Lincolnshire County Council

NORTH HYKEHAM RELIEF ROAD

Economic Case – Outline Business Case

70038233
DECEMBER 2018

CONFIDENTIAL

Lincolnshire County Council

NORTH HYKEHAM RELIEF ROAD

Economic Case – Outline Business Case

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70038233

OUR REF. NO. 70038233

DATE: DECEMBER 2018

Lincolnshire County **Council**

NORTH HYKEHAM RELIEF ROAD

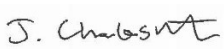
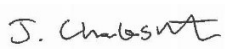
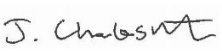
Economic Case – Outline Business Case

WSP

Lincolnshire County Council
Crown House
Grantham Street
Lincoln
LN2 1BD

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	First Draft	Final	Final_April19	
Date	18/12/2018	21/02/19	05/04/19	
Prepared by	BP / JB	BP / JB	BP / JB	
Signature				
Checked by	JC	JC	JC	
Signature				
Authorised by	JP / PR	JP / PR	JP / PR	
Signature				
Project number	70038233	70038233	70038233	
Report number	DRAFT	FINAL	FINAL_April19	
File reference	738233-WSP-T01-XX-RP-TP-0001	738233-WSP-T01-XX-RP-TP-0001	738233-WSP-T01-XX-RP-TP-0001_April19	

CONTENTS

1 ECONOMIC CASE OVERVIEW

1.1 INTRODUCTION

This section of the Business Case presents the Economic Case for the North Hykeham Relief Road (NHRR) scheme. The Economic Case identifies and assesses the impacts of the scheme to determine its overall value for money. It takes account of the costs of developing, building, operating and maintaining the scheme, and a full range of its impacts, including those impacts which can be monetised.

The Department for Transport's (DfT's) guidance document *'The Transport Business Case'* states that the Economic Case should consider economic, environmental, social and distributional impacts of a proposal using qualitative, quantitative and monetised information to determine the extent to which a proposal's benefits outweigh its costs. The guidance also outlines the elements that should be covered within the Economic Case for a scheme; these are summarised in Table 1.

Table 1 – DfT Economic Case Requirements

Issue	Description	Business Case Stage	
		Outline	Full
Introduction	Outline the approach to assessing value for money.	Completed	Updated
Options appraised	A list of the options (set out in the strategic case) that have been appraised.	Completed	Updated
Assumptions	WebTAG sets out assumptions that should be used in the conduct of transport studies. List any further assumptions supporting the analysis.	Completed	Updated
Sensitivity and Risk Profile	Set out how changes in different variables affect the Net Present Value/Net Present Cost. The risk profile should show how likely it is that these changes will happen.	Completed	Updated
Appraisal Summary Table	Various WebTAG units provide detailed guidance on producing the Appraisal Summary Table.	Completed	Updated
Value for Money Statement	The Value for Money Framework provides guidance on producing the VfM statement.	Completed	Updated

Completed = a full assessment

Updated = past information verified and new information incorporated

1.2 APPRAISAL SPECIFICATION REPORT

The Appraisal Specification Report (ASR) (September 2018) documents the approach to traffic modelling, forecasting and economic appraisal. This included:

- Identifying the area of impact of the scheme;
- Identifying the likely impacts of the scheme;
- Evaluating the expected scale of each impact given current evidence; and
- Defining a proportionate approach for assessing each impact in this Economic Case.

This took into consideration the guidance in various WebTAG documents.

The approaches described in this Economic Case are in line with what was set out in the ASR.

1.3 STRUCTURE OF THE DOCUMENT

This document reports on the methodology and results employed in the value for money assessment. These approaches have been developed in line with guidance set out in the DfT's Transport Assessment Guidance (TAG) and Treasury Green Book.

The remainder of this document is structured as follows:

- Chapter 2 summarises the **Approach to Traffic Modelling and Forecasting** including the options assessed, the base model and the forecasting methodology;
- Chapter 4 sets out the **Approach to Assessing Value for Money** including how the scheme objectives will be assessed;
- Chapter 4 describes the derivation of **Costs** for the scheme;
- Chapter 5 describes the assessment of **Benefits** for each impact in monetary, quantitative or qualitative terms;
- Chapter 6 compares the outcomes from the **Alternative Scenarios** that have been modelled;
- Chapter 7 presents the **Appraisal Summary Table**; and
- Chapter 8 provides a **Summary** of the Economic Case including the **Value for Money** statement.

1.4 LIST OF SUPPORTING DOCUMENTS

The following documents are attached to this Economic Case as appendices and are referenced throughout.

Table 2 – Supporting Documents

Appendix	Document Name	Abbreviation	Date
A	GLTM Local Model Validation Report	LMVR	October 2017
B	Traffic Forecasting Report	TFR	December 2018
C	Economic Appraisal Report	EcAR	December 2018
D	Environmental Appraisal Report	EnAR	December 2018
E	Economic Impacts Report	EIR	December 2018
F	Social and Distributional Impacts Report	SDIR	December 2018

2 APPROACH TO TRAFFIC MODELLING AND FORECASTING

2.1 OVERVIEW

The outcomes of the Economic Case are primarily based on forecasting traffic in and around the Lincoln urban area both with and without the proposed scheme.

This chapter documents the options appraised and key assumptions used in the traffic modelling and forecasting.

The requirements for traffic modelling and forecasting are informed by the nature of the scheme being assessed and its expected area of impact. The model must be fit for purpose for forecasting the impacts of the scheme including the model specification, coverage and validation where the greatest impacts are forecast to occur.

2.2 OPTIONS ASSESSED

The proposed scheme has been identified after consideration of a full range of options in line with the process set out in WebTAG '*Transport Analysis Guidance*' (May 2018). These included:

- Non-road options;
- Different route alignments;
- Upgrades to the existing network;
- Different route extents; and
- Different carriageway standards (single or dual).

Each stage of the assessment has made use of the analytical tools available at that time. The level of detail in the modelling has been progressively developed giving increased awareness and confidence in the scale of impacts. Analytics have also been updated at each stage to reflect changes to national and local data sources which underpin the forecasting assumptions and development.

The options development process and refinement of the preferred option are described extensively in the Options Appraisal Report (OAR) (September 2018) and summarised in the Strategic Case.

A new dual carriageway standard link was determined to be the preferred option. This has been appraised as the preferred scheme.

The alignment is illustrated in Figure 1.

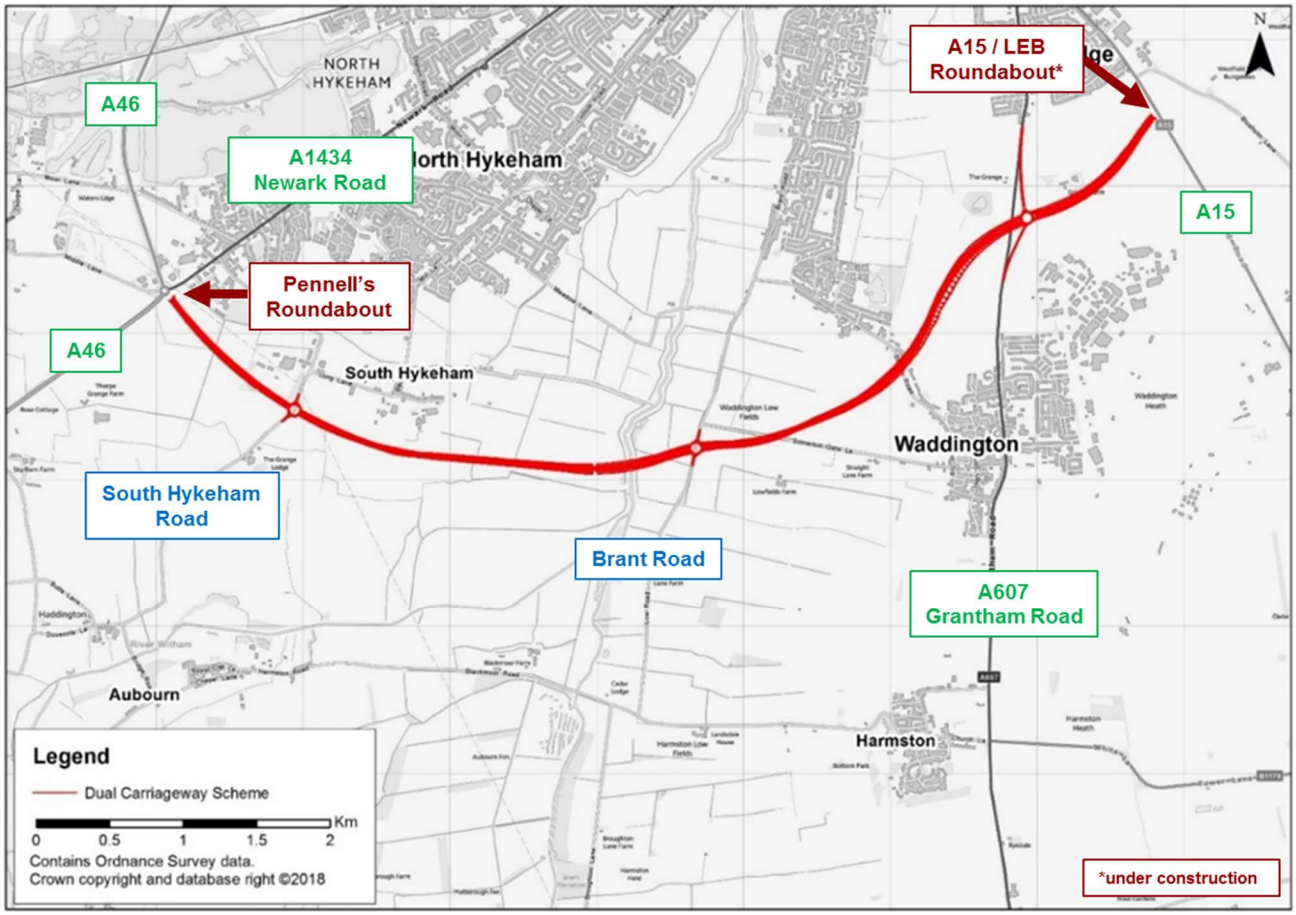
The scheme will provide a dual carriageway link with design speed 70mph from an enlarged A46 / A1434 Pennell's Roundabout to the under-construction A15 Lincoln Eastern Bypass. It will have at-grade roundabout junctions with South Hykeham Road, Brant Road and A607 Grantham Road and pass under Station Road beneath a new overbridge.

Two options have been appraised as alternative schemes.

- Single carriageway standard link; and
- Single carriageway standard link with future-proofed junctions and structures.

The alternative schemes have the same alignment as the preferred scheme and a design speed of 60mph.

Figure 1 - Alignment of Preferred Scheme



2.3 GREATER LINCOLN TRANSPORT MODEL

The Greater Lincoln Transport Model (GLTM) was used in the appraisal. This includes a highway assignment model in SATURN version 11.3.12W which determines journeys travelling on the highway network including traffic flows, speed, delays, route choice and journey costs.

The GLTM suite also includes a public transport assignment model and a variable demand model. Variable demand modelling has been applied when developing the forecast models in line with WebTAG Unit M2 '*Variable Demand Modelling'* (March 2017) guidance to forecast the demand responses from a scheme of this size. The public transport assignment model provides dynamic journey costs for bus and rail to facilitate mode shift in the variable demand forecasting.

The model has an area of detailed modelling, referred to by WebTAG as the Fully Modelled Area (FMA), in which all of the junctions are simulated with capacity constrained. The extent of the FMA is illustrated in Figure 2 which also illustrates the highway network detail.

The base year travel demand matrices were developed to replicate trip patterns on an average weekday.

There are three modelled time periods:

- AM Peak Hour: 08:00 – 09:00;

- Inter Peak Average Hour: between 10:00 – 16:00; and
- PM Peak Hour: 17:00 – 18:00.

There are five modelled user classes:

- Car Employer's Business;
- Car Commuting;
- Car Other;
- Light Goods Vehicles; and
- Heavy Goods Vehicles.

The GLTM development was focussed on developing a model that could be applied for a range of applications. Before undertaking work for this scheme appraisal, a model review was undertaken to determine its fitness for this purpose.

The scope included:

- Local flow and journey time validation around North Hykeham, including the radial routes which will intersect with the scheme;
- Zoning and network detail in the area around the scheme;
- Key junction coding on major routes (including A46 and A1434 Newark Road); and
- Junction coding and link speeds around the rural areas of North Kesteven close to the scheme area, which may be susceptible to rat running.

Several areas for improvement were identified and subsequently implemented in local area validation:

- Improved modelling of journey times on A46, through refinement of roundabout capacities.
- Modelling of capacity and 'rat-running' in North Hykeham
- Need for additional validation data on the rural routes immediately south of the scheme.

The link flow and journey time validation both comfortably exceed WebTAG standards.

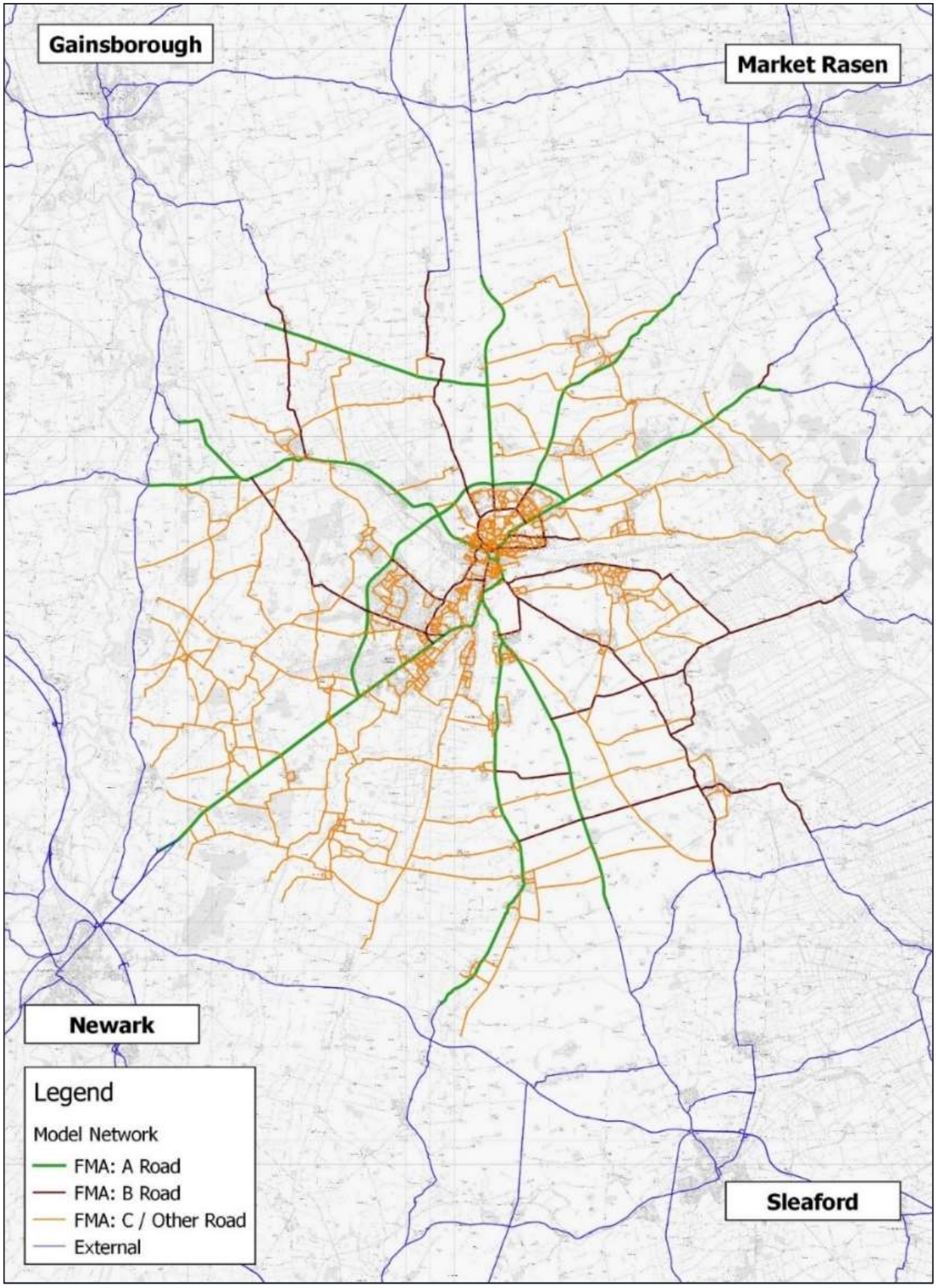
- Link flow validation is upwards of 90% for both flow and GEH criteria in all time periods.
- Journey time validation is upwards of 96% in all time periods.

The GLTM is considered fit for purpose to undertake the required traffic forecasting. The model suite is well specified for this purpose, constructed to current guidance and validated to a high level against recent data. The additional validation for this study provides further assurance for the outputs presented.

The level of validation across the FMA is important given that the scheme impacts on traffic flows across the Lincoln urban area network as a consequence of completing the ring road. It generates new route choice for some users and consequently provides congestion relief for other links which improves route choice for other users.

The GLTM LMVR (Appendix A) describes the process in detail.

Figure 2 – Highway Fully Modelled Area Coverage



2.4 TRAFFIC FORECASTING

The development of the traffic forecasts is underpinned by the validated base year models. Growth factors have been applied to the validated base year matrices to uplift the overall level of traffic to predicted levels in the forecast years. Network changes, including committed schemes and the scheme itself, have also been coded into the validated base year networks.

2.4.1 MODEL FORECAST ASSUMPTIONS

The approach to traffic forecasting has been undertaken in accordance with guidance in WebTAG Unit M4 '*Forecasting and Uncertainty*' (May 2018).

The TFR (Appendix B) describes the process in detail.

The modelled forecast years are:

- **2026** – scheme opening year; and
- **2041** – design year, 15 years post-opening.

The forecasting process comprised the following key stages:

- Defining future year travel scenarios;
- Preparing future year Reference Case demand;
- Preparing future year networks;
- Undertaking variable demand forecasting; and
- Checking and processing of outputs.

The Reference Case demand is developed by applying forecast trip end growth factors, based on demographic and economic trends, to the validated base year matrices.

However, changes in network conditions will lead to changes in demand patterns. The provision of new highway infrastructure can impact on a range of traveller choices including what mode people use to travel and where people choose to travel between. The scheme will provide an east-west link road which increases accessibility between the southern areas of the Lincoln urban area either side of the River Whitham.

Variable demand forecasting is undertaken to model the demand responses with and without the scheme in terms of mode choice and destination choice. These choices are facilitated based changes to travel cost derived from the highway model.

2.4.2 UNCERTAINTY

Traffic forecasting requires sources of uncertainty to be considered at a national and local level.

National uncertainty refers to projections such as demographic changes, GDP growth and fuel price trends. These are accounted for in the forecasting through growth factors from national datasets including the National Trip End Model (NTEM v7.2) and the DfT's Road Traffic Forecasts (2018 – Reference scenario). Overall growth in car trips between the base year and forecast years was controlled to NTEM values at a district level.

Local uncertainty refers to developments and transport infrastructure changes within the FMA which may occur during the forecast period. This information is documented in the GLTM Uncertainty Log which includes details of the proposal and the level of uncertainty. Only proposals which are

sufficiently progressed through the planning process against WebTAG classifications are included in the forecasting.

The level of uncertainty for all proposals in the Uncertainty Log was reviewed and cross-referenced with the latest planning information available by Lincolnshire County Council to assist in determining the classifications. The major proposals included in the forecast years are:

- Transport Schemes
  - Lincoln Eastern Bypass (LEB);
- Committed Development
  - North East Quadrant – Phase 1 (500 dwellings) only;
  - South East Quadrant – with 3,600 dwellings up to 2036;
  - Western Growth Corridor – full development by 2036 including the supporting highway infrastructure.

LEB is under construction and due to open in 2020. This is a major infrastructure scheme which will impact on existing traffic patterns in the Lincoln urban area and included in the without scheme networks. This introduces additional uncertainty, since the forecast impacts of the NHRR scheme are compared to and include the forecast impacts of LEB opening.

2.4.3 CORE SCENARIO

The Core Scenario is described by WebTAG as the best basis for decision making given current evidence based on more certain, unbiased assumptions. This includes two forecasts:

- **Without scheme forecast:** referred to as Do Minimum. This consists of the validated base year networks plus committed schemes, including LEB.
- **With scheme forecast:** referred to as Do Something. This consists of the Do Minimum assumptions plus the dual carriageway scheme as the preferred option.

2.4.4 ALTERNATIVE SCENARIOS

Alternative scenarios are also modelled to understand the impacts of varying input parameters or assumptions.

Two forecasts varying the level of traffic growth have been undertaken in line with WebTAG guidance.

- **Low Growth:** as per the Core Scenario but with lower forecast travel demand growth.
- **High Growth:** as per the Core Scenario but with higher forecast travel demand growth.

Two additional scheme options have also been forecast in line with guidance in WebTAG.

- **Next Best Alternative:** an alternative with scheme forecast consisting of the single carriageway plus future proofed junctions and structure scheme option.
- **Low Cost:** an alternative with scheme forecast consisting of the single carriageway scheme option.

2.4.5 DEPENDENT DEVELOPMENT TEST

One of the strategic outcomes for the scheme, defined in the Strategic Case, is to support the delivery of housing. The South West Quadrant (SWQ) is a sustainable urban extension located

adjacent to the scheme at the western end. A specific objective for the scheme is to provide the additional network capacity to support this development.

If some (or possibly all) traffic from a proposed development site would lead to an 'unreasonable level of service' on the highway network, or if the existing conditions already provide an 'unreasonable level of service', then the development will be dependent on an intervention. This dependency can be determined through traffic forecasting.

A dependent development assessment was undertaken to model and quantify the welfare and GDP effects of SWQ. A set of model forecasts following the guidance in WebTAG Unit A2-2 '*Induced Investment*' (May 2018) were developed. The scope of the assessment was to establish the level of dependency which was determined to be the full site, establish that the scheme addressed the dependency and to estimate the monetised benefits of unlocking the development land. The primary input for the monetised assessment is land value data, obtained from the Ministry of Housing, Communities and Local Government sources, to derive the land value uplift for the site.

3 APPROACH TO ASSESSING VALUE FOR MONEY

3.1 VALUE FOR MONEY FRAMEWORK

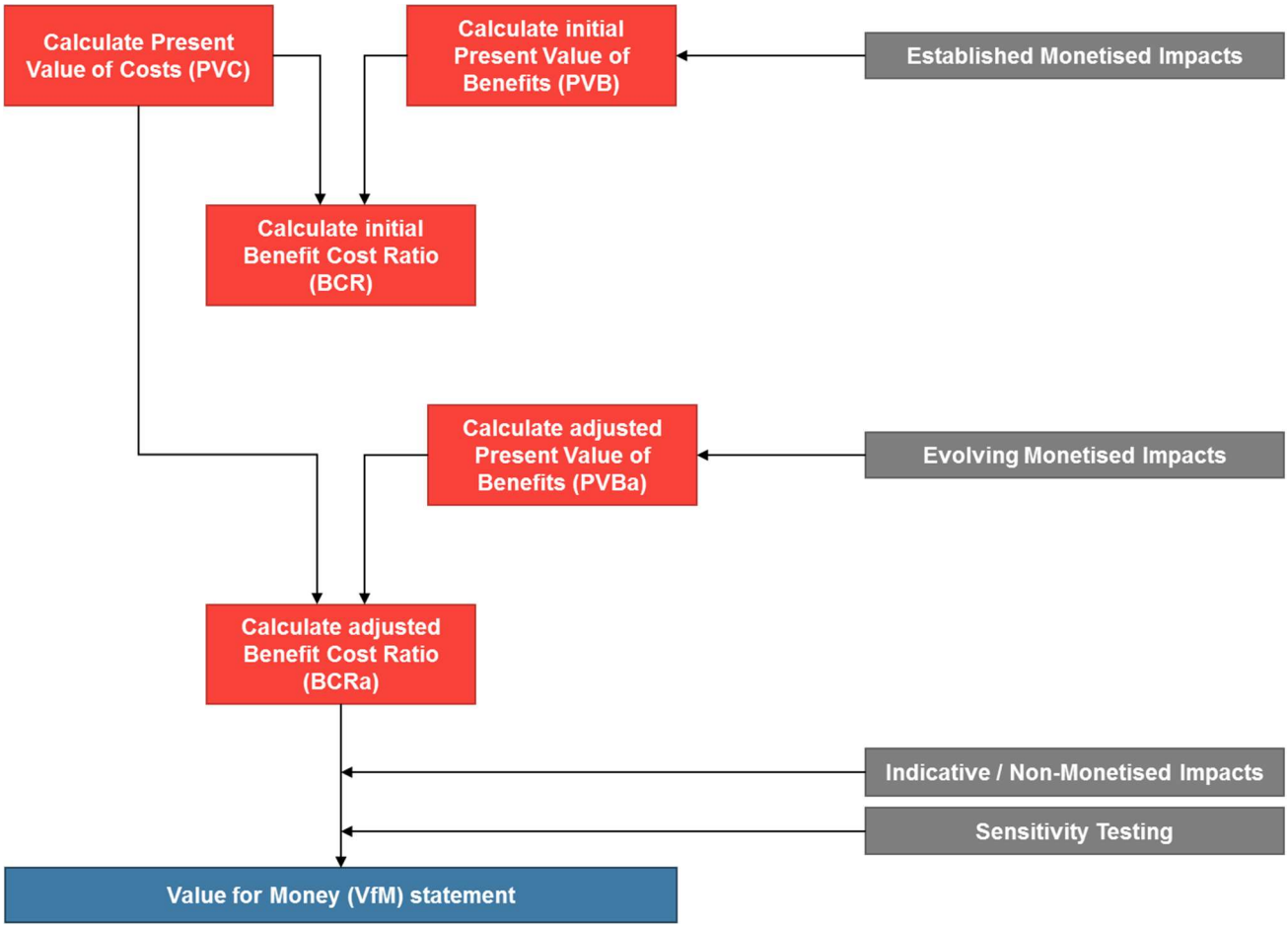
The approach to assessing the value for money of the scheme is based on undertaking an appropriate assessment for each impact of the scheme and using the overall evidence base to provide an informed value for money conclusion.

The assessment of impacts has been undertaken in accordance with the various WebTAG appraisal units including:

- A1 Cost Benefit Analysis;
- A2 Economic Impacts;
- A3 Environmental Impacts; and
- A4 Social and Distributional Impacts.

This process is based on the guidance set out in the DfT Value for Money Framework (2017) illustrated in Figure 3.

Figure 3 – Preparing the Value for Money Statement



The general process is summarised by the following key stages:

- The **Present Value of Costs (PVC)** has been calculated using the discounted whole life costs of the scheme.
- The **Present Value of Benefits (PVB)** has been calculated by considering the monetised impacts of the scheme on travel time, vehicle operating costs, safety, greenhouse gases and indirect tax revenues.
- An **Initial Benefit-Cost Ratio (BCR)** has been calculated by dividing the PVB by the PVC.
- An **Adjusted PVB** has been calculated by considering the monetised impacts of the scheme on journey time reliability which is then used to derive the **Adjusted BCR**.
- Any **non-monetised impacts** have been considered qualitatively, or quantitively, as appropriate.
- The results of **sensitivity tests** (or alternative scenarios) are reported and analysed for their impact on the value for money conclusion.
- A **Value for Money** (VfM) **statement** has been prepared which brings together and concludes the analysis based on all of the prior stages.

The following impacts have been monetised:

- User benefits:
  - Time savings;
  - The costs of operating vehicles;
  - Greenhouse gases; and
  - Taxes.
- Accidents; and
- Reliability.

Other benefits were assessed qualitatively through interpretation of traffic impacts and an understanding of the scheme's objectives. This approach is considered proportionate to the current stage of assessment and included the assessment of the following benefits.

The application of the stages above for the Core Scenario is detailed throughout the remainder of this Economic Case. The alternative scenarios are appraised in less detail up to calculation of the BCR for comparison and to inform the value for money conclusion.

3.2 ASSESSMENT OF IMPACTS

The approach to assessing impacts is based on using appropriate methodologies and techniques to evaluate how well the scheme is forecast to perform against the desired outcomes which were defined in the Strategic Case. The desired outcomes follow from the scheme objectives and are listed in Table 3 alongside how the outcome is assessed in this Economic Case.

Table 3 – Assessment of Scheme Outcomes

Scheme Outcome	Assessment Approach
Development of an efficient and effective transport network	The impact of improving east-west connectivity and transfer of trips to more appropriate routes is observed in flow difference plots presented in the TFR (Appendix B). **User benefits:** The efficiency of the transport network has primarily been assessed through the impact of the scheme on travel time savings. This assessment was undertaken using the DfT's TUBA (Transport User Benefit Analysis) software version 1.9.11 with the associated economic parameter file which monetises the impact of travel time savings and overall economic efficiency for users. The output is included in the initial BCR. **Reliability benefits:** In addition to travel time benefits, the efficiency of the transport network has been assessed through the impact of the scheme on journey time reliability. This assessment was undertaken in accordance with the guidance in Section 6.3 (Reliability – Urban Roads) of WebTAG A1-3 '*User and Provider Impacts'* (March 2017). The output is included in the adjusted BCR. **Accidents:** Accidents can have an adverse impact on the effectiveness of the transport network through partial or full road closures. The assessment of accident savings was undertaken using the DfT's Cost Benefit Light-Touch (COBALT) software version 2013.2 and standard parameter file. The study area was defined to be the whole of the traffic model simulation area given the wide area of impact of the scheme. Due to the size of the study area the COBALT combined links and junctions approach was used with COBALT default accident rates. The output is included in the initial BCR.
Support the delivery of housing	**User benefits:** The delivery of the SUEs is supported by improved performance of the network in those locales in order to facilitate additional demand. **Induced Investment:** The delivery of SWQ will be assessed through a dependent development test in accordance with the guidance in WebTAG Unit A2-2 *'Induced Investment'* (May 2018).
Support sustainable economic growth	Reduction of traffic levels on the existing orbital network is observed in flow difference plots presented in the TFR (Appendix B). The assessment of reduced levels of congestion for specific key routes and movements that support sustainable economic growth in the area follows from the TUBA analysis through considering the sectored benefits. Wider economic impacts have been assessed qualitatively. Sustainability, in respect of environmental impacts, has been assessed qualitatively. Resilience of the network is assessed qualitatively in addition to reliability.

3.3 TUBA

The Transport Economic Efficiency (TEE) benefits are derived from the forecast impacts of the scheme on travel time and vehicle operating costs based on model outputs. The (dis)benefits related to construction will be assessed and included in the Full Business Case. The scheme is primarily offline and disbenefits incurred for online work during the off peak period is outside the annualised periods. The total cost impact is therefore expected to be small.

TEE benefits were assessed using the DfT's Transport User Benefit (TUBA) software. TUBA version 1.9.11 was used with the standard economics file. The appraisal period in 60 years from opening year.

Monetised benefits for the three modelled periods are converted to annual totals using a series of annualisation factors which are listed in Table 4. Local traffic count data was used to determine the time periods to be annualised, the appropriate donor traffic model and the outturn annualization factor. The detailed calculations are included as an appendix to the EAR (Appendix C).

Table 4 – Assessment of Impacts

Time Period	Donor Traffic Modelled Period	Annualisation Factor
Weekday AM Peak 07:00 - 09:00	AM Peak Hour Model	500
Weekday AM Peak 09:00 - 10:00	Inter Peak Average Hour Model	250
Weekday Inter Peak 10:00 - 16:00	Inter Peak Average Hour Model	1518
Weekday PM Peak 16:00 - 18:00	PM Peak Hour Model	507
Weekday PM Peak 18:00 - 19:00	Inter Peak Average Hour Model	244
Weekends	Inter Peak Average Hour Model	675

Analysis of the benefits has been carried out to understand and give confidence in the results using the following segmentation of benefits:

- By year, over the 60-year appraisal period;
- Trip purpose;
- Vehicle type;
- Time period (AM/ IP/ PM periods); and
- By sector of origin and destination.

3.4 ACCIDENTS

Accident benefits are derived from the forecast impacts of the scheme on the number and severity of accidents based on junction and link characteristics, accident rates and forecast traffic volumes.

The assessment of accident benefits was undertaken using the DfT's Cost Benefit Light-Touch (COBALT) software with the study area defined to the whole of the traffic model simulation area given the wide area of impact of the scheme.

The 'combined links and junctions' mode was used with COBALT default accident rates. This is considered proportionate for assessing accidents across such a large study area.

3.5 RELIABILITY

Reliability benefits are calculated using the standard deviation for journey times between traffic model zones.

The assessment has been undertaken using the formulation for reliability on urban roads presented in Section 6.3 of WebTAG Unit A1-3. There are different methods for assessing reliability based on the scheme type and location and this was considered the most appropriate. The scheme is considered to form the southern boundary of the Lincoln urban area and it has large impacts for route choice and consequently travel time reliability for all users in the urban area network.

3.6 ENVIRONMENT

The environmental appraisal presents the findings of the assessment of the scheme against eight sub-objectives:

- Noise;
- Air Quality;
- Greenhouse Gases;
- Landscape;
- Townscape;
- Biodiversity;
- Historic Environment; and
- Water Environment.

The methodology adopted for each technical appraisal is informed by the guidance provided in the relevant chapter of WebTAG Unit A3. Where a monetary assessment is not feasible the impacts are then assessed using the recommended 7-point scale.

To inform the environmental appraisals, desk-based data gathering was undertaken for each of the technical disciplines. This data search involved reviewing previous studies / reports and publicly available datasets from sources such as online mapping, local authority websites and GIS digital downloads. This data gathering exercise was supplemented by site visits, where appropriate.

3.7 NON-MONETISED IMPACTS

The following impacts were assessed using qualitative methods.

- Wider Impacts;
- Physical activity;
- Journey quality;
- Security;
- Affordability; and
- Severance.

This process involved analysing results of traffic modelling and understanding how changes resulting from the scheme affect social and economic impacts.

Wider impacts analysis includes:

- Assessment of employment effects which is supported by analysis presented in the 'North Hykeham Relief Road – Strategic and Wider Economic Benefits Report' (Regeneris, November 2018) which forms an Appendix to the Strategic Case (Appendix C); and
- Tier 3 analysis which included an assessment of the impact from induced investment through dependent development (South West Quadrant).

Access to services (referring to public transport accessibility) and option values were not assessed since the scheme does not directly impact on accessibility or availability of transport services. In addition the scheme is not within a regeneration area and so regeneration has not been assessed.

3.8 DISTRIBUTIONAL IMPACTS

The following impacts were assessed in the distributional impact appraisal.

- User benefits;
- Noise;
- Air quality;
- Accidents;
- Severance;
- Security;
- Accessibility; and
- Affordability.

The process was undertaken in three stages.

- **Step 1: Screening process.** The likely impacts for each indicator are identified. Those which will have no or little impact are scoped out.
- **Step 2: Assessment.** Social groups and amenities in the area are identified.
- **Step 3: Appraisal.** Core analysis of the impacts is completed and reported.

Access to services (referring to public transport accessibility) and option values were scoped out in the screening process since the scheme does not directly impact on accessibility or availability of transport services.

3.9 REPORTING

Established monetised benefits and scheme costs are reported in the Transport Economic Efficiency (TEE) table, Public Accounts (PA) table and the Analysis of Monetised Costs and Benefits (AMCB) table. The AMCB table is used to present the net present value (NPV) and initial BCR.

An Appraisal Summary Table (AST) is presented in Chapter 7 which applies the principles of the Treasury's Green Book to record the impacts and inform the economic case for intervention.

The Value for Money Statement is included in Chapter 8.

4 COSTS

4.1 APPROACH TO COST ESTIMATION

Estimation of the scheme costs is a crucial part of the scheme appraisal process and directly determines the NPV and BCR reported in the value for money analysis.

There are three key components to a scheme cost estimate which need to be assessed and reported. They are:

- Base cost estimate, which includes:
  - Investment costs:
  - Maintenance and
  - Operation costs;
- Adjustment for risk; and
- Adjustment for optimism bias.

This is line with the guidance in WebTAG Unit A1-2 '*Scheme Costs'* (July 2017).

The Financial Case provides a detailed description of the development of the outturn cost estimate including risk allowance and inflation. In summary:

- The costing is based on the outline designs for the scheme including an assessment of the forecast construction, contractor risk, land and design and preparation costs.
- Inflation of 4.1% pa has been applied to the construction costs estimate.
- Inflation for other elements has been applied using the GDP (Gross Domestic Product) deflator.
- The risk allowance has been derived from a Quantified Risk Assessment calculated using the @Risk software programme using the 80% percentile.

The values are summarised in Table 5.

Table 5 – Scheme Cost Estimate

Cost Element	Total
Base cost at 2017 Q4 prices	£91,040,330
Risk allowance	£31,878,000
Inflation	£25,159,232
Total Outturn Cost	**£148,077,562**

2017 Q4 prices

4.2 OPTIMISM BIAS

Optimism bias represents the demonstrated systematic tendency for appraisers to be overly optimistic about key parameters; specifically estimating scheme costs and delivery times to be too low and too short respectively. An uplift factor is therefore applied to account for optimism bias.

WebTAG recommends a range of factors based on the nature of the scheme and the stage of development. The values are summarised in Table 6.

Since the scheme is at Outline Business Case stage a **15% optimism bias** is appropriate and has been applied to the scheme costs for the purposes of the economic appraisal.

Table 6 – Recommended Optimism Bias Uplifts for Road Schemes

Category	Stage	Uplift
Stage 1	Strategic Outline Business Case	44%
Stage 2	Outline Business Case	15%
Stage 3	Full Business Case	3%

Source: WebTAG Unit A1-2

4.3 PRESENT VALUE OF COSTS

For economic appraisal, present value costs are presented requiring three further calculations.

- Rebasing to the DfT's base year (currently 2010);
- Discounting to the DfT's base year; and
- Converting to market prices.

This is in line with guidance in WebTAG Unit A1-1 'Cost Benefit Analysis' (May 2018).

4.3.1 RE-BASING

WebTAG explains that when applying monetary values to impacts over a long appraisal period it is very important to take the effects of inflation in to account. Failure to do so would distort the results by placing too much weight on future impacts where values would be higher simply because of inflation.

For cost benefit analysis purposes, all values should be in real prices (including inflation) to stop the effects of inflation distorting the results. To convert nominal prices (not including inflation) to real prices, a price base year and an inflation index are needed. The real price in any given year is then the nominal price deflated by the change in the inflation index between that year and the base year (2010).

The GDP deflator has been used, as recommended by the DfT, which is a much broader price index than consumer prices (e.g. Consumer Price Index, Retail Price Index) as it reflects the prices of all domestically produced goods and services in the economy.

4.3.2 DISCOUNTING

Discounting is the process of adjusting monetary values to account for 'social time preference'; that is people's preference to consume goods and services now rather than in the future.

The discount rates listed in Table 7 are applied to convert future costs (and benefits) to their present value (the equivalent value of a cost (or benefit) in the future occurring today).

Table 7 – Discount Rates

Years from Current Year	Discount Rate
0 – 30	3.5%
31 – 75	3.0%

Source: WebTAG Databook

4.3.3 MARKET PRICES

The final stage in preparing the package cost for appraisal is to convert the cost from the 'factor cost' to the 'market price' unit of account using the indirect tax correction factor of 1.19 which reflects the average rate of indirect taxation in the economy.

4.3.4 PVC ESTIMATE

The PVC estimate for the scheme is **£145.8m**.

The investment and operating costs are summarised in Table 8 in 2010 market prices and values.

Table 8 – Scheme Cost Estimate

Cost Category	2010 Market Prices and Values
Investment Cost	£117,732,078
Operating Cost	£28,050,729
Total Cost	**£145,782,807**

4.4 CONTRIBUTIONS

The total PVC estimate of £145.783m is for the whole cost of the scheme.

For cost-benefit analysis and value for money appraisal the costs of a scheme should only include the cost to the Broad Transport Budget. This refers to costs (and revenues) which directly affect the public budget available for transport.

Costs incurred by the private sector need to be specified separately and are not included in the PVC estimate used for cost-benefit analysis.

From the Financial Case, the likely level of private developer funding is expected to be a minimum of £10m.

This amounts to a private sector contribution of **£7.947m** in 2010 prices and values.

Deducting the private contribution gives an outturn cost to the Broad Transport Budget of **£137.836m** in 2010 prices and values.

This will be split between local and central government funding sources. From the Financial Case, Lincolnshire County Council have identified a maximum contribution of £34m towards the scheme with the remainder to be secured from Central Government funding opportunities. Table 9 presents the PVC contribution split in 2010 prices and values.

Table 9 – PVC Split by Contributor

Contributor	Contribution (2010 prices and values)
Central Government	£82.412m
Local Government	£55.424m
Developer Contributions	£7.947m
Total	**£145.783m**

4.5 PUBLIC ACCOUNTS TABLE

The Public Accounts (PA) table summarises the overall cost to the Broad Transport Budget and Wider Public Finances. In this table costs appear as positive numbers whilst revenues and private contributions appear as negative numbers.

The overall cost to the Broad Transport Budget is **£137.836m** in 2010 prices and values as stated previously through deducting the developer contribution from the overall scheme cost estimate.

There is a revenue gain to Wider Public Finances of **£16.808m** in 2010 prices and values. This is due to an increase in fuel consumption with the scheme arising from the net impact of longer travel distances and faster travel speeds.

Table 10 – Public Accounts (PA) Table

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue	0		0			0
Operating Costs	28,051		28,051			0
Investment Costs	35,320		35,320			0
Developer and Other Contributions	-7,947		-7,947	0	0	0
Grant/Subsidy Payments	0		0	0	0	0
NET IMPACT	55,424	(7)	55,424	0	0	0
Central Government Funding: Transport						
Revenue	0		0			0
Operating costs	0		0			0
Investment Costs	82,412		82,412			0
Developer and Other Contributions	0		0	0	0	0
Grant/Subsidy Payments	0		0	0	0	0
NET IMPACT	82,412	(8)	82,412	0	0	0
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-16,808	(9)	-16,808	0	0	0
TOTALS						
Broad Transport Budget	137,836	(10) = (7) + (8)				
Wider Public Finances	-16,808	(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.

5 BENEFITS

5.1 TRANSPORT ECONOMIC EFFICIENCY

TEE benefits provide the largest component of the overall PVB.

The TEE benefit is broken down into three impacts:

- Travel time;
- Vehicle operating costs; and
- User costs.

The overall percentage of the total TEE benefits by period is summarised in Table 11. The inter peak provides the largest proportion in both years which is primarily because it is a longer period (6 hours) compared to the AM and PM (3 hours each). The benefits per hour are higher in the AM and PM since the level of congestion in the peak hours results in a greater impact on travel time savings.

From 2026 to 2041, the total inter peak benefit increases by 5% due to the higher level of demand and available network capacity. Conversely, there is a decrease in the AM and PM since the level of congestion has reached a point which constrains the benefit.

The proportion of the benefits for cars is 92% and 93% in 2026 and 2041 respectively. This is due to a combination of the large proportion of cars in relation to the total number vehicles on the network and that car users are more directly affected by the scheme. HGV trips are predominantly on the major routes and a key movement is to bypass Lincoln on the A46 / A15 corridor between the A1 and Humber Ports. There is some re-routeing from the A46 to the scheme, however in the peak hours that displacement is offset on some sections by re-routeing of local traffic to the A46. This provides benefits to the local network but limits the impact on some sections of the A46 at peak times.

Table 11 – Summary of TUBA TEE by Year and Period

Metric	AM Total	IP Total	PM Total	Weekend Total
% of TEE in 2026	24%	36%	21%	18%
% of TEE in 2041	23%	38%	21%	19%
% Change in TEE 2026 to 2041	-4%	5%	-3%	6%

At sector level, the largest benefits occur for trips to and from North Hykeham. There are also large benefits for trips to and from adjacent sectors and for trips making east-west movements which benefit most from the alignment of the scheme. Benefits are relatively evenly split between origins and destinations which reflects the fact that the scheme benefits trips travelling in both east and west directions and benefits are proportionate across time periods.

There is an overall disbenefit for vehicle operating costs. The reduction in travel time is a result of higher travel speeds but over longer average travel distances for the majority of users.

The private sector provider impacts account for revenue increases for the toll roads in the transport model buffer area and are reflected as a disbenefit in the user charges; specifically the Humber

Bridge, the Dunham Bridge and the M6 Toll. (The difference in the totals is accounted for by the impact of tax on business users).

Third party (developer) contributions were recorded as a negative under other business impacts in line with WebTAG guidance. This was previously stated to be £7.947m (2010 prices and values) in Section 4.4.

The Present Value of TEE Benefits is **£303.185m** in 2010 prices and values which is broken down in Table 12.

Table 12 – Transport Economic Efficiency (TEE) Table

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers	
Travel time	55,760		55,760				
Vehicle operating costs	-6,712		-6,712				
User charges	-70		-70				
During Construction & Maintenance	0		0				
COMMUTING	48,978	*(1a)*	48,978		0	0	0
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers	
Travel time	123,870		123,870				
Vehicle operating costs	-16,364		-16,364				
User charges	-332		-332				
During Construction & Maintenance	0		0				
NET NON-BUSINESS BENEFITS: OTHER	107,174	*(1b)*	107,174		0	0	0
Business							
User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	152,104		63,400	88,704			
Vehicle operating costs	2,405		297	2,108			
User charges	-360		-103	-257			
During Construction & Maintenance	0		0	0			
Subtotal	154,149	*(2)*	63,594	90,555	0	0	0
Private sector provider impacts						Freight	Passengers
Revenue	831				831		
Operating costs	0						
Investment costs	0						
Grant/subsidy	0						
Subtotal	831	*(3)*			831	0	0
Other business impacts							
Developer contributions	-7,947	*(4)*	-7,947				
NET BUSINESS IMPACT	147,033	*(5) = (2) + (3) + (4)*					
TOTAL							
Present Value of Transport Economic Efficiency Benefits (TEE)	303,185	*(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

5.2 ACCIDENTS

The outputs from COBALT are expressed as the change in the number of accidents and casualties when a scheme is introduced and the economic cost implications of these changes.

The scheme has a safety benefit of **£16.699m** (2010 prices and values) over the 60 year assessment period.

This is based on a reduction of 427 accidents with the scheme as presented in Table 13. The scheme provides a new route choice that is dual carriageway standard and has a lower accident rate than many of the roads it draws traffic from. This impact is particularly prevalent on the rural roads south of the Lincoln urban area. The east-west route through the villages of Harmston and Aubourn has a large accident benefit with the scheme.

Table 13 – COBALT Accident Benefits

Metric	Do Minimum	Do Something	Saving
Number of Accidents	16,166	15,739	427
Cost of Accidents	754,432	737,733	16,669

5.3 GREENHOUSE GASES

Greenhouse gas emissions are dependent on traffic composition, speed and volume which are outputs produced from the traffic model.

The monetised impact of changes in greenhouse gas emissions is calculated directly by TUBA.

Both traded and non-traded road-based emissions associated with the Do Something scenario are estimated to be higher over the appraisal period relative to the Do Minimum case.

The change in CO_2e emissions (+181,041 tCO_2e) equates to a dis-benefit of **-£7.849m** over the 60 year assessment period. This is due to the net impact of increased travel distance and higher travel speeds which were highlighted in the TEE analysis.

Table 14 – TUBA Greenhouse Gas Emissions

Emissions Class	Appraisal Period GHG Emissions (tCO_2e)		Change (tCO_2e)	Net Present Value (NPV £)
	Do Minimum	Do Something		
Non – Traded	185,939,993	186,118,072	178,079	-£7.849m
Traded	1,837,212	1,840,174	2,962	

5.4 AIR QUALITY

Table 15 provides a breakdown of the number of sensitive receptor locations that are situated within 200m of the affected road centrelines for the Do-Minimum and Do-Something scenarios.

Table 15 - Sensitive Receptors within 200m of the Affected Road Centreline

Distance	0-50m	50-100m	100-150m	150-200m	Total
Do-Minimum Receptors	6,276	4,726	4,361	4,045	19,408
Do-Something Receptors	6,273	4,722	4,366	4,047	19,408

The air quality sensitive receptors within 200m of the road centreline of the Proposed Scheme include residential properties, the closest of which are on Station Road in Waddington. Seven of these properties are estimated to be demolished as part of the Proposed Scheme.

Initial benefits are predicted in the overall property weighted concentrations of NO_2, however these will decrease over the life of the Proposed Scheme, with a deterioration in property weighted concentrations predicted by the operating year of 2041. Overall property weighted concentrations of PM_{10} are predicted to deteriorate as a result of the Proposed Scheme in both years. However, in all cases, more properties are predicted to experience improvements in concentrations than a deterioration. This suggests that where there are deteriorations these are greater in magnitude than the improvements experienced by the majority of receptors, see Table 16.

The air quality valuation is for a dis-benefit due to the Proposed Scheme as a result of overall increases in the mass emissions of both NO_x and PM_{10} over the valuation period. Any proposed air quality mitigation measures should be planned taking account of these figures, see Table 16.

Initial reductions in the predicted concentrations of NO2 are not expected to have a negative impact on the ability of the East Midlands zone to become compliant with EU Directive 2008/50/EC within the required period.

Conversely, a new dual carriageway is to be in operation, coupled with new roundabout configurations at strategic points and may attract road vehicles to utilise the Proposed Scheme. With a possible increase and intensification of traffic volume and composition (such as increased use by HGVs) that bypasses the city of Lincoln, on a regional level, total mass emissions of NO_x are predicted to increase as a result of the Proposed Scheme, see Table 16.

Table 16 - Summary of Air Quality Results

Scenario	Properties			Score	Emissions (tonnes)
	Improvement	No Change	Deterioration		
NO_2 2026	16345	86	2977	-454.87	
PM_{10} 2026	15430	0	3978	3130.11	
NO_2 2041	12979	39	6390	1221.83	
PM_{10} 2041	13044	0	6164	3550.42	
NOX 2026					+14.09
NOX 2041					+12.08

5.5 NOISE

The Proposed Scheme will introduce new traffic flows along its length and will change the physical alignment of existing traffic links at their junction with the Proposed Scheme. The Proposed Scheme therefore will alter the physical location of vehicles as well as have the potential to alter vehicle flow characteristics, such as flow volumes, composition, and speeds on the existing road network, with associated effects on noise likely to be experienced at nearby sensitive receptors.

The noise appraisal has been undertaken following the methodology presented in WebTAG Unit A3, Environmental Impact Appraisal, dated December 2015. A computer noise model has been generated following the guidance contained within CRTN and the DMRB.

Mitigation will be considered at a later stage, where consideration will be given to both residential and other sensitive receptors within proximity to the scheme.

5.5.1 The results of the noise appraisal are summarised as follows. These have been generated adopting least beneficial noise changes calculated at each residential receptor and thus represent a worst case:

- In the Opening Year (2026), a total of 970 properties would be subject to an increase in daytime noise levels and 712 properties would experience a reduction.
- In the Design Year (2041), a total of 748 properties would be subject to an increase in daytime noise levels and 3158 properties would experience a reduction.
- The overall appraisal indicates that the operation of the scheme is likely to generate a beneficial noise impact and that the 'net present value of change in noise' is calculated to be £5,212,053.
- The impact pathways described earlier in the report have been assessed, and the scheme is likely to generate a beneficial effect for all pathways. The following net present values have been calculated:
    - Sleep disturbance: £2,129,572
    - Amenity: £2,172,988
    - AMI: £427,416
    - Stroke: £192,055
    - Dementia: £290,022

5.5.2 The following should also be taken into consideration:

- In the Opening Year if the Proposed Scheme does not go ahead, then 822 properties would be subject to a daytime noise level $L_{Aeq,16h}$ of 66 dB or higher (equivalent to $L_{A10,18h}$ 68 dB or higher). Conversely, if the Proposed Scheme goes ahead, then the number of properties subject to 66 dB(A) or above would reduce slightly to 796.
- In the Design Year, if the Proposed Scheme does not go ahead, then 710 properties would be subject to a daytime noise level $L_{Aeq,16h}$ of 66 dB or higher (equivalent to $L_{A10,18h}$ 68 dB or higher). Conversely, if the Proposed Scheme goes ahead, then the number of properties subject to 66 dB(A) or above would decrease slightly to 603.

5.6 INITIAL BENEFIT-COST RATIO

The Benefit-Cost Ratio (BCR) is defined by dividing the Present Value of Benefits (PVB) by the Present Value of Costs (PVC).

The calculation of the PVB used to derive the initial BCR includes the monetised benefits of transport economic efficiency, safety, greenhouse gases and indirect taxation.

The initial BCR of the scheme is **2.4.**

The Analysis of Monetised Cost and Benefits (AMCB) table details the calculation.

Table 17 – Analysis of Monetised Costs and Benefits (AMCB)

Noise	5,212	*(12)*
Local Air Quality	-9,152	*(13)*
Greenhouse Gases	-7,850	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	16,699	*(17)*
Economic Efficiency: Consumer Users (Commuting)	48,978	*(1a)*
Economic Efficiency: Consumer Users (Other)	107,174	*(1b)*
Economic Efficiency: Business Users and Providers	147,033	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	16,808	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	**324,902**	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	137,836	*(10)*
Present Value of Costs (see notes) (PVC)	**137,836**	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	**187,066**	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	**2.4**	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.

5.7 RELIABILITY

The scheme has a reliability benefit of **£29.099m** (2010 prices and values) over the 60year assessment period. By completing the route around Lincoln to the south and east, the scheme should provide greater day-to-day reliability in journey time.

The monetised assessment does not include the impact of resilience which does not have an established method for deriving a monetary value. However, as set out in the Strategic Case, the scheme completes the ring road around the Lincoln urban area providing a new strategic route. The provision of an additional strategic route will help to provide resilience to the orbital and key route

network through and around Lincoln through providing an alternative route for traffic in the event of a major incident. This will help reduce the impact of major incidents, particularly on the A46.

5.8 ADJUSTED BENEFIT-COST RATIO

The calculation of the PVB used to derive the adjusted BCR includes adding the monetised impact of reliability benefits onto the initial PVB

The adjusted PVB of the scheme is **£354.001m**.

The adjusted BCR of the scheme is **2.6.**

5.9 NON-MONETISED IMPACTS

5.9.1 ENVIRONMENTAL IMPACTS

The monetised environmental impacts, greenhouse gas emissions, noise and air quality are shown in Sections 5.3 to 5.5.

The impacts are discussed in more detail in the EnAR (Appendix D).

5.9.1.1 Landscape

The scheme is at odds with the pattern of similar features within the landscape, creating an arc as opposed to a straight linear feature. It is not considered that the scheme will be integrated within the landscape, due to the western end of the road corridor being raised on embankment, through an otherwise predominantly flat landscape. In addition to this, the inclusion of structures in the form of bridges, will further detract from the landscape setting. The scheme will permanently alter the pattern of the landscape, in addition to creating a permanent change to the nature of the land use along the road corridor itself. The scheme will permanently sever linear features within the landscape of cultural significance resulting in a change to their current alignment. The scheme will also sever a number of policy lead designations as identified upon the adopted Central Lincoln Local Plan, including an 'Area of Great Landscape Value' and a 'Green Wedge.

At this stage, an overall assessment of **large adverse** has been given, as the scheme will clearly have an impact on the Landscape. To reduce impacts during both construction and operation, mitigation planting should be prepared as part of the scheme design, however this may not mitigate fully the visually intrusive nature of the scheme, from areas of higher ground, where long distance views are perceivable. A Landscaping Strategy has been produced to further align landscape into the emerging design of the scheme.

5.9.1.2 Historic Environment

There are 17 Listed Buildings within 1km Study Area, the nearest listed building is 90m from the Proposed Scheme, this is Grade II Gates and Walls to the Manor House (NHLE 1360604). There are numerous non-designated heritage assets within the 500m study area of which four (HER 62576, HER 65789, HER 61267 and HER 61259) are located within the scheme.

5.9.2 There is potential for below-ground archaeological remains to be damaged or destroyed as a result of the Proposed Scheme. The Proposed Scheme is over an area of arable land, therefore there is potential for the known and unknown below-ground heritage remains to be impacted during the construction of the Proposed Scheme.

5.9.3 There is also potential for impacts on the setting of built heritage assets within the area. As there is no infrastructure within the current landscape the construction of a new road is likely to cause changes to the visual landscape, levels of noise and introduce movement in the area.

5.9.4 Should the Proposed Scheme move forward to the FBC a DBA will be undertaken to assess the impacts on the Historic Environment and present mitigation methods to reduce the effect upon the finite resources.

5.9.5 The Proposed Scheme alignment would have minor adverse impacts upon designated heritage assets due to the impact being indirect, on setting, and moderate to major adverse impacts on below ground non-designated heritage assets due to the impact being direct and there being a high potential for survival. The overall assessment score is **moderate adverse.**

5.9.5.1 Biodiversity

A Preliminary Ecological Appraisal (PEA), supplemented by a desk study, has been undertaken to inform the appraisal of the scheme.

The scheme alignment passes through habitat that could support national and European species, then these species could be affected (including the presence of any built structures on site). The potential impacts include:

- Potential to impact bat roosts due to removal of potential roost sites, damage or removal to habitats currently contributing to foraging and commuting, and disturbance from lighting.
- Potential to impact Great Crested Newt using terrestrial habitat.
- Potential to impact otters due to the removal or damage to resting places or through road casualties.
- Potential to impact badgers due to the removal of setts.
- Potential to impact water voles due to the removal or damage to burrows and through casualties where field drains are intersected.
- Potential to impact birds due to removal of suitable nesting, over wintering and foraging habitat.
- Potential to impact reptiles due to removal of suitable habitat.
- Potential to impact plants by spread of Schedule 9 species and removal of species-rich hedgerow.

To enable compliance with relevant legislation and planning policy, as described above, general environmental protection measures, such as Construction Industry Research and Information Association guidance (CIRIA, 2015), must be implemented during the construction phase and appropriate mitigation measures should be designed in to the Proposed Scheme.

The Proposed Scheme alignment passes through habitat that could support national and European species, then these species could be affected (including the presence of any built structures on site) therefore a **moderate adverse** impact is anticipated.

5.9.5.2 Water Environment

The potential impacts on the water environment cover effects on surface hydrology and quality; groundwater quality and hydrogeology; and fluvial geomorphology. A desk study of the hydrological and hydrogeological features associated with the proposed alignments has been undertaken and a site walk-over was carried out to supplement the desk study.

The scheme crosses the River Witham immediately downstream of the Lincoln Washlands FAS. The River Brant flows in a northerly direction towards the scheme and confluences with the River Witham approximately 300m upstream of the scheme. The Beck flows in an easterly direction to the north of the scheme, discharging to the River Witham approximately 600m downstream of the scheme. In addition, several drains are located within the study area under the jurisdiction of the Upper Witham IDB.

The scheme is located within the Anglian River Basin District, within the Witham operational catchment. There are several protected areas in the catchment including drinking water protected areas, urban waste water directive sensitive sites and nutrient sensitive zones.

The most significant flood risk within the study area is associated with fluvial flooding from the River Witham. This affects approximately 1.3km of the scheme between South Hykeham and Brant Road. The Flood Map for Planning indicates that the scheme passes through Flood Zone 3 that is defined as land having a 1 in 100 or greater annual probability of river flooding, although highlights that this area benefits from flood defences. The flood defences that serve this area include the Lincoln Washlands FAS that comprises two off-line flood storage areas upstream of Lincoln: one on the River Witham immediately to the south of the scheme and the other on the River Till near Saxilby approximately 12km to the north-west of the scheme.

The study area is underlain by a Principal aquifer, Secondary B aquifers, Secondary A aquifers, and Major and Minor Aquifers High Groundwater Vulnerability Zones. The Witham Lias U groundwater body, located to the west of the River Witham, and the Witham Limestone Unit A, located to the east of the River Witham, quality of groundwater bodies within the study area. In addition, there are designated Groundwater Source Protection Zones within the east of the study area classified as Zone II.

The scheme has the potential for the following impacts upon the water environment during construction and operation:

- Potential for road runoff to impact surface and groundwater quality.
- Potential to impact the hydromorphological and ecological quality of the watercourses and drains.
- Potential to impact the flood conveyance routes and floodplain storage due to the embankments of the scheme.
- Potential to impact catchment hydrogeology and groundwater flow due subsurface structures associated with the embankment.

An overall assessment of **moderate adverse** has been given at this stage.

5.9.6 SOCIAL IMPACTS

The assessment of social impacts is detailed in the SDIR (Appendix F). Table 18 summarises the qualitative assessment score and summary of the impact.

Table 18 – Summary of Social Impacts

Impact	Qualitative score	Summary
Physical activity	Slight beneficial	The scheme provides new walking, cycling and equestrian infrastructure separated from vehicular traffic which will encourage physical activity. Decreases in traffic flow on local roads in the Lincoln urban area reduce a perceived barrier to walking and cycling.

Impact	Qualitative score	Summary
Journey quality	Slight beneficial	The scheme provides alternative route choice which reduces route uncertainty; in particular if there is an incident on the existing orbital route. The scheme also reduces congestion across the Lincoln urban area which reduces driver frustration.
Security	Slight beneficial	The scheme has opening year AADT up to 27,000 in the busiest section at the western end which provides informal surveillance for pedestrians. Pedestrian facilities will be designed to the latest DMRB guidance. There are no service stations of car parks within the immediate vicinity of the scheme for HGV (or other user) stops.
Affordability	Moderate adverse	The scheme increases travel distance which leads to a net increase in vehicle operating costs across all users. There is a very small increase in user charges incurred from a net increase in flow on toll routes (Humber Bridge, Dunham Bridge).
Severance	Large beneficial	The scheme reduces the overall level of traffic across the network in the residential areas of North Hykeham and Waddington. This improves accessibility to local community facilities and services for motorised users through reduced delay in the area and for non-motorised users through reducing the level of congestion as a perceived barrier to travel.

5.9.7 WIDER ECONOMIC IMPACTS

The scheme provides an overall improvement to the performance and reliability of the local transport network which improves the efficiency of businesses and will promote sustainable economic growth. In particular, this increases businesses' effective catchment areas which has positive benefits for labour supply and move to more productive jobs. This falls within Level 2 analysis of wider impacts.

The TEE analysis (see Section 5.1) also presented benefits for east-west movements which includes trips going to or from the Lincolnshire East Coast areas. These trips will have an alternative route to bypass Lincoln.

The 'Strategic and Wider Economic Benefits Report' (Regeneris, November 2018) is an Appendix to the Strategic Case. This shows that the scheme is a vital part of Lincolnshire's plans to support the growth of its priority economic sectors, improve the efficiency of the strategic transport network within the central Lincolnshire area – and in turn the links to the major national and international gateways and support the creation of new housing.

A primary objective of the scheme is to support housing growth. South West Quadrant (SWQ) is a sustainable urban extension located in the south west of the Lincoln urban area, adjacent to Pennell's Roundabout and at the western extent of the scheme. A dependent development assessment was undertaken as Level 3 wider impact analysis which is detailed in the EIR (Appendix E).

The whole of the SWQ development was determined to be dependent on the scheme. The baseline scenario established an unacceptable level of service at Pennell's Roundabout and rat-running on local roads adjacent to the site location as the result of congestion. Pennell's Roundabout was a key issue as this junction provides the primary access from the site to the A46 and from there other strategically important routes. There is poor access across the River Whitham towards the A15 and LEB in the east. The scheme resolves these key issues by providing additional an entry and wider capacity at Pennell's Roundabout and a direct link to the A15 / LEB.

An assessment of the benefits from unlocking dependent development estimated the monetised value at **£18.785m**.

Overall, wider economics have been qualitatively assessed to be **moderate beneficial** impact.

5.10 DISTRIBUTIONAL IMPACTS

The assessment of distributional impacts is detailed in the SDIR (Appendix F). Table 19 summarises the appraisal outcomes. The impact area was defined to be the traffic model simulation area, consistent with COBALT analysis.

Table 19 – Summary of Distributional Impact Appraisal

Impact	Distributional scale	Summary
User impacts	Moderate beneficial	Around 85% of the benefits are experienced by people living in the impact area, of which: ▪ 20% are experienced by people in the 40% most deprived communities; and ▪ 57% are experienced by people in the 40-80% income deprived group.
Noise	Slight beneficial	There are positive impacts for all income quintiles including large beneficial for the lowest quintile. There are neutral to slight beneficial impacts for education facilities (except for one receptor major adverse) and elderly facilities.
Air Quality	Moderate beneficial	Most of the benefits are concentrated in the lower two income deprivation quintiles, however negative impacts in the third quintile may have a negative impact on the positive impacts in the lower two quintiles. Positive impacts in the upper two quintiles, though they are smaller overall, may offset this.
Accidents	Moderate beneficial	There is a positive impact for all vulnerable groups assessed through a reduction in casualties – children (<16), young adults (16-25), older people (65+) and pedestrians.
Affordability	Moderate adverse	There is a disbenefit across all income groups. ▪ The highest disbenefit is in the least deprived income group (80-100%). ▪ The lowest disbenefit is in the 40-60% deprived income group. ▪ There is a moderate adverse impact in the 40% most deprived income groups.
Severence	Large beneficial	The WebTAG worksheet was completed and determined a large beneficial impact for all vulnerable groups assessed – children (<16), older people (65+), no car households and residents with long term health problems or disabilities.

6 ALTERNATIVE SCENARIOS

6.1 OVERVIEW

Alternative scenarios are modelled to understand the extent that the appraisal conclusions vary, including cost-benefit analysis and value for money, through changing specific parameters or assumptions.

Assessments for noise and air quality have only been undertaken for the Core scenario. As a result, in order to enable a direct comparison between the options, this section does not reference those impacts and the outputs.

6.2 ALTERNATIVE GROWTH SCENARIO SENSITIVITY TEST

As stated in Section 3.3, two of the sensitivity tests undertaken are based on varying the level of forecast growth in travel demand, specifically low and high growth.

The cost-benefit analysis is summarised in Table 20.

- The low growth scenario has a BCR of 1.7.
- The high growth scenario has a BCR of 2.1.

The scheme remains economically viable under low growth assumptions.

The total TUBA benefits, and user time benefits as a sub-component, in the High Growth are higher in the opening year but lower in the design year than the Core. This is due to the level of congestion by the design year and leads to a lower overall PVB in the High Growth through the appraisal period.

Table 20 – Cost-Benefit Analysis for Alternative Growth Scenarios

Impact	Low Growth	Core	High Growth
Greenhouse Gases	-15,735	-7,850	-12,682
Accidents	7,744	16,699	11,191
Economic Efficiency – Commuting	30,678	48,978	42,979
Economic Efficiency – Other	75,047	107,174	98,552
Economic Efficiency – Business	103,790	147,033	123,337
Indirect Tax Revenues	33,602	16,808	28,165
Present Value of Benefits	**235,126**	**328,842**	**291,542**
Present Value of Costs	**137,836**	**137,836**	**137,836**
Benefit-Cost Ratio	**1.7**	**2.4**	**2.1**

6.3 ALTERNATIVE SCHEME CONFIGURATIONS

Two of the sensitivity tests undertaken are based on alternative scheme configurations which were defined in Section 3.3.

The cost-benefit analysis is summarised in Table 21.

The BCRs are broadly similar between all three scheme configurations. The Next Best has a slightly higher BCR than the Core due to the Core having the highest costs. However, the Core has the highest NPV and total benefits. The Core also provides greater resilience as a dual carriageway which cannot be monetised, among other factors set out in the Strategic Case which are not monetised in this analysis.

Table 21 – Cost-Benefit Analysis for Alternative Scheme Configurations

Impact	Core	Next Best	Low Cost
Greenhouse Gases	-7,850	-4,163	-1,650
Accidents	16,699	-5,125	-4,329
Economic Efficiency – Commuting	48,978	41,891	34,920
Economic Efficiency – Other	107,174	93,121	76,059
Economic Efficiency – Business	147,033	119,812	83,686
Indirect Tax Revenues	16,808	9,122	3,939
Present Value of Benefits	**328,842**	**254,658**	**192,624**
Present Value of Costs	**137,836**	**101,885**	**86,385**
Net Present Value	**191,006**	**152,773**	**106,239**
Benefit-Cost Ratio	**2.4**	**2.5**	**2.2**

7 APPRAISAL SUMMARY TABLE

The Appraisal Summary Table (AST) presents all of the evidence from the economic appraisal in a single table. It records all of the impacts which have been assessed using monetised, quantitative or qualitative information as appropriate split into four categories:

- Economy;
- Environmental;
- Social; and
- Public Accounts (fiscal).

The AST is presented in Table 22.

Table 22 – Appraisal Summary Table

Appraisal Summary Table

Date produced:	5	4	2019

Contact:	
Name	Sam Edwards
Organisation	Lincolnshire County Council
Role	Promoter/Official

Name of scheme:	North Hykeham Relief Road
Description of scheme:	The NHRR is a proposed new link road to the south of Lincoln urban area. It will be dual carriageway standard providing a connection between the A46 / A1434 Pennell's Roundabout and the under-construction A15 / LEB roundabout. The scheme will include a new bridge over the River Witham and over Station Road; a shared pedestrian and cycle route on the north side; a bridleway on the south side of the new link; and three NMU structures.

Impacts		Summary of key impacts	Assessment					
			Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The scheme reduces total vehicle hours across the wider Lincoln network. The primary impacts for business users are: - Providing alternative route choice to the A46 for users to travel around (or bypass) the urban area which provides direct (scheme users) and indirect (non-scheme users) journey time savings for medium and longer trips on those routes; and - Reduced congestion on some radial routes into the city centre, in particular the A1434 Newark Road / A15 corridor plus Brant Road and A607 Grantham Road. For business users, the split of monetised benefit is broadly even between the three net change journey time categories. Business users make up just under half of all journey time benefits.	Value of journey time changes(£) £152.1m Net journey time changes (£) 0 to 2min: £55.6m 2 to 5min: £47.8m > 5min: £48.7m				-	£147.0m	Moderate Beneficial
	Reliability impact on Business users	The scheme produces some benefits for journey time reliability of business users but this is relatively small compared to the impact on non-business users since the proportion of business users is low relative to total car travel. The scheme produces benefits for journey time reliability through providing additional network capacity and route choice, in particular for east-west movements and as an alternative route around the city to the existing orbital network.	-				-	£6.3m	
	Regeneration	The scheme is not within a regeneration area and so this impact has not been assessed.	-				-	-	
	Wider Impacts	The scheme provides an overall improvement to the performance and reliability of the local transport network which improves the efficiency of businesses and will promote sustainable economic growth. In particular, this increases businesses effective catchment areas which has positive benefits for labour supply and move to more productive jobs. For Tier 3 analysis, a dependent development assessment concluded the scheme would unlock South West Quadrant providing additional induced investment benefits.					Moderate Beneficial	-	
Environmental	Noise	Receptors located in proximity to the scheme and existing routes feeding into the scheme are predicted to experience a significant increase in noise levels, however, overall the effects once operational are considered beneficial. Opening Year Daytime noise level of 66 dB LAeq, 16h or higher - Do Minimum (DM) 822 properties, Do Something (DS) 796 Design Year Daytime noise level of 66 dB LAeq, 16h or higher - 710 properties DM, 603 properties DS No properties subject to road traffic noise levels in excess of 80 dBLAeq, 16h	Households experiencing increased daytime noise in opening year: 156 Households experiencing reduced daytime noise in opening year: 19,353 Households experiencing increased daytime noise in design year: 644 Households experiencing reduced daytime noise in design year: 3,869				-	£5.2m *Based on least beneficial change	Slight Beneficial
	Air Quality	The scheme is not situated within an AQMA, however, several road links including A15 and B1262 feed in to the city centre AQMA.. All roadside NO2 Concentrations predicted for the opening year (2026) and operating year (2041) of the Proposed Scheme are below the annual mean NO2 EU limit value for Defra PCM model road links overlain by the Proposed Scheme. Links indicating the potential for exceedances no longer present in the opening year and operating year scenarios. In the majority of cases where significant changes in air quality were predicted these were improvements. Significant deteriorations in air quality were predicted on the A15 St Catherines junction in the city centre, and at the A46 Hykeham Roundabout.	Overall deterioration in property weighted air quality despite a greater number of properties experiencing an improvement compared to those experiencing no change or a deterioration in concentrations of air pollutants				-	-£9.2m	Moderate Beneficial
	Greenhouse gases	Predicted increase of GHG emission from road-based fuel consumption attributed to a predicted increase in fuel consumption as the scheme will attract / generate additional traffic flow and links the existing A46 bypass with Lincoln Eastern Bypass.	Change in non-traded carbon over 60y (CO2e): 181,041 Change in traded carbon over 60y (CO2e): 2,962				-	- £7.8m	

Scenario	Properties: Improvement	Properties: No Change	Properties: Deterioration	Score	Emissions (tonnes)
NO_2 2026	16345	86	2977	-454.87	-
PM_{10} 2026	15430	0	3978	3130.11	-
NO_2 2041	12979	39	6390	1221.83	-
PM_{10} 2041	13044	0	6164	3550.42	-
NOX 2026	-	-	-	-	+14.09
NOX 2041	-	-	-	-	+12.08

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
	Landscape	Permanent change to the pattern of the landscape. Road alignment at odds to the pattern of the existing road layout within the surrounding area creating a perceivable change to landscape character. Directly sever Area of Great Landscape Value, Green Wedge and linear features of cultural significance within the landscape including Viking Way. Change to the nature of the existing view through the introduction of scheme. Demolition of a number of residential properties along Station Road. Construction will result in significant impacts on the visual amenity, from areas of higher ground where long distance views over the floodplain are discernible.	-	Large Adverse	-	
	Townscape	Townscape was screened out as not applicable to the scheme.	-	-	-	
	Historic Environment	The scheme has: - Potential for direct impacts upon below-ground heritage remains (known and unknown) within the scheme footprint. Four known below-ground heritage assets within the scheme area. - Potential for indirect impacts to the settings of 17 Listed Buildings within 1 km of the scheme. - Direct impact on the historic landscape, through visual intrusion and an alteration of the landscape use.	-	Moderate Adverse	-	
	Biodiversity	The scheme has potential to impact: - Bat roosts, damage or removal to habitats currently contributing to foraging and commuting, and disturbance from lighting. - Great Crested Newt, Otters, badgers, water voles and reptiles due to the loss of suitable habitat for these species associated with land take - Birds due to removal of suitable nesting, over wintering and foraging habitat. - Plants by spread of Schedule 9 species and removal of species-rich hedgerow.	-	Moderate Adverse	-	
	Water Environment	The scheme has potential: - For road runoff to impact surface and groundwater quality. - To impact the hydromorphological and ecological quality of the watercourses and drains. - To impact the flood conveyance routes and floodplain storage due to the embankments of the Proposed Scheme. - To impact catchment hydrogeology and groundwater flow due subsurface structures associated with the embankment.	-	Moderate Adverse	-	
Social	Commuting and Other users	The scheme reduces total vehicle hours across the wider Lincoln network. The primary impacts for commuting and other users are: - Reduced congestion within the Lincoln urban area, in particular North Hykeham and Waddington, which reduces travel time for shorter local trips within that area; and - Reduced congestion on some radial routes into the city centre, in particular the A1434 Newark Road / A15 corridor plus Brant Road and A607 Grantham Road. There are substantially higher benefits for trips less than 5 minutes (and less than 2 minutes in particular) because Other Users comprise the largest proportion of all user classes and it has the shortest average trip length. Commuting and other users account for just over half of all journey time benefits.	Value of journey time changes(£): £179.6m Net journey time changes (£) 0 to 2min: £85.7m 2 to 5min: £54.1m > 5min: £39.8m	-	£156.2m	Moderate Beneficial
	Reliability impact on Commuting and Other users	The scheme produces benefits for journey time reliability through providing additional network capacity and route choice, in particular for east-west movements and as an alternative route around the city to the existing orbital network.	-	-	£22.8m	
	Physical activity	The scheme provides new segregated walking, cycling and equestrian infrastructure which will encourage physical activity not only for existing residents, but also for the SWQ. In addition, decreases in traffic flow on local roads in the Lincoln urban area reduces perceived barriers to walking and cycling.	-	Slight Beneficial	-	
	Journey quality	The scheme provides alternative route choice for strategic trips bypassing Lincoln and local trips. This reduces traveller stress through reduced congestion and improved journey times; the provision of an additional route; and improved network resilience when an incident does occur. A decrease in traffic flow within the urban area also contributes to reducing perceived barriers to accidents. In addition, NHRR itself will be adequately signed in line with DMRB guidance which provides route certainty and the landscape strategy will be sensitive to travellers' views of the surrounding countryside and townscape including the historic Lincoln.	-	Slight Beneficial	-	

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
	Accidents	The scheme reduces the total number of accidents through the transfer of traffic from less appropriate routes, in particular the rural roads to the south of the Lincoln urban area, onto a dual carriageway standard road with a typically lower accident rate. A key example is the route through the villages of Harmston and Aubourn which has a large benefit due to users rerouteing onto the scheme.	An assessment in COBALT derived a total of 427 accidents saved over the 60 year appraisal period.	-	£16.7m	Moderate Beneficial
	Security	The scheme has an opening year AADT up to 27,000 which provides informal surveillance for pedestrians and freight traffic. Pedestrian facilities will be designed to the latest DMRB guidance and there are no service stations or car parks within the immediate vicinity of the scheme for HGVs (or other user) to stop and leave their vehicle.	-	Slight Beneficial	-	Slight Beneficial
	Access to services	The reduction in traffic on existing bus routes may result in more reliable local bus services through the improvements in congestion. However, the addition of public transport services and changes to existing services is beyond the scope of this project. Therefore, access to services has been scoped out of this assessment.	-	-	-	Not assessed
	Affordability	The scheme increases travel distance which leads to a net increase in vehicle operating costs across all users. There is a very small increase in user charges incurred from a net increase in flow on toll routes (Humber Bridge, Dunham Bridge).	The monetary NPV of vehicle operating costs in the TUBA output is -£20.7m. The monetary NPV of user charges in the TUBA output is -£0.8m.	Moderate Adverse	-	Moderate Adverse
	Severance	The scheme reduces severance on key routes including radial, city centre and local roads in North Hykeham. This improves accessibility to local community facilities and services for motorised users through reduced delay in the area and for non-motorised users through reducing the level of congestion as a perceived barrier to travel.	The net impact for the number of residents experiencing a change in severance is: - Children (under 16) +12,645 - Older People (over 65) +12,795 - People with disabilities +14,609 - No car households +7,871	Large Beneficial	-	Large Beneficial
	Option and non-use values	New transport services could be introduced as part of the new development (SWQ) associated with the scheme. However, the impact on public transport services is outside the scope of this project.	-	-	-	
Public Accounts	Cost to Broad Transport Budget	The scheme has an overall present value of costs of £145.8m (2010 prices and values), which includes a 15% optimism bias, through the delivery period up to scheme opening in 2026. This includes a Local Government contribution of £27.3m, a Central Government contribution of £82.4m plus a developer contribution of £7.9m (all 2010 prices and values) which has been subtracted from that value to give the outturn cost to the Broad Transport Budget.	-	-	- £137.8m	
	Indirect Tax Revenues	The scheme increases travel distance and average travel speed which leads to a net increase in fuel consumption and consequently indirect tax revenue.	-	-	£16.8m	

8 ECONOMIC CASE SUMMARY

8.1 SUMMARY OF APPROACH

The Economic Case has identified and assessed all impacts of the proposed scheme to determine its overall value for money. This takes into account the costs of developing, building, operating and maintaining the scheme and a full range of its impacts, including those which can be monetised.

The proposed scheme, identified as the preferred option in the Strategic Case, has been assessed as the Core Scenario.

Traffic modelling and forecasting was undertaken using the GLTM which was well validated and considered fit for purpose for this assessment. The traffic forecasting for the scheme is based on the forecast traffic patterns after the opening of LEB which adds additional uncertainty to the forecast outputs and subsequent appraisal.

The approach to assessing value for money was based defining an assessment approach for each impact that was appropriate but proportional given the likely scale of impact and tied into analysing the forecast impacts against the scheme outcomes defined in the Strategic Case.

The scheme costs, set out in the Financial Case, were adjusted for optimism bias and converted to present value of costs for economic analysis.

The benefit, or disbenefit, of each impact was assessed in monetary, quantitative or qualitative terms in line with the individually defined approach.

8.2 VALUE FOR MONEY CATEGORIES

The DfT's guidance document '*Value for Money Framework*' (2017) provides the framework for assessing and reporting value for money based on economic appraisal outputs.

The value for money categories are defined in Table 23.

Table 23 – Value for Money Standard Categories

VfM Category	Implied by …
Very High	BCR greater than or equal to 4
High	BCR between 2 and 4
Medium	BCR between 1.5 and 2
Low	BCR between 1 and 1.5
Poor	BCR between 0 and 1
Very Poor	BCR less than or equal to 0

Source: Value for Money Framework 2017 (Box 5.1)

8.3 VALUE FOR MONEY STATEMENT

8.3.1 INITIAL BCR CATEGORY

The initial BCR for the scheme is 2.4.

This places the scheme within the High value for money category.

The calculation is based on monetised benefits of transport economic efficiency, accidents, greenhouse gases, noise, air quality and indirect tax revenue.

It does not include costs during construction which would be primarily offline and incurred for online work during the off peak period which is outside the annualised periods. The total cost impact is therefore expected to be small.

8.3.2 ADJUSTED BCR CATEGORY

The adjusted BCR for the scheme is 2.6.

This places the scheme within the High Value for Money category.

The calculation is based on adding monetised impacts of reliability to the initial present value of benefits.

The adjusted BCR does not include monetised wider economic impacts which have been qualitatively assessed as moderate beneficial and so would increase the adjusted BCR.

8.3.3 IMPACT OF DEPENDENT DEVELOPMENT

The monetised assessment of dependent development is not included in cost-benefit analysis. However, the derived value of £18.785m provides further evidence that, building on the adjusted BCR, the scheme is comfortably within the High Value for Money category.

8.3.4 NON-MONETISED IMPACTS

The net benefit of non-monetised impacts is assessed to be positive. The only adverse impact is for affordability. Physical activity benefits were not monetised for the initial BCR at this stage given the nature of the scheme however a qualitative assessment scored slight beneficial.

The distributional impact appraisal concluded a large beneficial impact for vulnerable groups through reduced severance, a moderate beneficial impact for vulnerable groups through reduced accidents and a moderate beneficial impact for low income groups from user benefits. The only adverse impact for low income groups was personal affordability however to a lesser extent than the highest income group. The net impact of the social appraisal and the distributional impact appraisal is considered to be positive for the scheme adding further weight to the High Value for Money category.

8.3.5 ENVIRONMENT

The environmental impacts are all varying degrees of adverse. The noise and air quality impacts have been assessed and monetised and show that there is expected to be benefits in relation to noise and overall disbenefits in relation to air quality.

The assessment of other impacts, including Landscape and Biodiversity, indicates that mitigation activities in the design may reduce the level of impact.

8.3.6 UNCERTAINTY

The Low Growth scenario has a BCR of 1.7 and the High Growth scenario has a BCR of 2.1. The scheme remains economically viable under alternative growth assumptions however a Medium value for money is possible, based on the initial BCR, for Low Growth.

There is some additional uncertainty in the benefits since they are derived from traffic forecasts predicting the impact of the scheme given the forecast changes in traffic patterns due to LEB.

8.3.7 CONCLUSION

Based on all of the evidence presented for the Core Scenario – including monetary, quantitative and qualitative assessments – plus the outcomes of the alternative scenarios, a likelihood for each value for money category has been derived, in line with the guidance.

The conclusion is that the scheme is **Very Likely** to offer **High** value for money.

Table 24 – Value for Money Likelihood

VfM Category	Low	Medium	High	Very High
Likelihood	Unlikely	Possible	**Very Likely**	Possible

Appendix A

GLTM LOCAL MODEL VALIDATION REPORT

Appendix B

TRAFFIC FORECASTING REPORT

Appendix C

ECONOMIC APPRAISAL REPORT

Appendix D

ENVIRONMENTAL APPRAISAL REPORT

Appendix E

ECONOMIC IMPACTS REPORT

Appendix F

SOCIAL AND DISTRIBUTIONAL IMPACTS REPORT

Lincolnshire County Council
Crown House
Grantham Street
Lincoln
LN2 1BD

wsp.com