AECOM

Leicestershire County Council,
Leicester City Council and
North West Leicestershire District Council

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Leicester - Burton Rail Passenger Service

Final Report

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Table of Contents

Executive Summary

AECOM was commissioned by Leicestershire County Council (LsCC), Leicester City Council (LCC) and North West Leicestershire District Council (NWLDC) to revisit the business case for the re-introduction of rail passenger services along the Leicester to Burton-upon-Trent Line, which is currently a freight only operation. In carrying out this study, two service concepts for the route were identified, a “Local Service” running between Leicester and Burton serving a number of intermediate stations and a “Strategic Service” which would connect Burton and a smaller number of intermediate stations, directly with London via Leicester. As the work progressed, additional tests were specified as variants of the Local Option to test the effects of increased line speed and service frequency to inform the ongoing progression of the scheme.

Methodology

A series of workstreams were identified in order to develop the study methodology. A timetabling exercise identified the end-to-end journey times and operational and infrastructure requirements for each service option. This informed the operating cost model, developed based on a combination of data from East Midlands Trains and our own industry knowledge. The resultant costs benchmarked well against other studies.

The fact that the proposed rail passenger service would be serving completely new markets meant that existing standard rail industry demand forecasting tools were inappropriate and therefore a more bespoke model was required. Use was therefore made of the Leicester and Leicestershire Integrated Transport Model (LLITM). However, it has to be acknowledged that use of the current version of this model contained a number of forecasting constraints, many of which will be resolved or improved in the next version of the LLITM model which is due to be completed in 2016. As a result, some caution needed to be applied when interpreting the demand and revenue results, which might be considered to be understated.

A bespoke appraisal model was developed in line with current WebTAG appraisal guidance, which incorporates the outputs from the LLITM model and the operating cost model. This generated the benefits for each of the scheme options, and ‘reverse engineered’ the level of capital costs that could be accommodated for each option in order to generate milestone Benefit Cost Ratios (BCRs). These were subsequently compared to high level indicative capital costs that were developed later during the study.

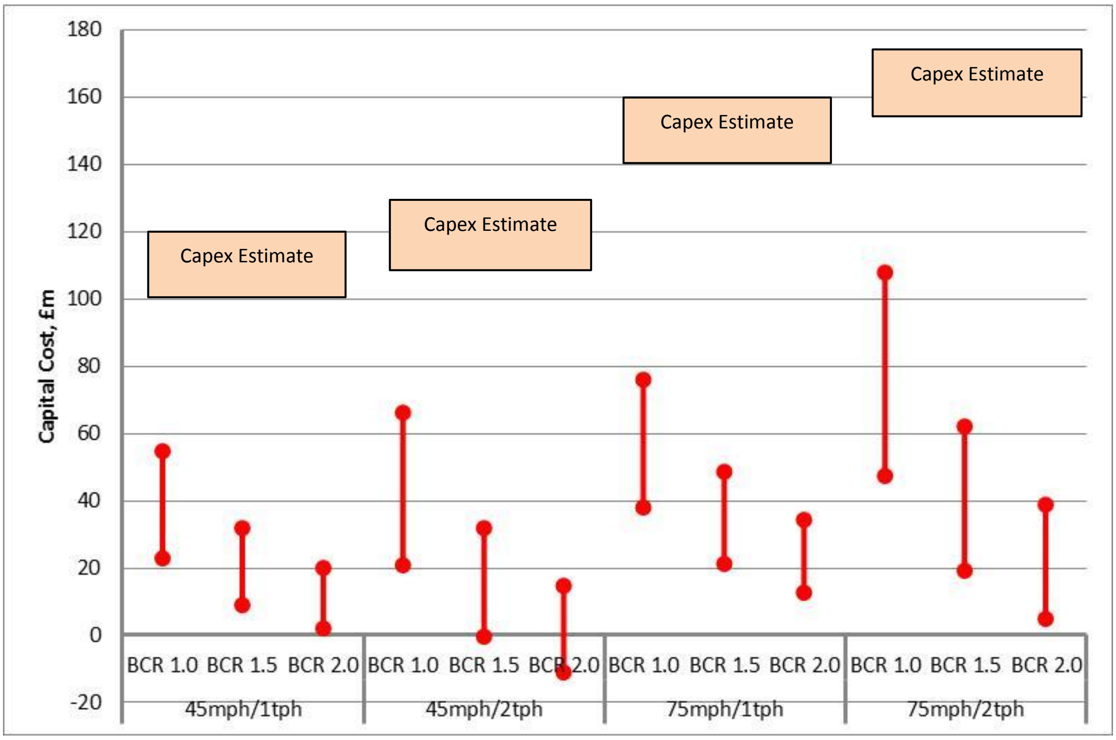
Results

The LLITM model forecast annual rail demand for two forecast years across all options appraised, as presented in the table below. Analysis of the results demonstrates the increases in demand attributable to improved service provision.

Option	Number of Stations	Service Pattern	End-to-end Journey Time	Annual Demand (single journeys)	
				2016	2031
Local	5	1 tph / 45 mph	52 mins	364,374	535,237
	5	1 tph / 75 mph	43 mins	447,596	657,965
	5	2 tph / 45 mph	52 mins	563,617	828,517
	5	2 tph / 75 mph	43 mins	645,718	949,205
Strategic	3	1 tph / 45 mph	51 mins	301,894	443,785

The forecasts associated with the Strategic Option are slightly lower than for the equivalent Local Option, indicating that the removal of two stations has a greater negative impact on demand than the increased demand of providing a through service to London. The operating costs for the Strategic Option however were some 87% higher than for the equivalent Local Option. Therefore, it was considered extremely unlikely that an appropriate business case could be identified for the Strategic Option and therefore the study then focused on the development of the Local Option around different potential service patterns.

The graph below summarises the emerging business case position for each version of the Local Option and milestone BCR, in terms of the anticipated range of capital cost budget available in order to generate that BCR (red lines) and also the estimated high level capital cost estimate (brown boxes).



For example, in order to obtain a BCR of 1.5 for the 75mph/1tph option, the capital cost would have to be between £20m and £45m. However, the initial high level capital cost estimation for this option is between £140m and £160m.

Based on the indicative capital costs outlined above, the annual demand forecasts would have to increase by circa 50% for the 2tph options and 80% for the 1 tph options to achieve a breakeven BCR of 1.0, and essentially double for a BCR of 1.5.

Our appraisal analysis has also provided an initial indication of the likely levels of ongoing annual revenue support that may be required, which is estimated to be £1.5m to £2m per annum for the hourly service pattern options (and nearer to £2m+ in the initial three years). Where the service frequency is doubled the revenue support would be in the region of £4m per annum.

Wider economic benefits (GVA impacts) have also been determined for the four Local Option variants. The annual GVA values are estimated to be between £0.3m and £1.0m per annum depending on the service pattern.

Conclusions

The findings from this study suggest that the level of benefits that could be generated by the scheme will not be enough to cover the costs of the scheme in order to produce a positive business case. The gap between the benefits and costs becomes even greater when considering key 'milestone' BCRs.

It should, however, be noted that this conclusion is based on a set of demand forecasts which we consider may well be understating the levels of demand for the scheme. In addition, the capital costs are based on an initial high level costing exercise that has been quickly undertaken for the purposes of informing this study.

Therefore, whilst it could be concluded that the increase in demand (and thus benefits) that would be required in order to generate a BCR over 1.5 would need to be significant and is unlikely to be realistically achievable, further work may be beneficial to robustly support decisions relating to the progress of the scheme. In particular, use of the updated LLITM model may generate additional demand and a detailed bottom-up costing exercise may reduce the capital costs (and possibly reduce the use of a 66% optimism bias factor too). For example, an increase in demand of around 40% to 50% coupled with a reduction in the capital costs of 40% to 50% could get close to achieving a BCR of around 1.5.

1 Background

1 Background

1.1 Introduction

1.1.1 The Leicester-Burton line is currently a freight-only line that passes through the towns of Coalville and Ashby-de-la-Zouch and passes close to Swadlincote. The proposal is to introduce rail passenger services on this route and therefore a business case is required.

1.1.2 Following discussions with Leicestershire County Council (LsCC), Leicester City Council (LCC) and North West Leicestershire District Council (NWLDC), it has become apparent that there is an immediate requirement to revisit the business case for a new rail passenger service on the Leicester-Burton line. The Councils acknowledged the requirement to develop the business case for the scheme in line with DfT guidance[1], but confirmed that there were pressing political reasons to firstly understand what the emerging economic business case might be specifically for the new rail service.

1.1.3 It is over six years since the previous business case was developed and the rail industry, political landscapes and rail scheme appraisal processes have changed considerably since then. There is arguably a more pro-rail agenda today, reflected in the early moves towards a devolution of rail powers in the North of England and in the West Midlands, development of HS2 in the longer term and the change in direction of Network Rail's planning process away from analysing what can be done with existing capacity to a more customer-orientated analysis of future requirements through to 2043.

1.1.4 The key objectives of this study are:

- To identify the scale of the potential business case for re-opening the Leicester-Burton line to rail passenger services;
- To test two differing service concepts for the route, firstly the concept of a local service running between Leicester and Burton serving a number of intermediate stations and secondly a strategic service which would connect Burton, and a smaller number of intermediate stations, with London via Leicester; and
- The outcome of this work will inform LsCC, LCC and NWLDC in ongoing discussions within local and regional government, such as Midlands Connect, and also with rail industry stakeholders, such as with Network Rail (East Midlands Route Study) and HS2.

1.1.5 The timescales to produce a new business case for the rail scheme were challenging and therefore the methodology applied made best use of available data and modelling tools. This has been achieved, although it is set out where this presents constraints in terms of the level of forecasting/appraisal accuracy.

1.1.6 It is also worth noting that this study does not develop a Benefit Cost Ratio (BCR), as the development of capital costs is not included in the scope[2]. However, an alternative approach has been adopted to undertake a 'reverse engineered' appraisal, whereby the level of capital cost required in order to generate milestone BCRs (such as 1.5 and 2.0) would be identified.

[1] Our first proposal submitted to LsCC set out the methodology to develop the Strategic Outline Business Case for the scheme in line with DfT appraisal guidance. This rightly focusses on the 'Strategic Case' for the scheme, something that might be better informed once the parallel Leicestershire Rail Strategy study has been progressed.

[2] Although subsequent analysis requested by the Client during the study was undertaken to identify high-level capital costs in order to inform the ongoing scheme development discussions.

1.2 Client Requirement

1.2.1 AECOM has been appointed by LsCC, LCC and NWLDC to carry out a re-appraisal of a new rail passenger service between Leicester and Burton-upon-Trent based on the following core tasks:

- Confirming scope and objectives;
- Reviewing previous work;
- Defining and confirming rail service options;
- Preparing and running the Leicester and Leicestershire Integrated Transport Model (LLITM) in order to generate demand forecasts;
- Developing scheme operating costs;
- Developing a scheme appraisal model; and
- Reporting.

1.3 Deliverables

1.3.1 The key deliverable is a demand and appraisal report, which sets out the inputs, assumptions, outcomes, conclusions and caveats associated with the work undertaken.

1.4 Additional Analysis

1.4.1 Following on from the original scope of work, additional analysis was identified through ongoing discussions with the Client during the study to test further enhanced options with the objective of maximising the potential benefits through enhanced service provision. New tests were therefore undertaken which examined increased frequency, an increase in assumed line speeds and a combination of the two. The results from this additional analysis have been incorporated into this Report accordingly.

1.4.2 In addition, during the course of this study, and following discussion with the client, it was agreed that AECOM would undertake a high-level costing exercise based on the emerging infrastructure requirements identified via the train planning exercise. The need for this additional work became apparent in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing.

1.5 Report and Business Case Structure

1.5.1 The remainder of the report is structured as follows:

- Chapter 2 presents a review of the previous work summarising the study undertaken by Scott Wilson[3] in 2009 in order to better understand how each of the core components of the business case were developed. This helped inform the current study and served as a useful benchmark.
- Chapter 3 summarises the assumptions underpinning the specification of the options and the timetabling analysis which has been undertaken.
- Chapter 4 sets out the scheme costs, including the development of the operating cost model, input data and assumptions.
- Chapter 5 describes the LLITM modelling which has been undertaken. This includes a summary and discussion of the outputs of the modelling.
- Chapter 6 sets out the inputs, assumptions and results of the scheme appraisal.
- Chapter 7 presents the conclusions and next steps.

[3] Ivanhoe Line Stage II Scheme Re-Appraisal Final Report, Scott Wilson, April 2009

2 Review of Previous Studies

2 Review of Previous Studies

2.1 Introduction

2.1.1 The purpose of this chapter is to review the previous work undertaken by Scott Wilson[4] in order to better understand how each of the core components of the business case, i.e. demand, revenue, economic benefits, operating costs and capital costs were developed. The report by Scott Wilson contains the most immediately relevant material and its review helped inform the current study and served as a useful benchmark.

2.1.2 The Scott Wilson report estimated a demand[5] of circa 350,000 single journeys per annum, which contributed to a BCR (Benefit Cost Ratio) of 0.4. The Scott Wilson report calculated that between 500,000 and 600,000 journeys might be required in order to generate a 'breakeven' BCR (i.e. a BCR of 1.0), given their assumptions around the costs.

2.1.3 ATOC (Association of Train Operating Companies) undertook a high level analysis of potential new rail schemes across the UK in 2009[6], one of which was a new rail service between Burton and Leicester. The demand forecasting was at a very high level (trip rates applied to populations), but the exercise served to demonstrate that a positive business case (in this case a BCR of 1.3 was quoted for the scheme) might be achievable.

2.2 Review of the Scott Wilson Report

Option Specification

2.2.1 The study analysed the impact of an hourly service running between Leicester and Burton as part of an extended Lincoln to Leicester service which also covers the Ivanhoe Stage I stations between Loughborough and Leicester. The assumed service was a local stopping service that would run for sixteen hours per day, six days per week, from Monday to Saturday. It would serve seven new stations between Leicester and Burton: These are Bede Island; Leicester Forest East; Kirby Muxloe; Coalville; Ashby-de-la-Zouch; Moira; and Castle Gresley.

Planned Development

2.2.2 Scott Wilson took into account planned and committed developments along the corridor. At the time, exact details of these developments were unavailable, but broad indications of new dwellings located in the area were provided by the client. For forecasting demand from new development, the study only took into account development that had, at that time, an approximate location. The assumption was made that two thirds of the housing allocation would be located within the defined station catchment areas.

2.2.3 The study also considered that all the planned development would be completed by the time the scheme was assumed to open, i.e. full realisation would be achieved by 2015.

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[4] Ivanhoe Line Stage II Scheme Re-Appraisal Final Report, Scott Wilson, April 2009

[5] Base year demand generated by the intermediate stations in 2008

[6] "Connecting Communities – Expanding Access to the Rail Network", ATOC June 2009

Demand Estimation

2.2.4 Scott Wilson estimated the annual demand using a multi-variable regression trip rate model sourced from the Scottish Strategic Rail Study (SSRS). The model, which is not specifically focused on any given spatial area, had been used by Scott Wilson on several pre-feasibility stages of railway appraisals to provide a high-level demand forecast.

2.2.5 For demographic data, Scott Wilson used data from the latest available Census at the time of the study. 2001 Census data for the economically active population was used and growthed to 2008 on the basis of employment forecasts.

2.2.6 The catchment area used for the modelling considers two radii 0.8 and 2.8km from the station. Scott Wilson acknowledges that these might be considered relatively tight and that larger catchment areas have been used in other railway patronage studies.

2.2.7 Base year patronage for the line was estimated by adding demand from existing populations to demand from a proportion of the planned development with an assigned location.

2.2.8 Scott Wilson estimated a base year patronage of 174,000 journeys generated in total by the intermediate stations, which translates into 350,000 single journeys per year[7]. Applying their assumed growth (circa 3% per annum) leads to the base demand of 549,000 in 2026 quoted in Table 14.7 in their report.

2.2.9 Tourist demand was not included in the appraisal, although it was calculated that this could potentially account for more than 16,000 trips per year. It was however noted that much of this demand could be expected on non-service days, as most tourists are likely to visit the area during weekends and the option appraised by Scott Wilson did not include a Sunday service.

Revenues

2.2.10 Revenues were estimated using average fares from existing published information. Applying this to the assumed average distance travelled by the forecast journeys resulted in an average fare of £3.65 per journey, leading to a base year forecast annual revenue of £635,000 per annum for the line[8].

Annual Passenger Growth

2.2.11 Scott Wilson estimated annual passenger growth using historic passenger flow data associated with Leicester Station (2001/02 to 2003/04), sourced from the MOIRA model[9]. These data showed an average growth of 9% per annum for Leicester station. However, on the basis that Leicester has a larger catchment and different demographics, Scott Wilson erred on the side of caution and used 3% growth per annum for patronage on the line.

[7] It is not made clear in the report whether the estimated demand does in fact represent a two-way journey. This is the conclusion we have reached from reviewing the analysis. It is therefore assumed every journey generated makes a return journey

[8] It is not made clear in the report whether the average fare calculated represents a single or return fare. The application of this fare to the forecast demand might lead us to conclude that it is assumed to be an average return fare, although one could consider this to be a low value for a return fare.

[9] MOIRA is a rail industry tool which provides revenue, mileage and journeys by service group and ticket type and can be used to model, via the application of standard rail industry demand elasticities, the effects of timetable changes on each of these.

Passenger Distribution

2.2.12 The report derived passenger distribution from Census Journey-To-Work data.

2.2.13 The estimated demand from each of the stations was assigned to the above distribution to obtain the pattern of movements through the study area. These were then converted to vehicle movements and, finally, annual vehicle kilometres of travel and vehicle hours of time saved were estimated. These were subsequently used to estimate vehicle operating cost (VOC) savings and decongestion benefits, using WebTAG values.

2.2.14 This approach might be considered to have produced conservative economic benefits as the average delays applied were sourced from a study which was outdated and no growth rates appear to have been applied to the value of decongestion benefits into the future.

Operations

2.2.15 The Scott Wilson report acknowledged that the Knighton Chord, south of Leicester, would be essential. The reinstatement of Knighton Chord would require changes to the existing signalling and that the main constraints on capacity could potentially exist at Derby and Leicester.

2.2.16 The scheme assumed an estimated end-to-end travel time of 55 minutes between Leicester and Burton-upon-Trent assuming 7 intermediate stations and line speeds raised to 45 mph where current speeds are less than this.

2.2.17 For an hourly service interval, the study estimated that the minimum number of train sets required to deliver the service would be 3. This number could be reduced to 2 by extending the Lincoln to Leicester service on to Burton and thus avoiding turnaround time at Leicester. This was deemed to be the most cost effective way of providing the service.

Operating and Capital Costs

2.2.18 Scott Wilson estimated total annual operating costs of £3.5m. In the appraisal, this increased to £4.9m with optimism bias[10] applied. For the capital cost estimate, Scott Wilson reviewed the 1997 Leicestershire County Council report and then adjusted this to reflect their scheme specification in order to generate an estimated capital cost of £33.1m (in 2008 prices). This estimation included the reinstatement of trackwork including the Knighton Chord and double track as far as Bede Island and between Coalville and Lounge Junction as well as seven new stations and the upgrading of over 8km of track to ensure 45mph operation.

[10] Optimism bias is a factor applied to capital costs in line with Government appraisal guidance. It addresses uncertainty and possible evidence for optimism in scheme cost determination, with higher factors applied at earlier stages of a project, when a project is less developed and refined.

Economic Analysis

2.2.19 Scott Wilson developed a Restricted Cost Benefit Analysis (RCBA) based on a spreadsheet model. In terms of benefits, only those relating to direct rail revenues, road decongestion and vehicle operating cost savings were calculated. This means that benefits relating to user time savings, modal shift (safety and environmental) were not calculated. On the costs side, indirect taxation impacts and renewals and replacement costs don't appear to have been incorporated into the RCBA.

2.2.20 Scott Wilson assumed that capital costs would be partly covered by developers that would potentially contribute towards capital costs with approximately £200,000 per year for a 10-year period around the construction phase.

2.2.21 Results from the RCBA indicated that the scheme delivers poor value for money and it is unable to cover its operating costs without subsidy. A negative Net Present Value (NPV) of -£71m and a Benefit Cost Ratio of 0.40 were estimated for the scheme.

2.2.22 The report suggested that a full CBA could yield more positive benefits such as modal shift, road safety benefits and wider economic benefits. On the other hand, a more detailed and wide ranging analysis of costs, particularly capital costs, could potentially mitigate the very low BCR to some extent. In order to test for these hypotheses, the report recommended that a multi-modal modelling exercise and full Transport Economic Efficiency (TEE) appraisal is carried out.

2.2.23 The economic analysis examined further the impact of diverting a greater proportion of the planned housing growth in Leicestershire to locations within the new station catchments along the line. In order to conduct this analysis, Scott Wilson created several scenarios bounded by different development assumptions.

2.2.24 Scott Wilson re-calculated the RCBA for 10% to 66% of this planned development being realised within the proposed station catchments. The upper development limit was the only one which could deliver a BCR above 1 if costs excluded optimism bias. When costs are adjusted for optimism bias, the estimated value of the BCR was 0.70 (with 66% planned development located within the station catchments). What can be inferred from this analysis was that a breakeven (in BCR terms) demand would require between 500,000 and 600,000 single journeys (base year), which could not realistically be achieved as it would be unlikely that there would be enough land available to accommodate the required level of additional housing.

3 Option Definition and Specification

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3.1 Introduction

3.1.1 One of the initial tasks was the definition and specification of the options to appraise. This section documents the approach to undertaking this, the schemes which have been assessed and the analysis of run times and anticipated infrastructure requirements[11].

3.1.2 It is important to note that at this stage of the analysis, the key objective of the study was to establish whether it is likely that a business case can be made for a Leicester Burton rail passenger service, and therefore two broad rail service concepts were defined.

3.1.3 These two service concepts were identified as a 'Local Option' and a 'Strategic Option', and the development of these is documented in this Chapter. As part of further refinement, a number of additional options were developed based on the Local Option and including higher frequencies, higher speeds and a combination of speed and frequency increases. These are documented in Section 3.7.

3.2 Approach to Defining Options

3.2.1 Two initial core rail service option concepts were discussed with the client, both of which needed to be analysed:

- a local service between Burton and Leicester, calling at a number of new stations en route.
- a more strategic service with a limited number of stops linking Burton with Leicester and onto London.

3.2.2 The detail associated with each of them needed to consider the following points and be finalised and confirmed with the client:

- station-to-station journey times, which were dictated by the assumed line speeds;
- service frequency levels, whether they should be hourly or half-hourly, taking into consideration what could be accommodated by the existing infrastructure;
- the number of new stations, which was determined by a review of the previous Scott Wilson study coupled with the latest growth plans for the corridor to assist in defining where the new stations might be located;
- start and end points for the service, for example whether services travel beyond Burton to Derby and whether the service could be linked to the existing Lincoln-Nottingham-Leicester service, etc.

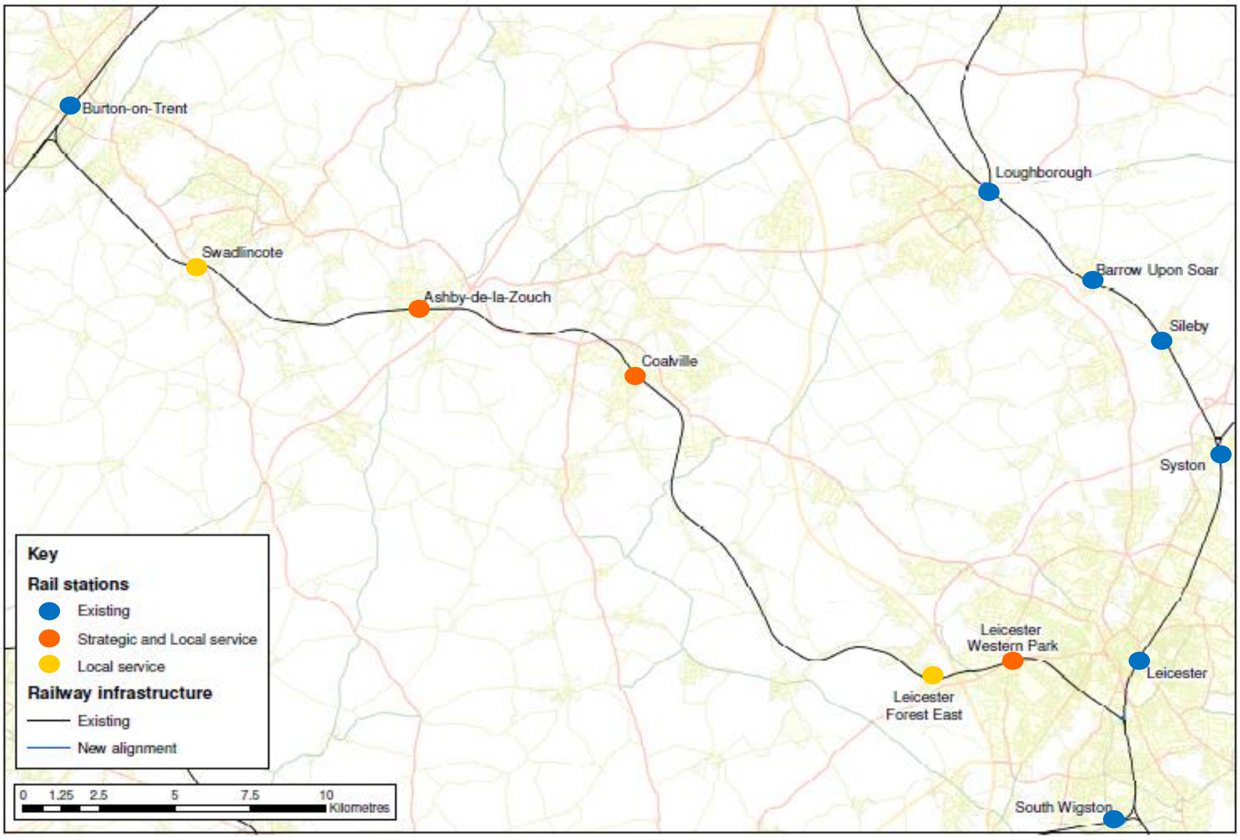
3.2.3 Clearly, therefore, a number of variant sub-options around these two broad service pattern concepts were possible. However, there was a requirement to keep these to a manageable level in order to achieve the study timescales.

[11] Noting that the generation of capital costs was not part of the original study remit

3.3 Outline of Proposed Schemes

3.3.1 The figure below shows the rail alignment between Leicester and Burton-upon-Trent, which is currently used for freight. This shows the proposed location of stations for passenger rail services for the local and strategic rail services, each of which is discussed in more detail below. The Scott Wilson study[12] identified seven stations between Leicester and Burton. However, after considering these in relation to the location of existing population and planned growth in the corridor, with one eye on maintaining a competitive rail journey time, it was considered that five stations would be appropriate as a starting point for the local option.

Figure 3.1: Leicester Burton Rail Alignment



[12] Ivanhoe Line Stage II Scheme Re-Appraisal Final Report, Scott Wilson, April 2009

3.3.2 In terms of defining the options to test, it was important to understand what the future 'base' situation will be, and how the strategic service option in particular, can be accommodated. Whilst it was recognised that this study is testing the concepts of local and strategic services, it is important to reflect options which have some basis in reality. The key relevant known facts relating to rail in the future include:

- At the initial stage of this study, during option definition, Midland Main Line (MML) electrification was committed and scheduled to start running in 2019. This would remove diesel services between London and Leicester and therefore the service options took this into account. However, during the course of the analysis, the electrification of the MML has been paused by the DfT. This has now been re-instated, albeit with phased delivery and longer timescales.
- It is likely that additional capacity will be provided through Leicester before electrification, including two more platforms proposed at Leicester Station, which will ease termination of trains at Leicester, dependent upon delivery of Network Rail's proposed Leicester capacity improvements. However the East Midlands Route Study suggests 6 fast trains per hour (tph) and 2 stopping tph between Leicester and London will use this additional capacity in the longer term.
- The East Midlands Trains franchise process will begin in early 2016, and the new franchise is expected to start in October 2017.
- The existing Leicester signalling was re-controlled from Derby a few years ago but this did not affect trackside functionality. However, the re-signalling needed before electrification would allow the best opportunity to incorporate layout changes.

3.3.3 The above issues have positive and negative effects on the possibility of a London service. It is plausible to imagine having extra London trains after re-signalling and electrification remove some of the capacity constraints, especially as Leicester does not benefit from HS2. However, as these will be electric trains, there would be the need to electrify the Leicester-Burton line, use dual mode trains or continue to run diesels on some London services.

3.4 Local Service Option

3.4.1 An hourly service between Leicester and Burton-upon-Trent has been assumed, mainly as this has been the core proposition for the previous studies undertaken and its implementation would be less constrained by the infrastructure (sections of single track) and rolling stock (availability) limitations that exist. A half-hourly frequency in the peaks has been considered as a sensitivity test, and is documented in Section 3.7.

3.4.2 Intermediate stations have been assumed at:

- Swadlincote: Located at Castle Gresley where the A444 crosses the line. This is not ideally located for serving Swadlincote, so may have to be marketed as a park and ride site.
- Ashby-de-la-Zouch: Located at the site of the old station in central Ashby.
- Coalville: Located just south of the level crossing on Hotel Street.
- Leicester Forest East: Located where Station Road crosses the line. This is located to serve proposed major development in the area as well as Kirby Muxloe and Kirby Fields, and
- Leicester Western Park: Located where the line crosses the Leicester ring road (A563).

Locations closer to central Leicester were considered, but these become less attractive locations when compared to the alternative bus and walk options available.

3.4.3 A station at Moira, serving the National Forest Centre, was initially considered, but rejected. This was a station proposed in the previous Scott Wilson study but the demand forecasts were poor. In our view, there is a balance to be struck in developing a business case for a scheme between accessibility to rail services and attractive journey times. In this case, it was felt that an additional station close to Swadlincote runs the danger of contributing to a poorer overall business case for the scheme and that the case for this station should be separately justified if desired.

3.4.4 It is noted that a significant proportion of the current alignment is single track (circa 55% of the route). This is not a constraint necessarily at the Leicester end, especially if the train terminates there, but may be more of an issue towards the centre of the line. High level train service planning and the determination of potential run times which has been undertaken as part of this study is reported in section 3.6 and considers the infrastructure requirements to achieve a given level of service. For the journey time determination the same working assumption is assumed as used previously – namely that existing line speeds are used wherever possible, but where this is less than 45mph then the line speed is assumed to be raised to 45mph. In terms of the Knighton Curve, the radius was determined and a maximum speed of 20 mph was assumed.

3.4.5 The operation of class 156 (2-car) rolling stock has been assumed, an example of which is shown to the right. These are currently in operation with East Midlands Trains and operate their local services across their network.

3.4.6 There is an allowance for one freight path per hour irrespective of direction in the assumptions. It is recognised that, given the number of current freight services on the line, as set out in paragraph 3.6.14, this is likely to be an over provision. Nonetheless, this assumption has been retained for planning purposes.

3.4.7 A final consideration is station capacity. At Leicester, it has been assumed that there would be no issues relating to platform availability, either by combining with other services or assuming additional station capacity. However, potential operational conflicts arising at Burton-upon-Trent station are foreseen, as it only has two through platforms[13]. For the purposes of testing the concept of a local service option, it has been assumed that the services could be accommodated (this may require the re-instatement of the south-facing bay platform in practice).

Local Service Option

Provision of an hourly service between Leicester and Burton-upon-Trent, calling at intermediate stations at Swadlincote, Ashby-de-la-Zouch, Coalville, Leicester Forest East and Leicester Western Park. Class 156 (2-car) rolling stock and line speeds to 45 mph where they are currently less than this.

3.5 Strategic Service Option

3.5.1 The Strategic Option has been designed to provide a guide as to the potential viability of a longer distance service option linking Burton to London via Leicester. As with the local service definition, an hourly service has been assumed. For this option, the assumed number of stations en route has been reduced compared to the local service option, recognising that this is a more strategic option but at the same time still acknowledging there is a key role for the service to serve local journeys into Leicester. Therefore, the Strategic Option was assumed to call at three stations, namely Ashby-de-la-Zouch (Swadlincote being dropped on the basis that demand from Swadlincote might consider using Ashby, given the relatively poor location of Swadlincote station), Coalville and Leicester Western Park (on the basis that one station in the western Leicester area is retained).

3.5.2 Whilst the specification for the Local Service Option was reasonably straight forward (and compares to work done in previous appraisals), a viable Strategic Service Option presented more difficulties in terms of specification. The starting position was to consider a number of options, some more viable than others, and these are summarised below:

[13] However, the previous Scott Wilson study did not appear to acknowledge this as a potential operating constraint.

Table 3.1: Strategic Service Options

Strategic Service Option	Description	For	Against
1	New hourly diesel service Burton-Leicester-London	Would be a fifth train per hour from Leicester to London and would generate significant benefits particularly between Leicester and London which are not necessarily related with Burton-Leicester Network Rail Route Study has identified need for additional capacity to cater for demand in the future	Potential capacity issues for this service at the moment on the MML (the view is it 'could' be squeezed in), but potential train path once MML electrified Would mean diesel operation under the wires once MML electrified Additional operating costs incurred to London Would require the use of MOIRA to model the benefits between Leicester and London Requires reversal at Leicester
2	Split and join at Leicester, using an existing Leicester-London service	No additional train path required between London and Leicester Lowest additional operating costs of these options Would not require any MOIRA modelling	Would mean that one MML service remains diesel operated north and south of Leicester once MML electrified (could be a wider MML capacity impact?) Ability to split and join at Leicester (performance impacts)? Outside of the peaks, no MML services are currently operated by two trains joined together
3	Leicester to London via Burton and Nuneaton (alternative route avoiding MML issues)	Avoids capacity issues on MML Quicker journey time from Burton to London? Burton to Nuneaton benefits (new direct service)	Requires reversal at Burton Would require a new curve at Whitacre Junction or Tamworth Unlikely that journey times would be attractive (i.e. people would probably interchange at Leicester anyway)? Capacity issues on WCML south of Nuneaton (and between Burton and Nuneaton?) Introduces diesel mileage under wires on WCML Would require us to use MOIRA to model the benefits between Nuneaton and London

3.5.3 The East Midlands Route Study suggests that a sixth train per hour on the MML will be required to support growth in Northamptonshire, particularly Wellingborough and Kettering. At the moment, this is identified as a Corby service, therefore providing 2 tph London to Corby. Option 1 in the table above essentially suggests that this service operates to Burton via Leicester instead, thus still serving the Northamptonshire towns (apart from Corby). Some initial high level operational analysis suggests that this service could be squeezed in, but that more detailed train service planning (outside the scope of this study) would be required in order to establish this more thoroughly.

3.5.4 This would have to assume diesel operation as the assumption is that the Leicester-Burton corridor would not be electrified[14]. In practice, therefore, it has been assumed that this service would be operated by a 4-car class 222, an example of which is shown to the right, which in turn means that longer platforms will have to be assumed at the proposed stations between Burton and Leicester (compared to the Local Service Option).

3.5.5 It was considered that Option 3 in the table above could be discounted because it does not provide an attractive service proposition and has no real operational benefits.

3.5.6 For modelling and appraising the Strategic Service Option the following was assumed:

- To determine the demand/revenue and benefits associated with this option generated specifically between Burton and Leicester only. Compared to the Local Service Option therefore, the differences will be related to providing a direct service to London (and other stations south of Leicester) from Burton and the intermediate stations, plus the impacts of calling at fewer stations between Burton and Leicester.
- To model the incremental operating costs of providing the service between Burton and Leicester only.

3.5.7 The modelling and appraisal of this option has NOT therefore assumed the following:

- The net benefits/costs of diverting this train at Kettering from Corby to Leicester (assuming Option 1 in the table above).
- The net benefits/costs of this service remaining a diesel operation on the MML (assuming either Option 1 or 2 in the table above).

3.5.8 In terms of journey times, this option assumed the same line speeds as per the Local Service Option. However, with two fewer stations there will be a small reduction in the end-to-end journey time between Burton and Leicester.

[14] There would be the possibility of using bi-mode trains at some point in the future – as planned to become operational on the East Coast Main Line (IEPs). However, this remains a possibility only at this stage and thus we have not proposed modelling this specifically.

Strategic Service Option

Provision of an hourly service between London and Burton-upon-Trent via Leicester calling at intermediate stations at Ashby-de-la-Zouch, Coalville and Leicester Western Park. To be operated by a 4-car class 222 trainset that continues to London by either operating as a sixth train on the MML or by splitting/joining at Leicester. Either way, a diesel service would need to be operated on the MML. For the purposes of this appraisal exercise, only costs and benefits generated between Burton-upon-Trent and Leicester have been included.

3.6 Run Time Analysis

3.6.1 This section discusses the options for an hourly passenger service between Leicester and Burton-on-Trent. The proposed rail service would operate on the Midland Main Line between Leicester and Knighton Junction (LN3201), freight line between Knighton Junction and Leicester Junction (LN3525) and Birmingham to Derby Cross Country route between Leicester Junction and Burton-on-Trent (LN3501). A new curve north of Knighton Junction would be required to link Leicester station with the freight only line.

3.6.2 The core timetables tested were:

- The initial Local Service between Leicester and Burton-on-Trent running at current speeds;
- The initial Local Service between Leicester and Burton-on-Trent running at 45mph on the renovated freight line;[15]
- The initial Strategic Service between Leicester and Burton-on-Trent running at 45mph on the renovated freight line.

3.6.3 It was assumed that the strategic service will call at new stations at Leicester Forest East[16], Coalville and Ashby-de-la-Zouch, with the local service also stopping at Leicester Western Park and Swadlincote.

3.6.4 It was assumed that class 156 trains will be deployed for the Local Service Option and class 222 units for the Strategic Option. The local alternative was tested for existing line speeds and rehabilitation to 45 mph, whilst the strategic service was only modelled for the improved line speed. Dwell times at intermediate stations were assumed to alternate between 30 and 60 seconds for the local service, and 90 seconds for the strategic service, due to the slow door operation of Class 222 trains.

[15] About 25% of the line (track miles) is currently 20mph running. The assumption has been, based on previous studies undertaken, that the 20mph sections would be rehabilitated to 45 mph running in line with the rest of the route.

[16] Initially Leicester Forest East was chosen as the station for the strategic service to call at (rather than Leicester Western Park). This was therefore the assumption made at the study's train planning stage. Subsequently, as the demand forecasts emerged, the decision was taken to swap these stations in this option. This did not alter the conclusions from the train planning exercise.

3.6.5 This analysis did not undertake any investigation into the work needed to upgrade the track, signalling and structures on the line to be capable of accommodating 45 mph running. Analysis of the track curvature evidenced that the line's geometry does not constrain maximum speeds under that threshold, with potential requirements to adjust the track's cant in some instances. Links with the Midland Mainline (Leicester) and Cross Country line (Burton-upon-Trent) are assumed to be limited to 20 mph (new junction) and 15 mph (existing junction) respectively. The new curve south of Leicester is considered to have an approximate radius of 225 metres with a maximum cant of 100 mm and 20 mph junctions.

3.6.6 In total, 27.1km of the route was identified for potential increasing line speeds to 45mph (56% of the route).

3.6.7 Run time simulations have been performed using ARTEM, an AECOM tool developed to model unconstrained rail journey times. This tool has been successfully applied across a significant number of Network Rail projects. The analysis presented in this section is based on information included in Network Rail's Working Timetables, Sectional Appendices, Timetable Planning Rules and Five Mile Plans.

3.6.8 Run time simulations have been performed to estimate unconstrained station to station timings for each option, engineering allowances of 30 seconds at each main line junction have been added to the journey times in all cases. Table 3.2 below shows simulation times for the down services, Leicester to Burton-on-Trent.

Table 3.2: Down Timings

		Local service Current sp., Cl156		**Local service 45 mph, Cl156**		**Strategic service 45 mph, Cl222**	
Station	**Distance from LEI**	arr (min)	dep (min)	arr (min)	dep (min)	arr (min)	dep (min)
Leicester	0 mi / 0 km		0		0		0
Leicester Western Park	4.0 mi / 6.4 km	8	8.5	8	8.5	-	-
Leicester Forest East	5.6 mi / 9.0 km	11	12	11	12	10	11.5
Coalville	16.1 mi / 26.0 km	30	30.5	27	27.5	26	27.5
Ashby-de-la-Zouch	23.5 mi / 37.8 km	44	45	38	39	38	39.5
Swadlincote	26.1 mi / 42.0 km	51	51.5	43.5	44	-	-
Burton-on-Trent	30.9 mi / 49.7 km	59.5		52		50.5	

3.6.9 Table 3.3 summarises the results for the up simulations, from Burton-on-Trent to Leicester.

Table 3.3: Up Timings

Station	Distance from BUT	Local service Current sp., Cl156		Local service 45 mph, Cl156		Strategic service 45 mph, Cl222	
		arr (min)	dep (min)	arr (min)	dep (min)	arr (min)	dep (min)
Burton-on-Trent	0 mi / 0 km		0		0		0
Swadlincote	4.8 mi / 7.7 km	8	8.5	8	8.5	-	-
Ashby-de-la-Zouch	7.4 mi / 11.8 km	15	16	13	14	11.5	13
Coalville	14.7 mi / 23.7 km	30	33.5	24.5	25	23.5	25
Leicester Forest East	25.2 mi / 40.6 km	51.5	52.5	39.5	40.5	39.5	41
Leicester Western Park	26.9 mi / 43.2 km	55.5	56	43.5	44	-	-
Leicester	30.9 mi / 49.7 km	63.5		52		50.5	

3.6.10 The run time simulations indicate that it would take 60 minutes (down) and 64 minutes (up) for a class 156 to run between Leicester and Burton today. Improving the line speeds to 45 mph would reduce these run times to 52 minutes (both directions)[17]. The use of class 222s and removal of two stations further reduces the end-to-end run time to 50.5 minutes (both directions).

3.6.11 Line capacity analysis has been undertaken to identify rolling stock requirements by option and assess the need for passing loops or additional infrastructure. Whilst both main line sections at each end are double track, the goods line has 26 km (16.1 miles) and 21.4 km (13.3 miles) of single and double track lines respectively. Line headways have been extracted from Network Rail's Timetable Planning Rules (where no information is available, a five minute headway has been assumed).

3.6.12 Main line capacity has not been considered as the freight line is the main objective of this analysis. Leicester to Burton-on-Trent passenger trains have been assumed to take available paths on the Midland and Cross Country routes.

3.6.13 Level crossing operational impacts have not been investigated, as the small number of trains operating on the line (up to 3 tph in total) would generate minor delays at level crossings. These have been considered acceptable for the characteristics of roads crossing the rail track at grade.

[17] This benchmarks well against the Scott Wilson timings of 55 minutes with 7 stations.

3.6.14 Since typically between seven and thirteen freight trains operate on the goods line from 06:00 to 23:00[18], a two-hourly freight service frequency (0.5tph) in each direction was considered sufficient for the freight movement requirements. Freight journey times were extracted from the Working Timetable (WTT), noting that pathing allowances needed to be revisited for combined freight/passenger operation. For the 45mph alternative it was assumed that freight trains will require an additional 15% time to cover the route compared to the non-stop class 156 journey time. Goods trains were considered to operate between Knighton Junction (Leicester) and Leicester Junction (Burton) only.

3.6.15 Figures 3.2 to 3.4 below show traingraphs for the identified scenarios consisting of one path an hour and direction for passenger services and 0.5 freight trains an hour and direction. This information is also presented in Table 3.4. Present day speeds on the freight line underpin the requirement for three passenger train units leading to poor turnaround times at Burton-on-Trent. Improving the line speed enables cutting the rolling stock requirement to two units, whilst optimising turnaround time and therefore reducing platform time requirement. It is estimated that an eight minute turnaround time at each end will be adequate to operate this service if the line is rehabilitated to 45mph. However this is towards the minimum for reliable operation with two train sets, so the operating costs of this option are sensitive to journey time.

Table 3.4: Train Graph Analysis by Scenario

Parameter	Local service Current speed Class 156	Local service 45 mph Class 156	Strategic service 45 mph Class 222
Passenger units needed	3	2	2
Freight loops	2 or 3	1 or 2	1 or 2
Burton-on-Trent turnaround time	52 min	8 min	9.5 min
Leicester turnaround time	6 min	8 min	9.5 min

[18] Source: Network Rail's Working Timetable (WTT) and analysis of actual trains that have operated

Figure 3.2: Train Graph Local Service (Current Line Speed) [19]

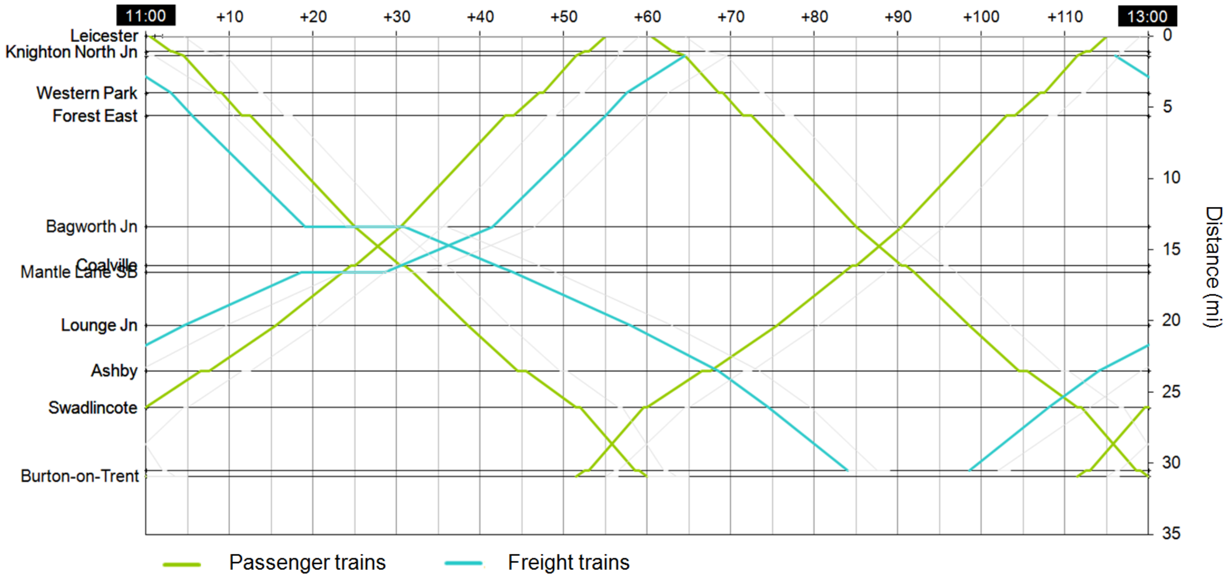
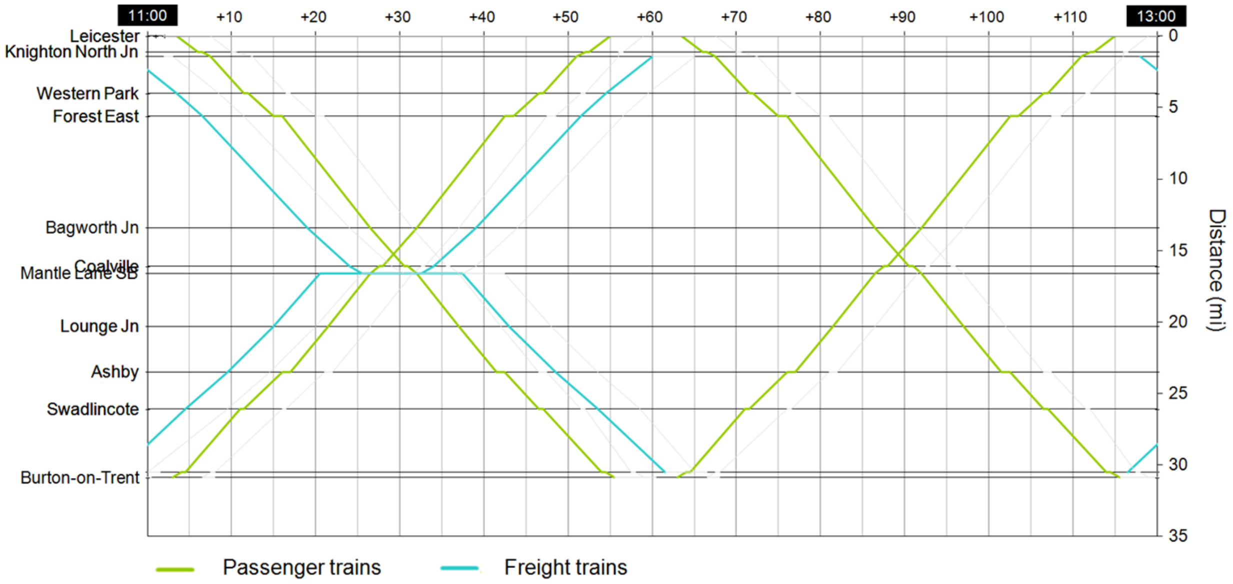
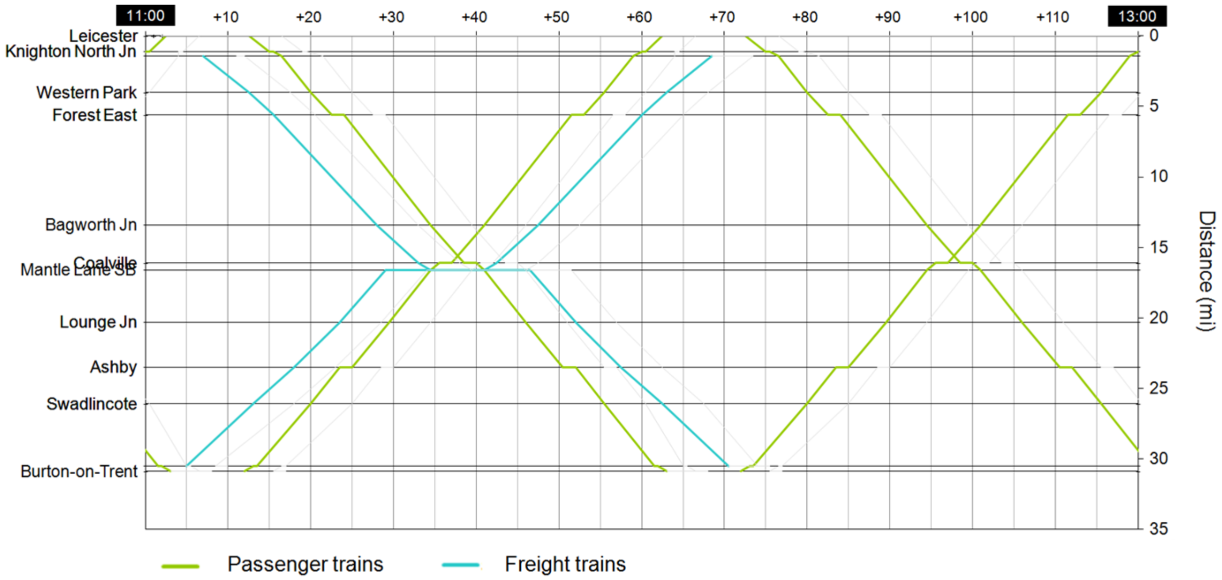


Figure 3.3: Train Graph Local Service (Rehabilitated Line Speeds)



[19] It has been assumed that up freight trains can be speeded up removing the need for a passing loop between Western Park and Knighton Junction

Figure 3.4: Train Graph Strategic Service(Rehabilitated Line Speeds)



3.6.16 Analysis of train paths demonstrates that it is possible to run the proposed passenger service without the requirement to re-double any existing single track sections. Therefore single platform stations could be assumed at Leicester Forest East and Leicester Western Park, whilst two platform stations would be required at Swadlincote, Ashby-de-la-Zouch and Coalville.

3.6.17 Leicester station currently has four platforms, with additional platforms under consideration albeit east of the existing tracks. The reduced usage of platform four confirms its potential to serve the local passenger service. It may be possible to divide it into two sections 4a and 4b for the Burton-on-Trent and Lincoln terminating local trains by adjusting the track's signalling. In the case where the strategic service is taken forward it is envisaged that no additional platforms will be needed to accommodate this service.

3.6.18 Platform space at Burton-on-Trent is constrained as there are currently only two through platforms. If the freight line is not rehabilitated a dedicated south facing bay platform would be necessary for the new passenger train. If the line is upgraded to 45mph circulation, then the turnaround of the service at one of the two through platforms (requiring 8 to 10 minutes) would be very restricted[20] and therefore it is our view that a new south facing bay platform is desirable in all cases. The site of the former south facing bay platform has not been altered substantially since closure, except for infilling to platform level. Therefore construction of a new platform for 2-car class 156 trains at the station seems feasible, with further platform lengthening needed for a 4-car train.

[20] Initial analysis suggests a maximum 15 minute window between trains at any point in the hour on one of the through platforms at Burton (current 2015 timetable).

3.6.19 Freight paths have been adjusted to maximise the use of existing loops, although detailed engineering inspection would be required to confirm that the infrastructure is adequate to cater for freight services using some of these loops that exist. In the current speeds option, loops for overtaking goods trains would be needed at Bagworth Junction and Mantle Lane SB and also somewhere between Western Park Station and Knighton Junction (however it is felt that freight trains operating in the up direction could be accelerated removing the need for the latter passing loop). For the 45mph options, two passing loops at Mantle Lane SB should be brought into service (they exist, but might require refurbishment/upgrading to cater for the traffic) to accommodate two freight trains per hour (one in each direction), whilst a single loop would be suitable to accommodate one freight train hour (irrespective of direction).

3.7 Additional Options

3.7.1 Following the reporting of the two core options described above, two potential service improvements were identified with the client for further consideration with a view to maximising benefits and improving the scheme's business case. These were:

- Maximum 75 mph operation on the line: This has used ARTEM to determine the maximum possible line speeds by section of line, up to a maximum of 75 mph. This analysis takes into consideration limitations relating to curvature, gradient and number of stations served.
- Doubling the service frequency to 2 tph: This has used ARTEM to identify potential impacts on journey times and to identify where possible additional infrastructure would be required (eg: further passing loops).

3.7.2 Taking the considerations above and based on the Local Service Option – which was generating a better appraisal result than the Strategic Option (refer to Section 6.6) – and using the same rolling stock assumptions, a further three options were therefore identified:

- Local Service Option with maximum 75 mph
- Local Service Option with 2 tph
- Local Service Option with 75 mph and 2 tph

3.7.3 The outputs from the run time analysis of the higher speed (maximum 75 mph) are presented in Tables 3.5 and 3.6.

Table 3.5: Down Timings – Higher Speed

Station	Distance from LEI	Local service Current sp., Cl156 arr (min)	Local service Current sp., Cl156 dep (min)	Local service 45 mph, Cl156 arr (min)	Local service 45 mph, Cl156 dep (min)	Local service 75 mph, Cl156 arr (min)	Local service 75 mph, Cl156 dep (min)
Leicester	0 mi / 0 km		0		0		0
Leicester Western Park	4.0 mi / 6.4 km	8	8.5	8	8.5	7	7.5
Leicester Forest East	5.6 mi / 9.0 km	11	12	11	12	10.5	11.5
Coalville	16.1 mi / 26.0 km	30	30.5	27	27.5	22	22.5
Ashby-de-la-Zouch	23.5 mi / 37.8 km	44	45	38	39	31	32
Swadlincote	26.1 mi / 42.0 km	51	51.5	43.5	44	35.5	36
Burton-on-Trent	30.9 mi / 49.7 km	59.5		52		42.5	

Note: the additional analyses have focused on the Local Option only and no assessment has been made of a 75mph Strategic Option.

Table 3.6: Up Timings – Higher Speed

Station	Distance from BUT	Local service Current sp., Cl156 arr (min)	Local service Current sp., Cl156 dep (min)	Local service 45 mph, Cl156 arr (min)	Local service 45 mph, Cl156 dep (min)	Local service 75 mph, Cl156 arr (min)	Local service 75 mph, Cl156 dep (min)
Burton-on-Trent	0 mi / 0 km		0		0		0
Swadlincote	4.8 mi / 7.7 km	8	8.5	8	8.5	6.5	7
Ashby-de-la-Zouch	7.4 mi / 11.8 km	15	16	13	14	11	12
Coalville	14.7 mi / 23.7 km	30	33.5	24.5	25	20	20.5
Leicester Forest East	25.2 mi / 40.6 km	51.5	52.5	39.5	40.5	31	32
Leicester Western Park	26.9 mi / 43.2 km	55.5	56	43.5	44	35	35.5
Leicester	30.9 mi / 49.7 km	63.5		52		42.5	

Note: the additional analyses have focused on the Local Option only and no assessment has been made of a 75mph Strategic Option.

3.7.4 A further 9.5 minutes can be shaved off the end-to-end journey time, compared to the 45mph option, by improving line speeds up to a maximum of 75mph. Coalville to Leicester would become 22 minutes, compared to 30 minutes with no line speed improvements and 27 minutes if line speeds are brought up to 45mph.

3.7.5 In determining the journey times, the maximum theoretical speed on each section has been calculated (up to a maximum 75mph) according to the track geometry and service stopping patterns. It is however assumed that the existing mainline infrastructure at either end of the route would not need to be upgraded to allow higher speeds since there is limited scope to reduce running times there. Overall the track geometry does not significantly constrain running speeds. The slowest sections are the transitions from double to single track and vice versa where trains are slowed down to between 50 and 60 mph. No track realignment has been considered. It should also be noted that no cant[21] information is available between Lounge Junction and Knighton West Junction. In this case, a 50mm cant for curves in this section has been assumed, which is the average cant between Leicester Junction and Lounge Junction.

3.7.6 In total, 46.8km of the route (98%) was identified for line speed improvements up to a maximum 75mph. In most cases this was to 60/65mph, with just one four mile section (between Forest East and Coalville) identified for potential 75mph running.

3.7.7 A graphing exercise has been undertaken for each of the additional options so that the likely additional infrastructure requirements could be identified. The consequent train graphs are presented in Figures 3.5, 3.6 and 3.7:

- 45 mph - 2tph: This requires the use of the existing siding at Mantle Lane – which is the same as per the 1tph option, but also requires approximately 4.5 km of line doubling around Forest East, and therefore a two platform station at Forest East. A total of four Class 156 trains are required.
- 75 mph - 1tph: In this option the faster journey times removes the requirement to bring the sidings at Mantle Lane into use. As per the 1tph 45mph option, a total of two Class 156 trains are required.
- 75 mph - 2tph: This requires the use of the existing siding at Mantle Lane and a new freight loop west of Forest East. Around 1 to 2 km of line doubling is also required east of Western Park. A total of four Class 156 trains are required.

[21] The cant of a railway track is the difference in elevation (height) between the two rails, usually where a banked curve is provided, which will allow higher speeds to be achieved than if the curve was flat.

Figure 3.5: **Train Graph Local Service- 2 Trains Per Hour**

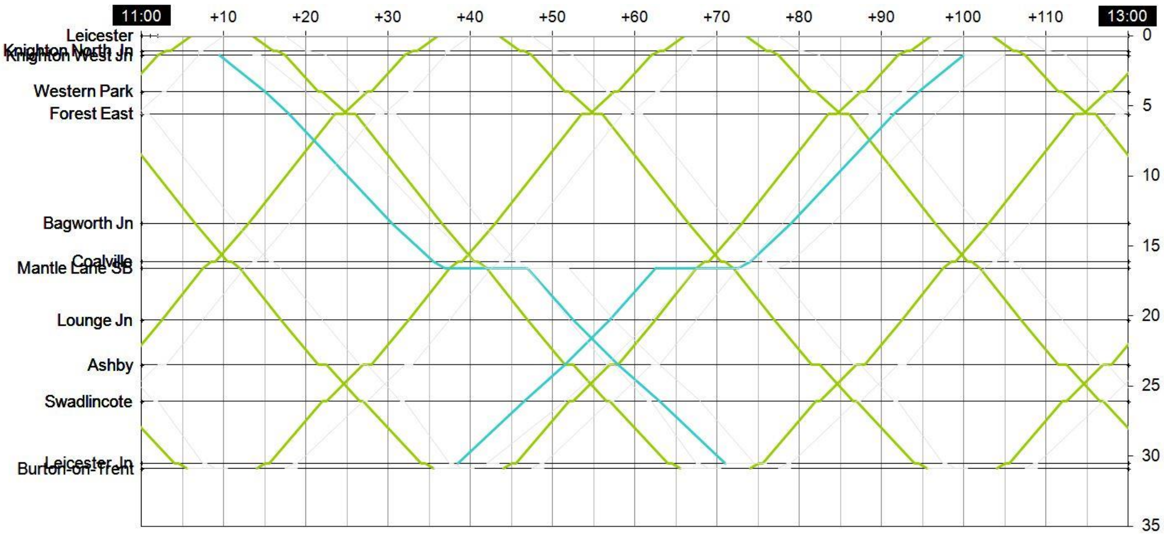


Figure 3.6: **Train Graph Local Service- Maximum 75 mph**

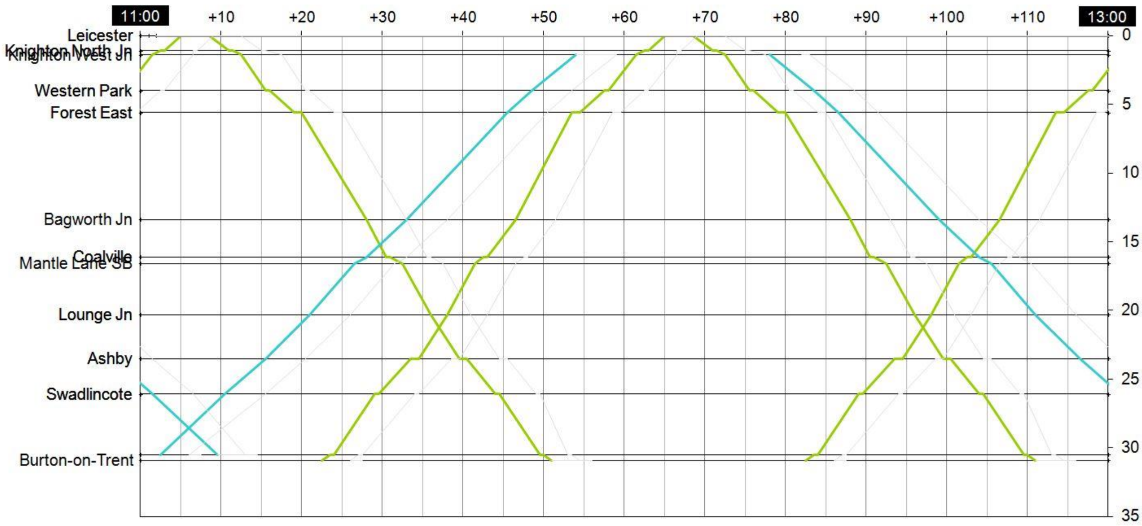
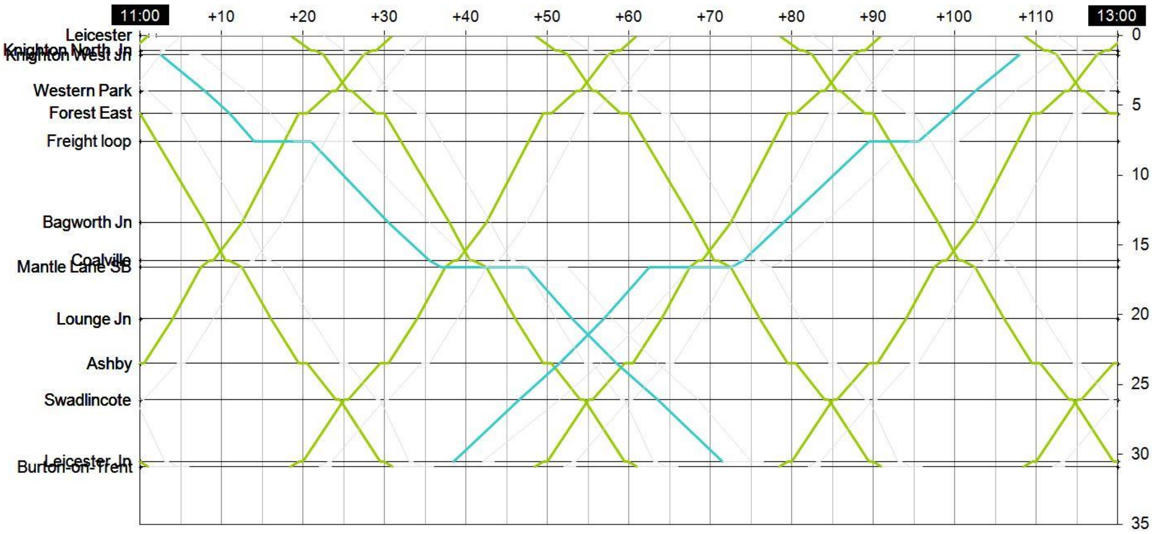


Figure 3.7: **Train Graph Local Service- Maximum 75 mph and 2 Trains per Hour**



4 Scheme Costs

4 Scheme Costs

4.1 Context

4.1.1 This section sets out the assumptions and forecasts relating to operating costs which have been included in the appraisal. For the avoidance of doubt, this appraisal study did not initially include the development of capital costs. The approach has therefore been to undertake a 'reverse engineered' appraisal, whereby the level of capital cost required (and taking into account an appropriate allowance for associated renewals and replacement costs[22]) in order to generate milestone BCRs (such as 1.0 (i.e. 'breakeven') and 1.5) has been identified.

4.1.2 However, during the course of this study, and following discussion with the client, it was agreed that AECOM would undertake a high-level costing exercise based on the emerging infrastructure requirements identified via the train planning exercise (Chapter 3). The need for this additional work became apparent in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing.

4.2 Operating Costs

4.2.1 The operating costs include a number of factors. Whilst some of these costs are fixed e.g. station asset/lease charges, others will be based on number of vehicles required and mileage operated in terms of fuel usage and staffing requirements.

4.2.2 Operating costs are developed by applying standard unit cost rates to changes in vehicle miles and to changes in the number of vehicles required. Both of these have been calculated based on the option specification (Chapter 3) and base timetables developed for each option.

4.2.3 East Midlands Trains (EMT) were approached on the basis that they might be able to provide some of the unit cost rates which are particularly relevant to this study. Whilst some data was forthcoming within the timescales, AECOM used information from their own database of rail operating costs to supplement data provided by EMT. The operating cost model therefore took account of:

- Annual rolling stock lease costs;
- Rolling stock Network Rail costs (track access, capacity charges);
- Rolling stock fuel costs;
- Rolling stock maintenance costs;
- On train staff costs;
- Station operating costs; and
- Other costs (an allowance is made to cover other ongoing costs that are incurred, such as British Transport Police costs and ATOC[23] charges).

[22] Renewal and replacement costs relate to those costs incurred during the appraisal period (60 years) for the scheme which are not ongoing operating costs. This would include, for example, the replacement of track once it has reached its life expectancy.
[23] Association of Train Operating Companies

4.2.4 The new stations on the line were assumed to be unstaffed stations with the basic facilities. On this basis, the station operating costs were assumed to be £50,000 per annum (which includes the Long Term Charge imposed by Network Rail).

4.2.5 A bespoke operating cost model was developed which is able to derive the operating costs for each of the local and strategic options defined in Chapter 3. This is based on DfT's WebTAG guidance, which is the industry standard guidance for modelling and appraisal, and assumes a 60 year appraisal period, price base of 2010, optimism bias and discount rates as specified in WebTAG. An opening year of 2020 was assumed.

4.2.6 The latest appraisal guidance requires assumptions to be made around the cost of rolling stock leasing, including when new rolling is assumed to replace existing rolling stock, with subsequent increases in costs (and lowering of maintenance costs).

4.2.7 The options tested have been based on the assumption of a seventeen hour day of operation, Monday to Saturday, running at a frequency of 1 train per hour, and assuming 2-car class 156 trains for the Local Option and 4-car class 222 trains for the Strategic Option. No Sunday service has been assumed (as per the previous work by Scott Wilson).

4.2.8 The total additional vehicle miles[24] that have been derived from the modelling are:

- 655,588 vehicle miles for the Local Option
- 1,311,176 vehicle miles for the Strategic Option

4.2.9 The resultant annual operating costs in 2010 prices are:

- £3.1m for the Local Option (£73.1m over the 60 year appraisal period, with discounting etc. applied)
- £5.8m for the Strategic Option (£122.6m over the 60 year appraisal period, with discounting etc. applied)

4.2.10 The Strategic Option costs over 80% more to operate than the Local Option between Burton-upon-Trent and Leicester. This reflects the use of 4 car class 222s as opposed to 2 car class 156s.

4.2.11 The operating costs for the Local Option have been benchmarked against those derived in similar studies where new rail services have been introduced. This benchmarking shows that, given differences in scheme length, there is a lot of compatibility with the annual operating cost derived for this option. In particular, benchmarking of this against the previous Scott Wilson study demonstrated that the output from the current model is very similar to that derived by Scott Wilson previously (£3.1m). This benchmarking has given a degree of assurance that the operating costs are of the right order of magnitude.

[24] Vehicle miles relates to the number of vehicles multiplied by miles travelled, and is an input to the operating cost model as this is one element upon which costs are dependent e.g. the derivation of fuel costs depends upon vehicle miles

4.3 Additional Options

4.3.1 Two potential service improvements were identified with the client for further consideration with a view to maximising benefits and improving the scheme's business case. These were:

- Maximum 75 mph operation on the line; and
- Doubling the service frequency to 2 tph.

4.3.2 Increasing the line speeds has no impact on the operating costs as the train graphing exercise has demonstrated that the same number of trains are required to operate the service.

4.3.3 Doubling the service frequency clearly will have an impact on operating costs and doubles the amount of rolling stock required to operate the service. Therefore, the annual operating costs for a 2tph operation is estimated to be £5.7m for the Local Option (2010 prices). The doubling of service frequency does not result in a doubling of the total operating costs, as there are some costs which do not vary in response to service frequency (eg: station operating costs).

4.4 Additional Work – Generation of High Level Capital Costs

4.4.1 Paragraph 2.2.19 set out the capital costs assumed by Scott Wilson in their 2009 report. Essentially, this estimate was a re-work of an earlier capital cost estimate from the late 1990s (Leicestershire County Council report, 1997) and then adjusted this to reflect their scheme specification in order to generate an estimated capital cost of £33.1m (in 2008 prices). This estimation included the reinstatement of trackwork including the Knighton Chord and double track as far as Bede Island and between Coalville and Lounge Junction as well as seven new stations and the upgrading of over 8km of track to ensure 45mph operation.

4.4.2 The basis for this cost estimate is now out of date and will not reflect current engineering and costing practices. In addition, the emerging infrastructure requirements for the scheme are likely to differ from that assumed previously. However, to undertake a fresh, detailed, bottom-up engineering costing exercise would require considerable resources/budget, outwith the scope of this study. However, during the course of this study, and following discussion with the client, it was agreed that AECOM would undertake a high-level costing exercise based on the emerging infrastructure requirements identified via the train planning exercise. The need for this additional work became apparent in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing.

4.4.3 The train planning exercise discussed in Chapter 3 identified the following core infrastructure requirements across the four service options developed:

Table 4.1: Emerging Infrastructure Requirements

Infrastructure Scheme	Option (note: all variants of the 'Local Option')			
	Option 1 1tph/45mph	Option 3 1tph/75mph	Option 2 2tph/45mph	Option 4 2tph/75mph
Knighton Chord	✓	✓	✓	✓
Re-instated bay platform at Burton-on-Trent	✓	✓	✓	✓
Mantle Lane siding extended and refurbished	✓		✓	✓
Line re-doubling: 4.5km near Forest East			✓	
Line re-doubling: 1.5km near Western Park				✓
New freight loop west of Forest East				✓
Line speed improvements to 45mph (total 27.1 route km)	✓		✓	
Line speed improvements up to 75mph (total 46.8 route km)		✓		✓
5 new stations	✓	✓	✓	✓
Re-signalling	✓	✓	✓	✓
Review of structures	✓	✓	✓	✓
Review of level crossings	✓	✓	✓	✓

4.4.4 The findings from the high level capital cost assessment are presented in Table 4.2. They are based on the physical infrastructure requirements identified above and also include standard costs to deliver these infrastructure improvements covering elements such as Network Rail and contractor costs, design costs, preliminaries, testing, possessions, Train Operating Company (TOC) compensation and project management (in total these can constitute circa 35% to 40% of the total costs).

4.4.5 It should be noted that a number of elements are excluded from this cost estimation. These include location specific issues (e.g. dealing with subsidence), any work that may be required at Leicester station, land and property, depots and stabling and any changes to signalling on the existing main lines. The cost of the new stations assumes they are basic with limited facilities and exclude any land and property costs, on the basis that everything can be contained within the cartilage of the railway.

Table 4.2: High Level Capital Costs (Q3 2015 Prices)

Option	Description	Range of Potential Capital Cost
1	1tph/45mph	£100m to £120m
2	2tph/45mph	£110m to £130m
3	1tph/75mph	£140m to £160m
4	2tph/75mph	£155m to £175m

The above values do not include contingency/risk or optimism bias

4.4.6 This cost assessment has been carried out to provide a high level indication of capital costs for each option to establish the likelihood of the scheme generating a sufficiently robust business case. It was a desk top study which has been completed without any detailed surveying of the route that would identify the full extent of track rehabilitation required or other location specific elements which may have a capital cost implication. As such, it relies on a number of assumptions, and therefore, the costs outlined above should not be taken as definitive costs.

5 Demand Modelling

5 Demand Modelling

5.1 Leicester and Leicestershire Integrated Transport Model (LLITM)

5.1.1 As there is currently no rail service using this line then the use of standard rail demand forecasting tools, such as MOIRA, are not possible in this case[25]. It has therefore been necessary to consider a bespoke demand forecasting tool and in this case the Leicester and Leicestershire Integrated Transport Model (LLITM) was available to use. The current working version of LLITM is version 5.2 and in the timescales available this has been used. It should, however, be noted that it is currently being updated, with a revised version expected in 2016.

5.1.2 The LLITM transport and land-use modelling suite was originally developed in 2008/9, and has been extensively used by LCC and others to help understand and predict travel patterns, land-use developments, and transport schemes across the County. Incremental updates to this model have taken the final version to LLITM 5.2 at the time of writing.

5.1.3 A new model suite, LLITM 2014, is currently being developed, incorporating up-to-date data and enhancements to the original LLITM methodology, to be used in future work. However, this version of the model has not been available for use in this current appraisal.

5.1.4 LLITM consists of three types of model, each developed separately using consistent principles and assumptions, before being combined into an integrated modelling system. These model types are as follows:

- highway and public transport assignment models, developed by AECOM;
- a land-use model, known as 'DELTA', developed by David Simmonds Consultancy; and
- a transport demand model, developed by AECOM.

5.1.5 Base year demand (2014) has been developed for highway, public transport and active modes, covering the whole country, with increasing detail and accuracy for areas close to the core study area of Leicester and Leicestershire.

5.1.6 The base year networks contain a representation of the supply of transport for highway and public transport users. The networks also cover the whole country with all roads of county and town-specific importance within Leicester and Leicestershire and surroundings, and skeletal detail outside the study area, but with sufficient detail to estimate travel costs for long-distance trips.

5.1.7 The LLITM model has been run for:

- three time periods (AM peak, Interpeak and PM peak);
- two future years (2016 and 2031)[26]; and
- three scenarios (base, Option 1 (Local) and Option 2 (Strategic)).

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[25] Although it may be appropriate to consider using MOIRA where the scheme might impact on existing rail flows (either north of Burton (e.g. Burton to Derby) or south of Leicester (e.g. Leicester to London).

[26] It should be noted that these are the modelled years in the LLITM model. They do not coincide with the proposed scheme opening year of 2020 and therefore the demand has to be interpolated between 2016 and 2031. This provides the demand levels in 2020 and subsequent years.

5.1.8 The rail scenarios were coded into the model based on the option definition discussed in Chapter 3.

5.2 Modelling Constraints – LLITM v5.2

5.2.1 It should be noted that there are a number of constraints associated with the use of version 5.2 of the model which will have an impact on the rail scheme's appraisal as previously discussed with LCC:

- The zone containing Burton-on-Trent is large and also encompasses Stafford and Stoke. Splitting the zone was not possible in time constraints for this work, although it will be done for the next version of LLITM. An interim approach was agreed to manipulate the zone centroid connector[27] to feed Burton-on-Trent, in order to attempt to provide a better representation of the demand relating specifically to/from Burton.
- LLITM v5.2 currently contains no bus demand outside Leicestershire at all, meaning there would be no bus demand outside the county that could potentially switch to rail. Bus demand between Burton and Leicestershire has been estimated for the LLITM 2014 model, currently in development, using ticket sales data, and has been transferred into LLITM v5.2 for this particular work.
- LLITM forecasts an understatement of rail passenger growth (relating to multi-modal logit models in general). This understatement originates from the National Trip End Model (NTEM)[28] trip rates that drive the LLITM trip-ends, and is a known issue in the rail demand forecasting industry. The trip-ends used in this process have, nevertheless, been reviewed in the study corridor (Ashby/Coalville) in order to ensure that the latest housing growth estimates are represented (for trip distribution purposes). Therefore, growth in rail demand has been applied outside the model, assuming a 47% growth between 2016 and 2031, based on growth forecast data in Network Rail's East Midlands (Draft) Route Study, and taking into consideration any change in distribution between 2016 and 2031 (based on development estimates in the corridor).

5.2.2 Section 5.6 summarises the modelling limitations and discusses how these might be resolved should the scheme be taken forward..

5.3 Model Outputs

5.3.1 The LLITM model has been run for the defined option scenarios, with the resultant forecast annual passengers for the scheme presented in the table below for both the Local and Strategic options.

[27] Centroid connectors are used in modelling to connect the centre of a zone (centroid), either centre of gravity or geographical centre to the highway or public transport network. They generally represent access modes, such as walk, cycle or kiss and ride.
[28] This model is a standard tool which is developed and maintained by DfT

Table 5.1: Annual Single Journeys

Scheme	Annual Single Journeys
2016 Local	364,374
2016 Strategic	301,894
2031 Local	535,237
2031 Strategic	443,785

5.3.2 The model is predicting over 350,000 journeys in 2016 for the Local Option, increasing to 535,000 journeys by 2031. The forecasts associated with the Strategic Option are slightly lower, indicating that the removal of two stations has a greater negative impact on demand than the increased demand of providing a through service to London. However, the uncertainties in the modelling discussed previously are such that at this stage, the modelling should not be considered as necessarily ruling out the Strategic Option.

5.3.3 The table below presents the forecast annual station entries and exits for stations on the Leicester to Burton line for both the Local and Strategic options in 2016 and 2031. What is evident from the station entries and exits table is the fact that the vast majority of passengers are using the stations at the Burton end of the line (Swadlincote, Ashby and Coalville in the local option, Ashby and Coalville in the strategic option.)

Table 5.2: Annual Station Entries and Exits

	Annual Station Entries and Exits							
	2016 Local		2016 Strategic		2031 Local		2031 Strategic	
Swadlincote	87,325	24%	-	0%	111,606	20%	-	0%
Ashby	140,371	38%	166,699	56%	191,083	35%	221,680	50%
Coalville	99,289	27%	100,669	34%	148,141	27%	146,073	33%
Forest East	18,549	5%	-	0%	28,846	5%	-	0%
Western Park	24,398	7%	28,459	10%	67,765	12%	73,321	17%

Note: these figures represent station entries and exits for the line excluding Leicester and Burton-upon-Trent stations, whereas those in Table 5.1 represent total annual single journeys on the line including these two stations

5.3.4 The high usage forecast at Ashby, relative to Coalville and Swadlincote, seems to be partly down to some travellers from the north of Swadlincote taking a bus to Ashby to catch the train to Burton, even in the Local Option where Swadlincote has its own station, albeit this is located to the southern periphery of the settlement. In general, internal buses in Swadlincote have not been coded and therefore the bus services between Swadlincote and Ashby are better than internal buses. The LLITM model update will address this partly by having many travellers use car to get to the station. Any follow up work could look to code any missing bus services around Swadlincote and Burton to improve routing in this area.

5.3.5 When comparing the differences between Local and Strategic Options, Ashby is shown to have a greater demand growth than Coalville. The reason for this is that, in the Strategic Option, some of the demand from Swadlincote is switching to Ashby. Clearly this will have local implications on the road network . .Whilst the mode shift transfer between rail and car is modelled in LLITM, car access to/ egress from stations is not explicitly modelled, and so people driving from Swadlincote to Ashby station to pick up a train are not modelled on the road network.

5.3.6 In terms of station usage, the suburban Leicester stations (Leicester Forest East & Leicester Western Park) generate a relatively low level of demand compared to the stations at the northern end of the line. This is related to the nature of the LLITM model assignment, which is 'all-or-nothing'. Therefore, because bus services in this part of Leicester run frequently and pick up and set down in multiple places, coupled with the rail station in Leicester being located a 15 minute walk from the shopping centre, then bus is significantly more attractive to rail. In the LLITM model update, there will be a sub-mode choice model between rail and bus, which will remove this 'all-or-nothing' assignment process and therefore more realistically allocate demand between these modes for these journeys. This would also enable an assessment of any risks associated with the transfer of passengers from bus to rail in respect of ongoing bus service viabaility. Relative zone size also needs to be considered when interpreting these outputs. For example, Burton is one zone and Swadlincote is only two or three zones and therefore the walk times for rail and bus users are effectively the same, as the zones only have one load point, which is effectively both the bus stop and rail station. Conversely in Leicester, the zone sizes are small, so that the increase in walk time for most people in using rail is fully captured. In almost all the zones one has to walk further to the rail station than to pick up the bus which is usually close – which is the correct representation.

5.3.7 It is noted that by 2031, Leicester Western Park shows a large increase relative to Leicester Forest East, despite Leicester Forest East being on the periphery of the major development at Lubbesthorpe. The reasons for this relate to the configuration of the local road network, which effectively leads to Leicester Western Park, despite the proximity of Leicester Forest East, which would be accessed by driving round local residential streets. In reality, people in the north west of the development would possibly use a station at Leicester Forest East, although they would probably be a minority. Given this, it might be considered that one Leicester suburban station could be advocated, at Western Park, which could be a Leicester 'gateway' station on the A563 ring road. However, as only an hourly service is being proposed in both Options 1 and 2, our view is that this could not be considered as a potential 'Parkway' or 'Park & Ride' station.

5.3.8 Table 5.3 presents the top 10 flows forecast to use the line for each option in 2016 and in 2031.

Table 5.3: Top 10 Flows 2016 and 2031 (Annual Single Journeys)

Top 10 Flows	Local 2016	Top 10 Flows	Strategic 2016
Ashby to Burton	57,221	Ashby to Burton	64,368
Burton to Ashby	39,494	Burton to Ashby	42,028
Burton to Swadlincote	27,310	Leicester to Coalville	27,439
Swadlincote to Burton	25,778	Coalville to Leicester	24,519
Coalville to Leicester	23,961	Other south to Ashby	14,382
Leicester to Coalville	22,883	Burton to Coalville	14,215
Ashby to Other south	15,449	Coalville to Burton	13,804
Burton to Coalville	13,980	Ashby to Other south	12,305
Coalville to Burton	13,611	Other south to Western Park	10,544
Other south to Swadlincote	13,250	Western Park to Other south	8,401

Top 10 Flows	Local 2031	Top 10 Flows	Strategic 2031
Ashby to Burton	74,297	Ashby to Burton	81,477
Burton to Ashby	50,106	Burton to Ashby	51,611
Burton to Swadlincote	37,451	Leicester to Coalville	38,641
Swadlincote to Burton	36,042	Coalville to Leicester	35,884
Coalville to Leicester	36,129	Ashby to Other south	34,227
Leicester to Coalville	33,617	Other south to Western Park	32,935
Ashby to Other south	21,430	Western Park to Other south	23,776
Burton to Coalville	17,631	Other south to Ashby	19,737
Coalville to Burton	17,970	Coalville to Burton	17,664
Other south to Swadlincote	15,335	Burton to Coalville	17,366

Note: Other south relates to flows which originate or terminate from origins and destinations to the south of Leicester.

5.3.9 This indicates that the larger flows are being predicted to/from Burton – which we discuss in more depth below. Not surprisingly, the Strategic Option produces a greater volume of journeys to/from ‘other’ stations south of Leicester – reflecting the fact that there are through trains to London in this option.

5.3.10 A key observation to be made about the model forecasts is that there is generally substantially higher usage of the scheme being predicted in the northwest (e.g. Burton-Ashby) than in the southeast (e.g. Leicester-Leicester Forest East). Given that Leicester has a much higher population, this is perhaps unexpected.

5.3.11 There are a number of reasons behind this forecast:

- The current bus services between the west of Leicester and the centre are generally good, as discussed above, with a headway[29] of around 5 minutes and 25 minute travel times. The proposed rail service with a 60 minute headway and 11 minute travel time, does not compare very well with this. On the other hand, bus services between Burton and Ashby currently take 45 minutes and are every 20 minutes, while the rail service would take only 14 minutes with a 60 minute headway, which looks very good by comparison. This pattern is generally true for other movements; bus service provision is relatively better by comparison with proposed rail in the south than in the north. The model tends to exaggerate this effect due to its "all-or-nothing" nature, however: a movement will either use bus or rail; in the current LLITM it cannot divide partly into bus users and partly into rail.
- A second issue relates to the walk times from Leicester and Burton railway stations to attraction sites. Burton station is more central than Leicester's, being within a 10 minute walk of most of the town centre and less than 5 minutes from much of it. Leicester railway station is to the south-east, around 15 minutes walk from the main shopping centre and a similar distance from the hospital. The bus services set down much closer to most of the sites passengers wish to travel to. This issue is exacerbated beyond reality in the model due to the first issue outlined above, however. The coarser zone and network detail in Burton is such that the bus and rail services essentially stop in the same place. In Leicester, however, the detailed zoning allows the correct walk times to be modelled, penalising the new rail service relative to bus.
- A third consideration relates to how access times to stations on the line are modelled in the current version of the LLITM. The current assignment process will only represent access times (to rail) that relate to walking or bus. This will therefore penalise those stations where one might expect a greater proportion of local car-based access due to the distribution of local population (e.g. at Coalville – where a significant proportion of the local station catchment is located in places beyond a reasonable walking distance (e.g. Whitwick), or Swadlincote – where the location of the station dictates the use of non-walk modes for a considerable part of the town). The next version of the model will remove this modelling constraint so that rail access times are more realistic from all station catchment zones.
- A final consideration for demand to and from Leicester is journey distances. Burton is within a 25 minute train ride of Swadlincote, Ashby and Coalville, while Leicester is within this range only for Coalville. The Leicester to Western Park/ Leicester Forest East movement is very little used in the model due to the superior bus routes, so there is far less population within a short travel time of Leicester than there is of Burton.

[29] Headway is the time between one vehicle and the next. For example, if a service operates with a frequency of 12 tph, then the headway is considered to be 5 minutes.

5.3.12 It is considered, therefore, that usage of the scheme in the south is almost certainly understated in the model, largely due to the all-or-nothing nature of the assignment and treatment of the rail movement strictly as an alternative to bus. However, usage of the scheme in the north may be slightly overstated in the model, again due to the all-or-nothing nature of the assignment (some of these passengers may in fact continue to use buses), although this is not thought to be of a larger scale than the understatement in the south.

5.3.13 The Leicester Western Park / Leicester Forest East to Leicester movement is little used, as discussed above. It may be noted that Leicester Western Park/Forest East to London (other stations) is significantly more heavily used; this is because these passengers are not penalised by being taken to Leicester railway station (unlike most passengers destined for central Leicester) as the railway station is where they need to be to continue their journey. This in itself is reasonable.

5.3.14 It may also be noted that there is some asymmetry by direction for certain movements. This relates in most cases to relatively small differences in journey time between the outbound and return directions being sufficient to move a significant number of passengers from bus to rail due to the all-or-nothing nature of the assignment.

5.3.15 Table 5.4 below presents the overall breakdown of movements being forecast by the modelling for both options and forecast years.

Table 5.4: Breakdown of Movements

	2016 Local			2016 Strategic	
	%	Trips		%	Trips
Proportion local internal	5%	16,419		3%	9,227
Proportion internal to/from Burton	49%	178,925		45%	135,852
Proportion internal to/from Leicester	18%	67,231		22%	67,287
Proportion Leics-Burton	2%	7,680		4%	11,166
Total proportion internal	**74%**	**270,255**		**74%**	**223,533**
Proportion other south	21%	78,059		21%	62,958
Proportion other north	4%	16,059		5%	15,403
Total proportion other	**26%**	**94,119**		**26%**	**78,362**
	100%	**364,374**		**100%**	**301,894**
	2031 Local			2031 Strategic	
	%	Trips		%	Trips
Proportion local internal	5%	27,101		3%	14,768
Proportion internal to/from Burton	44%	236,487		38%	170,719
Proportion internal to/from Leicester	18%	96,904		21%	95,377
Proportion Leics-Burton	2%	9,991		3%	12,225
Total proportion internal	**69%**	**370,484**		**66%**	**293,089**
Proportion other south	29%	153,275		32%	140,769
Proportion other north	2%	11,871		2%	9,926
Total proportion other	**31%**	**165,146**		**34%**	**150,695**
	100%	**535,630**		**100%**	**443,785**

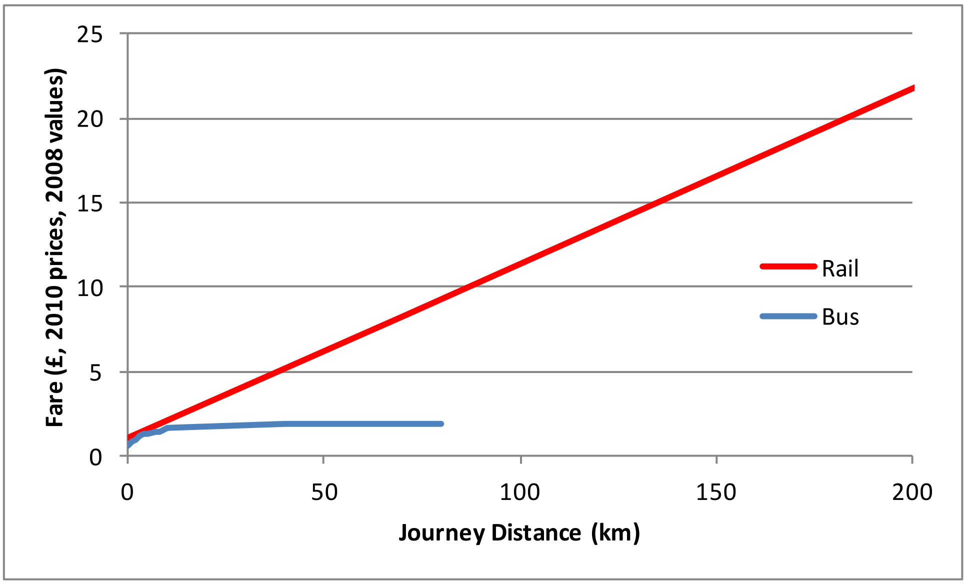
5.3.16 Flows to/from Burton account for a significant majority of the demand being forecast. This proportion is lower in the Strategic Option as the marginally faster journey times into Leicester and, by 2031, the greater attraction of through services to London, generate proportionally more journeys in that direction. Whilst 3 in 4 journeys are 'internal' to the scheme in both options in 2016, this reduces to circa 1 in 3 journeys by 2031.

5.4 Scheme Revenue Forecasts

5.4.1 Scheme revenue has been estimated using the modelled fare functions for bus and rail (which are functions of in-vehicle distance), and modelled public transport journeys.

5.4.2 The functions used are those defined in the LLITM model and are presented below. This represents average one-way fare actually paid, including the effects of return tickets, season tickets, concessions, railcards and advance tickets.

Figure 5.1: Fare Functions in LLITM



5.4.3 Table 5.5 presents the additional rail revenue generated by the scheme. It should be noted that these represent the overall net incremental impact on rail revenue forecast by the model.

Table 5.5: Annual Scheme Revenue Impacts, £000s

Rail	2016	2031
Local	863	1,693
Strategic	644	1,370

5.5 Additional Options

5.5.1 Following the reporting of the two core options described above, two potential service improvements were identified with the client for further consideration with a view to maximising benefits and improving the scheme's business case. These were:

- Maximum 75 mph operation on the line; and
- Doubling the service frequency to 2 tph.

Therefore, a further three options were identified:

- Local Option 1 with maximum 75 mph;
- Local Option 1 with 2 tph; and
- Local Option 1 with both 75 mph and 2 tph

5.5.2 The LLITM model was run for the three additional options. The LLITM model has not undergone any further enhancement and therefore these results are comparable with those presented earlier in this section, with the same model caveats applying. Table 5.6 presents the forecast annual passengers for the scheme for all versions of the 'Local Option'.

Table 5.6: Annual Single Journeys

Scheme	Year	Annual Single Journeys	Percentage Difference from Core Local Option
Local (1 tph 45 mph)	2016	364,374	-
Local (2 tph 45 mph)	2016	563,617	+55%
Local (1 tph 75 mph)	2016	447,596	+23%
Local (2 tph 75 mph)	2016	645,718	+77%
Local (1 tph 45 mph)	2031	535,237	-
Local (2 tph 45 mph)	2031	828,517	+55%
Local (1 tph 75 mph)	2031	657,965	+23%
Local (2 tph 75 mph)	2031	949,205	+77%

5.5.3 Doubling the service frequency increases demand by just over 50%. This is a greater increase compared to what might be expected if we were to use PDFH elasticities to measure such an impact[30]. However, the level of change in this case (i.e. a generalised journey time change of over 20%) would be considered at the limit of what PDFH should be used for. For some flows, it should also be considered that the flows are starting from a very low absolute base value (just one or two journeys in a given time period).

5.5.4 The line speed improvements reduce the end-to-end journey time by circa 17% and this translates into a 23% increase in demand across the corridor.

5.5.5 Combining the two interventions results in an increase in demand of 77% compared to the original Local Option.

5.5.6 Table 5.7 presents the annual station entry and exit figures for intermediate stations on the Leicester to Burton line for each of the additional options in 2016 and 2031. The core Local Option is also included for reference.

Table 5.7: Annual Station Entries and Exists

	Annual Station Entries and Exits (Local Option)							
	2016 1tph 45mph		2016 2tph 45mph		2016 1tph 75mph		2016 2tph 75mph	
Swadlincote	87,325	24%	118,891	21%	92,604	21%	122,847	19%
Ashby	140,371	38%	212,129	37%	178,760	40%	228,620	35%
Coalville	99,289	27%	144,480	25%	126,010	28%	180,541	28%
Forest East	18,549	5%	45,307	8%	23,571	5%	54,446	8%
Western Park	24,398	7%	48,059	8%	27,355	6%	58,137	9%

	Annual Station Entries and Exits (Local Option)							
	2031 1tph 45mph		2031 2tph 45mph		2031 1tph 75mph		2031 2tph 75mph	
Swadlincote	111,606	20%	155,352	18%	122,617	18%	152,574	17%
Ashby	191,083	35%	287,718	34%	243,058	36%	290,475	32%
Coalville	148,141	27%	227,358	27%	194,246	29%	265,748	29%
Forest East	28,846	5%	69,465	8%	38,035	6%	78,533	9%
Western Park	67,765	12%	111,333	13%	74,703	11%	119,317	13%

5.5.7 The table shows that all intermediate stations show an increase in annual entries and exits in each option, and again, the increases are most pronounced when both the speed and frequency enhancements are incorporated. Two particular trends are worth highlighting:

[30] Passenger Demand Forecasting Handbook (PDFH) provides industry standard guidance relating to demand elasticities (the rate of change of one variable in response to a change in another, for example the effects on demand of increasing service frequency).

- The line speed improvements increase the share of demand using Coalville (and to a lesser extent Ashby) stations, as well as absolute patronage using these stations. This reflects the reduction in journey time between Coalville and Leicester from 27 minutes to 22 minutes (nearly 20% reduction); and
- Doubling the service frequency doubles demand at both Forest East and Western Park stations. The rail 'offer' becomes relatively more attractive compared to the public transport alternatives at these locations, where high frequency bus services compete with the train.

5.5.8 Table 5.8 presents the additional rail revenue generated by each of the schemes. It should be noted that these represent the overall net incremental impact on rail revenue forecast by the model. The incremental effect of the schemes again shows a similar pattern to that evident in other outputs, with the greatest effect due to the combined speed and frequency increases.

Table 5.8: Annual Scheme Revenue Impacts, £000s

Rail	2016	2031
Local 1 tph 45 mph	863	1,693
Local 2 tph 45 mph	1,239	2,443
Local 1 tph 75 mph	1,075	2,188
Local 2 tph 75 mph	1,477	2,869

5.6 Taking the Scheme Appraisal Forward: Modelling Limitations and Resolutions

5.6.1 The overall modelled level of patronage presented in this Chapter appears plausible, although arguably erring on the conservative side. However, there are a number of issues in the more detailed breakdown of demand that are worth discussing. We have noted above where we consider the forecasts might be understated, and there may be one or two specifics where demand is arguably overstated. Much of this relates to weaknesses in the model for the purpose of modelling the Leicester-Burton rail link, noted at the inception of this work, and summarised below, arranged broadly in order of importance:

- LLITM is a model of Leicester and Leicestershire. It does not cover Burton-upon-Trent or Swadlincote in the same detail. In particular, the Burton-upon-Trent zone is very large (it includes Stoke-on-Trent), bus services not entering Leicestershire are not coded in the model and Swadlincote is modelled by only two zones. Although the key problem here of the large Burton zone has been compensated for by careful use of centroid connectors, there are still routeing issues around and between Burton and Swadlincote, an overstatement of the difficulty of travelling between Burton and Swadlincote by bus, and no detailed modelling of differential walk distances for rail and bus travel in Burton and Swadlincote. **The LLITM 2014 model will include a much smaller zone for Burton (still a single zone), more detailed zoning for Swadlincote and more network detail around the area. It will not model any more bus services; it is recommended that additional bus service coding be considered should the scheme be modelled in LLITM 2014.**
- LLITM does not model mode choice between bus and rail. It simply uses an all-or-nothing assignment routeing to determine which public transport route has the lowest average perceived cost. This is a fairly crude method, and not ideal for modelling a scheme likely to attract significant demand from bus to rail. In addition, LLITM does not model fares at an assignment level, meaning fares are not taken account of in the choice between bus and rail. Despite being a tour-based model, the current LLITM does not enforce outbound and return journeys using the same public-transport sub-mode (bus or rail). **The LLITM 2014 model will include a full bus versus rail mode choice, taking account of fares, and allowing demand to be split between modes based on preference rather than all being allocated to one or the other. This would address all of these issues.**
- LLITM uses an incremental mode choice model to calculate relative usage of car and public transport. This means that any demand for travel that might use the new Leicester-Burton link will be proportional (all other things being equal) to the existing level of public transport demand for that movement. In the case of the new stations, this means existing bus demand. For some of the longer movements (e.g. Ashby to Leicester), this methodology is probably not very accurate, as the existing bus demand will be very low, and the existing rail demand will be zero. The Burton-Leicester movement itself has existing rail demand and thus should be reasonably well modelled. **The LLITM 2014 model will be unchanged in this respect.**
- LLITM, in common with all multi-modal transport models, forecasts generally very low rail growth over time, much lower than has been observed in recent years in reality. This will necessitate an external adjustment to future year predicted rail demand – as has been adopted in this case. **Some assumptions in the LLITM 2014 model are likely to result in increased rail growth; the bus versus rail model will properly capture the effect of increasing bus fares, while the rail fare growth assumptions are likely to be lower in LLITM 2014 than in the current LLITM. However, we would still expect the predicted growth to be too low.**

6 Scheme Appraisal

6 Scheme Appraisal

6.1 Overview

6.1.1 A bespoke appraisal model has been developed to convert the LLITM outputs into the transport benefits, including user time savings, decongestion benefits and environmental benefits. The appraisal model also processes the operating costs and undertakes the 'reverse appraisal' in order to determine what level of capital cost[31] can be accommodated for milestone Benefit Cost Ratios (BCRs). This chapter describes the inputs assumptions and outcome of the appraisal for each of the options.

6.1.2 The appraisal has been undertaken in line with the latest WebTAG guidance. A 60 year appraisal period has been used from an assumed opening year of 2020, using a discount rate of 3.5% for the first thirty years and 3.0% for the remainder of the appraisal period. WebTAG data has been used to define discount rates, GDP deflators, price base, Value of Time (VoT) and VoT growth. PDFH (Passenger Demand Forecasting Handbook) data has been used to split benefits between the three journey purposes in the appraisal (commuting, business and other).

6.1.3 During the course of this study, and following discussion with the client, it was agreed that AECOM would undertake additional scheme appraisal to assess further potential service patterns that may generate higher levels of benefits and to undertake a high-level costing exercise based on the emerging infrastructure requirements identified via the train planning exercise. The need for this additional work became apparent in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing.

6.2 Demand and Revenue Inputs

6.2.1 Demand and revenue estimates were provided by the LLITM model for 2016 and 2031. Appropriate factors were used to combine the separate AM peak, Interpeak and PM peak models into an annualised value. These factors take account of peak hour and interpeak demand and factor this up to include off-peak and weekend demand in order to generate an overall annual value. The growth was assumed to be linear between 2016 and 2031 and was extrapolated to 2035, beyond which no further growth was assumed (in line with WebTAG guidance).

6.2.2 A demand ramp-up profile was assumed across the first three years of operation in line with PDFH guidance (70% in year 1, 85% in year 2 and 95% in year 3). The ramp-up profile reflects the fact that demand for a new service will not materialise immediately, but will take some time to build up once knowledge of the service is acquired.

[31] For the avoidance of doubt, capital costs in this case are defined as being the costs pre application of any optimism bias and without any uplift for risk.

6.3 Mode Transfer Benefits

6.3.1 A number of benefits are a direct function of the levels of mode transfer estimated to come from car, including decongestion benefits, environmental benefits and accident savings. These can be calculated by applying standard WebTAG rates to the forecast reduction in car kilometres.

6.3.2 The effect of rail patronage increase on car journey kilometres has not been taken directly from the LLITM model. Although the model does forecast a reduction in car kilometres in general in the Burton-Leicester scheme tests, it is considered that the convergence[32] of the model is not currently sufficient to make this estimate reliable (although the rail forecasts themselves are considered well-converged and stable). Accordingly, an external estimate of the impact of the schemes on car has been made.

6.3.3 The reduction in car kilometres has been calculated in the appraisal by assuming a proportion of rail demand is transferred from car. For the purposes of this appraisal a figure of 35% mode transfer from car has been assumed. Evidence across a number of appropriate sources suggest that this value can be as much as 50% to 60%, although in this case a more conservative value has been chosen based on relevant evidence from a similar study recently undertaken by the consultants elsewhere. For each movement, distances from the AA route planner have been applied to this forecast mode transfer, followed by a conversion into car vehicle kilometres by applying an average car occupancy of 1.34 in 2016 and 1.32 in 2031 (source: WebTAG).

6.4 User Time Benefits

6.4.1 Providing a direct rail passenger link between Leicester and Burton will result in savings in travel time. As there is currently no rail service in the study corridor (effectively rail is a 'new mode') then it was not possible to calculate user time savings in the conventional way in line with WebTAG guidance. In such circumstances, the guidance suggests that user time savings should be derived through the application of a more complex approach called numerical integration. This, however, requires a number of intermediate model runs for which the study timescales did not allow.

6.4.2 Consequently user time savings presented in this scheme appraisal have been determined at the higher level for the public transport mode as a whole. The main disadvantage of the approach taken is that it precludes the presentation of rail benefits as distinct from bus ones, although the overall benefit should be well estimated (given bus costs have not changed in the tests).

[32] Model convergence relates to how a model performs iteration-by-iteration in terms of changes from the previous iteration. The better the convergence, the less change there is between iterations and the more robust the results. In a fully converged, stable model, there will be negligible or no change between results from one iteration to the next.

6.5 Costs and Optimism Bias

6.5.1 The operating costs for each option have been sourced from the operating cost model discussed in Chapter 4 and imported into the appraisal model. These are already discounted and have a 'pre-feasibility' level of optimism bias applied in line with WebTAG guidance.

6.5.2 The appraisal model has been set up to include capital costs, although these have not directly been calculated as part of this work. Optimism bias has been applied to these costs in accordance with Green Book Guidance, with optimism bias during this stage set at 66.0% for the capital costs.

6.5.3 An allowance for ongoing renewal costs is generated from the capital costs by assuming a proportion of the set capital costs per annum.

6.5.4 In order to 'reverse engineer' the scheme appraisal, the appraisal model allowed the user to define a level of capital cost in order to determine what the resultant BCR might be. This allowed the level of capital cost to generate milestone BCRs to be identified.

6.6 Appraisal Outputs

6.6.1 The level of capital cost required to generate milestone BCRs has been identified for each option and is presented in turn below. The work initially considered BCR thresholds of 1.5 and 1.0 (breakeven), but subsequent analysis also considered a BCR threshold of 2.0.

6.6.2 For the Local Option (Option 1), the Transport Economic Efficiency (TEE) tables are presented in Appendix A and summarised below:

- To obtain a BCR of 1.5, the capital costs would need to be no more than £8.9m, which increases to £13.6m if the 66% optimism bias is removed.
- To obtain a BCR of 1.0 (breakeven), the capital costs would need to be no more than £22.9m, which increases to £34.7m if the 66% optimism bias is removed.
- For comparative purposes, the Scott Wilson study generated a BCR of 0.6 with capital costs of £33m without optimism bias and 0.4 with 66% optimism bias.

6.6.3 The above figures are based on the assumption of 35% mode transfer from car. This was an arguably cautious assumption made in the light of recent experience of modelling a similar rail scheme elsewhere in the UK. As a sensitivity test, if this is increased to 50%, the resultant outcome for Option 1 becomes:

- For a BCR of 1.5, the capital costs (including renewals) would need to be no more than £19.7m, which increases to £29.8m if the 66% optimism bias is removed.
- For a BCR of 1.0, the capital costs (including renewals) would need to be no more than £38.9m, which increases to £59.0m if the 66% optimism bias is removed.

6.6.4 A further sensitivity has been undertaken to determine what impact a 20% increase in demand might have on the scheme appraisal for Option 1[33]. For a BCR of 1.5, the capital cost allowance increases to £18.9m (with optimism bias). Therefore, a 20% increase in demand has added circa £10m of capital cost.

6.6.5 This demonstrates the level of sensitivity of the appraisal results to changes in the input assumptions. Bearing in mind the caveats around the use of arguably conservative appraisal inputs – including potential forecast demand levels, then it becomes apparent that capital cost allowance values greater than £30m might be expected to be achievable in order to generate a positive business case (ie: BCR >1.0) for the scheme (Local Option (Option 1)).

6.6.6 For the Strategic Option (Option 2) the position is less encouraging. A negative Net Present Value (NPV), where the Present Value Costs (PVC) are greater than the Present Value Benefits (PVB) is achieved, even with zero capital costs, because:

- The total value of the benefits (PVB) in Option 2 is circa 10% less than in Option 1;
- Revenue in Option 2 is 20% less than in Option 1; and
- Operating costs in Option 2 are 68% higher than in Option 1 – this is the key reason and relates to the fact that Option 2 assumes 4-car operation and class 222 rolling stock.

6.6.7 Option 2 does not include benefits/costs between Leicester and London.

6.7 Additional Options - Appraisal Outputs

6.7.1 Following the reporting of the two core options described above, two potential service improvements were identified with the client for further consideration with a view to maximising benefits and improving the scheme's business case. These were:

- Maximum 75 mph operation on the line; and
- Doubling the service frequency to 2 tph.

Therefore, a further three options were identified:

- Local Option 1 with maximum 75 mph;
- Local Option 1 with 2 tph; and
- Local Option 1 with 75 mph and 2 tph

[33] Note that this was undertaken on the final TEE table only by factoring up the appropriate appraisal elements.

6.7.2 Table 6.1 summarises the appraisal findings for the additional options.

Table 6.1: Available Capital Cost Budget for Given BCRs

Option	BCR = 1.0	BCR = 1.5
Local 1 tph 45 mph	£22.9m	£8.9m
Local 2 tph 45 mph	£20.6m	£0.0m
Local 1 tph 75 mph	£37.9m	£21.0m
Local 2 tph 75 mph	£47.2m	£19.0m

Note that these capital costs are exclusive of Optimism Bias. Optimism Bias of 66% is applied to these in the appraisal process to achieve the target BCRs.

6.7.3 The additional operating costs associated with doubling the service frequency results in this option not producing an improved business case. However, the line speed improvements do increase the amount of capital cost budget that can be accommodated, even more so when combined with the service frequency improvements. It should, however, be noted that the 75mph line speed improvement options are likely to require additional capital costs compared to the 45mph line speed options.

6.8 GVA Outputs

6.8.1 Further appraisal work has been undertaken by SLC and JMP to establish the wider economic benefits to the County in terms of GVA for each of the options. This has made use of a land use model developed by SLC/JMP and used for the rail strategy development work being undertaken by SLC for LCC, which determines the effect on economic productivity of changes to rail services. The model is consistent with Network Rail's approach to wider economic benefits and has been developed specifically to derive the benefits of rail service development on the wider economy. Table 6.2 presents the outputs from this model. The analysis indicates that the higher line speed options might produce additional GVA benefits of between £0.75m and £1m per annum. The slower timetables are estimated to produce GVA benefits of between £0.3m and £0.6m per annum. It should be noted that these figures indicate a general quantum of GVA which could be achieved, under each of the Local Options.

Table 6.2: GVA for the Local Options

Option	GVA per annum (2021 prices)	30 years discounted* GVA
Local 1 tph 45 mph	£298,400	£3,900,000
Local 2 tph 45 mph	£541,400	£7,100,000
Local 1 tph 75 mph	£747,300	£9,700,000
Local 2 tph 75 mph	£990,300	£12,900,000

* Discounted to 2010
For the avoidance of doubt, the GVA benefits are not included in the calculation of BCRs

6.9 Analysis of the Appraisal Outputs

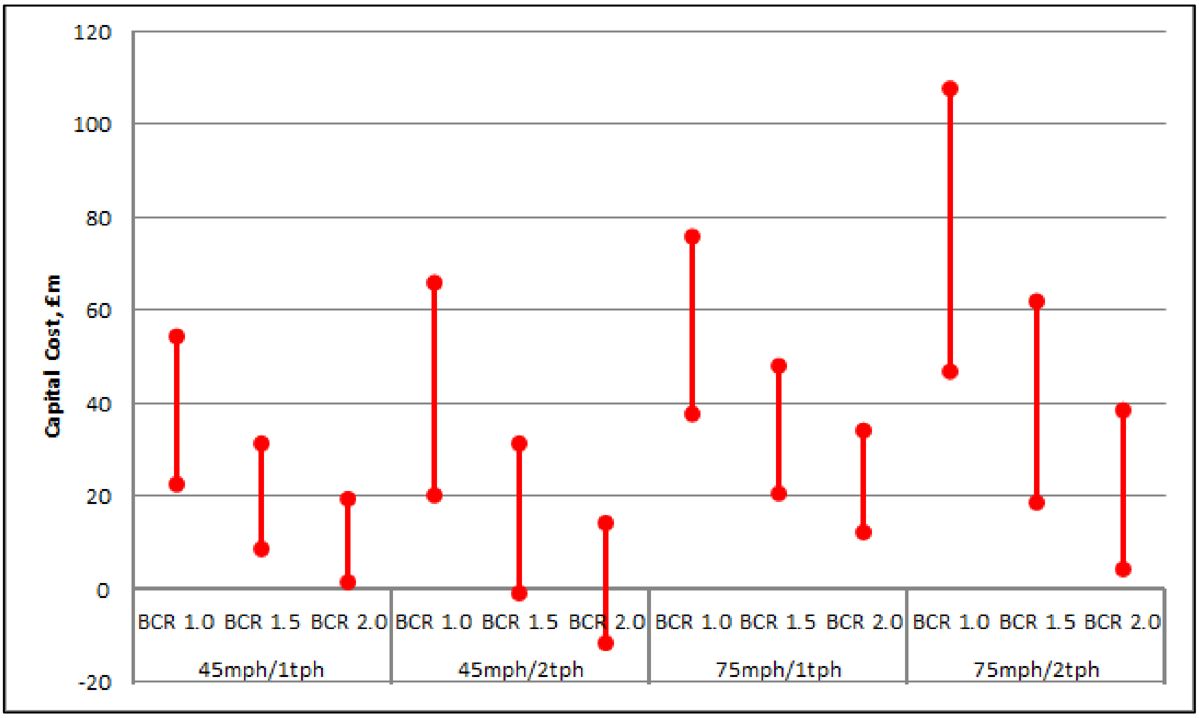
6.9.1 During the course of this study it became apparent that there was a need for additional work in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing. Therefore a number of service pattern variants (all based on the Local Option) have been modelled and appraised. The outcome from this work has been reported above, indicating the level of capital cost budget likely to be available in order to generate milestone BCRs. In addition, a high-level capital costing exercise has been undertaken. It is therefore possible to bring these together to provide an indication of the emerging business case for the scheme that can then contribute to the ongoing debate.

6.9.2 In bringing this together, both the modelling constraints discussed earlier in this report and the fact that the capital costs have been developed to a high-level only, need to be acknowledged. We have, however, in this analysis attempted to take these into account where we can.

6.9.3 Figure 6.1 sets out, for each option and milestone BCR, what the anticipated range of capital cost budget might be. In order to produce this range, we have considered the existing modelling constraints discussed earlier in this report and taken a 20% increase in demand and increase in the levels of mode transfer from car to 50% to produce an upper end estimate[34]. The lower end estimates are those reported above. At the request of the client we have also added the range for a milestone BCR of 2.0.

[34] The definition of this upper end estimate is purely arbitrary but serves a useful purpose to demonstrate the likely scale of benefits that in our view might be achievable. The reasons why we might consider the need to define an upper limit based on these factors are evidenced in paragraphs 5.3.12 and 6.3.3.

Figure 6.1: Capital Cost Budgets by Option and BCR Target



6.9.4 Based on the analysis presented in Figure 6.1, if the capital costs for the scheme exceed (circa) £110m then it is less likely that the scheme would be able to generate a positive business case. In order to generate a BCR of 2.0 or more, the capital costs should not be greater than circa £40m. Clearly there is variation by option to also consider, with those options with the higher line speeds (up to 75mph) generating the greater scope for accommodating more capital costs (although these options will require more capital costs than the 45mph options).

6.9.5 Indicative capital costs estimated from a high level costing assessment were presented in Table 4.2:

- Local Option 45mph/1tph: £100m to £120m;
- Local Option 45mph/2tph: £110m to £130m;
- Local Option 75mph/1tph: £140m to £160m;
- Local Option 75mph/2tph: £155m to £175m.

These are high level estimates developed in order to allow us to establish whether there is an emerging business case for reintroduction of rail passenger services on the Leicester to Burton line. The range of potential costs indicated exceed the available capital cost budgets set out in Figure 6.1 across all options and target BCRs.

6.9.6 Based on the indicative capital costs outlined above, it is possible to determine what percentage increase in the demand forecasts would be necessary in order to generate milestone BCRs (the capital cost budget ranges presented in Figure 6.1 assumed a 20% demand uplift). The outcome of this exercise is presented in Table 6.3.

Table 6.3: Anticipated Increase in Demand

Option	BCR=1.0	BCR=1.5	BCR=2.0
1tph/45mph	+79%	+136%	+181%
2tph/45mph	+59%	+111%	+152%
1tph/75mph	+84%	+142%	+187%
2tph/75mph	+49%	+100%	+141%

The mid-point of the capital cost ranges (Table 4.2) has been assumed

6.9.7 The table shows that to achieve a breakeven BCR of 1.0, the demand forecasts would have to increase by circa 50% for the 2tph options and 80% for the 1 tph options. To achieve a BCR of 1.5 the demand forecasts would essentially have to double. With reference to Table 5.6, in practice this would mean the number of journeys increasing to 860,000 (1tph/45mph, 2016) or to 1,291,000 (2tph/75mph, 2016). Paragraph 2.2.25 stated that the Scott Wilson report had determined that between 500,000 and 600,000 single journeys (base year) would be required to breakeven (i.e. BCR of 1.0). This analysis is now saying that this figure is nearer to between 800,000 and 900,000 journeys, given the higher capital cost estimates.

6.10 Subsidy Requirements

6.10.1 We have extended our appraisal analysis to include a financial appraisal to provide some initial indication of the likely levels of annual revenue support (franchise subsidy impact) that may be required. If net incremental operating costs are greater than the net incremental revenue, then there is a requirement for subsidy, which is normally administered via the Franchise Agreement. The subsidy can be justified if the scheme as a whole can demonstrate a positive economic business case.

6.10.2 It should be noted that this financial appraisal indicates the performance of the scheme measured at 'rail UK' level. Given that subsidy is normally paid via the relevant franchise, the individual Train operating Company (TOC) – in this case likely to be East Midlands Trains – will also be interested in the relative costs and revenues associated with their flows. Whilst all the additional operating costs would fall to East Midlands Trains, not all the additional revenue will necessarily fall to them (e.g. a Coalville to Manchester journey would generate a proportion of additional revenue to other TOCs).

6.10.3 Table 6.4 sets out the anticipated level of additional revenue support likely to be required at the 'rail UK' level. Again, we have presented a range based on upper and lower limit assumptions as outlined above. We have presented the average annual values for the first three years (of interest to scheme promoters who normally have to bear the additional support required for rail schemes over the first three years) and for the first 10 years.

Table 6.4: Average Subsidy per Annum

Option	Average annual subsidy requirement	
	Over first 3 years	Over first 10 years
1tph/45mph	£2.0m to £2.2m	£1.7m to £2.0m
2tph/45mph	£4.1m to £4.4m	£3.8m to £4.2m
1tph/75mph	£1.7m to £1.9m	£1.3m to £1.6m
2tph/75mph	£3.8m to £4.1m	£3.4m to £3.8m

6.10.4 The net additional revenue support is estimated to lie between £1.5m and £2m per annum for the hourly service pattern options (and nearer to £2m+ in the initial three years). Those options where the service frequency is doubled may require additional revenue support in the region of £4m per annum.

6.10.5 Additional analysis has been undertaken to derive the potential increase in the number of households in the study corridor that would be required in order to generate sufficient rail demand to remove the need for the subsidy identified in Table 6.4, i.e. converting the subsidy requirements into 'number of households'. This has been carried out using a number of assumptions as set out below.

6.10.6 The process adopted was to convert the subsidy requirement into demand based on the average fare paid per journey. This value could be established by year and by option from the model outputs. An average rail trip rate per household value was determined based on the number of households in the corridor and the forecast rail demand for 2016 (adjusted to allow for inbound demand). The application of this trip rate to the identified demand allowed us to identify the potential number of additional households required to eliminate the calculated subsidy, as shown in Table 6.5. The additional demand required is also included in Table 6.5.

Table 6.5: Estimate of Additional Households and Journeys Required in Rail Corridor to Eliminate Subsidy (000's)

Option		Number of households and journeys (000's)		
		In Year 1 (2020)	In Year 5 (2024)	In Year 10 (2029)
1tph/45mph	Households	178 - 191	121 - 141	117 - 139
	Journeys	845 – 900	575 – 665	555 – 655
2tph/45mph	Households	245 – 258	184 – 203	184 – 206
	Journeys	1,800 – 1,890	1,345 – 1,485	1,345 – 1,505
1tph/75mph	Households	126 – 138	70 – 89	62 – 84
	Journeys	730 – 800	405 – 520	360 – 485
2tph/75mph	Households	196 – 208	138 – 158	137 – 159
	Journeys	1,645 – 1,745	1,160 – 1,320	1,150 – 1,330

6.10.7 These values require some caution in terms of their interpretation. The range presented by option is the upper and lower limits as discussed above. Subsidy tends to reduce over time as demand (and thus revenue) increases due to initial ramp-up and then growth (although there are circumstances where subsidy can increase as well, for example when operating costs increase due to the introduction of new rolling stock). Thus in broad terms the number of additional households required to cover the subsidy tends to reduce over time. However the actual demand growth in the corridor will reflect some growth in population in the corridor plus changes in the propensity to travel and therefore the results presented in Table 6.5 need to be viewed as indicative values over and above the impacts of forecast growth in the corridor.

7 Conclusions and Next Steps

7 Conclusions and Next Steps

7.1 Introduction

7.1.1 AECOM was commissioned by Leicestershire County Council (LsCC), Leicester City Council (LCC) and North West Leicestershire District Council (NWLDC) to revisit the business case for the introduction of rail passenger services along the Leicester Burton Line, which is currently freight only. The key objective was to test two concept options, which were defined and agreed with the client as follows:

- a Local Option running hourly between Burton and Leicester calling at intermediate stations at Swadlincote, Ashby-de-la-Zouch, Coalville, Leicester Forest East and Leicester Western Park, operated by 2-car class 156 rolling stock; and
- a Strategic Option running hourly from Burton to London via Leicester, calling at Ashby-de-la-Zouch, Coalville and Leicester Western Park, operated by 4-car class 222 rolling stock.

7.1.2 The original analysis was expanded to appraise a number of sub-options based around the defined Local Option – variations on service frequency (half-hourly) and journey time (line speeds).

7.2 Approach and Findings

7.2.1 A timetabling exercise was undertaken (Chapter 3) which assumed an operational speed of 45 mph or (maximum) 75 mph, except where the infrastructure limits the maximum speed, and an hourly or half-hourly rail passenger service, with an allowance for 0.5 freight trains per hour in each direction. The 45 mph speed assumption was consistent with previous work undertaken by Scott Wilson in 2009. The timetabling exercise identified the following in terms of operating the service and associated infrastructure requirements:

- An hourly service between Leicester and Burton can be operated by two trainsets. A half-hourly service would require four trainsets;
- End-to-end journey times of between 50.5 and 52 minutes can be achieved with a 45 mph railway. This reduces to 42.5 minutes if line speeds are increased above 45 mph to a maximum of 75 mph (in reality infrastructure and operational constraints result in line speeds increasing to circa 60/65 mph in most cases);
- Circa 50% of the line would need to be upgraded to 45 mph line speeds (45 mph scenario). Virtually the whole line could be upgraded to line speeds greater than 45 mph (75 mph scenario);
- The Knighton Curve would be required to join the line to the Midland Main Line;
- New stations would need to be constructed in line with the option specification;
- No additional track would be required in a 75 mph scenario with one train per hour. For all other scenarios a passing loop for freight trains would be required at Mantle Lane Signal Box. Going to two trains per hour would require further re-doubling of track in the western fringes of Leicester; and
- A re-instated south facing bay platform at Burton station would be desirable.

7.2.2 An operating cost model has been developed, based on a combination of data supplied by East Midlands Trains where available, and our own industry knowledge, as documented in Section 4.2. It has been assumed that the service would operate for 17 hours per day, Monday to Saturday, but no Sunday service. Given these assumptions, the total annual operating costs were calculated to be:

- £3.1m for the hourly Local Option and £5.7m for the half-hourly Local Option (2 car cl156); and
- £5.8m for the hourly Strategic Option (4 car cl222).

These costs benchmark well against other studies.

7.2.3 As the rail passenger service in the study corridor is completely new, rail industry standard tools which would normally be used to model a rail scheme could not be used. Instead, use was made of the Leicester and Leicestershire Integrated Transport Model (LLITM), as detailed in Chapter 5. However, it has to be acknowledged that use of the current version of the model contains a number of caveats, many of which will be resolved or improved in the next version of the LLITM model which is being developed and expected in 2016. As a result, the demand and revenue that has been forecast in this case might be considered to be understated.

7.2.4 The LLITM model has forecast the following 2016 annual demand (single journeys) for the options appraised:

- Local Option: 364,374
- Strategic Option: 301,894

(both hourly service pattern and 45 mph line speeds)

7.2.5 Forecast demand for 2031 has also been estimated by taking the forecasts for that year from LLITM, which therefore incorporates any re-distributional impacts relating to demand associated with planned new development in the corridor between Leicester and Burton-upon-Trent, It should be noted that, whilst the LLITM model covers Leicestershire, the modelling of specific developments extends beyond the Leicestershire boundary. Therefore LLITM includes assumptions about development along the whole corridor, including that part which lies outside Leicestershire.. These forecasts are then control totalling the subsequent growth from 2016 in line with Network Rail's growth forecasts contained in their East Midlands Route Study. As a result of this, the 2031 annual demand was estimated to be:

- Local Option: 535,237
- Strategic Option: 443,785

(both hourly service pattern and 45 mph line speeds)

7.2.6 These demand forecasts are of the same order of magnitude as those forecast by Scott Wilson in their previous study in 2009.

7.2.7 The demand forecasting undertaken would appear to suggest (subject to the modelling caveats highlighted elsewhere) that it would be more beneficial to concentrate on serving the key local movements in the corridor than to provide a more 'strategic' option serving less stations. The evidence might also suggest that one station located at the ring road (Leicester Western Park) might suffice in terms of catering for the demand in the western Leicester suburbs.

7.2.8 Further sub-options based on the Local Option were modelled. The demand forecasts are summarised below. Reducing the end-to-end journey time by circa 10 minutes has the potential to increase demand by 23%. Doubling the service frequency increases demand by over 50%.

Table 7.1: Local Option Demand

Local Option	Annual Demand (single journeys)	
	2016	2031
1 tph / 45 mph	364,374	535,237
1 tph / 75 mph	447,596	657,965
2 tph / 45 mph	563,617	828,517
2 tph / 75 mph	645,718	949,205

7.2.9 The outputs from the LLITM model and the operating cost model have been brought together in a bespoke appraisal model that has been developed in line with the most up-to-date WebTAG appraisal guidance. This model has generated the benefits for the scheme and identified what level of capital costs can be accommodated for each option in order to generate a milestone BCR such as 2.0 or 1.5 and a 'breakeven' BCR of 1.0, as no capital cost data was available initially.

7.2.10 For the Local Option (Option 1), the estimated capital cost budget is:

Table 7.2: Local Option Capital Cost Budgets for a Given BCR

Local Option	Capital Cost Budget for Milestone BCR of…		
	BCR 1.0	BCR 1.5	BCR 2.0
1 tph / 45 mph	£22.9m	£8.9m	£1.9m
1 tph / 75 mph	£37.9m	£21.0m	£12.5m
2 tph / 45 mph	£20.6m	£0.0m	£0.0m
2 tph / 75 mph	£47.2m	£19.0m	£4.7m

7.2.11 For comparative purposes, the Scott Wilson study demonstrated a BCR of 0.4 with capital costs of £33m. If the same costs of £33m are incorporated into our own appraisal model then the BCR generated now becomes 0.8[35].

7.2.12 For the Strategic Option (Option 2) the position is less encouraging. A negative Net Present Value (NPV), where the Present Value Costs (PVC) are greater than the Present Value Benefits (PVB) is achieved, even with zero capital costs, mainly due to the fact that operating costs are significantly higher in this option.

7.2.13 We extended our analysis to include a financial appraisal to provide some initial indication of the likely levels of annual revenue support (franchise subsidy impact) that may be required (Table 6.4). If net incremental operating costs are greater than the net incremental revenue, then there is a requirement for subsidy, which is normally administered via the Franchise Agreement. The subsidy can be justified if the scheme as a whole can demonstrate a positive economic business case. The net additional revenue support[36] is estimated to lie between £1.5m and £2m per annum for the hourly service pattern options (and nearer to £2m+ in the initial three years). Those options where the service frequency is doubled may require additional revenue support in the region of £4m per annum.

[35] For the like-for-like service pattern – 1 tph / 45 mph

[36] It should be noted that this financial appraisal indicates the performance of the scheme measured at 'rail UK' level. Given that subsidy is normally paid via the relevant franchise, the individual Train operating Company (TOC) – in this case likely to be East Midlands Trains – will also be interested in the relative costs and revenues associated with their flows. Whilst all the additional operating costs would fall to East Midlands Trains, not all the additional revenue will necessarily fall to them.

7.2.14 Further analysis has been undertaken to establish the number of additional households which would be required to remove the need for subsidy The analysis shows for year 1 (2020), that up to 138,000 additional households may be required for the hourly 75 mph service, rising to 258,000 households for the half hourly 45 mph service. In general terms, the level of subsidy reduces over time and hence the number of households which would negate the need for subsidy will also reduce. By year 10 (2029) up to 83,000 additional households may be required for the hourly 75 mph service, rising to 205,000 households for the half hourly 45 mph service.

7.2.15 Wider economic benefits (GVA impacts) have also been determined for the four Local Option variants (Table 6.2). The annual GVA values are estimated to be between £0.3m and £1.0m per annum depending on the service pattern.

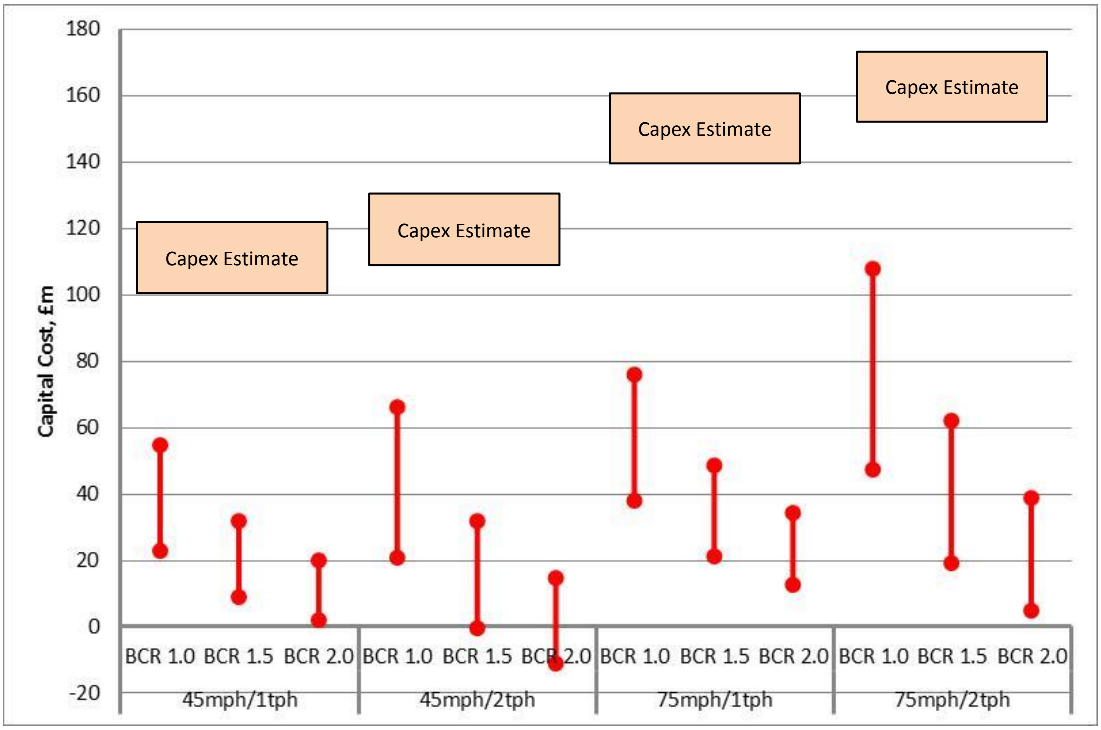
7.3 Emerging Scheme Business Case

7.3.1 During the course of this study it became apparent that there was a need for additional work in order to inform the ongoing debate around whether the scheme as a whole is likely to be able to generate a sufficiently robust business case and is therefore worth pursuing. Therefore a number of service pattern variants (all based on the Local Option) were modelled and, in addition, a high-level capital costing exercise was undertaken. It is therefore possible to bring these together to provide an indication of the emerging business case for the scheme that can then contribute to the ongoing debate.

7.3.2 In bringing this together, both the modelling constraints discussed earlier in this report and the fact that the capital costs have been developed to a high-level only, need to be acknowledged. We have, however, in this analysis attempted to take these into account where we can by determining a range for the likely capital cost budget by option and milestone BCR.

7.3.3 Figure 7.1 sets out, for each option and milestone BCR, what the anticipated range of capital cost budget might be and compares it to the estimated high level capital costs.

Figure 7.1: Capital Cost Budgets and Capital Cost Estimates by Option and BCR Target



7.3.4 Based on the analysis summarised and presented in Figure 7.1, the estimated capital costs for each option (the brown boxes) are an order of magnitude greater than the anticipated available capital cost budget (the red lines) given the level of benefits being forecast.

7.3.5 Based on the indicative capital costs outlined above, it is possible to determine what percentage increase in the demand forecasts would be necessary in order to generate milestone BCRs (the capital cost budget ranges presented in Figure 7.1 assumed a 20% demand uplift). To achieve a breakeven BCR of 1.0, the annual demand forecasts would have to increase by circa 50% for the 2tph options and 80% for the 1 tph options. To achieve a BCR of 1.5 the annual demand forecasts would essentially have to double. In practice this would mean the number of single journeys increasing to 860,000 (1tph/45mph, 2016) or to 1,291,000 (2tph/75mph, 2016). By way of comparison, Scott Wilson stated in their report that between 500,000 and 600,000 single journeys (base year) would be required to breakeven (i.e. BCR of 1.0). This analysis is now saying that this figure is nearer to between 800,000 and 900,000 journeys, given the higher capital cost estimates.

7.4 Conclusions

7.4.1 The findings from this study suggest that the level of benefits that could be generated by the scheme will not be enough to cover the costs of the scheme in order to produce a positive business case. The gap between the benefits and costs becomes even greater when considering key ‘milestone’ BCRs such as 1.5 or 2.0.

7.4.2 It should, however, be noted that this conclusion is based on a set of demand forecasts which we consider may well be understating the levels of demand for the scheme. In addition, the capital costs are based on an initial high level costing exercise that has been quickly undertaken for the purposes of informing this study.

7.4.3 Therefore, whilst it could be concluded that the increase in demand (and thus benefits) that would be required in order to generate a BCR over 1.5 would need to be significant and is unlikely to be realistically achievable, further work may be beneficial to robustly support decisions relating to the progress of the scheme. In particular, use of the updated LLITM model may generate additional demand and a detailed bottom-up costing exercise may reduce the capital costs (and possibly reduce the use of a 66% optimism bias factor too). For example, an increase in demand of circa 40% to 50% coupled with a reduction in the capital costs of circa 40% to 50% could get close to achieving a BCR of around 1.5.

Appendix A: Tables

Appendix A: Tables

Table A.1: TEE Table Local Option 1 tph 45 mph (BCR of 1.5)

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	£48,003		£40,704		£7,299	
Vehicle operating costs	£0					
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: COMMUTING	£48,003	*(1a)*	£40,704.4	£0	£7,299	£0

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	£21,367		£18,433		£2,934	
Vehicle operating costs	£0					
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£21,367	*(1b)*	£18,433	£0	£2,934	£0

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	£6,951			£3,775			£3,176	
Vehicle operating costs	£0							
User charges	£0							
During Construction & Maintenance	£0							
Subtotal	£6,951	*(2)*	£0	£3,775	£0	£0	£3,176	£0
Private sector provider impacts						Freight	Passengers	
Revenue	£38,182						£38,182	
Operating costs	-£73,102						-£73,102	
Investment costs	£0							
Grant/subsidy	£0							
Revenue Transfer	£34,920						£34,920	
Subtotal	£0	*(3)*			£0	£0	£0	£0
Other business impacts								
Developer contributions	£0	*(4)*						
NET BUSINESS IMPACT	£6,951	*(5) = (2) + (3) + (4)*						

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	£76,321	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Table A.2: Public Accounts (PA) Table Local Option 1 tph 45 mph (BCR of 1.5)

Public Accounts (PA) Table

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue	£0					
Operating Costs	£73,102					
Investment Costs	£16,115					
Developer and Other Contributions	£0					
Grant/Subsidy Payments	£0					
NET IMPACT	£0	*(7)*	£0	£0	£0	£0
Central Government Funding: Transport						
Revenue	-£38,182					-£38,182
Operating costs	£73,102					£73,102
Investment Costs	£15,752		-£363			£16,115
Developer and Other Contributions	£0					
Grant/Subsidy Payments	£0				£0	
	£0					
NET IMPACT	£50,672	*(8)*	-£363	£0	£0	£51,035
Central Government Funding: Non-Transport						
Indirect Tax Revenues	£7,220	*(9)*	£2,972		£4,248	
TOTALS						
Broad Transport Budget	£50,672	*(10) = (7) + (8)*				
Wider Public Finances	£7,220	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Table A.3: Analysis of Monetised Costs and Benefits Table Local Option 1 tph 45 mph (BCR of 1.5)

Analysis of Monetised Costs and Benefits

Noise	£386	*(12)*
Local Air Quality	£0	*(13)*
Greenhouse Gases	£1,637	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	£4,746	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£48,003	*(1a)*
Economic Efficiency: Consumer Users (Other)	£21,367	*(1b)*
Economic Efficiency: Business Users and Providers	£6,951	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-£7,220	*- (11) - sign changed from PA table, as PA table represents costs, not*
Present Value of Benefits (see notes) (PVB)	£75,870	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£50,672	*(10)*
Present Value of Costs (see notes) (PVC)	£50,672	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£25,199	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	**1.5**	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Table A.4: TEE Table Local Option 1 tph 45 mph (BCR of 1.0)

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	£48,003		£40,704		£7,299	
Vehicle operating costs	£0					
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: COMMUTING	£48,003	*(1a)*	£40,704.4	£0	£7,299	£0

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	£21,367		£18,433		£2,934	
Vehicle operating costs	£0					
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£21,367	*(1b)*	£18,433	£0	£2,934	£0

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	£6,951			£3,775			£3,176	
Vehicle operating costs	£0							
User charges	£0							
During Construction & Maintenance	£0							
Subtotal	£6,951	*(2)*	£0	£3,775	£0	£0	£3,176	£0

Private sector provider impacts				Freight	Passengers	
Revenue	£38,182				£38,182	
Operating costs	-£73,102				-£73,102	
Investment costs	£0					
Grant/subsidy	£0					
Revenue Transfer	£34,920				£34,920	
Subtotal	£0	*(3)*	£0	£0	£0	£0

Other business impacts		
Developer contributions	£0	*(4)*
NET BUSINESS IMPACT	£6,951	*(5) = (2) + (3) + (4)*

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	£76,321	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Table A.5: Public Accounts (PA) Table Local Option 1 tph 45 mph (BCR of 1.0)

Public Accounts (PA) Table

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue	£0					
Operating Costs	£73,102					
Investment Costs	£41,232					
Developer and Other Contributions	£0					
Grant/Subsidy Payments	£0					
NET IMPACT	£0	*(7)*	£0	£0	£0	£0
Central Government Funding: Transport						
Revenue	-£38,182					-£38,182
Operating costs	£73,102					£73,102
Investment Costs	£40,869		-£363			£41,232
Developer and Other Contributions	£0					
Grant/Subsidy Payments	£0				£0	
	£0					
NET IMPACT	£75,789	*(8)*	-£363	£0	£0	£76,152
Central Government Funding: Non-Transport						
Indirect Tax Revenues	£7,220	*(9)*	£2,972		£4,248	
TOTALS						
Broad Transport Budget	£75,789	*(10) = (7) + (8)*				
Wider Public Finances	£7,220	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Table A.6: Analysis of Monetised Costs and Benefits Table Local Option 1 tph 45 mph (BCR of 1.0)

Analysis of Monetised Costs and Benefits

Noise	£386	*(12)*
Local Air Quality	£0	*(13)*
Greenhouse Gases	£1,637	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	£4,746	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£48,003	*(1a)*
Economic Efficiency: Consumer Users (Other)	£21,367	*(1b)*
Economic Efficiency: Business Users and Providers	£6,951	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-£7,220	*- (11) - sign changed from PA table, as PA table represents costs, not*
Present Value of Benefits (see notes) (PVB)	£75,870	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£75,789	*(10)*
Present Value of Costs (see notes) (PVC)	£75,789	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£81	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	**1.0**	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.