Assisting Decisions

Chingford to Stratford Appraisal

Report for Waltham Forest Council

In Association With First Class Partnerships

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Primary Author:	Fiona Shore
Other Author(s):	David Pierce
Reviewer(s):	Chris Pownall
Formatted by:	Fiona Shore

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Summary

This report examines the operational and economic feasibility of re-introducing a train service between Chingford and Stratford, and also of re-opening Lea Bridge Station, which would be served by this re-instated service.

The infrastructure investment required to achieve this is limited to the reinstatement of Hall Farm Curve, a short stretch of track linking the existing Chingford to Liverpool Street route to the Coppermill Junction to Stratford Line, and the restoration of Lea Bridge Station to the modern standards. The total combined cost of these two investments has been estimated at £24.3m for the preferred option of double-track curve, but could be reduced to £18.4m if a single track curve is provided instead (2009 prices).

Our analysis has demonstrated that a regular 15-minute interval service between Chingford and Stratford is operationally feasible if overlaid on the current timetable, with only minor adjustments to the timings of the existing Stansted Airport to Stratford Service required to accommodate it. Our analysis also indicates that it should be possible to provide a similar level of service during the morning peak, with the exception that one return service would need to be missed out due to an extra peak period service that is currently run on the Chingford to Liverpool Street route. It is possible that with more detailed operational planning a solution could be found that allows a regular 15-minute interval service to be run throughout the day.

Transport for London's Railplan Public Transport model was used to forecast the level of demand on the reinstated service, as well as the wider impacts across the public transport network. This showed that in 2016, around 3900 passengers would be carried on this service during the period 0700-1000 on a typical weekday, rising 4300 by 2026. This is around 60% of the level of demand carried on the current Chingford – Liverpool Street service in the same years. However, of this number only around 350 were travelling to or from Lea Bridge station in 2016, rising to 410 by 2026, levels that are unlikely to justify its reinstatement. The analysis showed that passengers from Waltham Forest would use the Chingford – Stratford service not only to access Stratford itself, but also to reach the Docklands area and parts of central London due to the convenient interchange that Stratford offers to other rail routes, the Underground, Docklands Light Railway and Crossrail.

Economic appraisal showed the Chingford – Stratford scheme to have a strong business case, with a benefit to cost ratio of 3.0. This reflects the relatively modest level of infrastructure investment involved, and healthy level of demand the service attracts. However, the ratio for the scheme without Lea Bridge station is higher at 3.6, indicating that this element represents relatively poor value for money.

There is therefore a case for proceeding further with the development of the Chingford – Stratford scheme. Taking forward Lea Bridge as part of this process has limited merit at this stage, but may be better progressed as part of a package of measures to regenerate the Lea Bridge area at a later date, once the Chingford – Stratford service itself is secured.

To progress further, consensus needs to be established between stakeholders in north east London on the relative merits of this scheme compared to other proposals currently being developed by the Department for Transport that are likely to utilise the approach and platforms at Stratford needed for the Chingford - Stratford service.

1 Introduction

1.1 Introduction

1.1.1 The study examines the operational and economic feasibility of re-introducing a train service between Chingford and Stratford. To make this service possible requires the reinstatement of the Hall Farm Curve, a small piece of rail track that was closed in 1967. The re-opening of this track would allow a rail service to operate between Chingford and Stratford, linking Chingford, Highams Park, Walthamstow Central, St James's Street and Stratford. Residents of the London Borough of Waltham Forest would benefit from reduced journey times and increased accessibility to employment opportunities in Stratford.

1.1.2 In addition to the re-instatement of the Chingford to Stratford rail line, Lea Bridge station, which has been unused since 1985, could be re-opened. This would provide significant improvements to the public transport network in this area, which currently suffers from poor rail and bus networks.

1.1.3 An earlier project undertaken by Hyder Consultancy[1] concluded that re-opening the Hall Farm Curve was feasible. Four different options were tested including single track and double track chord scenarios for Hall Farm Curve. The reopening of Lea Bridge station was also included in the analysis with two of the options incorporating extra tracks through the station to increase capacity on the line. It was concluded that all four options were technically feasible with the double track Hall Farm curve and no additional tracks through Lea Bridge station option the most cost effective solution.

1.1.4 The aims of the study documented in this report are to:

- demonstrate the benefits of reintroducing the Stratford to Chingford Rail service and reopening Lea Bridge station;
- confirm the costs of the scheme and show that there is a viable economic case; and
- set out a programme of further work required to secure inclusion of the scheme in the National Rail Program (Control Period 5).

1.1.5 As there are several aspects to the scheme, costs and benefits have been assessed for the following variants:

- Assuming a double or single track line at Hall Farm Curve; and
- With and without re-introducing Lea Bridge station.

1.1.6 This report provides an overview of the analysis undertaken and is supported by detailed technical appendices.

[1] Maines Consulting & Hyder Consulting (2002), A Report on the Feasibility of Reinstating the Hall Farm Curve and Re-opening Lea Bridge Station.

2 Background

2.1 Existing Transport Provision: London Borough of Waltham Forest

Public Transport Provision

2.1.1 A large proportion of the Borough of Waltham Forest is served by the Chingford to Liverpool Street rail service currently operated by National Express East Anglia as part of the Greater Anglia franchise. The current service runs four trains per hour and the journey from Chingford takes 30 minutes in the peak (26 minutes off peak). The other rail service in the borough is the Victoria Line, which terminates at Walthamstow and provides links to King's Cross, the West End and South London. Links to Central London from the borough from the borough are therefore good.

2.1.2 However, relative to neighbouring areas east and west, the catchment of the Chingford branch suffers from poor connections to Stratford. This means that access is impaired to the major employment opportunities beyond Stratford in Docklands, increasingly at Stratford, and in the future the lower Lea corridor and in particular potential Olympic legacy developments.

2.1.3 In addition to poor rail connections there is also not a direct bus service between Chingford and Stratford. Figure 2.1 provides an overview of the available bus routes serving this area, in particular:

- Chingford is linked to Leyton by a ten minute headway service (Route 97). This journey is timetabled to take 45 minutes in the off peak;
- Chingford Mount is linked to Stratford via service 158, This is a 12 minute headway service but takes 50 minutes (off peak) to reach Stratford;
- Walthamstow is linked directly to Stratford via bus routes 67 and 257. Both run every eight minutes and are scheduled to take about half an hour to reach Stratford.

2.1.4 In addition to this, bus journeys undertaken during the peak hours can often be subject to delay through traffic congestion, adding ten to fifteen minutes to the otherwise long journey.

2.1.5 This existing lack of public transport provision has resulted in reduced accessibility for the residents of Chingford in comparison to residents living in close proximity to similar neighbouring rail lines. Figures 2.2 and 2.3 show the generalised time in accessing neighbouring zones for Chingford in comparison to Tottenham Hale using information from Railplan, Transport for London's public transport assignment model.

2.1.6 The greener the area, the more accessible it is for residents of Chingford or Tottenham Hale. Tottenham Hale can be seen as having access to a larger area of employment opportunities, with 864,117 jobs (Railplan 2006 jobs) being accessible within less than 80 minutes. In comparison Chingford has only 233,833 jobs within 80 minutes.

Figure 2.1 Overview of Available Bus Routes

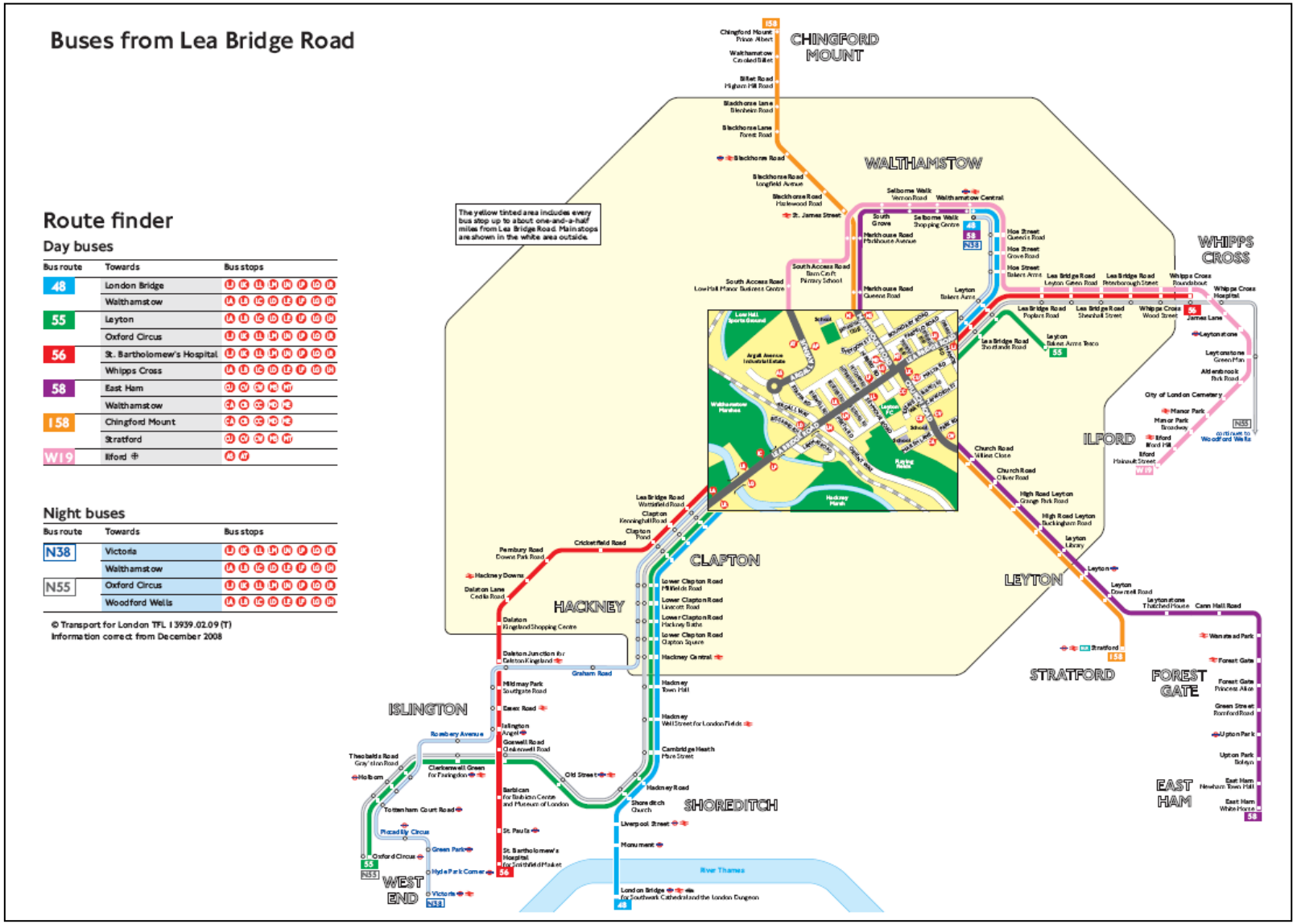


Figure 2.2 Generalised Time in Minutes from Chingford

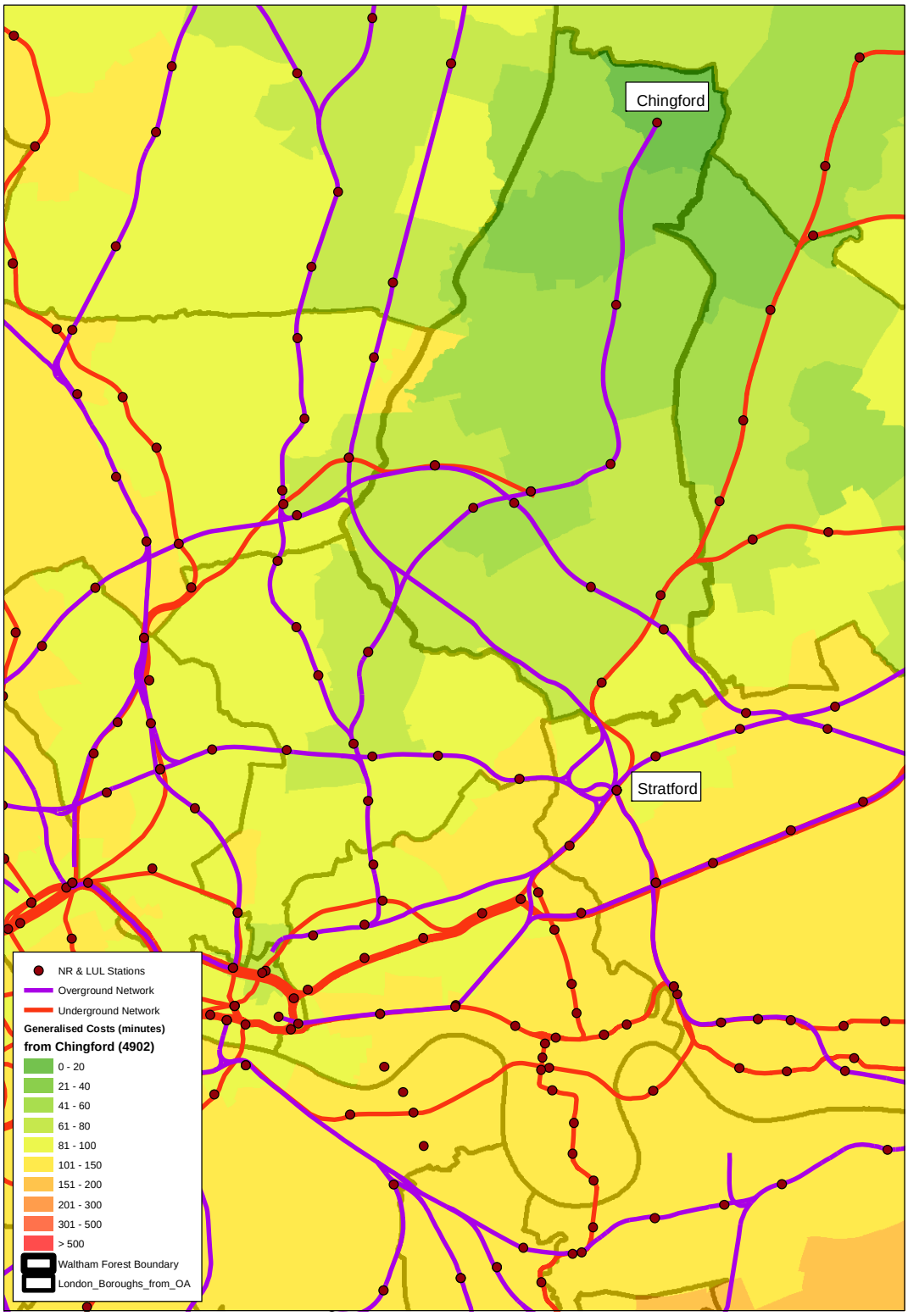
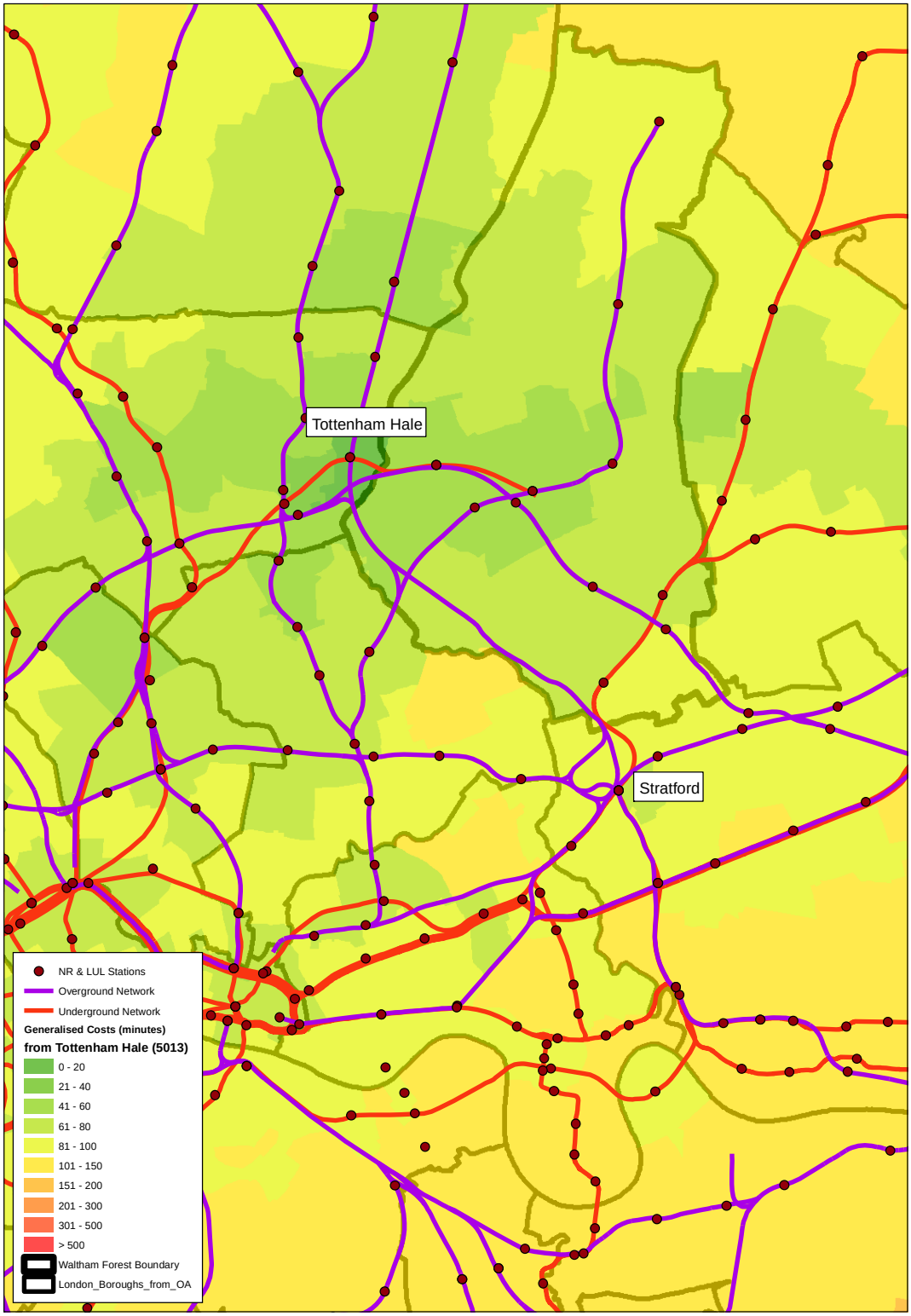


Figure 2.3 Generalised Time in Minutes from Tottenham Hale



2.1.7 Re-opening the Hall Farm Curve and allowing a train service to operate between Chingford and Stratford will significantly improve the public transport provision between these two

places reducing the journey times from between 30 to 50 minutes to less than 20 minutes by rail. It will also significantly improve the accessibility for Chingford residents to employment opportunities in Stratford, potentially allowing them access to 24,432 jobs (LTS 2006).

2.2 Existing Transport Provision: Lea Bridge Station

2.2.1 The Lea Bridge area is well-placed as a centre for future development but suffers from being isolated from the rail network and also lacks public transport linkage to Stratford. There is no direct bus service from Lea Bridge station to Stratford although route 158 stops at the junction of Markhouse Road and Lea Bridge Road and takes 20 to 25 minutes to reach Stratford. The lack of public transport provision is also highlighted by the low public transport accessibility level (PTAL) assigned to the area by TfL[2].

2.2.2 Although the disused station is currently surrounded by light industry there are plans for future housing developments in the area. Waltham Forest's Local Implementation Plan states that reopening the station could potentially lead to the construction of over 2,000 dwellings[3]. The GLA's Strategic Housing Land Availability Assessment (2009) includes 967 dwellings of constrained housing capacity within one mile of the station.

2.2.3 Reopening Lea Bridge station and connecting the area to the Chingford to Stratford rail line will provide the required links to Stratford and beyond. A further possibility, outside the scope of this study, is to stop the existing Stratford to Stansted service at Lea Bridge station, which will provide further access links for local residents.

2.3 Wider Transport Proposals

2.3.1 The Chingford to Stratford rail line is not the only proposed improvement to the rail network in this area. Significant improvements are also proposed for the West Anglia Main Line (WAML) by the Department for Transport. These are outlined in the 'West Anglia Main Line – Progress Report', dated March 2009.

2.3.2 The WAML is currently one of the most restricted routes into London with an intensive passenger service operating on only two tracks. Plans are proposed to increase the number of tracks from two to four and operate more frequent services to Stansted Airport and Cambridge in particular. This increase in passenger services will also support planned housing and employment development in the Upper Lea Valley.

2.3.3 Amongst the proposals is a plan to operate a four train per hour service between Northumberland Park and Stratford via Tottenham Hale. These services would use the same approach to Stratford as the Chingford service, and although the document is not specific on the subject, is also likely to use the same platforms too. As will be discussed in Chapter 4, there is insufficient capacity at Stratford for both services to run with out investment in additional infrastructure. This issue should be considered in more detail before plans for either scheme are finalised.

[2] Lea Bridge Planning Framework (October 2009), p25

[3] Waltham Forest's Local Implementation Plan (August 2007), Chapter 2, Section 5: Regeneration Opportunities

3 Infrastructure Costs

3.1 Introduction

3.1.1 Section 3 outlines the costs associated with the infrastructure for reinstating Hall Farm Curve (HFC) and the re-building of Lea Bridge station to contemporary standards. These costs include the cost of possession work to connect the curve into the existing network.

3.1.2 Appendix A provides a detailed breakdown of the various cost elements and any assumptions made when assembling the costs.

3.2 Methodology

3.2.1 As a base case the workscope used is that described in detail in the Hyder Consulting Limited report WX20741/D1/3, Option 2. This option includes a new double track curve at Hall Farm allowing trains to pass, the demolishment of redundant structures at Lea Bridge station, the reinstatement of two platforms and the new construction of a ticket office and a lift served passenger bridge connecting the platforms.

3.2.2 A number of minor changes have been made to the Hyder scope to reflect contemporary standards and to reduce cost. These are:

- The reduction to a minimal level the platform and ticketing passenger facilities at Lea Bridge; and
- The re-positioning and re-alignment of the track along the Hall Farm curve and the connections at either end to comply with current track design requirements and components to allow a 40mph train speed throughout.

3.2.3 As part of the estimating methodology a basic construction and possession plan was developed to determine construction and implementation timescales. Current track access conditions were drawn from Network Rail's Rules of the Route. Most of the work involved in constructing the curve and rehabilitating Lea Bridge station can be undertaken without affecting train running. However, overnight possessions (approximately 60) will be required for the platform work, laying of signalling cabling, construction of track cabinet bases and electrification works.

3.2.4 Up to six weekend closures of either the Chingford or Lea Bridge lines, potentially both, will be required to lay the curve switches and crossings, make connections and commission the signalling and electrification works. It is envisaged that providing these possessions are available the works can be undertaken in approximately nine months from site establishment to implementation. The weekend possessions may well have to be booked 18 months in advance of the works; details will be determined by Network Rail at the time the project is initiated.

3.3 Infrastructure Costs

3.3.1 Table 3.1 provides an overview of the total costs for each different option. The first column details the cost at 2009 prices assuming a 2015 construction year as detailed in Appendix A. These costs are what the scheme would cost today, should it be constructed.

3.3.2 The second column presents the cost assumed in the calculations for the business case which are in 2002 prices and discounted to 2002. It is a DfT requirement that appraisals are conducted in 2002 prices and discounted to 2002 which ensures that all appraisals are conducted on a consistent basis. Given the early stage of scheme development these estimates include a 66% optimism bias as suggested by DfT Webtag Guidance Unit 3.5.9.

Table 3.1 Infrastructure Costs

Scheme	2009 Cost	Appraisal Cost
Double track HFC & Lea Bridge	£24.3m	£28.4m
Single track HFC & Lea Bridge	£18.4m	£21.9m
Double track HFC no Lea Bridge	£20.0m	£23.7m
Single track HFC no Lea Bridge	£14.3m	£17.0m
Build Lea Bridge station separately	£4.64m	£5.2m[4]

3.3.3 The additional cost of building Lea Bridge station in conjunction with Hall Farm Curve is approximately £4.2m. The cost of building Lea Bridge station separately, for example, if it were to be re-opened at a later stage from the re-instatement of HFC as part of wider development, would be £4.64m. This is slightly higher than building the station as part of the overall scheme due to economies of being able to 'share' possession between the two elements of the project.

3.3.4 Note that the costs presented in Table 3.1 are in October 2009 prices. In the current economic climate, construction costs have decreased by over 8% in the last 20 months. This should be borne in mind as construction costs could potentially increase significantly in the future.

3.3.5 In compiling these costs, discussions were held with Network Rail and Transport for London to ensure that up to date costs and methodologies were used and that any local knowledge of the service operations was considered.

3.3.6 Network Rail has indicated that new services on the network in this area may exceed the existing supply of electricity. Should this be the case then an additional feeder station will be required. This has not been included in the costs above as would be required for any future enhancement of any services operating within the wider area. It would also be detrimental to assume that the Chingford to Stratford scheme would have to cover all of the costs of the feeder station when wider services would ultimately benefit as well.

[4] This is assuming an opening year of 2020 if the station were to open at a later date: it should be noted that assuming a different opening year would lead to a change in the appraisal cost due to discounting see Appendix D.

4 Operational Feasibility

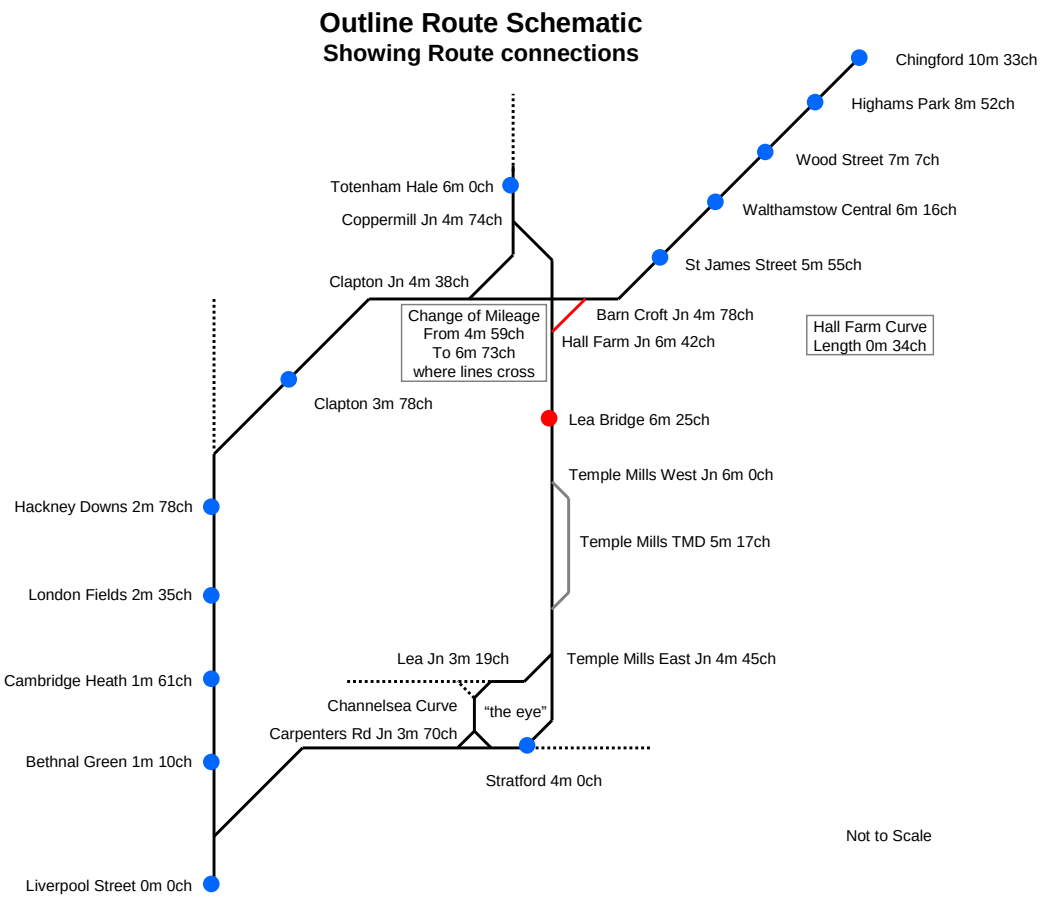
4.1 Introduction

4.1.1 This section demonstrates that running a fours trains per hour service between Chingford and Stratford via the reinstated Hall Farm Curve is operationally feasible as well as assessing the rolling stock, train crew and other cost implications of running this service. Further detail about the methodology and assumptions are presented in Appendix B.

4.2 Operational Feasibility

4.2.1 Figure 4.1 shows the infrastructure over which the Chingford – Stratford service will operate. It will call at all stations from Chingford to Barn Croft Junction, then take the reinstated Hall Farm Curve and Junction (shown in red in Figure 4.1), call at the reopened Lea Bridge Station and terminate at Stratford.

Figure 4.1 Outline Route Schematic



4.2.2 Figures 4.2 and 4.3 show the proposed off-peak timetables for the service together with the existing Stansted Airport service, which uses the platforms at Stratford station (platforms 11 and 12), that the Chingford to Stratford service would use.

Figure 4.2 Chingford to Stratford Proposed Timetable

Stansted Airport					12:03:00
Tottenham Hale					12:55:00
Chingford	12:02:00	12:17:00	12:32:00	12:47:00	
Highams Park	12:06:00	12:21:00	12:36:00	12:51:00	
Wood Street	12:09:00	12:24:00	12:39:00	12:54:00	
Walthamstow Central	12:11:00	12:26:00	12:41:00	12:56:00	
St James Street	12:13:00	12:28:00	12:43:00	12:58:00	
Lea Bridge	12:17:30	12:32:30	12:47:30	13:02:30	
Stratford	12:24:00	12:39:00	12:54:00	13:09:00	13:05:00

Figure 4.3 Stratford to Chingford Proposed Timetable

Stratford	12:01:00	12:16:00	12:31:00	12:33:00	12:46:00
Lea Bridge	12:08:00	12:23:00	12:38:00		12:53:00
St James Street	12:12:00	12:27:00	12:42:00		12:57:00
Walthamstow Central	12:14:00	12:29:00	12:44:00		12:59:00
Wood Street	12:16:00	12:31:00	12:46:00		13:01:00
Highams Park	12:19:00	12:34:00	12:49:00		13:04:00
Chingford	12:24:00	12:39:00	12:54:00		13:09:00
Tottenham Hale				12:43:00	
Stansted Airport				13:18:00	

4.2.3 The proposed working timetable shown in Figures 4.2 and 4.3 for the new service has been devised and analysed to meet the following criteria:

- the additional trains can be fitted around existing train services; no existing trains services are withdrawn or significantly retimed
- the only alternations required to existing train services will be a minor re-timing of the Stratford to Stansted service (as shown in Figures 4.2 and 4.3), and possibly some freight services
- a regular 15-minute interval Chingford to Stratford service is provided throughout the day, except that one Chingford – Stratford service has to be missed out during the AM peak due to capacity constraints
- no additional infrastructure is required other than Hall Farm Curve and Lea Bridge Station
- the timings of the service meet Network Rail's 'Rules of the Plan' (ROTP) that specifies the operational criteria that must be met for a robust service to be operated.

4.2.4 In developing a working timetable a number of constraints were identified. These are discussed in more detail in Appendix B with the key issues highlighted below:

- Chingford Station has three platforms, but Platform 1 can only be used for terminating services, as the 'up' line cannot be directly accessed from this platform: this is not a

problem for the level of service we are considering as long as the turnaround time for services is not excessive. There is also scope for conflicting movements at the station throat. For example, a train cannot arrive in platform 3 at the same time as one is leaving platform 2;

- At Higham's Park there is a level crossing. Additional trains will increase the amount of time that the gates are closed, reducing the capacity of the road. However, a transport assessment undertaken on behalf of Tesco (Waterman Boreham Ltd. (2009), Supplementary Transport Assessment for Highams Park on behalf of Spenhill) showed that all traffic queues would clear between road closures with 8tph. Discussions with Waltham Forest Council Highway Department suggest that the increased closure would not have an adverse impact on the feasibility of the Chingford to Stratford rail link, but that the impact on the reliability of the bus services should be investigated. In addition to this traffic management measures at Highams Park should be considered as part of the implementation process of the rail scheme.
- Hall Farm Curve: while the core scheme assumes this is reinstated as a double track curve, a single track option is also considered in the development of the business case. If the latter was adopted, trains in opposite directions would need to be timed so as not to meet on the curve;
- Stratford station: the signalling and platform layout at this location presents the single most challenging constraint on the current exercise. Several solutions are discussed in Appendix B, of which the recommended solution is to move the Stansted service to Platform 11, and have it leave Stratford by running round the Channelsea curve. Investigations have been required to establish that this curve can be used for passenger trains in service: this was not the case until recently, but the necessary upgrade was recently undertaken to facilitate changes to North London line services. This leaves Platform 12 available for exclusive use by the Chingford service.

4.2.5 It should be stressed that the current exercise is one of establishing feasibility, not one of optimisation. Through more detailed timetabling work, potentially involving changes to trains elsewhere on the West Anglia main line, it may be possible to produce a timetable that delivers more robust performance and more attractive timings, but that is not within the scope of the current study.

4.2.6 It should also be noted that this proposal assumes that DfT's proposed Northumberland Park to Stratford service is not introduced. This would require a further 3 trains paths per hour to be found between Coppermill Junction and Stratford, as well as platform capacity to turn all of these services[5]. In principle, it may possible to find the additional train paths, but the platform capacity certainly is not available in the current layout. This implies that any proposal to terminate a total of 8tph at Stratford is going to require infrastructure investment to create additional platforms.

4.2.7 The operational analysis showed that it is feasible to operate the proposed timetable on a single track chord. However, there are two major disadvantages to this:

- With a single track chord, the performance of the service is likely to be at risk. If any single train is delayed entering the chord, this will cause a knock-on effect to every

[5] The DfT proposal is for the Northumberland Park to Stratford service to be 4tph, but the Stansted – Stratford service would be withdrawn in their proposal, hence the net increase in trains is 3tph.

train in the timetable. However, the impact of this has not been quantified in this work as it requires detailed simulation modelling;

- A single track chord would not allow more than four trains per hour to operate, which conflicts with the long term aspirations. In particular, it would not be possible to support Network Rail's proposal to operate all trains from Chingford to Liverpool Street via Stratford.

4.2.8 For the above reasons, it is therefore recommended that the Hall Farm Curve is a double track chord.

4.3 Operational Costs

4.3.1 Operational costs are any additional operating expenses incurred by the incumbent Train Operating Company in providing rolling stock, crew, station staff and meeting any additional track access charges.

4.3.2 The operational costs are based on the operation of four 4-car units operating four services per hour in each direction. The service is calculated to operate over 1,376 miles and require 12 drivers and conductors per day.

4.3.3 The annual operational costs in 2002 prices are shown in the following table. An optimism bias of 10% was applied to staff costs and 20% to both train leasing and station costs.

Table 4.1 Estimated Annual Operational Costs

Annual Operating Cost	Lea Bridge Open	Lea Bridge Closed
With Optimism Bias	£5.19m	£4.95m
Without Optimism Bias	£4.64m	£4.44m

4.3.4 Station operational operating costs are assumed to be £200,000 per annum in 2002 prices. This assumes a staff presence at the station for four hours a day, six days a week.

5 Demand and Impacts on Travel Patterns

5.1 Introduction

5.1.1 Railplan, TfL's public transport assignment model, was used to forecast the anticipated number of passengers on the proposed Chingford to Stratford rail service as well as the expected use of Lea Bridge station.

5.1.2 Details of the forecasting methodology and assumptions are included in Appendix C.

5.2 Changes to Existing Travel Patterns

5.2.1 One of the key consequences and benefits of introducing any new scheme is the opportunities that it opens up to residents and employers in an area. This increase in accessibility leads to changes in travel patterns, which needs to be estimated and assessed as part of the impacts of a scheme.

5.2.2 There are two distinct changes to travel patterns, both of which were taken into account when assessing the Chingford to Stratford rail scheme and re-opening of Lea Bridge station:

- Changes in work or residential locations; looking at how travel demand is redistributed given the new opportunities provided by the scheme; and
- The number of new trips that are now feasible, thereby leading to the generation of new demand.

5.2.3 As would be expected, the impact of the redistribution of demand affected the area of North Waltham Forest the most, with the most significant increase in demand being between North Waltham Forest and the London Borough of Newham where Stratford is located (an increase in demand of 22%[6]). Through improved access to central London via an interchange at Stratford station, demand increases were also seen between North Waltham Forest and the City (5.8%), Westminster (5.9%) and Tower Hamlets (16.9%).

5.2.4 The effect of the scheme on generating new trips is minimal with 244 estimated induced trips in the 2016 Lea Bridge open scenario. The majority of these trips were from Waltham Forest to Central London and Tower Hamlets. This pattern was repeated in the other scenarios with 265, 269 and 291 extra trips for the 2016 Lea Bridge closed, 2026 Lea Bridge open and 2026 Lea Bridge closed scenarios respectively.

5.3 Estimated Demand on the Chingford to Stratford Rail Service

5.3.1 Table 5.1 shows the modelled flows for the Chingford to Stratford and Chingford to Liverpool Street services for each modelled year and scenario for the morning peak period (0700-1000). The first two columns are the reference case scenarios and then for each year flows are presented assuming that Lea Bridge station is opened (LB) or closed (NLB). Flows on the Chingford to Stratford rail line increase when Lea Bridge station is not re-opened. This is

[6] Figures based on the change in demand between the 2016 reference case and the 2016 redistributed scenario assuming Lea Bridge station is re-opened.

due to an assumed reduction in travel time, due to the train not stopping at Lea Bridge station.

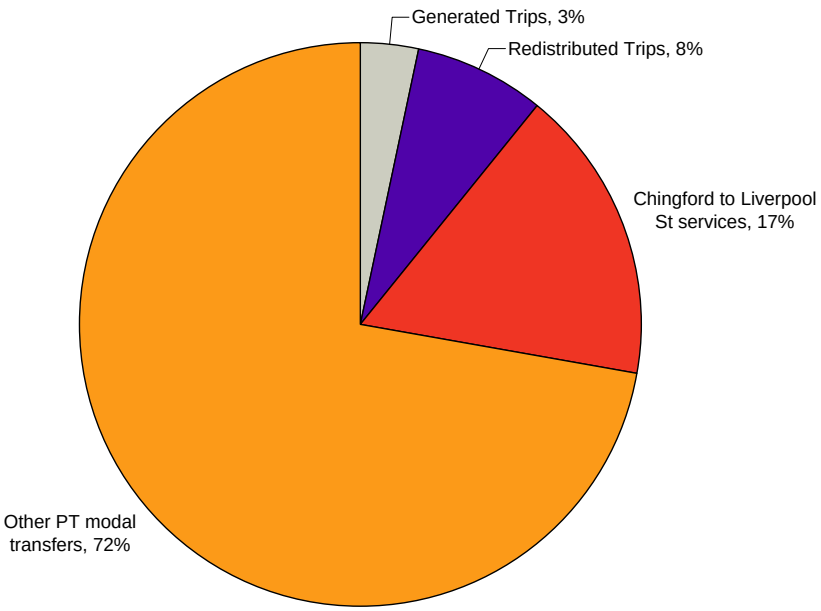
Table 5.1 Modelled Flows on the Chingford to Stratford / Liverpool Street Rail Lines

Service	2016 Ref	2026 Ref	2016 LB	2016 NLB	2026 LB	2026 NLB
Chingford – Stratford	-	-	3,224	3,364	3,500	3,716
Stratford – Chingford	-	-	709	683	802	782
Chingford – Liverpool St	6,040	6,228	5,421	5,467	5,603	5,715
Liverpool St - Chingford	385	419	521	518	563	559

5.3.2 Table 5.1 shows a reasonable flow of passengers using the Chingford to Stratford service, over 4,000 people in the AM peak, which is over 60% of the demand on the Chingford to Liverpool Street service currently operating. While some of this demand is abstracted from the Chingford to Liverpool Street service, the majority of the demand is abstracted from bus services, which are currently serving this area.

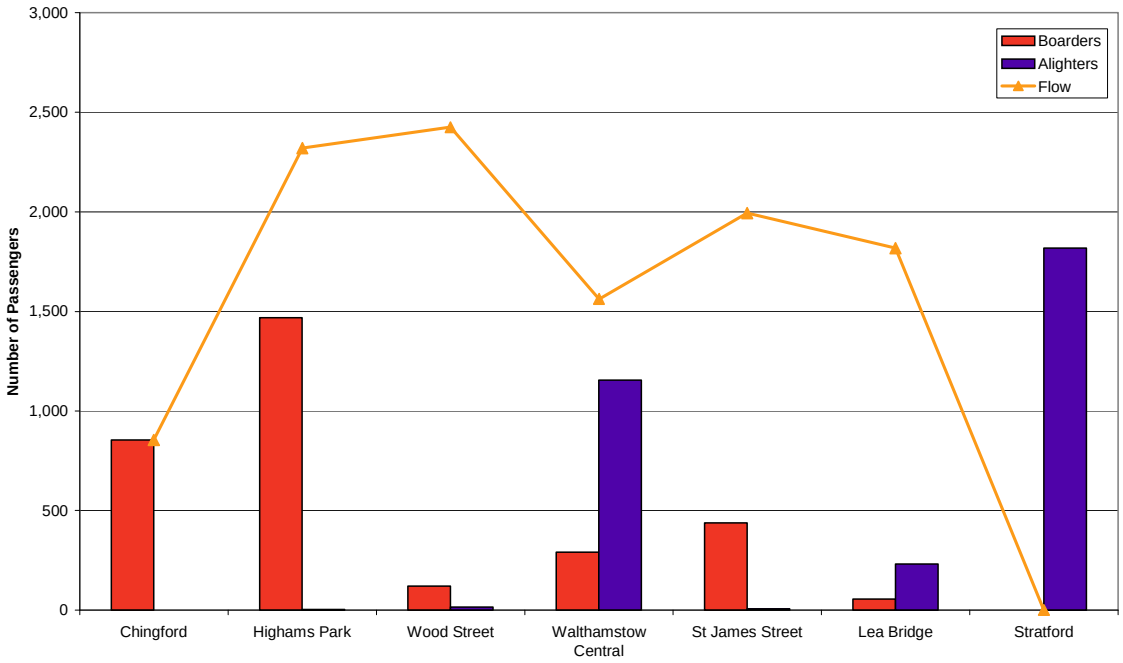
5.3.3 Figure 5.1 shows where journeys made on the Chingford to Stratford services have been abstracted from. The vast majority of the trips abstracted from other PT modal transfers are from bus services in the local area.

Figure 5.1 Chingford to Stratford Abstraction of Trips for 2016 Lea Bridge



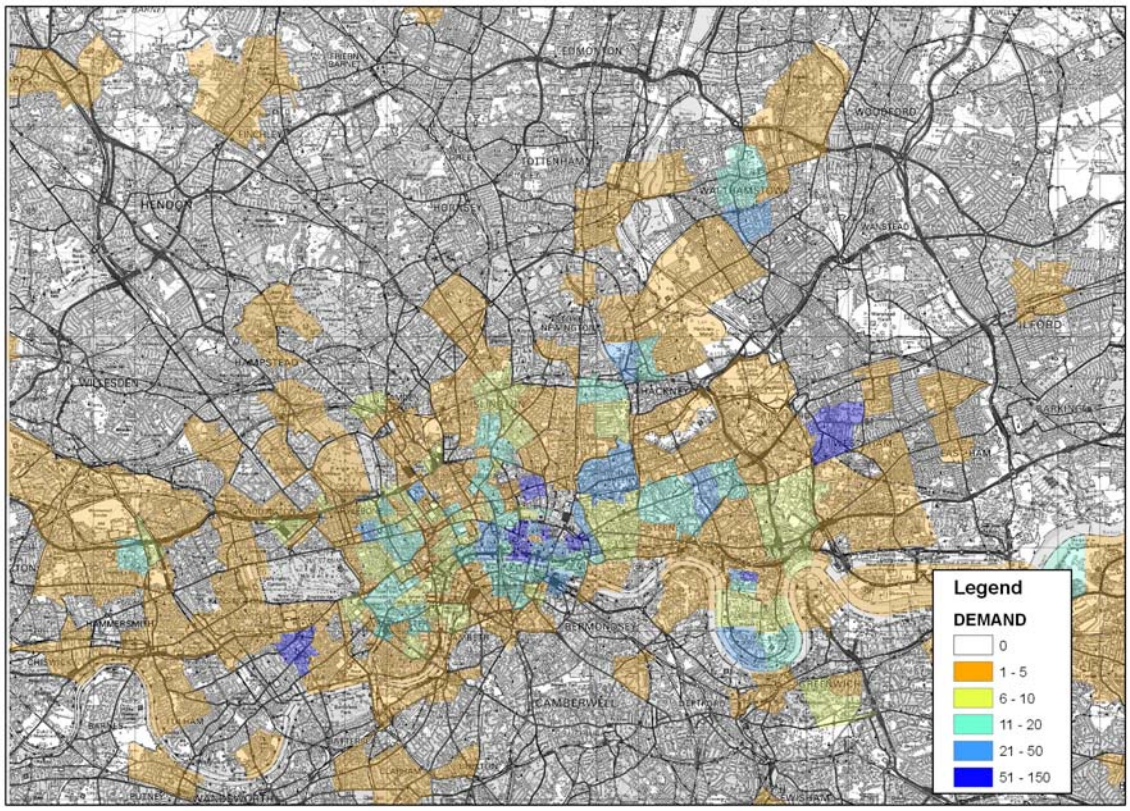
5.3.4 Figure 5.2 shows the demand for the service by station, showing that the majority of people board the service at Chingford and Highams Park and alight at Walthamstow Central or Stratford. This profile is slightly different for the reverse service from Stratford to Chingford, with the majority of people boarding at Stratford and Walthamstow Central and alighting at Walthamstow, Highams Park and Chingford.

Figure 5.2 Chingford to Stratford Line Profile: 2016 Lea Bridge



5.3.5 56% of the expected passengers on the Chingford to Stratford rail line in the morning peak are anticipated to alight at Stratford. 95% of these passengers are expected to interchange at Stratford with the vast majority going to a range of destinations in Docklands and Central London. Figure 5.3 shows the destinations of all passengers using the Chingford to Stratford service in the 2016 scenario with Lea Bridge open. The bluer the area the higher the number of people ending their trip in that particular Railplan zone. Popular destinations of passengers of the Chingford to Stratford service include Stratford, the Isle of Dogs, the City, and Central London.

Figure 5.3 Passenger Destinations of the Chingford to Stratford Rail Service



5.4 Lea Bridge Station

5.4.1 Table 5.2 shows the number of people estimated to board and alight the train service at Lea Bridge station in the AM peak period. The numbers show that even after redistribution and growth uplift the estimated passengers are relatively low and hence further analysis was undertaken to substantiate this figure.

Table 5.2 Number of People Boarding and Alighting at Lea Bridge Station

Service	Output	2016 LB	2026 LB
Chingford – Stratford	Boarders	54	85
Chingford – Stratford	Alighters	233	233
Stratford – Chingford	Boarders	6	7
Stratford – Chingford	Alighters	61	85

5.4.2 The anticipated level of demand at Lea Bridge station was compared with modelled passenger information for similar stations, in particular Highams Park station. Even taking into account that there are a lower number of dwellings in the vicinity of Lea Bridge, due to

industrial land use, the number of trips at Lea Bridge station is lower than would be expected.

5.4.3 Development is anticipated around the Lea Bridge station as specified in the GLA's 2009 Strategic Housing Land Availability Assessment (SHLAA). At least some of this development is reflected in the Railplan demand through an increase in origins and destinations around Lea Bridge station between 2006 and 2016/2026.

5.4.4 Due to the estimated low demand of Lea Bridge station, it is unlikely that the station would be implemented for economic reasons. However, re-opening the station would significantly increase the levels of accessibility for surrounding residents and will be particularly important if the area is to be significantly re-developed in the future.

5.4.5 Despite this, the additional passengers Lea Bridge station attracts needs to be traded off against the time penalty imposed on other users of the service. This is apparent as more people are estimated to use the Chingford to Stratford service when the service is not scheduled to stop at Lea Bridge station.

5.5 Chingford to Stratford: 11 Services in AM Peak

5.5.1 Given the timetable constraints resulting from the additional Chingford to Liverpool Street service in the morning three hour peak period in the existing timetable, model runs were also undertaken with only 11 (previously 12) Chingford to Stratford services in the morning peak period.

5.5.2 The reduction in the number of services results in a reduction of 9% of passengers on the Chingford to Stratford service and 7% of passengers boarding and alighting at Lea Bridge Station.

6 Economic Appraisal

6.1 Introduction

6.1.1 There a large number of different sources of cost and benefit associated with the scheme that can be quantified. These have been brought together in an economic appraisal.

6.1.2 At a fundamental level the economic appraisal assesses the cost of the scheme against the resulting benefits. Simply comparing these values is not in itself meaningful, as while costs tend to 'front loaded' towards the construction phase of the project, the benefits will reaped over a much longer period. In order to assess the long term worth of a scheme are considered over a longer time horizon – typically 60 years – to determine the Net Present Value and Benefit to Cost ratio of the scheme, and this a the basis of the economic appraisal process.

6.1.3 The process followed is compliant with both DfT and TfL appraisal methodologies and is detailed in Appendix D.

6.2 Scheme Costs

6.2.1 The economic costs are divided into two categories:

- Capital expenditure on all infrastructure, maintenance and renewal costs related to construction of Hall Farm Curve and reopening of Lea Bridge station. This information was presented in Section 2; and
- Operating expenditure borne by the Train Operating Company (TOC) and includes train leasing costs, station and train staffing costs and track access charges, described in Section 3.

6.2.2 For the purpose of appraisal a risk premium is applied to the scheme capital to reflect the risks and likelihood of each occurring. Optimism biases are also applied to capital and operating costs, in line with DfT WebTAG guidance to account for the consistently observed underestimation of costs in major construction projects.

6.2.3 All costs in the appraisal were inflated to cash, converted to market prices, deflated to base cost year prices and discounted to the discount base year.

6.3 Scheme Benefits

6.3.1 Benefits will change from year to year as demand grows and other factors change: modelling all 60 years will not be practical, so the approach adopted was to model 2016 and 2026 and to interpolate and extrapolate the benefits in the remaining years.

6.3.2 In line with DfT WebTAG guidance, the following benefits have been calculated for each scenario:

- Time saving benefits
- Highway decongestion benefits;

- Vehicle operating cost savings;
- Changes in indirect tax revenue;
- Environmental benefits; and
- Accident cost savings.

6.3.3 Further detail about how these benefits were calculated and assumptions are described in Appendix D.

6.3.4 The results of the business case are shown in the following table. Results are presented against constructing a single or a double track curve at Hall Farm as well as with and without the opening of Lea Bridge station (LB, NLB respectively). All figures (with the exception of the Benefit-Cost Ratio (BCR)) are shown in £m at 2002 prices. The BCR is calculated from the table as (NPV benefits / (NPV Costs – NPV Revenue)).

Table 6.1 Appraisal Summary

Benefit/Cost	LB Single Track	LB Double Track	NLB Single Track	NLB Double Track
NPV Benefits	281.84	281.84	306.26	306.26
NPV Revenue	35.96	35.96	33.77	33.77
NPV Costs	122.38	129.35	112.94	119.66
BCR	3.26	3.02	3.87	3.57

6.3.5 The benefits and revenues differ depending on whether Lea Bridge station is re-opened or not. The benefits are slightly larger with Lea Bridge station closed as a large proportion of the benefits are time saving benefits as an additional two minutes time saving was modelled when the train did not stop at Lea Bridge station.

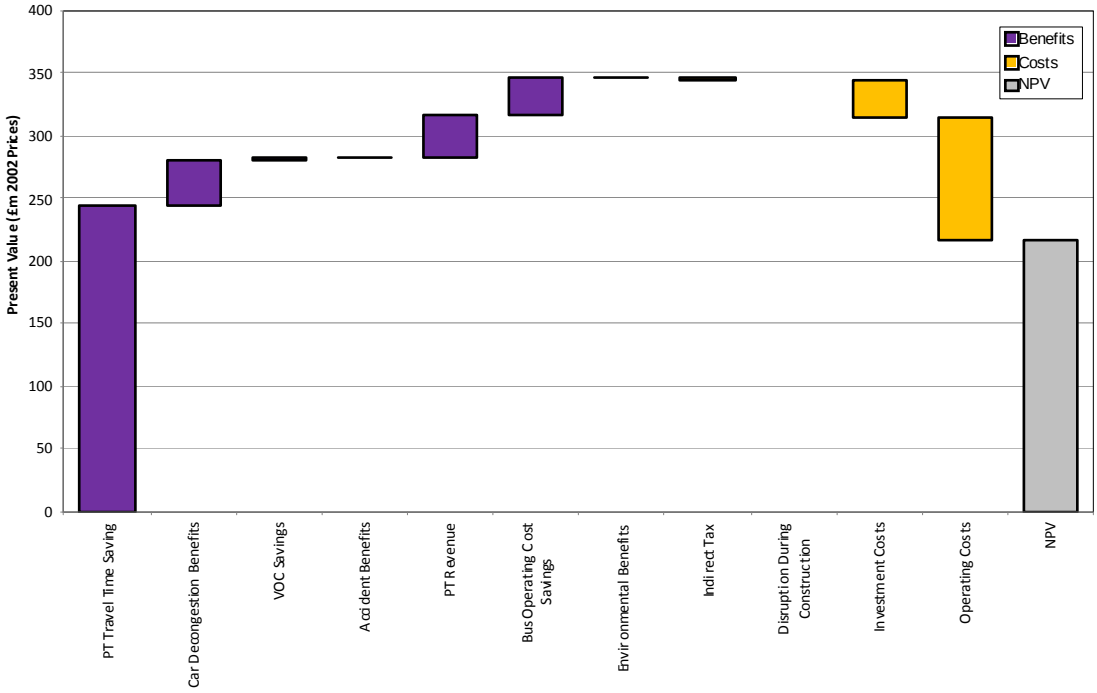
6.3.6 The NPV Costs include the initial construction costs as well as the on-going station and train operating costs. The costs of each scheme differ depending on whether there is a single or double track curve and with or without Lea Bridge station, with the double track curve with Lea Bridge station being the most expensive.

6.3.7 In all cases, the BCR is positive and greater than two, indicating that all schemes represent good value for money in government spending terms. It should be noted that all the scenarios assume a 1% annual growth in passenger volumes from 2026 onwards, in line with guidance provided by WebTAG and PDFH. If this growth is removed, the BCR for the Lea Bridge, double track scenario (which has the lowest BCR) reduces from 3.02 to 2.41, which still represents good value for money.

6.3.8 The impact of opening Lea Bridge station results in an incremental change to the BCR of -3.37 assuming a single track and -3.26 assuming a double track at Hall Farm curve. Therefore, whereas the overall scheme has a reasonable BCR, the opening of Lea Bridge station is not beneficial from an economic point of view.

6.3.9 The relative importance of each benefit and cost in the appraisal can be shown using a 'waterfall' chart as in Figure 6.1. This shows that the majority of the scheme benefits are a result of time savings on the public transport network. The scheme is also shown not to produce a significant amount of revenue. In terms of costs, the figure shows that the operating costs spread over the lifetime of the scheme are greater than the initial capital expenditure required.

Figure 6.1 Waterfall chart of Economic Appraisal Results for the Lea Bridge Open and Double Track Hall Farm Curve



6.4 Chingford to Stratford: 11 Services in AM Peak

6.4.1 The modelling results from the sensitivity test of 11 trains in the morning peak from Chingford to Stratford services were also tested in a business case. The results and comparisons to the original business case results are shown in the following table.

Table 6.2 Appraisal Summary: 11 Trains in AM Peak Period (0700-1000)

Benefit/Cost	Single Track 11 trains	Single Track 12 trains	Double Track 11 trains	Double Track 12 trains
NPV Benefits	267.79	281.84	267.79	281.84
NPV Revenue	35.58	35.96	35.58	35.96
NPV Costs	122.36	122.38	129.33	129.35
BCR	3.09	3.26	2.86	3.02

6.4.2 As would be expected these results show that with only 11 trains in the morning peak there is small reduction in the strength of the business case, nether-the-less the overall BCR is still greater than two.

7 Conclusions and Next Steps

7.1 Conclusions

7.1.1 The study examines the operational and economic feasibility of re-introducing a train service between Chingford and Stratford and the re-opening of Lea Bridge Station.

7.1.2 Overall the analysis showed that the scheme addresses important 'gaps' in transport provision, is operationally feasible and represents good value for money.

The Need for the Service

7.1.3 Relative to neighbouring areas east and west, the catchment of the Chingford branch suffers from poor connections to Stratford. This means that access is impaired to the major employment opportunities, in particular at Stratford. Re-opening the Hall Farm Curve and allowing a train service to operate between Chingford and Stratford would significantly improve the public transport provision and the accessibility for Chingford residents to employment opportunities in Stratford, potentially allowing them access to 24,432 jobs (LTS 2006).

7.1.4 Similarly reopening Lea Bridge station and connecting the area to the Chingford Stratford rail line would provide essential public transport provision, which the area is currently lacking. In particular, this will be important if future housing construction is to be realised.

Infrastructure Costs

7.1.5 An assessment of the infrastructure costs, suggests that the scheme costs range from £14.3m, assuming a single track line for Hall Farm Curve and without the re-opening of Lea Bridge station to £24.3m (double track and Lea Bridge station).

7.1.6 A cost for constructing Lea Bridge station independently was also calculated, of £4.64m. This may be important should it be desired to provide the Chingford to Stratford service first followed by the re-opening of Lea Bridge station at a later date, for example when further housing is constructed.

Operational Feasibility

7.1.7 The analysis demonstrated that running a fours trains per hour service between Chingford and Stratford via the reinstated Hall Farm Curve is operationally feasible. In developing the service, a number of potential future considerations were highlighted:

- Traffic management measures may need to be considered around the Higham's Park level crossing to ensure that the increased closure would not result in a significantly adverse impact on the traffic;
- Hall Farm Curve: the core scheme assumes this is reinstated as a double track curve; a single track option would mean that trains in opposite directions would need to be timed so as not to meet on the curve;
- Stratford station platform utilisation: it is recommended to move the Stansted service to Platform 11, and have it leave Stratford by running round the Channelsea curve, thereby allowing Platform 12 available for exclusive use by the Chingford service.

Forecasting and Economic Appraisal

7.1.8 The forecasting of demand for the service, undertaken in Railplan, showed that there was a reasonable level of demand for the Chingford to Stratford rail services. However, there was less of a demand for people using the Lea Bridge station. The lack of demand is partly due to low public transport trip rates in the area, reflecting the existing poor level of public transport provision. However, even with increased public transport provision it is unlikely that the station would generate sufficient demand to justify the re-opening of Lea Bridge station as a stand-alone business case.

7.1.9 Therefore, whereas the overall scheme represents good value for money with BCRs in the range of 3.02 - 3.87, the incremental BCR for Lea Bridge is -3.37 assuming a single track curve and -3.26 assuming a double track curve at Hall Farm Curve.

7.1.10 The appraisal highlights that whereas the overall scheme is value for money, Lea Bridge station represents poor value for money. It is an additional cost to the scheme and does not generate sufficient benefits to outweigh the costs of the station. Therefore whereas a small number of passengers boarding and alighting at Lea Bridge station will benefit, this needs to be compared against the dis-benefit that it will cause other rail passengers using the service through the additional time required to stop at the station.

7.2 Next Steps

7.2.1 The next step is to work with neighbouring councils and TfL to harness their support before approaching DfT or other bodies.

7.2.2 One of the key aspects that requires further investigation is the impact that the WAML proposals will have on the Chingford to Stratford rail line. We recommend that this is investigated further, both in terms of operational feasibility of running the two train services as well as from a demand forecasting and economic appraisal point of view. It may be that one scheme offers significantly more benefits, or has a higher BCR relative to the other.

7.2.3 Other variants of the Chingford to Stratford rail service that were not tested in the modelling, but may have an impact on the demand include:

- Stopping the Stratford to Stansted service at Lea Bridge station; and
- Running trains from Chingford to Liverpool Street via Stratford.

7.2.4 These aspects could be tested in future modelling scenarios if required. We would recommend that any future work involves the liaison with TfL, in particular, to ensure that the scheme is recognised in their future planning process.

Appendix A – Infrastructure Costs

1 Introduction

1.1 The tables below provide a detailed breakdown of the cost estimate of construction of the infrastructure required to rebuild the Hall Farm curve and also Lea Bridge station to allow the re-opening of a Stratford to Chingford rail link.

1.2 Five cost estimates have been detailed:

- A single line connection at Hall Farm and the rebuilding of Lea Bridge station together
- A double line connection at Hall Farm and the rebuilding of Lea Bridge station together
- A single line connection at Hall Farm without rebuilding Lea Bridge station
- A double line connection at Hall Farm without rebuilding Lea Bridge station
- The rebuilding of Lea Bridge station if undertaken separately to the Hall Farm curve

1.3 A commentary has been provided below where further detail explains the cost build up

1.4 All of the costs rates used have been built up using:

- Network Rail agreed schedule rates where these are available.
- Spon's Railways Estimating guide, 2009
- Comparison estimates and output costs from similar UK railway infrastructure schemes as a check

1.5 All rates used have been adjusted to an October 2009 base where this is applicable. It must be noted that the rail infrastructure and general civil engineering industry has seen a significant reduction in the predicted construction rates increase over the last 18 months. This has resulted in an Infrastructure Cost Estimate lower than would have been expected if construction trend had increased at the rate predicted from 2000-2007 and may likely be a short term effect.

1.6 The estimates produced have been formatted and grouped in the same headings as those used in the reference Hyder Consulting Limited study report to allow comparison of cost.

2 Commentary

Site Preparation

2.1 These costs include site mobilisation costs and the setting up of Portakabins on the railway land between the Chingford and Lea Bridge lines. Road access is difficult to this site and a considerable amount of railway construction material will need transportation by road. The estimate includes the building of a haul road, site access and secure fencing for the site.

2.2 The south end of the curve goes over a bridge over the culverted river. Whilst there is no reason to suspect this bridge may require remedial work an inspection is included to confirm

this. Inspection work is also included for the road over rail bridge at Lea Bridge station to confirm the status of the abutments and structure following demolition.

2.3 Additional expenditure is included for letter drops and other community relations work.

Permanent Way

2.4 Current Network Rail standards have been applied which vary to a small degree from those applied previously be Hyder. It has been assumed that the railway will be built to Track Category 1/2 standards owing to the volume of traffic. New material will be used

Earth Structures

2.5 The original formation of the Hall farm curve accommodated a double line. Since being dismantled railway standards have changed in that the double line track separation has increased and there is now a requirement for a safe cess pathway on either side of the track. In addition, over the years of abandonment, the embankment has slipped and deteriorated.

2.6 Therefore to construct an adequate double track formation with contemporary substrate and sufficient room for electrification, signalling and other structures requires considerable earth structures constructions to widen the embankment top. The work estimated includes the provision of soil nailing, use of gabion embankment footings, a widened embankment top to accommodate the track form and a small curve realignment to allow for a 40mph transit speed.

2.7 The single line chord and associated infrastructure can be accommodated on the existing embankment without major new earth works required for the double line apart from those to construct a stable and consolidated formation.

Station Works

2.8 The cost estimate includes only the very basic of facilities at Lea Bridge.

2.9 The existing platforms are of adequate construction but require being re-profiled to slope away from the track edge and have new topping, a tactile strip and coping stones. A platform extension to accommodate a 12-car, 20m vehicle train is included, built to match the current structure.

2.10 No platform awnings or other public cover is included; basic furniture, compliant lighting and Commutaport 'bus shelters' provide the only passenger comfort. The ticket office has no other facilities above those required by one staff member to sell tickets together with some automatic ticket machines.

Electrification and Signalling Works

2.11 The scope of works is as defined by Hyder. An adjustment has been made for the infrastructure required for the single line.

Highway Works

2.12 The provision of a A 'Kiss and Drop' lay-by and bus stop has been estimated together with safe pedestrian access paths and a Pelican crossing from Argall Way.

Ancillary Costs

2.13 Industry standard mark-ups have been used to estimate overhead and project management on-costs

2.14 A basic production schedule was produced to estimate the number of registered and Rules of the Route possessions required to undertake the work required. The possession regime allowed by Network Rail has a significant effect upon the estimate. It is envisaged that the major possessions planned will only be used to connect the chord once completed and where work has to be done on the present running railway. Therefore, the earthworks, track laying, paths, trough route, drainage, Lea Bridge platform works and the chord signalling and electrification will be constructed in a safe environment without effect to the current train service. If this is not possible, owing to changed Network Rail safety requirements in the future, the possession costs may increase considerably.

3 Detailed Cost Estimate – Hall Farm Curve (Single Line) and Lea Bridge Station

Description of Works	Total Cost
Site Preparation, Contractor Costs	385,000
Permanent Way Works	3,152,625
Earthstructure Works	301,860
Station Works (Buildings and Civils)	1,860,000
Station Works (Fixtures, Fittings, Electrical and Plant)	350,000
Signalling (based upon HyderScheme Plan- Validated)	2,882,500
Electrification Works	771,000
Highway Works (based upon Hyder Option 2 Proposal)	247,000
Sub total (Construction Cost)	**9,949,985**
Design Costs	1,160,000
Contractor Preliminaries, Overhead and Profit	2,188,997
Possession Costs	2,422,500
Sub total (Base Cost)	**15,721,482**
Project Contingencies and Network Rail On-cost	2,712,487
Total Construction Cost at October 2009 base	**18,433,969**

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Site Preparation, Contractor Costs							
Establishment of Site Offices	250,000	350,000	1	Item	325,000	325,000	Provisional Sum
						-	
Bridge Inspections	20,000	30,000	1	Item	25,000	25,000	
Local Communications and advertising	30,000	40,000	1	item	35,000	35,000	
Sub Total						**385,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Earthstructure Works							
Vegetation Clearance from area to be remediated	2.2	3.0	3,000	m2	2.5	7,500	
						-	
Remediation of current embankment on Chord						-	
Earth move - 15m wide by 2m deep	23	28	7,320	m3	26	190,320	620m in length
						-	
Track substrate preparation						-	
Single track	32	38	915	m	36	32,940	
						-	
Sand Blanket and geotextile layer						-	
Single track	75	105	290	m	90	26,100	
						-	
Construction of bases for location and equipment cases	3,000	5,500	10	No	4,500	45,000	Including Safety railing
Bases and piling for signals	1,500	2,250	10	No	2,000	20,000	
Sub Total						**301,860**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Permanent Way Works							
300mm ballast layer layed on pre-constructed substrate							
Single Line in Up direction at either end of chord	350	550	915	m	420	384,300	High cost for short length
						-	
NR60E 17.25 - 40mph transitioned crossovers	450,000	650,000	2	No	600,000	1,200,000	Difficult access
						-	
NR60E 17.25- Transitioned Turnouts						-	
Left hand - Chingford Branch	150,000	225,000	1	No	200,000	200,000	
Right hand - Lea Valley Line	150,000	225,000	1	No	200,000	200,000	
						-	
CEN60 Rails - double track						-	
Single track	350	450	1,830	m	425	777,750	
						-	
G44 Sleepers clips and fastenings on 600mm centres	55	73	1,525	No	63	96,075	Difficult access
						-	
Stressing	40,000	60,000	1	Item	30,000	30,000	Difficult access
						-	
Stabilisation, tamping and alignment works	10,000	15,000	2	No	12,500	25,000	Price per possession
						-	
Trackbed drainage, catchpits and pipeworks	225	350	620	m	175	108,500	
						-	
Provision of Safe Cess walkways, both sides of line	200	250	620	m	150	93,000	
						-	
Lineside signage	2,000	10,000	1	Item	3,000	3,000	Provisional Sum
						-	
Remedial and new work where necessary to lineside security fencing	20,000	40,000	1	Item	35,000	35,000	Provisional Sum
Sub Total						**3,152,625**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Buildings and Civils)							
Demolition and Removal of Existing Structures							
Ticket office (30m2 - Hyder Plan)	35,000	55,000	1	Item	50,000	50,000	Urban environment
Transfer Deck, podium and support bridge (126m2 - Hyder Plan)	55,000	75,000	1	Item	70,000	70,000	
Staircases	13,000	20,000	2	No	18,000	36,000	
						-	
Provision of repairs to existing bridge abutments			1	Item	50,000	50,000	Provisional Sum
						-	
Remedial work to existing platforms						-	
Clearance of Vegetation	2.2	3.0	312	m	2.5	780	2 platforms - each presently 156m long
Construction of platform crossfall and re-surface	350	450	312	m	400	124,800	
Fitting of tactile strip and coping stones	70	90	312	m	85	26,520	
						-	
Platform extension to accommodate 12 x 20m vehicles	1,300	1,650	168	m	1,550	260,400	Inclusive of ramps and 5m stopping tolerance
						-	2 platforms each extended 84m
New Structures						-	
New Ticket Office bordering Argall Way	550,000	750,000	1	Item	725,000	725,000	
Commutaport Shelters, 2 per platform	35,000	50,000	4	No	45,000	180,000	
Platform Seating (fixed)	1,500	1,750	10	No	1,500	15,000	
						-	
Passenger Overbridge						-	
Staircase 6m rise with landing - 2m width	52,000	65,000	2	No	60,000	120,000	
Passenger Overbridge - covered - 2.5m wide - 28m long	80,000	95,000	1	No	85,000	85,000	
Passenger lift structure including landings, lift pit and equipment room	22,000	25,000	2	No	23,000	46,000	
						-	
New wall at rear of platforms	55	85	480	m	75	36,000	
Security fencing facing Argall way	55	75	300	m	65	19,500	
General public signage	10,000	20,000	1	Item	15,000	15,000	Provisional Sum
Sub Total						**1,860,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Fixtures, Fittings, Electrical and Plant)							
Provision of Electrical Supply for buildings and lighting							
Supply Company installation and meter	65,000	90,000	1	Item	80,000	80,000	Provisional Sum
Electrical Supply for lift chamber						-	
						-	
Ticket Office fixtures and fittings	30,000	45,000	1	Item	35,000	35,000	Provisional Sum
						-	
Security Access Gates and Ticket Barrier	4,000	8,000	3	No	6,000	18,000	
						-	
Self Serve Ticket Machines	3,000	6,000	2	No	4,500	9,000	
						-	
Passenger lift, equipment and fixtures	35,000	60,000	2	No	45,000	90,000	
						-	
Platform Lighting	50,000	75,000	1	Item	65,000	65,000	Provisional Sum
Ticket office, bridge and lift lighting	15,000	22,000	1	Item	18,000	18,000	Provisional Sum
CCTV Cameras and equipment	2,500	3,500	6	No	3,000	18,000	
LLPA and Help points	1,500	2,250	1	Item	2,000	2,000	Provisional Sum
						-	
Communications wiring and connection to Network Rail network and PSTN	12,000	18,000	1	Item	15,000	15,000	
Sub Total						**350,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Signalling (based upon HyderScheme Plan- Validated)							
Detailed Design and Engineering Costs	750,000	1,250,000	1	Item	800,000	800,000	Provisional Sum
						-	
Modifications to RR interlocking at Stratford	225,000	350,000	1	Item	325,000	325,000	Based upon Allington Curve
Modifications to dataset and SSI interlocking on Chingford Line	400,000	650,000	1	Item	400,000	400,000	Based upon Allington Curve
Modifications to signalling interfaces at Liverpool Street	100,000	150,000	1	Item	100,000	100,000	Provisional Sum
						-	
New TI Track Curcuits and resiting of changed	2,500	3,500	12	No	3,000	36,000	
						-	
Point machines (HW2020 or HPSS)	15,000	25,000	6	No	20,000	120,000	
						-	
New 3 aspect controlled signals	35,000	45,000	8	No	40,000	320,000	
						-	
New position lights signals	10,000	15,000	4	No	12,500	50,000	
						-	
Additional junction indication for existing signals	6,000	8,000	2	No	7,000	14,000	
						-	
Location cases and equipment cases	1,500	2,000	6	No	1,750	10,500	
						-	
Alterations to Signalling Power supply and equipment	30,000	80,000	1	Item	70,000	70,000	Provisional Sum
						-	
Undertrack Crossings (UTX)	14,400	16,500	2	item	15,000	30,000	
						-	
Cable trough route	150	175	600	m	160	96,000	
						-	
Signalling cable	25	35	1,200	m	30	36,000	
						-	
SCADA and datalogging systems	30,000	60,000	1	Item	45,000	45,000	
						-	
TPWS provision	40,000	80,000	1	Item	60,000	60,000	
						-	
Testing and Commissioning	250,000	450,000	1	Item	300,000	300,000	
						-	
Removals and recovery of existing equipment	60,000	80,000	1	Item	70,000	70,000	
Sub Total						**2,882,500**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Electrification Works							
Piling and bases for masts and Headspans	1,500	2,250	28	No	2,000	56,000	
						-	
Provision of single cantilever OHLE masts	5,000	8,000	16	No	7,000	112,000	
Provision of new Headspans	8,000	14,000	4	No	12,000	48,000	
Provision of Anchor posts	6,000	9,000	2	No	7,500	15,000	
						-	
Neutral Sections and Section Insulators	30,000	50,000	1	Item	40,000	40,000	Provisional Sum
						-	
Connections and Isolation equipment	25,000	50,000	1	Item	35,000	35,000	
						-	
Catenary wiring, droppers and tensioning	250	350	1,200	m	325	390,000	
						-	
Changes to Electrical Control Room schematic, remote control and SCADA	50,000	90,000	1	Item	75,000	75,000	
Sub Total						**771,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Highway Works (based upon Hyder Option 2 Proposal)							
Diversion of all Mains Statuatory Authority services to facilitate kerb and roadway realignment proposals	65,000	125,000	1	Item	90,000	90,000	
						-	
Bus Stop, Kiss and Drop area extended into existing highway (Argall Way)						-	
Highway marking	15,000	25,000	1	Item	22,000	22,000	
						-	
Provision of Bus stop and Kiss and drop area	60,000	75,000	1	Item	65,000	65,000	
Realignment of footpath						-	
						-	
New Pedestrian crossing - pelican	12,500	19,000	1	Item	14,000	14,000	
						-	
Re-routing of existing footpaths around ticket hall	12,000	14,000	1	Item	13,000	13,000	
						-	
Renew all road markings	5,000	5,000	1	Item	5,000	5,000	
						-	
Introduce new street and information signage	12,000	14,000	1	Item	13,000	13,000	
						-	
Provision of soft lanscaping, fencing and retaining walls	12,000	30,000	1	Item	25,000	25,000	
Sub Total						**247,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Ancilliary Costs							
Design Costs							
Civil and Building Structures Works	300,000	400,000	1	Item	300,000	300,000	
Highways Works	100,000	150,000	1	Item	110,000	110,000	
Signalling Works - schematics	350,000	450,000	1	Item	375,000	375,000	
Electrification Works	250,000	350,000	1	Item	250,000	250,000	
Permanent Way Works	100,000	150,000	1	Item	125,000	125,000	
Sub Total						**1,160,000**	
Track Possessions							
Possession arrangement costs							
Possession management costs							
Track access compensation							
Full Weekend Blockades to connect new chord with existing railway	200,000	350,000	6	No	310,000	1,860,000	Based upon 2009 RoR availability
Within RoR Possessions for station works, unloading of material	10,000	15,000	45	No	12,500	562,500	
Sub Total						**2,422,500**	
Network Rail Project Management Overheads (9.2% of base estimate)	8%	12%		Item	9.2%	1,446,376	Current estimate provision - Network Rail source
Sub Total						**1,446,376**	1,446,376
Contractor Overhead, Preliminaries and Profit	15%	25%		Item	22.0%	2,188,997	Typically 15%-25% of Construction Cost
Sub Total						**2,188,997**	
Optimism Bias - None applied in this estimate							
Project Construction Contingency (% of Base estimate)	5%	10%		Item	7.5%	1,179,111	
Design and Constuction contingency (% of Design Cost)	5%	10%		Item	7.5%	87,000	
Sub Total						**1,266,111**	

4 Detailed Cost Estimate– Hall Farm Curve (Single Line) without Lea Bridge Station

4.1 In this estimate the detailed costs for the permanent way, signalling, site preparation, earth structure and electrification works remain the same as those above. The costs of the station and associated highways modifications have been removed and the possession regime and ancillary costs revised to account for the reduced scope of works

Description of Works	Total Cost
Site Preparation, Contractor Costs	385,000
Permanent Way Works	3,152,625
Earthstructure Works	301,860
Signalling (based upon HyderScheme Plan- Validated)	2,882,500
Electrification Works	771,000
Sub total (Construction Cost)	**7,492,985**
Design Costs	975,000
Contractor Preliminaries, Overhead and Profit	1,648,457
Possession Costs	2,085,000
Sub total (Base Cost)	**12,201,442**
Project Contingencies and Network Rail On-cost	2,110,766
Total Construction Cost at October 2009 base	**14,312,207**

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Ancilliary Costs							
Design Costs							
Civil and Building Structures Works	150,000	300,000	1	Item	300,000	225,000	
Signalling Works - schematics	350,000	450,000	1	Item	375,000	375,000	
Electrification Works	250,000	350,000	1	Item	250,000	250,000	
Permanent Way Works	100,000	150,000	1	Item	125,000	125,000	
Sub Total						**975,000**	
Track Possessions							
Possession arrangement costs							
Possession management costs							
Track access compensation							
Full Weekend Blockades to connect new chord with existing railway	200,000	350,000	6	No	310,000	1,860,000	Based upon 2009 RoR availability
Within RoR Possessions for station works, unloading of material	10,000	15,000	18	No	12,500	225,000	
Sub Total						**2,085,000**	
Network Rail Project Management Overheads (9.2% of base estimate)	8%	12%		Item	9.2%	1,122,533	Current estimate provision - Network Rail source
Sub Total						**1,122,533**	
Contractor Overhead, Preliminaries and Profit	15%	25%		Item	22.0%	1,648,457	Typically 15%-25% of Construction Cost
Sub Total						**1,648,457**	
Optimism Bias - None applied in this estimate							
Project Construction Contingency (% of Base estimate)	5%	10%		Item	7.5%	915,108	
Design and Constuction contingency (% of Design Cost)	5%	10%		Item	7.5%	73,125	
Sub Total						**988,233**	

5 Detailed Cost Estimate– Hall Farm Curve (Double Line) and Lea Bridge Station

Description of Works	Total Cost
Site Preparation, Contractor Costs	385,000
Permanent Way Works	4,497,200
Earthstructure Works	1,008,934
Station Works (Buildings and Civils)	1,860,000
Station Works (Fixtures, Fittings, Electrical and Plant)	350,000
Signalling (based upon HyderScheme Plan- Validated)	3,734,500
Electrification Works	1,180,000
Highway Works (based upon Hyder Option 2 Proposal)	247,000
Sub total (Construction Cost)	**13,262,634**
Design Costs	1,335,000
Contractor Preliminaries, Overhead and Profit	2,917,780
Possession Costs	3,230,000
Sub total (Base Cost)	**20,745,414**
Project Contingencies and Network Rail On-cost	3,564,609
Total Construction Cost at October 2009 base	**24,310,023**

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Permanent Way Works							
300mm ballast layer layed on pre-constructed substrate							
Double track Chord	600	790	625	m	730	456,250	High cost for short length
Single Line in Up direction at either end of chord	350	550	290	m	420	121,800	High cost for short length
						-	
NR60E 17.25 - 40mph transitioned crossovers	450,000	650,000	2	No	600,000	1,200,000	Difficult access
						-	
NR60E 17.25- Transitioned Turnouts						-	
Left hand - Chingford Branch	150,000	225,000	2	No	200,000	400,000	
Right hand - Lea Valley Line	150,000	225,000	2	No	200,000	400,000	
						-	
CEN60 Rails - double track						-	
Double track	350	450	2,480	m	425	1,054,000	Difficult access
Single track	350	450	580	m	425	246,500	
						-	
G44 Sleepers clips and fastenings on 600mm centres	55	73	2,550	No	63	160,650	Difficult access
						-	
Stressing	40,000	60,000	1	Item	55,000	55,000	Difficult access
						-	
Stabilisation, tamping and alignment works	10,000	15,000	4	No	12,500	50,000	Price per possession
						-	
Trackbed drainage, catchpits and pipeworks	225	350	620	m	275	170,500	
						-	
Provision of Safe Cess walkways, both sides of line	200	250	620	m	225	139,500	
						-	
Lineside signage	2,000	10,000	1	Item	8,000	8,000	Provisional Sum
						-	
Remedial and new work where necessary to lineside security fencing	20,000	40,000	1	Item	35,000	35,000	Provisional Sum
Sub Total						**4,497,200**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Site Preparation, Contractor Costs							
Establishment of Site Offices	250,000	350,000	1	Item	325,000	325,000	Provisional Sum
						-	
Bridge Inspections	20,000	30,000	1	Item	25,000	25,000	
Local Communications and advertising	30,000	40,000	1	item	35,000	35,000	
Sub Total						**385,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Earthstructure Works							
Vegetation Clearance from area to be remediated	2.2	3.0	16,000	m2	2.5	40,000	
Creation of widened embankment on Chingford Line							
3m increase in embankment width x 8m high	23	28	3,900	m3	26	101,400	156m in length
Capping layer 300mm	25	32	515	m3	28	14,414	
Soil nails and stabilisation	600	900	156	m	860	134,160	
						-	
Ground preparation for third track on Lea bridge line						-	
widening of existing formation by 5m x 1m high	23	28	670	m3	26	17,420	134m in length
						-	
Remediation of current embankment on Chord						-	
Earth move - 15m wide by 2m deep	23	28	18,600	m3	26	483,600	620m in length
						-	
Track substrate preparation						-	
Double track	56	65	620	m	60	37,200	
Single track	32	38	290	m	36	10,440	
						-	
Sand Blanket and geotextile layer						-	
Double track	125	175	620	m	160	99,200	
Single track	75	105	290	m	90	26,100	
						-	
Construction of bases for location and equipment cases	3,000	5,500	10	No	4,500	45,000	Including Safety railing
Bases and piling for signals	1,500	2,250	10	No	2,000	20,000	
Sub Total						**1,008,934**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Buildings and Civils)							
Demolition and Removal of Existing Structures							
Ticket office (30m2 - Hyder Plan)	35,000	55,000	1	Item	50,000	50,000	Urban environment
Transfer Deck, podium and support bridge (126m2 - Hyder Plan)	55,000	75,000	1	Item	70,000	70,000	
Staircases	13,000	20,000	2	No	18,000	36,000	
						-	
Provision of repairs to existing bridge abutments			1	Item	50,000	50,000	Provisional Sum
						-	
Remedial work to existing platforms						-	
Clearance of Vegetation	2.2	3.0	312	m	2.5	780	2 platforms - each presently 156m long
Construction of platform crossfall and re-surface	350	450	312	m	400	124,800	
Fitting of tactile strip and coping stones	70	90	312	m	85	26,520	
						-	
Platform extension to accommodate 12 x 20m vehicles	1,300	1,650	168	m	1,550	260,400	Inclusive of ramps and 5m stopping tolerance
						-	2 platforms each extended 84m
New Structures						-	
New Ticket Office bordering Argall Way	550,000	750,000	1	Item	725,000	725,000	
Commutaport Shelters, 2 per platform	35,000	50,000	4	No	45,000	180,000	
Platform Seating (fixed)	1,500	1,750	10	No	1,500	15,000	
						-	
Passenger Overbridge						-	
Staircase 6m rise with landing - 2m width	52,000	65,000	2	No	60,000	120,000	
Passenger Overbridge - covered - 2.5m wide - 28m long	80,000	95,000	1	No	85,000	85,000	
Passenger lift structure including landings, lift pit and equipment room	22,000	25,000	2	No	23,000	46,000	
						-	
New wall at rear of platforms	55	85	480	m	75	36,000	
Security fencing facing Argall way	55	75	300	m	65	19,500	
General public signage	10,000	20,000	1	Item	15,000	15,000	Provisional Sum
Sub Total						**1,860,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Fixtures, Fittings, Electrical and Plant)							
Provision of Electrical Supply for buildings and lighting							
Supply Company installation and meter	65,000	90,000	1	Item	80,000	80,000	Provisional Sum
Electrical Supply for lift chamber						-	
						-	
Ticket Office fixtures and fittings	30,000	45,000	1	Item	35,000	35,000	Provisional Sum
						-	
Security Access Gates and Ticket Barrier	4,000	8,000	3	No	6,000	18,000	
						-	
Self Serve Ticket Machines	3,000	6,000	2	No	4,500	9,000	
						-	
Passenger lift, equipment and fixtures	35,000	60,000	2	No	45,000	90,000	
						-	
Platform Lighting	50,000	75,000	1	Item	65,000	65,000	Provisional Sum
Ticket office, bridge and lift lighting	15,000	22,000	1	Item	18,000	18,000	Provisional Sum
CCTV Cameras and equipment	2,500	3,500	6	No	3,000	18,000	
LLPA and Help points	1,500	2,250	1	Item	2,000	2,000	Provisional Sum
						-	
Communications wiring and connection to Network Rail network and PSTN	12,000	18,000	1	Item	15,000	15,000	
Sub Total						**350,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Signalling (based upon HyderScheme Plan- Validated)							
Detailed Design and Engineering Costs	750,000	1,250,000	1	Item	1,100,000	1,100,000	Provisional Sum
						-	
Modifications to RR interlocking at Stratford	225,000	350,000	1	Item	325,000	325,000	Based upon Allington Curve
Modifications to dataset and SSI interlocking on Chingford Line	400,000	650,000	1	Item	550,000	550,000	Based upon Allington Curve
Modifications to signalling interfaces at Liverpool Street	100,000	150,000	1	Item	125,000	125,000	Provisional Sum
						-	
New TI Track Curcuits and resiting of changed	2,500	3,500	18	No	3,000	54,000	
						-	
Point machines (HW2020 or HPSS)	15,000	25,000	8	No	20,000	160,000	
						-	
New 3 aspect controlled signals	35,000	45,000	10	No	40,000	400,000	
						-	
New position lights signals	10,000	15,000	4	No	12,500	50,000	
						-	
Additional junction indication for existing signals	6,000	8,000	4	No	7,000	28,000	
						-	
Location cases and equipment cases	1,500	2,000	10	No	1,750	17,500	
						-	
Alterations to Signalling Power supply and equipment	30,000	80,000	1	Item	70,000	70,000	Provisional Sum
						-	
Undertrack Crossings (UTX)	14,400	16,500	4	item	15,000	60,000	
						-	
Cable trough route	150	175	1,000	m	160	160,000	
						-	
Signalling cable	25	35	2,000	m	30	60,000	
						-	
SCADA and datalogging systems	30,000	60,000	1	Item	45,000	45,000	
						-	
TPWS provision	40,000	80,000	1	Item	60,000	60,000	
						-	
Testing and Commissioning	250,000	450,000	1	Item	400,000	400,000	
						-	
Removals and recovery of existing equipment	60,000	80,000	1	Item	70,000	70,000	
Sub Total						**3,734,500**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Electrification Works							
Piling and bases for masts and Headspans	1,500	2,250	44	No	2,000	88,000	
						-	
Provision of single cantilever OHLE masts	5,000	8,000	16	No	7,000	112,000	
Provision of new Headspans	8,000	14,000	10	No	12,000	120,000	
Provision of Anchor posts	6,000	9,000	8	No	7,500	60,000	
						-	
Neutral Sections and Section Insulators	30,000	50,000	1	Item	40,000	40,000	Provisional Sum
						-	
Connections and Isolation equipment	25,000	50,000	1	Item	35,000	35,000	
						-	
Catenary wiring, droppers and tensioning	250	350	2,000	m	325	650,000	
						-	
Changes to Electrical Control Room schematic, remote control and SCADA	50,000	90,000	1	Item	75,000	75,000	
Sub Total						**1,180,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Highway Works (based upon Hyder Option 2 Proposal)							
Diversion of all Mains Statuatory Authority services to facilitate kerb and roadway realignment proposals	65,000	125,000	1	Item	90,000	90,000	
						-	
Bus Stop, Kiss and Drop area extended into existing highway (Argall Way)						-	
Highway marking	15,000	25,000	1	Item	22,000	22,000	
						-	
Provision of Bus stop and Kiss and drop area	60,000	75,000	1	Item	65,000	65,000	
Realignment of footpath						-	
						-	
New Pedestrian crossing - pelican	12,500	19,000	1	Item	14,000	14,000	
						-	
Re-routing of existing footpaths around ticket hall	12,000	14,000	1	Item	13,000	13,000	
						-	
Renew all road markings	5,000	5,000	1	Item	5,000	5,000	
						-	
Introduce new street and information signage	12,000	14,000	1	Item	13,000	13,000	
						-	
Provision of soft lanscaping, fencing and retaining walls	12,000	30,000	1	Item	25,000	25,000	
Sub Total						**247,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Ancilliary Costs							
Design Costs							
Civil and Building Structures Works	300,000	400,000	1	Item	375,000	375,000	
Highways Works	100,000	150,000	1	Item	110,000	110,000	
Signalling Works - schematics	350,000	450,000	1	Item	425,000	425,000	
Electrification Works	250,000	350,000	1	Item	300,000	300,000	
Permanent Way Works	100,000	150,000	1	Item	125,000	125,000	
Sub Total						**1,335,000**	
Track Possessions							
Possession arrangement costs							
Possession management costs							
Track access compensation							
Full Weekend Blockades to connect new chord with existing railway	200,000	350,000	8	No	310,000	2,480,000	Based upon 2009 RoR availability
Within RoR Possessions for station works, unloading of material	10,000	15,000	60	No	12,500	750,000	
Sub Total						**3,230,000**	
Network Rail Project Management Overheads (9.2% of base estimate)	8%	12%		Item	9.2%	1,908,578	Current estimate provision - Network Rail source
Sub Total						**1,908,578**	1,908,578
Contractor Overhead, Preliminaries and Profit	15%	25%		Item	22.0%	2,917,780	Typically 15%-25% of Construction Cost
Sub Total						**2,917,780**	
Optimism Bias - None applied in this estimate							
Project Construction Contingency (% of Base estimate)	5%	10%		Item	7.5%	1,555,906	
Design and Constuction contingency (% of Design Cost)	5%	10%		Item	7.5%	100,125	
Sub Total						**1,656,031**	

6 Detailed Cost Estimate– Hall Farm Curve (Double Line) without Lea Bridge Station

6.1 In this estimate the detailed costs for the permanent way, signalling, site preparation, earth structure and electrification works remain the same as those above. The costs of the station and associated highways modifications have been removed and the possession regime and ancillary costs revised to account for the reduced scope of works

Description of Works	Total Cost
Site Preparation, Contractor Costs	385,000
Permanent Way Works	4,497,200
Earthstructure Works	1,008,934
Signalling (based upon HyderScheme Plan- Validated)	3,734,500
Electrification Works	1,180,000
Sub total (Construction Cost)	**10,805,634**
Design Costs	1,075,000
Contractor Preliminaries, Overhead and Profit	2,377,240
Possession Costs	2,792,500
Sub total (Base Cost)	**17,050,374**
Project Contingencies and Network Rail On-cost	2,928,037
Total Construction Cost at October 2009 base	**19,978,411**

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Ancilliary Costs							
Design Costs							
Civil and Building Structures Works	200,000	350,000	1	Item	225,000	225,000	
Signalling Works - schematics	350,000	450,000	1	Item	425,000	425,000	
Electrification Works	250,000	350,000	1	Item	300,000	300,000	
Permanent Way Works	100,000	150,000	1	Item	125,000	125,000	
Sub Total						**1,075,000**	
Track Possessions							
Possession arrangement costs							
Possession management costs							
Track access compensation							
Full Weekend Blockades to connect new chord with existing railway	200,000	350,000	8	No	310,000	2,480,000	Based upon 2009 RoR availability
Within RoR Possessions for station works, unloading of material	10,000	15,000	25	No	12,500	312,500	
Sub Total						**2,792,500**	
Network Rail Project Management Overheads (9.2% of base estimate)	8%	12%		Item	9.2%	1,568,634	Current estimate provision - Network Rail source
Sub Total						**1,568,634**	
Contractor Overhead, Preliminaries and Profit	15%	25%		Item	22.0%	2,377,240	Typically 15%-25% of Construction Cost
Sub Total						**2,377,240**	
Optimism Bias - None applied in this estimate							
Project Construction Contingency (% of Base estimate)	5%	10%		Item	7.5%	1,278,778	
Design and Constuction contingency (% of Design Cost)	5%	10%		Item	7.5%	80,625	
Sub Total						**1,359,403**	

7 Detailed Costs – Separate Build of Lea Bridge Station

7.1 The following cost breakdown details the estimate to construct Lea Bridge Station if this work was not done as together with the construction work for the Hall Farm Curve. Additional possessions, site mobilisation and material costs would be incurred together with an increased amount of design and labour hours.

Description of Works	Total Cost
Site Preparation, Contractor Costs	160,000
Station Works (B&C)	1,858,100
Station Works (E&P)	392,000
Highway Works	272,000
Sub total (Construction Cost)	**2,682,100**
Design Costs	190,000
Contractor Preliminaries, Overhead and Profit	590,062
Possession Costs	500,000
Sub total (Base Cost)	**3,962,162**
Project Contingencies and Network Rail On-cost	675,931
Total Construction Cost at October 2009 base	**4,638,093**

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Site Preparation, Contractor Costs							
Establishment of Site Offices	100,000	150,000	1	Item	125,000	125,000	Provisional Sum
						-	
Local Communications and advertising	30,000	40,000	1	item	35,000	35,000	
Sub Total						**160,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Buildings and Civils)							
Demolition and Removal of Existing Structures							
Ticket office (30m2 - Hyder Plan)	35,000	55,000	1	Item	50,000	50,000	Urban environment
Transfer Deck, podium and support bridge (126m2 - Hyder Plan)	55,000	75,000	1	Item	70,000	70,000	
Staircases	13,000	20,000	2	No	17,000	34,000	
						-	
Provision of repairs to existing bridge abutments	100,000	150,000	1	Item	125,000	125,000	Provisional Sum
						-	
Remedial work to existing platforms						-	
Clearance of Vegetation	2.2	3.0	312	m	2.5	780	2 platforms - each presently 156m long
Construction of platform crossfall and re-surface	350	450	312	m	400	124,800	
Fitting of tactile strip and coping stones	70	90	312	m	85	26,520	
						-	
Platform extension to accommodate 12 x 20m vehicles	1,300	1,650	168	m	1,500	252,000	Inclusive of ramps and 5m stopping tolerance
						-	2 platforms each extended 84m
New Structures						-	
New Ticket Office bordering Argall Way	550,000	750,000	1	Item	650,000	650,000	
Commutaport Shelters, 2 per platform	35,000	50,000	4	No	45,000	180,000	
Platform Seating (fixed)	1,500	1,750	10	No	1,500	15,000	
						-	
Passenger Overbridge						-	
Staircase 6m rise with landing - 2m width	52,000	65,000	2	No	60,000	120,000	
Passenger Overbridge - covered - 2.5m wide - 28m long	80,000	95,000	1	No	90,000	90,000	
Passenger lift structure including landings, lift pit and equipment room	22,000	25,000	2	No	24,000	48,000	
						-	
New wall at rear of platforms	55	85	480	m	75	36,000	
Security fencing facing Argall way	55	75	300	m	70	21,000	
General public signage	10,000	20,000	1	Item	15,000	15,000	Provisional Sum
Sub Total						**1,858,100**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Station Works (Fixtures, Fittings, Electrical and Plant)							
Provision of Electrical Supply for buildings and lighting							
Supply Company installation and meter	65,000	90,000	1	Item	85,000	85,000	Provisional Sum
Electrical Supply for lift chamber						-	
						-	
Ticket Office fixtures and fittings	30,000	45,000	1	Item	40,000	40,000	Provisional Sum
						-	
Security Access Gates and Ticket Barrier	4,000	8,000	3	No	7,000	21,000	
						-	
Self Serve Ticket Machines	3,000	6,000	2	No	5,000	10,000	
						-	
Passenger lift, equipment and fixtures	35,000	60,000	2	No	55,000	110,000	
						-	
Platform Lighting	50,000	75,000	1	Item	70,000	70,000	Provisional Sum
Ticket office, bridge and lift lighting	15,000	22,000	1	Item	20,000	20,000	Provisional Sum
CCTV Cameras and equipment	2,500	3,500	6	No	3,000	18,000	
LLPA and Help points	1,500	2,250	1	Item	2,000	2,000	Provisional Sum
						-	
Communications wiring and connection to Network Rail network and PSTN	12,000	18,000	1	Item	16,000	16,000	
Sub Total						**392,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Highway Works (based upon Hyder Option 2 Proposal)							
Diversion of all Mains Statuatory Authority services to facilitate kerb and roadway realignment proposals	65,000	125,000	1	Item	110,000	110,000	
						-	
Bus Stop, Kiss and Drop area extended into existing highway (Argall Way)						-	
Highway marking	15,000	25,000	1	Item	20,000	20,000	
					-	-	
Provision of Bus stop and Kiss and drop area	60,000	75,000	1	Item	70,000	70,000	
Realignment of footpath						-	
						-	
New Pedestrian crossing - pelican	12,500	19,000	1	Item	16,000	16,000	
						-	
Re-routing of existing footpaths around ticket hall	12,000	14,000	1	Item	13,000	13,000	
						-	
Renew all road markings	5,000	5,000	1	Item	5,000	5,000	
						-	
Introduce new street and information signage	12,000	14,000	1	Item	13,000	13,000	
						-	
Provision of soft lanscaping, fencing and retaining walls	12,000	30,000	1	Item	25,000	25,000	
Sub Total						**272,000**	

Description of Works	Unit Cost Range		Quantity		Site Specific Rate Used	Total Cost	Comments
	Min	Max					
Ancilliary Costs							
Design Costs							
Civil and Building Structures Works	100,000	125,000	1	Item	120,000	120,000	
Highways Works	50,000	125,000	1	Item	70,000	70,000	
Sub Total						**190,000**	
Track Possessions							
Possession arrangement costs							
Possession management costs							
Track access compensation							
Within RoR Possessions for station works, unloading of material	10,000	15,000	40	No	12,500	500,000	
Sub Total						**500,000**	
Network Rail Project Management Overheads (9.2% of base estimate)	8%	12%		Item	9.2%	364,519	Current estimate provision - Network Rail source
Sub Total						**364,519**	
Contractor Overhead, Preliminaries and Profit	15%	25%		Item	22.0%	590,062	Typically 15%-25% of Construction Cost
Sub Total						**590,062**	
Optimism Bias - None applied in this estimate							
Project Construction Contingency (% of Base estimate)	5%	10%		Item	7.5%	297,162	
Design and Constuction contingency (% of Design Cost)	5%	10%		Item	7.5%	14,250	
Sub Total						**311,412**	

Appendix B – Timetable Feasibility

1 Introduction

1.1 The objectives of Appendix B are:

- to demonstrate that running a rail four trains per hour service between Chingford and Stratford via the reinstated Hall Farm Curve is operationally feasible
- to assess the rolling stock, train crew and other cost implications of running this service.

1.2 To meet these objectives, a working timetable for the new service has been devised and analysed that meets the following criteria:

- the additional trains can be fitted around existing train services; no existing trains services are withdrawn or significantly retimed
- the only alternations required to existing train services will be a minor re-timing of the Stratford to Stansted service, and possibly some freight services
- a regular 15-minute interval Chingford to Stratford service is provided throughout the day, except that one Chingford – Stratford service has to be missed out during the AM peak due to capacity constraints
- no additional infrastructure is required other than Hall Farm Curve and Lea Bridge Station
- the timings of the service meet Network Rail's 'Rules of the Plan' (ROTP) that specifies the operational criteria that must be met for a robust service to be operated.

1.3 It should be stressed that the current exercise is one of establishing feasibility, not one of optimisation. Through more detailed timetabling work, potentially involving changes to trains elsewhere on the West Anglia main line, it may be possible to produce a timetable that delivers more robust performance and more attractive timings, but that is not within the scope of the current study.

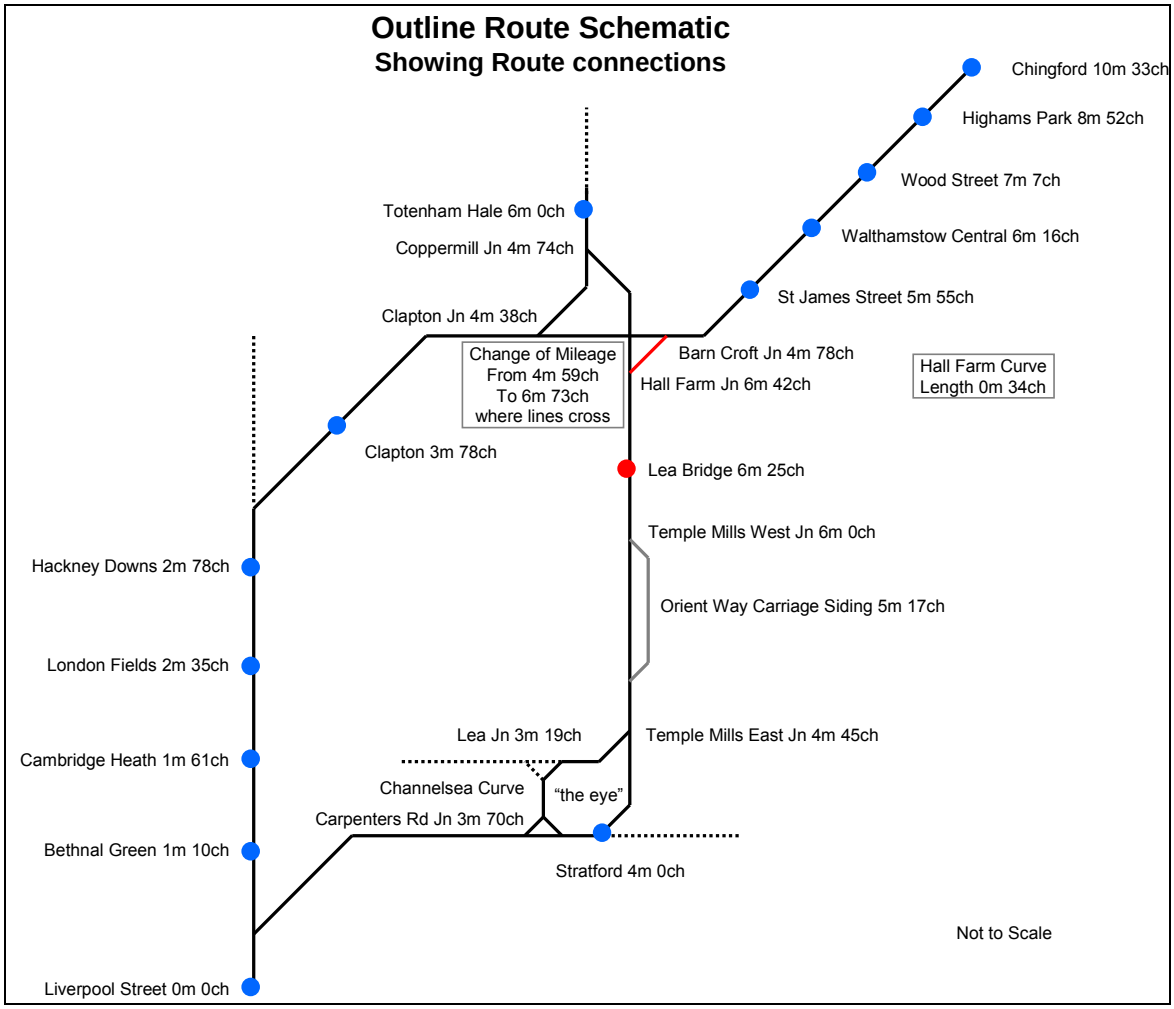
1.4 In the next section we describe the infrastructure that will be used by the Chingford to Stratford service, the existing services that use it, and summarise the constraints on the route. The following sections then set out:

- the assumptions we have made in developing a timetable
- the timetabling methodology used
- the working timetables developed
- a summary of the performance checks undertaken
- the rolling stock, train crew and other cost implications of the timetable

2 Infrastructure

2.1 Figure 1 shows the infrastructure that the Chingford – Stratford would use, and other lines with which the service would interact.

Figure 1 Outline Route Schematic



2.2 The Chingford – Stratford service is intended to call at all stations from Chingford to Barn Croft Junction, via the reinstated Hall Farm Curve and Junction (shown in red), call at the reopened Lea Bridge Station and terminate at Stratford. Ideally trains should approach and leave Stratford using the more direct route to the east, avoiding Channelsea Curve.

2.3 Three other services use sections of this route:

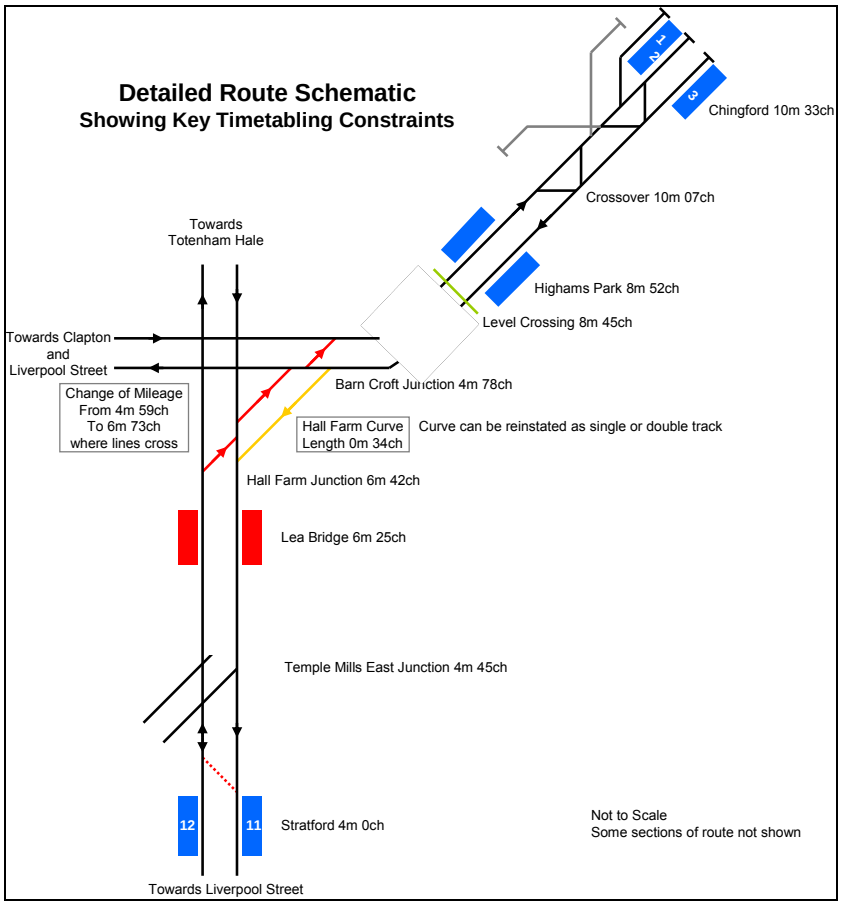
- The 4 trains per hour (tph) Chingford to Liverpool Street service calls at all stations between Chingford and Barn Croft Junction, then via Clapton and Hackney Downs to Liverpool Street.
- There is a 1tph service off-peak from Stratford to Stansted Airport that uses the section of track between Stratford and Hall Farm Junction, continuing via Coppermill Junction to join the West Anglia Main Line (WAML) south of Tottenham Hale. During the peak the frequency of this service increases to 2tph from Stratford, although most trains during this period do not run as far north as Stansted Airport.

- Freight services and empty coaching stock (ECS) movements use the section of track between Temple Mills East and Coppermill Junction, including a number of services operating to and from Orient Way sidings. These can be summarised from data observed on 23 September 2009 at Temple Mills, as follows:
  - between 07:00 and 10:00 there are 9 ECS moves between Liverpool Street and Orient Way Sidings and 3 Freight services
  - between 12:00 and 15:00 there were 2 ECS moves and 8 freight services
  - between 16:00 and 19:00 there are 10 ECS moves between Orient Way Sidings and Liverpool Street and 4 Freight services.

Constraints

2.4 Figure 2 summarises the timetabling constraints on the route.

Figure 2 Timetabling Constraints



2.5 The nature of the constraint at each location is as follows:

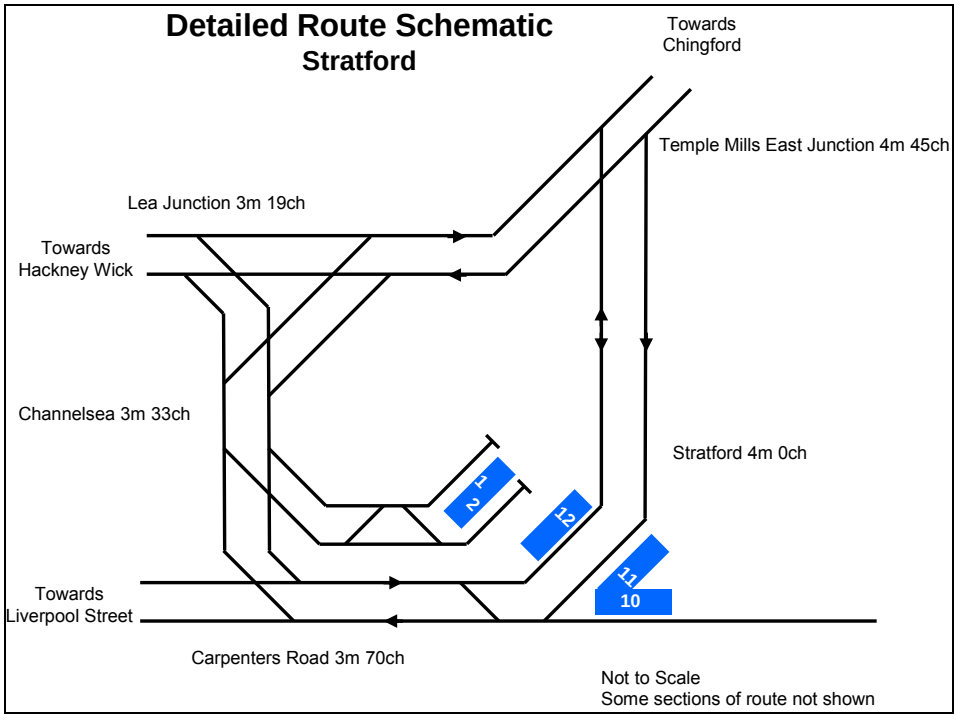
- Chingford Station has three platforms, although Platform 1 can be used as a turnaround platform, there are an increased number of potential conflicts when exiting the platform as services need to run wrong line to the next crossover. This is not a problem for the level of service we are considering as long as the turnaround time for services is not excessive. There is also scope for conflicting movements at the station throat. For example, a train cannot arrive in platform 3 at the same time as one is leaving platform 2.

- At Higham's Park there is a level crossing. Additional trains will increase the amount of time that the gates are closed, reducing capacity of the road. Ideally trains should be timed to pass on the crossing, to minimise the number of times the gates have to close.
- Barn Croft junction: trains from Stratford to Chingford must be timed so as not to conflict with trains from Chingford to Liverpool Street.
- Hall Farm Curve: while the core scheme assumes this is reinstated as a double track curve, a single track option is also being considered. If the latter was adopted, trains in opposite directions would need to be timed so as not to meet on the curve.
- Hall Farm Junction: trains from Stratford to Chingford must be timed so as not to conflict with southbound trains from Tottenham Hale.
- Stratford station: the signalling and platform layout at this location presents the single most challenging constraint on the current exercise, and is described in the following paragraphs.

Constraints at Stratford

2.6 Figure 3 shows in more detail the layout of the relevant lines at Stratford.

Figure 3 Layout At Stratford



2.7 Ideally trains from Chingford would reverse using Platforms 11 and 12. However, signalling and track layout constraints mean that only platform 12 can be used for this purpose. Platform 11 is signalled only for operation in the 'Up' direction (i.e. towards Liverpool Street), and even if trains could reverse in this platform, there is no crossover available that allows the train to join the 'down' line once they have reversed. Trains from platform 11 are therefore forced to continue in the up direction, but there is an option to run services in a loop around the Channelsea curve to the down line at Temple Mills East Junction.

2.8 Platform 12 alone does provide sufficient capacity to run the Chingford service at the desired frequency of 4tph. However, the platform is already used by the service to Stansted Airport. This service has an especially long layover time at Stratford, some 28 minutes in every hour during the off-peak. Platform 12 cannot therefore be used by both services.

2.9 The solution we have devised to this problem is to move the Stansted service to Platform 11, and have it leave Stratford by running round the Channelsea curve. Investigations have required to establish that this curve can be used for passenger trains in service: this was not the case until recently, but the necessary upgrade was recently undertaken to facilitate changes to North London line services. This leaves Platform 12 available for exclusive use by the Chingford service.

2.10 This is one of a number of possible solutions that we considered to the problem:

- add a new crossover to allow exit from platform 11 in the down direction – the cost of build, problems with track possessions required to implement, limited space, limited operational benefits means that this scheme will not be cost-effective.
- convert the track to bi-directional operation to allow exit from platform 11 in the down direction with a crossover at Temple Mill East Junction - the cost of build, problems with track possessions required to implement, limited operational benefits means that this scheme will not be cost-effective.
- running the new Chingford services via platform 11 and round "the eye" was considered. However, the ability to find four paths per hour over a number of complex junctions was not considered feasible.
- 'permissive working' in platform 12 to allow Chingford services to share the platform with the Airport services. This practice is employed at a number of locations on the existing railway, but is not considered best practice. It would also impose a limit to train lengths that could be accommodated without extending the platform, as well as putting the single line assess to the platform at or very close to operational capacity with the implications for performance.
- running the new Chingford services into platforms used by London Overground services (1 & 2) was considered but future service enhancements and junction conflicts mean that this was not considered feasible.
- extending the Stansted airport service to Liverpool Street was considered as this would free up the platform capacity. However this would require a change to the current timetable and was not considered feasible in the peak when the service in enhanced and the platforms at Liverpool Street are heavily utilised.
- operating an interworked 2tph service with the Stansted airport services so that they are able to use the single platform 12 with short turn around times with recovery at Chingford. This would require a change to the current timetable and does not present a 4tph service to Chingford. This may be worth pursuing as a cut down version of the scheme.

3 Timetable modelling methodology

Methodology

Sectional Running Time (SRT) calculation

3.1 To calculate the Sectional Running Times (SRTs), RailSys a timetabling and train performance tool approved by Network Rail was used. This process involved:

- creating the infrastructure to represent the Hall Farm Curve track layout and the new station stop at Lea Bridge
- selecting a train with the correct the stopping pattern in each direction
- selecting the appropriate rolling stock type and formation, 4car and 8car class 315
- running the train performance calculation to create Minimum Running Times (MRTs). The longest of the timings for each stopping pattern will then be rounded up to the nearest half minute use in the Timetable plan.

3.2 The following Rolling Stock assumptions were made:

Rolling Stock Assumptions
■ Services operated by Class 315 8-car rolling stock assumed for MRT calculation in RailSys[1]
■ Minimum Running Time (MRT) calculation made with 95% Tractive effort in RailSys
■ Scheduled Running Time (SRT) calculated by assuming MRT values rounded up to the nearest half minute, with an additional 30 seconds added if the rounding up is less than 5 seconds. This is the process recommended by Network Rail's Train Planners
■ all sections not impacted by the new infrastructure retain the current SRT.

3.3 The following Infrastructure assumptions were made:

Infrastructure Assumptions
■ Hall Farm Curve is assumed to be a single line
■ location of junction turnouts for the curve at:
– 4miles 78chains on the Temple Mills line
– 6miles 42chains on the Chingford branch
■ headways on the Chingford branch are 3 minutes
■ headways on the line between Lea Bridge and Stratford are 4 minutes

[1] 8 car trains are assumed for modelling purposes as this represents the maximum turnaround times and performance considerations in the modelling. In reality the service would consist of 4-car trains.

- minimum turnarounds at Chingford are:
  - 4 minutes for a 4car
  - 6 minutes for an 8car
- minimum turnarounds at Stratford are:
  - 4 minutes for a 4car on
  - 6 minutes for an 8car on
- 7 minutes Platform re-occupation on platform 11 at Stratford

- junction margins on the Chingford station throat are 2 minutes
- junction margins on the new Stratford station throat crossover are assumed to be 3 minutes
- junction margins on the new Barn Croft Junction are assumed to be 3 minutes
- junction margins on the new Hall Farm Junction are assumed to be 3 minutes

- line speed of the new Hall Farm curve is 40mph (25mph option)
- line speed across the points is 40mph (25mph option)
- all other lines speeds and junction margins remain as stated in the current sectional appendices and ROTP.

Timetable Plan

3.4 The SRT information feeds directly into a spreadsheet that in which two timetables have been built:

- a standard hour off peak timetable and
- a morning peak period timetable.

3.5 The off-peak timetable represents the standard pattern of operation, and includes the following services:

- 4tph Chingford – Liverpool Street Passenger services
- 4tph Chingford – Stratford Passenger services
- 3tph Coppermill Jn – Temple Mills East Jn Freight/Empty Coaching Stock (ECS)
- 1tph Stratford - Stansted Airport Passenger services

3.6 The spreadsheet allows checking of junction margins, running times, turnaround times and Headways against the ROTP. A conflict free timetable for a standard hour period during at typical weekday can been produced if the paths exist without moving trains in the existing timetable from there allotted times.

3.7 The morning peak period is more complex due to the presence of additional 'peak strengthener' services. The services included in this timetable are:

- 4tph (+ peak strengtheners) Chingford – Liverpool Street Passenger services
- 3 or 4tph Chingford – Stratford Passenger services
- 2tph Coppermill Jn – Temple Mills East Jn Freight/Empty Coaching Stock (ECS)
- 2tph Stratford - Bishops Stortford / Hertford / Broxbourne Passenger services
- 2tph ECS contra peak

3.8 Unfortunately, one of the Chingford – Liverpool Street peak strengtheners occupies the path and platform at Chingford that are needed for one of the Chingford – Stratford services in the standard 15-minute pattern (the 0832 departure). In practice, there is a good chance that a solution could be found to this problem, either by making detailed adjustments to some existing services to release a path, or if sufficient demand is abstracted from Chingford to Liverpool Street services by the new service, it may be possible to dispense with the peak strengthener. However, this would require a more detailed level of analysis than has been undertaken in the current study, so for the purposes of the current business case analysis we have taken a conservative view by assuming that this service does not run.

3.9 A further potential problem with the AM peak timetable is that 'down' Chingford services need to depart three minutes earlier from Stratford than the do in the off-peak. This shortens the turnaround time a Stratford to 4.5 minutes, which is less than the ROTP minimum of 6 minutes for an eight car set, but would acceptable for 4-car sets. Our initial demand analysis, indicates that 4-car units are probably sufficient for the level of demand being forecast, but if 8-car sets were needed for the service the timetable would need to be adjusted slightly. This might include minor timing changes to existing services, so is outside the scope of the current study.

3.10 While developing the timetable we needed to determine the current non passenger usage. Non passenger usage can include Empty Coaching Stock (ECS), Freight movements, Light engines, tamper trains etc. Many of these are not published in the working timetable, primarily because they cannot be planned a long time in advance. The Freight /ECS paths in this timetable are a combination of known movements and an estimate of typical service level. Data sources included:

- current working timetable
- train running data from 23rd Sept 2009 via Temple Mills
- Freightmaster 2009, a guide to regular rail-borne freight services
- current tonnage Network Rail, NCAP Tonnage Capability 30th June 2008

Timetable checks

3.11 The following tables show the timetable checks for the standards off peak service. They show how for each of the key timetabling points outlined in Figure 2 how trains have timed so as not to conflict with each other. Red text and asterisks indicate movements where conflicts could have occurred: in all cases these conflicts have been resolved and the timings shown are compliant with the ROTP.

3.12 Up services are those which are heading towards Stratford/London (Southbound). Down services are those which are heading down from Stratford/London (Northbound).

Platform working at Chingford

3.13 As Figure 2 shows, a 'down' train cannot arrive into Platform 3 at Chingford at the same time as an 'up' train arrives into Platform 2. This table shows how timing have been arranged to avoid this happening by leaving a three minute gap.

Chingford	Minutes past the hour			
Existing service Chingford – LST				
Down - In to platform 3 *	14	29	44	59
Up - Out of platform 3	25	40	55	10
New Service Chingford - Stratford				
Down - In to platform 2	09	24	39	54
Up - Out of platform 2 *	17	32	47	02

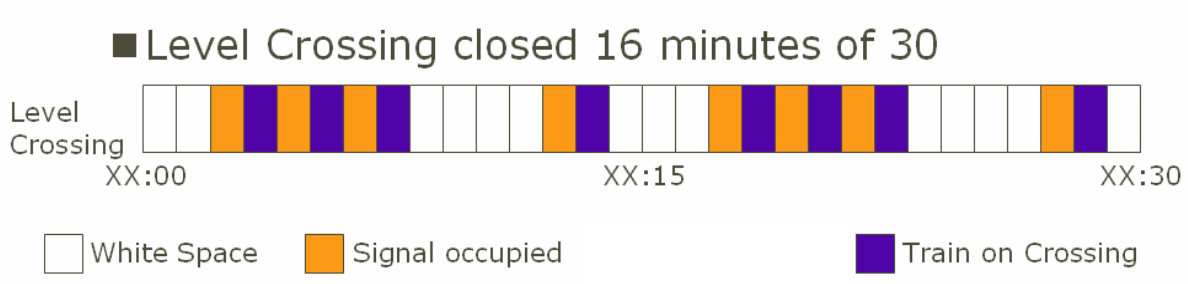
* Potential conflict between trains going In to platform 3 and Out of platform 2

3.14 In summary:

- Existing service has 11 minute Turnaround (minimum 6)
- New service has 8 minute Turnaround (minimum 6)
- Junction margin: 3 minutes

3.15 The junction margin is the minimum acceptable, so there is a higher risk of knock-on delays being caused if either service is running slightly late than if a more generous junction margin were provided.

Highams Park Level Crossing Utilisation



- Utilisation of the level crossing assumes 2 minutes gate closure time for each service passing.
- Additional time for warning lights before crossing closes.

Junction conflicts at Barn Croft Junction

3.16 At this location the 'down' service from Stratford to Chingford could conflict with 'up' Chingford to Liverpool Street services. The table below shows that the timetable provides the required Junction Margin of 3 minutes. Because this timing is right at the margin, there is

a higher risk of knock-on delays being caused if either service is running slightly late, but this risk is within acceptable limits.

Barn Croft Junction	Minutes past the hour			
Existing service Chingford –LST				
Down	14½	29½	44½	59½
Up *	07	22	37	52
New Service Chingford – Stratford				
Down *	10	25	40	55
Up	14	29	44	59

* Potential conflict between new down services and existing up services

- Junction Margin 3 minutes

Hall farm Curve Occupation

3.17 The timetable outlined is able to operate over a single line curve, however a two track solution has a number of advantages:

- future opportunity to increase services to 8tph
- improved performance when the trains are running late
- more timetable flexibility

Junction conflicts at Hall Farm Junction

3.18 At this location, 'up' (i.e. southbound) freight services and the passenger service from Stansted to Stratford could conflict with new 'down' Stratford – Chingford trains turning right into Hall Farm Curve.

Hall Farm Junction	Minutes past the hour			
Existing service (Airport, Freight/ECS)				
Down	12½	27½	38½	57½
Up *	11	26	41	58
New Service Stratford – Chingford				
Down *	08½	23½	38½	53½
Up	01	16	31	46

* Potential conflict between new down service and existing up Freight/ECS and Airport service

3.19 The Junction Margin is 3 minutes so we can see that there is a small violation here as the timetable only allows 2½ minutes. This issue would need to be addressed at when a final timetable is produced.

Junction conflicts at Temple Mills East Jn

3.20 There are two potential conflicts at this location:

- 'down' Stratford to Chingford services conflicting with 'up' Freight and ECS movements that are turning right towards the North London Line; and
- conflict between 'down' Stratford to Chingford services and 'up' services that cross to the bi-directionally-signalled 'down' line at this location to run into Stratford.

Temple Mills East Junction	Minutes past the hour			
Existing service (Airport, Freight/ECS)				
Down	09	24	30	52
Up *	15	30	45	02
New Service				
Down * +	03	18	33	48
Up +	06	21	36	51

* Potential conflict between new down service and existing up Freight/ECS services

3.21 In all cases, a junction margin of the minimum 3 minutes or more has been provided.

Platform working at Stratford

3.22 The platforming arrangement at Stratford has already been discussed in Chapter 2. For our proposed arrangement to work, two constraints need to be addressed:

- the new service to Chingford must be timed to allow trains to run into Platform 12, allow sufficient time for the driver to walk to the opposite end of the train, the train to run out again and clear the platform in time to allow the following service to run in; and

- the existing Stratford to Stansted service must be able to run into Platform 11, wait, depart, run around the Channelsea curve and pick up its existing path along the West Anglia Main Line.

Stratford	Minutes past the hour			
Existing services				
Down – Out of platform 11 *			25	
Up – In to platform 11	05			
New Service				
Down – Out of platform 12	01	16	31	46
Up – In to platform 12 *	09	24	39	54

* Potential conflict between In 12, Out 12.

3.23 The turnaround time for the Stratford – Chingford services is 7 minutes, against a minimum of 6 for an eight-car train.

3.24 The down Stratford to Stansted Airport service needs to depart 8 minutes earlier than its current timing. This is for two reasons:

- to allow extra time to negotiate 'the eye' around Channelsea curve; and
- avoid catching up with the 'down' Stratford – Chingford service at it stops at Lea Bridge.

3.25 There is therefore a time penalty applied to this service. This additional time could be put to good use, however, by stopping the Stratford – Stansted service to stop at Lea Bridge station as well. This would require no further penalty to the 'down' service, but there would be a two-minute penalty for the additional stop in the 'up' service. This would still leave some 18 minutes dwell time at Stratford, which is more than adequate – especially considering that driver will not have to walk back down the train.

3.26 Overall, the timetable works best if both the Stratford – Stansted and the Stratford – Chingford service both stop at Lea Bridge, or equally if Lea Bridge is not reopened and no stop is made.

Maintenance implications

3.27 Running the additional Stratford – Chingford services means that the level of wear and tear on the network will increase and therefore maintenance and renewal costs. Within certain thresholds, this would be covered by track access charges, but if the level of usage exceeds the current maximum for the route, then additional charges may need to be passed on to the operator.

3.28 The following table shows the change in usage of each section of line in Equivalent Million Gross Tons per annum.

Route Section		Current (EMGTPA)	Max (EMGTPA)	Existing 1tph Airport service (EMGTPA)	New 4tph Chingford service (EMGTPA)
Chingford	Hall Farm Curve	4.70	8.0		5.8
Hall Farm Curve	Temple Mills East	2.95	4.0	1.5	5.8
Temple Mills East	Stratford	2.52	4.0	1.5	5.8

Equivalent Million Gross Tons per annum (EMGTPA)

EMGTPA = S K MGTPA

3.29 The following assumptions were made when estimating passenger tonnage:

S = Speed factor = 1.00 (for vehicles up to 40 mph)

K = Axle load factor = 0.80 (for vehicles with axle loads not exceeding 11 tonnes)

- services are operated by 4-car EMUs at 130 tonnes each
- 8 services per hour (4 in each direction)
- 20 hours of passenger services per day
- 350 days per year

Categorisation of Track Railway Group Standard GC/RT5023 Issue Two

Martin Fargher Standards Project Manager October 1999

Methodology to Calculate Variable Usage Charges for Control Period 4 UK NR Report No. 08-002

By John Tunna, Richard Joy,Xinggao Shu and Ben Madrill TTCI(UK), Ltd. 27 March 2008

3.30 The increased tonnage of the new services would increase the annual tonnage above the route maximum, this is likely to result in higher maintenance and renewals costs that would be passed on to the operator.

4 Operating Costs

Rolling Stock & Train Crew Requirement

4.1 Using the completed timetable, we made an assessment of the rolling stock requirement. This has been completed within Excel.

4.2 An assessment of the number of train crew including drivers and conductors has also been completed from the timetable data.

4.3 The rolling stock requirement is for an **additional 4 units** this is defined as follows:

- Round trip duration for one unit is 1 hour
- 4 train per hour
- an additional 4 units (315 4car) in service required.

4.4 Therefore the rolling stock requirement is for four units that will be in continuous use. There may be a requirement to procure an additional unit as maintenance spare if this cannon be covered within the existing spare. For the costing we have assumed maintenance spare can be covered within existing larger fleet

4.5 The train mileage of the new services is **1376 train miles per day** this is calculated as follows:

- First service off Chingford at 05:00
- Last service back to Chingford at 00:30
- Route length 8.6miles
- Equates to approximately 20 hours of train operation with ECS moves
- Services every 15 minutes in each direction = 8 services per hour
- 8.6miles x 8 services per hour x 20 hours of operation = 1376 train miles per day

4.6 The train crew requirements for the new services are for **12 drivers and 12 conductors** this is determined as follows:

- First service off Chingford at 05:00
- Last service back to Chingford at 00:30
- 19½ hours of passenger service operation
- Plus sign on/off and train set-up ECS move off / on to the depot
- 21½ hours of staffing required
- 4 units in service = 4 drivers and 4 conductors at any one time
- average shift length 8 hours
- 21½ hours service / 8 hour shifts
- 3 shifts of approximately 7 hours
- 3 shifts of 4 drivers = 12 drivers and 12 conductors required

5 Performance Assessment

5.1 The performance assessment involved looking at the compliance of the proposed timetable against the Network Rail ROTP to assess how much time above the minimum values is available to allow services to recovery from delays. We have also discussed the rolling stock and infrastructure in terms of changes to reliability, maintenance and possessions.

5.2 To make a performance assessment of the addition of new services we first look at the additional time within the timetable for the service to recover should delays occur:

- on approach to Chingford there is 30 seconds pathing
- during turnaround at Chingford there are 2 minutes recovery time
- on approach to Stratford there is 1 minute pathing
- during turnaround at Stratford there is 1 minute recovery time

5.3 This gives a total of 4½ minutes of recovery during an hour of operation. This is less than would be considered desirable but with good operations or the opportunity to cancel services this can be considered acceptable.

5.4 Other factors also need to be considered in performance terms:

5.5 The NXEA Class 315 rolling stock has a miles per 5 minute delay (MP5MD) rate of 11758 which is below average the NXEA Class 317 has a MP5MD rate of 22097. (Source MR Dec 2008)

5.6 The increase of services on the branch would detrimentally impact of infrastructure reliability and the need for more frequent maintenance work.

5.7 The mix of Freight and passengers services can have a detrimental impact on performance due to the different running characteristics.

5.8 In current operation the section between Temple Mills East Junction and Copermill Junction is sometimes used as a holding space for services between main freight routes when they need to be held out of the way of passengers services. This would also have a detrimental impact on performance.

5.9 On the Chingford Branch the doubling of services would also lead to a detrimental impact on performance as the knock on impacts of late running services is likely to cause additional delays.

5.10 To measure these effects in detail a more complete modelling exercise with a complete RailSys study would be recommended.

5.11 The current PPM figure for the NXEA West Anglia Branch services is 90.9% of services arriving with 5 minutes of published time. The introduction of any new services will need to be carefully managed to ensure that this figure is not impacted.

6 Conclusions

6.1 Through this exercise we have demonstrated that:

- a 4tph Chingford to Stratford train service calling at Lea Bridge can be operated during the interpeak
- a similar level of service is likely to be feasible during the peaks. The only exception is that one Chingford – Stratford service may need to be missed out: this represents a worst case scenario and more detailed work demonstrate a means by which it can be run.

6.2 This can be achieved:

- without changes to existing services, other minor retiming of the Stratford to Stansted service
- without investment in further infrastructure over and above Hall Farm Curve and Lea Bridge Station
- without comprising the Rules of the Plan

6.3 Rolling stock and Train Crew requirements for running the additional services have been calculated.

Appendix C – Railplan Modelling

1 Introduction

1.1 Appendix C outlines the modelling of the introduction of the Chingford to Stratford rail services and reopening of Lea Bridge station. The modelling was undertaken in Railplan Version 5.4, Transport for London's public transport assignment model, for the following scenarios:

- 2006 Reference Case;
- 2016 Reference Case;
- 2016 and 2026 Chingford-Stratford services, Lea Bridge station open and improved connectivity to the bus network with fixed crowding; and
- 2016 and 2026 Chingford-Stratford services, Lea Bridge station closed and improved connectivity to the bus network with fixed crowding.

2 Validation

Network Validation

2.1 In order to ensure that the public transport network was representative of the existing services and hence the introduction of the new service was accurately modelled, the following network checks and subsequent changes were made:

- Rail timetables including Chingford – Liverpool Street and Stratford – Stansted services were checked. The run times between stations shared by the proposed rail service were updated to be those shown in Table 3.1. This was to ensure that existing trains were as attractive as new services for local movements; and
- Bus routes and timetables in the area around Lea Bridge station were checked to ensure that they were representative of existing services;
- In both the reference case and do something scenarios the extension of the London Overground from Surrey Quays to Clapham Junction via Denmark Hill and Wandsworth Road was coded in as this had previously been omitted.

2.2 It should be noted that although the model runs use 2016 demand matrices the networks are for 2017 and include Crossrail.

Demand Validation

2.3 To demonstrate that Railplan is fit for a particular application modelled demand is compared against observed values to ensure there are no major discrepancies. The model was validated against the 2006 reference case but unfortunately there was only a limited amount of observed data available. The comparison between the available observed and modelled flows are shown in Table 2.1.

Table 2.1 Model Validation: Demand

Description	Direction	Source	Observed Flow	Model Flow	Diff.	% Diff
TOC (Liverpool St)	In	CAPC/PIXC	64,674	70,055	5,381	+8.3%
TOC (Liverpool St)	Out	TOC flows	4,152	7,562	3,410	+82.1%
LUL(Woodford – S Woodford)	In	RODS	11,224	9,370	(1,854)	-16.5%
LUL (S Woodford– Woodford)	Out	RODS	2,000	2,055	55	+2.8%
LUL(Snaresbrook – S Woodford)	In	RODS	14,238	12,832	(1,406)	-9.9%
LUL(S Woodford – Snaresbrook)	Out	RODS	1,800	2,252	452	+25%
LUL (Redbridge – Wanstead)	In	RODS	12,099	9,761	(2,338)	-19.3%
LUL (Wanstead – Redbridge)	Out	RODS	1,531	2,595	1,064	+69.5%

2.4 The model results show that TOC inbound flows into Liverpool Street are reasonable. However, there are nearly twice as many modelled TOC outbound trips from Liverpool Street than observed. As the model is a morning peak model, the dominant flow is inbound and therefore it is more important that the modelled inbound flow is accurately modelled compared with the outbound flow, which is the case shown in Table 2.1.

2.5 For inbound Central line flows (LUL) there are 15% fewer trips than in the observed. For outbound flows there are 30% more trips than in the observed.

3 Scheme Representation

Chingford to Stratford Rail Line

3.1 In the three scenarios the Chingford – Stratford services were coded with the run times from the operational assessment as detailed in Appendix B and shown in Table 3.1.

Table 3.1 Chingford to Stratford Run Times

Station A	Station B	Run Time Up (Chingford to Stratford: Minutes)	Run Time Down (Stratford to Chingford: Minutes)
Chingford	Highams Park	4	5.5
Highams Park	Wood Street	3	3
Wood Street	Walthamstow Central	2	2
Walthamstow Central	St James Street	2	2
St James Street	Lea Bridge	4	4
Lea Bridge	Stratford	6.5	7

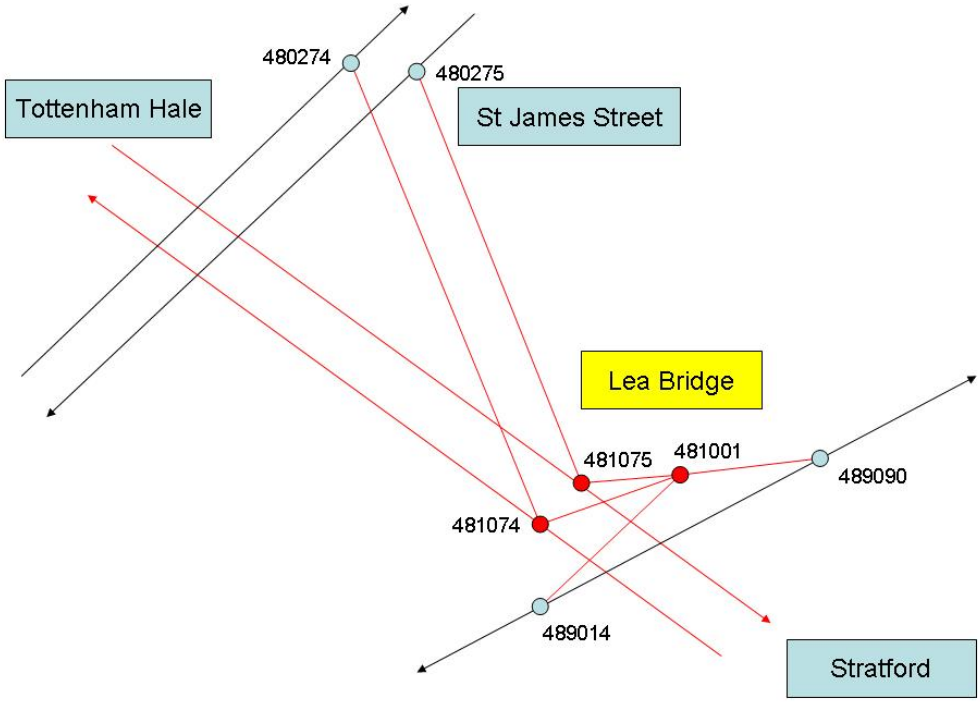
3.2 The differences in run times between the two directions are due to changes in track layouts, gradient and line speeds.

3.3 In the scenarios with Lea Bridge closed the run times shown above were reduced by 2 minutes between Stratford and St. James Street in both directions. This was to represent the fact that the services were not modelled to stop at Lea Bridge station.

Lea Bridge Station

3.4 Figure 3.1 shows how Lea Bridge station and Hall Farm Curve were coded into Railplan.

Figure 3.1 Coding of Lea Bridge Station and Hall Farm Curve in Railplan



3.5 Nodes 481074 and 481075 are the platforms at Lea Bridge station and 481001 is the station entrance. The platform nodes are connected to the station entrance with station walk links which also allow interchanges between platforms. The rail links between the platform nodes at Lea Bridge and those at St James Street (nodes 480274 and 480275) include the Hall Farm Curve. Nodes 489014 and 489090 are bus stops on Lea Bridge Road and are connected to the station entrance with other walk links. Centroid connectors from nodes 489014 and 489090 to zone centroids 4802 and 4811 respectively connect the station to the nearby zones.

3.6 The effect of adjusting the length of the walk links between Lea Bridge station and the nearest bus stops was tested to represent a better integration between the station and the existing public transport network. The links were reduced to 0.01km (previously 0.19km and 0.23km). It was found that reducing the lengths of the walk links did result in a higher number of boarders and alighters at Lea Bridge. As bus stops may well be moved closer to the station, the 0.01km length links in the model runs are reported in this document.

Crowding

3.7 It was apparent during the modelling that using the dynamic crowding functions resulted in changes in travel patterns across the UK when the scheme was implemented. As this is unlikely in reality, the impact was assumed to be a result of the crowding functions, which can cause 'flipping' between alternative routes between model iterations.

3.8 To mitigate this issue, the scenarios were run using fixed crowing by importing the factors by segment from the reference cases. This ensured that changes in travel patterns were observed only in the vicinity of the scheme as would be expected.

4 Impact of Scheme Implementation on Journey Times

4.1 In order to understand the impact on journey times when the Chingford to Stratford services are operational, analysis comparing the changes in travel time between the scenarios and the reference case was undertaken.

4.2 Tables 4.1 and 4.2 show the changes in generalised travel time between Railplan zones sectored into geographical areas between 2016 and the reference case. Table 4.1 represents the changes for 2016 with Lea Bridge station open and Table 4.2 shows similar information for 2016 without Lea Bridge station.

Table 4.1 Changes in Generalised Journey Time (Minutes): 2016 Lea Bridge Station

Area	Epping Forest	North Waltham Forest	South Waltham Forest	West Redbridge	Newham (Stratford)	City	Westminster	Tower Hamlets	Other Central	East	West	North	South	Outside London	Total
Epping Forest	-	-0.1	-0.0	-	-0.4	-0.0	-0.1	-0.3	-0.1	-0.1	-0.1	-0.2	-0.0	-0.2	-0.1
North Waltham Forest	-0.0	-0.2	-0.3	-0.0	-5.5	-1.3	-4.2	-5.6	-3.3	-2.8	-2.2	-0.5	-1.5	-2.4	-1.7
South Waltham Forest	-0.0	-1.1	-0.0	-0.0	-0.4	-0.2	-0.0	-0.5	-0.0	-0.1	-0.0	-0.0	-0.0	-0.2	-0.1
West Redbridge	-	-0.0	-0.1	-	-0.0	-	-	-	-0.0	-0.0	-	-0.0	-	-	0.0
Newham (Stratford)	-0.2	-0.5	-1.3	0.0	-0.0	-	-	0.0	0.0	-0.0	-0.0	-0.2	-	-	0.0
City	-	-0.0	-0.0	-	-	-	-	-0.0	-	0.0	-	-0.0	-	-	0.0
Westminster	-	-1.2	-0.0	-0.0	-0.0	-	-	0.0	-	0.0	-	0.0	-	-0.0	0.0
Tower Hamlets	-0.1	-1.4	-0.1	-0.0	0.0	-	0.0	0.0	-0.0	0.0	-	-0.0	-	0.0	0.0
Other Central	-0.0	-1.7	-0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-	-0.0	-0.0	-	0.0	0.0
East	-0.0	-0.4	-0.1	0.0	-0.0	-0.0	-0.0	-0.0	0.0	-0.0	-0.0	-0.0	0.0	-0.0	0.0
West	0.0	-0.7	-0.1	-	0.0	-	-0.0	0.0	-	0.0	-	-0.0	0.0	-	0.0
North	0.0	-0.2	-0.1	-0.0	-0.0	-0.0	0.0	-0.0	-0.0	-0.0	0.0	0.0	-0.0	-0.0	0.0
South	-	-1.0	-0.1	0.0	-0.0	0.0	0.0	-0.0	0.0	-0.0	0.0	0.0	-	-0.0	0.0
Outside London	-0.1	-2.2	-0.3	0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	0.0	0.0
Total	0.0	-0.5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.01

Table 4.2 Changes in Generalised Journey Time (Minutes): 2016 Without Lea Bridge Station

Area	Epping Forest	North Waltham Forest	South Waltham Forest	West Redbridge	Newham (Stratford)	City	Westminster	Tower Hamlets	Other Central	East	West	North	South	Outside London	Total
Epping Forest	-	-0.1	-0.0	-	-0.5	-0.0	-0.1	-0.3	-0.1	-0.2	-0.1	-0.2	-0.0	-0.2	-0.1
North Waltham Forest	-0.0	-0.2	-0.2	-0.0	-6.5	-1.8	-4.4	-6.4	-3.5	-2.3	-2.3	-0.5	-1.6	-2.6	-1.8
South Waltham Forest	-0.0	-1.0	0.0	-0.0	-0.4	-0.3	-0.0	-0.6	-0.0	-0.1	-0.0	-0.0	-0.0	-0.2	-0.2
West Redbridge	-	-0.0	-0.0	-	-0.0	-	0.0	0.0	-0.0	-0.0	0.0	-0.0	-	0.0	0.0
Newham (Stratford)	-0.3	-1.0	-0.6	0.0	-0.0	-	-	0.0	0.0	0.0	-	-0.3	-	-0.0	0.0
City	-	-0.0	-	-	-	-	-	-0.0	-	0.0	-	-0.0	-	-0.0	0.0
Westminster	-0.0	-1.2	0.0	-0.0	-0.0	-	-	0.0	-	0.0	-	0.0	-	-	0.0
Tower Hamlets	-0.1	-1.8	-0.0	0.0	0.0	-	0.0	0.0	-	0.0	-	-0.0	-	0.0	0.0
Other Central	-0.0	-1.7	-0.0	0.0	0.0	0.0	-0.0	0.0	-0.0	-0.0	-0.0	-0.0	-	-0.0	0.0
East	-0.0	-0.5	-0.0	0.0	-0.0	-0.0	0.0	-0.0	0.0	0.0	-0.0	-0.1	-0.0	-0.0	0.0
West	0.0	-0.7	-0.0	-0.0	0.0	-0.0	-0.0	0.0	-0.0	-0.0	-	-0.0	0.0	-0.0	0.0
North	0.0	-0.2	-0.0	0.0	-0.0	-0.0	0.0	-0.0	0.0	-0.0	0.0	0.0	-0.0	-0.0	0.0
South	-0.0	-1.0	-0.0	0.0	0.0	0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	-	-0.0	0.0
Outside London	-0.1	-2.5	-0.0	-0.0	0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-	0.0
Total	0.0	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.01

4.3 The maximum modelled time savings are between North Waltham Forest and Newham and Tower Hamlets (5.5 minutes and 5.6 minutes respectively). This increases by approximately one minute without Lea Bridge station due to the increased run times between the stations.

5 Changes to Existing Travel Patterns

5.1 One of the key consequences and benefits of introducing any new scheme is the opportunities that it opens up to residents and employers in an area. This increase in accessibility leads to changes in travel patterns, which needs to be estimated and assessed as part of the impacts of a scheme.

5.2 There are two distinct changes to travel patterns, both of which were taken into account when assessing the Chingford to Stratford rail scheme and re-opening of Lea Bridge station:

- Changes in work or residential locations: looking at how travel demand is redistributed given the new opportunities provided by the scheme; and
- The number of new trips that are now feasible, thereby leading to the generation of new demand.

Redistribution of Demand

5.3 This was achieved by calibrating a gamma function to establish a relationship between the reference case origin and destination movements and the associated generalised time with each movement. This relationship was then used with the scenario generalised times (after the scheme has been implemented) to estimate the impact that the scheme would have on origin and destination movements.

5.4 As the scheme is not associated with changes in the number of employment opportunities or housing, the total number of trips originating and terminating in each zone remained constant.

5.5 The following table shows the estimated change in demand for 2016 with Lea Bridge station after redistribution for Railplan zones sectored into geographical areas.

Table 5.1 Percentage Change in Demand Following Redistribution (2016 Lea Bridge)

	Epping Forest	North Waltham Forest	South Waltham Forest	West Redbridge	Newham (Stratford)	City	Westminster	Tower Hamlets	Other Central	East	West	North	South	Outside London
Epping Forest	-0.3%	-0.9%	0.4%	0.1%	0.9%	-0.0%	-0.1%	0.4%	-0.1%	0.1%	-0.2%	-0.8%	-0.0%	-0.1%
North Waltham Forest	-5.3%	-2.8%	-2.4%	-2.9%	21.6%	-5.8%	5.9%	16.9%	4.0%	6.6%	2.5%	-3.0%	0.9%	4.0%
South Waltham Forest	-0.1%	2.5%	0.2%	-0.0%	1.8%	0.3%	-0.6%	2.1%	-0.8%	0.2%	-0.5%	-0.9%	-0.7%	-0.0%
West Redbridge	0.1%	-2.5%	0.9%	0.3%	0.1%	0.1%	0.0%	-0.1%	0.0%	-0.0%	0.1%	0.2%	0.0%	-0.2%
Newham (Stratford)	0.9%	2.1%	6.0%	0.2%	-0.1%	-0.0%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%	0.8%	-0.1%	-0.1%
City	0.1%	-8.7%	0.2%	0.1%	0.1%	0.1%	0.1%	-0.0%	0.1%	0.1%	0.1%	0.0%	0.1%	-0.3%
Westminster	-0.1%	4.5%	0.2%	0.1%	-0.0%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.0%	0.0%	-0.0%
Tower Hamlets	0.3%	6.2%	0.5%	0.1%	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.1%	0.0%	0.0%
Other Central	0.1%	5.2%	-0.0%	0.1%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	-0.0%	0.0%	-0.0%
East	0.1%	0.3%	0.9%	0.1%	-0.1%	0.1%	-0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.2%	0.0%	0.0%
West	0.1%	3.1%	0.4%	0.3%	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.0%	0.0%	0.0%
North	-0.0%	1.4%	-0.3%	0.3%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	0.0%	-0.0%	-0.0%
South	0.1%	3.5%	-0.2%	0.1%	-0.0%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	0.0%	0.0%	0.0%
Outside London	0.3%	8.8%	0.8%	0.1%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	0.2%	-0.1%	0.0%	-0.0%

5.6 The vast majority of changes are for trips to and from North and South Waltham Forest with other sectors largely unaffected. This is to be expected as it is in the immediate vicinity of the scheme.

5.7 The largest increases in demand are from North Waltham Forest to Stratford and Tower Hamlets. This is due to the reduction in generalised time for these trips (as shown in Table 4.1) as a result of the new services to Stratford and the onward connections to Stratford by the Jubilee line, DLR and bus. The largest decreases are in either direction between the City and North Waltham Forest and from North Waltham Forest to Epping Forest as these trips have become relatively less attractive as a result of the new services.

6 Generation of New Demand

6.1 The new public transport service will also lead to generated trips which are made only because of the introduction of the new service. This was done using an elasticity based (PDFH)[1] approach using changes in generalised times as follows:

$$I_j = \left(\frac{GJT_{new}}{GJT_{base}} \right)^{-0.7}$$

6.2 Where I_j is the index for the change in demand related to changes in journey time, GJT_{new} is the generalised time with the scheme and GJT_{base} is the time without the scheme and -0.7 is the PDFH elasticity for season tickets in the London Travelcard Area**.** The elasticity was applied to the redistributed demand matrix explained above.

6.3 Table 6.1 shows the number of additional trips generated assuming the above formula for each of the scenarios. The additional trips represent less than 1% of total demand modelled in Railplan and suggests that the scheme is not likely to generate a significant new number of journeys.

Table 6.1 Generation of New Demand

Scenario	Number of Additional Journeys
2016 Lea Bridge Station	244
2016 Without Lea Bridge Station	265
2026 Lea Bridge Station	269
2026 Without Lea Bridge Station	291

6.4 Table 6.2 shows the percentage change in the number of trips between the original reference case demand and fully adjusted number of trips for the sectored demand (taking into

[1] Passenger Demand Forecasting Handbook, Chapter B4, Section B4.4

account the redistributed and induced demand) and Table 6.3 the actual change in numbers of trips.

Table 6.2 Percentage Change in Demand (Redistributed and Generation: 2016 Lea Bridge)

	Epping Forest	North Waltham Forest	South Waltham Forest	West Redbridge	Newham (Stratford)	City	Westminster	Tower Hamlets	Other Central	East	West	North	South	Outside London
Epping Forest	-0.3%	-0.7%	0.4%	0.1%	1.2%	-0.0%	-0.0%	0.6%	-0.1%	0.1%	-0.2%	-0.7%	-0.0%	-0.1%
North Waltham Forest	-5.3%	-2.6%	-1.9%	-2.9%	27.2%	-4.7%	9.2%	22.2%	6.7%	8.9%	3.8%	-2.6%	1.7%	5.3%
South Waltham Forest	-0.1%	4.1%	0.2%	-0.0%	2.2%	0.5%	-0.6%	2.6%	-0.8%	0.4%	-0.5%	-0.9%	-0.7%	0.1%
West Redbridge	0.1%	-2.5%	1.0%	0.3%	0.1%	0.1%	0.0%	-0.1%	0.0%	-0.0%	0.1%	0.2%	0.0%	-0.2%
Newham (Stratford)	1.0%	2.4%	7.5%	0.2%	-0.1%	-0.0%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%	1.0%	-0.1%	-0.1%
City	0.1%	-8.7%	0.2%	0.1%	0.1%	0.1%	0.1%	-0.0%	0.1%	0.1%	0.1%	0.0%	0.1%	-0.3%
Westminster	-0.1%	5.5%	0.2%	0.1%	-0.0%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.0%	0.0%	-0.0%
Tower Hamlets	0.4%	7.5%	0.6%	0.1%	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.1%	0.0%	0.0%
Other Central	0.1%	6.6%	-0.0%	0.1%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	-0.0%	0.0%	-0.0%
East	0.1%	0.7%	1.1%	0.1%	-0.1%	0.1%	-0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.3%	0.0%	0.0%
West	0.1%	3.6%	0.4%	0.3%	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.0%	-0.0%	0.0%	0.0%	0.0%
North	-0.0%	1.6%	-0.2%	0.3%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	0.0%	-0.0%	-0.0%
South	0.1%	4.1%	-0.2%	0.1%	-0.0%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	-0.0%	0.0%	0.0%	0.0%
Outside London	0.3%	10.3%	0.9%	0.1%	-0.1%	0.0%	-0.0%	-0.1%	-0.0%	-0.0%	0.2%	-0.1%	0.0%	-0.0%

Table 6.3 Actual Change in Demand (Redistributed and Generation: Numbers of Trips: 2016 Lea Bridge)

	Epping Forest	North Waltham Forest	South Waltham Forest	West Redbridge	Newham (Stratford)	City	Westminster	Tower Hamlets	Other Central	East	West	North	South	Outside London	Total
Epping Forest	-1	-0	1	0	0	-1	-0	6	-1	1	-0	-0	-0	-0	3
North Waltham Forest	-1	-62	-27	-16	3	-105	83	84	129	46	15	-11	4	23	165
South Waltham Forest	-0	55	6	-0	2	24	-32	67	-64	17	-9	-7	-6	1	54
West Redbridge	0	-16	6	9	0	4	0	-2	1	-0	1	0	0	-2	1
Newham (Stratford)	0	10	2	0	-1	-0	-2	-2	-2	-4	-1	2	-0	-1	2
City	0	-4	0	0	0	3	3	-0	3	1	1	0	1	-8	0
Westminster	-0	3	0	0	-0	4	0	-4	1	-1	-2	0	0	-4	1
Tower Hamlets	0	4	3	1	-0	4	0	-12	0	-0	-1	1	0	1	1
Other Central	0	17	-0	1	-0	16	-1	-16	-1	-5	-6	-0	0	-0	4
East	1	5	19	3	-2	22	-0	-29	3	-29	-3	16	1	0	8
West	0	8	3	1	-1	13	2	-15	1	-1	-16	1	1	5	1
North	-0	9	-1	1	-0	7	-2	-8	-1	-1	-3	4	-0	-3	1
South	0	6	-0	0	-0	14	-1	-16	-1	-3	-1	0	2	1	1
Outside London	0	8	2	0	-0	26	-19	-18	-17	-3	30	-2	0	-6	1
Total	0	41	14	0	1	32	30	35	52	19	6	5	2	8	244

6.5 These results follow a similar pattern to the results from the demand redistribution stage. The largest increases in trips are in the North Waltham Forest and South Waltham Forest sectors and in particular from these sectors to Stratford and Tower Hamlets. There are falls in some of the trips from the Waltham Forest sectors as these become relatively less attractive compared to other destinations as a result of the new service. Most sectors outside the Waltham Forest zones remain largely unaffected.

7 Estimated Demand on the Chingford Stratford Services

Modelled Demand on the Rail Service

7.1 Table 7.1 shows the modelled flows for the Chingford to Stratford and Chingford to Liverpool Street services for each modelled year and scenario for the morning peak period (0700-1000). The first two columns are the reference case scenarios and then for each year flows are presented assuming that Lea Bridge station is opened (LB) or closed (NLB). Flows on the Chingford to Stratford rail line increase when Lea Bridge station is not re-opened. This is due to an assumed reduction in travel time, due to the train not stopping at Lea Bridge station.

Table 7.1 Modelled Flows on the Chingford to Stratford / Liverpool Street Rail Lines

Service	2016 Ref	2026 Ref	2016 LB	2016 NLB	2026 LB	2026 NLB
Chingford – Stratford	-	-	3,224	3,364	3,500	3,716
Stratford - Chingford	-	-	709	683	802	782
Chingford – Liverpool St	6,040	6,228	5,421	5,467	5,603	5,715
Liverpool St - Chingford	385	419	521	518	563	559

7.2 Table 7.1 shows a reasonable flow of passengers using the Chingford to Stratford service, over 4,000 people in the AM peak, which is over 60% of the demand on the Chingford to Liverpool Street service currently operating. While some of this demand is abstracted from the Chingford to Liverpool Street service, the wider network is also affected.

7.3 Table 7.2 shows the change in demand (million passengers per annum[2]) on selected services for each scenario (Chingford – Stratford services are included in West Anglia Rail).

Table 7.2 Modelled Flows on Selected Services

Service	2016 Ref	2026 Ref	2016 LB	2016 NLB	2026 LB	2026 NLB
West Anglia Rail	49.2	53.2	+1.5	+1.6	+4.2	+4.5
Great Eastern Rail	59.8	64.6	+0.1	+0.1	+0.1	+0.1
Crossrail	158.4	177.6	+0.3	+0.5	+0.3	+0.4
Overground	73.3	81.4	-	-	-0.1	-
LUL Central	173.7	183.2	+0.3	+0.4	+0.3	+0.4
LUL Jubilee	175.6	190.0	+0.1	+0.2	+0.1	+0.1
LUL Victoria	172.2	186.8	-	-0.1	-	-0.2

[2] AM peak modelled figures were annualised using information from Transport for London's Business Case Development Manual

Service	2016 Ref	2026 Ref	2016 LB	2016 NLB	2026 LB	2026 NLB
Bus	1542.0	1637.2	-2.6	-2.7	-2.8	-3.1

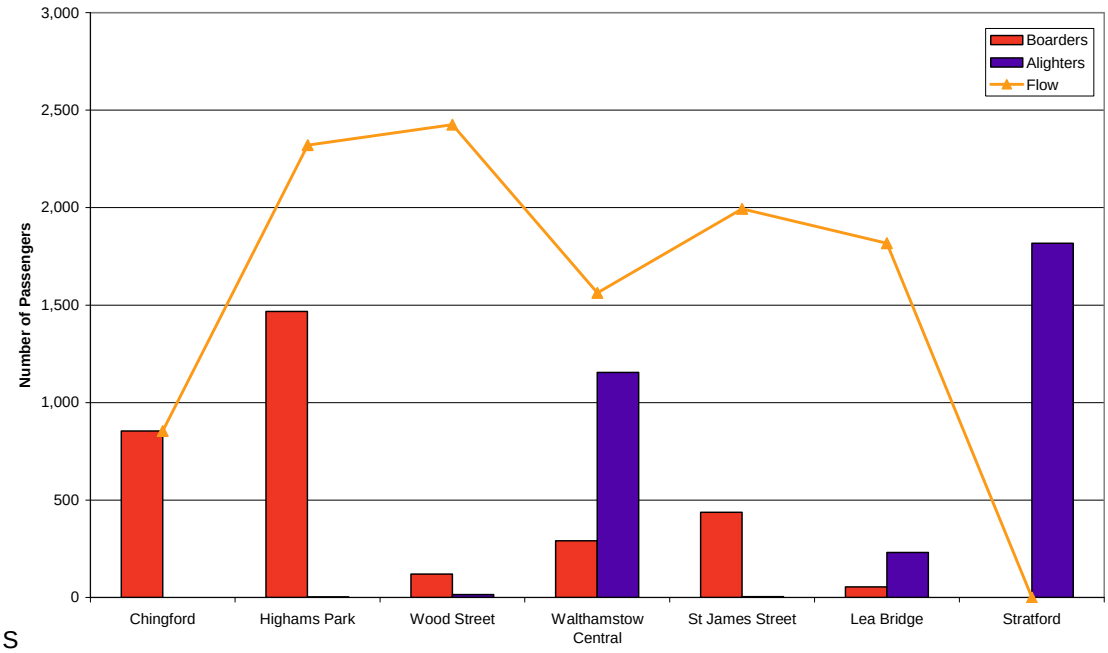
7.4 The greatest increase in flows is on the West Anglia Rail, as would be expected as the Chingford to Stratford service in included in this category. However, increases across the rail network are also observed, in particular on the Central line and Crossrail. Reductions in demand are only observed on the Victoria line when Lea Bridge station is not opened. The majority of the journeys on the Chingford to Stratford line are abstracted from the bus services, which are currently serving this area.

Line Profile

7.5 The demand on the Chingford to Stratford rail line will be a mixture of short-distance traffic going to/from Stratford and longer distance traffic interchanging at Stratford to go to a range of destinations in Docklands and central London.

7.6 Figure 7.1 shows the line profile of the Chingford to Stratford line in 2016, assuming Lea Bridge station is open. As expected the majority of people are boarding at Chingford and Highams Park and alighting at Stratford. The highest flow on the service is on the section between Wood Street and Walthamstow Central where there are a significant number of alighters.

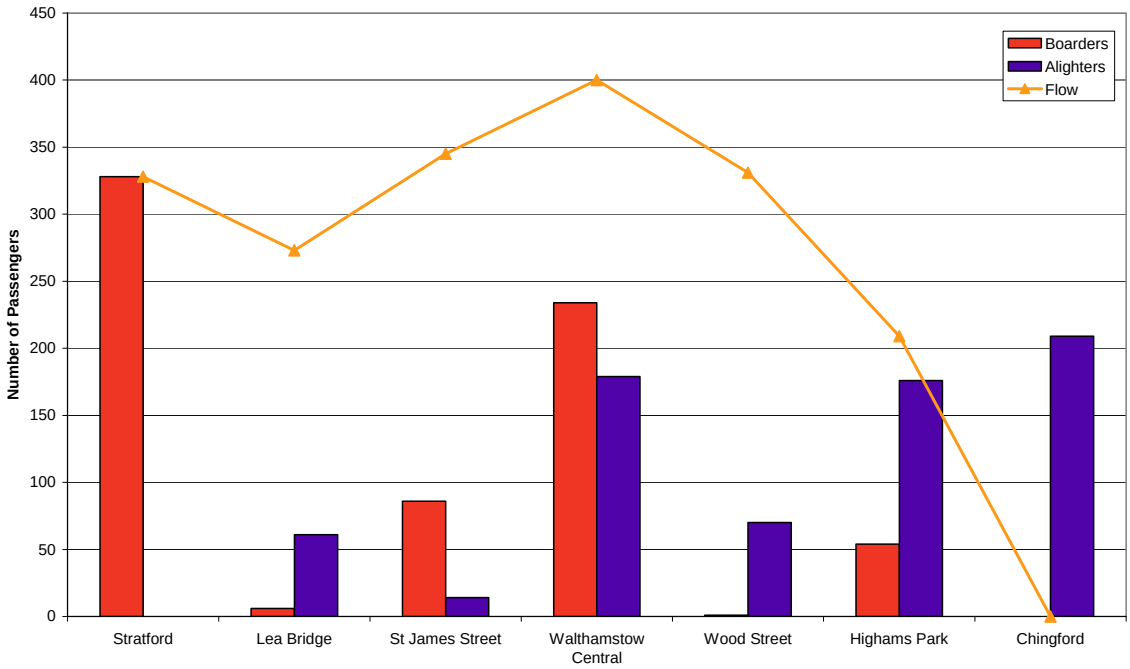
Figure 7.1Line Profile of Chingford to Stratford (0700-1000 AM Peak Totals)



7.7 Similarly Figure 7.2 shows the line profile from Stratford to Chingford. There are far fewer boarders and alighters in this direction than for Chingford to Stratford as the service is heading away from the main employment centres. The majority of passengers board at

Stratford and Walthamstow Central and there are a significant number of alighters at Walthamstow Central, Highams Park and Chingford. The highest flow on the service is between Walthamstow Central and Wood Street which is used by over 400 people over the three hour period.

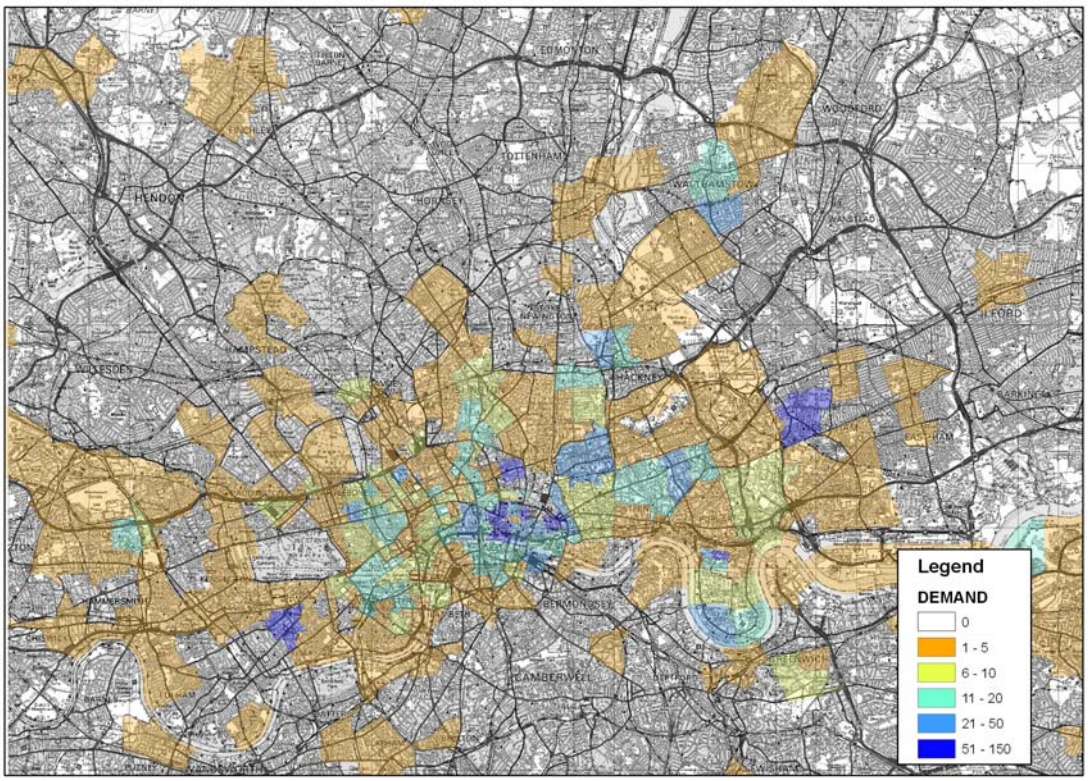
Figure 7.2Line Profile of Stratford to Chingford (0700-1000 AM Peak Totals)



Passenger Destinations

7.8 As Figure 7.1 showed, the majority of people are alighting the Chingford to Stratford service at Stratford. Figure 7.3 shows the destinations of passengers using the Chingford to Stratford service in the 2016 scenario with Lea Bridge open. This includes all passengers using the service and not only those alighting at Stratford. The bluer the area the higher the number of people ending their trip in that particular Railplan zone. Popular destinations of passengers of the Chingford to Stratford service include Stratford, the Isle of Dogs, the City, and Central London.

Figure 7.3 Passenger Destinations of the Chingford to Stratford Rail Service



8 Lea Bridge Station

8.1 Table 8.1 shows the number of people estimated to board and alight the train service at Lea Bridge station. The numbers show that even after redistribution and growth uplift the estimated passengers are relatively low and hence further analysis was undertaken to substantiate this figure.

Table 8.1 Number of People Boarding and Alighting at Lea Bridge Station (AM Peak)

Service	Output	2016 LB	2026 LB
Chingford – Stratford	Boarders	54	85
Chingford – Stratford	Alighters	233	233
Stratford - Chingford	Boarders	6	7
Stratford - Chingford	Alighters	61	85

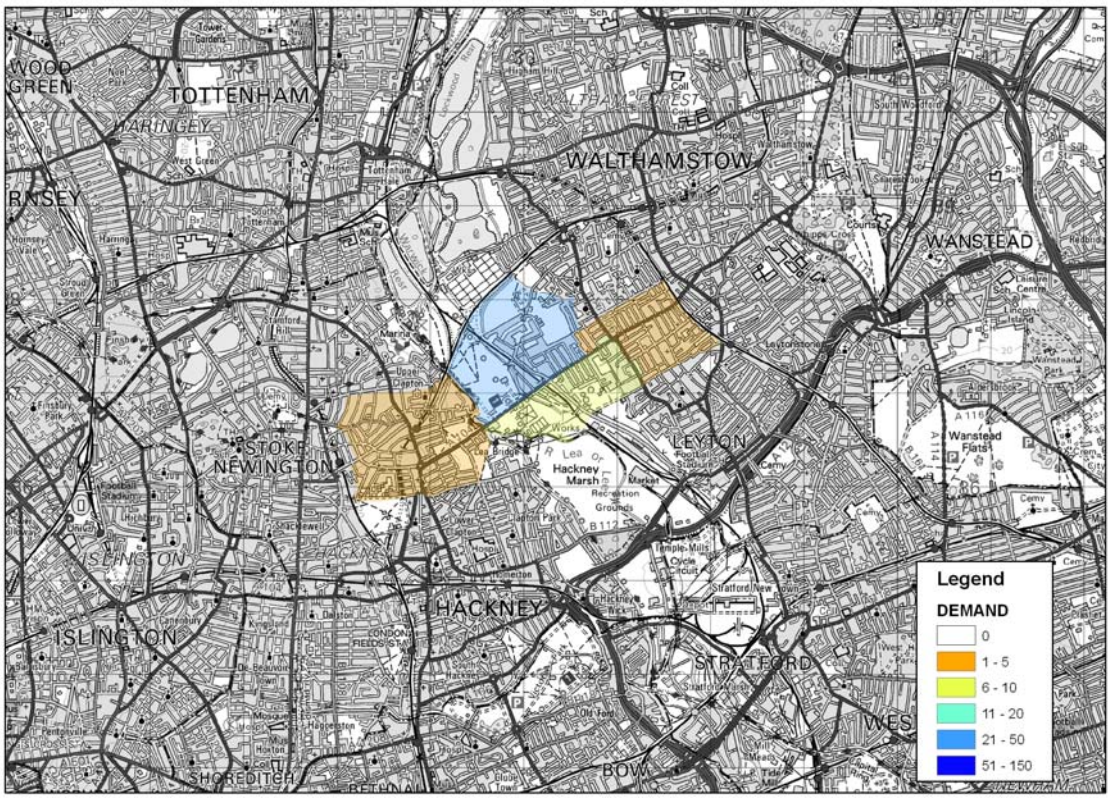
8.2 The anticipated level of demand at Lea Bridge station was compared with modelled passenger information for similar stations, in particular Highams Park station. Lea Bridge

has approximately 40% of the number of dwellings within a 500m distance of the station compared with the number around Highams Park. The low number of dwellings is mainly due to the higher level of industrial land use around Lea Bridge station compared with Highams Park. However, despite this the number of anticipated trips is only 4% that of those boarding the Chingford to Stratford station at Highams Park.

8.3 The low number of anticipated trips is partly due to a lower public transport trip rate, reflecting the fact that there is currently a low public transport service provision around Lea Bridge station. However, even assuming a higher public transport trip rate to take into account the new service, it is unlikely that Lea Bridge station will generate demand levels observed at Highams Park station.

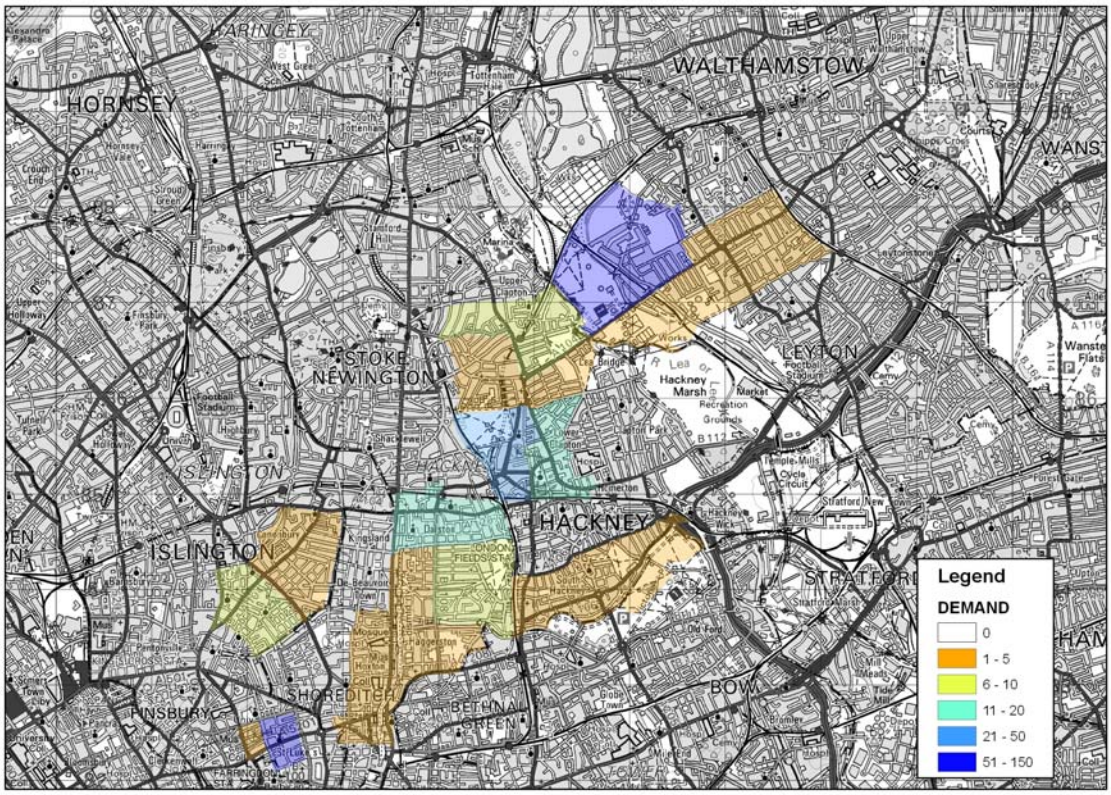
8.4 The catchment area serving Lea Bridge station is relatively narrow for boarders as shown in the following map for the 2016 scenario.

Figure 8.1 Catchment Area for Lea Bridge Station



8.5 The destination of passengers alighting at Lea Bridge is shown for 2016 in the following map, showing a wider area than for boarders.

Figure 8.2 Catchment Area for Lea Bridge Station



8.6 The area GLA's 2009 Strategic Housing Land Availability Assessment (SHLAA) identifies sites within 1km of Lea Bridge station for future housing development with a maximum of 982 assuming the unconstrained housing figure. Analysis of the increase in numbers of trips originating and terminating at Lea Bridge station indicated that at least some of this development was reflected in the underlying demand assumptions in Railplan. There was a 14% - 40% increase in origins and destinations around Lea Bridge station between 2006 and 2016 / 2026 respectively.

8.7 Due to the estimated low demand of Lea Bridge station, it is unlikely that the station would be implemented for economic reasons. However, re-opening the station would significantly increase the levels of accessibility for surrounding residents and will be particularly important if the area is to be significantly re-developed in the future.

8.8 Despite this, the additional passengers Lea Bridge station attracts needs to be traded off against the time penalty imposed on other users of the service. This is apparent as more people are estimated to use the Chingford to Stratford service when the service is not scheduled to stop at Lea Bridge station.

9 Chingford to Stratford 11 Services in AM Peak Period

9.1 Given the timetable constraints resulting from the additional Chingford to Liverpool Street service in the morning three hour peak period in the existing timetable, model runs were

also undertaken with only 11 (previously 12) Chingford to Stratford services. Transit services are coded in Railplan using service headways. The Chingford – Stratford service was reduced to 11 services in the 3-hour AM peak period by changing the headway from 15 to 16.36 minutes. The 12 services on the down service from Stratford to Chingford were left unaltered.

9.2 The reduction in the number of services results in a reduction of 9% of passengers towards Stratford as shown in Table 9.1. The Stratford-Chingford demand does not change as there were still 12 services coded in this direction.

Table 9.1 Chingford to Stratford Demand: 11 Trains in AM Peak

Service	2016 LB 11 trains	2016 LB 12 trains	Change (%)
Chingford – Stratford	2,964	3,224	-8.8%
Stratford - Chingford	709	709	-
Chingford – Liverpool Street	5,523	5,421	+1.9%
Liverpool Street - Chingford	521	521	-

9.3 The reduction in morning peak services result in 7 fewer boarders at Lea Bridge station and 13 fewer alighters as shown in Table 9.2.

Table 9.2 Lea Bridge Station: 11 Trains in AM Peak

Service	Output	2016 LB 11 trains	2016 LB 12 trains	Change (%)
Chingford – Stratford	Boarders	47	54	-13.0%
Chingford – Stratford	Alighters	220	233	-5.6%

Appendix D - Economic Appraisal

1 Introduction

1.1 There are a large number of different sources of costs and benefits associated with the introduction of the Chingford to Stratford rail services and the re-opening of Lea Bridge station that can be quantified. These have been brought together in an economic appraisal that is compliant with Transport for London's and the Department for Transport's appraisal methodology.

1.2 Appendix D details the economic benefits and costs associated with the scheme, together with the key calculations, processes involved and results of the scheme appraisal.

1.3 Economic appraisals were conducted for the following scenarios:

- Lea Bridge open with Double Track Hall Farm Curve;
- Lea Bridge open with Single Track Hall Farm Curve;
- Lea Bridge closed with Double Track Hall Farm Curve; and
- Lea Bridge closed with Single Track Hall Farm Curve.

1.4 In each appraisal it was assumed that the scheme opening year was 2016 and that it was a sixty year appraisal period.

1.5 In the following sections the calculations of economic costs and benefits are outlined and the sources of the assumptions used.

2 Economic Cost Calculations

2.1 The economic costs were divided between:

- Capital expenditure on all infrastructure, maintenance and renewal costs related to construction of Hall Farm Curve and reopening of Lea Bridge station; and
- Operating expenditure borne by the Train Operating Company (TOC) and includes train leasing costs, station and train staffing costs and track access charges.

Capital Expenditure

2.2 Capital expenditure were based on the bill of quantities and overall cost for construction as described in Appendix A. The bill of quantities were finalised after a review of the Hyder report. The overall scheme cost was then estimated after assessing how the chord and station will be constructed taking account of issues including land access, plant and equipment and track possessions.

2.3 For the purpose of appraisal a risk premium was applied to the scheme capital cost. To estimate this all risks to the project were identified, assessed and the likelihood of each

occurring was estimated. The level of risk premium applied was in line with Network Rail's GRIP 3 (Option Selection) standard. The inclusion of the premium results in a risk-adjusted estimate of costs.

2.4 An optimism bias was also applied to the capital costs to account for the consistently observed underestimation of costs in major construction projects. An optimism bias of 66% was applied to capital expenditure in line with DfT Webtag Guidance for schemes at the initial stage of development.

Operational Expenditure

2.5 Operating expenditure was estimated by applying cost rates and annualisation factors to the outputs from the operational assessment detailed in Appendix B. The assessment concluded that the service is calculated to operate over 1,376 miles per day over a total of 80 hours.

2.6 As with the capital expenditure, optimism biases were applied to the operating costs as follows:

- Train Leasing: 20%
- Staffing: 10%
- Station: 20%

2.7 All costs in the appraisal were inflated to cash, converted to market prices, deflated to base cost year prices and discounted to the discount base year.

3 Economic Benefit Calculations

3.1.1 Benefits will change from year to year as demand grows and other factors change: modelling all 60 years will not be practical, so the approach adopted was to model 2016 and 2026 and to interpolate and extrapolate the benefits in the remaining years.

3.1.2 In line with DfT WebTAG guidance, the following benefits have been calculated for each scenario:

- Time saving benefits
- Highway decongestion benefits;
- Vehicle operating cost savings;
- Changes in indirect tax revenue;
- Environmental benefits; and
- Accident cost savings.

3.1.3 The calculation of these benefits and associated assumptions are explained in more detail below.

Time Saving Benefits

3.2 One of the key benefits identified from the scheme are time savings. These benefits were estimated by applying the rule-of-a-half to the changes in generalised costs and demand from Railplan using the following formula:

$$TimeBenefits = 0.5 * \Delta AverageGJT * (DMDemand + DSDemand) * VoT$$

3.3 The time saving benefits were estimated using the do-minimum (without scheme) demand and the do-something (with scheme) demand and the change in average generalised costs from Railplan. These benefits were segmented by journey purpose using the splits from the London Travel Demand Study[1] (LTDS) 08/09 so that different values of time can be applied can be applied to different segments.

3.4 Business time saving benefits were estimated using working values of time and commuting and leisure time saving benefits are estimated using non-working values of time. The values of time are in line with DfT Webtag Guidance and are shown in the following table.

Table 3.1 Values of Time

Mode	Value of Time (£/hr, 2002 market prices)
Rail (Business)	36.96
Commuting	5.04
Leisure	4.46

Decongestion Benefits

3.5 These are time saving benefits as a result of faster car journey times as some people change their mode of transport from car to public transport due to the implementation of the scheme. These benefits were estimated in a two stage process. First, the change in car kilometres due to the scheme must be estimated by calculating the proportion of additional public transport kilometres which are from car journeys. The additional public transport km is equal to the difference between PT km with redistributed demand and fully adjusted demand including uplift. The proportions of PT km were estimated using diversion factors by journey purpose from PDFH[2]. The proportions for Business (32%), Commuting (31%) and Leisure (15%) were multiplied by the AM peak journey purpose split from LTDS to give an overall diversion factor of 28%.

3.6 The second stage in the process is to apply values per km removed from WebTAG to the change in car kilometres. The values per km removed are based on a traffic weighted average of levels of congestion by road type and area. These were estimated by multiplying the marginal external costs by road type, area type and congestion band by the proportion of London roads by road type, area type and congestion band.

Vehicle Operating Cost Savings

3.7 These are the cost savings as a result of fewer car kilometres. They include savings in fuel costs and non-fuel costs such as oil, tyres, maintenance, depreciation and vehicle capital savings.

[1] LTDS is an annual survey undertaken in households across London to determine travel patterns of residents.

[2] PDFH (August 2009), Chapter B2, Section B2.9, Table B2.8

3.8 Vehicle operating cost savings were calculated by applying the change in car kilometres to fuel and non-fuel costs disaggregated by work and non-work trips using the parameters and assumptions from WebTAG Unit 3.5.6. The calculations were broken down into work and non-work trips using the LTDS journey purpose splits.

Changes in Indirect Tax Revenue

3.9 The change in government indirect tax revenue was calculated using the change in passenger kilometres by mode. The changes arise from the fact that car trips are heavily taxed (including fuel duty and VAT) whereas public transport trips are not subject to VAT. The indirect tax was calculated separately for work and non-work trips using the formulae and assumptions in WebTAG Unit 3.5.3.

Environmental Benefits (Greenhouse Gas Emissions Savings)

3.10 Greenhouse gas emission savings represent the benefit of less carbon dioxide polluting the atmosphere and the consequential affect on global warming.

3.11 Environmental Benefits were calculated using the change in passenger kilometres by public transport and vehicle kilometres by car and assumptions from Webtag Unit 3.3.5 in a two step process. Firstly, emissions per kilometre were applied to the change in passenger kilometres to estimate the change in carbon dioxide emissions. Secondly, the values per tonne of carbon dioxide removed were applied to the change in carbon dioxide emissions.

Accident Savings

3.12 Accident cost savings are an estimate of the economic cost of a change in the number of accidents. Accident cost savings were estimated by applying assumptions from WebTAG Unit 3.4.1 to the changes in passenger kilometres by mode.

4 Revenue Changes

4.1 The change in public transport revenue as a result of the scheme was estimated by applying an average fare per kilometres to the change in passenger kilometres. The average fare per kilometre was derived from the Travel in London Report 2009 and Network Rail's National Rail Trends 2008-2009. The fares used are shown in the following table in 2002 market prices.

Table 4.1 Revenue per km

Mode	Revenue per km (p)
Underground	19.3
DLR	19.9
Rail	11.7
Bus	14.1
Croydon Tramlink	15.6

5 Annualisation Factors

5.1 The Railplan model estimates the number of people using the scheme during the morning peak period only (0700-1000). In order to calculate economic benefits for a year, annualisation factors are applied to the Railplan results with different factors being applied by mode. The annualisation factors used in the appraisal calculations were from the TfL Business Case Development Manual (BCDM)[3] and were 1,076 for rail modes and 1,699 for bus.

5.2 Applying these annualisation factors allowed annual benefits to be estimated for 2016 and 2026. Benefits for the years between 2016 and 2026 were calculated by interpolation using the average annual change between the two years. The growth in passenger demand for the scheme after 2026 was assumed to be 1%.

6 Results: Transport Economic Efficiency (TEE) Tables

6.1 The TEE table provides the summary business case results and includes the estimation of Net Present Value (NPV) and Benefit Cost Ratio (BCR) for each scenario. The BCR is the ratio of the monetary benefits of the scheme, relative to its cost. The magnitude of the BCR indicates the number of times that the benefits cover the costs. A BCR of two or more is generally accepted as an indication that the scheme is beneficially.

6.2 A positive BCR indicates that the costs will not be funded by the revenue generated from the scheme and therefore additional financial investment is required.

6.3 The results of the business case are shown in the following table. Results are presented against constructing a single or a double track curve at Hall Farm as well as with and without the opening of Lea Bridge station (LB, NLB respectively). All figures (with the exception of the Benefit-Cost Ratio (BCR)) are shown in £m at 2002 prices. The BCR is calculated from the table as (NPV benefits / (NPV Costs – NPV Revenue)).

[3] TfL Business Case Development Manual, September 2009, Appendix C, Section C4.2

Table 6.1 Appraisal Summary

Benefit/Cost	LB Single Track	LB Double Track	NLB Single Track	NLB Double Track
NPV Benefits	281.84	281.84	306.26	306.26
NPV Revenue	35.96	35.96	33.77	33.77
NPV Costs	122.38	129.35	112.94	119.66
BCR	3.26	3.02	3.87	3.57

6.4 The benefits and revenues differ depending on whether Lea Bridge station is re-opened or not. The benefits are slightly larger with Lea Bridge station closed as a large proportion of the benefits are time saving benefits. An additional two minutes time saving was modelled when the train did not stop at Lea Bridge station.

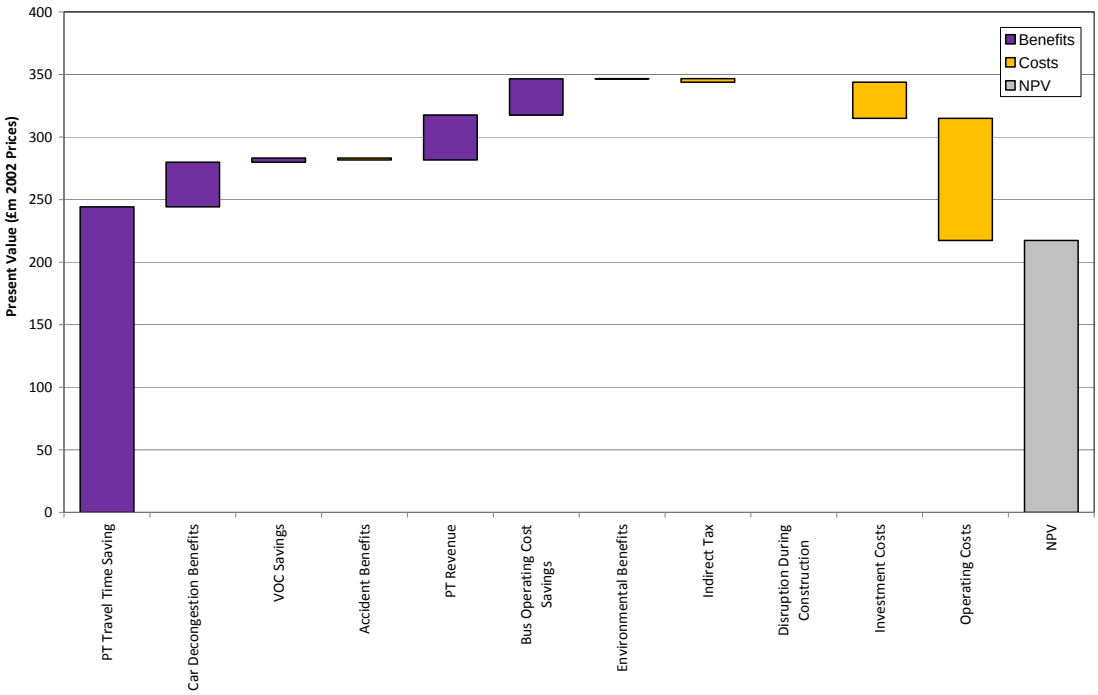
6.5 The costs of each scheme differ depending on whether there is a single or double track curve and with or without Lea Bridge station.

6.6 In all cases, the BCR is positive and greater than two, indicating that all schemes represent good value for money in government spending terms.

6.7 The impact of opening Lea Bridge station results in an incremental change to the BCR of -3.37 assuming a single track and -3.26 assuming a double track at Hall Farm curve. Therefore, whereas the overall scheme has a reasonable BCR, the opening of Lea Bridge station is not beneficial from an economic point of view.

6.8 The relative importance of each benefit and cost in the appraisal can be shown using a 'waterfall' chart as in Figure 6.1. This shows that the majority of the scheme benefits are a result of time savings on the public transport network. The scheme is also shown not to produce a significant amount of revenue. In terms of costs, the figure shows that the operating costs spread over the lifetime of the scheme are greater than the initial capital expenditure required.

Figure 6.1 Waterfall chart of Economic Appraisal Results for the Lea Bridge Open and Double Track Hall Farm Curve



6.9 The TEE tables of the four business cases are shown in the tables below.

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Open & Double Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)

	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	117.42	31.23	86.19
Vehicle Operating Cost		2.70	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	120.12	33.93	86.19
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	162.45	4.41	158.04
Vehicle Operating Cost		0.58	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	163.03	4.99	158.04
Private Sector Provider Impact		Road	PT
Revenue	35.96		35.96
Operating Cost	-97.65		-97.65
Investment Cost	-28.84		-28.84
Grant/subsidy	90.52		90.52
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	163.03	4.99	158.04
Total Present Value of Benefits	283.15	38.92	244.23
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			90.52
Indirect tax revenues		2.87	
Net Impacts	93.39	2.87	90.52
Total Present Value of Costs	93.39		

Analysis of Monetised Costs and Benefits (AMCB) Table

	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.22		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.53	0.58	-2.11
Consumer Users	120.12	33.93	86.19
Busines Users and Providers	163.03	4.99	158.04
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	281.84	39.49	242.12
PV of costs (b)	93.39		
Overall Impacts			
NPV (a-b)	188.45		
BCR (a/b)	3.02		

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Open and Single Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)

	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	117.42	31.23	86.19
Vehicle Operating Cost		2.70	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	120.12	33.93	86.19
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	162.45	4.41	158.04
Vehicle Operating Cost		0.58	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	163.03	4.99	158.04
Private Sector Provider Impact		Road	PT
Revenue	35.96		35.96
Operating Cost	-97.65		-97.65
Investment Cost	-21.87		-21.87
Grant/subsidy	83.55		83.55
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	163.03	4.99	158.04
Total Present Value of Benefits	283.15	38.92	244.23
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			83.55
Indirect tax revenues		2.87	
Net Impacts	86.42	2.87	83.55
Total Present Value of Costs	86.42		

Analysis of Monetised Costs and Benefits (AMCB) Table

	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.22		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.53	0.58	-2.11
Consumer Users	120.12	33.93	86.19
Busines Users and Providers	163.03	4.99	158.04
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	281.84	39.49	242.12
PV of costs (b)	86.42		
Overall Impacts			
NPV (a-b)	195.42		
BCR (a/b)	3.26		

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Closed and Double Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)

	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	127.51	33.79	93.72
Vehicle Operating Cost		2.91	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	130.42	36.70	93.72
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	176.60	4.77	171.83
Vehicle Operating Cost		0.63	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	177.23	5.39	171.83
Private Sector Provider Impact		Road	PT
Revenue	33.77		33.77
Operating Cost	-93.13		-93.13
Investment Cost	-23.70		-23.70
Grant/subsidy	83.05		83.05
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	177.23	5.39	171.83
Total Present Value of Benefits	307.64	42.09	265.55
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			83.05
Indirect tax revenues		2.83	
Net Impacts	85.88	2.83	83.05
Total Present Value of Costs	85.88		

Analysis of Monetised Costs and Benefits (AMCB) Table

	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.24		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.62	0.62	-2.25
Consumer Users	130.42	36.70	93.72
Busines Users and Providers	177.23	5.39	171.83
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	306.26	42.72	263.30
PV of costs (b)	85.88		
Overall Impacts			
NPV (a-b)	220.37		
BCR (a/b)	3.57		

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Closed and Single Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)			
	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	127.51	33.79	93.72
Vehicle Operating Cost		2.91	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	130.42	36.70	93.72
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	176.60	4.77	171.83
Vehicle Operating Cost		0.63	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	177.23	5.39	171.83
Private Sector Provider Impact		Road	PT
Revenue	33.77		33.77
Operating Cost	-93.13		-93.13
Investment Cost	-16.98		-16.98
Grant/subsidy	76.33		76.33
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	177.23	5.39	171.83
Total Present Value of Benefits	307.64	42.09	265.55
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			76.33
Indirect tax revenues		2.83	
Net Impacts	79.16	2.83	76.33
Total Present Value of Costs	79.16		

Analysis of Monetised Costs and Benefits (AMCB) Table			
	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.24		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.62	0.62	-2.25
Consumer Users	130.42	36.70	93.72
Busines Users and Providers	177.23	5.39	171.83
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	306.26	42.72	263.30
PV of costs (b)	79.16		
Overall Impacts			
NPV (a-b)	227.09		
BCR (a/b)	3.87		

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Open (11 trains/hr for Chingford to Stratford) & Double Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)

	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	112.49	31.27	81.22
Vehicle Operating Cost		2.71	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	115.20	33.97	81.22
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	153.33	4.41	148.92
Vehicle Operating Cost		0.58	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	153.91	4.99	148.92
Private Sector Provider Impact		Road	PT
Revenue	35.58		35.58
Operating Cost	-97.65		-97.65
Investment Cost	-28.84		-28.84
Grant/subsidy	90.90		90.90
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	153.91	4.99	148.92
Total Present Value of Benefits	269.11	38.97	230.14
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			90.90
Indirect tax revenues		2.85	
Net Impacts	93.75	2.85	90.90
Total Present Value of Costs	93.75		

Analysis of Monetised Costs and Benefits (AMCB) Table

	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.22		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.54	0.58	-2.12
Consumer Users	115.20	33.97	81.22
Busines Users and Providers	153.91	4.99	148.92
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	267.79	39.55	228.02
PV of costs (b)	93.75		
Overall Impacts			
NPV (a-b)	174.03		
BCR (a/b)	2.86		

7 Chingford to Stratford: 11 Trains Morning Peak

7.1 The modelling results from the sensitivity test of 11 trains in the morning peak from Chingford to Stratford services were also tested in a business case. The results and comparisons to the original business case results are shown in the following table.

Table 7.1 Appraisal Summary: 11 Trains per Hour

Benefit/Cost	Single Track 11 trains/hr	Single Track 12 trains/hr	Double Track 11 trains/hr	Double Track 12 trains/hr
NPV Benefits	267.79	281.84	267.79	281.84
NPV Revenue	35.58	35.96	35.58	35.96
NPV Costs	122.36	122.38	129.33	129.35
BCR	3.09	3.26	2.86	3.02

7.2 As would be expected these results show that with only 11 trains in the morning peak there is small reduction in the strength of the business case, nether-the-less the overall BCR is still greater than two. The detailed TEE tables for each of the scenarios using eleven trains in the morning peak period are shown in the subsequent tables.

Summary Tables (TEE, AMCB & Public Accounts)

Scenario - Lea Bridge Open (11 trains/hr for Chingford to Stratford) and Single Track Hall Farm Curve

Economic Efficiency of the Transport System (TEE)

	Total (£m, 2002 prices)		
Consumers		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	112.49	31.27	81.22
Vehicle Operating Cost		2.71	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Consumer Benefits	115.20	33.97	81.22
Business		Road	PT
User Benefits			
Travel Time Saving (includes crowding)	153.33	4.41	148.92
Vehicle Operating Cost		0.58	
User Charges			
Disruption During Construction and Maintenance		0.00	
Net Impact	153.91	4.99	148.92
Private Sector Provider Impact		Road	PT
Revenue	35.58		35.58
Operating Cost	-97.65		-97.65
Investment Cost	-21.87		-21.87
Grant/subsidy	83.93		83.93
Revenue Transfer	0.00		
Sub-total	0.00		0.00
Other business impacts			
Developer and other contributions			
Net Business Impact	153.91	4.99	148.92
Total Present Value of Benefits	269.11	38.97	230.14
Public Accounts		Road	Rail
Local Government Funding			
Direct Revenue			
Operating Costs			
Investment Costs			
Developer and other contributions			
Grant/subsidy payments			
Sub-total	0.00	0.00	0.00
Central Government Funding			
Direct Revenue			
Operating costs			
Investment costs			
Developer and other contributions			
Grant/subsidy payments			83.93
Indirect tax revenues		2.85	
Net Impacts	86.78	2.85	83.93
Total Present Value of Costs	86.78		

Analysis of Monetised Costs and Benefits (AMCB) Table

	Total	Road	PT
Passenger			
Noise			
Local Air Quality			
Greenhouse Gases	0.22		
Journey Ambience (inc. rolling stock quality, station quality and crowding)			
Accidents (inc. safety)	-1.54	0.58	-2.12
Consumer Users	115.20	33.97	81.22
Busines Users and Providers	153.91	4.99	148.92
Reliability (inc. performance and reliability)			
Option value			
Interchange (including station quality and station crowding)			
PV of Benefits (a= sum of all benefits)	267.79	39.55	228.02
PV of costs (b)	86.78		
Overall Impacts			
NPV (a-b)	181.00		
BCR (a/b)	3.09		

8 Conclusions

8.1 The appraisals for all schemes are shown to represent good value for money with BCRs in the range 3.02 - 3.87 assuming twelve trains per hour in the morning peak period. The strength of the business case reduces slightly with eleven trains per hour, but the BCR is still greater than two.

8.2 The majority of the benefits are due to time savings resulting from the implementation of the scheme. These time savings are greater when Lea Bridge station is not re-opened, however, the scheme incorporating Lea Bridge is still show

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Abu Dhabi
AS Business Centre, First Floor, Suites 201-213, Al Ain Road, Umm al Nar, P.O. Box 129865, Abu Dhabi, UAE
T: +971 2 558 9809 F: +971 2 558 3809

Birmingham
Second Floor, 37a Waterloo Street
Birmingham B2 5TJ United Kingdom
T: +44 (0)121 233 7680 F: +44 (0)121 233 7681

Dubai
Office 402, Building 49, Dubai Healthcare City
PO Box 123166, Dubai, UAE
T: +971 (0)4 433 0530 F: +971 (0)4 423 3613

Dublin
First Floor, 12/13 Exchange Place
Custom House Docks, IFSC, Dublin 1, Ireland
T: +353 (0)1 542 6000 F: +353 (0)1 542 6001

Edinburgh
Stewart House, Thistle Street, North West Lane
Edinburgh EH2 1BY United Kingdom
T: +44 (0)131 220 6966 F: +44 (0)131 220 6087

Glasgow
Seventh Floor, 78 St Vincent Street
Glasgow G2 5UB United Kingdom
T: +44 (0)141 225 4400 F: +44 (0)141 225 4401

London
Second Floor, 17 Hanover Square
London W1S 1HU United Kingdom
T: +44 (0)20 7529 6500 F: +44 (0)20 7529 6556

Lyon
11, rue de la République, 69001 Lyon, France
T: +33 (0)4 72 10 29 29 F: +33 (0)4 72 10 29 28

Manchester
25th Floor, City Tower, Piccadilly Plaza
Manchester M1 4BT United Kingdom
T: +44 (0)161 236 0282 F: +44 (0)161 236 0095

Marseille
76, rue de la République, 13002 Marseille, France
T: +33 (0)4 91 37 35 15 F: +33 (0)4 91 91 90 14

Paris
12-14, rue Jules César, 75012 Paris, France
T: +33 (0)1 53 17 36 00 F: +33 (0)1 53 17 36 01

Woking
Dukes Court, Duke Street, Woking
Surrey GU21 5BH United Kingdom
T: +44 (0)1483 728051 F: +44 (0)1483 755207

Email: info@mvaconsultancy.com

Offices also in
Bangkok, Beijing, Hong Kong, Shenzhen and Singapore

mvaconsultancy