3.2 Freight

The Route Study area has two main corridors for freight traffic – the WLL and the BML. The BML is predominantly a passenger network, however a standard service pattern of one or two freight paths per hour is maintained for the sizeable aggregates traffic on the route. Freight services generally do not operate during the peak hours in order to maximise passenger capacity and minimise the risk of disruption to either service type.

The WLL is a key freight corridor between London, the Midlands and the North, via the West Coast Main Line. It is the easternmost non-high speed freight crossing of the River Thames. Freight services share this two-track railway off-peak with London Overground (4tph) and Southern (1tph) services.

The freight requirements on this corridor include a large number of train paths that are protected by law for Channel Tunnel freight traffic. In 2016, the route from Wembley to Europe via Kensington Olympia, Swanley, Dollands Moor and the Channel Tunnel will be designated as part of the North Sea to Mediterranean Rail Freight Corridor 2 by the European Union.

Figure 20 shows the key freight terminals and routes. The most recent addition is at Newhaven Town, which receives aggregates traffic and the same train serves the local incinerator by transporting ash for re-use in the London area.

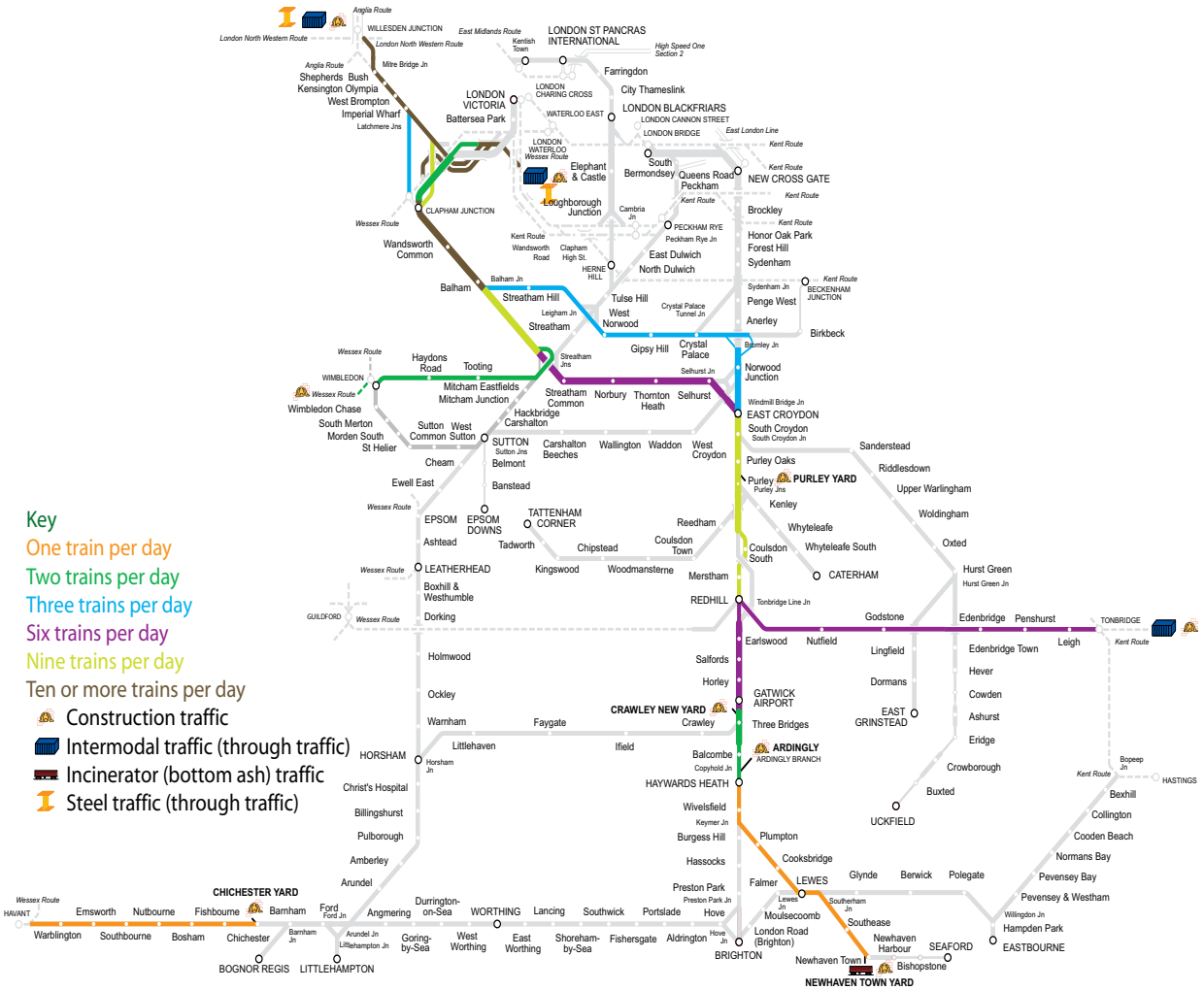
2.4 Route characteristics – the longer term to 2043

Looking further ahead, High Speed 2 (HS2) which is the new high speed line proposal between London, the West Midlands and the North, will trigger significant changes across the entire rail network, including within this Route Study area. A new station on HS2 has been proposed at Old Oak Common, which may be served via connections to/from the West London Line. This would provide links between parts of the Sussex Route area and HS2 without the requirement for interchange in central London.

Several options have been proposed and were subject to public consultation in late 2014. The favoured option sees a new station on the West London Line between Shepherd's Bush and Willesden Junction (High Level) stations. This location prevents the Southern services to/from Watford Junction/Milton Keynes Central from calling at the station.

Another potential major scheme affecting the Route Study area is Crossrail 2, which is proposed to run between south west London and north London. Although the focus of this scheme on the national network south of the River Thames is improving capacity and providing journey time benefits on the South West network, there will be a significant interface with the Sussex Route Study area at Clapham Junction. Although the new line is planned to be subterranean at this point, it will encourage greater interchange at what is already one of the UK's busiest stations.

Figure 20 – Freight facilities on the Sussex area



3.0 Future Demand & Resulting Conditional Outputs

3.1 Background

In 2013 as part of the Long Term Planning Process, Network Rail published four Market Studies: London and South East, Regional Urban, Long Distance and Freight . These Market Studies established a number of 'conditional outputs' in consultation with the rail industry, funders, local authorities and other interested parties. The conditional outputs established by the Market Studies are aligned to a number of strategic goals for the transport sector, which are:

- Supporting and stimulating sustainable economic growth
- Reducing the impact of travel and transport on the environment
- Improving the quality of life for communities and individuals.

The conditional outputs as presented in this chapter describe the rail service which the industry aspires to deliver over the longer term, however these outputs are conditional on being deliverable in a manner which represents both value for money, and affordability for funders.

Consistent with this longer term plan, the Sussex Area Route Study also considers which conditional outputs are a priority for Network Rail's next Control Period (CP6, 2019-24), thus providing funders with choices as they prepare for the next High Level Output Statement (HLOS) for rail.

The following sections (3.2 to 3.4) translate the high level conditional outputs established through the London and South East Market Study (2013) into a set of conditional outputs specific to the Sussex Route. Section 3.5.7 considers how the conditional outputs from the Freight Market Study (FMS) can be accommodated. All conditional outputs considered by the Sussex Area Route Study are identified by a unique conditional output reference number. Sections 3.6 and 3.7 consider other conditional outputs relevant to the Route Study Area.

3.2 Sussex Area Route Study Conditional Outputs

Figures 21-27 display all the conditional outputs addressed in the Sussex Area Route Study. Each individual conditional output will be described in full in its relevant section.

Figure 21 - Peak Capacity Conditional Outputs

Conditional Output Reference	Conditional Output
CO1 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services
CO2 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Bridge suburban services
CO3 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Victoria suburban services
CO4 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Wimbledon Loop[1] to Thameslink Core[2] suburban services (London Blackfriars to London St Pancras International section)
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)
CO6 (2023)	Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
CO7 (2023)	Consistent with the longer term strategy identified to meet CO2, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – London Bridge suburban services
CO8 (2023)	Consistent with the longer term strategy identified to meet CO3, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – London Victoria suburban services
CO9 (2023)	Consistent with the longer term strategy identified to meet CO3, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Wimbledon Loop to Thameslink Core suburban services
CO10 (2023)	Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)

[1] Wimbledon Loop refers to services from London Blackfriars and beyond via Wimbledon.

[2] Thameslink Core refers to the section of route across Central London between London Blackfriars and London St Pancras International

Figure 22 – Short Distance Conditional Outputs	
Conditional Output Reference	Conditional Output
CO11	To provide a minimum of three or four trains per hour for stations within 30 miles from London: Stations on the Wimbledon Loop
CO12	To provide a minimum of three or four trains per hour for stations within 30 miles to London: Stations on the Epsom Downs branch between Epsom Downs and Sutton
CO13	To provide a minimum of three or four trains per hour for stations within 30 miles to London: Stations on the Beckenham Junction branch
CO14	To provide a minimum of three or four trains per hour for stations within 30 miles to London: Stations on the Tattenham Corner and Caterham to Purley branches

Figure 23 – Long Distance Conditional Outputs	
Conditional Output Reference	Conditional Output
CO15	To reduce the Generalised Journey Time (GJT) for longer distance journeys to central London from significant urban centres of population: Eastbourne
CO16	To reduce the GJT for longer distance journeys to central London from significant urban centres of population: Worthing and Hove
CO17	To reduce the GJT for longer distance journeys to central London from significant urban centres of population: Brighton

Figure 24 – Additional Connectivity Conditional Outputs	
Conditional Output Reference	Conditional Output
CO18	To accommodate, during off-peak hours, the cross-boundary passenger services specified by the Long Distance Market Study (2013)
CO19	To provide adequate connectivity for passengers travelling to and from Gatwick Airport.

Fihure 25 – Freight Conditional Outputs	
Conditional Output Reference	Conditional Output
CO20	To accommodate the anticipated demand for freight services to 2043 on the West London Line, as expressed by the Freight Market Study

Figure 26 – Passenger circulation capacity at stations Conditional Outputs	
Conditional Output Reference	Conditional Output
CO21	To provide sufficient passenger circulation capacity at stations within the Sussex Route, taking into account anticipated growth over the period to 2023

Figure 27 Other Conditional Outputs	
Conditional Output Reference	Conditional Output
CO22	To provide sufficient capacity for the leisure market at weekends and on weekday evenings
CO23	To provide appropriate connectivity and capacity for tourist attractions outside of the region's large urban centres
CO24	To provide access to higher education establishments and other social infrastructure
CO25	To make the rail network more accessible to passengers

3.3 Providing sufficient capacity for rail passengers

3.3.1 Conditional outputs from the Market Studies

The London and South East Market Study (2013) established a conditional output to provide sufficient capacity for rail passengers travelling into central London during peak hours, taking into account anticipated growth in the market. Figure 28 sets out the level of growth expected on each corridor.

Figure 28 – Anticipated increase in the number of rail passengers travelling to central London during peak hours (2011 to 2043)

London Bridge	Thameslink & Sussex fast services	115 per cent
	Sussex stopping services	39 per cent
London Victoria	Sussex routes - fast services	34 per cent
	Sussex routes - stopping services	44 per cent
London Blackfriars	All services via Elephant & Castle	21 per cent

Source: London & South East Market Study, Network Rail, October 2013

For capacity planning purposes, the Sussex Area Route Study considers the provision of passenger rail services on the London Bridge, London Victoria and London Blackfriars corridor. Services arriving into London stations during the weekday morning peak between 0800 and 0859[1] have been examined as this broadly corresponds to the busiest period. The morning peak period at these three London stations are typically more pronounced than the evening peak, with a greater number of passengers travelling during the busiest hour, and as a result the overall capacity requirement is slightly higher in the morning.

[1] Train arrival times from the working timetable (WTT) are used. For some Sussex train services, the arrival time at the London stations shown in the public timetable may differ slightly

3.3.2 Capacity assumptions

The capacity provided by all services on the Sussex network is defined as the number of seats, plus a further standing allowance. A standing allowance is applied for journeys that are within 20 minutes from the busiest point on the corridor (critical load point). This is an industry standard set by funders, as standing for 20 minutes or less is deemed acceptable in peak periods.

The capacity allowance for standing passengers on the Sussex Area is dependent on the type of rolling stock in operation. Appendix A, Figure 1 shows the standing allowance per route and service group.

3.4 Interpretation of conditional outputs CO1 to CO10

3.4.1 Brighton Main Line fast services[2]

In the December 2012 timetable, services travelling north on the Brighton Main Line terminated at either London Bridge or London Victoria or passed through the route to destinations north of the River Thames via London Blackfriars and London St Pancras International. The December 2012 timetable has been used for analysis purposes as this is the most recent year for which passenger counts are available. The service specification for December 2012 can be found in Appendix A, Figures 2 and 3.

Thameslink Key Output 2 (due for completion in 2018) will restructure today's timetable with Brighton Main Line (BML) fast trains to destinations north of London travelling through London Bridge to the Thameslink core, while also changing the origin and timing of London Victoria services. Thameslink Key Output 2 will introduce metro style Class 700 rolling stock; this will deliver additional capacity arriving into London Bridge. Please refer to Appendix A, Figure 1 for further details regarding the capacity assumptions on the Thameslink corridors.

Details on the service specification in 2018 and rolling stock changes for services arriving into London Bridge are displayed in Appendix A, Figure 4 and services arriving into London Victoria are displayed in Appendix A, Figure 5.

It should be noted for all references to the 2018 service

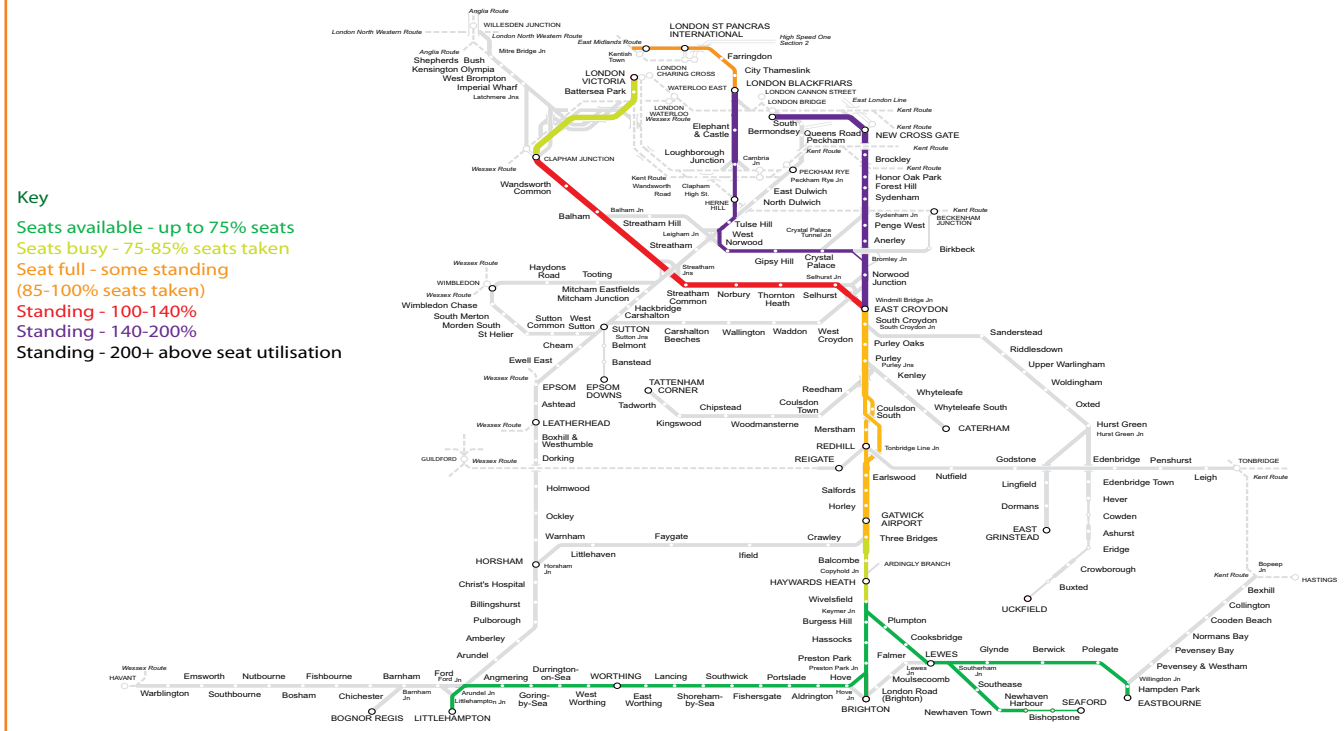
[2] Services that utilise the fast lines between East Croydon and London

specification, this is based on work completed by Network Rail, with support from the Train Operating Companies in CP4 (2009-2014) to establish an approximate baseline timetable for December 2018 as set out in Chapter 2. Govia Thameslink Railway (GTR), the winning bidder for the franchise will have some timetable proposals that differ – although the overall quantum of service is likely to be similar. In all cases access rights have yet to be agreed for December 2018, and therefore these figures can only be considered as a planning assumption at this stage.

There are 27,000 passengers that use the Brighton Main Line services to access central London during the high-peak hour, measured at the busiest points on the route; for London Victoria services this is upon approach to Clapham Junction station, for London Bridge services this is departure from East Croydon. The number of passengers is forecast to increase to over 37,600 (source: London and South East Market Study, 2013) by 2043.

On current high-peak hour BML train services, some passengers have to stand for a period of time in excess of the 20 minute guidance typically specified by funders. Figure 29 displays the seat

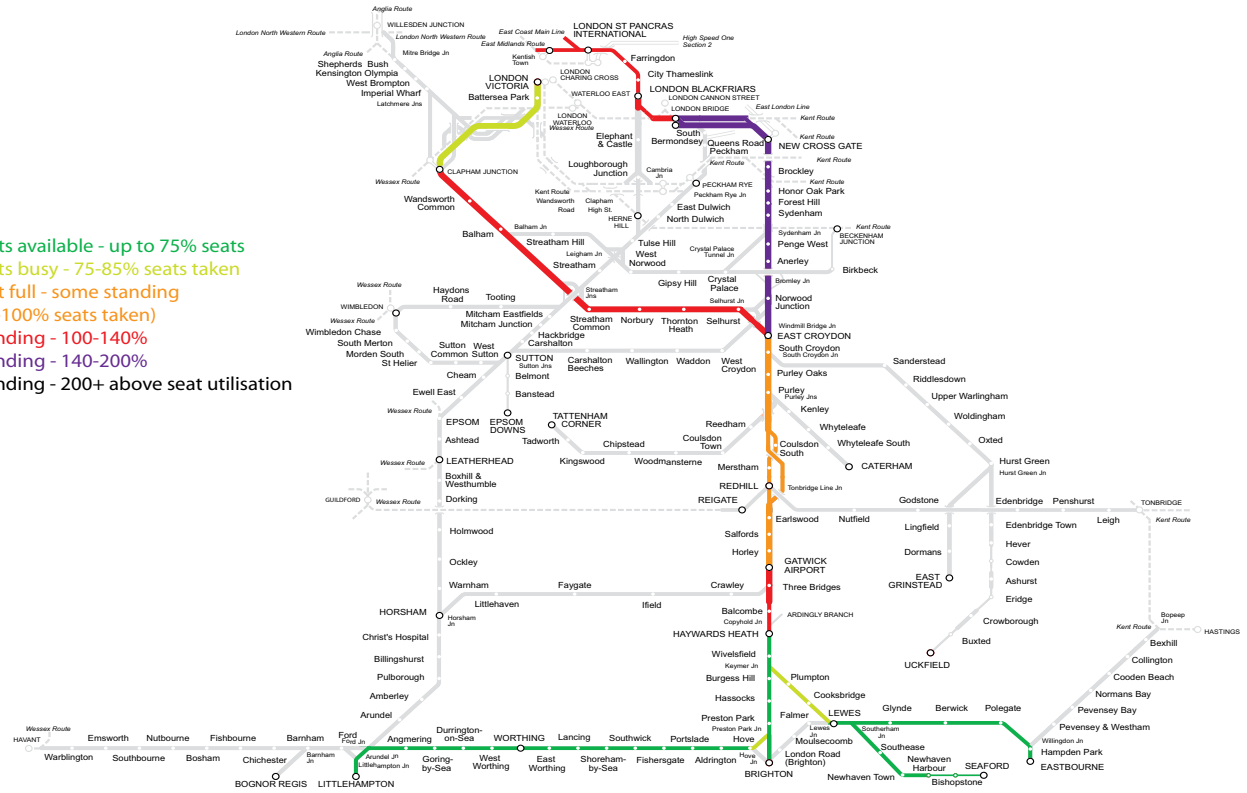
Figure 29 - Seat utilisation on the Brighton Main Line 2012.



utilisation build up on the Brighton Main Line services to London Bridge and London Victoria in the morning high-peak hour in 2012.

By 2024, the BML will start to experience significant standing issues even after the additional on-train capacity introduced following the Thameslink Programme completion. Providing sufficient numbers of seats for passengers becomes an issue due to significant passenger demand growth and the introduction of metro style rolling stock as part of the Thameslink Programme. The new class 700 vehicles will have more standing space but fewer seats per vehicle, thus providing greater on-train capacity. Although there will be some churn of passengers at key points on the BML such as at Gatwick Airport and East Croydon, some passengers travelling to London will have to stand from as far out as Haywards Heath which is 40 to 50 minutes journey time from Central London. Figure 30 displays the

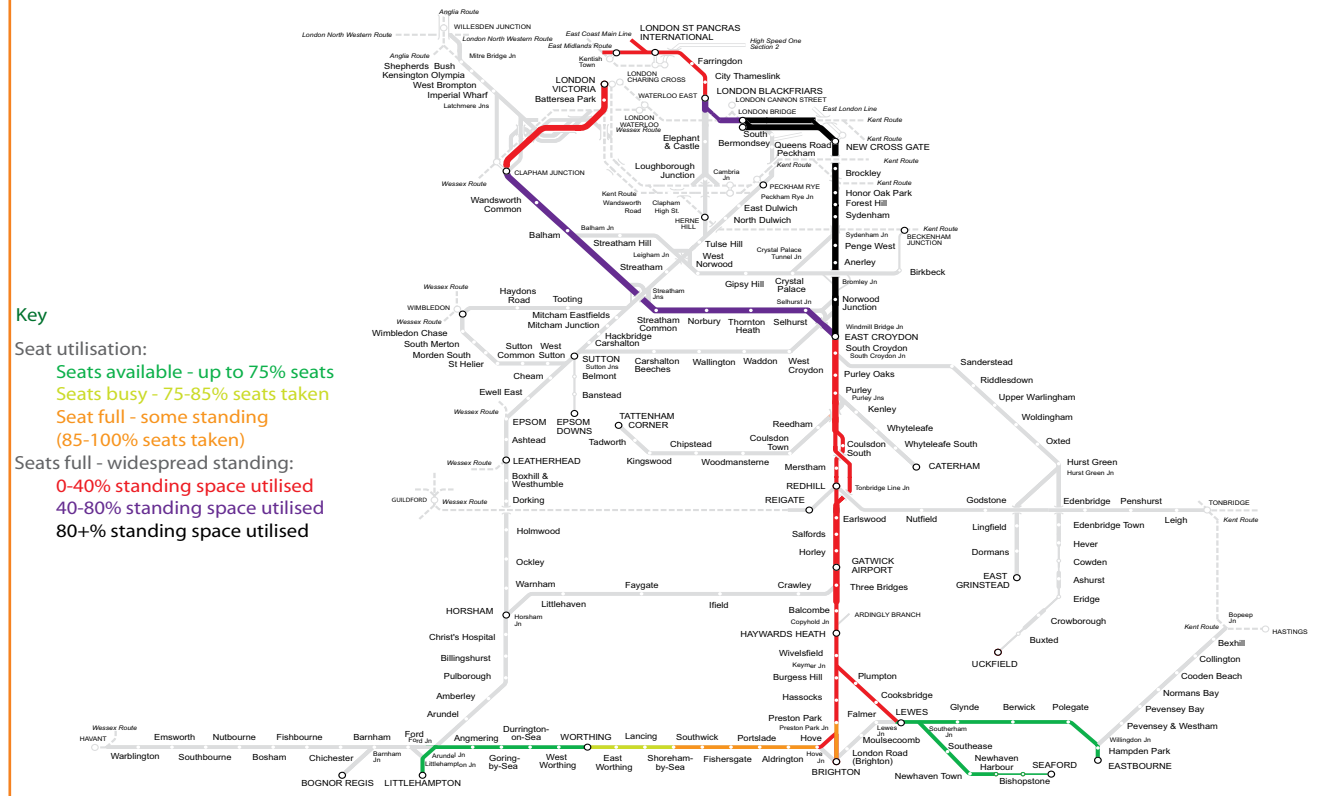
Figure 30 – Seat utilisation on the Brighton Main Line 2023 including committed CP5 interventions



seat utilisation build up in 2024, and helps identify where standing starts.

By 2043 standing issues will deteriorate further due to continued passenger demand growth. Figure 31 displays the seat utilisation build up in 2043 where all sections between Haywards Heath and Central London will experience overcrowding.

Figure 31 – Seat utilisation on the Brighton Main Line 2043, with no interventions after CP5



The Route Study's assessment of the capacity gap in 2024 and 2043 is shown in Figure 32.

Satisfying the conditional output in 2043 is defined as reaching a target of less than 100 per cent seat utilisation at the following stations on the BML: Hove, Haywards Heath and Redhill. A target of 100 per cent seat utilisation has been used for 2043, because the number of vehicles required to meet an 85 per cent seat utilisation target (the target for 2024) requires an unrealistic quantum of trains which is considered uneconomical to deliver. The additional services assumed above what the Thameslink Programme will provide in CP5 will help deliver extra capacity, reducing the number of passengers having to stand for greater than 20 minutes into London.

Since publication of the Sussex Area Route Study Draft for Consultation document, new Railplan forecasts from Transport for London (TfL) have been made available utilising the latest census data and forecasts on population and employment. The forecasts for the Thameslink corridor, London Bridge and London Victoria suburbans remain much the same. However, the new forecasts for the fast services arriving into London Victoria in 2043 are notably higher; this therefore affects the requirement to meet conditional output CO1. A small number of further services would be required to ensure there was sufficient seating capacity along the BML. It is important to note that in neither demand scenario would all standing beyond 20 minutes duration be completely eliminated on the BML by the additional 6tph service pattern. Chapter 6 details likely standing levels by 2043.

Figure 32– Brighton Main Line fast services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO1 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services	At least an additional six 12-car services during the high peak hour.
CO6 (2024)	Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services	An additional four 12-car services during the high peak hour.

3.4.2 London Bridge suburban services

In the December 2012 timetable there were two suburban service groups arriving into London Bridge, they were split according to whether they passed through Tulse Hill or Forest Hill. The service specification for December 2012 can be found in Appendix A, Figure 6.

There are 9,300 passengers that use Sussex suburban services to travel to London Bridge during the high-peak hour, measured at the busiest points on the route: for the Tulse Hill service group this is on departure from South Bermondsey, for the Forest Hill service group this on departure from New Cross Gate. The number of passengers is forecast to increase to over 12,900 (London and South East Market Study, 2013) by 2043.

It should be noted that there is strong interaction between London Bridge Suburban Forest Hill and East London Line services; this is because stations between Sydenham and New Cross Gate are served by both sets of services. Some passengers take the first train arriving at these stations and then change when appropriate. Therefore any capacity interventions made on one service group will benefit the other[1].

With strong growth expected on London Bridge suburban services, passenger demand is expected to exceed total capacity in CP5, see Figure 34. The seat utilisation build up on each line from 2012 to 2043 can be found in the Appendix A, Figure 6-9.

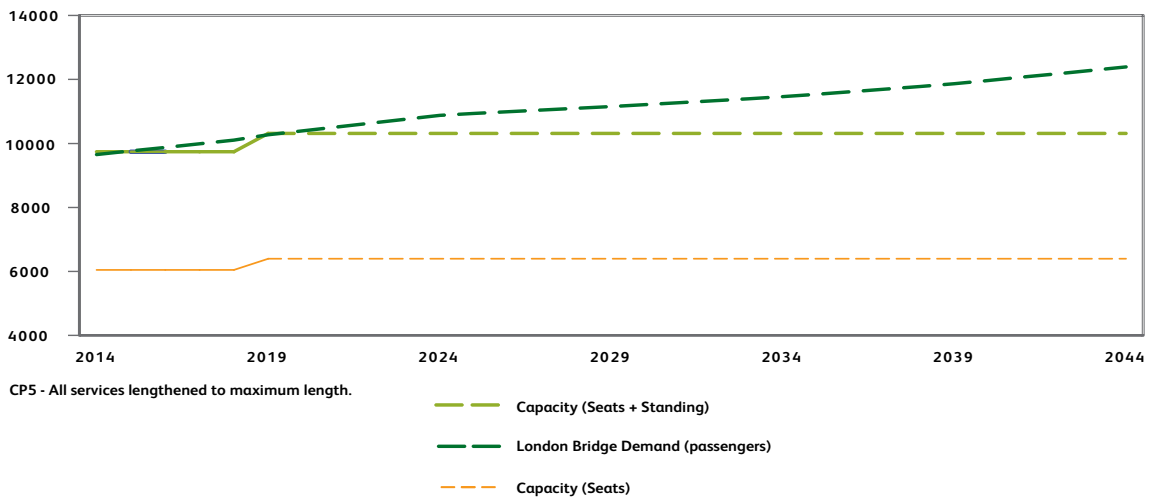
The Route Study's assessment of the capacity gap to meet an 85 per cent average load factor in 2024 and 2043 is shown in Figure 33.

[1] For the purposes of the Route Study, the two service groups have been examined separately due to differing constraints on the their respective routes.

Figure 33 – London Bridge suburban services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO2 (2043)	To provide sufficient passenger circulation capacity at stations within the Sussex Route, taking into account anticipated growth over the period to 2023	An additional 32 vehicles during the high peak hour. • 22 vehicles for the Tulse Hill Service Group • 10 vehicles for the Forest Hill Service Group.
CO7 (2024)	Consistent with the longer term strategy identified to meet CO2, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – London Bridge suburban services	An additional 10 vehicles during the high peak hour for the Tulse Hill service group only.

Figure 34 – Demand and capacity arriving into London Bridge via suburban lines with no further interventions after CP5



3.4.3 London Victoria suburban services

In the December 2012 timetable there were three suburban service groups arriving into London Victoria, they are split according to whether they passed through Streatham Hill, Hackbridge or Norbury.

From December 2013 all services on the Streatham Hill and Hackbridge service group started operating at the maximum length of 10-car. On the Norbury service group, four services operating at 10-car and two services operating at 8-cars. The total capacity provided, and the rolling stock type for each of these services is detailed in Appendix A, Figure 10.

There are 12,900 passengers that use Sussex suburban services to travel towards London Victoria during the high-peak hour, measured at the busiest points on the route, for all service groups this is upon arrival at Clapham Junction. The number of passengers is forecast to increase to over 18,600 (London and South East Market Study, 2013) by 2043.

With strong growth expected on London Victoria suburban services, passenger demand is expected to exceed total capacity in CP5 as shown in Figure 36. The seat utilisation build up from 2012 to 2043 can be found in the Appendix A, Figure 11-12.

The Route Study's assessment of the capacity gap to meet an 85 per cent average load factor in 2024 and 2043 is shown in Figure 35.

Figure 35 – London Victoria suburban services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO3 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Victoria suburban services	An additional 76 vehicles during the high peak hour. • 34 vehicles for the Streatham Hill service group • 14 vehicles for the Hackbridge service group • 28 vehicles for the Norbury service group.
CO8 (2023)	Consistent with the longer term strategy identified to meet CO3, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – London Victoria suburban services	An additional 28 vehicles during the high peak hour. • Eight vehicles for the Streatham Hill service group • Eight vehicles for the Hackbridge service group • 12 vehicles for the Norbury service group.

Figure 36 – Demand and capacity arriving into London Victoria via suburban lines with no further interventions after CP5

3.4.4 Wimbledon Loop to Thameslink Core suburban services

Train services operating on the circular route between Tooting, Wimbledon, Sutton and Streatham are described in this Route Study as Wimbledon Loop services. This description applies to services in both directions. In the December 2012 timetable there are two suburban service groups arriving at London Blackfriars, they are split according to whether they pass through Tooting or Hackbridge.

In the December 2012 timetable all services on the Tooting and Hackbridge service group operate at the maximum length of 8-car. The total capacity provided, and the rolling stock type is detailed in Appendix A, Figure 12.

Thameslink Key Output 2 (due for completion in 2018) will restructure today's timetable with Brighton Main Line fast trains travelling through London Bridge to the Thameslink core, while also improving the frequency of services originating from the Wimbledon Loop. Upon completion of Thameslink Key Output 2, rolling stock will also be upgraded to metro style Class 700s. Details on service specification, rolling stock and capacity assumption changes for services arriving into the Thameslink Core from the Wimbledon Loop are displayed in Appendix A, Figures 13 and 1.

There are 2,750 passengers that use the Wimbledon Loop to Thameslink Core suburban services in the high-peak hour, measured at the busiest points on the route (arrivals at Elephant & Castle). The number of passengers is forecast to increase by 21 per cent (London and South East Market Study, 2013) by 2043.

In 2013, the number of passengers using Wimbledon Loop to Thameslink Core suburban services during the high-peak hour is greater than the total allowable capacity.

In today's timetable there are two Brighton to Bedford services which travel via Elephant and Castle arriving into the Thameslink Core (London Blackfriars to London St Pancras International) in the high-peak hour. With the completion of Thameslink Key Output 2 in 2018, these services will run via London Bridge. This will result in a reduction in Thameslink services serving Elephant and Castle, Herne Hill and Tulse Hill. In future, passengers which use this service will have to switch to either the Wimbledon Loop or Kent Thameslink services. This will add to the crowding issues already existing on the route.

However with the implementation of Thameslink Key Output 2, the additional Hackbridge service and the introduction of new higher capacity rolling stock will provide a large step change in capacity. The Route Study's assessment, Figure 37, is that there are no additional capacity requirements on top of what Thameslink Key Output 2 will provide, in 2024 and up until 2043. Conditional output CO4 and conditional output CO9 are therefore satisfied with existing planned infrastructure and rolling stock changes. Satisfying the conditional output in this instance is defined as reaching a target average load factor of less than 85 per cent in the high-peak hour for services arriving into Elephant & Castle. This conclusion is however provisional on the extra Hackbridge service being accommodated in the 2018 timetable.

Figure 37 – Wimbledon Loop to Thameslink Core (London Blackfriars to London St Pancras section) conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO4 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Wimbledon Loop to Thameslink Core suburban services	The capacity already planned for CP5 as part of the Thameslink Key Output 2 programme will be sufficient to meet this conditional output.
CO9 (2023)	Consistent with the longer term strategy identified to meet CO3, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Wimbledon Loop to Thameslink Core suburban services	The capacity already planned for CP5 as part of the Thameslink Key Output 2 programme will be sufficient to meet this conditional output.

3.4.5 Orbital services - East London Line (ELL)

In the December 2012 timetable there are 16 train services running north on the ELL during the high-peak hour. There are four different origins of service: Clapham Junction, Crystal Palace, New Cross and West Croydon, each running a four trains per hour service throughout the peak.

In the December 2012 timetable all services on the East London Line operate at the maximum length of 4-car. But with the completion of the London Overground Capacity Improvement Programme (LOCIP) in CP5, all vehicles will be lengthened to 5-car. The total capacity provided after LOCIP, and the rolling stock type is detailed in Appendix A, Figure 14.

Approximately 8,400 passengers travel north on the East London Line during the high-peak hour. This figure has been measured at the busiest point on the route; for the Clapham Junction, Crystal Palace and West Croydon service groups this is upon departure at Surrey Quays. The busiest point on the New Cross service group is Wapping to Shadwell. The number of passengers is forecast to increase to over 10,150 by 2043. (Transport for London forecasts 20,300 passengers in 2043 in the three hour peak, half of this demand is expected to occur in the high-peak hour).

Out of the four service groups, the services originating from West Croydon and Crystal Palace experience crowding in the high-peak hour. The Route Study concludes that a capacity driven intervention would only be required on two sets of services.

It should be noted that there is strong interaction between London Bridge suburban Forest Hill and ELL services; this is because stations between Sydenham and New Cross Gate are served by both sets of services. Some passengers take the first train arriving at these stations and then change when appropriate. Therefore any capacity interventions made on one service group will benefit the other[1].

The Route Study's assessment of the capacity gap to meet an 85 per cent average load factor in 2024 and 2043 is shown in Figure 38 whilst the impact of loadings is shown in Figure 39.

[1] For the purposes of the Route Study, the two service groups have been examined separately due to differing constraints on the their respective routes.

Figure 38 – East London Line conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)	An additional 13 vehicles during the high-peak hour. • Eight vehicles from West Croydon • Five vehicles from Crystal Palace
CO10 (2023)	Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)	An additional six vehicles during the high-peak hour. • Four vehicles from West Croydon • Two vehicles from Crystal Palace)

Figure 39 – Impact on loadings on the East London Line with no further interventions after CP5

Origin	Load 2023	Load 2043
West Croydon: Surrey Quays to Canada Water – northbound	105%	122%
Crystal Palace: Surrey Quays to Canada Water - northbound	91%	108%
New Cross: Wapping to Shadwell – northbound	30%	43%
Clapham Junction: Surrey Quays to Canada Water - northbound	73%	88%[5]
Total East London Line (16tph)	74%	90%

Figure 40 – West London Line conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	
		No HS2/OOC Connection Scenario	With HS2/ OOC Connection Scenario
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)	An additional 18 vehicles during the high-peak hour.	An additional 27 vehicles during the high-peak hour.
CO10 (2023)	Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)	The capacity already planned for CP5 as part of the LOCIP programme will be sufficient to meet this conditional output.	Not applicable.

3.4.6 Orbital services - West London Line (WLL)

In the December 2012 timetable there were two Train Operating Companies operating on the WLL - London Overground and Southern - with eight train services running north on the WLL during the high peak hour. Currently, all London Overground services on the WLL operate at the maximum length of 4- or 5-car. But with the completion of the London Overground Capacity Improvement Programme (LOCIP) in CP5, all trains will be lengthened to 5-car.

Additionally, in summer 2014 a scheme to lengthen services between Milton Keynes Central and South Croydon and Watford and Clapham Junction to 8-car was completed. The origin of services, total capacity provided after LOCIP and WLL train lengthening, as well as the rolling stock types for each service group are detailed in Appendix A, Figure 15.

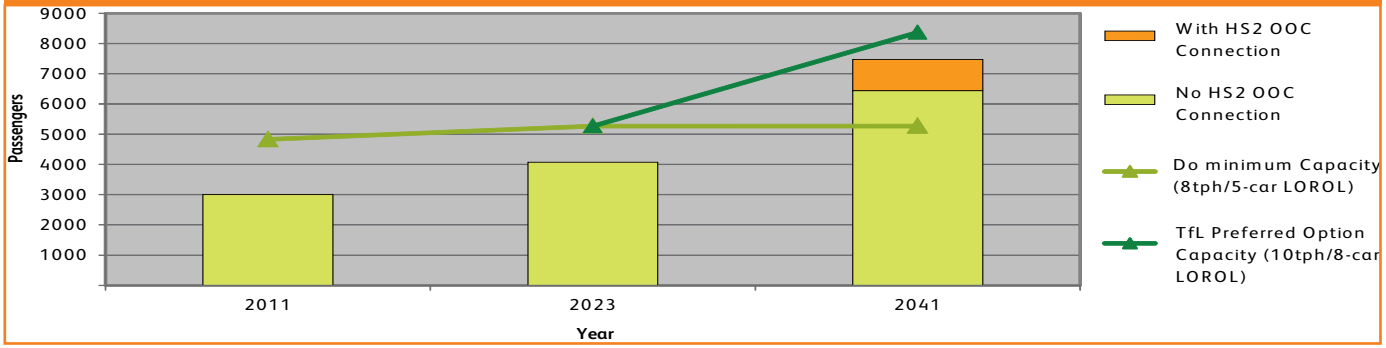
The busiest direction on the West London Line is services starting at Clapham Junction heading north. Currently 3,000 passengers travel north on the WLL during the high-peak hour. This figure has measured at the busiest point on the route; for all service groups this is upon departure at West Brompton. Transport for London (TfL) forecasts the number of passengers (with no further interventions) will increase to 6,300 by 2041 (TfL three hour peak forecasts, 43 per cent of this demand is expected to occur in the high peak hour).

TfL is currently investigating linking the WLL to High Speed Two (HS2). A new station, Old Oak Common (OOC) is already planned to provide an interchange between Crossrail, the Great Western Main Line and HS2. If the proposal to link the West London Line to Old Oak Common goes ahead, TfL estimate this would generate approximately 1,100 new journeys on the WLL at the busiest point in the high-peak hour in 2041. In order to accommodate the extra demand, TfL's current preferred option at publication is to increase the number of London Overground services to six trains per hour in the medium term and to lengthen those services from five to eight carriages in the longer term. (the feasibility of TfL's proposals are discussed further in Chapter 6). The effect of the change in demand brought by HS2 and an OOC connection is shown in Figure 41 below.

The Route Study's assessment of the capacity gap to meet an 85 per cent average load factor in 2024 and 2043 is shown in Figure 40.

The Route Study's assessment is that for 2024, no additional capacity (due to the LOCIP programme) is required to satisfy conditional output CO10. However as demonstrated by the strong growth on the orbital services over the past few years, when the frequency and capacity of the service provided improves, passenger demand quickly follows. Previous forecasts have also typically underestimated the level of suppressed demand on the route. Therefore both the Route Study and TfL believe the opportunity to increase the frequency of service on the West and North London Line should be investigated as an option for CP6 & CP7.

Figure 41 – Demand and capacity graph for the West London Line, with two HS2/OOC connection scenarios displayed



3.5 The level of connectivity provided by passenger rail services

3.5.1 Conditional outputs from the Market Studies

The Long Distance and London and South East Market Studies established a number of conditional outputs relating to the level of connectivity provided by passenger rail services. Connectivity covers several aspects of the passenger timetable, with the principal components being:

- Train service frequency between stations
- Timetabled journey times
- The provision of direct journeys which do not require an interchange.

Figure 42 illustrates the connectivity conditional outputs interpreted from the Market Studies for the Sussex Area Route Study into an Indicative Train Service Specification (ITSS) for 2043.

Sussex Area Route Study 2043 Indicative Train Service Specification

The Route Study Working Group consulted widely with industry stakeholders to identify how the Conditional Outputs could be delivered: this takes the form of a 2043 Indicative Train Service Specification (ITSS). The ITSS identifies the number and type of train services over each section of the Route Study area that are required to meet the Conditional Outputs in 2043. The conditional outputs are expressed as 'journey opportunities' per hour. The approach has been to create an ITSS that can meet the desired outputs and then use it to test whether the baseline infrastructure that forms the starting point of the Study is capable of supporting those services.

The Sussex ITSS is not constrained by network capacity or considerations of rolling stock. The ITSS is an all day off-peak scenario. Specific calling patterns have not been identified as part of this high-level analysis.

There is a general conditional output to at least maintain the same level of service as anticipated in the 2018 baseline Indicative Train Service Specification. Therefore, the ITSS would normally maintain a direct service where one exists in the baseline.

Figure 42 – Short journeys to and from central London conditional outputs

Conditional Output Reference	Conditional Output
CO11	To provide a minimum of three of four trains per hour for stations within 30 miles from London: Stations on the Wimbledon Loop
CO12	To provide a minimum of three or four trains per hour for stations within 30 miles to London: Stations on the Epsom Downs branch
CO13	To provide a minimum of three or four trains per hour for stations within 30 miles to London: Stations on the Beckenham Junction branch

The Sussex Area Route Study considers options for delivering these conditional outputs during off-peak hours of operation. Sections 3.5.2 to 3.5.5 translate the high level connectivity conditional outputs established through the Market Studies into a set of conditional outputs specific to the Sussex Area.

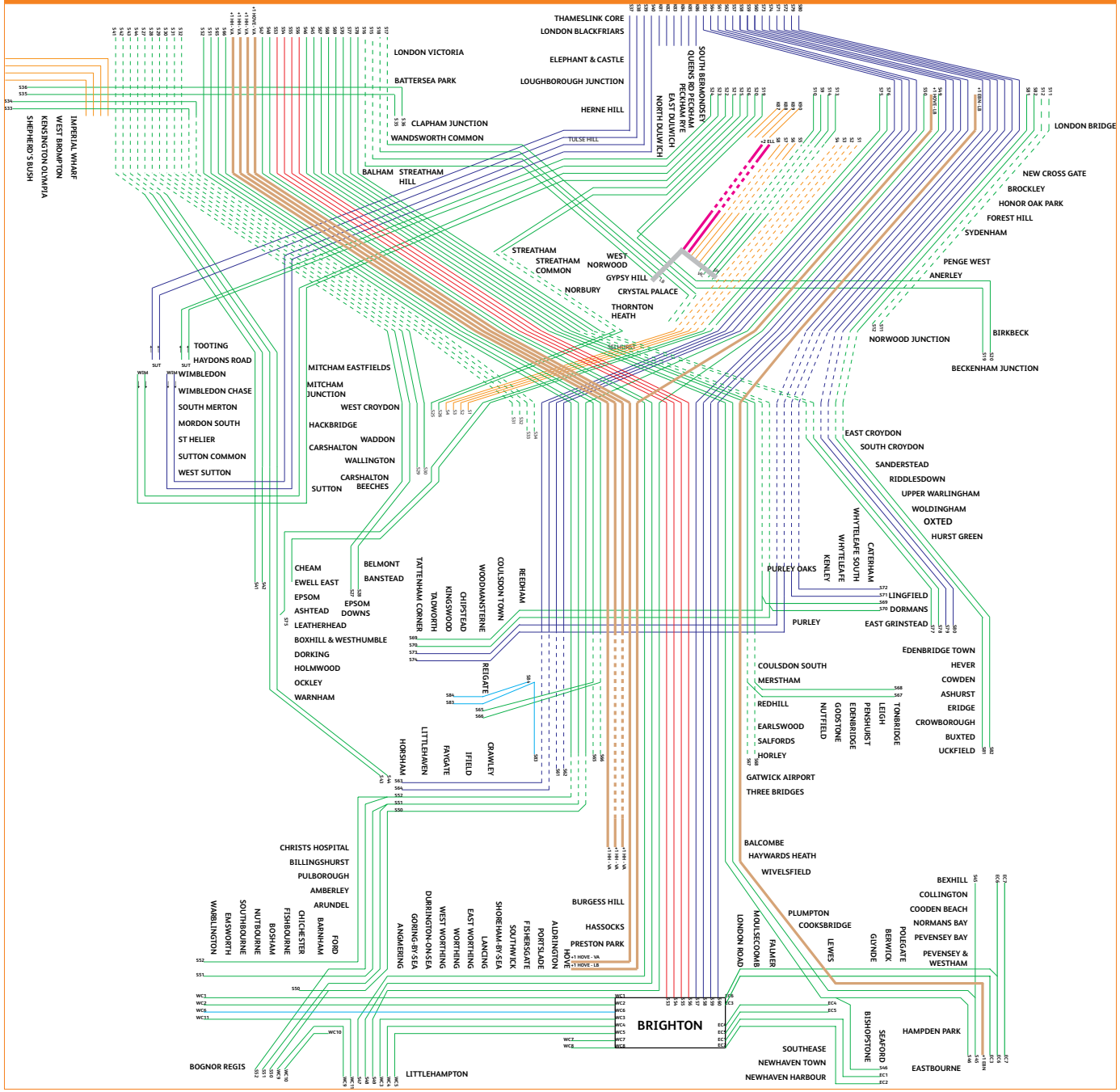
Figure 43 illustrates the connectivity Conditional Outputs interpreted from the Market Studies for the Sussex Area Route Study into an ITSS for 2043.

3.5.2 Short journeys to and from central London

The London and South East Market Study established a conditional output to provide a minimum of three or four trains per hour to and from central London during off-peak hours, from stations which are broadly within a 30 mile radius of central London.

Due to the relatively dense operation of the London network, many suburban stations on the Sussex Route already provide/exceed this level of connectivity. The branches listed below do not however achieve the required level of connectivity prescribed by the Market Study:

Figure 43 - Indicative Train Service Specification (ITSS) 2043.



Key

Each line represents a train travelling in the peak direction arriving at its destination in the high peak hour (08:00-08:59). The colour of the line refers to the train operating company or GTR service group:

Southern

Gatwick Express

London Overground

Thameslink

First Great Western

Additional BML services proposed by this Route Study

Additional ELL services proposed by this Route Study

(Based on DTT2011)

Wimbledon Loop to Thameslink Core

Conditional output CO11 requires that stations along the Wimbledon Loop have an off-peak service to London of three or four trains per hour. There is currently an uneven service on the Wimbledon Loop such that some stations satisfy this conditional output, while others don't.

In the Thameslink 2018 timetable, the Wimbledon Loop is planned to have a two trains per hour service in each direction. This service upgrade will satisfy connectivity conditional output CO11 for services via Hackbridge by providing an even service each side of the Loop. Fully satisfying this conditional output is however reliant on the extra Hackbridge service successfully being accommodated in the 2018 timetable. However post Thameslink Key Output 2, Wimbledon Loop services via Tooting will still not satisfy conditional output CO11.

Please refer to Section 3.4.4 for further details on capacity changes on the Wimbledon Loop to London Blackfriars corridor.

Epsom Downs branch

Conditional output CO12 requires that stations along the Epsom Downs branch require an off-peak service to London of three or four trains per hour. There is currently an hourly service due to traffic demand. The single line between Sutton and Epsom Downs restricts the number of trains it is possible to operate on the branch to 2tph.

The low footfall and insufficient off-peak demand, together with limitations of a single track line, mean that the Route Study will not be examining options to improve the service on this line.

Beckenham Junction branch

Conditional output CO13 requires that Beckenham Junction and Birkbeck have an off-peak London service of three or four trains per hour.

Beckenham Junction meets this conditional output as it has 4tph to London Victoria in addition to the 2tph service to London Bridge, however, Birkbeck does not meet this requirement as it is only served by the London Bridge services.

The low footfall at Birkbeck and Beckenham Junction (for the London Bridge services only) and capacity constraints on the single line between Bromley Junction and Beckenham Junction, also at London Bridge, mean that the Route Study will not be examining options to improve the service on the line.

It is also recognised that Transport for London is developing the case for an extension of Tramlink services to Crystal Palace which could involve taking over the control of this line.

Caterham and Tattenham Corner Branches

Conditional output CO14 requires that Caterham and Tattenham Corner branch lines have an off-peak London service of three or four trains per hour.

In the current service, Tattenham Corner has 2tph to London Bridge whilst Caterham has 2tph to London Bridge and 2tph to London Victoria.

The level of service is not planned to change with the implementation of the Thameslink Programme in 2018, this therefore means the Tattenham Corner branch does not meet the conditional output CO14. The Thameslink Southern Great Northern (TSGN) franchise examined the possibility of operating a third train in the hour between Tattenham Corner and Purley, to provide additional connection to the Caterham service. This service has since been withdrawn, but the Route Study believes this service could be re-examined at a later date to meet desired conditional output requirements.

3.5.3 Longer distance journeys to and from central London

The London and South East Market Study established a conditional output to improve 'generalised' journey times to and from central London, for the significant urban centres of population, 30 or more miles from central London.

'Generalised' journey time is a measure of rail connectivity which combines both the speed and frequency of rail services. Generalised journey time can therefore be reduced by either reducing timetabled journey time or by operating a more frequent service. The London and South East Market Study prescribes the following conditional outputs to the Sussex Area Route Study.

The Route Study has identified three conditional outputs within the Sussex Area Route, these conditional outputs are shown in Figure 44.

3.5.4 Rail connectivity between large regional centres within the Sussex Route

The Long Distance Market Study established conditional outputs for passenger rail connectivity between major centres of population right across Great Britain.

The Cross-Boundary Working Group have translated these conditional outputs into a national train service specification, defining all passenger services which cross Network Rail's planning boundaries in order to substantially meet the conditional outputs. This cross-boundary train service specification has been remitted to all of the Route Studies to ensure consistency of planning assumptions. The cross-boundary passenger services relevant to the Sussex Route are described in Appendix C. The conditional outputs established by the Long Distance Market Study are implicit in the conditional output showin in Figure 45 for Sussex.

Figure 44 – Long distance journeys to and from central London conditional outputs

Conditional Output Reference	Conditional Output
CO15	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Eastbourne
CO16	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Worthing and Hove
CO17	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Brighton

Figure 45 – Cross-Boundary conditional outputs

Conditional Output Reference	Conditional Output
CO18	To accommodate, during off-peak hours, the cross-boundary passenger services specified by the Long Distance Market Study (2013).

3.5.5 Rail connectivity to airports

In December 2013, the independent Airports Commission chaired by Sir Howard Davies published a shortlist of three airport expansion schemes for further consideration, two at Heathrow and one at Gatwick. The Commission's final report was published on the 1 July 2015, setting out the recommendations for maintaining the UK's status as an international hub for aviation.

The report contains a range of recommendations which Government will now consider. The Secretary of State is expected to provide clear direction on the Government's plans in the autumn.

London Gatwick Airport

Gatwick Airport station is situated on the Brighton Main Line. The airport is well connected with direct services to London and the south coast. In the December 2018 Thameslink timetable, Gatwick Airport has a frequency of 24 trains to central London in the high-peak hour: ten trains per hour to London Bridge and fourteen trains per hour to London Victoria. Four of the London Victoria bound trains in the high-peak hour are premium services that call at a reduced number of stations. This already exceptional level of connectivity leads the Route Study to conclude that on the Brighton Main Line there is no specific connectivity gap to/from London at Gatwick Airport.

Gatwick Airport passengers travelling to London should not have issues boarding most trains at Gatwick Airport during the peak hours at end CP5. However without general interventions on the BML after CP5, passengers at Gatwick Airport , with or without expansion, are likely to experience some significant congestion and standing in the high-peak hour.

However journey times on the North Downs line to Gatwick Airport are poor. The North Downs line is a two track railway linking Reading (with connections from the West Country and Midlands) with the Brighton Main Line via Wokingham, Guildford and Redhill. The line crosses into Network Rail's Wessex route (for planning purposes) between Guildford and Reigate. This Route Study will examine the various options to improve journey time and therefore improve generalised journey time.

The Cross - Boundary Working Group has remitted the Sussex, Western and Wessex Route Studies to consider the following services:

- 2tph semi-fast service between Reading (and potentially Oxford) and London Gatwick Airport. In order to deliver best possible journey times, a third service may also be required over this route to meet demand from smaller stations

Accommodating these services is implicit in conditional output CO18 (to accommodate, during off-peak hours, the cross-boundary passenger services specified by the Cross-Boundary Working Group, as a proxy for meeting all conditional outputs which are not wholly internal to the Sussex Route.

London Heathrow Airport

London Heathrow Airport is situated within Network Rail's Western Route, located on a spur off the Great Western Main Line. The Airport is served by Heathrow Express and Heathrow Connect from London Paddington. There are no rail services to London Heathrow Airport which operate over any part of the Sussex Route.

3.5.6 Rail connectivity with HS2

The 2043 passenger service specification developed to meet LTPP conditional outputs provides connectivity between the Sussex Route and HS2 through the development of a new Old Oak Common station with a connection to the West London Line.

The Old Oak Common and West London Line connection has been considered in Section 3.4.6 orbital services.

Figure 46 – Rail connectivity to Airports conditional outputs

Conditional Output Reference	Conditional Output
CO19	To provide adequate connectivity for passengers travelling to and from Gatwick Airport.

3.5.7 Providing sufficient capacity for freight services

The Freight Market Study established a conditional output to provide sufficient network capacity and capability to accommodate the anticipated demand for freight services to 2043. This requirement is expressed by the Freight Market Study in freight paths per day for network sections by 2043.

Figure 47 shows the projected growth in construction material and Channel Tunnel through rail traffic on the Sussex Route area. These commodities collectively comprise the growth forecast by the Freight Market Study (2013) which is the freight conditional output for this Route Study.

On the Sussex Route the freight activity is largely centred on the West London Line between Latchmere Junction and Mitre Bridge Junction. The majority of freight along this route is either: construction materials and Channel Tunnel traffic. On the WLL Network Rail is contractually obliged to provide capacity for freight. For example Network Rail, in the 1987 Usage Contract, has committed to provide the infrastructure to accommodate 5,200,000 tonnes of non-bulk freight and 2,900,000 tonnes of bulk freight per year between London and the Channel Tunnel.

In 2012 there was a utilisation of freight path factor of 18 per cent. With forecasted freight growth this utilisation factor rises to 38 per cent by 2043. Therefore it can be assumed the paths already protected in the existing timetable are sufficient to satisfy conditional output CO20, Figure 48. The Route Study notes there is no requirement to propose active interventions.

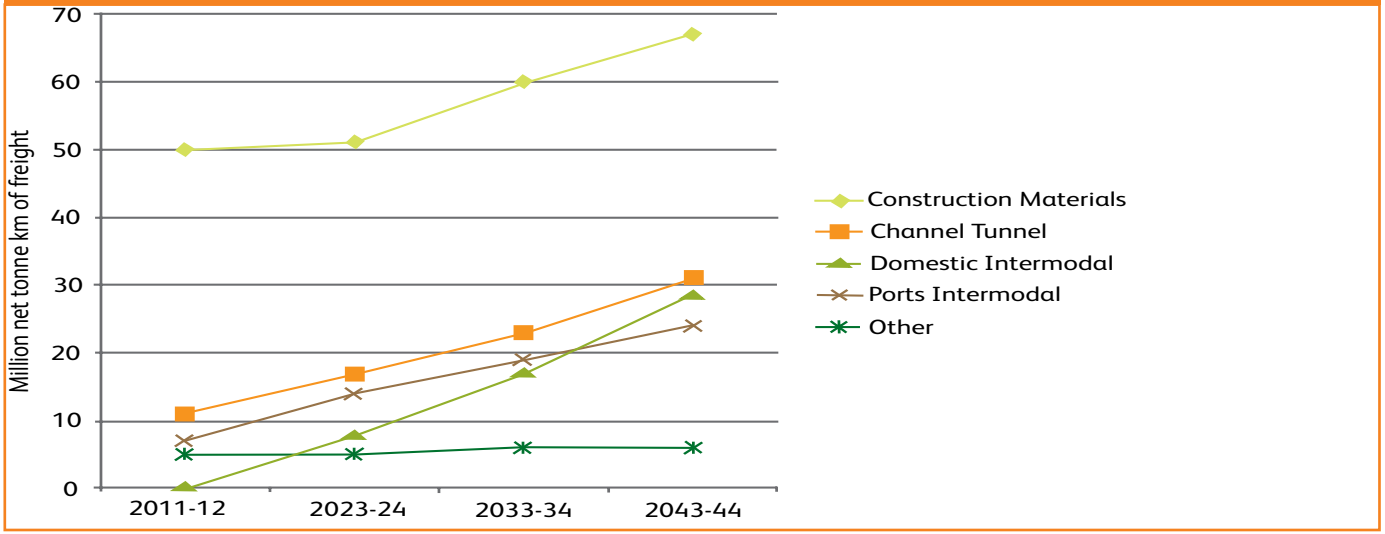
Figure 48 – Freight conditional outputs

Conditional Output Reference	Conditional Output
CO20	To accommodate the anticipated demand for freight services to 2043 on the West London Line, as expressed by the Freight Market Study

Instead the approach taken has been to ensure that this level of freight capacity must be protected in all options to improve passenger services on the WLL that are referenced in this document.

There are no additional capacity constraints elsewhere on the Route given the off-peak nature of most freight movements. The Route Study believes that freight capacity on the Sussex Area therefore is sufficient to facilitate forecast growth in the freight market thereby satisfying conditional output CO20.

Figure 47 – Sussex Freight conditional output net tonne kilometres per annum 2012, 2023, 2033, and 2043



3.5.8 Passenger circulation capacity at stations

Continued growth in the rail passenger market on the Sussex Route Study area has resulted in a number of stations being congested in the peak hours, making movement through the station to the platforms slow and potentially difficult.

The Route Study has been tasked with assessing busy stations on the route to examine whether there are issues with passenger circulation at present, and identify stations where future passenger growth will be putting increasing pressures on the station. Conditional output CO21, Figure 49, requires the Sussex Area Route Study to improve passenger circulation and relieve congestion at these stations.

Figure 49 - Passenger circulation at stations conditional outputs

Conditional Output Reference	Conditional Output
CO21	To provide sufficient passenger circulation capacity at stations within the Sussex Area Route Study area, taking into account anticipated growth over the period to 2023

3.5.9 Other conditional outputs

The London and South East Market Study established further conditional outputs, detailed in Figure 50.

Figure 50 – Other conditional outputs

Conditional Output Reference	Conditional Output
CO22	To provide sufficient capacity for the leisure market at weekends and weekday evenings
CO23	To provide appropriate connectivity and capacity for tourist attractions outside of the region's large urban centres
CO24	To provide access to higher education establishments and other social infrastructure
CO25	To make the rail network more accessible to passengers

Consideration of these conditional outputs is principally a matter for franchise specification and management, although the terms of reference for the Sussex Area Route Study allows consideration of any specific examples raised where a more strategic, longer term solution may be required. Whilst no specific examples were raised during the development of this Route Study, the Long Term Planning Process will continue to engage with stakeholders on these issues.

The London and South East Market Study also articulated a conditional output to improve the level of rail passenger satisfaction. This aspiration is well aligned to the other conditional outputs, as research commissioned by Transport Focus highlights that improving rail performance, capacity, journey times and frequency of services are priorities for passengers, alongside improving the value for money of rail services.

4.0 Consultation Responses

4.1 Development of the process

Network Rail has taken a collaborative and consultative approach to the development of the Long Term Planning Process (LTPP). The Sussex Area Route Study is a key part of this process.

Care has been taken to ensure there is an opportunity for all interested stakeholders, both within and outside the rail industry, to contribute if they wish to influence the rail industry's plans for the future.

4.2 Sussex Area Route Study – Stakeholder Groups

The Route Study has been developed with the close involvement of a wide range of stakeholders. This has sought to ensure that the work has been subject to comment and review by an informed audience throughout.

Consultation and guidance has been extensive and held at a number of levels, using the groups set out in the governance structure outlined in Chapter 1. The four key groups guiding the development of the work have been:

- Rail Industry Planning Group (RIPG)
- Sussex Area Route Study Board
- Sussex Area Route Study Working Group
- Sussex Area Route Study Regional Working Group.

The study was discussed at a number of Regional Working Group meetings held across the Route where Local Authority, Local Enterprise Partnership and other interested stakeholders were briefed on the work, and informal feedback was received. These groups were an important opportunity for participants to raise any queries they may have and inform their own organisations to assist in focusing the responses received as part of the consultation process.

In addition, these groups have been complemented by wider stakeholder events, Technical Working Groups and one-to-one discussions with individual group members to guide and develop the work.

4.3 Consultation Process

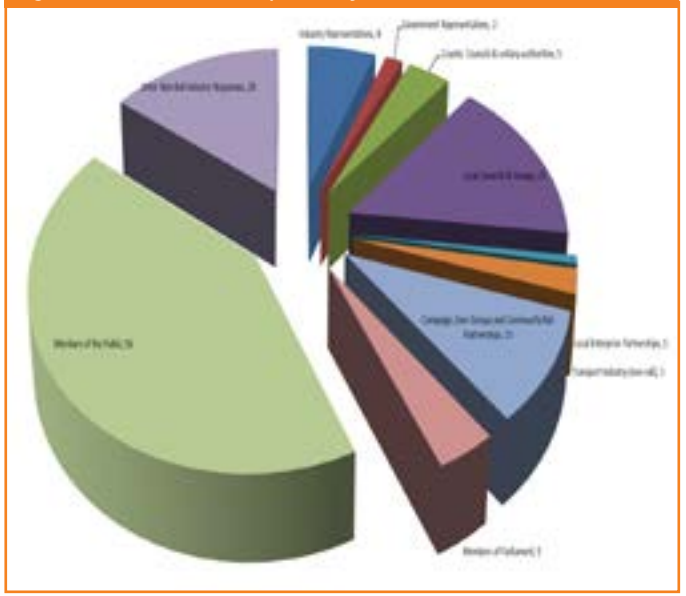
The Sussex Area Route Study Draft for Consultation was published on the Network Rail website on 15 October 2014. A 90-day consultation period on the document closed on 13 January 2015.

During the consultation period, some additional analysis has been undertaken. This is incorporated into the final document. The various Route Study forums have continued to convene during the consultation period, and further meetings have been held with all groups following the consultation period to determine and share further work and the final strategy.

4.4 Consultation Responses

In total, 132 responses were received from stakeholders, and these have been categorised as shown in Figure 51. The consultation responses are published on the Network Rail website alongside this study.

Figure 51 - Consultation responses by stakeholder

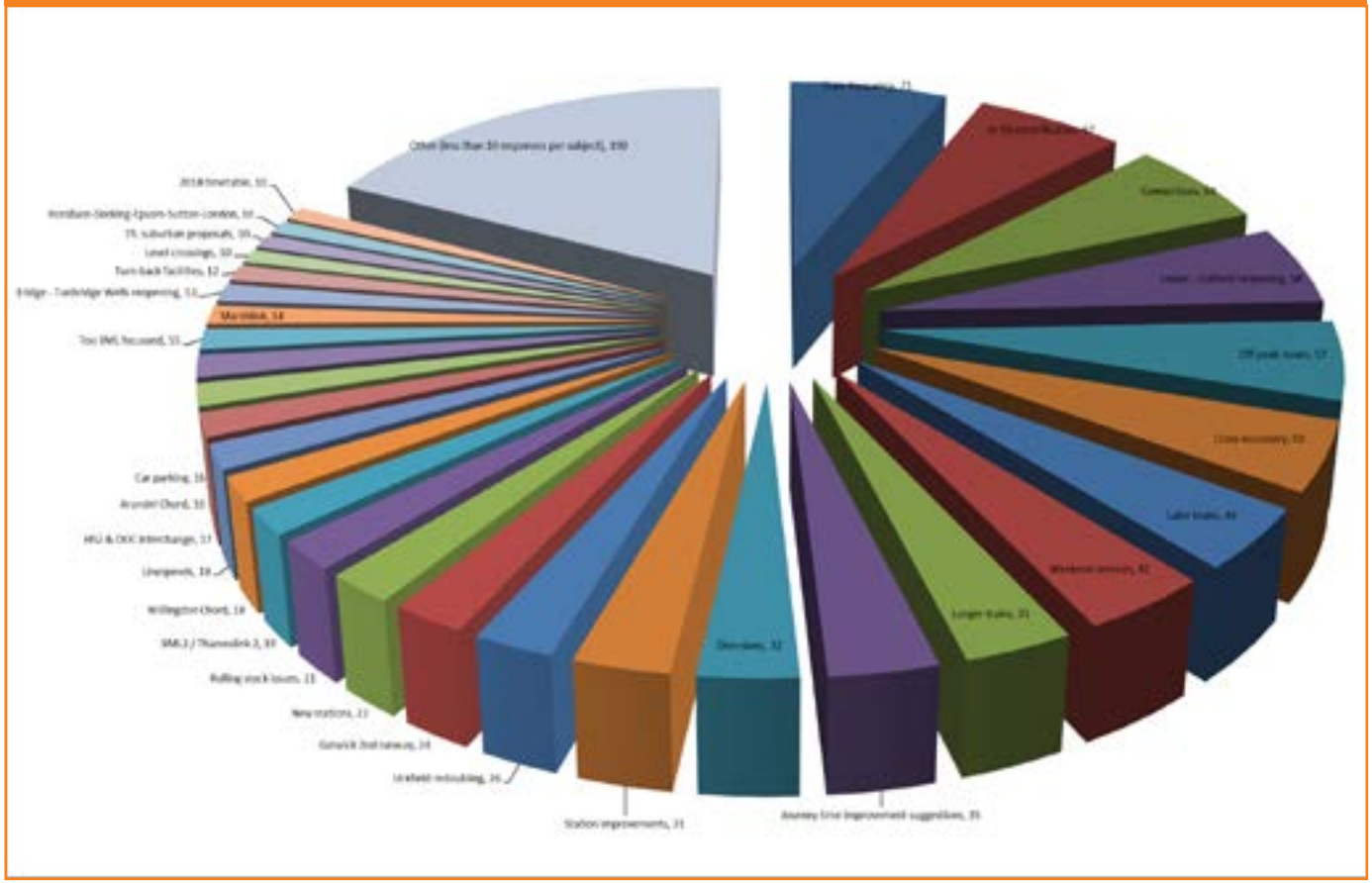


4.5 Key themes in the consultation responses

The responses Network Rail received were in many cases comprehensive and detailed. As a result, it is difficult to provide a précis of each individual response, subjects mentioned by more than nine respondees have been detailed in Figure 4.2. These included constructive suggestions and requests for clarification, which have been reviewed and addressed within this Sussex Area Route Study.

A high proportion of respondents expressed support for the approach taken by the industry in developing the LTPP and the Route Study. Industry and Government organisation respondents particularly expressed their support for the level of stakeholder engagement that was undertaken as part of the Route Study process and the collaborative approach taken. The responses also noted support for the process of Control Period 6 (CP6, 2019-24) prioritisation and the longer-term context, with stakeholders

Figure 52 - Consultation responses by theme



confirming their support for the choices for funders described in the document. Respondees were positive about the Route Study document, outlining that it is a clear, concise document with a sufficient level of detail for the reader to gain understanding.

A number of responses included requests for clarification on maps, figures and wording and to that end we have undertaken the amendments and updated the final document.

The Department for Transport noted in their consultation response that the draft study has sought to accommodate a series of conditional outputs derived from the various Market Studies. It also noted that whilst the need for recommendations of the studies to be focused on meeting forecast demand growth was recognised, a degree of flexibility in relation to the conditional outputs should be applied.

Transport for London (TfL) believed that the demand forecasts needed updating in a few specific areas – and this update has been undertaken. On specifics, TfL felt the Wimbledon Loop analysis was flawed because two trains arriving just outside the high peak hour were excluded from the analysis. It agreed though with the 4tph in each direction service aspiration on the Wimbledon Loop and the 2tph Epsom Downs and Beckenham Junction services. TfL also expressed an aspiration for 4tph on the Tattenham Corner Branch.

TfL asked if Network Rail could further investigate options for increased capacity between West Croydon and Norwood Junction/ Selhurst and at Clapham Junction. Network Rail has completed some further work on this since the draft document and this is referenced in Chapter 6. There are some synergies with the proposed BML upgrade works.

It noted that 12 of the 13 stations identified by the Route Study as requiring congestion relief schemes are in London and six are operated by London Overground – these are already being monitored and congestion relief schemes being developed.

TfL offered to share updated passenger demand modelling with Network Rail to ensure that the strategy for the West London Line and Old Oak Common HS2 interchange has current data, and this updated data has since been incorporated.

TfL disagreed with the low level of growth projected into London Victoria post-Thameslink Programme citing that many passengers cannot choose whether to travel via Clapham Junction or Sydenham. It should be noted that the lower Victoria growth was projected on the Fast Line services rather than the suburban services but, equally it is accepted that the precise balance of demand post Thameslink completion between London Bridge and Victoria on the Fast Lines remains to be seen.

The Office for Rail and Road (formerly the Office for Rail Regulation) asked that on-train capacity is clarified, Figure 53 shows the seating

Figure 53 - Rolling stock seating and total capacity

Unit Type	Class 171	Class 377	Class 378	Class 387	Class 442	Class 455	Class 700
2-car	116 205						
3-car		176 299					
4-car	256 449	241 382	146 416	222 N/M		310 431	
5-car		298 505	183 520		342 N/M		
6-car	375 654	352 598					
7-car		417 681					
8-car	518 898	482 764		444 N/M		620 862	416 1160
9-car		528 897					
10-car	634 1103	596 1010			684 N/M		
11-car		658 1063					
12-car		723 1146		666 N/M			660 1776

(the top number) and total capacity with standing (bottom number) for the various types of rolling stock operating on the Brighton Main Line and suburban routes. N/M refers to not modelled.

First Great Western (FGW), Southern and Govia Thameslink Railway (and predecessor First Capital Connect) were closely involved in the development of the Route Study and consequently only FGW responded formally. FGW expressed concerns about future capacity provision for their services to/from Guildford/Reading. Chapters 5 and 6 contain an update on future options for these services.

The possibility of through running from west of Reading was welcomed by FGW subject to a robust timetable. Options for journey time and frequency improvements on the West Coastway services were also welcomed but it was felt that further work needs to be carried out when it comes to omitting station stops.

There was strong support from a wide selection of stakeholders for in-fill electrification of the Uckfield Branch and North Downs Line (also Marshlink which is outside the scope of the Route Study). As noted in the Draft Route Study, the Electrification RUS rather than this document will provide further assessment of those options.

The remaining responses can be broadly split into the following categories:

- Brighton Main Line
- West of the Brighton Main Line
- East of the Brighton Main Line
- London suburban area
- Other.

Brighton Main Line

There was a lot of support for the schemes described in the Draft for Consultation to enable extra train services to operate on the Brighton Main Line (BML) into London Victoria and London Bridge, and to allow for more robust operation of present service levels.

The Route Study ethos is very clear in that the first step is to make best use of the infrastructure through timetabling and train lengthening, the BML has been doing this for many years. The infrastructure options serve to de-congest junctions and stations which will be a benefit to not just the passengers on the additional trains but everyone who uses the BML and this was recognised in the responses.

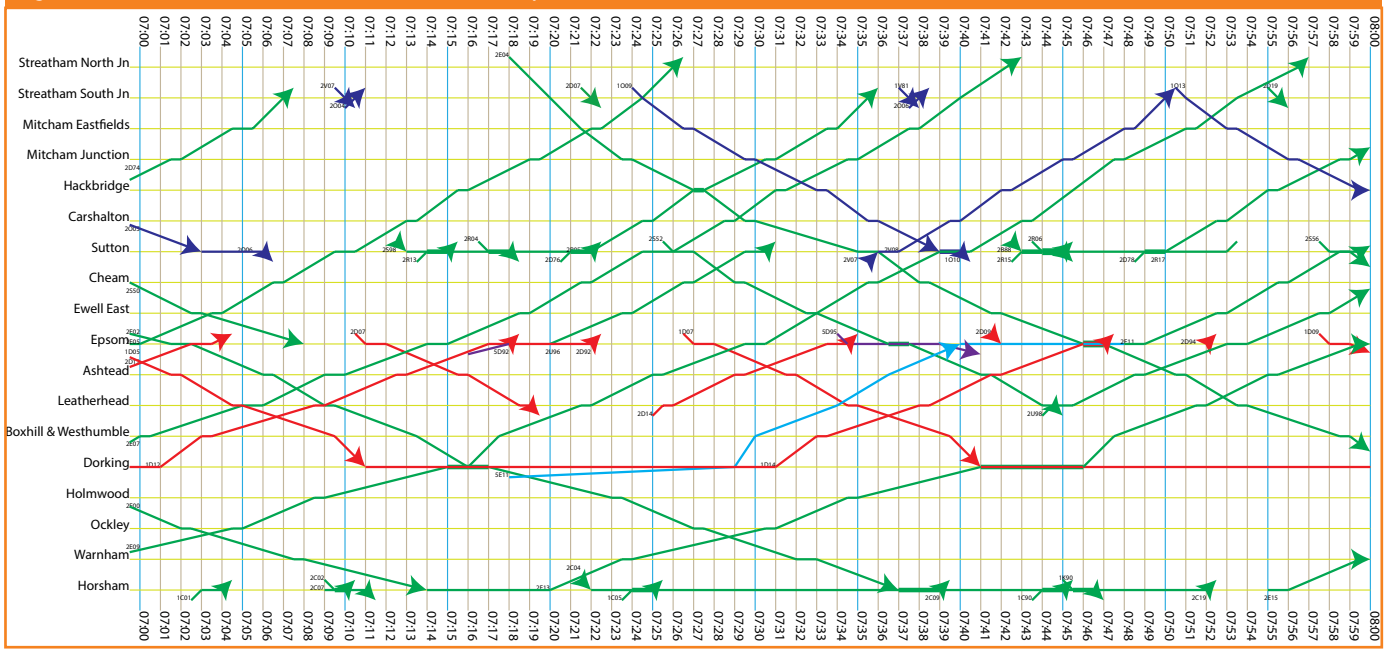
There was support for alternative routes to the core BML, some involving additional infrastructure and/or significant timetable challenges:

- **Brighton Main Line 2:** This has been proposed by the Wealden Line Campaign as an evolution to reopening Lewes – Uckfield. By linking the Uckfield line through to Brighton directly via Falmer. The proposal also references the opportunity to reopen the line between Eridge and Tunbridge Wells and Sanderstead to Elmers End and then through to London. Both the Tunbridge Wells route and Lewisham into London Bridge (and beyond) are close to capacity today, the whole package of works including double-deck track over Croydon Tramlink and a tunnel under the South Downs would be extremely expensive and without new railway inwards of Lewisham would not yield any new through train paths into central London. Despite this Chapters 5 and 6 consider further the long term value of this proposal.
- **Thameslink 2:** this is a further evolution by the Wealden Line Campaign, accepting that the route into London Bridge is close to capacity it looks to provide a new route connecting both the BML and the Uckfield/East Grinstead Branch to Canary Wharf, Stratford and on to Stansted Airport to provide a Gatwick Airport – Stansted Airport link. The proposal requires tunnelling between Lewisham and Tottenham Hale. Chapter 6 considers some of the fundamental issues around a long term new lines solution.
- **Double-deck track Clapham Junction to Merstham or Gatwick Airport:** the West London Line Association suggested that the Route Study look beyond 2043 to 2100 as infrastructure is expected to last 100 years, its ambitious suggestions include an elevated track above the BML between Clapham Junction and Merstham/Gatwick Airport.
- **Additional reversible line between Purley and East Croydon:** this would provide additional peak direction capacity between

Key

- Southern service
- Thameslink service
- South West Train service
- Empty Southern train
- Empty SWT train
- London direction
- Away from London

Figure 54 - Horsham to Streatham North Junction train paths (07:00-08:00)



Purley and East Croydon. This stretch of track is mostly on high embankments between Purley and South Croydon where it goes into cuttings with structures on the Up Fast-side of the line and the already cut into embankment on the Down Slow-side of the formation with structures on or close to the boundary. The final approaches to East Croydon station see the Down Slow-side in a high walled cutting whilst structures can be found close to the line on the opposite side. The existing proposals in the Route Study would allow some more services to operate through this section without additional tracks – though it is noted and agreed that in the long term either a signalling technology solution or an additional track could be required on this section.

- **Additional services on the Arun Valley Line to London Victoria/London Bridge via Horsham and Sutton:** although the rural stretch of line between Horsham and Dorking is not heavily used, the number of trains using the two-track railway between Horsham and Sutton increases considerably between Leatherhead and Epsom, see Figure 54. The graph shows the train service between 07:00 and 08:00 between Horsham and Streatham North Junction. Each line represents a train, lines progressing up the page are heading towards London. In addition to the trains shown, extra time is allocated behind a train before the next one to allow for section running times and platform reoccupation, this differs between fast and stopping trains and varies between two minutes for fast and nine minutes for stopping trains, this makes it difficult to run a fast service in the suburban area as it catches up with the stopping

trains in front. One option proposed was to reinstate the centre lines at Cheam to enable fast trains to pass slow ones, this would then result in an undesirably long station stop for slow services whilst waiting for fast trains to pass. It would also not be possible to path any additional fast services in the peak into the London termini via this route

- **Four tracks to the sea:** this entails constructing an additional two track between Balcombe Tunnel Jn (just south of Three Bridges) to Preston Park. There are many challenges such as constructing at least four new tunnels parallel to existing tunnels, two viaducts (including the picturesque Ouse Valley Viaduct), rebuilding most of the stations and purchasing land to make room for the widened railway. On its own without investment in the inner area of the Brighton Main Line this proposal would not yield any additional through train paths.
- **Additional through line at East Croydon:** there is a wide space between the tracks servicing Platforms 2 and 3 at East Croydon station that could be used for a through line for Gatwick Express services. The CP6 proposals for new platforms at East Croydon use this space for the new Platform 4 so it would not be possible to reinstate a through line. A platform line is better than a through line as it can be used by a wider range of services including those stopping at East Croydon.

West of the Brighton Main Line

The West Coastway between Angmering and Brighton was raised in a number of responses, it is a very restricted area in terms of growth for housing, road and rail development – the simple diagram (Figure 55) shows the key constraints on this stretch of line. There is nowhere to provide 4-track sections to allow fast trains to overtake slower trains. The level crossings are a recognised problem but the alternatives are road over rail bridges or closure of the crossings and that in turn has an effect on north-south traffic flows and communities.

A new station was proposed at Wick/Lyminster between Arundel Junctions and Angmering, this would exacerbate the capacity issues described above on the West Coastway as stopping trains would require an additional two to three minutes to call at the new station.

Figure 55 - The West Coastway Space Challenge

Turn-back locations were identified by respondents at Worthing and Ford, the former would be beneficial in times of perturbation and engineering works although there are some technical issues at this site, the latter would be a good alternative to the Arundel Chord and is slightly closer than Littlehampton but extensive works would be required to reinstate Platform 3, provide turn-back facilities in Platform 2 and with the interface with the level crossing just off the east-end of the platforms. Chapter 5 considers the Journey time outputs of a Ford turn back option when diverting trains via the Arun Valley.

Two new stations have been proposed between Horsham and Crawley, namely North Horsham and Kilnwood Vale. Network Rail and Southern have been working with the developers, local authorities and Department for Transport with the clear direction that only one of these stations may be constructed and that the promoter of the new station would need to propose closure of Faygate (which has a low footfall and limited service) to reduce the impact on existing passengers on trains that will be calling at the new station. West Sussex County Council is working with stakeholders to decide which station is to be built.

East of Brighton Main Line

Lewes – Uckfield reinstatement was mentioned by 58 respondents, 19 mentioned the BML2 (Brighton Main Line 2) proposals although not all were in support. An incremental approach was proposed by Railfuture. 26 respondents proposed the re-doubling of the single line sections of the Uckfield Branch.

A horseshoe curve at Lewes was suggested by Railfuture and others to enable trains from a reopened Lewes – Uckfield line to continue to Brighton, the new chord would diverge from the East Coastway just east of Lewes station and curve around to run parallel to the A27 towards Falmer, joining the Lewes – Brighton line where the road is close to the existing railway. The role of BML diversionary options via Lewes is considered in Chapter 5.

There was a lot of comment and suggestions for Marshlink (Hastings to Ashford International) services and the line of route, however, this will be covered by the Kent Area Route Study, which commenced in September 2015, for 2016 Draft for Publication – these comments will be passed on to the Kent Area Route Study team.

The Spa Valley Railway operates over the former branch line between Tunbridge Wells West and Eridge. The preservation society operates from adjacent to the former Tunbridge Wells West station but the link to Tunbridge Wells station remains closed. A number of respondents saw this route as an ideal reopening scheme to link Tunbridge Wells to Eridge and beyond to Uckfield (and potentially Lewes).

Willingdon Chord, providing a direct route from the East Coastway East (between Pevensey & Westham and Polegate), was suggested by a number of respondents. The alignment of this former connection has been largely breached now by housing developments, industrial sites and the Jubilee Way road. An alternative location has been proposed but would require extensive engineering across the marshes and with a very restrictive curvature resulting in low line speeds. The Sussex RUS established there was no business case to re-open the Willingdon Chord, as the diversion of services away from Eastbourne was undesirable given the volume of passengers for that station. The Study also established there was no business case for additional trains that did not call at Eastbourne.

Journey time improvements, particularly for the Ashford International – Brighton services, are often used to describe the benefit of the scheme but this ignores the fact that the vast majority of passengers travelling from the Bexhill direction alight at Eastbourne and a similar number of passengers then board the same train for the next leg to Brighton. It is accepted that the reason for this could be that the extended journey time deters people from catching the train, preferring to travel by car instead, but a timetabled interchange at Hampden Park could probably achieve a significant journey time improvement for much less cost.

New stations were also proposed at Stone Cross and Glynde Gap, the former would be atop a high embankment and extremely difficult to construct as well as being visually intrusive to many of the lineside neighbours and the latter has a poor catchment area (being on the seafront) and too close to Bexhill station.

London Suburban

Numerous infrastructure schemes were suggested for the suburban network, some detailed above. The closure of the Beckenham Junction Branch was commented on by TfL and a London Assembly Member who identified that it is key to the extension of Tramlink to Crystal Palace. This scheme could deliver the proposed turn-back facilities at Norwood Junction that were looked at in CP4 and the Sussex RUS but cannot be delivered before the Thameslink blockade at London Bridge completes at end CP5.

Another turn-back scheme was suggested for Belmont where the line could be redoubled from Sutton and used to turn-back some of the existing trains that terminate at Sutton, this would provide better connections with the hospital and the development area.

Respondents were also keen to see interchange between modes and transport corridors:

- **St. Helier Interchange:** an extension of the Northern Line between Morden and St. Helier

- **Streatham Interchange:** TfL's scheme to divert the Slow Lines via Streatham Hill in a tunnel with interchange at Streatham station – this plan has since been revised
- **Balham Interchange:** to provide connections to the Northern Line, this exists but respondents want Brighton services to call here but this would severely restrict fast line capacity.
- **Norwood Junction Interchange:** requires more Fast line trains to call at Norwood Junction, this would be detrimental to journey times and may cause extensive standing
- **New Cross Gate Interchange:** to provide a new interchange on to the Bakerloo Line Extension.

A number of new stations were also suggested although the full impact of the additional stops on the existing timetable should be noted (particularly on the West London Line): Brixton East, Camberwell, North Kensington and White City as well as the already proposed Old Oak Common HS2 Interchange station. Beyond the new Old Oak Station proposal for the West London line it is not considered feasible to add any further stations to this piece of railway.

Other

A number of linespeed alterations, rolling stock improvements/ deployment etc. were proposed. The key ones are shown below:

- **Kent to Gatwick Airport via Tonbridge:** this service was abandoned due to low passenger numbers, Kent County Council commissioned a report which found that demand for a through service was low
- **Kent to Gatwick Airport via Marshlink:** there is already a service to Ore but this is the extension of a proposed St. Pancras International – Hastings High Speed service being extended to Gatwick Airport
- **Coastway Express service:** that by-passes two key markets (Eastbourne and Brighton) to connect East and West Coastways
- **M25 Rail and Bedford – Tonbridge via Oxford:** imaginative ideas to link various routes to provide an orbital service reducing the journeys into London. Passenger demand, linespeeds and stopping patterns will be the biggest challenges to this proposal. As the Western and Sussex Route Studies note however an Oxford to Gatwick link may be possible.
- **Southampton Airport Parkway:** some Southern services already call at this station en route to Southampton Airport Parkway, it is a significant challenge to timetable due to the various interfaces, mix of traffic on the South West Main Line and turning back at Eastleigh – see the London & South East Route Utilisation Strategy.

4.6 Next Steps

The Sussex Area Route Study will become established 60 days after publication unless the Office of Rail Regulation issues a notice of objection within this period.

4.7 Planning for Control Period 6 and beyond

As detailed in Chapter 1 the output from both this and other Route Studies will present the case for continuing investment in the rail sector.

The Route Studies will inform plans for CP6, the period from 2019-24. The outputs will be used to inform the Initial Industry Plan in September 2016 and to update the Network and Route Specifications published on the Network Rail website.

5.0 Control Period 6 priorities

In this chapter the Route Study highlights the priorities which have been identified for Network Rail's next control period for funding (Control Period 6, commencing April 2019), and seeks to inform funders of the implications in terms of interventions, industry outputs, value for money, and affordability.

5.1 Overview

The Rail Value for Money Study[1] highlighted the need to make best use of the existing capacity of the network, before considering further investment-based strategies to accommodate the rising demand from passengers and freight users. This theme is consistent with the way the rail industry currently plans the use and development of capacity through the following broad hierarchy of responses:

- First, by making adjustments to the timetable and train plan in order to better match the available capacity with demand. This sometimes includes creating extra capacity by making informed trade-offs against other rail outputs (for example, performance and journey times). These changes are typically planned and delivered through the 'day-to-day' planning of the railway and the franchising process, although the Long Term Planning Process (LTPP) also identifies trade-offs through consideration of a 'making best use' scenario
- Next, delivering extra capacity by deploying additional operational resources (such as rolling stock), where this can be done within the existing capability of the rail network. These opportunities are typically identified through the LTPP and franchising processes
- Finally, by investing in the capability of the network to allow more or longer trains to be operated. These interventions are typically identified through the LTPP, and delivered by aligning the franchising and Periodic Review processes in a back-to-back manner.

As demand for passenger and freight services grows, so too will the pressure on the network. In some circumstances, making best use of the existing network will require informed trade-offs to be made between outputs and the Sussex Area Route Study highlights where these choices exist.

After examining choices which make best use of existing network capacity the Route Study identifies a number of investment priorities for CP6. All of the CP6 investment choices identified meet one or both of the following criteria:

- Investments which are required to provide sufficient capacity for the anticipated level of passenger and freight demand at the end of CP6 (where this investment is also consistent with the longer-term capacity strategy identified by the Route Study)
- 'Once in a generation' opportunities where conditional outputs (or some part of the capital works necessary to enable accommodation of the conditional outputs over a longer period of time) can be delivered efficiently during CP6, for example, in conjunction with the planned renewal of life-expired assets.

1 "Realising the Potential of GB Rail", May 2011

5.2 The December 2018 timetable

Chapter 2 Figure 18 sets out the potential end of Control Period 5 (CP5) service specification on the route. The service specification is derived from the last full iteration completed of the December 2018 timetable for the post-Thameslink Programme construction period – before the recent re-franchising process.

This timetable was constructed specifically to make maximum use of available capacity in the Sussex Area after Thameslink Programme completion, and it is the view of Network Rail that this specification represents the absolute maximum practical peak use of the railway on most routes in the study area. This conclusion is reflected in more detail as each of the individual conditional outputs are considered.

In some areas this base specification will differ slightly from the proposed timetable of Govia Thameslink Railway (GTR), the winning bidder for the Thameslink, Southern and Great Northern (TSGN) Franchise, though the overall hourly quantum of service is the same or similar on most routes. The timetable has been used as a working assumption to allow a baseline position to be established ahead of the finalising of GTR's 2018 timetable. This working assumption does not represent a confirmation of track access, and it is expected that considerable further work will be required over the next three years, including further performance modelling before a final 2018 timetable is completed.

5.3 The impact of Performance on 'making best use' scenarios

As set out in Chapter 2, the Sussex Route Area has struggled in recent years to meet performance targets. The reasons for the particular performance challenge in the Sussex area are many and varied, but the intensity of service operated in the peak and off-peak and in particular the way the service is operated with numerous conflicting moves on flat junctions and moves between slow and fast lines, leads to high potential for delay to be passed between service groups. The extent of reactionary delay highlighted for 2014/15 in Chapter 2 partly illustrates this point, as does the statistics highlighted in that chapter, setting out the number of conflicting moves potentially impacting each main service group.

Against this backdrop, any initiatives to make best use of existing capacity, that involve operating more trains than operate today without altering the infrastructure will always be likely to constitute a performance risk. This issue is considered on a case by case basis against each conditional output.

5.4 The Strategic challenge facing the BML and the Sussex Route Area

Over the last two Control Periods, Network Rail has worked closely with Southern and First Capital Connect (FCC) to identify and implement the remaining incremental opportunities to increase peak capacity within the study area. These initiatives have been primarily focused on platform lengthening to allow maximum practical train lengths to operate in the peak, but also tactical opportunities to enhance layouts at the time of re-signalling have been taken.

The conclusions of the South London (2008), Sussex (2010) and London and South East Route Utilisation Studies (2011) have all now been implemented with the exception of Uckfield line train lengthening which is funded and will be completed in 2016.

As a result of this policy of best value incremental enhancement, large volumes of additional capacity have been delivered promptly, with very small infrastructure investment outlay when compared with other routes in the UK.

To complement this approach, when completed the Thameslink Programme will have resolved the central London bottleneck that part of this route feeds into and also allowed maximum length 12-car trains to operate through the Thameslink Core (London St Pancras International to London Blackfriars section) and onto the Brighton Main Line (BML).

With all the best value smaller scale incremental options delivered over the last two control periods, significant and difficult choices now need to be made about the future development of the BML. A number of these decisions need to be made in time for implementation in CP6 both as a consequence of this Control Period coinciding with replacement of life expired signalling equipment on the route, but also as Chapter 3 illustrates so it is clear how, or indeed whether, CP6 demand is to be catered for by this railway.

As the following sections of this chapter illustrate, the choices for further capacity improvements to BML services involve a series of challenging works to unblock key bottlenecks along the route.

Various combinations of these works are set out. The scale of these works should not be underestimated. In every case infrastructure feasibility work is at an early stage of development. Following closure of the consultation process for the Route Study Draft for Consultation in January 2015, Network Rail launched Governance for Railway Investment Projects (GRIP) Stage 2 development work on a number of the BML options set out below. This will allow more accurate costings and delivery plans to be available for consideration at the point of the Initial Industry Plan (IIP) submission for CP6 in September 2016. It is possible some works locations and details will change as part of this next stage of work.

Conclusions by conditional output

Section A: Capacity conditional outputs:

5.5 Providing sufficient peak capacity for passengers – BML Fast Line services into London Victoria and London Bridge

This group of services comprise all trains operating on the fast lines to London Bridge and London Victoria inwards of Norwood Junction/Selhurst. This effectively includes all services using the BML south of Croydon. Figure 56 sets out the relevant routes that have services that fall into this category.

Figure 56 - BML Fast Line Services

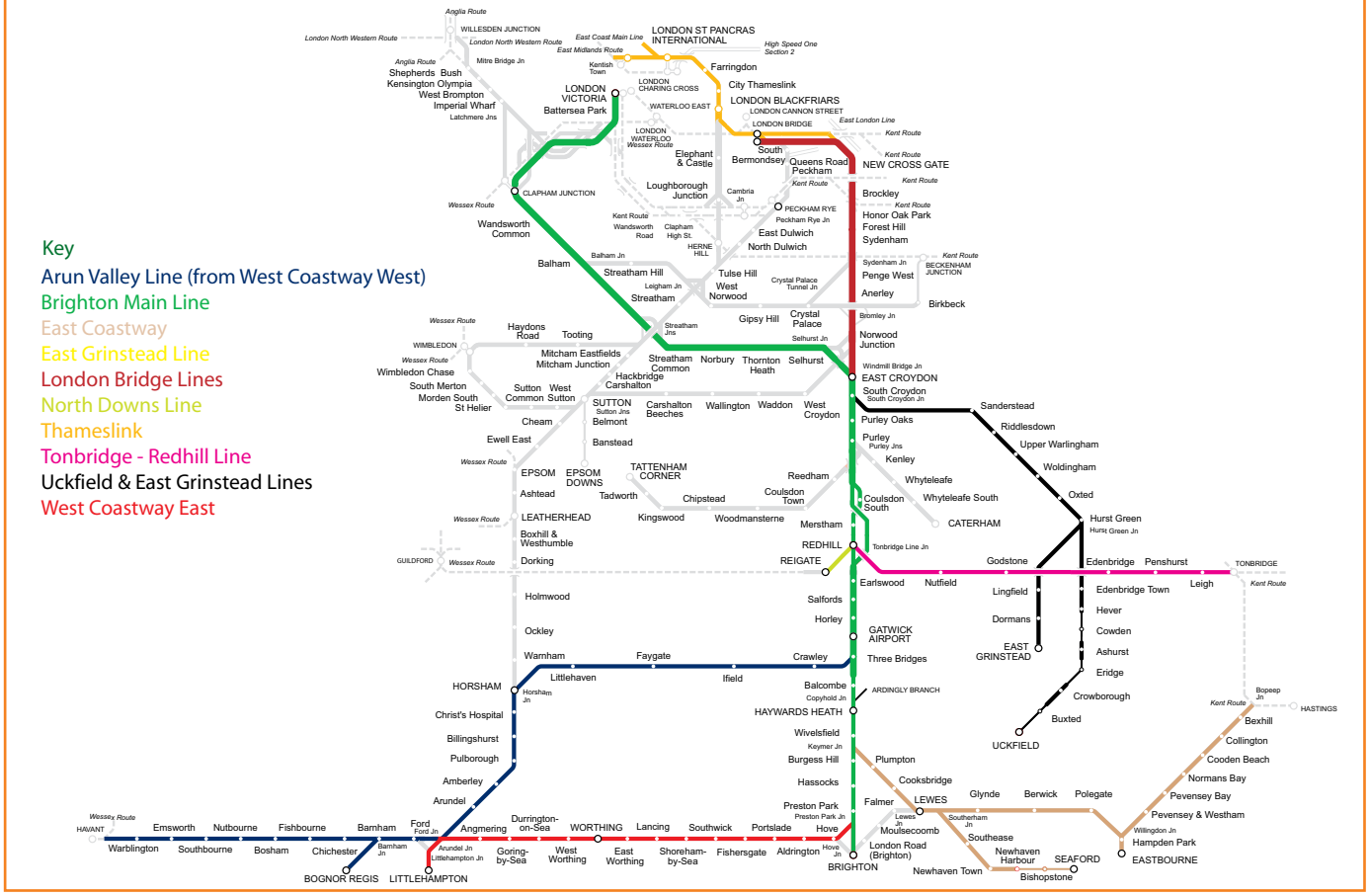


Figure 57 – BML Fast Line services conditional outputs		
Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO1 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – BML fast services	At least an additional six 12-car services during the high-peak hour.
CO6 (2023)	Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – BML fast services	An additional four 12-car services during the high-peak hour.

Figure 57 sets out the gaps in peak main line service provision that would exist if the end CP5 base timetable assumption is carried forward to end CP6 (2024) and 2043.

5.5.1 Making best use of existing infrastructure to accommodate Main Line demand by end CP6

Figure 58 indicates the extent to which the end of CP5 timetable will squeeze capacity out of what are already congested and poor performing sections of the BML. It is Network Rail's view that further attempts to squeeze additional paths onto the end of CP5 infrastructure over and above the scenario set out here are impractical[1].

[1] December 2018 usage estimates are from DTT 2011 – Network Rail's draft December 2018 Timetable. The quantum of traffic indicated is beyond that currently operated in the peak and does not yet represent an output commitment by Network Rail.

Figure 58 - 2013 BML usage versus end 2018 usage		
Plain line section	Up Main usage morning peak – high peak hour 2013	Indicative usage post December 2018
Keymer Junction – Balcombe Tunnel Junction	13	13[2]
Stoats Nest Junction - Purley	17 FL 3 SL	18 FL 6 SL
Purley – South Croydon	17 FL 6 SL	20 FL 10 SL
South Croydon – East Croydon	17 FL 13 SL 3 RVS	20 FL 12 SL 6* RVS
North of Norwood Junction – Bricklayers Arms Junction	14 FL 14 SL	20 FL 14 SL
Selhurst – Battersea Park (Measured at Wandsworth Common)	16 FL 15 SL	18 FL 16 SL

FL = Fast Line, SL = Slow Line, RVS = Reversible line

Figure 59 - BML interventions / high peak paths generated

		2023				2043	
Location	Required Intervention	Eastbourne - London Bridge (fast)	Hove - London Bridge (fast)	Hove - London Victoria (fast)	Haywards Heath - London Victoria (semi-fast)	Haywards Heath - London Victoria (semi-fast)	Haywards Heath - London Victoria (fast)
London Victoria	Connect Platform 8 to Sussex side, Brighton Reversible, bi-directional Up Fast			X	X	X	X
Clapham Junction	Additional Infrastructure or ETCS Level 2/3 with ATO for inner area			X	X	X	X
Windmill Bridge Jn*	Fast Lines grade separation & 6th track to East Croydon	X	X	X	X	X	X
East Croydon*	Additional platforms	X	X	X	X	X	X
Stoats Nest Jn*#	Grade separation				X	X	
Redhill[1]*	Additional infrastructure, remodel country end				X	X	
Reigate	12-car bay platform and Platform 2				X	X	
Gatwick Airport*	Additional/reconfigured crossovers	X	X	X			X
Haywards Heath*	Additional crossovers				X	X	X
Keymer Jn/Wivelsfield*	Additional up platform & grade separation	X	X	X			
Hove*	Upgrade turnback siding		X	X			
Hassocks/Preston Park*	Headway enhancements		X	X			

[1] This is an intervention at the southern end of Redhill. Network Rail already has planned a CP5 intervention at the north end of the station.

* Within CP6 resignalling area

Need under review, now potential to grade separate slow to fast moves at Selhurst Junction is being investigated

It remains possible that even some elements of the baseline scenario detailed may not be achievable alongside acceptable route performance without some of the CP6 infrastructure assessed below. Figure 59 sets out the interventions required to meet the end CP6 and 2043 demand forecasts on fast line services.

5.5.2 Infrastructure enhancement – investment priorities for delivering the BML fast line services conditional outputs in Control Period 6

Figure 14 in Chapter 2 sets out the key capacity constraints on the BML.

Figure 59 sets out the combination of infrastructure interventions that have been tested to deliver the end CP6 and 2043 capacity requirements set out by conditional output CO1 and CO6 in Chapter 3. The table also indicates whether the intervention area falls within the CP6 re-signalling plan area also set out in Chapter 2. Appendix A contains more detail on each of these interventions including high level summaries of track layout options. As identified in Chapter 3, crowding will be prevalent in 2043 from as far out as both Shoreham-by-Sea and Lewes and the origin points of the train services shown in Figure 59 have been chosen to accommodate demand from these locations and from stations on the BML itself.

It will be noted a greater number of potential paths have been found on the London Victoria route than the London Bridge route. This is due to the December 2018 timetable largely maximising the number of trains that can realistically be operated into London Bridge Low Level and the Thameslink Core (though the grade separation of the Windmill Bridge Junction area effectively opens up the prospect of viable operation of the last addition two paths on that route).

Whilst the demand forecasts predict stronger growth to London Bridge, all of the additional capacity added by December 2018 is on that corridor. In the long term should Crossrail 2 move ahead, a rebalancing of some demand toward Clapham Junction and London Victoria is possible.

In order to assess the best combination of infrastructure and service outputs from an economic appraisal point of view, six different combinations of infrastructure and service output have been tested. Although not located on the BML, Reigate has been included in the infrastructure intervention list to help remove some splitting and joining of trains at Redhill station through turning back 12-car services at Reigate and also protecting Reigate's direct London Bridge services for the future.

Figure 60 provides a summary of the infrastructure option packages against combinations of the additional path requirements. Infrastructure package Option S1i and S1ii fully satisfy the conditional output requirements for CP6. Satisfying the conditional output is defined as reaching a target of less than 85 per cent seat utilisation at the following key points on the BML: Hove, Haywards Heath, Redhill and East Croydon.

Options S2 and S3 however will only partially satisfy the conditional outputs set by the London & South East Market Study. Option S2i and S2ii would provide the infrastructure to support additional paths originating from Haywards Heath, but would not satisfy the capacity conditional output for services originating on the East and West Coastways. Option S3i and S3ii would provide the infrastructure to support additional paths originating from Haywards Heath, Hove and Eastbourne, but would not satisfy the capacity conditional output for services passing through Redhill on the slow lines. These options have been examined in the Route Study alongside Option S1 to demonstrate more affordable and better value for money options for BML interventions.

It should be noted at Clapham Junction some and/or choices exist between infrastructure alterations and earlier roll out of European Train Control System (ETCS) with Automatic Train Operation (ATO). Options at this location are at a particularly early stage of development.

Before reviewing the Benefit Cost Ratios (BCRs) a number of important points should be noted:

The additional services enabled by the schemes are built on top of the baseline Development Timetable for December 2018 described in Chapter 2. It remains possible that Network Rail may decide that some elements of that timetable e.g. the uplift from 16tph to 18tph on the fast lines into London Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined in Figure 59. In this eventuality the BCRs of all options would be improved.

Figure 60 - Summary of BML Fast Line services infrastructure option packages against net additional paths

Option	Starting Locations	Infrastructure Intervention Locations		VfM Rating	GRIP 2 Sensitivity Benefit Cost Ratio
Option S2i	**London Victoria** 2 x Haywards Heath fast services 2 x Haywards Heath slow services via Redhill **London Bridge** 2 x Haywards Heath fast services	London Victoria station, Windmill Bridge junction, East Croydon station, Stoats Nest Junction, Redhill South Junction, Reigate station, Gatwick Airport, Haywards Heath. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement	1.5	Medium	2.4 (High)
Option S3i	**London Victoria** 3 x Haywards Heath 1 x Hove fast service **London Bridge** 1 x Eastbourne 1 x Hove fast service	London Victoria station, Windmill Bridge Junction, East Croydon station, Stoats Nest Junction, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield, Hove. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement	1.5	Medium	2.3 (High)
Option S1i	**London Victoria** 2 x Haywards Heath slow services via Redhill 1 x Haywards Heath fast service 1 x Hove fast service **London Bridge** 1 x Eastbourne 1 x Hove fast service	London Victoria station, Windmill Bridge Junction, East Croydon station, Stoats Nest Junction, Redhill South Junction, Reigate station, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield, Hove. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement	1.4	Low	1.9 (Medium)
Option S2ii	Same as Option S2i	All Infrastructure items listed in Option S2i above but including interventions at Clapham Junction	1.1	Low	1.5 (Medium)
Option S3ii	Same as Option S3i	All Infrastructure items listed in Option S3i above but including interventions at Clapham Junction.	1.1	Low	1.5 (Medium)
Option S1ii	Same as Option S1i	All Infrastructure items listed in Option S1i above but including interventions at Clapham Junction	1.0	Low	1.4 (Low)

The journey time benefits of avoiding splitting and joining trains on Coastway services at Haywards Heath in the off-peak have been included.

Performance and certain wider socio-economic benefits have not yet been included in the business case. Network Rail will revise the business case at a later date to reflect this.

There are also some known exclusions from costs at the moment and these are recorded in Appendix A.

5.5.3 Conclusions, BML fast line services priorities for CP6:

From each of the options assessed there is a set of common works that in all scenarios would be required:

These comprise:

1. London Victoria approach alterations and Platform 8 access
2. Windmill Bridge Junction grade separations and additional track between Windmill Bridge Junction and East Croydon
3. East Croydon additional platforms
4. Coulsdon area grade separation[1]
5. Reigate additional platform
6. Gatwick switch and crossing alterations
7. Haywards Heath switch and crossing alterations

Of these locations, 2, 3, 4, 5 and 6 fall within the Three Bridges resignalling area for CP6 and should be considered the highest priority for further development in preparation for the Initial Industry Plan (IIP). If that further development proves the feasibility and business case, this would mean development work would have been completed in time to allow those schemes to be combined with disruptive renewals work in CP6. Alongside these four items, the signalling alterations to London Victoria approaches are likely to be important in delivering some of the additional paths into London Victoria and therefore it would be sensible to include these in a CP6 package.

This could deliver Option S2i - an additional 6tph but focused initially from Haywards Heath inwards.

It is important to note however that without the infrastructure alterations set out in Figure 59 at Keymer Junction, the additional services enabled by main line works would only be able to operate from inwards of Haywards Heath until such point as that scheme and the Hove alterations are made. Once completed Option S3i would then have been achieved through delivering an additional 6tph but from a wider range of origin points including the Coastway.

Finally it should be noted that without either the infrastructure intervention outlined at Clapham Junction or alternatively successful implementation at a later date of ETCS/ ATO on the inner area of the Brighton Main Line (BML) fast lines, some of the additional paths identified to London Victoria in Figure 60 would not be able to run. The additional paths into London Bridge would still be able to operate in this eventuality.

Overall the impact of the full infrastructure package on the end of CP6 crowding versus the do nothing post 2018 scenario is illustrated in Figures 61 and 62. Standing from as far out as Haywards Heath, Gatwick and Redhill would be substantially relieved. Only a 4tph uplift has been displayed in Figure 62, although if all works were completed in CP6 the additional 6tph would be likely to be achievable. Figures 6.2 and 6.3 in Chapter 6 set out the full impact of the additional 6tph by 2043.

The cost estimates that inform the BCRs are based on initial engineering feasibility assessments but are pre-GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs.

The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power

[1] Network Rail is currently reviewing the need for the Couldson area grade separation, in light of a possible option to grade separate Selhurst Junction instead.

Figure 61 – Seat Utilisation on the BML 2023 including committed CP5 interventions only

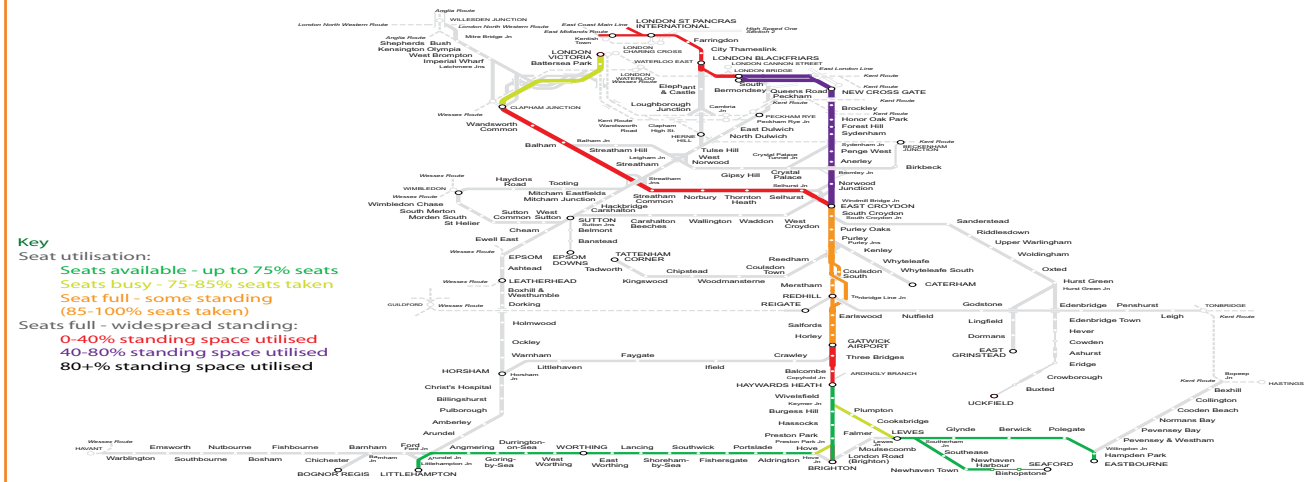
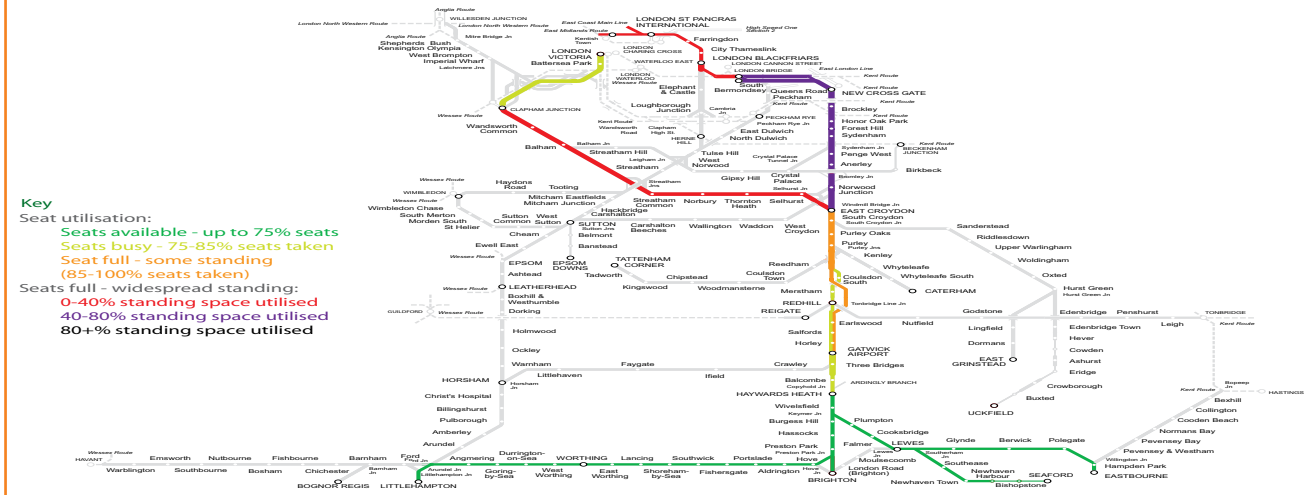


Figure 62 - Seat Utilisation on the BML 2023 with Option S1 plus 4tph (out of a potential 6tph)



supply analysis and examine any depot and stabling implications later in the development process and BCRs will be revised accordingly at that point.

If one of the option combinations set out in Figure 60 were to be progressed, further analysis would be completed to refine the option and update the value for money rating of the scheme.

Main Line Performance

The options in this Route Study amount to an integrated BML upgrade project that, in recognition of affordability and disruption related constraints, could be timed where appropriate alongside the signalling renewals programme. In almost every case the infrastructure interventions set out are aimed at improving performance by separating traffic flows or providing additional platform faces.

Despite this, as identified in Chapter 2, there is a current shortfall in the capability of the BML to deliver the current timetable reliably. This is partly driven by a number of locations where the infrastructure is not capable of achieving the Timetable Planning Rules currently assumed. Network Rail is presently reviewing mitigations for each location affected. In addition to the options outlined in Figure 59, to generate additional capacity on the BML, it is possible some further investment will be required in CP6 to complete the process of resolving current issues with the existing timetable planning rules and resultant performance.

Since publication of the Route Study Draft for Consultation this workstream has progressed further and the first additional infrastructure items to support this baseline activity have been identified – the most notable being signalling alterations around South Croydon and the approaches to South Croydon from Sanderstead. In this case work is underway to identify solutions that could be implemented at the same time as the alterations proposed in Figure 59 at East Croydon.

The Digital Railway

The Digital Railway Programme is being developed by Network Rail and industry partners. The Programme is seeking to accelerate the roll out of new technology on the network nationally and in particular to accelerate the roll out of European Train Control System (ETCS) / Automatic Train Operation (ATO) operation.

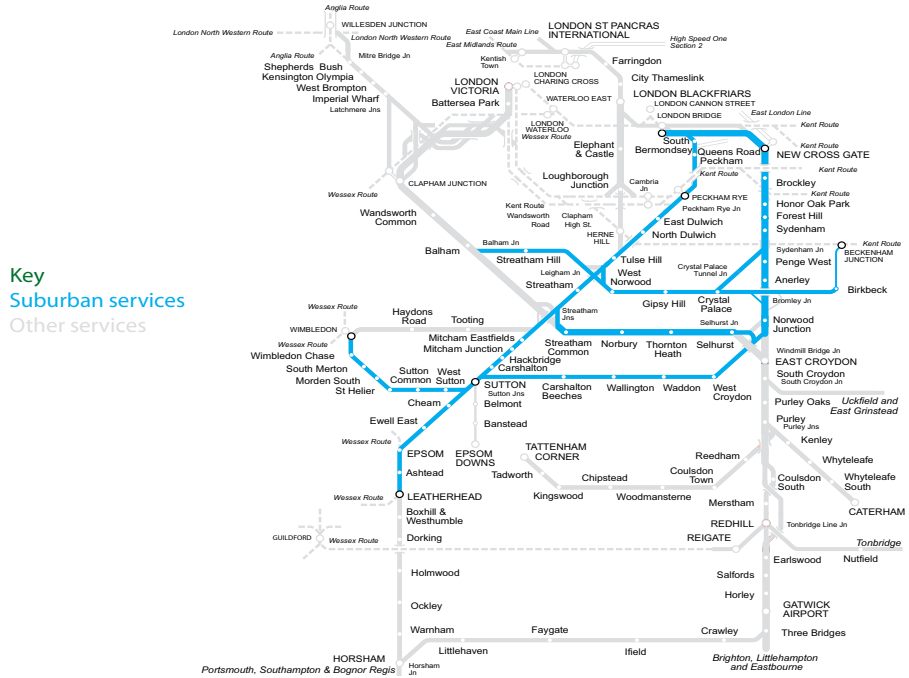
Work is ongoing to determine a revised roll out strategy for this technology in the South East. At this preliminary stage it is still possible to draw some important conclusions about the potential benefits of this technology for services in the Sussex Area and importantly how the technology could add benefits to the options set out in Figure 59. These could be:

- Clapham Junction: as noted above this study has set out a complex and challenging infrastructure option to release main line capacity here, but implementation of ETCS/ATO could delay the need for such a scheme
- The Croydon area: whilst ETCS/ATO cannot replicate the benefit of grade separation at Windmill Bridge Jn, it could, depending on how the technology develops, provide a number of benefits in the wider Croydon area where numerous complex issues with conventional signalling lead to restrictions on speed and certain combinations of operational moves that restrict capacity
- With ETCS/ATO delivered in the Thameslink Core from December 2018 and a substantial proportion of GTR's rolling stock being compatible with the system, a logical opportunity exists to extend the technology south towards Norwood Junction at least, as part of an incremental plan.

5.6 Providing sufficient peak capacity for passengers - suburban services to / from London Bridge

Figure 63 shows the geographical area being discussed in this section.

Figure 63 - London Bridge Suburban Services



5.6.1 Making best use of existing infrastructure to accommodate suburban demand on the Tulse Hill corridor to and from London Bridge by the end of CP6

Figure 64 details the London Bridge suburban services conditional outputs. Chapter 3 established that the recent 10-car train lengthening on the Sydenham Route, combined with baseline extension to 5-car of East London Line services on this route, means that no further interventions are likely to be required in the study timescale on radial capacity Sydenham corridor to London Bridge. This particular market to London Bridge is closely linked to changes in service provision on the ELL route, with many passengers taking the first train and changing at Canada Water, if an ELL service arrives first.

However, the route via Tulse Hill was not lengthened to 10-car operation in CP4 due to constraints at Tulse Hill itself, and passengers do not have the benefit of alternative orbital options. Chapter 3 sets out the significant crowding challenge on the route if no action is taken.

Prior to infrastructure alterations or significant additional rolling stock procurement the most obvious mitigation that could be implemented to ease crowding density would be alterations to the seating configurations of Class 377/455 stock operating on the route to permit a higher total capacity for each vehicle.

A timetabling solution that would require additional rolling stock has also been tested. This option S4 is summarised in Figure 65. An additional 2tph was added to the Wimbledon Loop to give a 4tph service throughout the high-peak hour both clockwise and anti-clockwise via the loop with the resulting in 2tph providing a supplement to the Tulse Hill to London Bridge corridor. This uplift to 8tph from the Tulse Hill corridor would require use of the reversible line on the approach to London Bridge, which would involve interaction with main line services terminating at London Bridge. This represents a performance risk that given current performance on the Route may not be an acceptable trade off.

A scenario with running two additional services across the morning and evening three hour peak has been assessed. However running the two additional paths across the peak requires a new diagram in order to run a consistent service around the loop. This raises the operational costs of the scheme and as a large majority of the crowding benefits arise from the high peak, a high peak only service is preferable to a three hour peak service.

Figure 64 – London Bridge suburban services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO2 (2043)	To provide sufficient passenger circulation capacity at stations within the Sussex Route, taking into account anticipated growth over the period to 2023	An additional 32 vehicles during the high-peak hour: • 22 vehicles for the Tulse Hill Service Group • 10 vehicles for the Forest Hill Service Group

Figure 65 - Assessment of option S4 – Wimbledon Loop +2tph high peak service to London Bridge (clockwise)

Concept	To provide a 2tph service in each direction on the Wimbledon Loop to London Bridge in the high peak
Operational Analysis	Providing an additional 2tph represents a significant performance risk
Infrastructure required	Planned CP5 enhancements to signal spacing as part of signal interlocking renewals in 2015/16 on the southern end of the loop assumed in the baseline. Further infrastructure requirements to be investigated after performance modelling
Passenger impact	Improved connectivity on the Wimbledon Loop with an improved service to London in the high-peak hour. An additional 16 vehicles in the high-peak hour to help relieve crowding
Freight impact	None anticipated
Socio-economic value for money categorisation	Low
Conclusion	Due to the scale of operating costs of the scheme compared against the benefits, this option represents low value for money.

Clearly the operation of the additional peak only trains has a weak business case due to the cost of additional rolling stock for the peak only. A second option S8 has been tested looking at all day operation of 4tph via the Wimbledon Loop, as well as the peak only service – this is detailed in Section 5.10 later in this chapter and has a significantly stronger business case.

5.6.2 Infrastructure enhancement – investment priorities for delivering the London Bridge suburban conditional outputs in Control Period 6.

The Route Study has also tested an infrastructure based option to increase peak capacity on the Tulse Hill corridor.

This option involves extending platforms on the route to allow services to operate at 10-car rather than the current 8-car during the high-peak hour as the rest of the South Central suburban network currently does.

Figure 67 - Assessment of Option S5 – 10-car suburban lengthening on the Tulse Hill corridor

Concept	To lengthen services on the Tulse Hill corridor to 10-car to meet peak passenger demand into London Bridge.
Operational Analysis	Selective Door Opening to be utilised on several stations on the Wimbledon Loop.
Infrastructure required	Infrastructure interventions at 10 stations on the Tulse Hill corridor: Beckenham Junction, Birkbeck Station, East Dulwich, North Dulwich, Peckham Rye, Queens Road Peckham, South Bermondsey, Streatham, Tulse Hill and Wimbledon.
Passenger impact	An additional 12 vehicles in the high-peak hour to help relieve crowding.
Freight impact	None anticipated.
Socio-economic Value for money categorisation	Low
Conclusion	Due to the high capital costs of the scheme, and crowding benefits only achieved in the high-peak hour, this option represents low value for money.

Option S5 is summarised in Figure 67.

As can be seen from the appraisal, the key issue with this option is the significant capital cost of lengthening platforms on the route, in particular at Tulse Hill itself where costs of the cheapest option are estimated at between £35m-£75M as a result of the need amongst other things to widen the Thurlow Park Road overbridge.

5.6.3 Conclusions: London Bridge suburban priorities for CP6

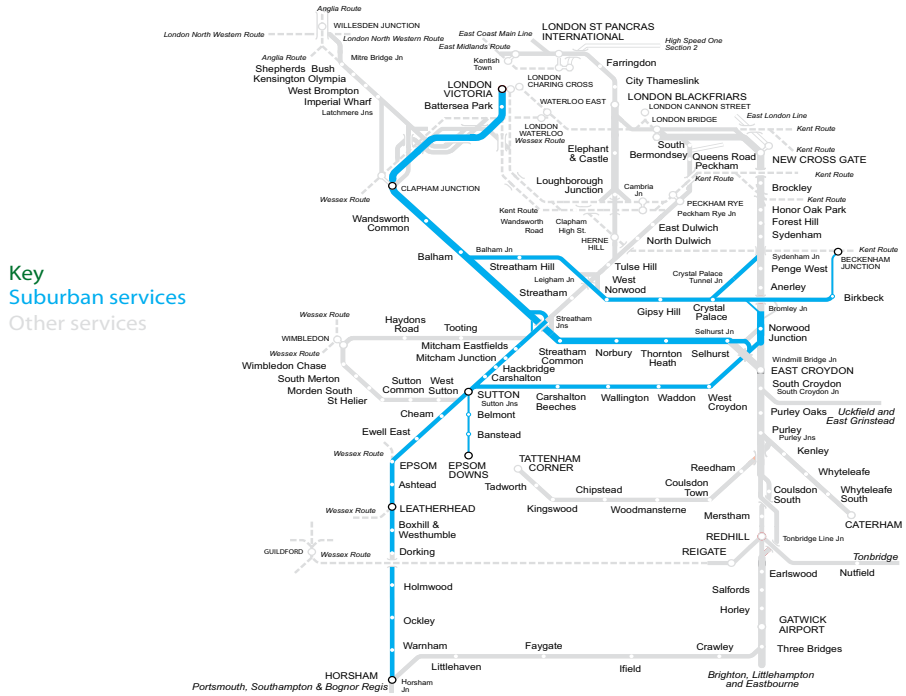
The options available to funders to relieve crowding on the Tulse Hill Route can be summarised as:

- Changes to seating arrangements – potentially low cost and high business case but eases problem only during CP6 not beyond
- Extension of platforms to allow 10- rather than 8-car trains to operate. High cost, low business case, but resolves crowding issue for CP6 and CP7
- Operation of an additional 2tph throughout the day on the Wimbledon Loop. High business case, but performance impact would need to be clearly factored into Route PPM targets for CP6.

5.7 Providing sufficient peak capacity for passengers - suburban services to / from London Victoria

Figure 68 shows the geographical area being discussed in this section.

Figure 68 - London Victoria Suburban Services



5.7.1 Making best use of existing infrastructure to accommodate suburban demand on suburban routes to/from London Victoria

Figure 69 details the London Victoria suburban services conditional outputs. **As noted in the previous section, the suburban routes into London Victoria are already operating at the maximum length (10-car) the infrastructure allows.**

Given current performance and the number of interactions between the suburban service groups and other service groups impacted by the December 2018 timetable change, options that increase the frequency of high peak services into London Victoria have been ruled out for CP6 .

Figure 69 - London Victoria Suburban Services

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO3 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Victoria suburban services	An additional 76 vehicles during the high peak hour: • 34 vehicles for the Streatham Hill service group • 14 vehicles for the Hackbridge service group • 28 vehicles for the Norbury service group
CO8 (2023)	Consistent with the longer-term strategy identified to meet CO3, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – London Victoria suburban services	An additional 28 vehicles during the high peak hour: • Eight vehicles for the Streatham Hill service group • Eight vehicles for the Hackbridge service group • 12 vehicles for the Norbury service group

Instead, Figure 70 sets out the advantages of reconfiguring seat formations in CP6, to make suburban stock more akin in terms of carrying capacity to South West Trains (SWT) suburban stock. As the figure shows, this would maintain capacity above demand into CP7.

Conditional output CO8 is partially but not fully met by altering the seating configuration. To meet the conditional output a further 14 vehicles are required in 2024 and 58 vehicles by 2043, Chapter 6 sets out options to achieve this. Satisfying the conditional output in this instance is defined as reaching a target average load factor of less than 85 per cent in the high peak hour for services departing Clapham Junction.

5.7.2 Infrastructure enhancement – investment priorities for delivering the London Victoria suburban conditional outputs in Control Period 6

No infrastructure options are set out for CP6. Extensive infrastructure investment has just been completed in December 2013 to allow 10-car trains to operate, and the most logical approach for CP6 would be low cost alterations to seating configurations on suburban rolling stock.

5.7.3 Conclusions - London Victoria suburban priorities for CP6

The significant investment completed in CP4, allowing the extension of the majority of suburban services from 8 to 10-car operation is likely to prove sufficient capacity for CP5 and 6. The most obvious step during that timescale to relieve overcrowding would be alterations to the seating layout of Class 377 units operating in the suburban area, to allow for a higher carrying capacity, and consequentially a slightly higher passengers per square metre allowance – more consistent with standards in place for example on South West Trains suburban operations.

As **Chapter 6** sets out, there will be the need for further interventions in CP7 (2024-2029), and importantly because of the need to make allowance for these long term requirements in infrastructure alterations that are made in the meantime, these interventions have some relevance to the CP6 plan.

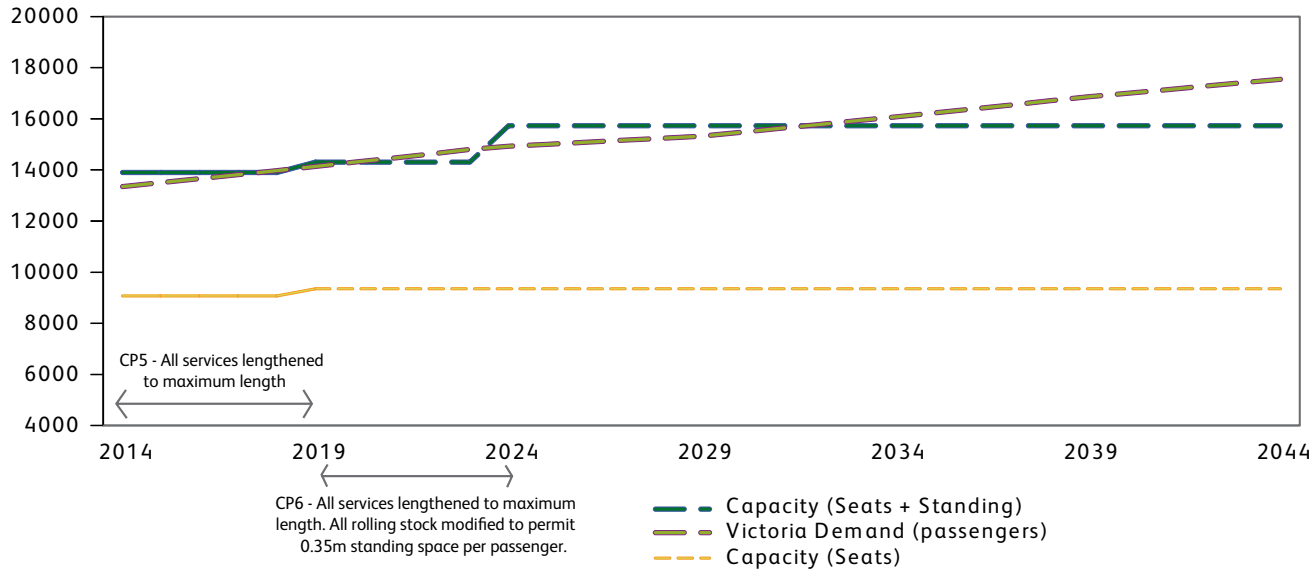
The longer term options are:

- A: Extend peak suburban services from 10 to 12-car.
- CP6 implications of A: Where signals are being renewed in CP6, repositioning – particularly those in the immediate vicinity of stations to allow for 12-car operation will need to be considered
- B: Adopt a number of service frequency improvements as proposed by TfL (see Chapter 6 for detail)
- CP6 implications of B: Could have an impact in the Gloucester Road – West Croydon area, where CP6 works are recommended to relieve main line congestion in Section 5.5 of this chapter (at Windmill Bridge Junction). The opportunity should be taken to see if any work can be combined in this area .

Chapter 3 sets out the capacity challenge on the routes from Crystal Palace and West Croydon to/from the East London Line (ELL). The baseline for this study includes 5-car operations in CP5.

Despite this, demand growth indicates the requirement for a further intervention by the end of CP6.

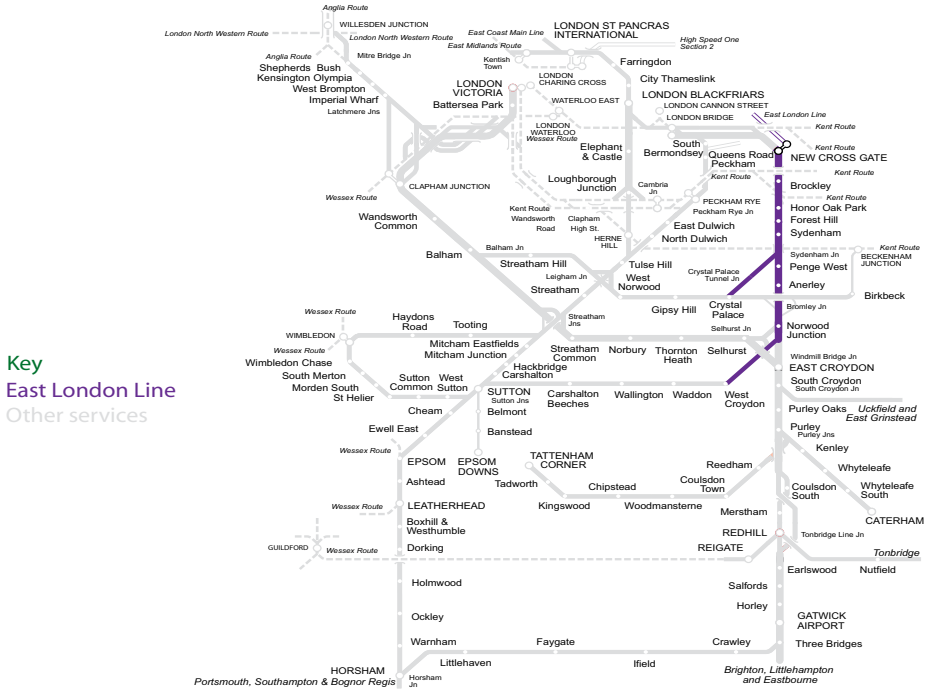
Figure 70 - Demand and capacity arriving into London Victoria via suburban lines accommodating a 0.35m² per passenger standing layout



5.8 Providing sufficient peak capacity for passengers - Orbital routes - East London Line

Figure 71 shows the geographical area being discussed in this section

Figure 71 - East London Line services (from Crystal Palace and West Croydon)



5.8.1 Making best use of existing infrastructure to accommodate demand to/from the Sussex suburban area and the East London Line

Figure 72 details the East London Line conditional outputs.

To tackle this capacity gap the Route Study has looked at a timetabling solution, with an additional 2tph during the peaks tested. This increment of service is not viable on the West Croydon route due to the complexity of operation in the Norwood Junction – Gloucester Road Junction – West Croydon area.

Furthermore, see Figure 73, it has not proved possible to instead timetable an additional 2tph between Crystal Palace and the ELL core during the morning and evening peaks alongside achieving additional BML paths to London Bridge as per Figure 60, using

Figure 72 - East London Line conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)	An additional 13 vehicles during the high peak hour: • Eight vehicles from West Croydon • Five vehicles from Crystal Palace
CO10 (2023)	Consistent with the longer-term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)	An additional six vehicles during the high peak hour: • Four vehicles from West Croydon • Two vehicles from Crystal Palace)

Network Rail's draft December 2018 timetable as a base. This is due to the additional empty stock workings required for additional main line services which have to utilise the same infrastructure between New Cross Gate and Sydenham due to limited capacity via other routes.

Further assessment is required to investigate whether there could be any potential solution through wider timetable changes. If this increment of service was achieved, this would relieve the capacity gap in CP6 and beyond. However, there are a number of other issues which would also need resolving:

- The extra trains would take the service quantum on the ELL core to 18tph. Current Timetable Planning Rules indicate this could be an issue at core stations with minimum dwell times over half a minute, namely Canada Water and Whitechapel, whilst platform re-occupation time is 2½ minutes. This restriction requires further investigation.
- Additional services come at the cost of journey time increases to some services due to pathing constraints between New Cross Gate and Surrey Quays
- More detailed assessment of the performance implications of the additional trains is required.

If all of the issues are resolved, the above timetabling solution is the only option to meet the conditional output within current infrastructure.

5.8.2 Infrastructure enhancement – investment priorities for accommodating demand to/from the Sussex suburban area and the East London Line in Control Period 6

With significant developments underway in the Croydon area, passenger patronage is expected to increase sharply in CP6. Services which start at West Croydon are already the busiest service group on the ELL. It would therefore be preferable to start the two new paths found at West Croydon station. However due to constraints at Norwood Junction and Gloucester Road Junction this is not feasible. A number of infrastructure options have been assessed at a high level that may allow starting additional ELL trains at West Croydon. Using Transport for London's (TfL) estimates, Figure 74 indicates the business case for this

Figure 73 - Assessment of Option S7 - East London Line +2tph peak service from Crystal Palace	
Concept	To provide an additional two trains from Crystal Palace on the East London Line (on top of 4tph currently running)
Operational Analysis	Potential issues with: • Pathing conflicts on Sydenham corridor with main line stock working • Future changes to new franchise suburban timetable causing conflicts • Availability of empty rolling stock paths • Timetable planning rules regarding platform re-occupation at East London Line core stations Canada Water and Whitechapel.
Infrastructure required	None identified– subject to power supply analysis and any depot and stabling implications
Passenger impact	Improved connectivity on the East London Line, and an additional 30 vehicles in the morning and afternoon peak to help reduce crowding
Freight impact	None anticipated
Socio-economic VfM cat.	High
Conclusion	Timetable issues need to be resolved before option can be recommended

Figure 74 - Assessment of Option S7 – East London Line +2tph peak service from West Croydon	
Concept	To provide an additional two trains from West Croydon on the East London Line (on top of 4tph currently running)
Operational Analysis	• Potential issues with: • Future changes to new franchise suburban timetable causing conflicts • Availability of empty rolling stock paths • Timetable planning rules regarding platform re-occupation at East London Line core stations Canada Water and Whitechapel
Infrastructure required	Interventions required at West Croydon Station and Gloucester Road junction. Also subject to power supply analysis and any depot and stabling implications
Passenger impact	Improved connectivity on the East London Line, and an additional 30 vehicles in the morning and afternoon peak to help reduce crowding
Freight impact	None anticipated
Socio-economic VfM cat.	Low
Conclusion	Due to the high capital costs of the scheme and the alternative of an infrastructure free option from starting services at Crystal Palace, this option represents low value for money.

intervention, which is low due to the infrastructure costs. Chapter 6 considers this issue further for the longer term.

If the timetable intervention set out in Section 5.8.2 cannot be achieved, the alternative option to meet peak demand would be through further train lengthening. This would require platform lengthening on ELL core stations between Surrey Quays and Dalston Junction; this is particularly challenging for some of the stations which are located at underground level.

5.8.3 Conclusions - East London Line priorities for CP6

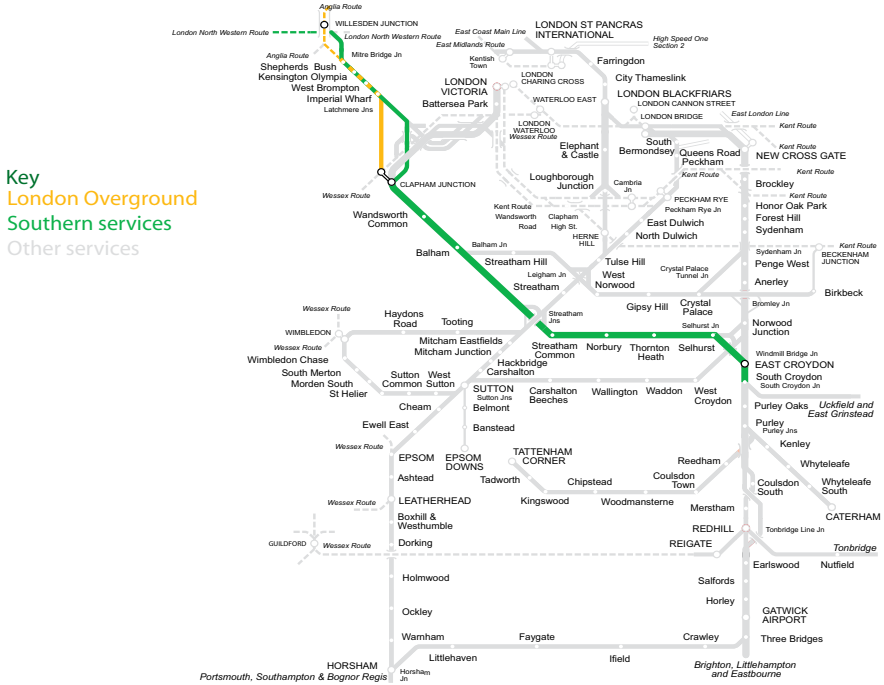
The timetable intervention set out in Section 5.8.2 would resolve crowding issues until around 2043. As this option requires no infrastructure interventions, starting two additional services at Crystal Palace is the preferred option to satisfy conditional output CO10. The viability of this option will depend on overcoming a number of timetabling issues and if this isn't possible, then train lengthening remains the sole alternative to meet CO10.

Although the West Croydon option represents low/medium value for money if built in CP6, after CP6 some further options related to this are outlined in Chapter 6.

5.9 Providing sufficient peak capacity for passengers - Orbital routes - West London Line

Figure 75 shows the geographical area being discussed in this section

Figure 75 - West London Line Services



5.9.1 Making best use of existing infrastructure to accommodate peak demand on the West London Line in CP6

Chapter 3 sets out the capacity challenge on the West London Line. Within the baseline of the analysis are two significant developments on the route: Firstly, the delivery of platform lengthening allowing 8-car operation to replace 4-car operation of Southern services in September 2014 and secondly, achieved by the same infrastructure scheme, extension of LOROL services from 4- to 5-car in 2014/15.

Taking this base which delivers a substantial uplift in capacity, Figure 76 sets out the capacity gap on the route between now and 2023.

As can be seen from the graph, the capacity provided by lengthening services from 4- to 5-car provides sufficient total capacity up until 2023.

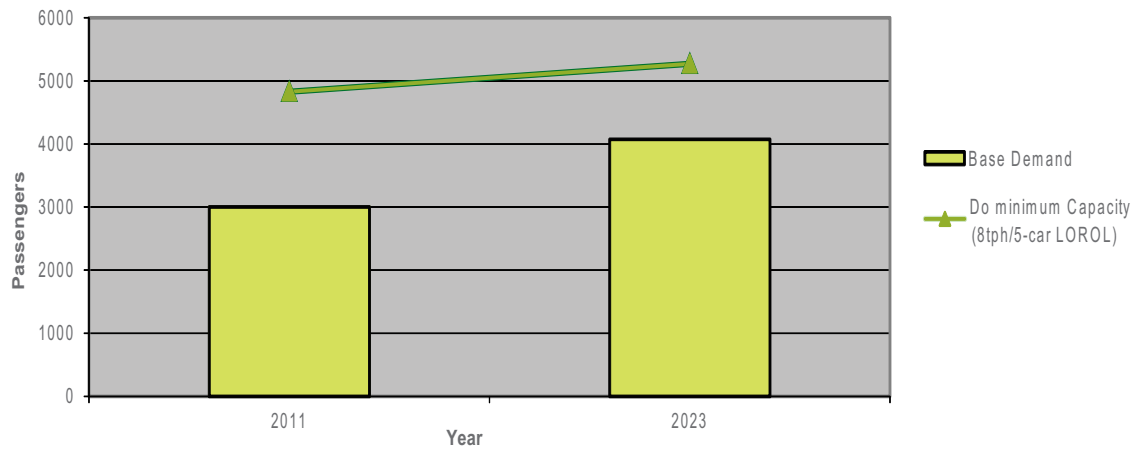
The key issue is when an increase from an 8tph to a 10tph high peak timetable is required. Indications are this will be at some point between late CP6 and the end of CP7 but could be earlier if demand grows more sharply than forecast, this issue is addressed in Chapter 6.

5.9.2 Infrastructure enhancement – investment priorities for accommodating demand on the West London Line in CP6

Although the demand analysis shows interventions in CP4 and CP5 should be sufficient to meet capacity to the end of CP6, there are a number of infrastructure alterations that would support robust operation if a full 10tph (with 6tph LOROL services) timetable is adopted earlier on the WLL: These can be summarised as:

- The need to re-open Platform 0 at Clapham Junction to allow for reliable operation of this level of service in the peak and off-peak. This requires re-opening a disused platform face, but

Figure 76 – Demand and Capacity graph for the West London Line up to 2023 in the am high peak



works will also require some strengthening of structures supporting this end of the station and relocation of signalling equipment. Without the additional platform turnaround times for LOROL service at Clapham Junction would be significantly reduced. Analysis completed for the Route Study suggests departure lateness at Clapham for LOROL services as a result of late arrival could increase by 160 per cent over and above today, based on a sample of historic data from January 2015. With the additional platform intervention an improvement over today's performance is projected.

- Reduction in the four minute ruling signalling headway on the route (desirable for performance but service can still be timetabled)
- Any depot and stabling implications identified to service the extra stock required.

Chapter 6 explores the implications of a 10tph (6tph LOROL) WLL timetable further.

A business case in conjunction with TfL has been put together to test the value for money rating of an additional two trains per hour on the West London and North London lines. In this document this option will be referred to as Option WLL, see Figure 77.

5.9.3 Conclusions: West London Line priorities for CP6

Overall the significant interventions planned for CP5, including the recently completed 8-car capability of the route for Southern services and the soon to be implemented 5-car operation for LOROL, should see the route capable of handling CP6 demand. If demand grows more sharply than forecast, TfL's next priority would be moving to a 10tph (six LOROL, three/ four GTR) peak operation.

Figure 77 - Assessment of Option WLL - West London Line +2tph all day service from Stratford to Clapham Junction

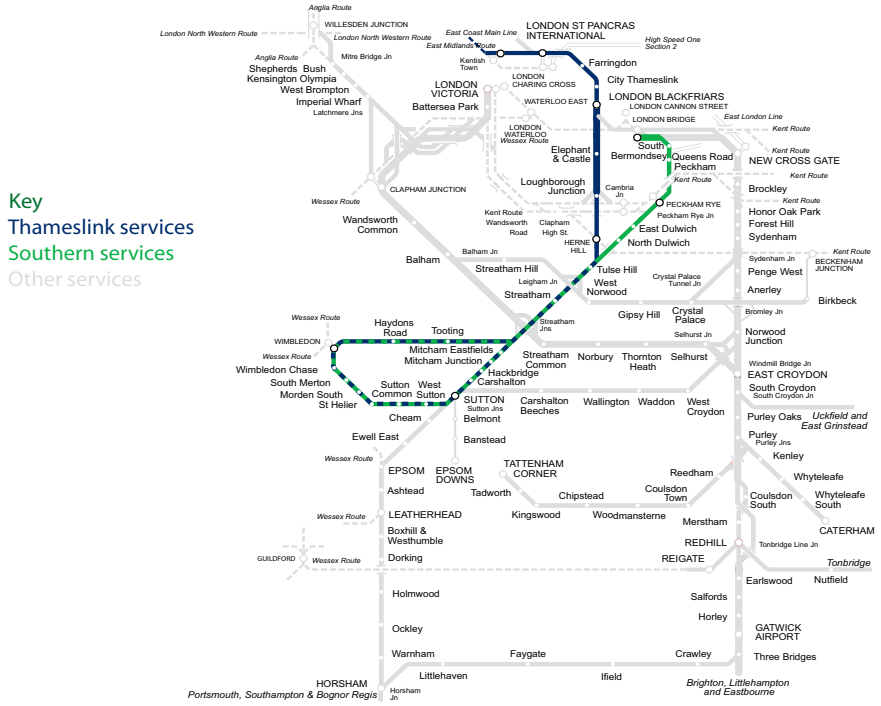
Concept	To provide an additional two trains from Stratford to Clapham Junction on the West London Line (on top of 4tph currently running)
Operational analysis	New train diagrams to operate an additional 2tph 5-car service all day
Infrastructure required	Additional platform capacity is required at Clapham Junction to accommodate the additional two trains. This could be accommodated through operational changes, or the re-opening of Platform 0. Operational implications on the NLL are still under review.
Passenger impact	There is standing on all peak trains on the North and West London Lines, trains are particularly busy between Dalston and Highbury and between Kensington Olympia and Shepherds Bush. Additional services will strengthen services over and above the capacity delivered through lengthening from 4 to 5-car
Freight impact	Running services in the off peak could limit the available capacity for freight services
Socio-economic VfM categorisation	Medium/High
Conclusion	This option offers medium to high value for money depending on the cost of providing platform capacity at Clapham Junction

Section B: Connectivity and Journey Time conditional outputs

5.10 Providing sufficient connectivity for passengers - Four trains per hour on the Wimbledon Loop

Figure 78 shows the geographical area relevant to Wimbledon Loop services

Figure 78 - Wimbledon Loop Services



As discussed in Chapter 3, the London and South East Market study identifies that the Wimbledon Loop would benefit from an improved off-peak service Figure 79 details the conditional output..

Figure 79 - Wimbledon Loop connectivity conditional output

Conditional Output Reference	Conditional Output
CO11	To provide a minimum of three of four trains per hour for stations within 30 miles from London: Stations on the Wimbledon Loop

5.10.1 Making best use of existing infrastructure to accommodate four trains per hour on the Wimbledon Loop

Section 5.6.2. identifies a low value for money business case for moving to a four trains per hour pattern both clockwise and anti clockwise round the loop in order to relieve capacity constraints on the Tulse Hill – London Bridge corridor in the high peak. However as Figure 80 shows, running those services all day significantly improves the business case.

5.10.2 Infrastructure enhancement – investment priorities to accommodate four trains per hour on the Wimbledon Loop

The signal interlocking is due to be replaced in 2015/16 on the southern end of the loop. This part of the loop has some particularly long headways. As part of the renewal, Network Rail has identified some improvements in the headways on this section that could be delivered. This would be required to operate a 4tph all day service on this section and improve the regulation of trains approaching the busy Sutton area.

It is possible other infrastructure interventions could be identified as required in CP6 to allow a 4tph service to run throughout the day robustly . Although timetabling analysis shows the operation is possible, performance modelling may show the need for further works. Figure 81 shows the number of potential conflicts Wimbledon Loop services encounter during the peak compared to other suburban operations on Sussex Area and Wessex Routes. The Wimbledon Loop operation, particularly with the recent specification that services must continue to operate through the Thameslink Core post-December 2018 is already complex and additional trains throughout the day are likely to result in a lower PPM being achieved than today.

Figure 80 - Considers the case for an all day 4tph service

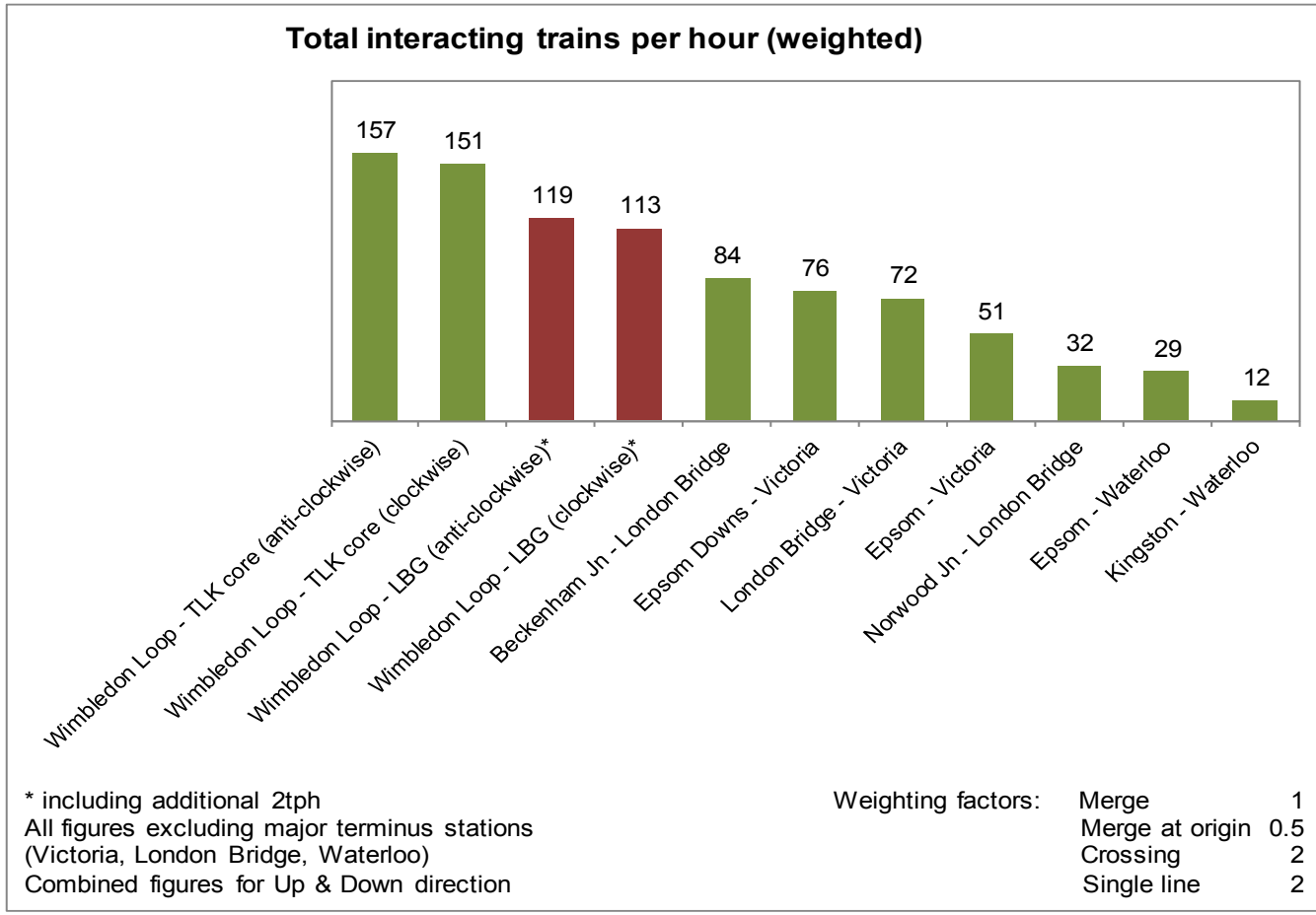
Concept	To provide a 2tph service in each direction on the Wimbledon Loop to London Bridge all day
Operational analysis	Providing an additional 2tph represents a significant performance risk
Infrastructure required	Planned CP5 enhancements to signal spacing as part of signal interlocking renewals in 2015/16 on the southern end of the loop assumed in the baseline. Further infrastructure requirements to be investigated after performance modelling
Passenger impact	Improved all day connectivity on the Wimbledon Loop with a doubled service to London An additional 48 vehicles in the three peak hours to help relieve crowding
Freight impact	None anticipated
Socio-economic value for money categorisation	High
Conclusion	Providing an additional 2tph on the Wimbledon Loop represents the best value for money option in satisfying capacity conditional output CO6 and connectivity conditional output CO9

5.10.3 Conclusions: Four trains per hour on the Wimbledon Loop

CP5 investment on the back of signalling renewals is required and is planned. Any further investment in CP6 will be identified through performance modelling.

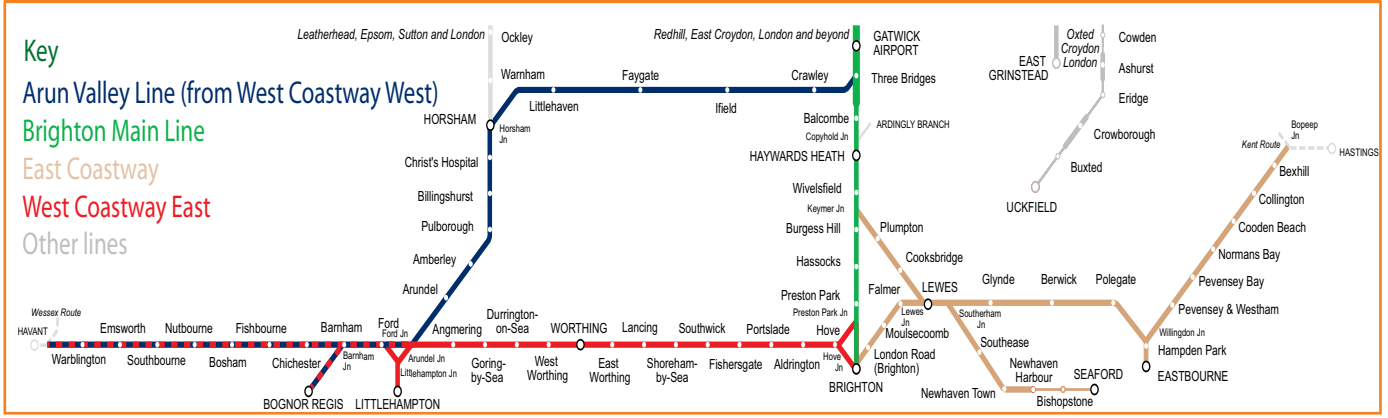
Moving to a 4tph all day service has a high value for money case for implementation and would provide a step change in the service offer in particular between Sutton – St Helier and Wimbledon, a route that is currently significantly disadvantaged when compared with other South London suburban routes.

Figure 81 - Total interacting trains per hour (weighted)



5.11 Providing sufficient connectivity to passengers: East/West Coastway and Brighton to London journey times.

Figure 82 - East and West Coastway



The Market Studies identified that several large towns on the Coastway routes have poor journey times to and from Central London when compared with other regional centres of similar size and distance to London, see Figure 82 for the geographical area. The conditional output prescribed by the Market Studies, Figure 83, aims to reduce Generalised Journey Time (GJT) from these regional centres into Central London. The following journey time conditional outputs apply to the Sussex Route Study:

5.11.1 Making best use of existing infrastructure to improve journey times between the East/ West Coastway and Brighton to Central London

East Coastway: GTR have identified clear opportunities as part of their proposals for the May 2015 timetable change, to improve journey times between Eastbourne/Lewes and London. This opportunity is twofold:

- To take advantage of linespeed increases that have been made possible by the completion of the East Sussex re-signalling scheme
- To re-work the stopping pattern of some East Coastway to London services to create a faster service for the main population centres.

Figure 83 - Long Distance conditional outputs

Conditional Output Reference	Conditional Output
CO15	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Eastbourne
CO16	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Worthing and Hove
CO17	To reduce the 'generalised' journey time for longer distance journeys to central London from significant urban centres of population: Brighton

In addition to the above, if the full set of BML improvements were implemented in CP6 or CP7 as set out in Section 5.5. it may be more acceptable from a performance point of view to run a slightly more intense main line service frequency in the off-peak, and so eradicate splitting and joining practices on Coastway services at Haywards Heath. This could save up to 10 minutes on off-peak journey times. The case for this would need to be weighed up against a potential increase in operating costs.

West Coastway: West Coastway to London journey times are more difficult to improve as linespeed improvements are not as straight forward to achieve as on the East Coastway route and obvious opportunities for changes to stopping patterns to improve journey times to/from key population centres are more complex to deliver without disadvantaging a number of stations.

Only one clear option exists:

If the full set of BML enhancements identified in Section 5.5 are delivered in CP6, this would result in an extra 2tph in the peak hours from the West Coastway. This would reduce GJT significantly in the peak. In the off-peak as noted with the East Coastway services, it may also then be possible to end splitting and joining at Haywards Heath and save a circa 10 minutes journey time in some off-peak services.

Brighton: Improved Brighton to Central London journey times are difficult to achieve without changing the stopping pattern. Currently Brighton services to London consist of 4tph to London Blackfriars (and beyond) and 3tph to London Victoria in the off-peak and 4tph to London Victoria and 2tph to London Blackfriars (and beyond) in the peak.

The new TSGN franchisee, Govia Thameslink Railway (GTR), is looking at various solutions to reduce journey times and improve connectivity during the life of the franchise. There will inevitably be changes to the services during the London Bridge improvement works being carried out by Thameslink Programme until 2018. After 2018, it is planned that there will be additional services from Brighton to the Thameslink Core throughout the peak delivering reduced journey times against today's peak service via Elephant & Castle.

5.12 North Downs Journey Times

The North Downs line is a two track railway linking Reading (with connections from the West Country and Midlands) with the BML via Wokingham, Guildford and Redhill. The line crosses into Network Rail's Wessex route (for planning purposes) between Guildford and Reigate as can be seen in Figure 85.

It offers one through train per hour between Reading and Gatwick currently with a journey time of 1 hour 16 minutes for the 52 miles.

The Route Study recognises the need to improve the journey time through a combination of some increased through frequency (so reducing GJT) and if possible some decrease in journey time on existing operations. In particular, a challenge exists in delivering a good journey time once the second train in each hour operates through to Gatwick Airport.

The Sussex Route study has the following conditional output in relation to Gatwick Airport:

Figure 84 – Additional Connectivity Conditional Outputs

Conditional Output Reference	Conditional Output
CO19	To provide adequate connectivity for passengers travelling to and from Gatwick Airport

The BML plans detailed in Section 5.5 have outlined options for improving peak connectivity to Gatwick Airport on the North to South axis between London and the coast with all potential additional services identified planned to call at the station. Within the baseline for this study outlined in Figure 18 in Chapter 2, a considerable improvement in all day North to South connectivity is already assumed with the Thameslink Programme delivering from the end of 2018 more direct London Bridge and Thameslink Core services and longer trains.

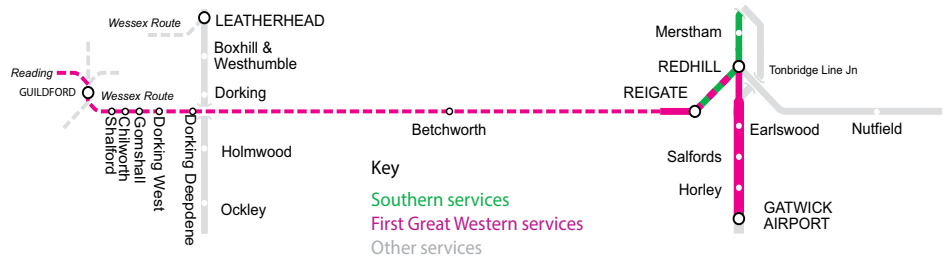
Against this backdrop this section has focused on connectivity from the West, the other key rail corridor into the airport.

5.12.1 Making best use of existing infrastructure to improve journey times on the North Downs route

Within Network Rail's Business Plan for CP5 are works to deliver an additional platform face at Redhill. This along with layout enhancement works that were delivered at Gatwick Airport in CP4 will mean that, depending on finalisation of the December 2018 timetable, 2tph will be able to operate between Reading and Gatwick Airport in most hours (at present the second train usually terminates at Redhill).

Ordinarily such a service change would offer a significant improvement in GJT to/from the airport, but the extent of the improvement will depend on the structure of the slow lines timetable via Redhill in December 2018. It is important that North

Figure 85 - North Downs Line



Downs services can depart and arrive at Redhill in slots that reduce the layover time at the station, and this requirement will need to be considered carefully in the December 2018 timetable change with GTR.

The second hourly service which is extended to Gatwick Airport would achieve substantially slower journey times than the current Gatwick Airport service as connectivity to and from smaller stations on the North Downs route has to be maintained.

5.12.2 Infrastructure enhancement – investment priorities for improving journey times on the North Downs route in CP6

Two options have been considered with regard to journey time improvement in CP6 and beyond

AC electrification option

Firstly, work undertaken for this Route Study and the Wessex Route Study has assessed the impact AC electrification could have on journey times between Reading, Guildford and Gatwick Airport.

The assessment indicates a saving of four to five minutes for the faster service could be achieved between Reading and Gatwick Airport over the current service offer, through improved acceleration. The potential for journey time saving of the slower service is for up to 10 minutes due to the higher number of stops, although a difference in journey time compared to the faster service would remain.

The refresh of the Network RUS: Electrification, expected to be published in 2015/16, will report on the case for further electrification of the rail network. As part of this, the case for electrification of the North Downs line will be considered with an indication of its priority against other schemes nationally. For this reason, a bespoke appraisal of this option for the North Downs line is not included in this document, however the potential journey time benefits identified here will be included in that assessment, alongside a comparison of the other benefits of an electrification scheme on this route.

Alterations to services and stopping patterns

Timetable alterations have also been considered to assess the benefits of what a faster service with fewer stops on the route might deliver.

A half-hourly service with fewer stops can be achieved by introduction of a third hourly service between Redhill and Reading to retain existing connectivity.

This is reflected in the service specification remitted by the Cross-Boundary Working Group to meet the conditional output (CO18):

- A 2tph semi-fast service between Gatwick Airport and Reading (with options to extend this service beyond Reading to Oxford being considered by the Western Route Study), with options to improve journey times to be identified by the Route Study
- An additional stopping service between Reading and Redhill which is required to maintain connectivity to and from smaller stations on the North Downs line.

Further infrastructure investment at the southern end of Redhill would be required to accommodate this service pattern with optimal journey times alongside meeting peak demand to and from London (CO1). As an alternative, the service might be offered during the off-peak only which may be acceptable although would result in a gap in connectivity to and from Gatwick Airport during peak hours.

The Wessex Route Study has identified that the timetabling of a 3tph service over the North Downs line is feasible but could be improved through investment in the layout in the Guildford station area and also through a reduction to the current signalling headway, which would reduce the length of time which the stopping service has to wait at Guildford.

In case an electrification option is taken forward, this may present the opportunity to link the stopping service with Reigate to London services which could aid relieving capacity constraints at Redhill and Reigate, although this benefit could be outweighed by the requirement for splitting and joining at Redhill due to short platforms on the North Downs line.

A review will be required with regards to the impact of an additional hourly service on level crossings on the North Downs line and whether this drives any investment in upgrading them.

The BCRs for this 3tph option were presented in the Wessex Route Study which was published as a Draft for Consultation in November 2014, and as a final document in August 2015.

5.12.3 Conclusions: Priorities for CP6

The highest priority is delivery of a timetable in late CP5 early CP6 which offers quick reversal times at Redhill for through running services to and from Gatwick Airport on the basis of a 2tph only service on the North Downs route. This will require co-ordination between Network Rail, FGW and the new franchisee for the TSGN area GTR. Network Rail has identified the optimal slots that North Downs to Gatwick Airport trains should occupy to protect and improve through journey times. As long as the second train to Gatwick Airport has to pick up a large number of intermediate stops, journey times will be extended.

Of the proposed electrification infill projects in the Sussex area, the electrification of the North Downs line is the highest priority given its role in serving Gatwick Airport and the link it provides between major towns and cities. Network Rail's publication of the Network RUS: Electrification refresh in early 2015/16 will assess the business case and set out how the project sits in terms of priority against electrification schemes in other routes nationally.

Operation of a third stopping service on the North Downs Line to allow the second through Gatwick Airport service to have improved journey times has a high business case, however the case for infrastructure investment at Redhill and Guildford to achieve acceptable performance will need to be considered, as will any level crossing upgrade costs.

5.13 Providing sufficient capacity for freight services in CP6

Figure 86 – Freight Conditional Outputs

Conditional Output Reference	Conditional Output
CO20	To accommodate the anticipated demand for freight services to 2043 on the West London Line, as expressed by the Freight Market Study

As set out in Chapter 2, Figure 19, the BML has a number of important freight terminals, all for the delivery of aggregates and other building materials. Additionally, as Chapter 2 also notes a new terminal has also recently opened at Newhaven, dispatching ash from a major incinerator. Figure 86 details the conditional output.

In addition to the BML, the West London Line (WLL) is within the study area and is a key artery for freight being the principal route for all traffic between the South East/the Channel Tunnel and the rest of the country.

The key aim for CP6 is to ensure existing access on these routes is maintained for freight. Freight demand is predominantly in the off-peak, therefore it is usually only the off-peak options set out in this study for passenger traffic that need to be considered to confirm they are consistent with protecting capacity for freight demand.

The relevant off-peak options, with a brief description of how freight capacity can be protected should they be implemented, are listed below:

Wimbledon Loop 4tph all day option

The only interface with commercial freight is with the 2 paths per day operated between Tolworth (on the Wessex Route) and Acton/ Cliffe. Any move to the 4tph pattern will need to ensure these paths are protected. This will be straight forward given space between services on the Wimbledon Chase – Wimbledon – Tooting – Streatham section where this interface occurs

West London Line – moves to a 10tph peak, 6-8tph off-peak timetable

This is a key interface and service changes will need to be fully validated against Working Timetable (WTT) freight paths on the WLL. Initial assessment suggests this is theoretically possible on the WLL but potential conflicts arise on the North London Line, and these are presently being analysed.

Ending of off-peak splitting and joining at Haywards Heath

Depending the extent to which this option was implemented it could in the long term (most probably post CP6) lead to + 2tph on the main line. This would need to be tested against current freight paths and also assurance that some capacity remained to grow freight in the off-peak.

There are a number of prospects for freight growth in the study area that are worth noting. Firstly, the site at Salfords is likely to return to regular use. There is also the prospect of some traffic increases, possibly on the WLL from traffic associated with the new Thames sewer project. In addition to these there will always be new flows from time to time – in particular on the WLL.

5.14 Brighton Main Line diversionary Routes:

Although not a specific conditional output from the Market Studies, it was agreed by the Route Study Board that a review of medium to long term diversionary options to the BML should be made as part of this Route Study, Figure 87 specifically shows the Arundel Chord option.

The driver for this additional assessment was twofold, firstly, to look at benefits during unplanned disruption given current performance levels on the route, but also to consider any benefits associated with planned blockages of the BML. Several options have been assessed.

Part of the analysis below was published in the BML: emerging capacity for CP6 by the DfT in May 2014 as part of a report Network Rail produced for the Department on CP6 priorities for the BML. Since this report cost estimates have been worked up for the Arundel Chord option and are reflected in Figure 88. The overall conclusions have not altered. Additional consideration is also given in this section to diversionary benefits of the Lewes - Uckfield route.

5.14.1 Diversion via the Arun Valley and the Arundel Chord

Diversionary benefits

During engineering works on the BML, trains can currently be diverted into London Victoria via the Arun Valley and back onto the BML at Three Bridges, or alternatively via the Arun Valley and back onto the slow or fast lines of the BML on the London side of Streatham Common.

Presently trains diverted by this route have to go into Littlehampton to reverse. This adds to the journey time and makes the routeing generally unattractive. Figure 89 outlines indicative journey times that might be achievable were an Arundel Chord in place and compares them to existing options and a Ford turnback option.

As can be seen from the analysis, the route with the chord would offer better diversionary journey times than reversing at Littlehampton or Ford. Journey times from Brighton would still be significantly extended but less so for the Worthing market. For Brighton passengers the journey time penalty, even with the Chord, is at least 50 minutes.

Figure 87 - Arundel Chord

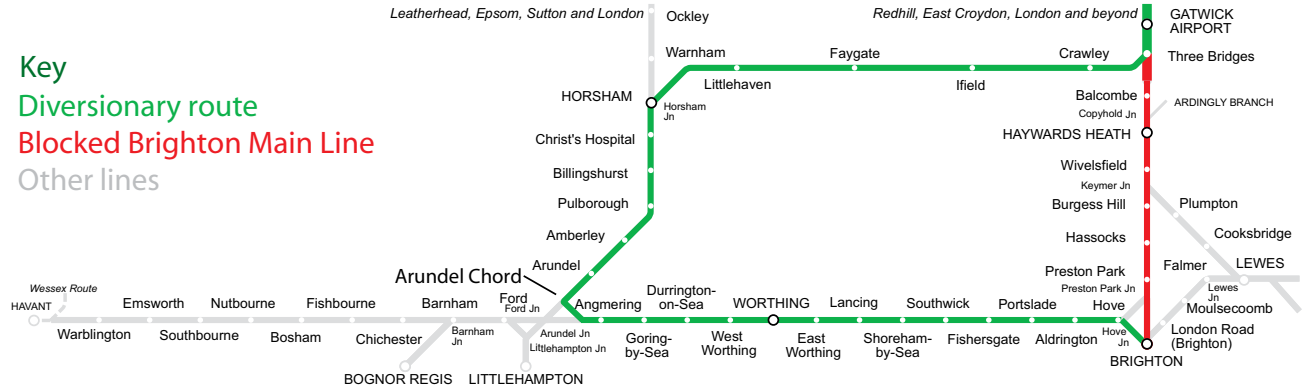


Figure 88 - Assessment of Option S9 – Arundel Chord, double track embankment	
Concept	Provide a diversionary route for the BML to reduce the impact of delays for passengers between Three Bridges and Brighton during periods of extreme perturbation
Operational analysis	The chord would provide additional operational capability during periods of extreme perturbation
Infrastructure required	Option S9 is to build a 1.04km double track embankment chord. This will allow a diversionary Three Bridges to Brighton via Horsham service to operate at 2tph in both directions
Passenger impact	Diversions around the chord would reduce journey times by 20 minutes per passenger. New off-peak service between Brighton to Horsham in the off-peak
Freight impact	None anticipated
Socio-economic value for money categorisation	Low

The appraisal for the Arundel Chord preferred option is set out in Figure 88. The key factor that reduces the benefits side of the calculation is the number of trains that can actually be accommodated in the West Coastway facing platforms at Brighton. There is only one 12-car platform accessible from this route and just two other platforms and no practical means of working rolling stock from the central and eastern sides of the station into the West Coastway platforms. Therefore even with disruption of the Coastway service it is unlikely more than 2tph would be diverted from Brighton in planned or unplanned disruption.

To see if additional benefits of the Chord could be found through use by regular planned service trains from Horsham, Figure 88 includes a new 1tph Brighton to Horsham service in the off-peak. This service helps generate connectivity benefits along the West Coastway.

Figure 89 - Diversionary route journey time comparison

Brighton to	London Victoria via Gatwick		London Bridge		London Victoria via Sutton	
Route:	Mins	Stops skipped	Mins	Stops skipped	Mins	Stops skipped
Fast direct train	51		56			
Semi-fast direct train	59		64			
Lewes & Keymer Junction	83	3	80	3		
Ford	118	6	115	6	139	9
Littlehampton	125	6	122	6	146	9
Arundel Chord	105	6	102	6	126	9
Lewes - Uckfield	96	8	93	8		
Lewes - Uckfield with curve	84	8	81	8		
BML2 Uckfield - Falmer	76	8	73	8		

Three Arundel Chord options have been appraised as part of this Route Study. The options test the value for money rating of constructing a single track embankment, single track viaduct and double track viaduct. The appraisal tables for these options can be found in Appendix A.

Of the options set out, the best option is Option S9 ; the double track embankment would offer maximum operational flexibility and is considerably cheaper than the two viaduct options. But overall this option was found to add little benefit due to the aforementioned constraints at Brighton, plus the lack of any additional paths being available inwards of Sutton in the peak for trains diverted this way, see Chapter 4 Figure 54.

In the off-peak, proposals to extend existing London Victoria to Horsham services to Brighton via the Arun Valley and Arundel Chord were found to deliver poorer journey times than Horsham to Brighton changing at Three Bridges. This was due to the difficulty in pathing the extended service in amongst the West Coastway services between Shoreham/ Worthing and Brighton.

5.14.2 Diversion via Lewes - Uckfield

At times of planned or unplanned prolonged disruption on the BML south of the Croydon area, there would be some diversionary benefit in having the Lewes – Uckfield route open. However under the scheme assessed in Network Rail's 2008 report on the route, diversionary benefits would be predominantly for East Coastway passengers, with any passengers from Brighton only able to use the route with services reversing at Lewes, and passengers from the West Coastway and any stations north of Brighton on the BML receiving no benefit.

Regardless of the direction and layout of future connections at Lewes (and alternatives have been proposed that would allow through running from Brighton without reverse), capacity limitations north of Uckfield mean that it is unlikely at times of diversion that more than 1tph additional to the existing Uckfield service could be diverted this way without doubling the single line sections of the existing branch and associated re-signalling. Electrification would of course also have to be completed.

The scale of such a scheme would not be justified on diversionary benefits alone, this is due to the relatively low number of delay minutes that would be avoided in major incidents by having the route available and the length of the diversionary route itself.

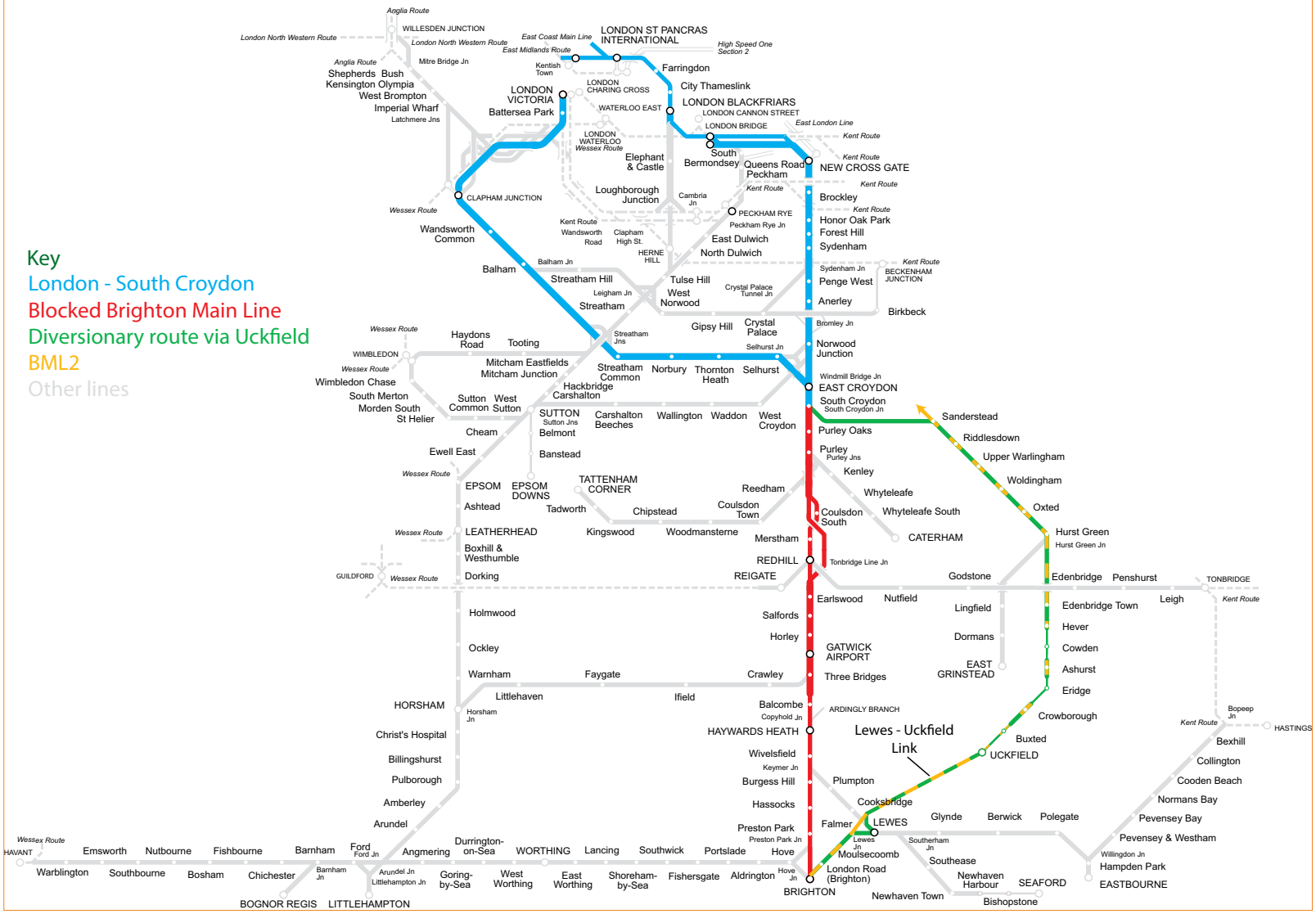
The Department for Transport has commissioned a report to review the Brighton Main Line 2 scheme alongside shorter term plans for the BML. The BML 2 scheme would utilise the former alignment of the Lewes - Uckfield line but instead of connecting to Lewes would tunnel under the South Downs to run directly to Falmer and onward to Brighton via the East Coastway. Chapter 4 details these proposals further.

Chapter 6 considers the longer term case for Lewes – Uckfield re-opening / BML 2 on capacity grounds.

Figure 89 shows Brighton to London Victoria and London Bridge journey times via a variety of routes and is based on the assumption that trains have a clear run and do not catch up with slower trains:

- **Fast direct:** running fast from East Croydon to Brighton
- **Stopping direct:** a typical stopping service
- **Via Lewes:** involves the train running fast from Brighton to Lewes, departing the platform and stopping just beyond the station where the driver changes ends (unless a second driver is located in the rear cab) and then the train returns to Lewes station on the other route to continue its journey fast to Wivelsfield or Haywards Heath
- **Via Ford:** running fast to Ford where the driver changes ends to drive the train via the Arun Valley line fast to Three Bridges via Horsham and Crawley (this assumes signalled turn-back facilities at Ford)
- **Via Littlehampton:** running fast to Littlehampton where the driver would change ends or another driver take over for the journey fast to Three Bridges via Horsham and Crawley
- **Arundel Chord:** assuming the Chord is constructed, trains would run fast to Three Bridges via Worthing and Horsham

Figure 90 - Uckfield - Lewes Diversion



- **Lewes – Uckfield:** the train runs fast to Lewes and shunts to the other line (as Via Lewes above) then runs fast to East Croydon via Uckfield
- **Lewes – Uckfield with the Horseshoe Curve:** the train runs fast to East Croydon via the Horseshoe Curve, Lewes and Uckfield
- **BML2 Falmer – Uckfield:** the train runs fast to East Croydon via Falmer and Uckfield.

The 'stops skipped' column is there as a reminder that not all passengers are travelling from the origin station and going to the destination station of the train, there are a lot of people who board and/or alight at intermediate stations so diverting the train from the BML means many cannot board or alight from a service. This will be inevitable if they are close to the incident but the industry tries to provide a service to all passengers particularly at busy interchange on the routes in times of perturbation.

Figure 90 shows the impact of the diversions to the intermediate stations, diversion via the Uckfield line being most disruptive to passengers as the train misses the key markets on the Brighton Main Line between Brighton and East Croydon.

Diverting trains is reliant upon crew route knowledge, pathways and platform availability at the terminus and, equally, a plan to deal with that train when it arrives at destination – redeployment on another train or shunting to the sidings to clear the platform – without this plan and all the resources required to achieve it, diversionary routes during unplanned disruption cannot be used effectively.

With all the above in mind Network Rail has reviewed likely use of an Arundel Chord or a re-opened Lewes - Uckfield route from a day-to-day Route Control perspective.

It is likely that the maximum number of trains that would be diverted via the East (via Uckfield) or West Coastways (via Arundel) is two trains per hour. During planned engineering works this may be slightly higher. This level of diversion would not justify the cost of investment in either alternative route.

5.15 Control Period 6 Conclusions

Figure 91 is a summary table of the appraised options set out in this chapter and their initial Value for Money rating, noting all cost assumptions are pre-GRIP.

Figure 91 - Summary of options considered by the Sussex Route Study

Conditional Output type	Intervention location	Intervention description	Option number	Value for money rating
Capacity	BML	additional 6tph to London in AM & PM peaks	S2i	Medium / High
Capacity	BML	additional 6tph to London in AM & PM peaks	S3i	Medium / High
Capacity	BML	additional 6tph to London in AM & PM peaks	S1i	Low / Medium
Capacity	BML	additional 6tph to London in AM & PM peaks	S2ii	Low / Medium
Capacity	BML	additional 6tph to London in AM & PM peaks	S3ii	Low / Medium
Capacity	BML	additional 6tph to London in AM & PM peaks	S1ii	Low
Capacity	London Bridge Suburban	10-car lengthening on Tulse Hill service group	S4	Low
Capacity & Connectivity	London Bridge Suburban	additional 2tph from the Wimbledon Loop (HPH only)	S5	Low
Capacity	East London Line	additional 2tph from Crystal Palace (three hour peak)	S6	High
Capacity	East London Line	additional 2tph from West Croydon (three hour peak)	S7	Low/Medium
Capacity & Connectivity	London Bridge Suburban	additional 2tph from the Wimbledon Loop (all day)	S8	High
Diversionary Route	BML (Arundel Chord)	1km Double track diversionary route	S9	Low

5.16 Improved passenger circulation at Sussex stations

Figure 92 - Passenger circulation capacity at stations Conditional Outputs	
Conditional Output Reference	**Conditional Output**
CO21	To provide sufficient passenger circulation capacity at stations within the Sussex Route, taking into account anticipated growth over the period to 2023

Many of the rail stations in the Sussex Area date from Victorian times, and in terms of overall footprint and layout some have not changed substantially for many decades. As a result of this and growth in the market, some stations are congested during peak hours, making movement through the station to and from the platforms slow and potentially difficult. Figure 92 details the conditional output.

The Route Study anticipates that some of the busiest stations in the Sussex area will be improved via planned or ongoing station improvement projects during CP5, this includes London Bridge, London Victoria, Clapham Junction and Gatwick Airport. As a result the Sussex Route Study has not considered these stations for further investment during CP6. Should capacity at any of these stations not be addressed by these projects, then they will become a priority for investment during CP6.

Elsewhere on the Sussex area, it is anticipated that investment will be required at a number of other stations to meet conditional output CO21 during CP6. These stations are listed in Figure 93. The list has been generated based on preliminary analysis of 2013 ticket sales data, followed by discussions with both internal and external stakeholders, and site visits during peak times.

Other stations may require smaller interventions during CP6. These stations are:

- Balham
- Battersea Park
- Brockley
- Forest Hill
- Norbury
- Sydenham
- Three Bridges
- West Croydon

For each station highlighted, Network Rail plans to develop more specific costs over the next two years to better inform funder's choices by the time of the Initial Industry Plan for CP6.

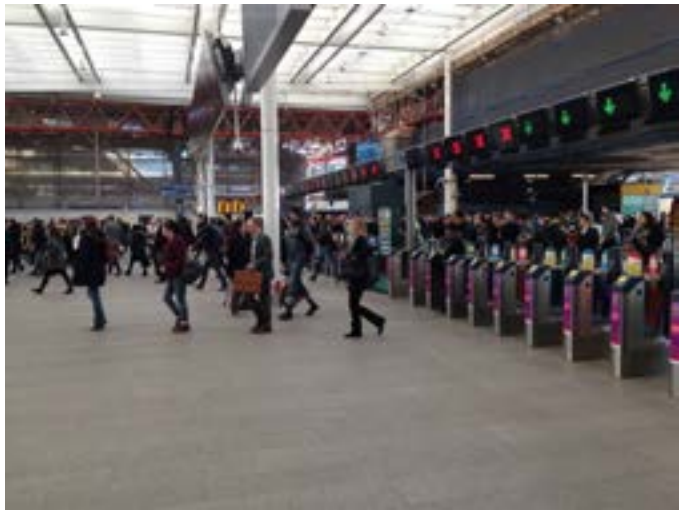
Figure 93 - Station investment priorities for CP6	
Station	**CP6 investment priority**
Imperial Wharf	Increase capacity for passengers exiting from both platforms
Peckham Rye	Increase capacity for passengers exiting from platforms and increase capacity of the gateline
Tulse Hill	Increase capacity for passengers exiting from platforms. An increase in gateline capacity may also be required
West Brompton	Increase capacity for passengers exiting the platforms and interchanging between National Rail and London Underground services
East Croydon	Increase main concourse capacity. Potential direct synergy with alterations to the operational railway footprint below set out in Section 5.5.3 and Appendix B

6.0 Accommodating conditional outputs in 2043

6.1 Overview

In this chapter the Route Study highlights the longer term choices for funders that exist to meet the conditional outputs set out in the Market Studies to 2043. In each case the approach has been to establish the long term challenges in meeting the conditional outputs and ensure that the CP6 options set out in Chapter 5 are consistent with the potential longer term solutions set out in this chapter.

As this chapter covers options for beyond CP6 – appraisals have not been included at this stage (with the exception of Brighton Main Line (BML) infrastructure interventions), though in some cases some initial engineering feasibility, operational planning and costing work has been completed.



Conclusions by conditional output

Section A: Capacity conditional outputs:

6.2 Providing sufficient peak capacity for passengers – Brighton Main Line fast line services into London Victoria and London Bridge[1]

Figure 94 details the conditional output for 2043.

6.2.1 Brighton Main Line infrastructure investment.

Chapter 5 Figure 58 sets out the suite of infrastructure options that would meet the full 2043 specification for fast line commuters. Appraisal Figure 59 in Chapter 5 - options S1 to S3 show the relevant Benefit Cost Ratio's (BCR) at this early stage.

The 2043 fast line options are set out in Chapter 5 (CP6), as it is difficult to separate the infrastructure required for the 2043 output from the infrastructure required for the end of CP6 output. In both cases key network bottlenecks need to be resolved and the re-signalling opportunity – and the main demand shortfall (4tph out of the necessary 6tph) happens to be in CP6.

Despite this, as the conclusions section of Chapter 6 sets out for the BML, it may be desirable or indeed necessary to stagger the required infrastructure investment over more than one Control Period. To this end Chapter 5 sets out some options that might allow delivery to be staggered and outputs to be split across the two control periods.

The chapter notes that the CP6 priorities could be set as unblocking the Windmill Bridge Junction/East Croydon bottlenecks with more minor works at Haywards Heath, London End of Gatwick Airport and on the approaches to London Victoria – Option S2i.

This raises the possibility that full benefits could be delivered in CP6 for passengers at Haywards Heath/Gatwick Airport and inwards towards London with a longer term plan for Keymer Junction in CP7 to eventually release more through capacity from the East and West Coastways – should that scheme prove affordable. With Keymer Junction completed, the 2043 conditional output would then be met in full (with some of the additional services extended to/from the East and West Coastways).

This is of course just one possible option combination, and it will be for the industry working with funders to determine which outputs and infrastructure interventions should fall in which control period.

Figures 95 and 96 set out the significant impact on crowding in 2043 under the Option S1. Option S3 would have the same impact with the exception of the improvement on the Redhill Corridor. Option S2 would have the same impact north of Haywards Heath. It should however be noted that standing is not eradicated for fast line commuters on the BML, with Figure 96 indicating significant standing would still exist on some services in the high peak inwards of Gatwick Airport.

1 Throughout this study, the term 'fast lines' services refers to all services that operate on the fast lines inwards of Croydon to London Bridge or London Victoria

Figure 94 - BML fast services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	Assessment of Capacity Required (Above what preferred CP6 options could deliver)
CO1 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – BML fast services	At least an additional six 12-car services during the high peak hour	Depends on Option chosen in CP6. Some options set out in Chapter 5 deliver full +6tph specification in CP6

Figure 95 - High peak hour: Seat Utilisation on the Brighton Main Line 2043 including committed CP5 interventions only

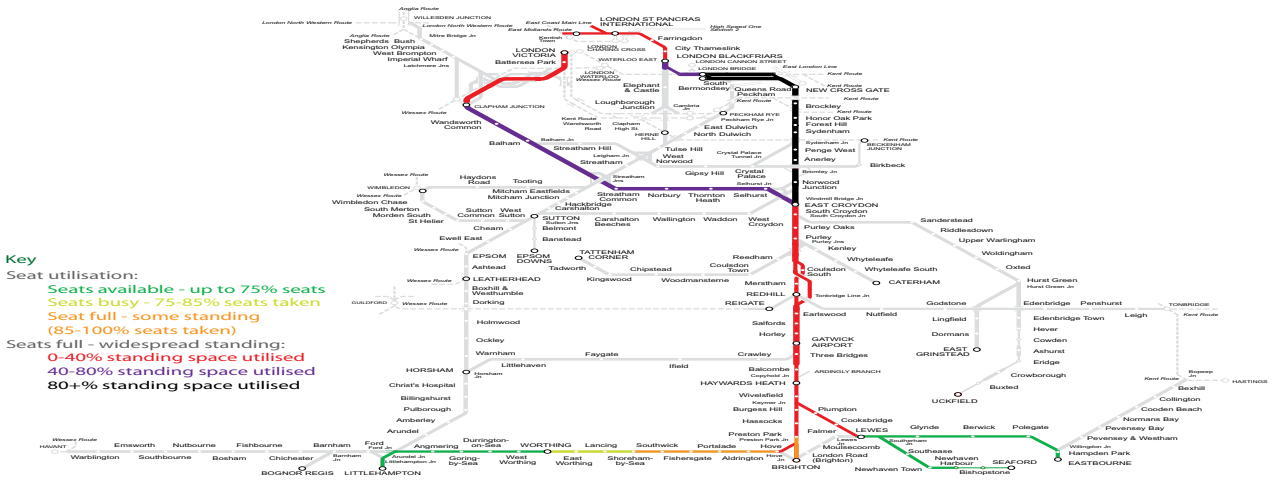
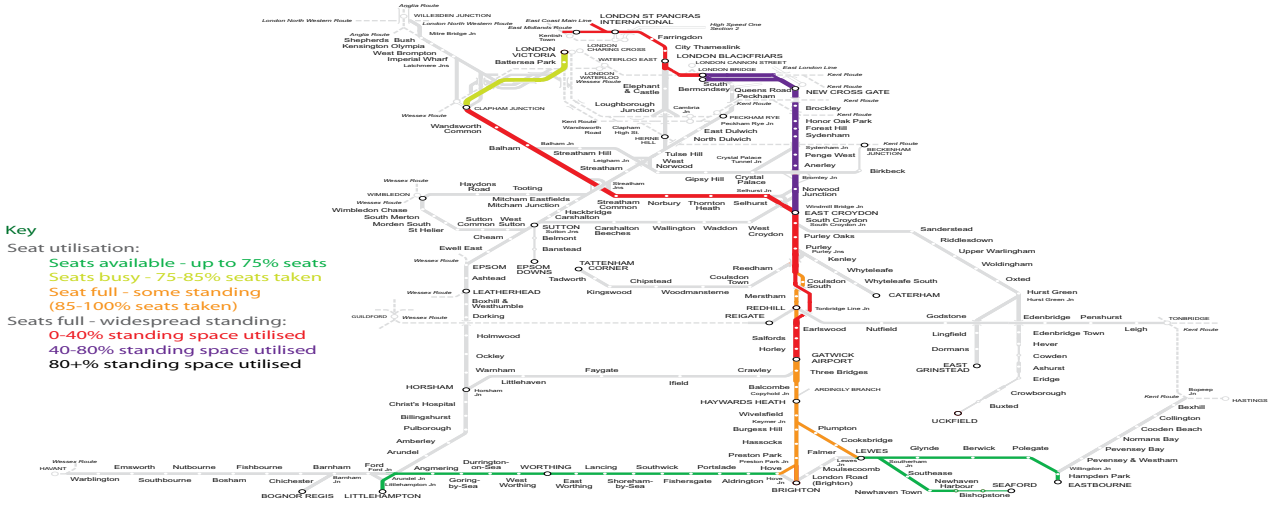


Figure 96 - High peak hour: Seat Utilisation on the Brighton Main Line 2043 with Option S1 plus 6tph



6.2.2 Potential Gatwick Airport Expansion

The airports picture in the UK is currently a matter of significant scrutiny through the work of the Airports Commission led by Sir Howard Davies. Set up to examine the need for additional UK airport capacity and to recommend to Government how this can be met in the short, medium and long term.

In December 2013, the Commission published a shortlist of three schemes for further consideration, two at Heathrow and one at Gatwick. The Commission's final report was published on the 1 July 2015, setting out the recommendations for maintaining the UK's status as an international hub for aviation.

The report contains a range of recommendations which Government will now consider. The Secretary of State is expected to provide clear direction on the Government's plans in autumn 2015.

Irrespective of airport expansion, Network Rail is presently working with the Department for Transport and GAL on options to expand the concourse at Gatwick Airport station to improve vertical circulation and, related to that, change the access points to/from the platform to spread passengers more evenly along platforms. This latter point is critical both now and in the future in terms of managing dwell times of trains at the station.

Aside from Gatwick Airport station itself and the immediate railway operational area, no other specific enabling works have been identified in this Route Study as specifically required to meet airport passenger growth as opposed to the large set of works required anyway to meet wider BML growth.

It should be noted however that, as demand would be slightly higher overall should a second runway option be taken forward, there would in turn be slightly higher high peak hour crowding measures for services between London and Gatwick Airport than are displayed in Figure 96 (2043 post intervention crowding map).

6.2.3: Other incremental options for the Fast Lines – East Croydon commuters

Chapter 3 highlights the need for investment to allow additional services from the outer area of the BML and Chapter 5 sets out how this may be achieved. This focus on relieving the outer area of the BML is driven by the fact that current standing on services to London starts as far out as Haywards Heath, and on some services Hove.

For this reason Chapter 5's CP6 priorities do not list the few remaining incremental investments that would release capacity specifically for inner Fast Line commuters only, as opposed to Fast Line commuters route wide. Baseline investment in CP4 and CP5 will already make a significant difference here. In particular the 12-car operation of East Grinstead services (since 2011), the lengthening of Caterham and Tattenham services to 10-car and the CP5 lengthening of Uckfield trains to 10-car are all significant additions to capacity for inner Fast Line commuters already in the baseline.

Despite all these interventions, by CP7 (2024-29) it may be necessary to look again at what remaining incremental interventions can be made to fast line train lengths in the inner area. The one remaining service group by then that will not be operating at 12-car (or 10-car 23m) will be the Caterham and Tattenham Corner trains that join at Purley. An option would be to further extend Purley Platforms 5 and 6 to 12-car, this would allow London Victoria services to operate at 12-car rather than 10-car, but Thameslink Core services on this route would remain limited to 8-car until an integrated project to improve platform lengths on linked Thameslink routes north of the River Thames.

6.2.4. Beyond 2043

The key question to be answered here is, at what point are options to optimise the capacity of the existing route expended?

There remains some possible options on the existing route beyond 2043 and they are summarised below.

Further European Train Control Systems (ETCS) deployment:
Chapter 5 has already established that there might be some significant benefit from ETCS/Automatic Train Operation (ATO) roll out in the inner area of the BML in the 2020s, not least to possibly part mitigate or at least delay the cost of major remodelling at Clapham Junction. ETCS/ATO could also play a role in improving performance and increasing capacity on the plain line sections of the BML generally.

Further train lengthening:
It is possible that a move to 14- or 16-car operations, in particular into London Victoria could be a long term option for some service groups. The preferable option would be on dedicated fast services that originate at Gatwick Airport or Haywards Heath and stop only at a minimal number of locations. This would still necessitate major works – not least a long term remodelling of at least part of London Victoria throat - but could still offer a better case than a new lines solution, as early as the 2040s, and therefore cannot be ruled out.

In terms of timing, this option needs to remain on the table until GRIP 3 feasibility is completed on the CP6/CP7 Main Line options outlined in Chapter 5. It remains possible that it could be required earlier than the 2040s if certain elements of the CP6/CP7 package in Chapter 5 were deemed unaffordable. For this reason planning of Victoria Station during CP5 and CP6 cannot rule out the possibility that in the long term 14- or 16-car platforms could be required on at least part of the Main Line side.

The impact of further train lengthening is that it is unlikely to ever fully meet the capacity gaps identified in this study in the way the infrastructure investment identified in Chapter 5 could. To avoid large scale remodelling around almost every significant station on the route, it would only ever be possible to lengthen a subset of the full fast line service into London Victoria and lengthening of trains into London Bridge Low Level or the Thameslink Core beyond 12-car is extremely difficult to achieve. This would ultimately yield only a relatively small number of additional vehicles arriving into central London during the peak.

New Lines:
Beyond incremental changes to the existing route detailed above, eventually a new line solution could be required. This is likely to be outside the timescale of this study (2043) but nevertheless some comments can be made to build on the position outlined in Network Rail's Emerging Strategy for CP6 BML report for the DfT which touched on the closed route between Lewes and Uckfield in the spring of 2014.

The report noted that with a long term new lines solution in mind, safeguarding of the Lewes to Uckfield alignment was sensible. Despite this, the report noted a number of significant issues with making best use of the alignment in future to relieve capacity constraints on the BML. Critical amongst these was the fact that without a new railway from somewhere south of the Croydon area on the Sanderstead route to somewhere in inner London, reopening and upgrading of the route serves little purpose in terms of through capacity generated. Further work for this Route Study has re-enforced this point.

Remaining paths that can be found inwards of East Croydon are mostly on the London Victoria-side. To access the London Victoria Fast Lines from the Sanderstead route necessitates flat junction moves from the slow line to fast line at Selhurst that even Windmill Bridge Junction grade separation may not remove. This effectively means remaining capacity that can be created on the London Victoria route is best served directly from the existing main line as set out in Chapter 5. This just leaves the additional 2tph identified into London Bridge, as Chapter 5 highlights these can be utilised by upgrades to the existing main line without building a new route.

The conclusion is re-enforced therefore that Lewes to Uckfield adds value only when combined with a new lines scheme north of Hurst Green/Sanderstead. On the current understanding of demand growth, it is outside the timeframe of this study to determine what shape such a scheme would take, save to recognise that protection of the existing Lewes to Uckfield alignment is a sensible approach for the future.

In the event of further work in the future on a new lines solution, optioneering should not however be solely limited to the Lewes – Uckfield routing. A key challenge with rehabilitating that route has always been that it does not automatically relieve the key demand centres on the BML. Whilst new services from the East Coastway and possibly even Brighton might be routed that way (in the latter case most likely at a significant journey time cost), there may be limited benefit to the West Coastway and most of the key population centres on the existing BML itself. This is a critical factor that must be considered when new line options are reviewed.

6.3 Providing sufficient peak capacity for passengers – suburban services to/from London Bridge

Chapters 3 and 5 set out the key challenge as being on the Tulse Hill to London Bridge route. Figure 97 sets out the remainder of the capacity gap that would need to be resolved to 2043 if seat configuration changes were made to all vehicles on the corridor and additional 2tph operated in the peak on the route as set out in Chapter 5.

As can be seen the remaining gap is very small and wider analysis of the three hour peak has shown it is particularly focused on a very small window within the high peak.

The only remaining option not expended in CP6 is platform lengthening to 10- or 12-car. As Chapter 5 sets out, this is an expensive option with a poor BCR and with major disruptive infrastructure works at Tulse Hill. Figure 97 shows the impact of such an intervention and how it would cover total demand to 2043.

Despite the cost, the scheme needs to be considered going forward alongside any plans for major changes to the station at Tulse Hill to improve passenger capacity, in case there is some synergy between required works to improve passenger flow and safety at the station and a longer term plan to alter platform widths/position (which would also be required under a platform lengthening scheme).

Figure 97 - London Bridge suburban services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	Assessment of Capacity Required (Above what preferred CP6 options could deliver)
CO2 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Bridge suburban services	An additional 32 vehicles during the high peak hour: • 22 vehicles for the Tulse Hill Service Group, • 10 vehicles for the Forest Hill Service Group	An additional 11 vehicles during the high peak hour: • Eight vehicles on the Tulse Hill Service group. • Three vehicles on the Forest Hill service group.

6.4 Providing sufficient peak capacity for passengers – suburban services to/from London Victoria)

Figure 98 shows the remaining gap to meeting the 2043 Conditional Output after the CP6 interventions.

6.4.1 10 to 12-car operations

The most obvious option for bridging this gap would be to move to a 12-car railway for suburban services into London Victoria in CP7. Figure 99 below shows the impact of such an intervention and how it would cover total demand to 2043.

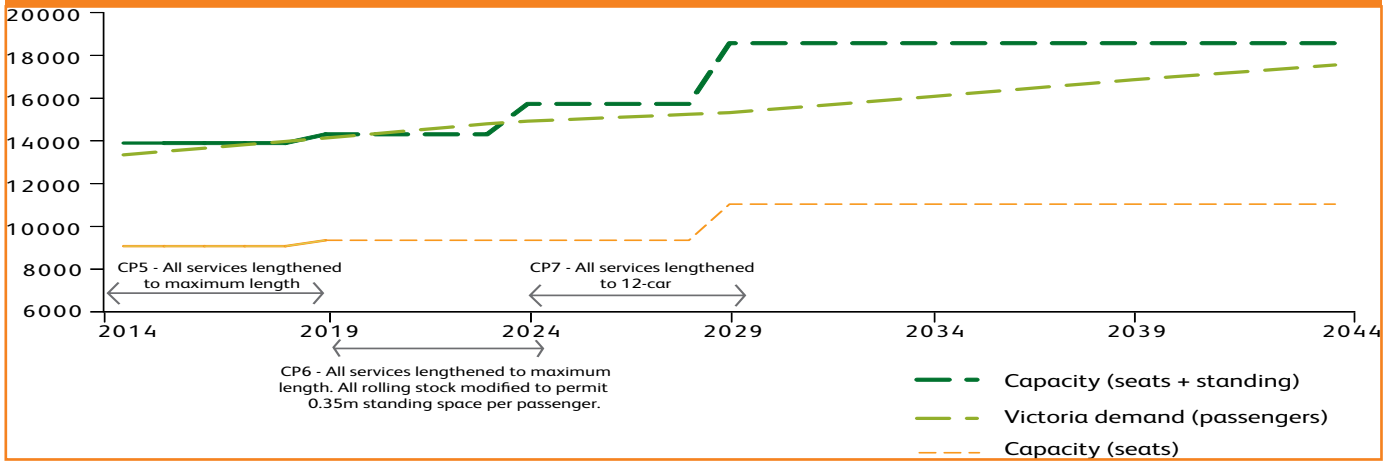
Such a move from 10 to 12-car would be more expensive and disruptive than the recent 8 to 10-car extension programme. This is because a number of key locations on the suburban network such as Balham and Epsom would require major infrastructure alterations. The option is nevertheless deliverable in CP7 timescales.

As Chapter 5 highlights, it is important that renewals of signalling equipment and other lineside equipment in CP5 and CP6 are aligned where practical with the long term goal of 12-car operation, to minimise abortive work.

Figure 98 - London Victoria suburban services conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	Assessment of Capacity Required (above what preferred CP6 options could deliver)
CO3 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Victoria surburban services	An additional 76 vehicles during the high peak hour: • 34 vehicles for the Streatham Hill Service Group • 14 vehicles for the Hackbridge Service Group • 28 vehicles for the Norbury Service Group	An additional 50 vehicles during the high peak hour: • 22 vehicles for the Streatham Hill Service Group • 9 vehicles for the Hackbridge Service Group • 19 vehicles for the Norbury Service Group

Figure 99 – Demand and Capacity arriving into London Victoria via suburban lines with possible future interventions



To meet conditional output CO3 and fully satisfy the requirement of an average load factor of less than 85 per cent, an additional 25 vehicles are required on top of lengthening all services to 12-car and altering seat configurations.

With this in mind another option has been set out by Transport for London (TfL), aimed at facilitating significant alterations to service frequency on the suburban routes.

6.4.2 Frequency improvement option

This option is aimed at facilitating significant alterations to train frequency on the suburban routes. North London has a dense network of London Underground routes in addition to suburban rail services, whereas few Underground lines reach into south London, resulting in a greater dependency on rail services.

Despite this dependency, there is evidence to suggest that there is still over-reliance by passengers on the Underground network, with Underground stations in south London being substantially busier than equivalent rail stations and large volumes of bus demand from rail-served areas to Underground stations (particularly Brixton, Tooting Broadway, Elephant & Castle and Morden).

The rail network is therefore potentially under-utilised and could deliver far more for passengers if major changes were made.

TfL believes that by adopting some of the characteristics of the Underground on rail services in south London, capacity could be increased, helping to accommodate the expected growth in passenger demand across the suburban area:

- Reconfiguring of the network to a simple set of approximately eight lines across south, south west and south east London with consistent stopping patterns which passengers can better understand
- Frequencies of at least 6tph in inner London (roughly Zones 2 to 4) and at least 4tph in outer London (Zones 5 and 6)
- A simplified network would result in a reduced choice of London terminal stations and destinations, so easy to reach strategic interchange stations (hubs) need to be developed where passengers can change trains quickly and confidently
- A simplified network means it could be more reliable depending on frequencies employed and the extent of supporting infrastructure work
- All stations staffed during customer hours, staff use new ticketing and mobile technology, with real time information at every station and on every train.

It is recognised that some passengers would not welcome the loss of journey options, for example if they no longer had a choice of travelling directly to both London Victoria and London Bridge. However, TfL considers that provided the benefit to passengers is sufficiently large (higher frequencies, simple interchanges, better journey experience), then this disadvantage can be overcome, with most passengers benefiting in economic terms despite the loss of some direct routes.

Hubs would be required where the lines converge, for example in the Streatham area and at Peckham Rye. In some cases, significant improvements to the interchanges would be required with new station layouts and modified track layouts.

TfL recognises that there will be challenges to delivering this option and that it will be important to not adversely affect longer distance services from outside London, freight services or the availability of diversionary routes for trains during planned or unplanned disruption.

Whilst detailed work on these proposals has yet to commence, it is likely that they would have substantial passenger benefits and could offer good value for money. More detailed work is required on the benefits as well as the costs, operational feasibility and acceptability to passengers.

The Route Study considers that this upgrade across the suburban network is an option for funders to consider beyond CP6. TfL plans to develop the proposals further, working with Network Rail and the wider rail industry.

The TfL proposals include interventions at Clapham Junction and the Windmill Bridge Junction area. The proposals for alterations to West Croydon to Gloucester Road Junction could have synergy with the Windmill Bridge Junction option proposed for fast line capacity

in Chapter 5, if a three track West Croydon to Gloucester Road option was selected. The proposals for the Clapham Junction area would require more work to develop an integrated scheme with the fast line proposals already set out as an option in Chapter 5.

6.5: Providing sufficient peak capacity for passengers – Orbital routes – East London Line

Chapter 3 sets out the capacity challenge on the routes from Crystal Palace and West Croydon to/from the East London Line (ELL) and Chapter 5 sets out a potential timetable solution. As Figure 100 sets out, if achievable, this would significantly reduce crowding issues and leave only a small capacity gap in 2043.

In the longer term it is worth noting that some of the ELL core stations in particular Canada Water represent the most significant engineering challenges on the whole orbital network to lengthening trains beyond 5-car. However, if it does not prove possible to operate additional services as set out in Chapter 5, only two options remain for the long term:

- train lengthening
- some form of service substitution of orbital services for radial services.

Figure 100 - East London Line conditional outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	Assessment of Capacity Required (Above what preferred CP6 options could deliver)
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)	An additional thirteen vehicles during the high peak hour: • 8 vehicles from West Croydon • 5 vehicles from Crystal Palace	An additional three vehicles during the high peak hour

6.6 Providing sufficient peak capacity for passengers – Orbital routes – West London Line

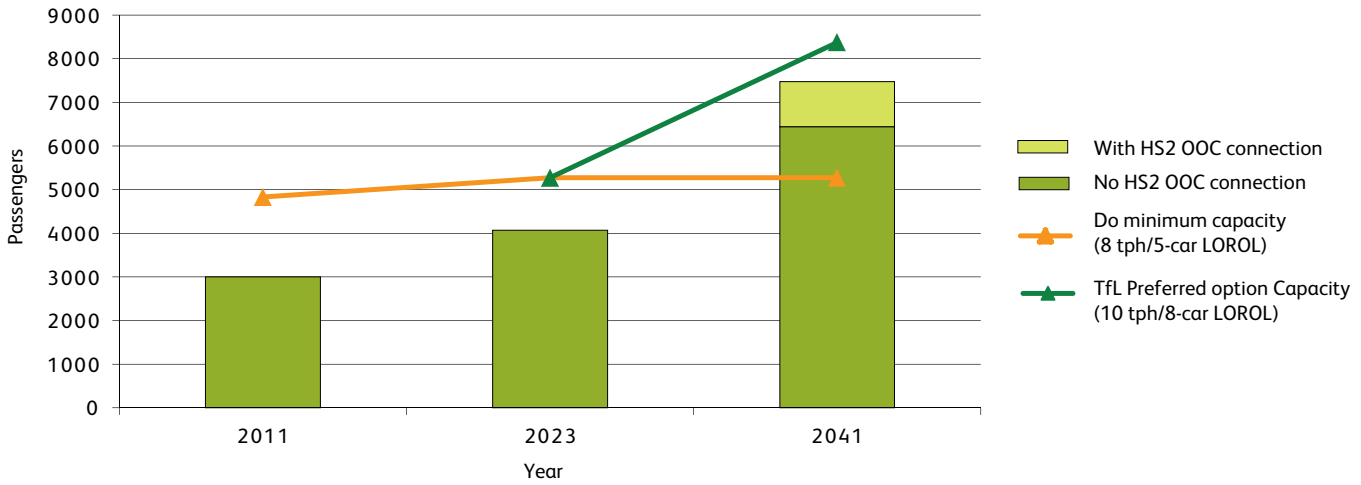
Chapter 3 sets out the capacity challenge on the West London Line (WLL) and Chapter 5 identifies that the recent delivery of 8-car capability for Southern services plus the imminent delivery of 5-car operation for London Overground Rail Operations Ltd (LOROL) services will be sufficient to manage demand growth in CP6.

However a capacity gap exists to 2043 from CP7 onwards. If no further capacity improvements are made after CP5 there would be a capacity gap of 18 vehicles to meet conditional output CO5. If a link to the HS2 station at Old Oak Common were to be made, and no further capacity improvements were made to the WLL after CP5, there would be a capacity gap of 27 vehicles to meet conditional output CO5, see Figures 101 and 102.

Figure 101 - East London Line Conditional Outputs

Conditional Output Reference	Conditional Output	Assessment of Capacity Required	Assessment of Capacity Required (Above what preferred CP6 options could deliver)
CO5 (2043)	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Orbital services (East and West London Lines)	An additional 18 vehicles during the high peak hour	An additional 27 vehicles during the high peak hour

Figure 102 - Demand and Capacity graph for the West London Line showing the impact of a link to the HS2 Old Oak Common station



TfL have produced a draft timetable for a 10tph service on the WLL after the opening of a link to Old Oak Common station and, as Chapter 5 notes, depending on how demand growth pans out in coming years, this level of high peak service may be required earlier than the current forecasts are showing – i.e. potentially pre any Old Oak Common connections being implemented .

If allied with 8-car operation of all peak services (i.e. those currently operated by LOROL and Southern) a 10tph peak timetable would cover the capacity conditional output gap to 2043.

Potential mitigations to help sustain performance in a peak 10tph timetable scenario are already listed in Chapter 5. Additionally, moving to an all 8-car operation has the following implications:

- The need to provide 8-car turnback capability within the designs for Old Oak station (or at locations beyond Old Oak station) on the WLL/North London Line (NLL) link
- The need to provide 8-car capability at a new Clapham Junction Platform 0 and/or existing LOROL platforms
- The need to provide 8-car turnback capability between Willesden Junction and Kensal Rise, to allow some LOROL services that would continue to run through to the NLL to operate at increased length or lengthening of platforms on the NLL through to Stratford if services are to continue to operate through
- Any depot and stabling implications identified from some further operation of additional 8-car formations in the long term.

The above point relating to the now differing capabilities of the WLL and NLL is relevant to future planning of at least the Willesden High Level part of the latter route. The WLL is already an 8-car capable railway and in future the capability of the turnback points and stations on the NLL for WLL services will determine whether LOROL services have potential to take full advantage of the capability of the WLL.

In the long term, in the peaks it will normally be preferable from a performance and reliability point of view to lengthen trains on the WLL before operating additional services and this is also true in the off-peak, in particular because of the critical interface with freight on this route.

The capability of turnback facilities and stations on the NLL to handle up to 8-car operation is likely to become the focus of capacity strategy in the long term, as long as services operating from the WLL continue to operate to/from this route.

6.6.1 Through running Brighton Main Line – West London Line

The Route Study has also considered the longer term possibility of longer distance trains from the BML, for example Gatwick operating onto the WLL to provide direct connectivity with Old Oak Common and HS2.

There are a number of key reasons why this proposal is not viewed as likely to provide value for money as a peak time service:

- To run fast line services onto the WLL in the peaks would require grade separated access somewhere in the Clapham area between the fast lines and the WLL to avoid slow flat junction moves on the approaches to Clapham between fast and slow lines. This could only be achieved by new tunnels
- Dedicating peak fast line paths to run onto the WLL would mean reducing fast line peak capacity as instead of current 12-car operation the diverted paths would be restricted to 8-car formations
- With the opening of Crossrail in CP5, fast line passengers from Gatwick Airport and the rest of the BML will have a good high frequency interchange option at Farringdon to access HS2 at Old Oak Common and Heathrow Airport.

If further development work were to identify that either the infrastructure options set out for Clapham Main Line platforms were not affordable or an ETCS/ATO solution did not provide sufficient alternative capacity, it would be legitimate to revisit the above conclusion in light of a wider alternative plan to find alternative routes for some Fast Line paths.

In the off-peak, it may be possible to operate some through services, though this might involve making trade offs with other existing operations.

Section B: Connectivity and journey time conditional outputs:

6.7 Four trains per hour on the Wimbledon Loop.

As Chapter 5 sets out, a timetabling option exists in CP6 to deliver the capacity conditional output CO4 and connectivity conditional output CO11.

The remaining question is whether the railway can perform adequately with a 4tph all day service on the Loop.

Chapter 5 sets out a planned CP5 mitigation as part of the Wimbledon Loop interlocking replacement but notes further measures might be desirable.

Network Rail will work with GTR to identify further what these may be, should funders wish to proceed with this option. It has already been identified that a risk on the Loop itself is the single bi-directional platform at Wimbledon for loop services. Should Crossrail 2 go ahead and the Wimbledon station area be significantly remodelled, consideration should be given to the opportunity to re-instate a second Wimbledon Loop platform as part of the new layout to aid performance. It is noted however that this will need to be balanced with the needs of other service groups including Tramlink.

6.8 East and West Coastway/Brighton to/from Central London journey times.

Chapter 5 sets out a number of 'making best use' scenarios that could improve journey times between the Coastway and London in CP6.

Beyond CP6 timescales options could be investigated around further linespeed improvements on the BML itself.

Previous investigations have indicated that significant linespeed improvements would be expensive. Even moving the linespeed to 100mph on many stretches is complicated by track alignment and curvature and the clearance to platform faces.

The alternative would be a large scale power upgrade to allow electric rolling stock to operate on higher amp settings on the BML. Such an upgrade to the Direct Current (DC) system is likely to run into the £100m's with previous work completed showing that although there are potentially some minute savings to be made here through improved acceleration, these are limited by the length of route to less than a five minutes saving for fast/semi-fast services. An (Alternating Current) AC electrification upgrade would be likely to yield similarly limited numbers of minutes saved.

6.9 North Downs Journey Times Reading – Redhill – Gatwick Airport

Chapter 5 establishes the options for improving connectivity and journey time on this route from the West into Gatwick Airport.

CP6 should see a 2tph through service established, however, the challenge in the longer term will be improvements in actual journey times on the route.

Chapter 5 sets out the options linked to AC electrification and further timetable changes. In the case of electrification the Network RUS: Electrification Draft for Consultation 2015/16 will set out more information with regard to the national prioritisation of the North Downs route.

In terms of the 3tph timetable option outlined in Chapter 5 and appraised in the Wessex Route Study, if infrastructure investment at Guildford is required to ensure reliable operation this is likely to form a CP7 timescale scheme. If not, depending on service pattern and whether the further Redhill alterations set out in Chapter 5 are delivered in CP6 – such a service change could be implemented earlier.

Figure 103 summarises the Long Term plan to meet the conditional outputs.

Figure 103 - Summary of Long Term (beyond CP6 options)

Conditional Output Reference	Conditional Output	Intervention Location	Intervention Description
Capacity	CO1	BML	Additional 6tph to London in AM & PM peaks. Mix of infrastructure work. Some items likely to have been completed in CP6 Beyond CP6 will be remaining items only – potentially Keymer Junction and possibly Clapham Junction, but depends on industry and funder choices
Capacity	CO1	BML	ETCS/ATO to further reduce section headways and improve performance and possible add some further paths
Capacity	CO1	BML	Lengthening services from 12 to 14/16-car. Likely to be viable into London Victoria only. Likely to be workable on only a small number of very limited stop services that start inwards of Brighton. Lengthening of Purley to Thameslink Core services to 10-/12-car.
Capacity	CO1	BML	New lines to enable more services to run in the peak. Currently envisaged as post-2043
Capacity	CO2	London Bridge suburban services	Lengthening all Tulse Hill Line services from 8- to 10-car
Capacity	CO3	London Victoria suburban services	Lengthening all services from 10- to 12-car
Capacity	CO3	London Victoria suburban services	TfL South London high frequency proposals
Capacity	CO5	West London Line	10tph timetable and lengthening all Clapham Junction to Stratford services from 5 to 8-car. Platform lengthening would be required on the North London Line and on platforms 0-2 at Clapham Junction. To support timetable increase, reduction in four minute signalling headway and potential reopening of platfom 0 at Clapham Junction
Connectivity	CO11	Wimbledon Loop	Further work to determine any other performance mitigation interventions for a 4tph all day service
Connectivity	CO15,16&17	East and West Coastway/ Brighton to London	Possible electrification upgrades to allow electric units to operate on higher amp settings on the BML
Connectivity	CO19	North Downs Line	Implement 3tph service – two through Gatwick services and one stopping service. This may be implemented off-peak in CP6, depending on performance analysis, further Redhill southern end analysis and Automatic Half Barrier/foot crossing upgrade requirements

Appendix A: Economic Appraisals

Figure A1 – London Bridge capacity – Brighton Main Line Fast Services 2018 high-peak hour

Route	Service Group	Number of train services per hour	Passenger vehicles per train & rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Bridge - fast services 2018	West Coastway via Hove	1	1 x 12-car 377*	12	60 (seats only) or 99 (with standing allowance)	1,188
	East Coastway via Eastbourne**	0	0 x 12-car 377	0	60 (seats only) or 99 (with standing allowance)	0
	Brighton	4	4 x 12-car 700	48	55 (seats only) or 148 (with standing allowance)	7,104
	Uckfield	2	2 x 10-car 171	20	61 (seats only) or 102 (with standing allowance)	2,040
	East Grinstead	2	2 x 12-car 700	24	55 (seats only) or 148 (with standing allowance)	3,552
	Redhill corridor	4	4 x 12-car 700	48	55 (seats only) or 148 (with standing allowance)	7,104
	Caterham/Tattenham Corner	4	4 x 8-car 700	32	55 (seats only) or 148 (with standing allowance)	4,736
	Chichester/Bognor Regis via Horsham	1	1 x 12-car 377	12	60 (seats only) or 99 (with standing allowance)	1,188
	Epsom via West Croydon	2	2 x 12-car 700	24	55 (seats only) or 148 (with standing allowance)	3,552
Total						30,464

* An average capacity per vehicle has been taken for Class 377 rolling stock.
**Services from the East Coastway to London Bridge in the December 2012 timetable operate at two trains per hour in the high-peak hour, but no services in the shoulder peaks (0700-0800 and 0900-1000). In the development timetable used in this Route Study as the 2018 base, there is one train per hour in each shoulder peak (but close to the high peak) and no services in the high-peak hour itself. The 2024 conditional outputs require at least one train per hour across the three hour peak from the East Coastway route to London Bridge.

Figure A2 – London Victoria capacity - Brighton Main Line Fast Services 2018 high-peak hour

Route	Service Group	Number of train services	Passenger vehicles per train & Rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Victoria - fast services 2018	West Coastway via Hove	2	2 x 12-car 377*	24	60 (seats only) or 99 (with standing allowance)	2,376
	East Coastway via Eastbourne	2	2 x 12-car 377	24	60 (seats only) or 99 (with standing allowance)	2,376
	Brighton	4	4 x 12-car 377	48	60 (seats only) or 99 (with standing allowance)	4,752
	East Grinstead	2	2 x 12-car 377	24	60 (seats only) or 99 (with standing allowance)	2,376
	Redhill corridor	4	2 x 12-car 377	48	60 (seats only) or 99 (with standing allowance)	4,752
	Caterham/Tattenham Corner	2	2 x 10-car 377	20	60 (seats only) or 99 (with standing allowance)	1,980
	Chichester/Bognor Regis via Horsham	2	2 x 12-car 377	24	60 (seats only) or 99 (with standing allowance)	2,376
Total		18		212		20,988

*** An average capacity per vehicle has been taken for Class 377 rolling stock**

Figure A3 – Existing high-peak suburban capacity into London Bridge

Route	Service group	Number of train services	Passenger vehicles per train & rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Bridge - suburban services	Tulse Hill	6	6 x 8-car 455	48	79 (seats only) or 108 (with standing allowance)	5,184
	Forest Hill	6	3 x 10-car 377* 2 x 8-car 377	46	60 (seats only) or 99 (with standing allowance)	4,554
			1 x 8-car 455	8	79 (seats only) or 108 (with standing allowance)	864
Total		12		102		10,602

* An average capacity per vehicle has been taken for Class 377 rolling stock

Figure A4 – Seat utilisation on the London Bridge Tulse Hill lines 2012

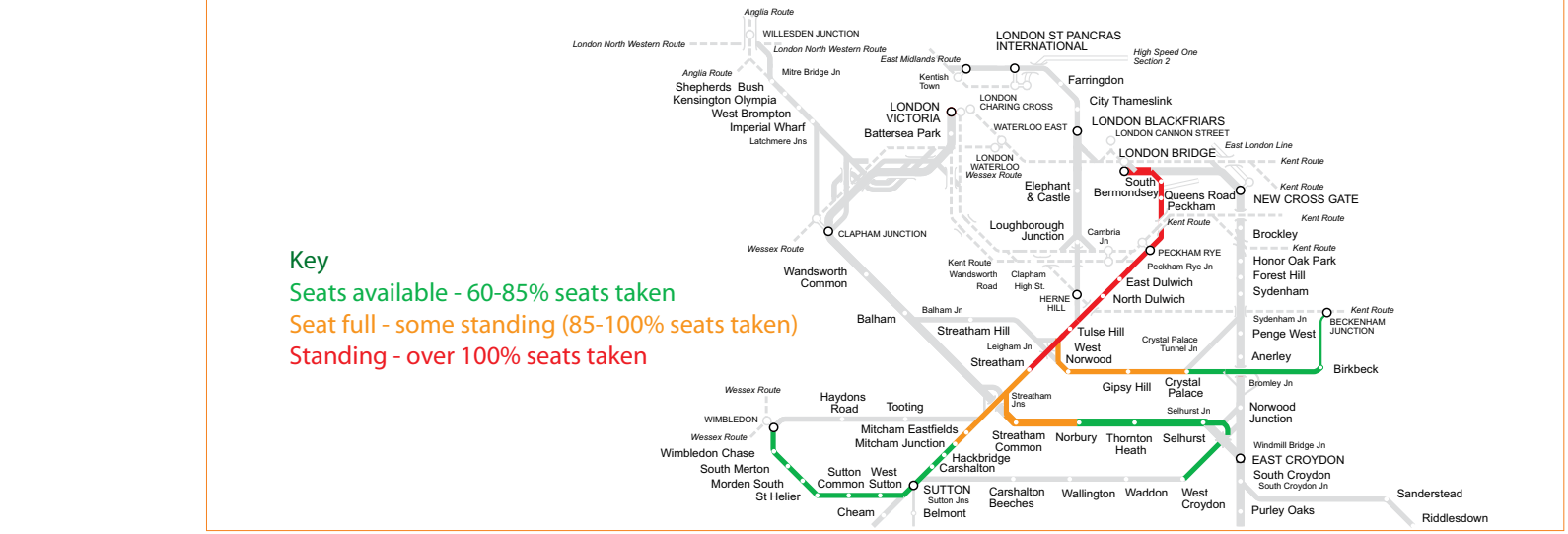


Figure A5 – Seat utilisation on the London Bridge Tulse Hill lines 2043, with no interventions after CP5

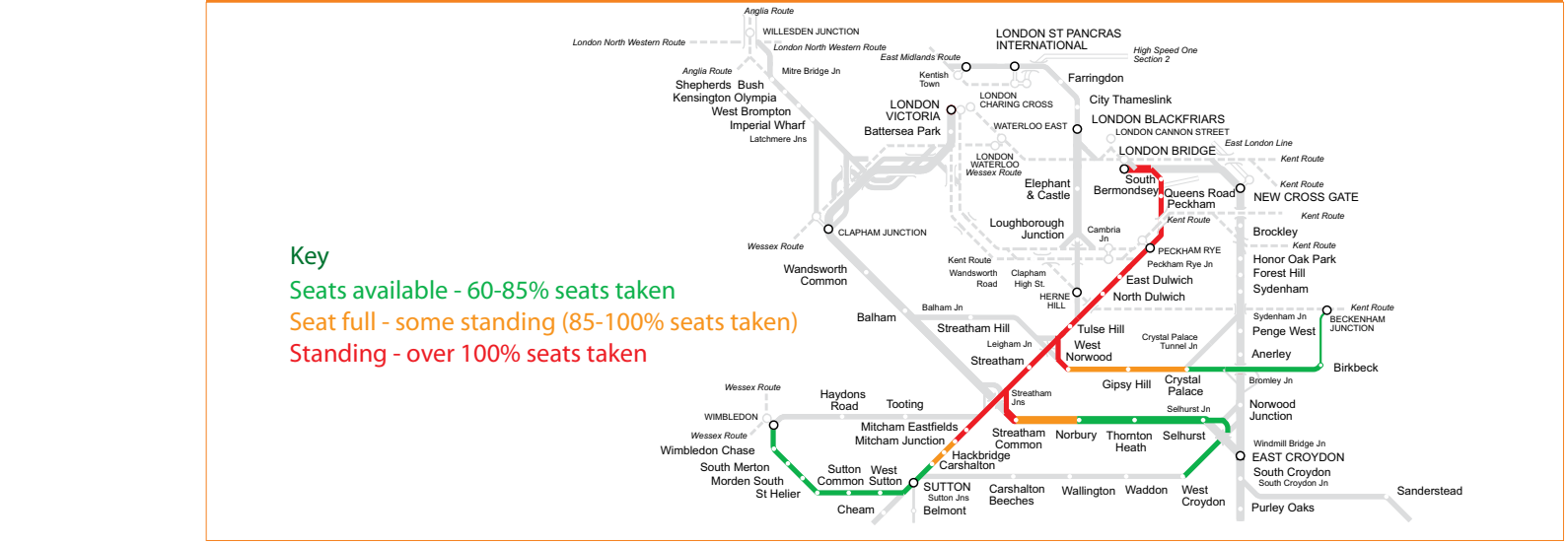


Figure A6 – Seat utilisation on the London Bridge Forest Hill lines 2012

Figure A7 – Seat utilisation on the London Bridge Forest Hill lines 2043, with no interventions after CP5

Figure A8 – Existing high-peak hour suburban capacity into London Victoria

Route	Service Group	Number of train services	Passenger vehicles per train & Rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Victoria - suburban services	Streatham Hill	4	4 x 10-car 377*	40	60 (seats only) or 99 (with standing allowance)	3,960
	Hackbridge	4	4 x 10-car 377	40	60 (seats only) or 99 (with standing allowance)	3,960
	Norbury	6	4 x 10-car 455 1 x 8-car 455	48	79 (seats only) or 108 (with standing allowance)	5,184
			1 x 8-car 377	8	60 (seats only) or 99 (with standing allowance)	792
Total		14		136		13,896

* An average capacity per vehicle has been taken for Class 377 rolling stock

Figure A9– Seat utilisation on the London Victoria suburban lines 2012 (2012 demand compared against 2013 10-car lengthened capacity on the

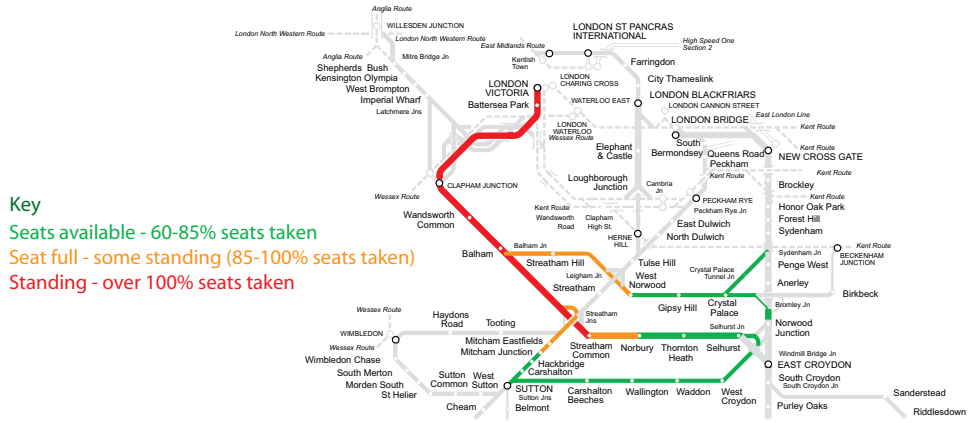


Figure A10 – Seat utilisation on the London Victoria suburban lines 2043, with no interventions after CP5

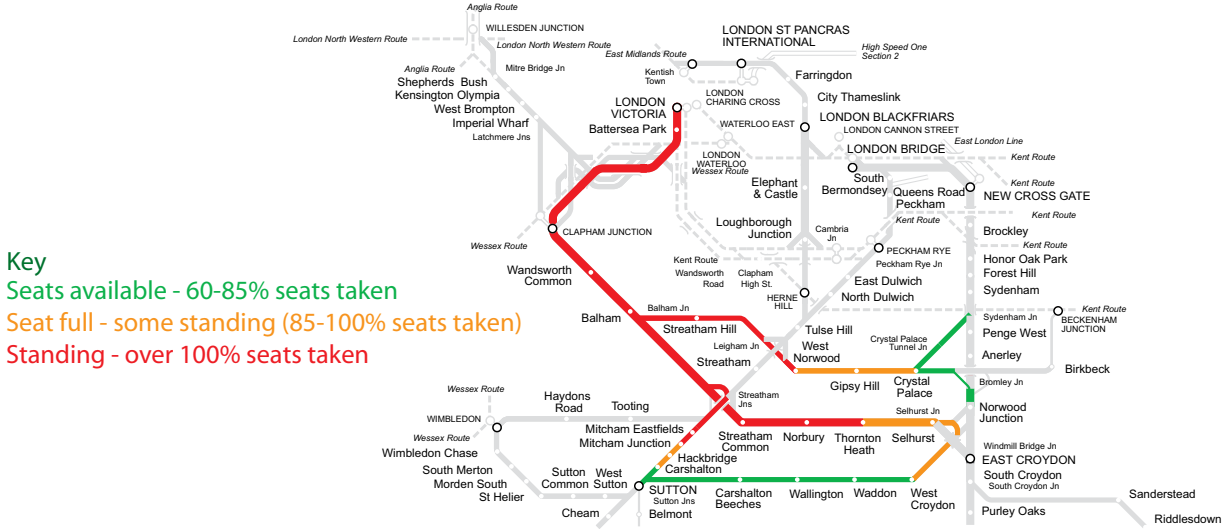


Figure A11– Existing high-peaksuburban capacity into the Thameslink Core (London Blackfriars to London St Pancras International section) from the Wimbledon Loop

Route	Service Group	Number of train services	Passenger vehicles per train & Rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Thameslink Core - Wimbledon Loop services	Tooting	2	2 x 8-car 319	16	65 (seats only) or 98 (with standing allowance)	1,568
	Hackbridge	1	1 x 8-car 319	8	65 (seats only) or 98 (with standing allowance)	784

Figure A12 – Wimbledon Loop to Thameslink Core suburban services 2018 High-peak hour (Network Rail Thameslink Development Timetable, 2011)

Route	Service Group	Number of train services	Passenger vehicles per train & Rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
London Thameslink Core - Wimbledon Loop Services	Tooting	2	2 x 8-car 700	16	55 (seats only) or 148 (with standing allowance)	2,368
	Hackbridge	2*	2 x 8-car 700	16	55 (seats only) or 148 (with standing allowance)	2,368
Total		2		32		4,736

*The additional service from Hackbridge included in the Development Timetable (DTT) 2011 is currently being tested as to whether or not it can be successfully accommodated.

Figure A13 – Post LOCIP high-peakorbital capacity on the East London Line

Route	Service Group	Number of train services	Passenger vehicles per train & rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
East London Line	Clapham Junction	4	5-car 378	20	37 (seats only) or 141 (with standing allowance)	2,820
	Crystal Palace	4	5-car 378	20	37 (seats only) or 141 (with standing allowance)	2,820
	New Cross	4	5-car 378	20	37 (seats only) or 141 (with standing allowance)	2,820
	West Croydon	4	5-car 378	20	37 (seats only) or 141 (with standing allowance)	2,820
Total		16		80		11,280

Figure A14 – Planned CP5 high-peakorbital capacity on the West London Line.

Route	Service Group	Number of train services	Passenger vehicles per train & Rolling stock type	Total passenger vehicles	Average capacity per passenger vehicle	Total capacity
West London Line	Clapham Junction to Stratford	4	5-car 378	20	37 (seats only) or 141 (with standing allowance)	2,810
	South Croydon to Milton Keynes Central, Clapham Junction to Watford Junction and Clapham Junction to Shepherds Bush shuttles	4	8-car 377	32	60 (seats only) or 99 (with standing allowance)	3,056
Total		8		52		5,866

The choices identified for the next Control Period (CP6, commencing April 2019) have been categorised from a financial and socio-economic perspective.

In the context of the financial perspective, CP6 choices have been categorised into those that:

(a) worsen the rail industry's net operating position (in other words, the additional operating costs exceed the value of revenue generated); or

(b) choices which improve the industry's net operating position. For these schemes, the Route Study also indicates the extent to which this improvement is able to cover the capital cost of the initial investment.

The choices have also been appraised from a wider 'socio-economic' perspective, which compares the value of benefits to users and non-users to the net financial cost to funders. The appraisals have been conducted in line with funders' guidelines, in particular WebTag; the Department for Transport's appraisal guidelines.

Anticipated final costs (AFCs) have been displayed as ranges to reflect that the estimates produced through engineering feasibility assessments are pre: GRIP (Governance for Railway Investment Projects). If the option is progressed into GRIP, a more defined AFC will emerge.

Fixed bands have been used to express potential cost ranges. For example, if an option currently has an estimated price of £610m, it will currently be listed as £500m - £1.25bn. Whilst this means that some options will have their 'potential' price significantly over or under stated against the current estimate, it is felt this wide range approach is most appropriate at this early state of development. In all cases costs indicated are intended as a rough guide only and further, more detailed, work is now underway to provide more accurate costings for the IIP.

Option S1i Additional services on the Brighton Main Line to London Bridge and London Victoria.	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath slow via Redhill 1 x Haywards Heath fast 1 x Hove fast To London Bridge 1 x Eastbourne 1 x Hove fast
Infrastructure requirement	London Victoria station, Windmill Bridge, East Croydon station, Stoats Nest, Redhill, Reigate station, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield and Hove. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement. Anticipated Final Cost (AFC): £500M-£1,250M
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity to for stations on the Brighton Main Line.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: Medium BCR = 1.9 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Low capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT 2011) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs • A sensitivity test has been completed to demonstrate the case when GRIP 2 optimism bias is applied. Analysis has already been completed in the form of a diagramming exercise to understand the operating costs of the option. Therefore the results of the sensitivity test may be a better reflection of the VfM of the option.

Option S1i: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (>100%)	No	

Option S1i: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	882.86
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	124.48
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	21.74
	Rail user and non-user disruption benefits during possessions	-45.02
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-124.40
	sub-total (a)	**859.66**
Costs to government (broad transport budget)		
	Capital costs (c)	597.89
	Non-user benefits - road/infrastructure cost changes	-1.00
	Revenue transfer*	-656.76
	NR operating costs and TOC operating costs transfer**	720.36
	sub-total (b)	**660.49**
Net Present Value (NPV) (a-b)		**199.17**
Benefit Cost Ratio (BCR) (a/b)		**1.30**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.11*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		656.76
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		720.36

Option S1ii Additional services on the Brighton Main Line to London Bridge and London Victoria.	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak (08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath slow via Redhill 1 x Haywards Heath fast 1 x Hove fast To London Bridge 1 x Eastbourne 1 x Hove fast
Infrastructure requirement	London Victoria station, Windmill Bridge, Clapham Junction, East Croydon station, Stoats Nest, Redhill, Reigate station, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield and Hove. AFC: £875M-£1,975M
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity for stations on the Brighton Main Line
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: Low BCR = 1.4 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Low capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs.

Option S1ii: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S1ii: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	882.86
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	124.48
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	21.74
	Rail user and non-user disruption benefits during possessions	-56.58
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-124.40
	sub-total (a)	**848.11**
Costs to government (broad transport budget)		
	Capital costs (c)	751.34
	Non-user benefits - road/infrastructure cost changes	-1.00
	Revenue transfer*	-656.76
	NR operating costs and TOC operating costs transfer**	720.36
	sub-total (b)	**813.94**
Net Present Value (NPV) (a-b)		**34.17**
Benefit Cost Ratio (BCR) (a/b)		**1.04**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.08*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		656.76
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		720.36

Option S2i Additional services on the Brighton Main Line to London Bridge and London Victoria.	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath fast 2 x Haywards Heath slow via Redhill To London Bridge 2 x Haywards Heath fast
Infrastructure requirement	London Victoria station, Windmill Bridge, East Croydon station, Stoats Nest, Redhill, Reigate station, Gatwick Airport and Haywards Heath. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement. AFC: £375M-£875M.
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity for stations on the Brighton Main Line
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low/Medium
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: High BCR = 2.4 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Low capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT 2011) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs • A sensitivity test has been completed to demonstrate the case when GRIP 2 optimism bias is applied. Analysis has already been completed in the form of a diagramming exercise to understand the operating costs of the option. Therefore the results of the sensitivity test may be a better reflection of the VfM of the option.

Option S2i: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low/Medium
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S2i: Summary results of socio-economic appraisal (60 year appraisal)	
30 year appraisal	£m (PV)
Net benefits to consumers and private sector (plus tax impacts)	
Rail user reliability benefits	0.00
Rail user journey time benefits	701.65
Journey ambiance inc. station amenity	0.00
Non user benefits - road decongestion	104.08
Non user benefits - noise, air quality, greenhouse gases & accident benefits	18.19
Rail user and non-user disruption benefits during possessions	-31.31
Current TOC revenue benefits*	0.00
Current TOC operating costs**	0.00
Indirect taxation impact on government	-109.31
sub-total (a)	**683.30**
Costs to government (broad transport budget)	
Capital costs (c)	415.76
Non-user benefits - road/infrastructure cost changes	-0.83
Revenue transfer*	-574.39
NR operating costs and TOC operating costs transfer**	620.23
sub-total (b)	**460.77**
Net Present Value (NPV) (a-b)	**222.54**
Benefit Cost Ratio (BCR) (a/b)	**1.48**
Commercial BCR to Government (CBCR) ((d-e)/c)	*-0.11*
Notes:	
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)	574.39
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)	620.23

Option S2ii Additional services on the Brighton Main Line to London Bridge and London Victoria	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath fast 2 x Haywards Heath slow via Redhill To London Bridge 2 x Haywards Heath fast
Infrastructure requirement	London Victoria station, Windmill Bridge, Clapham Junction, East Croydon station, Stoats Nest, Redhill, Reigate station, Gatwick Airport and Haywards Heath AFC: £500M-£1,250M
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity for stations on the Brighton Main Line.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: Medium BCR = 1.5 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Low capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT 2011) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs • A sensitivity test has been completed to demonstrate the case when GRIP 2 optimism bias is applied. Analysis has already been completed in the form of a diagramming exercise to understand the operating costs of the option. Therefore the results of the sensitivity test may be a better reflection of the VfM of the option.

Option S2ii: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S2ii: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	701.65
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	104.08
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	18.19
	Rail user and non-user disruption benefits during possessions	-42.86
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-109.31
	sub-total (a)	**671.75**
Costs to government (broad transport budget)		
	Capital costs (c)	569.21
	Non-user benefits - road/infrastructure cost changes	-0.83
	Revenue transfer*	-574.39
	NR operating costs and TOC operating costs transfer**	620.23
	sub-total (b)	**614.21**
Net Present Value (NPV) (a-b)		**57.53**
Benefit Cost Ratio (BCR) (a/b)		**1.09**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.08*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		574.39
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		620.23

Option S3i Additional services on the Brighton Main Line to London Bridge and London Victoria	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath fast 2 x Haywards Heath slow via Redhill To London Bridge 2 x Haywards Heath fast
Infrastructure requirement	London Victoria station, Windmill Bridge, East Croydon station, Stoats Nest, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield and Hove. ETCS ATO has been assumed to replace Clapham Junction infrastructure requirement. AFC: £500M-£1,250M
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity for stations on the Brighton Main Line.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low/Medium
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: High BCR = 2.3 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Medium capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT 2011) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs • A sensitivity test has been completed to demonstrate the case when GRIP 2 optimism bias is applied. Analysis has already been completed in the form of a diagramming exercise to understand the operating costs of the option. Therefore the results of the sensitivity test may be a better reflection of the VfM of the option.

Option S3i: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		X	Medium
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S3i: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	817.34
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	122.21
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	21.37
	Rail user and non-user disruption benefits during possessions	-40.71
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-124.66
	sub-total (a)	**795.56**
Costs to government (broad transport budget)		
	Capital costs (c)	540.57
	Non-user benefits - road/infrastructure cost changes	-0.98
	Revenue transfer*	-655.15
	NR operating costs and TOC operating costs transfer**	651.81
	sub-total (b)	**536.25**
Net Present Value (NPV) (a-b)		**259.31**
Benefit Cost Ratio (BCR) (a/b)		**1.48**
Commercial BCR to Government (CBCR) ((d-e)/c)		*0.01*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		655.15
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		651.81

Option S3ii Additional services on the Brighton Main Line to London Bridge and London Victoria.	
Conditional Output	CO1 (2043) – To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – Brighton Main Line fast services. CO6 (2023) – Consistent with the longer term strategy identified to meet CO1, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Brighton Main Line fast services
Timeframe	CP6 to 2043
Purpose	To accommodate estimated 2023 and 2043 demand and reduce on-train crowding on services into London Bridge and London Victoria. High growth forecasts established in the London and South East Market Study indicate that the high peak hour(08.00-08.59) arrivals into London Bridge and London Victoria will grow significantly resulting in passengers having to stand from as far out as Haywards Heath (approximately 43 minutes from London termini). This scheme provides the capacity required to meet 2023 and 2043 demand and reduce on-train crowding.
Description	The scheme will deliver +4tph to London (+2tph London Bridge, +2tph London Victoria) in 2024, an additional +2tph to London Victoria provided at 2033. Starting location of services: To London Victoria 2 x Haywards Heath fast 2 x Haywards Heath slow via Redhill To London Bridge 2 x Haywards Heath fast
Infrastructure requirement	London Victoria station, Windmill Bridge, East Croydon station, Stoats Nest, Gatwick Airport, Haywards Heath, Keymer Junction/Wivlesfield and Hove. AFC: £875M-£1,975M
Operational requirement	New train diagrams to operate four 12-car services in 2024 and a further two 12-car services in 2033.
Passenger impact	An additional 48 vehicles in 2024 and a further 24 vehicles provided in 2033 in each hour of the morning and afternoon peak to help relieve crowding. Improved peak connectivity for stations on the Brighton Main Line.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	VfM Categorisation: Medium BCR = 1.5 (OPEX optimism bias at GRIP 2) Rail industry financial impact = Decreases operating subsidies (Low capital cost coverage)
Note	• The additional services enabled by the schemes are built on top of Development Timetable 2011 (DTT 2011) as the base timetable. It remains possible that Network Rail may decide that some elements of DTT 2011 e.g. the uplift from 16tph to 18tph on the fast lines into Victoria are only achievable (with acceptable performance) with some of the additional infrastructure outlined above. • The journey time benefits of avoiding splitting and joining practices on Coastway services at Haywards Heath in the off-peak have been included. • Performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this. • The cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process. • The cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs • A sensitivity test has been completed to demonstrate the case when GRIP 2 optimism bias is applied. Analysis has already been completed in the form of a diagramming exercise to understand the operating costs of the option. Therefore the results of the sensitivity test may be a better reflection of the VfM of the option.

Option S3ii: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		X	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S3ii: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	817.34
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	122.21
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	21.37
	Rail user and non-user disruption benefits during possessions	-52.26
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-124.66
	sub-total (a)	**784.01**
Costs to government (broad transport budget)		
	Capital costs (c)	694.02
	Non-user benefits - road/infrastructure cost changes	-0.98
	Revenue transfer*	-655.15
	NR operating costs and TOC operating costs transfer**	651.81
	sub-total (b)	**689.70**
Net Present Value (NPV) (a-b)		**94.31**
Benefit Cost Ratio (BCR) (a/b)		**1.14**
Commercial BCR to Government (CBCR) ((d-e)/c)		*0.00*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		655.15
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		651.81

Option S4 – Wimbledon Loop +2tph high peak service to London Bridge (clockwise).	
Conditional Output	CO7 (2023) - To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Bridge suburban services
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on services into London Bridge on the Tulse Hill service group. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge via Tulse Hill will continue to be congested. This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding.
Description	To provide a 2tph service in each direction on the Wimbledon Loop to London Bridge in the high peak hour.
Infrastructure requirement	Planned CP5 enhancements to signal spacing as part of signal interlocking renewals in 2015/16 on the southern end of the loop assumed in the baseline. Further infrastructure requirements to be investigated after performance modelling.
Operational requirement	16 vehicles in the high peak hour.
Passenger impact	Improved connectivity on the Wimbledon Loop with a doubled service to London in the high peak. An additional 16 vehicles in the high peak hour to help relieve crowding.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	Providing an additional 2tph represents a significant performance risk.

Option S4: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S4: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	41.82
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	1.34
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.24
	Rail user and non-user disruption benefits during possessions	0.00
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-0.94
	sub-total (a)	**42.46**
Costs to government (broad transport budget)		
	Capital costs (c)	0.00
	Non-user benefits - road/infrastructure cost changes	-0.01
	Revenue transfer*	-11.62
	NR operating costs and TOC operating costs transfer**	44.66
	sub-total (b)	**33.03**
Net Present Value (NPV) (a-b)		**9.44**
Benefit Cost Ratio (BCR) (a/b)		**1.29**
Commercial BCR to Government (CBCR) ((d-e)/c)		*N/A*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		11.62
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		44.66

Option S5 – 10-car suburban lengthening on the Tulse Hill corridor.	
Conditional Output	CO7 (2023) - To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Bridge suburban services
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on services into London Bridge on the Tulse Hill service group. High growth forecasts established in the London and South East Market Study indicate that the high peak hour (08.00-08.59) arrivals into London Bridge via Tulse Hill will continue to be congested. This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding.
Description	To lengthen services on the Tulse Hill corridor to 10-car to meet peak passenger demand into London Bridge. Selective Door Opening to be utilised on several stations on the Wimbledon Loop.
Infrastructure requirement	Infrastructure interventions at 10 stations on the Tulse Hill corridor: Beckenham Junction, Birkbeck Station, East Dulwich, North Dulwich, Peckham Rye, Queens Road Peckham, South Bermondsey, Streatham, Tulse Hill and Wimbledon.
Operational requirement	12 vehicles in the high peak hour.
Passenger impact	An additional 12 vehicles in the high peak hour to help relieve crowding.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	

Option S5: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S5: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	26.90
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion , noise, air quality, greenhouse gases & accident benefits	1.43
	Rail user and non-user disruption benefits during possessions	-9.55
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	0.00
	sub-total (a)	**18.78**
Costs to government (broad transport budget)		
	Capital costs (c)	126.84
	Non-user benefits - road/infrastructure cost changes	-0.01
	Revenue transfer*	-9.42
	NR operating costs and TOC operating costs transfer**	36.35
	sub-total (b)	**153.76**
Net Present Value (NPV) (a-b)		**-134.98**
Benefit Cost Ratio (BCR) (a/b)		**0.12**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.21*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		9.42
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		36.35

Option S6 – East London Line +2tph peak service from Crystal Palace	
Conditional Output	CO10 (2023) - Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on the East London Line at the busiest point on the route (Surrey Quays to Canada Water). Transport for London (TfL) forecasts for the East London Line expect the crowding problem to deteriorate further especially on services which start at Crystal Palace and West Croydon. This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding..
Description	To provide an additional two trains from Crystal Palace on the East London Line (on top of 4tph currently running).
Infrastructure requirement	None identified– subject to power supply analysis and any depot and stabling implications
Operational requirement	New train diagrams to operate an additional 2tph on the East London Line.
Passenger impact	Improved connectivity on the East London Line, and an additional 30 vehicles in the morning and afternoon peak to help reduce crowding.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	High
Rail industry financial categorisation	Increases operating subsidies
Sensitivity check	N/A
Note	Potential issues with: • Future changes to new franchise suburban timetable causing conflicts • Availability of empty rolling stock paths • Timetable planning rules regarding platform re-occupation at East London Line core stations, e.g. Canada Water and Whitechapel.

Option S6: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	High
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)		

Option S6: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	69.98
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion , noise, air quality, greenhouse gases & accident benefits	5.07
	Rail user and non-user disruption benefits during possessions	0.00
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-2.02
	sub-total (a)	**73.04**
Costs to government (broad transport budget)		
	Capital costs (c)	0.00
	Non-user benefits - road/infrastructure cost changes	-0.02
	Revenue transfer*	-11.44
	NR operating costs and TOC operating costs transfer**	42.13
	sub-total (b)	**30.67**
Net Present Value (NPV) (a-b)		**42.37**
Benefit Cost Ratio (BCR) (a/b)		**2.38**
Commercial BCR to Government (CBCR) ((d-e)/c)		*N/A*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		11.44
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		42.13

Option S7 – East London Line +2tph peak service from West Croydon	
Conditional Output	CO10 (2023) - Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on the East London Line at the busiest point on the route (Surrey Quays to Canada Water). TfL forecasts for the East London Line expect the crowding problem to deteriorate further especially on the Crystal Palace and West Croydon starters. This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding..
Description	To provide an additional two services from West Croydon to the East London Line (on top of 4tph currently running).
Infrastructure requirement	Interventions required at West Croydon Station and Gloucester Road junction. Also subject to power supply analysis and any depot and stabling implications. AFC: £50M-£100M
Operational requirement	New train diagrams to operate an additional 2tph on the East London Line.
Passenger impact	Improved connectivity on the East London Line, and an additional 30 vehicles in the morning and afternoon peak to help reduce crowding.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	Low/Medium
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	Potential issues with: • Future changes to new franchise suburban timetable causing conflicts • Availability of empty rolling stock paths • Timetable planning rules regarding platform re-occupation at East London Line core stations, e.g. Canada Water and Whitechapel.

Option S7: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low/Medium
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S7: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	136.14
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion , noise, air quality, greenhouse gases & accident benefits	14.24
	Rail user and non-user disruption benefits during possessions	-6.88
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-3.36
	sub-total (a)	**140.15**
Costs to government (broad transport budget)		
	Capital costs (c)	55.04
	Non-user benefits - road/infrastructure cost changes	-0.04
	Revenue transfer*	-17.56
	NR operating costs and TOC operating costs transfer**	56.95
	sub-total (b)	**94.38**
Net Present Value (NPV) (a-b)		**45.77**
Benefit Cost Ratio (BCR) (a/b)		**1.48**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.72*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		17.56
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		56.95

Option S8 – Wimbledon Loop +2tph all day service to London Bridge (clockwise)	
Conditional Output	CO7 (2023) - To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 – London Bridge suburban services CO11 - To provide a minimum of three of four trains per hour for stations within 30 miles from London: Stations on the Wimbledon Loop
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on services into London Bridge on the Tulse Hill service group. High growth forecasts established in the London and South East Market Study indicate that the high peak (08.00-08.59) arrivals into London Bridge via Tulse Hill will continue to be congested. This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding. In addition to relieving crowding the option seeks to meet the connectivity conditional output of providing greater than 3tph service to London in the off-peak.
Description	To provide a 2tph service in each direction on the Wimbledon Loop to London Bridge all day.
Infrastructure requirement	Planned CP5 enhancements to signal spacing as part of signal interlocking renewals in 2015/16 on the southern end of the loop assumed in the baseline. Further infrastructure requirements to be investigated after performance modelling.
Operational requirement	New train diagrams to operate an additional 2tph all day.
Passenger impact	Improved all day connectivity on the Wimbledon Loop with a doubled service to London. An additional 48 vehicles in the three peak hours to help relieve crowding.
Freight impact	None
Relates to other options	None
Socio-economic value for money categorisation	High
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	Due to constraints at London Bridge operating an additional 2tph service into London Bridge while operationally possible, represents a significant performance risk. From an operational point of view it would be better to terminate these services at Blackfriars Bays (Platforms 3 & 4)..

Option S8: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	High
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)		

Option S8: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.00
	Rail user journey time benefits	127.65
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	4.56
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.82
	Rail user and non-user disruption benefits during possessions	0.00
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-5.52
	sub-total (a)	**127.51**
Costs to government (broad transport budget)		
	Capital costs (c)	0.00
	Non-user benefits - road/infrastructure cost changes	-0.04
	Revenue transfer*	-36.44
	NR operating costs and TOC operating costs transfer**	91.78
	sub-total (b)	**55.30**
Net Present Value (NPV) (a-b)		**72.21**
Benefit Cost Ratio (BCR) (a/b)		**2.31**
Commercial BCR to Government (CBCR) ((d-e)/c)		*N/A*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		36.44
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		91.78

Option S9 – Arundel Chord, double track embankment	
Conditional Output	To improve resilience in times of perturbation on the Brighton Main Line.
Timeframe	CP6
Purpose	To provide a diversionary route for the Brighton Main Line to reduce the impact of delays for passengers between Three Bridges and Brighton during periods of extreme perturbation.
Description	The Chord will provide a diversionary route for Brighton Main Line services travelling between London and Brighton. The chord will remove the need to reverse services at Littlehampton or Ford, reducing diversion journey times for passengers. The chord could also be utilised to implement a new 1tph Brighton to Horsham service in the off-peak.
Infrastructure requirement	Option S9 is to build a 1.04km single track embankment chord. AFC: £35-75M
Operational requirement	New train diagrams to operate an additional 1tph 3-car service in the off-peak. (Rolling stock has been assumed to be sourced from existing fleet).
Passenger impact	Diversions around the chord would reduce journey times by 20 minutes per passenger when compared against reversing at Littlehampton or Ford. A new off-peak service between Brighton to Horsham in the off-peak.
Freight impact	None
Relates to other options	Brighton to Bournemouth and Brighton to Bristol cross-boundary analysis.
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	The constraints of platform availability at Brighton plus the lack of any additional paths being available between Sutton and London in the peak for trains constrict the number of services that can be diverted in times of perturbation. In addition the off-peak proposals to extend existing London Victoria – Horsham services to Brighton via Pulborough were found to deliver poorer journey times than Horsham to Brighton changing at Three Bridges..

Option S9: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S9: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.13
	Rail user journey time benefits	22.41
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	2.35
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.41
	Rail user and non-user disruption benefits during possessions	-3.43
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-1.45
	sub-total (a)	**20.41**
Costs to government (broad transport budget)		
	Capital costs (c)	45.51
	Non-user benefits - road/infrastructure cost changes	-0.02
	Revenue transfer*	-7.72
	NR operating costs and TOC operating costs transfer**	33.17
	sub-total (b)	**70.94**
Net Present Value (NPV) (a-b)		**-50.52**
Benefit Cost Ratio (BCR) (a/b)		**0.29**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.56*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		7.72
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		33.17

Option S10 – Arundel Chord, single track embankment	
Conditional Output	To improve resilience in times of perturbation on the Brighton Main Line.
Timeframe	CP6
Purpose	To provide a diversionary route for the Brighton Main Line to reduce the impact of delays for passengers between Three Bridges and Brighton during periods of extreme perturbation.
Description	The Chord will provide a diversionary route for Brighton Main Line services travelling between London and Brighton. The chord will remove the need to reverse services at Littlehampton or Ford, reducing diversion journey times for passengers. The chord could also be utilised to implement a new 1tph Brighton to Horsham service in the off-peak.
Infrastructure requirement	Option S10 is to build a 1.04km single track embankment chord. AFC: £35-75M
Operational requirement	New train diagrams to operate an additional 1tph 3-car service in the off-peak. (Rolling stock has been assumed to be sourced from existing fleet).
Passenger impact	Diversions around the chord would reduce journey times by 20 minutes per passenger when compared against reversing at Littlehampton or Ford. A new off-peak service between Brighton to Horsham in the off-peak.
Freight impact	None
Relates to other options	Brighton to Bournemouth and Brighton to Bristol cross-boundary analysis.
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	The constraints of platform availability at Brighton plus the lack of any additional paths being available between Sutton and London in the peak for trains constrict the number of services that can be diverted in times of perturbation. In addition the off-peak proposals to extend existing London Victoria – Horsham services to Brighton via Pulborough were found to deliver poorer journey times than Horsham to Brighton changing at Three Bridges.

Option S10: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S10: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.13
	Rail user journey time benefits	22.41
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	2.35
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.41
	Rail user and non-user disruption benefits during possessions	-3.31
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-1.45
	sub-total (a)	**20.53**
Costs to government (broad transport budget)		
	Capital costs (c)	43.90
	Non-user benefits - road/infrastructure cost changes	-0.02
	Revenue transfer*	-7.72
	NR operating costs and TOC operating costs transfer**	33.17
	sub-total (b)	**69.33**
Net Present Value (NPV) (a-b)		**-48.80**
Benefit Cost Ratio (BCR) (a/b)		**0.30**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.58*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		7.72
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		33.17

Option S11 – Arundel Chord, double track viaduct	
Conditional Output	To improve resilience in times of perturbation on the Brighton Main Line.
Timeframe	CP6
Purpose	To provide a diversionary route for the Brighton Main Line to reduce the impact of delays for passengers between Three Bridges and Brighton during periods of extreme perturbation.
Description	The Chord will provide a diversionary route for Brighton Main Line services travelling between London and Brighton. The chord will remove the need to reverse services at Littlehampton or Ford, reducing diversion journey times for passengers. The chord could also be utilised to implement a new 1tph Brighton to Horsham service in the off-peak.
Infrastructure requirement	Option S10 is to build a 1.04km single track embankment chord. AFC: £35-75M
Operational requirement	New train diagrams to operate an additional 1tph 3-car service in the off-peak. (Rolling stock has been assumed to be sourced from existing fleet).
Passenger impact	Diversions around the chord would reduce journey times by 20 minutes per passenger when compared against reversing at Littlehampton or Ford. A new off-peak service between Brighton to Horsham in the off-peak.
Freight impact	None
Relates to other options	Brighton to Bournemouth and Brighton to Bristol cross-boundary analysis.
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	The constraints of platform availability at Brighton plus the lack of any additional paths being available between Sutton and London in the peak for trains constrict the number of services that can be diverted in times of perturbation. In addition the off-peak proposals to extend existing London Victoria – Horsham services to Brighton via Pulborough were found to deliver poorer journey times than Horsham to Brighton changing at Three Bridges.

Option S11: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S11: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.13
	Rail user journey time benefits	22.41
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	2.35
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.41
	Rail user and non-user disruption benefits during possessions	-4.19
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-1.45
	sub-total (a)	**19.65**
Costs to government (broad transport budget)		
	Capital costs (c)	55.65
	Non-user benefits - road/infrastructure cost changes	-0.02
	Revenue transfer*	-7.72
	NR operating costs and TOC operating costs transfer**	33.17
	sub-total (b)	**81.08**
Net Present Value (NPV) (a-b)		**-61.43**
Benefit Cost Ratio (BCR) (a/b)		**0.24**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.46*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		7.72
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		33.17

Option S12 – Arundel Chord, single track viaduct	
Conditional Output	To improve resilience in times of perturbation on the Brighton Main Line.
Timeframe	CP6
Purpose	To provide a diversionary route for the Brighton Main Line to reduce the impact of delays for passengers between Three Bridges and Brighton during periods of extreme perturbation.
Description	The Chord will provide a diversionary route for Brighton Main Line services travelling between London and Brighton. The chord will remove the need to reverse services at Littlehampton or Ford, reducing diversion journey times for passengers. The chord could also be utilised to implement a new 1tph Brighton to Horsham service in the off-peak.
Infrastructure requirement	Option S10 is to build a 1.04km single track embankment chord. AFC: £35-75M
Operational requirement	New train diagrams to operate an additional 1tph 3-car service in the off-peak. (Rolling stock has been assumed to be sourced from existing fleet).
Passenger impact	Diversions around the chord would reduce journey times by 20 minutes per passenger when compared against reversing at Littlehampton or Ford. A new off-peak service between Brighton to Horsham in the off-peak.
Freight impact	None
Relates to other options	Brighton to Bournemouth and Brighton to Bristol cross-boundary analysis.
Socio-economic value for money categorisation	Low
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	The constraints of platform availability at Brighton plus the lack of any additional paths being available between Sutton and London in the peak for trains constrict the number of services that can be diverted in times of perturbation. In addition the off-peak proposals to extend existing London Victoria – Horsham services to Brighton via Pulborough were found to deliver poorer journey times than Horsham to Brighton changing at Three Bridges..

Option S12: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)	No	

Option S12: Summary results of socio-economic appraisal (60 year appraisal)		
30 year appraisal		£m (PV)
Net benefits to consumers and private sector (plus tax impacts)		
	Rail user reliability benefits	0.13
	Rail user journey time benefits	22.41
	Journey ambiance inc. station amenity	0.00
	Non user benefits - road decongestion	2.35
	Non user benefits - noise, air quality, greenhouse gases & accident benefits	0.41
	Rail user and non-user disruption benefits during possessions	-3.91
	Current TOC revenue benefits*	0.00
	Current TOC operating costs**	0.00
	Indirect taxation impact on government	-1.45
	sub-total (a)	**19.93**
Costs to government (broad transport budget)		
	Capital costs (c)	51.90
	Non-user benefits - road/infrastructure cost changes	-0.02
	Revenue transfer*	-7.72
	NR operating costs and TOC operating costs transfer**	33.17
	sub-total (b)	**77.33**
Net Present Value (NPV) (a-b)		**-57.40**
Benefit Cost Ratio (BCR) (a/b)		**0.26**
Commercial BCR to Government (CBCR) ((d-e)/c)		*-0.49*
Notes:		
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)		7.72
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)		33.17

Option WLL – West London Line +2tph all day service from Stratford to Clapham Junction	
Conditional Output	CO10 (2023) - Consistent with the longer term strategy identified to meet CO4, to provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) – Orbital services (East and West London Lines)
Timeframe	CP6
Purpose	To accommodate estimated 2023 demand and reduce on-train crowding on the West London and North London Line at the busiest points on the route (Dalston and Highbury and between Kensington Olympia and Shepherds Bush). This scheme provides the capacity required to meet 2023 demand and reduce on-train crowding.
Description	To provide an additional two trains from Stratford to Clapham Junction on the West London Line (on top of 4tph currently running).
Infrastructure requirement	Additional platform capacity is required at Clapham Junction to accommodate the additional two trains. This could be accommodated through operational changes, or the re-opening of Platform 0. AFC: £50-100M
Operational requirement	New train diagrams to operate an additional 2tph 5-car service all day.
Passenger impact	There is standing on all peak trains on the North and West London Lines, trains are particularly busy between Dalston and Highbury and between Kensington Olympia and Shepherds Bush. Additional services will strengthen services over and above the capacity delivered through lengthening from 4 to 5-car.
Freight impact	Running services in the off peak could limit the available capacity for freight services.
Relates to other options	None
Socio-economic value for money categorisation	Medium/High
Rail industry financial categorisation	Increases operating subsidies
Sensitivity test	N/A
Note	This option offers medium to high value for money depending on the cost of providing platform capacity at Clapham Junction. The analysis of benefits, revenue and operating costs has bene completed by Transport for London; Network Rail has assessed the cost of the additional platform capacity and included this in the appraisal. This is a 30 year appraisal. Future iterations should include the PV of benefits and operating costs over 60 years. This is likely to improve the case further.

Option WLL: Financial and socio-economic categorisation			
Rail industry financial impact (Categorisation of Revenue, Operating costs, and Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R - O < 0)		✓	Medium/High
Scheme decreases operating subsidies (i.e. R - O > 0)	Low capital cost coverage (i.e. (R - O) / C < 33%	N/A	
	Medium capital cost coverage (33 – 66%)	N/A	
	High capital cost coverage (66 – 100%)	N/A	
	Positive financial case (> 100%)		

Option WLL: Summary results of socio-economic appraisal (60 year appraisal)	Low Cost	High Cost	No Cost
30 year appraisal	£m (PV)	£m (PV)	£m (PV)
Net benefits to consumers and private sector (plus tax impacts)			
Rail user reliability benefits	0.00	0.00	0.00
Rail user journey time benefits	286.51	286.51	286.51
Journey ambiance inc. station amenity	0.00	0.00	0.00
Non user benefits - road decongestion	53.17	53.17	53.17
Non user benefits - noise, air quality, greenhouse gases & accident benefits	3.24	3.24	3.24
Rail user and non-user disruption benefits during possessions	0.00	0.00	0.00
Current TOC revenue benefits*	0.00	0.00	0.00
Current TOC operating costs**	0.00	0.00	0.00
Indirect taxation impact on government	0.00	0.00	0.00
sub-total (a)	**342.92**	**342.92**	**342.92**
Costs to government (broad transport budget)			
Capital costs (c)	47.02	88.15	0.00
Non-user benefits - road/infrastructure cost changes	-6.89	-6.89	-6.89
Revenue transfer*	-19.84	-19.84	-19.84
NR operating costs and TOC operating costs transfer**	131.46	131.46	131.46
sub-total (b)	**151.74**	**192.88**	**104.73**
Net Present Value (NPV) (a-b)	**191.18**	**150.04**	**238.19**
Benefit Cost Ratio (BCR) (a/b)	**2.26**	**1.78**	**3.27**
Commercial BCR to Government (CBCR) ((d-e)/c)	*-3.22*	*-1.72*	*N/A*
Notes:			
*Total revenue benefits = revenue benefits to private sector + revenue transfer to government (d)	-19.84	-19.84	-19.84
**Total change in operating costs = change in operating costs to private sector + change in operating cost transfer to government (e)	131.46	131.46	131.46

Appendix B: Summary schematic drawings of layout options in Chapter 5

This Appendix has been split into two to reflect the schemes that are currently under development for CP6 delivery and those which are to be developed for delivery in CP7 and beyond.

CP6 schemes currently under development:

- Victoria Platform 8 access and reversible working
- Windmill Bridge Junction and East Croydon interventions
- Coulsdon North grade separated junction
- Reigate 12-car platforms
- Gatwick Airport track layout changes
- Haywards Heath turnback

Schemes for further development for CP7 and beyond:

- Clapham Junction
- Redhill South Junction
- Wivelsfield & Keymer Junction
- Hove
- Gatwick Airport (potential long term option)

Figure B1 - Victoria to Battersea Park Interventions

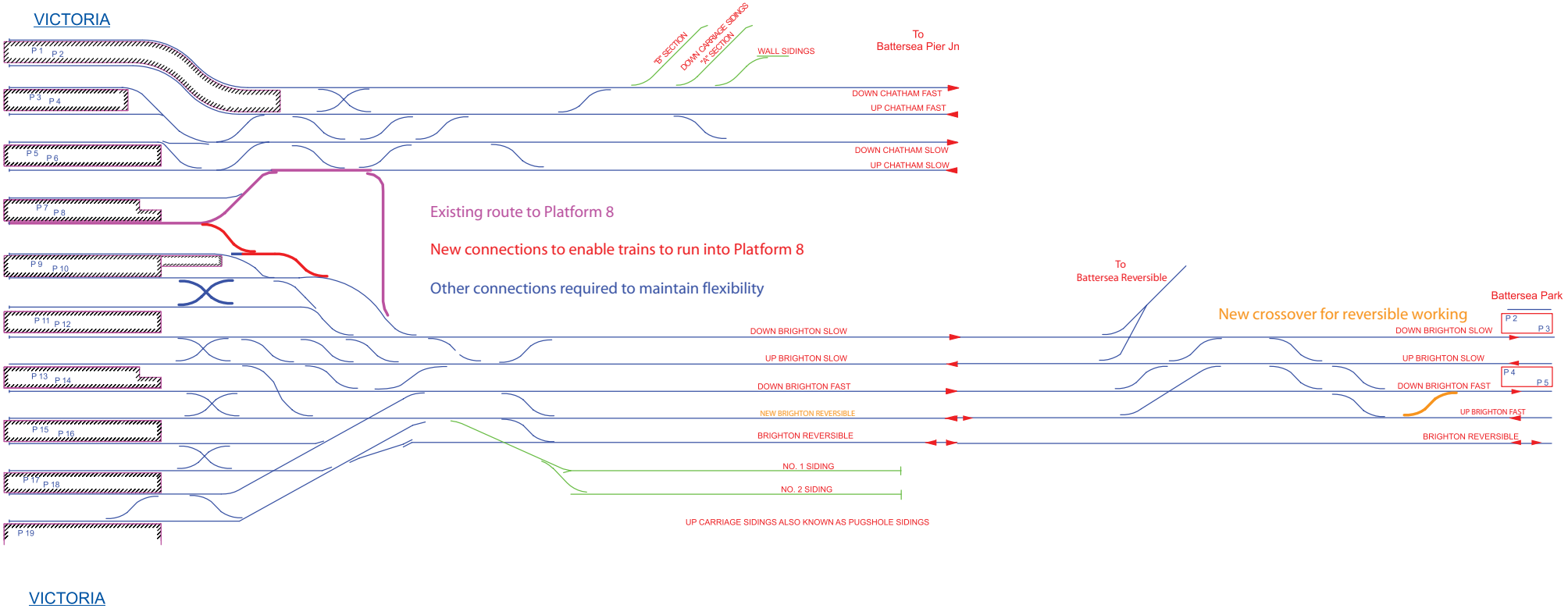


Figure B2 - Windmill Bridge and East Croydon Interventions

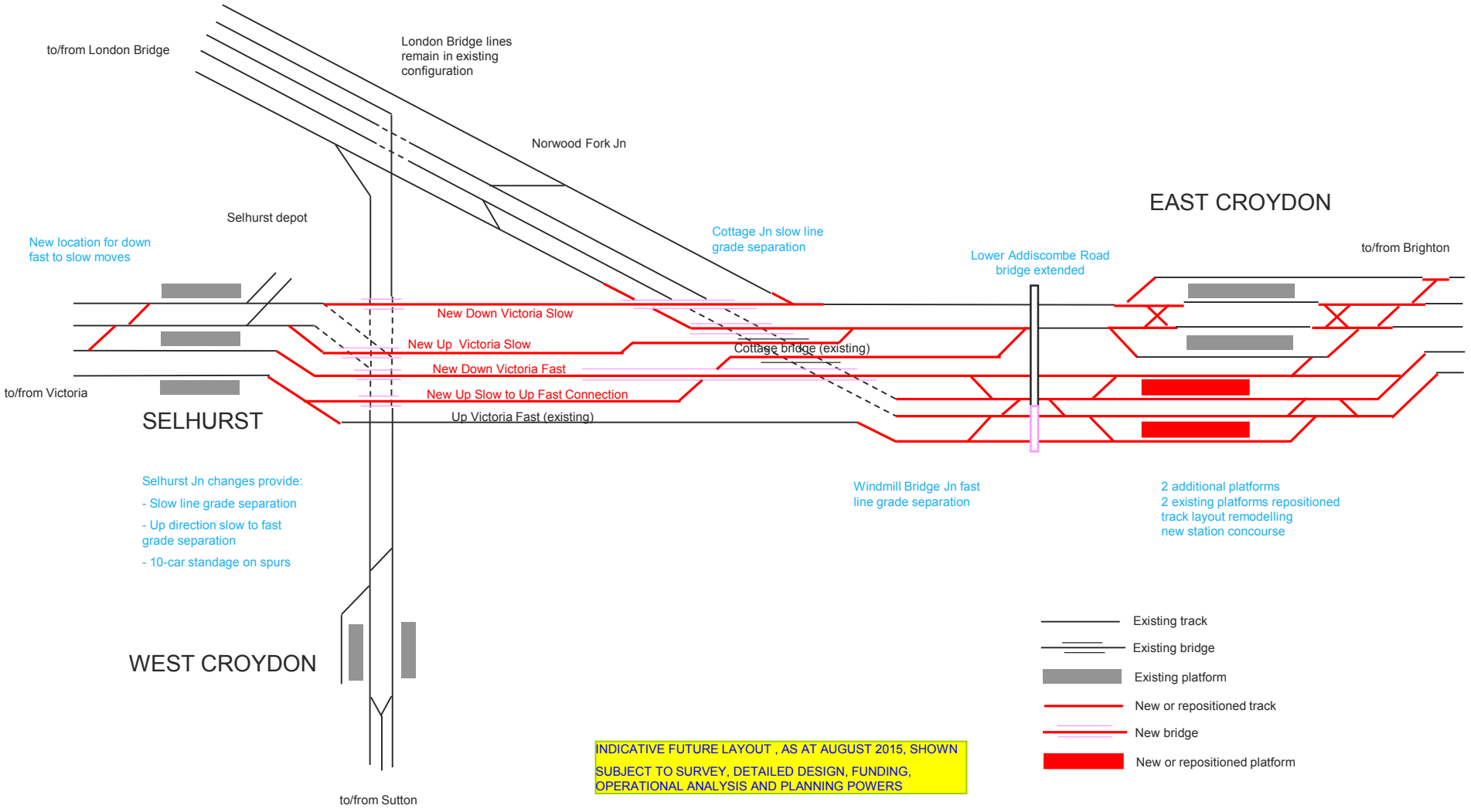


Figure B3 - Coulsdon North Grade Seperated Junction

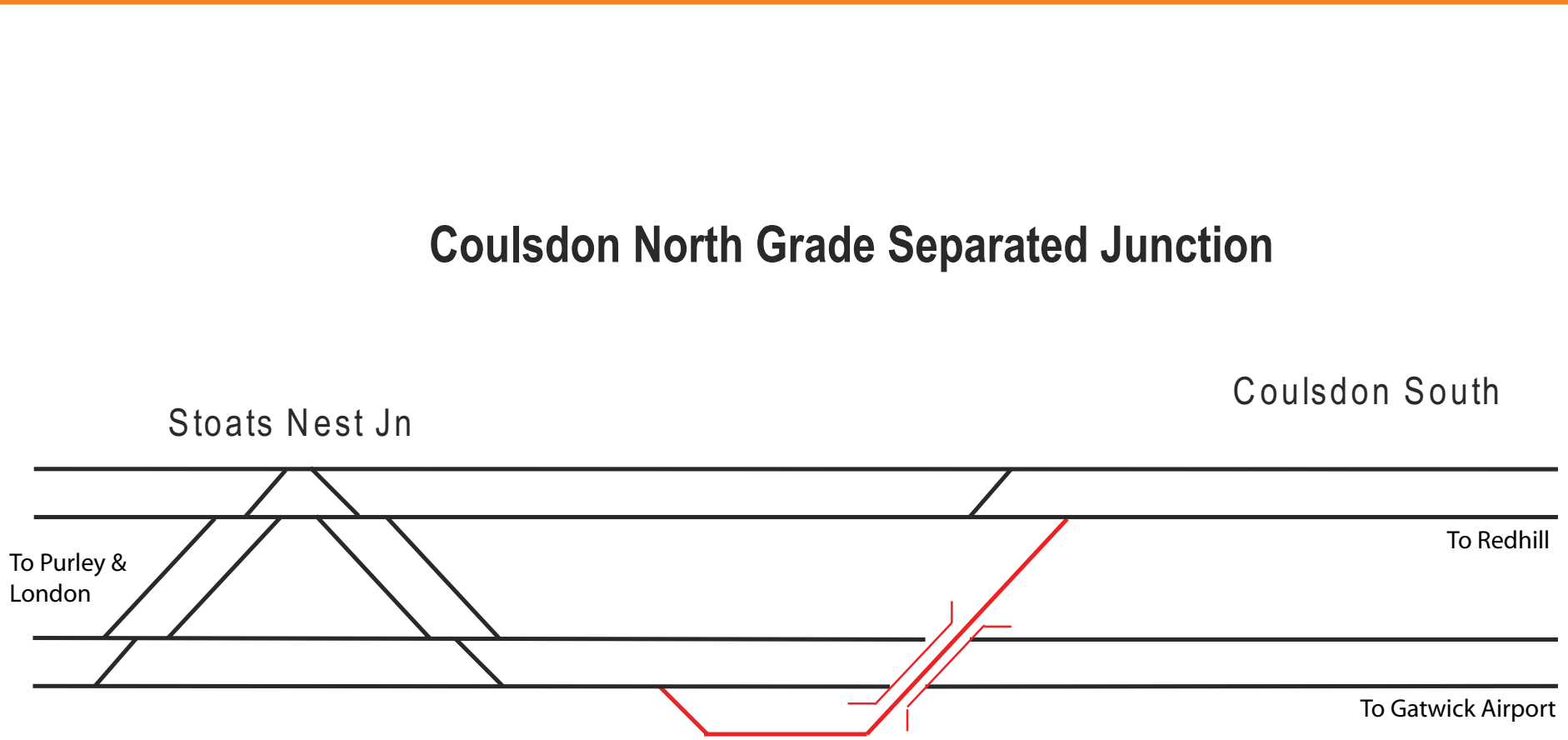
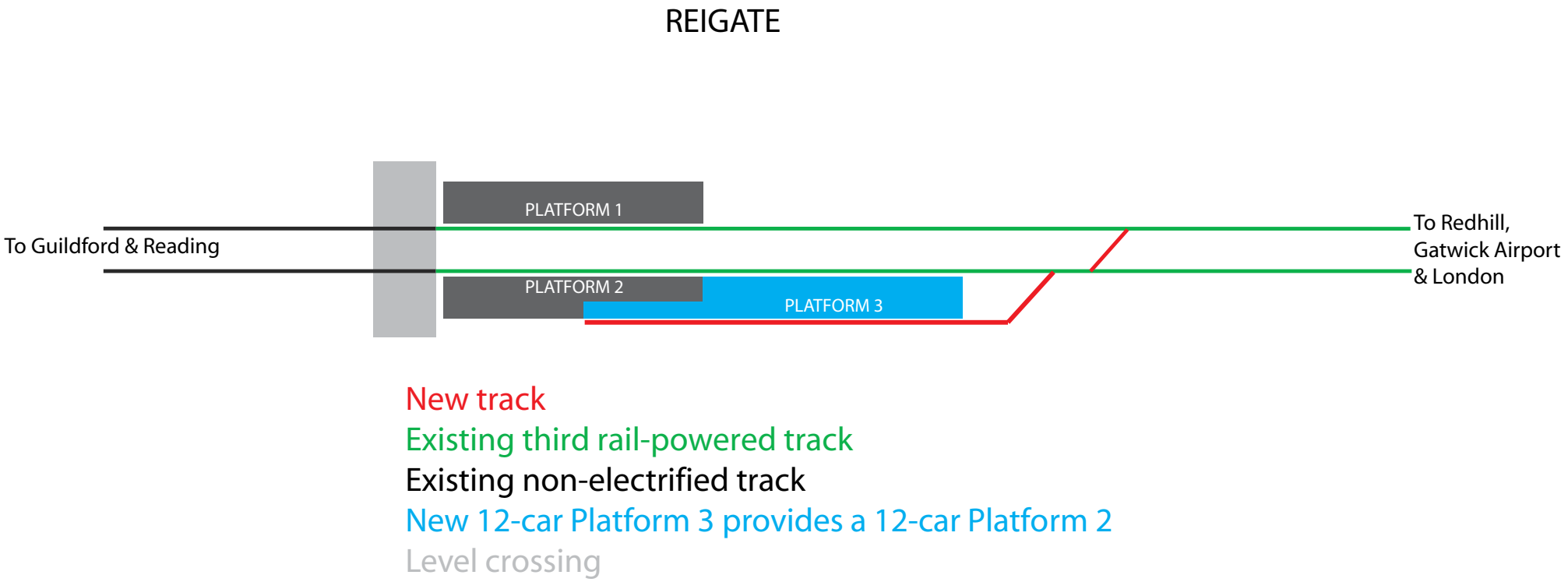


Figure B4 - Reigate Intervention



In the base timetable each peak hour service from Reigate and Tonbridge joins at Redhill with another portion originating at Gatwick Airport, respectively. In order to provide sufficient network capacity at Redhill the concept of joining services would have to be abandoned for Reigate services. In order to meet peak demand into London and making best use of capacity available north of Redhill, the Reigate portion will have to operate as a 12 car service. The additional services via Redhill (as per conditional outputs to meet peak demand) are assumed to take up both the paths and station stops of the former Gatwick Airport portion of the joining service so that connectivity is retained.

As a result, the station layout at Reigate would require an additional 12-car bay platform in order to accommodate the lengthened service.

Figure B5 - Gatwick Airport Intervention

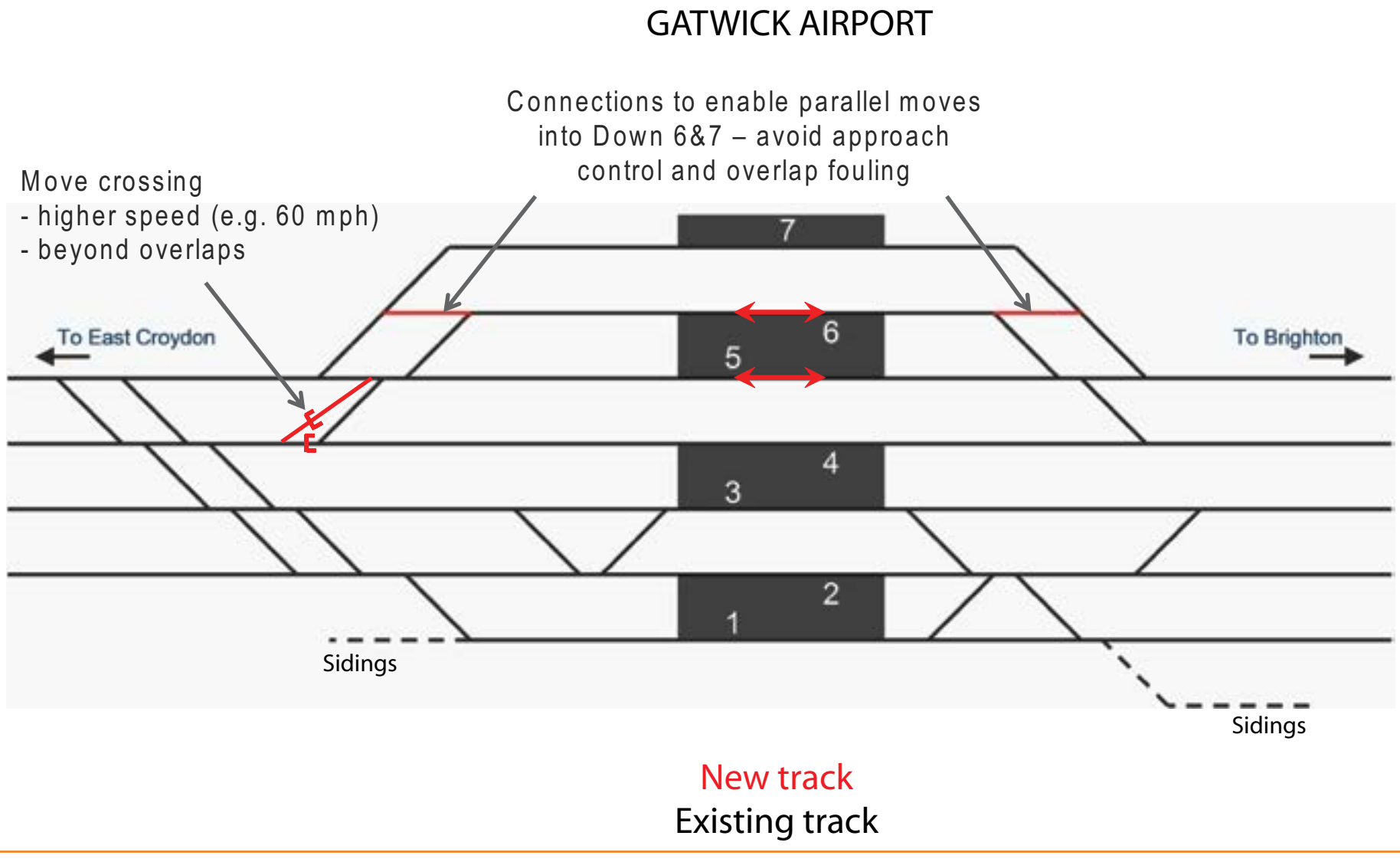


Figure B6 - Haywards Heath Intervention

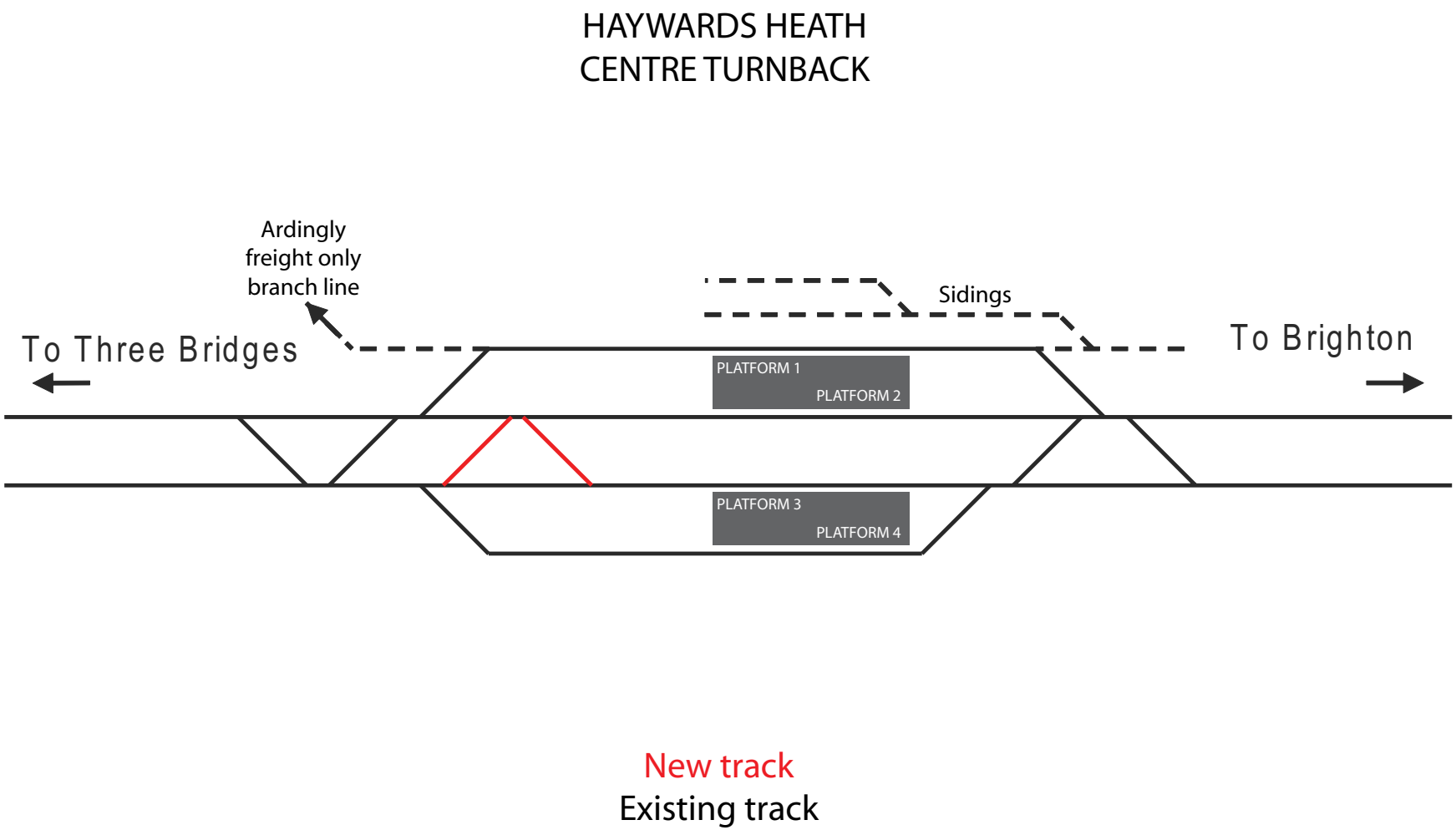
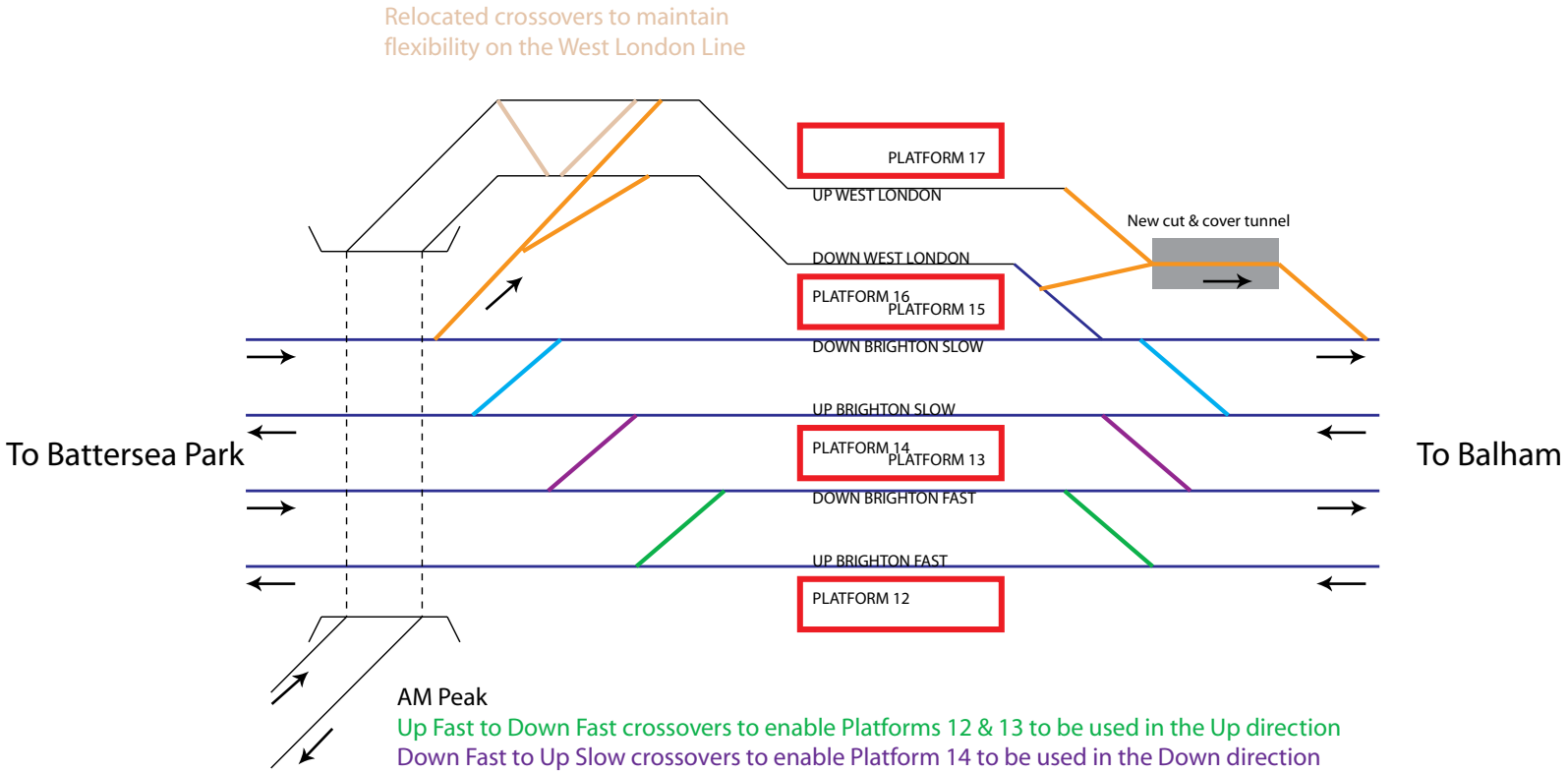


Figure B7 - Clapham Junction Intervention

Clapham Junction



AM Peak

Up Fast to Down Fast crossovers to enable Platforms 12 & 13 to be used in the Up direction

Down Fast to Up Slow crossovers to enable Platform 14 to be used in the Down direction

Up Slow to Down Slow crossovers to enable Platform 15 to be used in the Up direction

Down Slow to Up/Down West London line to enable Down Slow trains to use the new Down Slow tunnel

PM Peak

Down Fast to Up Slow crossovers to enable Platforms 13 & 14 to be used in the Down direction

Up Slow to Down Slow crossovers to enable Platform 15 to be used in the Up direction

Down Slow to Up/Down West London line to enable Down Slow trains to use the new Down Slow tunnel

Figure B8 - Redhill Intervention

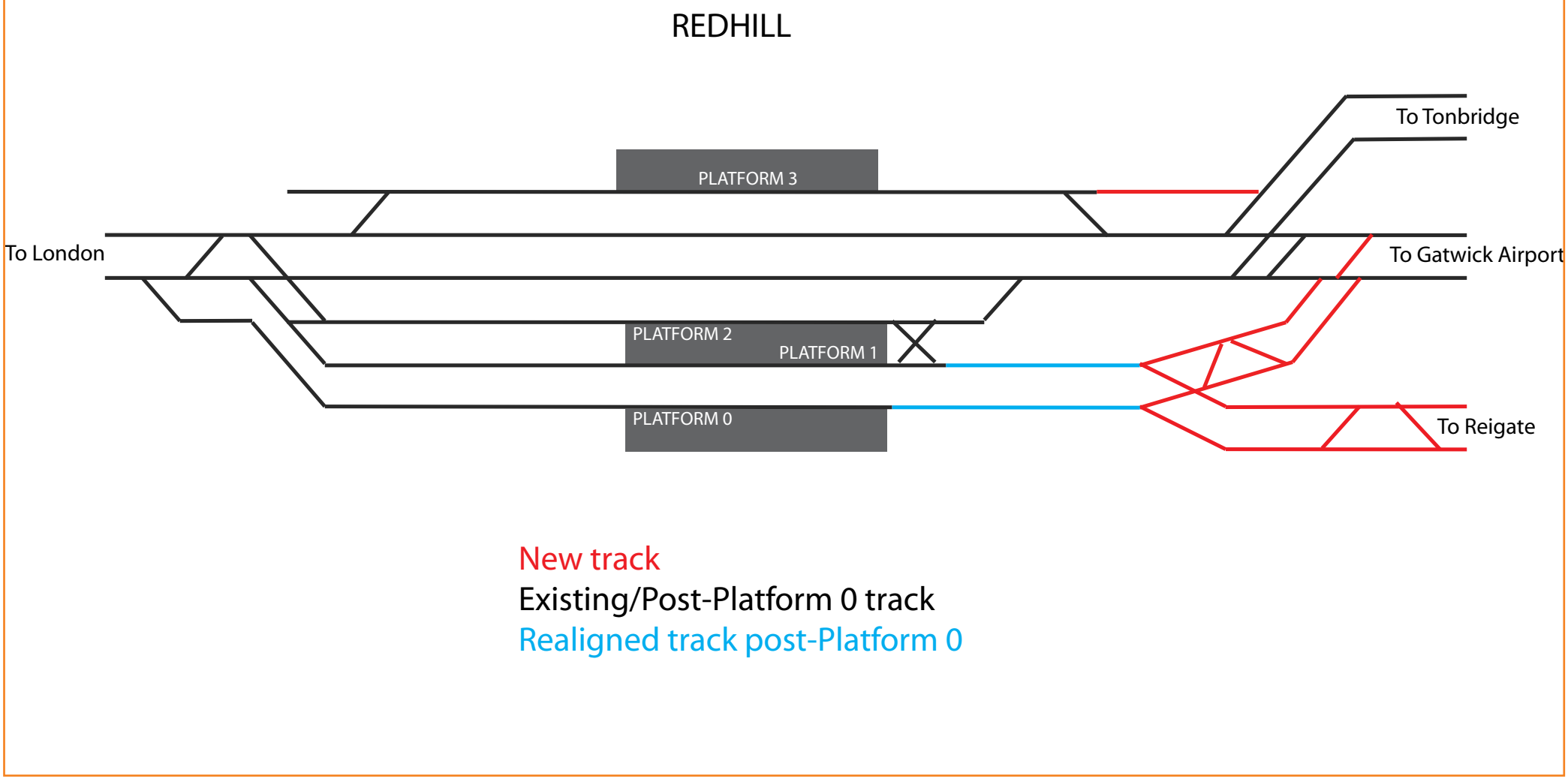


Figure B9 - Wivelsfield and Keymer Interventions Option 1

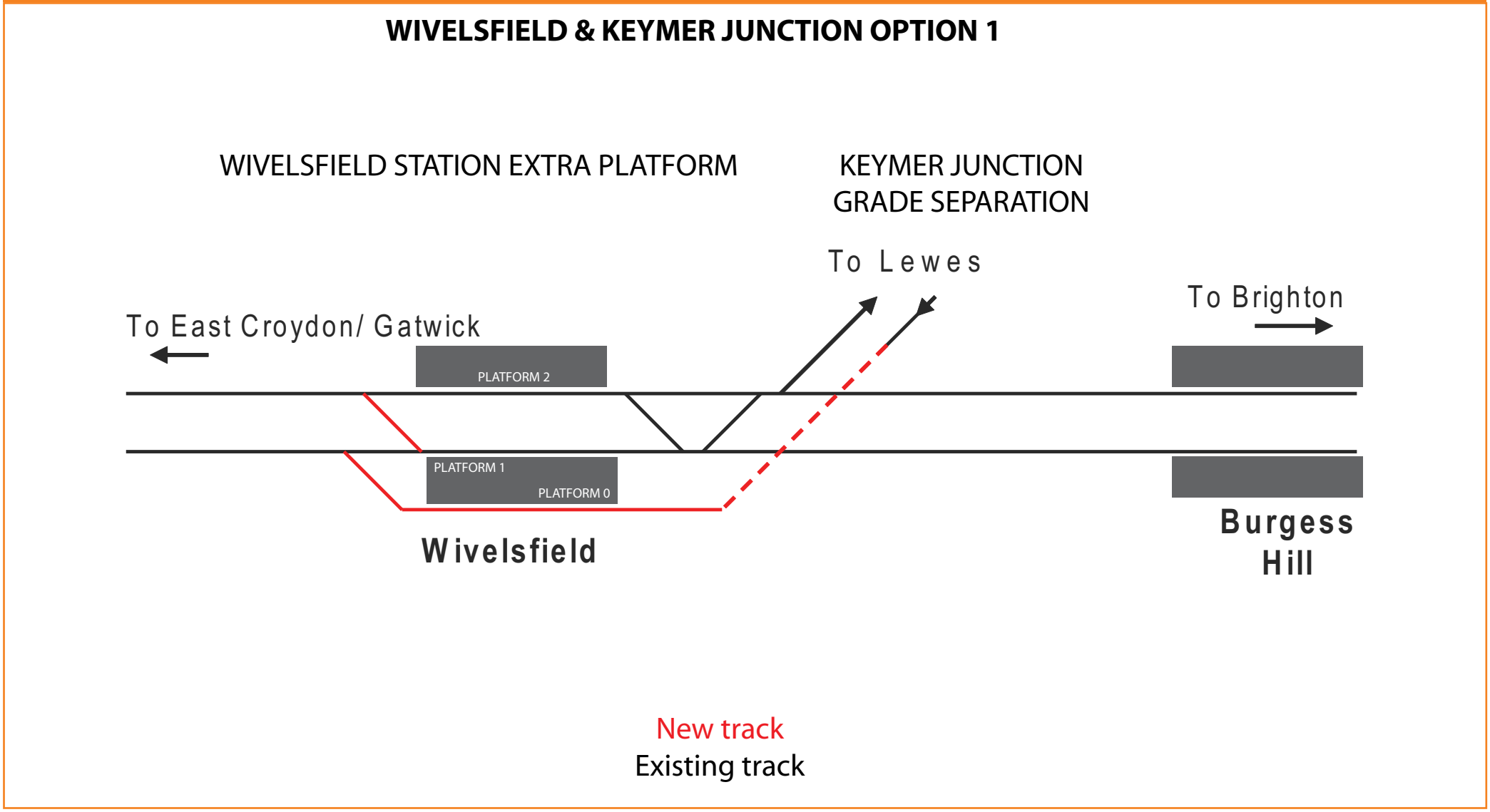


Figure B10 - Wivelsfield and Keymer Junction Interventions Option 2

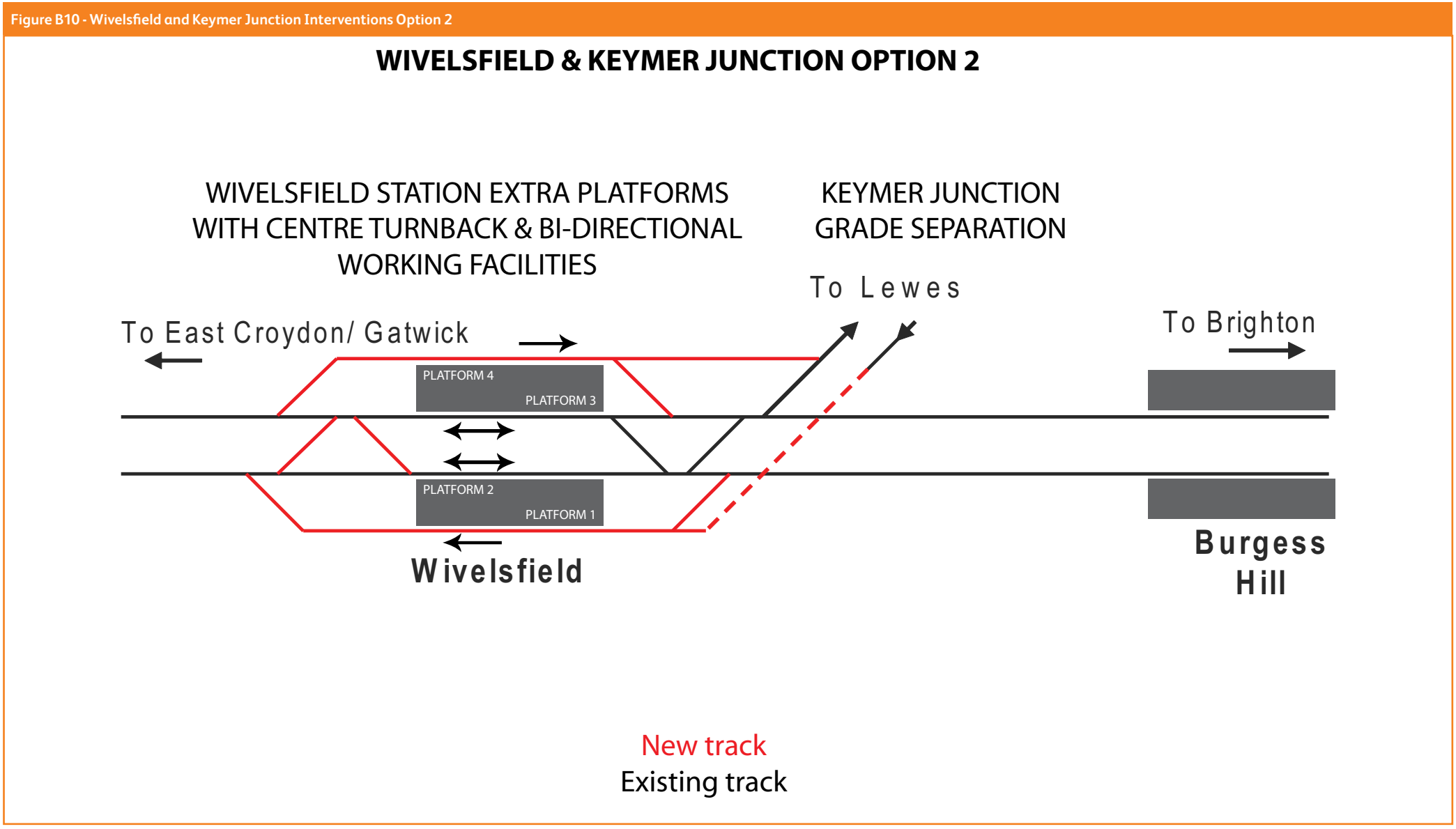


Figure B11 - Hove Intervention

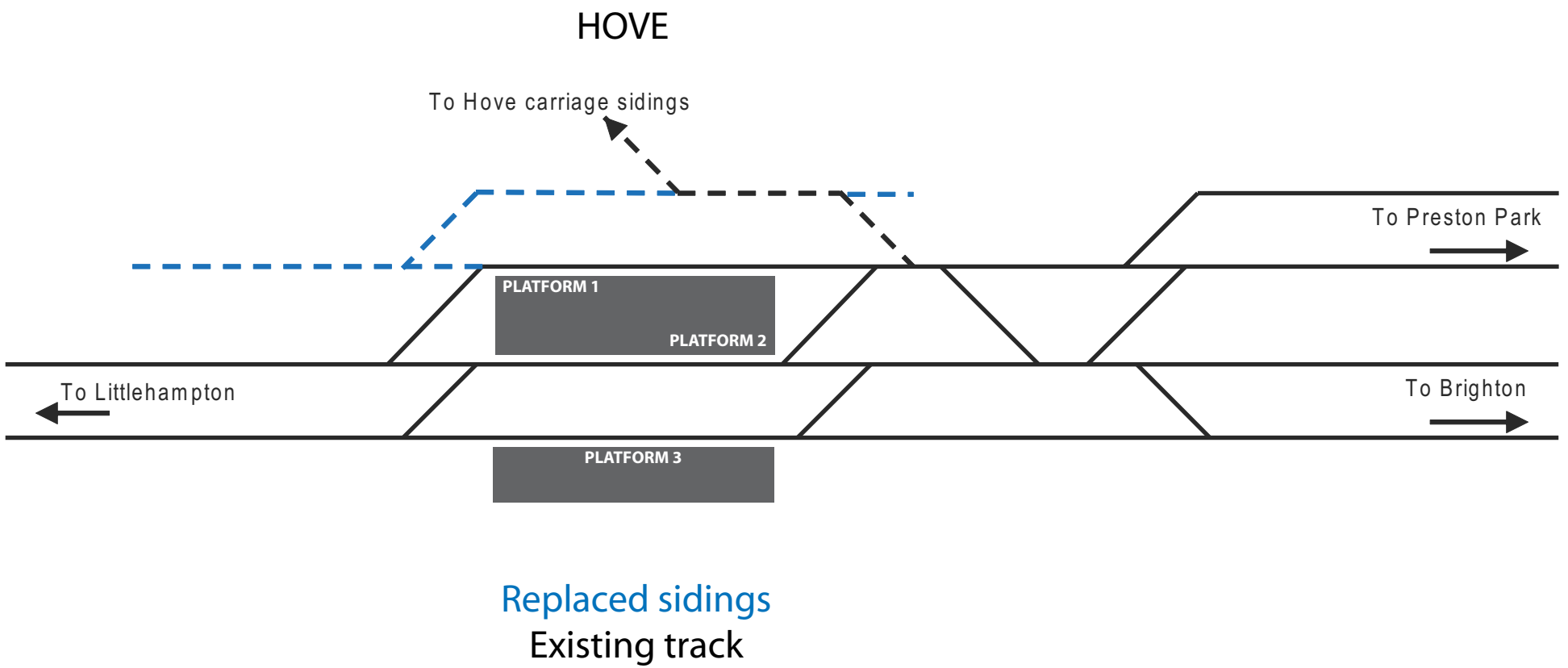
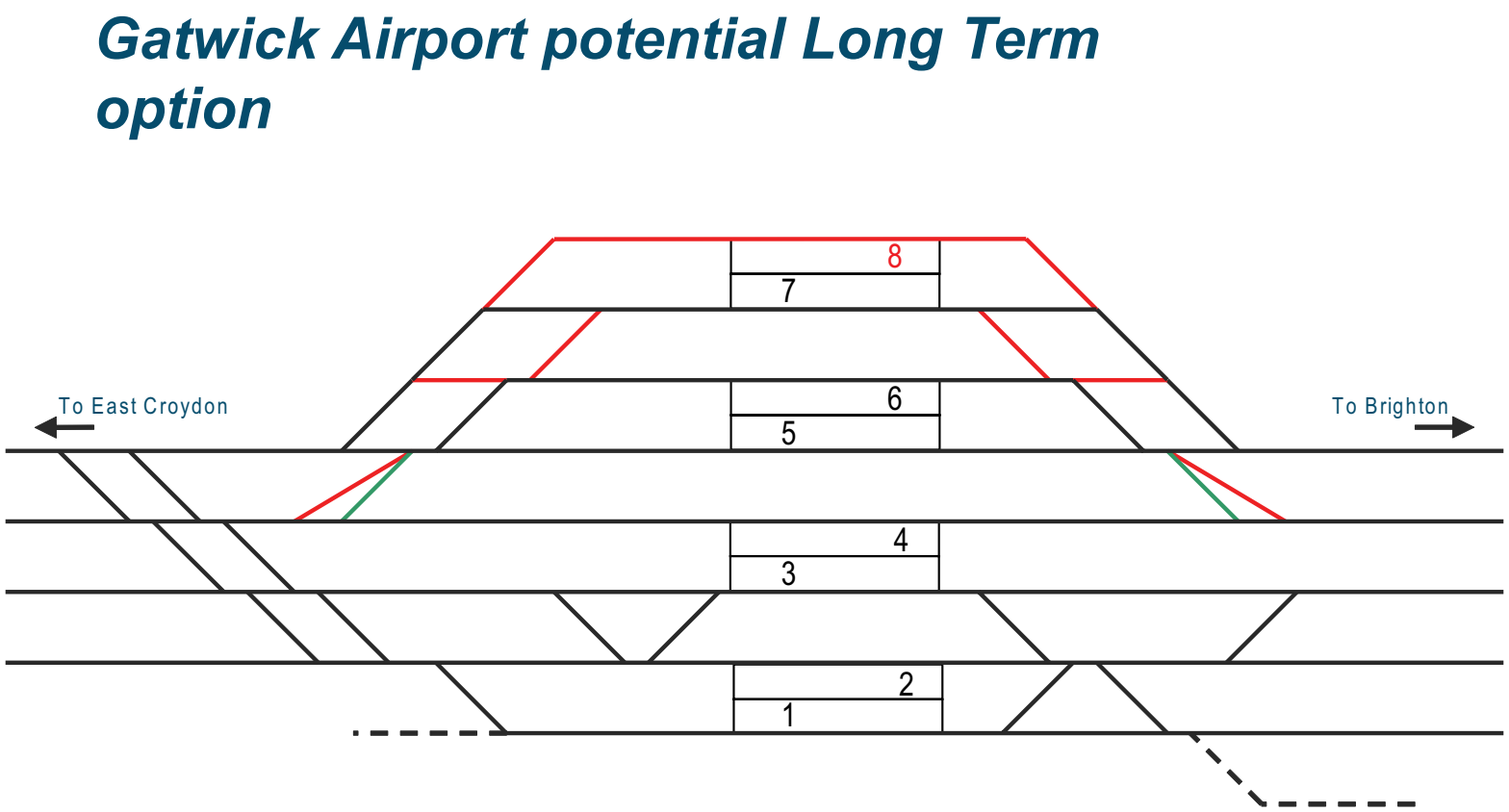


Figure B12 - Gatwick Airport potential long term intervention



Timetabling work has not established the need for an eight platform station against the current additional trains forecast to 2043. Despite this Network Rail have looked - from an operational planning perspective - at a potentail long term eight platform option that would optimise operation of the railway in the station area.

At this stage such a proposal does not form part of the core works set out in Chapter 5 for the Brighton Main Line, but could be required in the long term'

Appendix C: Cross-Boundary Analysis

This chapter outlines why it has been necessary to consider the approach to services (passenger and freight) which operate across the boundaries of the Route Study area. It details those services that operate in the 2019 baseline, before going on to describe the process for developing the cross-boundary services which meet the conditional outputs for the longer term as articulated in the established Market Studies, describing the assumptions that have been made. Finally it provides a number of examples of how the conditional outputs relevant to these services have been interpreted to assist in developing the 2043 Indicative Train Service Specification (ITSS) for Sussex Area detailed in Chapter 3.

C1 The Cross-Boundary Approach

By necessity, for the purposes of undertaking the Long Term Planning Process (LTPP), the Network Rail geography is divided into Route Study Areas; this is to make the process manageable, across the rail network which covers the whole of the Great Britain. For this reason, the Route Studies do not run in parallel, but are phased over the available time period within the five-year planning cycle.

By working at the Route Study level, the Network Rail route teams and relevant local stakeholders, both within and outside the industry, can be involved in work relevant to them addressing their requirements.

The Route Study boundaries broadly follow those of the Network Rail devolved routes, with some exceptions to break down into smaller, more manageable areas (from a Route Study perspective), and to reduce the number of interfaces where possible. Due to this division of the rail network geography, it is necessary to co-ordinate the treatment of passenger and freight trains which cross Route Study boundaries, hence the cross-boundary process.

C2 The Route Study Boundaries and the services that operate across them in 2019

For the purposes of the LTPP passenger and freight services which traverse the study area boundary are referred to as cross-boundary services. For the baseline year of 2019, these are broadly summarised in Figures C1 and C2.

Figure C1 - Cross-Boundary Passenger Services

	Route Boundary	Service Details
Boundaries between Sussex and Anglia Route Studies	Willesden High Level	Suburban services between Clapham Junction and Stratford
Boundaries between Sussex and Kent Route Studies	Bo-peep Junction	Regional services between Brighton and Ashford International
		Long distance services between London Victoria / London Bridge and Hastings/Ore via Eastbourne
	Godstone	Long distance services between London Bridge and Tonbridge via Redhill
Boundaries between Sussex and East Coast Route Studies	London St Pancras International Low Level	Suburban / Long Distance services between the Sussex Route Study area via London Blackfriars and Welwyn Garden City, Cambridge and Peterborough
Boundaries between Sussex and East Midlands Route Studies	London St Pancras International Low Level	Suburban / Long Distance services between the Sussex Route Study area via London Blackfriars and Luton and Bedford
Boundaries between Sussex and Wessex Route Studies	Epsom and Leatherhead is a shared line controlled by Wessex Route operations	Suburban services between London Victoria / London Bridge and Epsom, Dorking and Horsham (1 train per day to Guildford)
	Dorking Deepdene	Regional trains between Redhill / Gatwick Airport and Reading
	Warblington	Long distance trains between London Victoria and Southampton / Portsmouth
		Regional trains between Brighton and Southampton Central / Portsmouth Harbour (1 train per day to Bristol Temple Meads)
Boundaries between Sussex and West Coast Route Studies	Mitre Bridge Junction	Suburban services between Croydon stations and Watford Junction / Milton Keynes Central
Boundaries between Sussex and non-Network Rail infrastructure	Surrey Quays	Suburban services between West Croydon / Crystal Palace / Clapham Junction and Highbury & Islington / Dalston Junction

Figure C2 - Cross-Boundary Freight Services		
Freight flows destined to Sussex	**Origin Route**	**Commodity**
Marks Tey to Stewarts Lane	Anglia	Aggregates
Cliffe, Bardon and Mendips to Purley	Kent, East Midlands, Western	Aggregates
Mendips, Bardon and Cardiff to Crawley New Yard	Western, East Midlands, Wales	Aggregates
Mendips to Newhaven	Western	Aggregates
Mendips to Ardingly	Western	Aggregates
Mendips to Chichester	Western	Aggregates
Freight flows originating in Sussex	**Destination Route**	
Newhaven to Brentford	Western	Ash products
Flows that traverse Sussex		
Hoo Junction to Whitemoor	Kent	Engineering (Network Rail)
Angerstein Wharf to Merehead	Kent	Construction
Daventry International Rail Freight Terminal <> Dollands Moor	London North Western	Channel Tunnel Intermodal
Barking <> Dollands Moor	Anglia	Channel Tunnel Intermodal
Dollands Moor <> Llanwern	Welsh	Steel
Scunthorpe <> Dollands Moor	London North Eastern	Steel
Hams Hall <> Dollands Moor	London North Western	Channel Tunnel Intermodal
Irvine <> Dollands Moor	Scotland	Channel Tunnel Clay slurry
Trafford Park <> Dollands Moor	London North Western	Channel Tunnel Intermodal

C3 Conditional Outputs

Market Studies were undertaken for each of four identified markets: Long Distance passenger, London & South East passenger, Regional Urban passenger and Freight.

The passenger Market Studies generated conditional outputs, i.e. aspirations for the industry to meet, subject to affordability and value for money which are set out in detail in Chapter 3. These are guided by economic analysis of future demand, and where investment is likely to provide the greatest socio-economic return.

The conditional output for freight is to accommodate the forecast demand. The Freight Market Study produced forecasts for every point-to-point flow. The assumption was that existing flows would follow existing routeings. New flows were assumed to follow the shortest practical route taking into account such constraints as loading gauge.

Not all conditional outputs are contained within Route Study boundaries. Clearly, passenger and freight movements are not constrained to Route Study geographical areas, and the cross-boundary process has been designed to ensure that these are reflected in the analysis within the Sussex Route Study.

C4 Development of the Process

The cross-boundary process has been developed by a working group composed of Network Rail, passenger and freight train operating company representatives and the Department for Transport.

The group have developed a Cross-Boundary Indicative Train Service Specification (ITSS) for passenger services which cross any Route Study boundary across the Great Britain. This specification is an interpretation of how the connectivity conditional outputs articulated in the established Market Studies could be delivered. There are many ways in which the conditional outputs could be expressed and the Cross-Boundary ITSS has, as a start point, sought to minimise the number of train movements over any given corridor by linking conditional outputs together and where possible having many conditional outputs delivered by the same train service. Given that the conditional outputs are conditional on a value for money business case being found, it could be that the Cross-Boundary ITSS may need to change in the future.

There are also a number of planning cycles to be undertaken between the time of writing and 2043 which may change priorities in the future. However, it is necessary to develop a set of service level assumptions in order to test the capability and capacity of infrastructure based on professional judgement of industry stakeholders. Using this approach allows a consistent methodology to be applied across Great Britain to ensure that opportunities can be identified and tested.

The Cross-Boundary ITSS does not seek to consider every passenger service that crosses a boundary – rather it looks at changes to the 2019 baseline service pattern where change may be required to deliver the conditional outputs. So, for example, the commuter services between Epsom and Leatherhead have not been changed as the Thameslink Development Timetable 2018 is deemed sufficient to deliver the London and South East Market Study conditional outputs over the longer term. Equally the services specified in the 2018 Thameslink timetable deliver a considerable increase in capacity and connectivity.

The services contained in the Cross-Boundary ITSS have been included within the Sussex Route Study ITSS detailed in Chapter 3.

The Cross-Boundary Working Group continues to meet to receive and approve proposals from the Route Studies to amend the cross-boundary specification (for either passenger or freight trains), and to advise on resolving capacity issues affecting more than one Route Study.

The Route Studies do not all run in parallel so the cross-boundary process is continuous throughout the LTPP cycle.

C5 Cross Boundary Service assumptions for the longer term for the Sussex Route Study Area

To produce the Cross-Boundary ITSS requires the conditional outputs from the four established Market Studies (both those that cross the Route Study boundary and those that don't) to be interpreted. Of most relevance are the passenger connectivity conditional outputs and the accommodating freight demand conditional outputs.

Any passenger conditional output crossing a Route Study boundary will require a train service to reflect the output, whilst noting any

given service can in some cases cover more than one conditional output. Thus a long distance train travelling across different routes e.g. from Gatwick Airport to Reading may reflect conditional outputs between, for example, Guildford, and many other places en route. It will also be seen that conditional outputs work in both directions.

The conditional outputs are expressed as 'journey opportunities' per hour. This recognises the fact that it is impractical to provide direct trains between all origin-destination pairs due to the number of train services this would require, even taking into account the possibility of trains joining and dividing en route.

However there is a general conditional output to provide broadly the same level of service as in the baseline. Thus the service specification would endeavour to maintain a direct service where one already exists. The major exception to this is flows affected by High Speed 2 (HS2), which is taken as a committed scheme for the purposes of the LTPP.

As well as describing connectivity conditional outputs between the major towns and cities of Great Britain, the passenger Market Studies also describe 'other conditional outputs' including improved access to and from large airports and HS2 stations. In practical terms cross-boundary services to large airports which are most pertinent to the Sussex Route Study area are for journeys to and from London Luton Airport and London Gatwick Airport. The 2018 Thameslink service specification potentially increases the quantum of services currently running from the Route Study area to London Luton Airport. This level of service is deemed sufficient to meet this improved access to airports conditional output. The provision of an interchange from Thameslink services to CrossRail services at London Farringdon and connections to the West London Line at Old Oak Common will significantly improve connectivity to both London Heathrow Airport and HS2 services.

It should be noted that the both the Cross-Boundary ITSS and the Sussex Route Study 2043 ITSS are unconstrained for example by network capacity or considerations of rolling stock.

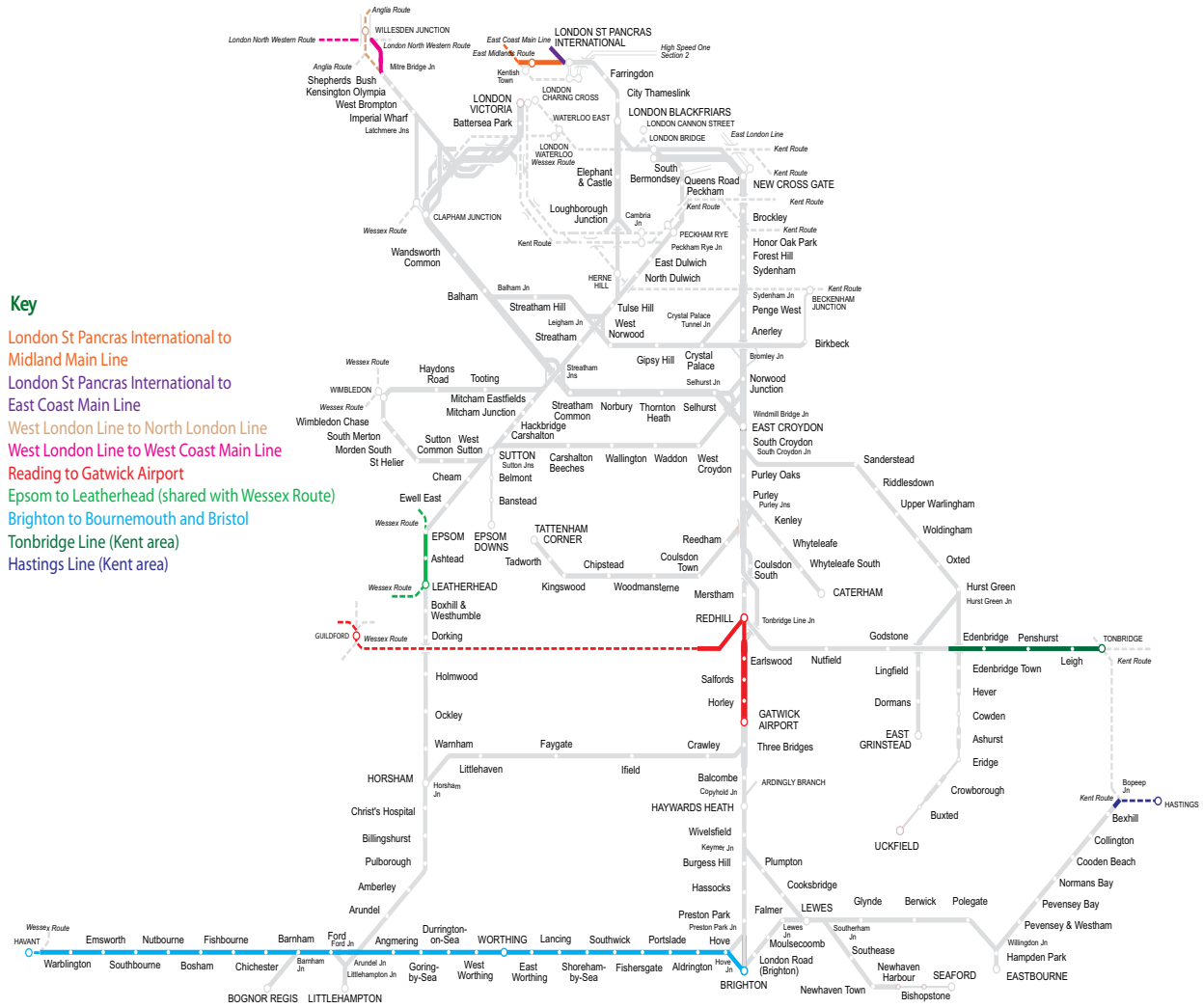
C6 Cross-Boundary services within, and across, the Sussex Route Study Area for the longer term to 2043

The Sussex Route Study area is served by a number of 'Cross-Boundary' services which are included within the 2043 ITSS map. This includes broad groups of services serving markets as set out in Figure C3. Additional cross-boundary services identified by the Cross-Boundary working group to deliver the Long Distance Market Study connectivity conditional outputs are listed below. At the end of this section a number of worked examples are provided to show how the conditional outputs have been interpreted in practice and how the subsequent train services shown in the 2043 ITSS to accommodate them have been derived.

- An hourly service operating from Brighton to Bristol Temple Meads (see Figure C4)
- An hourly journey opportunity between Brighton and Bournemouth (see Figure C4)
- A change to the service operating over the North Downs Route between Reading and Redhill / Gatwick Airport to include two fast services from Reading and potentially Oxford to Gatwick Airport with a slower service operating over the route to accommodate passengers from the smaller stations on the route. These proposals are considered in Chapter 5.

These services are shown diagrammatically in Figure C3.

Figure C3 - Cross-boundary passenger services



C7 Worked Examples

The ITSS for cross-boundary flows includes one direct service per hour between Brighton and Bristol Temple Meads as well as one journey opportunity per hour between Brighton and Bournemouth with one interchange at Southampton Central.

Figure C4 - Indicative train service specification to meet Long Distance Market Study Conditional Output

Flow	Long Distance Market Study Conditional Output	Indicative Train Service Specification
Brighton to Bristol Temple Meads	(1 or 2 trains per hour at 80mph)	1 train per hour (tph) in each direction between Brighton and Bristol Temple Meads via Southampton Central stopping at principal stations
Brighton to Bournemouth	(1-2 trains per hour at 45/80mph)	Journey opportunity with one interchange at Southampton Central: 1tph in each direction between Brighton and Bournemouth via Southampton Central.

C7.1 Brighton and Bristol

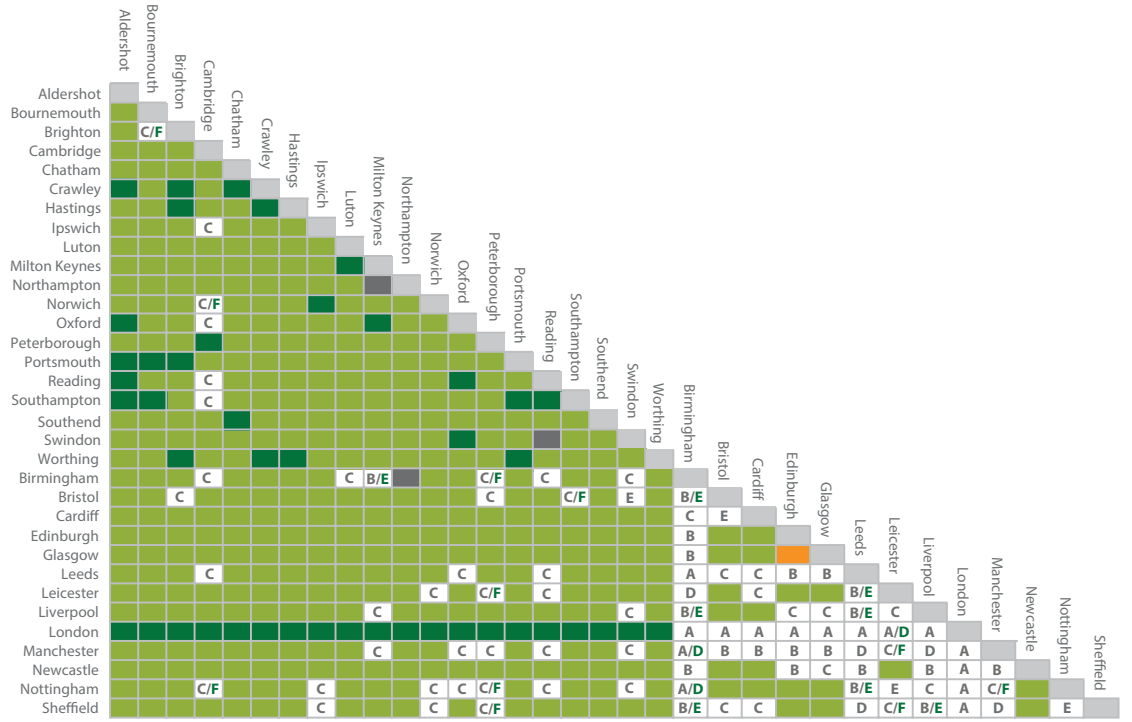
Figure C6 taken from the Long Distance Market Study shows the service level aspirations for the year 2043. The service level aspired for between Brighton and Bristol, is defined as one or two opportunities to travel per hour with an average, end-to-end speed of 80 mph.

The base train service at the end of CP5 comprises various journey opportunities along different routes, none of which meet the conditional output with regards to journey time as shown in Figure C5.

Figure C5 - Current journey opportunities and journey times

Current journey opportunities	Indicative journey time west-/eastbound
1-2 trains per day, direct	3h30
1 tph, one interchange at Fratton/Fareham	3h45 / 3h56
1 tph, two interchanges at Gatwick Airport and Reading	3h14 / 3h47
2 tph, two interchanges at London Victoria and London Paddington	3h25 / 3h28

Figure C6 - Long term service level conditional outputs for the South East – aspirations for 2043



*Norwich has been used as a proxy for Norfolk on the basis that it is a single functioning economic area and therefore anologous to a city-region

Key

	Distance	Aspiration	Description	Illustrative service characteristics	
				End to end journey speed	Opportunities to travel
A	> 100 miles	Best possible future	Very fast	160 mph	3 or 4 per hour
B	> 100 miles	Best current	Intercity	100 mph	2 or 3 per hour
C	> 100 miles	Good current	Interurban	80 mph	1 or 2 per hour
D	< 50 miles	Best possible future	High frequency interurban	At least 60 mph	5 or 6 per hour
E	< 50 miles	Best current	Medium frequency interurban	60 mph	3 or 4 per hour
F	< 50 miles	Good current	New interurban connection	45 mph	1 or 2 per hour
A/D	Between 50 and 100 miles	Best possible future	Route Study to determine whether to use outputs related to under 50 miles or over 100 miles		
B/E	Between 50 and 100 miles	Best current			
C/F	Between 50 and 100 miles	Good current			
	Any	Maintain existing level of service			
	Short distance and/or a high proportion of commuters, considered in the London and South East Passenger Market Study				
	Outside the scope of the Long Distance Market Study, will be considered in the Scotland Route Study				
	Short distance and/or a high proportion of commuters, considered in the final Regional Urban Passenger Market Study				

The cross-boundary analysis has investigated improving journey opportunities along the direct route via Havant and Westbury, covering Sussex, Wessex and Western Routes.

The direct train service offered at the end of CP5 is characterised by:

- infrequency, with one train per day towards Brighton and two trains per day towards Bristol
- serving interurban as well as local markets
- thus not offering a competitive journey time for the long distance market.

Whilst on the Sussex and Wessex Routes the number of station stops is moderate, for the Western Route most stations on the route are currently served to provide local connectivity to and from Bristol.

The Route Study has investigated the potential to provide a regular hourly off-peak service with reduced journey times by only stopping at principal stations. Not only would this address the cross-boundary service aspiration but also address a long held local aspiration for a faster service option between principal towns on the West Coastway route (between Brighton and Havant via Chichester) itself.

Figure C7 - Stopping pattern of current and indicative option Brighton – Bristol Temple Meads service

Intermediate stops	Current service	Indicative hourly service
Hove	•	
Shoreham-by-Sea	•	
Worthing	•	•
Barnham	•	
Chichester	•	•
Havant	•	•
Cosham	•	•
Fareham	•	•
Southampton Central	•	•
Romsey	•	
Salisbury	•	•
Warminster	•	•
Dilton Marsh	•	
Westbury	•	•
Trowbridge	•	•
Bradford-on-Avon	•	
Avoncliff	•	
Freshford	•	
Bath Spa	•	•
Oldfield Park	•	
Keynsham	•	

Whilst in terms of journey time a more direct route via Eastleigh would provide the potential for further savings, Southampton is considered a stronger market. The benefits of serving Southampton outweigh the moderate journey time penalty.

The West Coastway route between Brighton and Southampton is being utilised close to network capacity. The coastal area is characterised by its dense population and short distance between stations, most of which are served by at least two trains per hour. Several terminus stations which are located off the route such as Littlehampton, Bognor Regis and Portsmouth Harbour require a complex service pattern to provide a good level of connectivity. In addition, connectivity between West Coastway stations and London is important for access to work and leisure facilities and is provided via the Brighton Main Line (via Haywards Heath) and Arun Valley (via Horsham) routes. As a result, service speeds along the route are relatively slow compared to routes towards London.

There is no available capacity to accommodate an additional hourly fast service with the proposed stopping pattern that achieves best possible journey times. Additional infrastructure that would be required to provide such a service includes various dynamic loops to enable faster services to overtake slower ones. Regardless of enhancements to capacity, the conditional output for journey time cannot be met on the current route alignment.

The alternative way to provide an additional service is to reduce the journey time of the current hourly Brighton to Southampton Central service by amending the stopping pattern. The loss of some connectivity can be partially compensated through stations being served by other trains that currently don't stop there.

There is a trade-off between provision of local connectivity, in particular between some West Coastway stations and Southampton Central , and faster journey times between Brighton and Bristol Temple Meads, as well as principal stations served along the route. Figure C8 compares indicative journey times. Alongside journey time savings concerning the conditional output from the Long Distance Market Study, the indicative train service provides further improvement of interurban journey times between stations such as Brighton, Worthing, Chichester and Southampton Central.

Infrastructure to enable such a service to operate would include an enhancement of signalling headways between Arundel Junction and Emsworth. It would also include amendments to the track layout at Worthing to provide additional infrastructure to enable Brighton – Worthing stopping services which currently terminate at West Worthing to reverse at Worthing without impacting on other services.

In addition to constraints on the core West Coastway Route, capacity for this service on the Wessex Route is driven by constraints through the Southampton area. In particular, the combination of:

- Interaction with stopping services via Netley
- Trains crossing over the junction with the South West Main Line between London Waterloo and Southampton Central at St. Denys
- The two-track section through Southampton Tunnel, and
- Platform capacity at Southampton Central.

Achievable journey times are driven by interaction with other services through this key section, particularly with passenger services between London and Hampshire, cross-boundary passenger services via the Midlands, and intermodal freight flows to/from Southampton Docks/Port. Therefore, there is potentially a trade-off to be made between the journey time and frequency achieved by a Brighton to Bristol Temple Meads service, the journey time and frequency achieved by other passenger flows through the Southampton area (which are key flows to/from London, the Midlands and the North), and freight capacity conditional outputs.

This level of trade-off can be reduced with modest infrastructure changes in the Southampton area, such as through provision of additional platform capacity at Southampton Central (to maximise the throughput of Southampton Tunnel), or signalling headway reductions between St. Denys and Fareham. The overall journey time does still not meet the conditional output. However, an improvement to current is achieved, in addition to the provision of an hourly direct service. With regards to station stops west of Southampton, there is a trade-off between local connectivity and optimal long-distance journey time which requires consideration. If the service would stop at all stations between Southampton Central and Bristol Temple Meads as shown in Figure C7, this would increase journey times in the region of 10 minutes.

Overall, an hourly service with a journey time of approximately three hours between Brighton and Bristol Temple Meads is achievable without major infrastructure requirements. This would be approximately 15 minutes less than current fastest journey times with multiple interchanges, and half an hour less than the current direct service. The journey time equates to an approximate speed of 45 mph.

FigureC8 - Current and indicative option journey times between key stations

Journey	Current journey time	Indicative journey time (direct)	Indicative journey time (one interchange) west-/eastbound
Brighton – Shoreham	14 min*	14 min*	
Brighton – Worthing	23 min*	12 min*	
Brighton – Barnham	41 min*	43 min*	
Brighton – Chichester	49 min*	35 min	
Brighton – Havant	1h 3 min	47 min	
Brighton – Portsmouth & Southsea	1h 13 min	1h 22 min	1h 09min/1h 20min
Brighton – Southampton Central	1h 46 min	1h 25 min	
Hove – Chichester	45 min*	47 min	
Shoreham – Portsmouth & Southsea	1h 5 min	1h 9 min	
Worthing – Chichester	26* min*	22 min	
Worthing – Portsmouth & Southsea	56 min	1h	56min/1h 4min
Worthing – Southampton Central	1h 24 min	1h 12 min	
Barnham – Portsmouth & Southsea	37 min*	37* min*	
Barnham – Southampton Central	1h 2 min	1h 7 min	
Chichester – Portsmouth & Southsea	29* min	29 min	
Chichester – Southampton Central	54 min	50 min	
Brighton – Bristol Temple Meads	3h 30 min	~3h	

* Journey time is an average of different services available. Where the difference between services is greater than 5 minutes the journey time for the minimum is given.

** Assumes an estimation of journey time between Southampton Central and Bristol Temple Meads with reduced station stops. With station stops as per today the journey time would be around 3h 10min.

C7.2 Brighton – Bournemouth

The level of service shown on Figure C9 between Brighton and Bournemouth, is defined as one or two opportunities to travel per hour with an average speed of 80 mph for the long distance market such as Brighton to Bournemouth , and 45 mph for the interurban market such as Chichester to Fareham.

The train service specification planned for the end of CP5, offers an hourly journey opportunity with one interchange at Southampton Central:

Figure C9 - Current journey opportunities and journey times between Brighton and Bournemouth	
Current journey opportunities	Indicative journey time
1 tph, one interchange at Southampton Central	2h27 / 2h19

The route between Brighton and Southampton Central is identical to the one used by services to and from Bristol Temple Meads. Given the diverse markets served along this route there is limited capacity for fast services. In addition, there are already frequent limited stop services on the route between Southampton Central and Bournemouth, mixing with stopping services on a route which limits overall capacity.

Meeting the conditional output between Brighton and Bournemouth by means of an interchange between frequent services between a fast Brighton to Bristol Temple Meads service and a fast Southampton Central to Bournemouth service represents best use of available capacity.

An indicative reduction in journey time can be achieved. Figure C10 illustrates the passenger long distance conditional outputs for the South East in 2043.

Figure C10 - Indicative option journey opportunities and journey times between Brighton and Bournemouth	
Indicative journey opportunities	Indicative journey time
1 tph, one interchange at Southampton Central	2h12 / 2h14

C8 Ongoing Process

The 2043 Cross-Boundary ITSS for the Sussex Route area is unconstrained and is provided as an input to the Route Studies, which seek to accommodate it alongside trains which run purely within the Route Study area.

Where it is not possible to accommodate all trains on the baseline infrastructure using the baseline rolling stock assumptions then Route Studies can:

- Reroute, or
- Use different rolling stock assumptions
- Consider the case for additional infrastructure.

Where these affect cross-boundary trains (passenger or freight) then it is important to work with all the other Route Studies to ensure that assumptions are consistent on routeing, rolling stock type and length (in the case of accommodating demand).

Where a business case is being made for infrastructure to accommodate cross-boundary trains, then it is important to work with other Route Studies to ensure that all costs are captured on the line of route.

This is managed by the Cross-Boundary Working Group which meets throughout the Route Study process.

C9 Summary

This appendice has outlined how the cross-boundary process has been developed for both passenger and freight services. It also defines how it has been applied in the Sussex Route Study, as well as the broad range of services which are included within it. These services are set out in detail in the 2043 ITSS in Chapter 3.

Glossary

Glossary	
Term	**Meaning**
AC	Alternating Current (Overhead Line Equipment)
ATO	Automatic Train Operation, being developed for high intensity operation of the Thameslink Core
BCR	Benefit Cost Ratio
BML	Brighton Main Line
Control Period 4 (CP4)	The 2009-2014 period
Control Period 5 (CP5)	The 2014-2019 period
Control Period 6 (CP6)	The 2019-2024 period
Control Period 7 (CP7)	The 2024-2029 period
Control Period 8 (CP8)	The 2029-2034 period
Crossrail 2	Proposed rail route in South East England, running between Surrey and Hertfordshire providing a new rail link across London on the Crossrail network
DC	Direct Current (third rail)
DfT	Department for Transport
Down line	Usually the line away from London, on the East and West Coastways this is also away from Brighton
DTT 2011	Thameslink Development Timetable from 2011
ELL	East London Line
ERTMS	European Rail Traffic Management System
ETCS Level 2/3	European Train Control System is a signalling, control and train protection system. Level 2 refers to in cab signalling with fixed block sections, level 3 refers to in-cab signalling with moving blocks.
Fast line (FL)	Predominately used by trains with limited stops on the line
FCC	First Capital Connect, train operating company
FGW	First Great Western, train operating company
FOC	Freight Operating Company
GAL	Gatwick Airport Limited
Generalised journey time	A measure of the rail service offer that takes account of in vehicle time, service frequency and interchange penalty
GRIP	Governance for Railway Investment Projects
GTR	Govia Thameslink Railway, the winner of the Thameslink Southern and Great Northern franchise
HS2	Proposed high speed link between London and Birmingham beyond to Leeds and Manchester
Initial Industry Plan	A plan to examine the key choices and options facing funders in specifying the future outputs of the railway and the level of funding required
Key Output 1	Thameslink Programme's second phase which extended platforms for 12-car operations and rebuilt Blackfriars station
Key Output 2	Thameslink Programme's final phase which will result in 24tph through the Thameslink Core

Glossary	
Term	**Meaning**
LOROL	London Overground Rail Operations Limited
LSE	London and South East
LTPP	Long Term Planning Process
MML	Midland Main Line
MPH	Miles Per Hour
NRDF	Network Rail Discretionary Fund
OOC	Old Oak Common, a proposed High Speed 2 station
ORR	Office of Rail Regulation (the regulator for the rail industry in Great Britain)
RUS	Route Utilisation Strategy
RVS	Reversible line
S&C	Switches and Crossings
Slow line (SL)	Predominately used by trains serving stations on the line
SWML	South West Main Line
SWT	South West Trains, train operating company
TfL	Transport for London
Thameslink	Services linking destinations in the south, such as Brighton, and those north of London, such as Luton
Thameslink Core	The line and stations between Blackfriars and St Pancras station.
Thameslink Programme	The project team responsible for upgrading the Thameslink Routes
TOC	Train Operating Company
TPH	Trains Per Hour
TSGN	Thameslink, Southern and Great Northern (franchise name)
Up line	Usually the line towards London, on the East and West Coastways this is also in the direction of Brighton
WCML	West Coast Main Line
WLL	West London Line
WTT	Working Timetable

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