Norfolk County Council
LONG STRATTON BYPASS
Economic Appraisal Report

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1.1 BACKGROUND

1.1.1 This report details the economic assessment undertaken as part of the Long Stratton Bypass scheme and Outline Business Case.

1.1.2 The report presents the monetised costs and transport benefits of the scheme and describes the methodologies used to derive the economic impacts. The economic impacts are used to inform the overall value for money (VfM) assessment for the scheme.

1.2 REPORT STRUCTURE AND PURPOSE

1.2.1 The Economic Appraisal Report (EAR) sets out information, detail and evidence pertaining to the economic assessment of transport related impacts of the scheme. The primary focus of the EAR is to explain the transport-related economic impacts of the scheme and the methodologies adopted to derive these from the relevant transport inputs.

1.2.2 Following this introductory chapter, the remainder of this EAR is structured as follows:

- Chapter 2 – Study Overview
- Chapter 3 – Economic Assessment Approach
- Chapter 4 – Scheme Costs
- Chapter 5 – Level 1 impacts
- Chapter 6 – TEE, PA and AMCB Tables
- Chapter 7 – Level 2 impacts
- Chapter 8 – Level 3 impacts
- Chapter 9 – Switching Value Analysis
- Chapter 10 – Sensitivity testing
- Chapter 11 – Summary

1.2.3 The following scheme impacts have separate independent reports to support the economic appraisal.

- Distributional Impacts
- Environmental Impacts

2 STUDY OVERVIEW

2.1 SCHEME DESCRIPTION

2.1.1 Long Stratton is a small town in the county of Norfolk, with a population of 4,424 as of the 2011 Census. It lies about 10 miles south of Norwich on the A140 Ipswich to Cromer road, mid-way between the county town, Norwich and the market town of Diss.

2.1.2 Long Stratton is in South Norfolk district and is home to the District Council's offices. Norfolk is a member of the New Anglia Local Economic Partnership (LEP) together with Suffolk County Council.

Figure 2-1 - Location of Long Stratton

THE A140

2.1.3 The A140 is part of the MRN. It connects Ipswich and Norwich – the two largest economies in the New Anglia area, before continuing northwards to the A149 at Cromer. It connects to the Strategic Road Network (SRN) at the A14 near Needham Market and the A47 and A11 at Norwich. The A140 used to be classified as a trunk road but was de-trunked in May 2001 when responsibility passed from the Highways Agency (now Highways England) to the local authorities (Norfolk and Suffolk County Councils). The A140 is a mix of different standards, ranging from 70 mph dual carriageway to 30 mph single carriageway within towns and villages.

THE TOWN

2.1.4 Previously a village, Long Stratton became a town at the local elections in May 2019, when its Parish Council became a Town Council. This important change reflects its fast-growing population,

which increased by almost 20% between 2001 and 2011[1], as well as transformational plans for at least 1,800 new homes and 9.5ha. of new employment land in the town.

2.1.5 Long Stratton has infant, junior and high schools, two churches, three pubs, a doctors' surgery, a library and a leisure centre. Town Centre shopping facilities and a supermarket are located along the A140, which forms the main street of the town, as well as in two shopping centres. Other significant employers are the District Council and the Saffron Housing Trust. There are currently 1,900 people working in Long Stratton, 30% of whom commute in from outside the district, whilst 39% of employed people who live in the town commute to work in Norwich.[2]

2.1.6 The A140 passes through the centre of Long Stratton, forming the town's main street. It is subject to a 30mph speed limit through the centre of the town, between Lime Tree Avenue and St. Michael's Road. 50mph zones extend either side of the 30mph restriction for approximately 700m to the north and 900m to the south. Gateway signing, 'dragon teeth' markings and carriageway roundel markings have been introduced to reinforce the speed restrictions on the approach to the built-up area.

2.1.7 Within the built-up area, the A140 is relatively narrow with a minimum carriageway width of 5.7m and 1.2m footways in places. There are eight priority junctions, a signal-controlled junction (with Flowerpot Lane) and a signal-controlled pedestrian crossing (between Swan Lane and Star Lane). There is frontage access to residential and commercial premises along the whole length of the road within the town and on-street parking is prohibited through the town centre.

[1] 2001 and 2011 census. Office for National Statistics
[2] Long Stratton Area Action Plan (May 2016), paragraph 2.6

Figure 2-2 - Long Stratton

2.1.8 The A140 at Long Stratton carries approximately 22,000 vehicles per day, of which 5.69% are heavy goods vehicles (HGV). For users of the A140, the section through the town is a notorious bottleneck on a key route into Norfolk. For residents and visitors to the town it brings unwanted through traffic into an otherwise attractive town, bringing problems of noise, pollution, visual intrusion, accidents and community severance.

2.1.9 The continued presence of the A140 and its traffic in the centre of Long Stratton is inconsistent with the town's existing character and function and a serious barrier to the planned housing and economic growth.

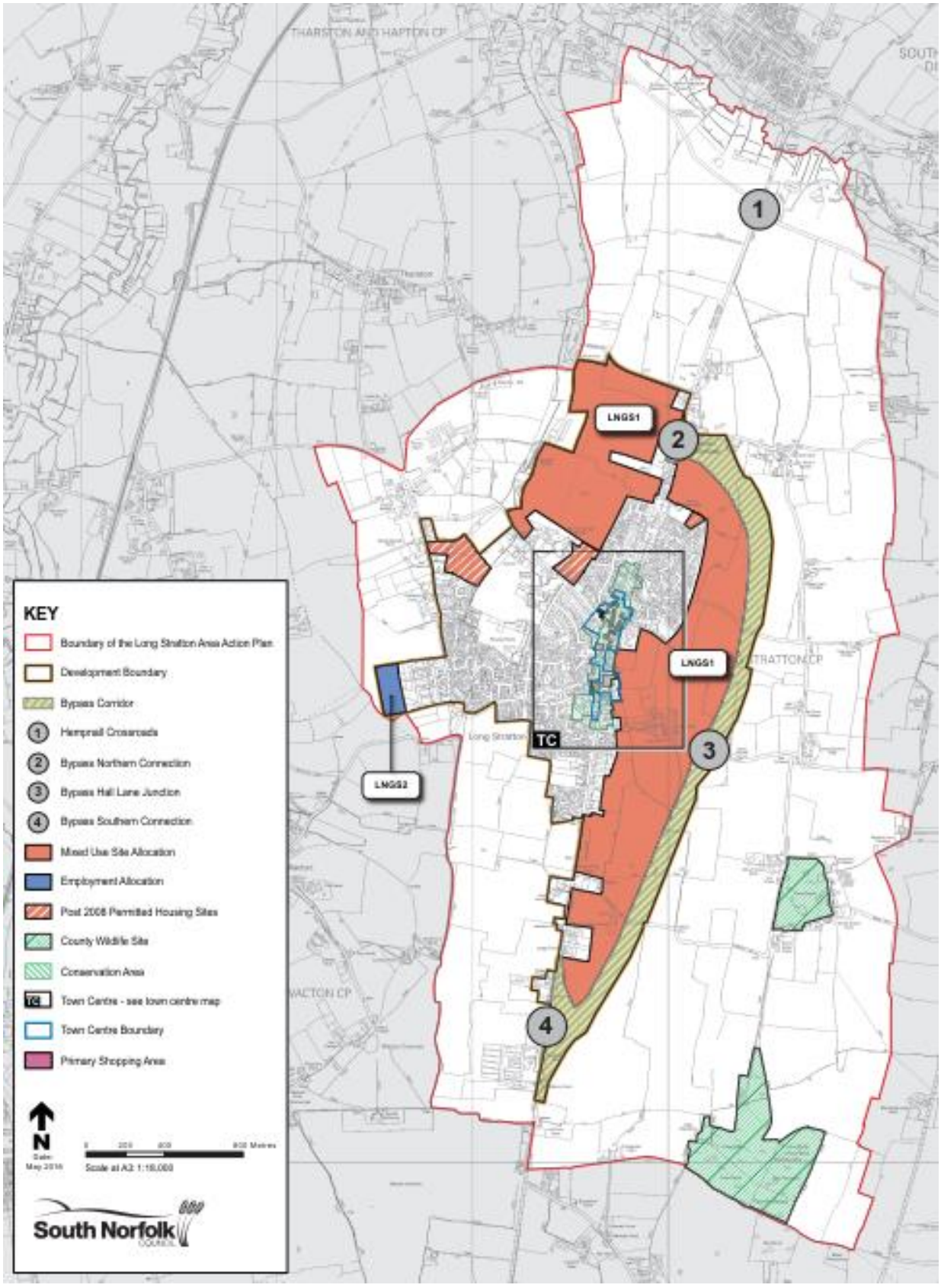
PLANNED HOUSING AND EMPLOYMENT DEVELOPMENT

2.1.10 The proposal for a bypass is inextricably linked in local planning policies to plans for major new housing and employment development in Long Stratton.

2.1.11 The adopted Joint Core Strategy for Broadland, Norwich and South Norfolk identifies Long Stratton as a key location for growth and proposes the development of 1,800 new houses with supporting school facilities and green infrastructure and 9.5ha of employment land, over the period 2008 to 2026. This scale of development would not be acceptable unless a bypass were also provided to remove A140 traffic from the town centre. The adopted Long Stratton Area Action Plan (AAP) confirms that a bypass is an essential requirement for housing growth and must be in place before the 250th house is occupied.

2.1.12 Figure 2-3 shows the development sites allocated in the AAP and the indicative line of a bypass.

Figure 2-3 - Site allocations in the Long Stratton AAP



2.1.13 Two planning applications were submitted to South Norfolk District Council in January 2018.

An outline application for 109.7ha of land to the east of Long Stratton comprising:

- 1,275 houses
- 8 hectares of employment land
- Primary school (2ha site)
- Community facilities, associated infrastructure and open space

2.1.14 Together with a full application for:

- An eastern bypass, including roundabouts and junctions

2.1.15 An outline application for 45.2ha of land to the west of Long Stratton comprising

- 387 houses
- 1.5ha of employment land
- Associated infrastructure and public open space

2.1.16 Together with a full application for:

- An initial phase of 213 houses
- A western relief road

2.1.17 NCC and South Norfolk District Council (SNDC) have been working with the developers to assess the proposals and develop the bypass proposal. The applications have not yet been determined and a revised application is anticipated in May 2021.

THE PROPOSED BYPASS

2.1.18 The bypass will provide:

- Access to the new development without adding to the traffic on the A140
- A new, more efficient route for through traffic on the A140
- Traffic relief in the town centre
- Opportunities to further improve conditions for people walking, cycling or using public transport

The proposed scheme, together with the currently anticipated pattern of development, is illustrated in Figure 2-4. It comprises a 4km long all-purpose bypass on the eastern side of Long Stratton, with:

- A 7.3m single carriageway
- Two 1.0m hard strips
- Variable width soft verges
- A design speed of 100 *km/h* with a speed limit of 60 *mph* between Rhees Green roundabout and the existing A140 to the south, and an 85km/h design speed and 50mph speed limit between Rhees Green roundabout and the proposed Roundabout north of Long Stratton

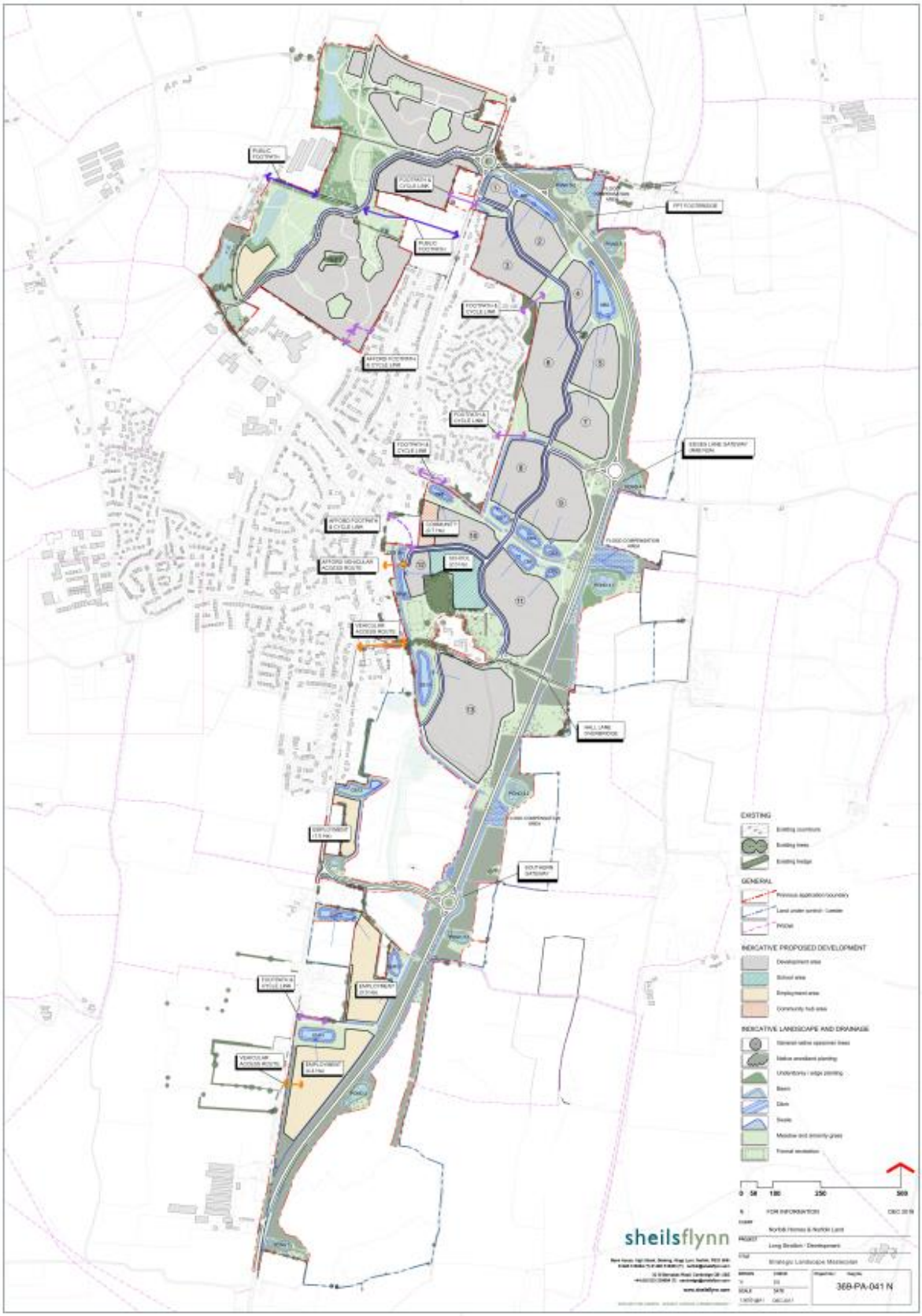
2.1.19 From south to north, the bypass will include:

- A new four-arm roundabout on A140 Norwich Road (the Northern Gateway Roundabout) incorporating an access to development west of the A140
- A priority junction with a new link to Church Lane, which will be diverted
- A footbridge crossing for non-motorised users (NMUs) on the footpath between Long Stratton and St Michael's Church

- A new three-arm roundabout near Edge's Lane, providing a link into new development
- A road overbridge to carry Hall Lane over the bypass
- A new three-arm roundabout north of Parker's Lane with a single carriageway link to the A140 Ipswich Road at Parker's Lane
- A free-flowing connection to A140 Ipswich Road

2.1.20 The A140 Ipswich Road will remain open for access and cyclists between the bypass and Parker's Lane, with no through traffic.

Figure 2-4 - A140 Long Stratton Bypass and indicative development



2.2 SCHEME OBJECTIVES

2.2.1 This section sets out specific objectives and strategic outcomes for the scheme. In line with DfT guidance, these have been developed and updated from those set out in the SOBC.

2.2.2 The strategic outcomes define, at a high level, what the scheme aims to achieve, reflecting the strategic aims of NCC, the Government and other organisations. Because there may be other factors affecting these outcomes, it may be difficult to measure directly the impact of the scheme.

2.2.3 For this reason, a set of specific objectives has been set. These are directly related to the scheme and achieving them will help to achieve the strategic outcomes. As far as possible, the specific objectives are SMART. i.e. specific, measurable, achievable, realistic and time-bound.

The strategic, or high level, outcomes are:

- Reduced congestion
- Improved connectivity
- Delivery of planned new housing development and reduced pressure on house prices
- Increased economic growth and employment
- Improved road safety
- Reduced greenhouse gas emissions
- Improved quality of life for communities

The specific or intermediate objectives are:

- To remove through traffic, including HGVs, from the centre of Long Stratton
- To reduce congestion, queueing and delay on the A140 at Long Stratton
- To improve journey times and journey time reliability, for all users of the A140
- To improve the journey times and reliability of bus routes through Long Stratton
- To improve conditions for people walking or cycling in Long Stratton
- To enable full delivery of 1,800 planned new houses in Long Stratton
- To enable the development of up to 9.5ha of new employment land in Long Stratton
- To improve conditions for businesses in Long Stratton and stimulate investment in the town
- To improve the accessibility of Long Stratton town centre for people
- To improve conditions for the delivery of goods and reduce transport costs for businesses
- To improve the environment of Long Stratton town centre by reducing noise and visual intrusion
- To achieve a net reduction in greenhouse gas emissions
- To improve air quality in Long Stratton town centre
- To reduce community severance in Long Stratton
- To facilitate improvements to the public realm in Long Stratton
- To reduce the number of people killed or injured in collisions in the area affected by the scheme

2.3 ECONOMIC ASSESSMENT PURPOSE

2.3.1 An assessment of the transport related economics is required in order to:

- Assess the impact of the transport element of the scheme in terms of benefit to the economy through reduced congestion on the A140 corridor;
- Assess the environmental impact of the scheme in terms of impacts on greenhouse gas, noise and air quality emissions
- To quantify the wider economic benefits of the scheme, reflecting the importance of the A140 to regional economy;

- Assess the economic impacts of dependent development in terms unlocked housing that is brought forward as a result of the scheme;
- To provide input into the Appraisal Summary Tables (AST), allowing for the presentation of transport related benefits in terms of social factors; and
- To provide input in the Economic Case of the Outline Business Case (OBC), allowing for the value for money (VfM) of the scheme to be determined.

2.4 TRAFFIC MODELLING

INTRODUCTION

2.4.1 The Long Stratton Traffic Model (LSTM) was developed to support the business case for the proposed LSB scheme in Long Stratton, Norfolk. The transport model was developed to accurately represent existing traffic conditions so that it could be used to predict the future traffic condition with and without the LSB.

2.4.2 The LSTM has been generated by expanding the existing Suffolk County Transport Model (SCTM). SCTM is a model developed for Suffolk County Council (SCC) for their scheme appraisal and forecast modelling and it has been agreed between NCC and SCC that this was the best tool to use to assess the LSB.

2.4.3 The SCTM comprises of a Highway Assignment Model (HAM) built in SATURN as well as a Public Transport Assignment Mode (PTAM) and Variable Demand Model (VDM) developed in VISUM. The development of the LSTM and subsequent assessment uses the HAM only as the focus of the proposal on how the highway network within South Norfolk and Mid Suffolk is affected by the proposed infrastructure. WSP have demonstrated that a VDM assessment was not required and this has been agreed with the DfT In January 2020, details are provided in the Long Stratton Local Model Validation Report[3].

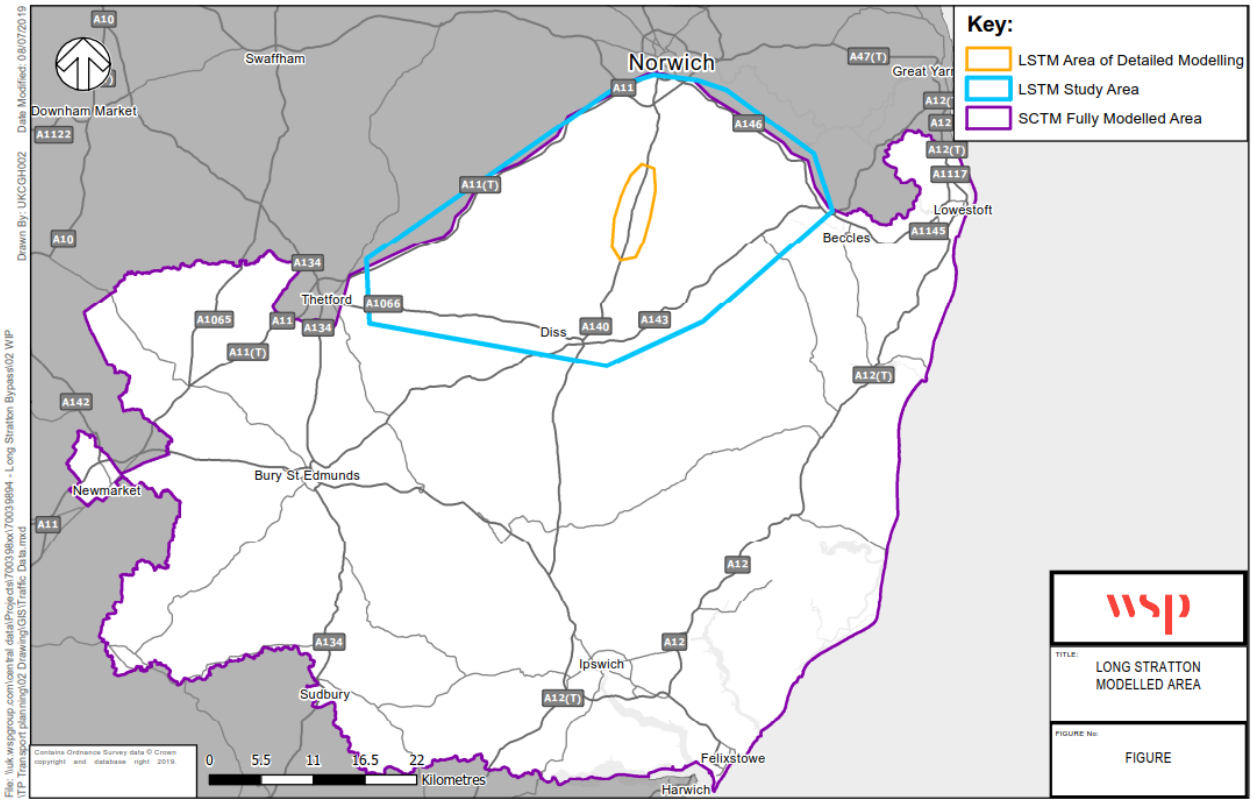
KEY FEATURES OF THE MODEL

2.4.4 The LSTM fully modelled area is shown in Figure 2-5. The Fully Modelled Area (FMA) is the area over which proposed interventions are likely to have influence. In the SCTM, and therefore the LSTM, the area is bounded by Norwich in the north, by the coastline in the east, by Felixstowe and Sudbury in the south and by Newmarket and Thetford in the west.

2.4.5 The LSTM study area is the area in which the network and zone refinements were made for the purpose of the LSTM. The area of detailed modelling is the area over which significant impacts of the intervention are certain. Modelling detail in this area would be characterised by representation of all trip movements, small zones and very detailed networks and junction modelling, which is marked by the orange boundary in the figure.

[3] 200629_LongStratton_DRAFT_LMVR_OBC, July 2020

Figure 2-5 - LSTM Traffic Model



2.4.6 The LSTM has a base year of 2016 and two forecast years of 2024 as the opening year and 2039, as the design year (15 years after the scheme opening).

2.4.7 The model has been developed for the following time periods:

- AM Peak Hour: 08:00 - 09:00;
- Average Interpeak Hour: 10:00 - 16:00; and
- PM Peak Hour: 17:00 -18:00

2.4.8 The following user classes have been modelled:

- User Class 1: Cars Home Based Work - Inbound;
- User Class 2: Cars Home Based Work - Outbound;
- User Class 3: Cars Home Based Employer Business - Inbound;
- User Class 4: Cars Home Based Employer Business - Outbound;
- User Class 5: Cars Non-Home-Based Employer Business;
- User Class 6: Cars Home Based Others – Inbound;
- User Class 7: Cars Home Based Others – Outbound;
- User Class 8: Cars Non-Home-Based Others;
- User Class 9: Light Goods Vehicles; and
- User Class 10: Heavy Goods Vehicles.

BASE MODEL OVERVIEW

2.4.9 The Base model network has been refined in the Long Stratton Study Area to develop the LSTM, which involved network refinement, updating the zoning system as well as well as changes and improvement to the trip matrices.

2.4.10 It is considered the LSTM highway model has been shown to provide a reasonable match to observed traffic count and journey time data. Local validation undertaken within Long Stratton and the area of detailed modelling shows the required flow, GEH and journey time performance is achieved. The LSTM highway model provides a robust basis from which to create forecast assignments for future scheme and development testing. For further details on the Base model, refer to the Long Stratton Local Model Validation Report[4].

FORECASTING APPROACH

2.4.11 The development of forecast supply and demand for the LSB is based on the approach set out in TAG Unit A2.2 Appraisal of Induced Investment[5] which requires the preparation of scenarios P, Q, R and S. It provides guidance on how to assess the value of transport scheme, particularly the impacts of induced investments to the local economy. Table 2-1 based on Table 1 of TAG Unit A2.2, shows the transport model scenarios required to estimate the quantification of dependent developments.

Table 2-1 - TAG Unit 2.2 - Combination of Scenarios – with/without dependent development and the transport scheme

	Without Dependent Development	With Dependent Development
Without transport scheme	P	Q
With transport scheme	S	R

CORE SCENARIO

2.4.12 For the purposes of assessing the LSB transport scheme, a Core Assessment has been produced in accordance with TAG guidance with a deadweight development of 250 dwellings - this non-dependant development quantum is defined in the Long Stratton Area Action Plan (LSAAP).

2.4.13 The scenarios that have been developed as part of the core assessment are detailed below:

- **Scenario P / Do Minimum (DM)**: Doesn't include the LSB scheme. Growth is constrained to NTEM 7.2 with schemes and proposed developments represented which have been identified as More Than Likely or Near Certain within the uncertainty log and includes 250 dwellings as deadweight development associated with LSB;
- **Scenario S / Do Something 1 (DS1):** Includes the LSB transport scheme and applies identical growth as Scenario P. The only difference between Scenario P and S is the transport scheme;

[4] 201104_LongStratton_FINAL_LMVR_OBC, November 2020
[5] https://www.gov.uk/government/publications/tag-unit-a2-2-induced-investment

- **Scenario Q / Do Something Q (DSQ):** Doesn't include the LSB scheme. Growth is constrained to NTEM 7.2 with schemes and proposed developments represented which have been identified as More Than Likely or Near Certain within the uncertainty log and includes full build out of all development associated with LSB;
- **Scenario R / Do Something 2 (DS2)**: Includes the LSB transport scheme. Growth is constrained to NTEM 7.2 with schemes and proposed developments represented which have been identified as More Than Likely or Near Certain within the uncertainty log and includes full build out of all development associated with LSB

DEADWEIGHT SENSITIVITY

2.4.14 Whilst defined in local policy, strategic modelling was not considered to demonstrate that a deadweight development of 250 dwellings significantly decreases the level of service on the existing highway network. A sensitivity test has been undertaken whereby the deadweight proportion of development has been increased to represent 979 dwellings, split between the west and east of the existing A140 in Long Stratton.

2.4.15 The scenarios that have been considered within the deadweight sensitivity are described as follows:

- **Scenario P / Do Minimum (DM)**: Does not include the LSB scheme. Growth is constrained to NTEM 7.2 with schemes and proposed developments represented which have been identified as More Than Likely or Near Certain within the uncertainty log and includes 979 dwellings as deadweight development associated with LSB; and
- **Scenario S / Do Something 1 (DS1)**: Includes the LSB transport scheme and applies identical growth as Scenario P. The only difference between Scenario P and S is the transport scheme.

2.4.16 For the assessment of the LSB, the full Long Stratton development is 1,885 dwellings and 1,272 jobs, with the deadweight assumption being 250 dwellings in the core scenario (1,635 dependant dwellings) and 979 dwellings in the deadweight sensitivity (906 dependant dwellings). It is assumed that no employment will be brought forward without the supporting LSB infrastructure scheme and therefore all employment land uses are considered to be dependant development.

LOW and HIGH GROWTH SCENARIOS

2.4.17 Low and High Growth scenarios have been developed as per the WebTAG guidance, with low and high background growth. The scenarios developed are similar to the Core scenario explained in the earlier section.

FORECASTING METHODOLOGY

2.4.18 The forecasting methodology adopted for developing the forecast models in context of the dependent development is summarised below:

- Obtain information on local committed developments and infrastructure schemes within South Norfolk and Mid Suffolk and compile in an uncertainty log;
- Agree the network and matrix assumptions for assessing the LSB transport scheme and associated development
- Prepare Forecast Supply:
    - Develop Scenario P and Q networks (i.e. Do Minimum), based on validated base networks, that take account of committed infrastructure entries in the uncertainty log;

- Develop Scenario S and R networks (i.e. Do Something), based on validated base networks that take account of committed infrastructure entries in the uncertainty log as well as the LSB scheme itself.

- Prepare Forecast Demand:
  - Develop Scenario P and S matrices (i.e. Deadweight development), based on validated base matrices, that take account of committed development entries in the uncertainty log and the deadweight development associated with the LSB. Adjusted background growth is taken from the National Trip End Model (NTEM) and the National Road Traffic Forecasts (RTF). The overall demand is constrained to NTEM 7.2;
  - Develop Scenario Q and R matrices (i.e. Dependant development), based on validated base matrices, that take account of committed development entries in the uncertainty log and the dependant development associated with the LSB. Adjusted background growth is taken from the NTEM and the RTF. The overall demand is constrained to NTEM 7.2.

2.4.19 Full details on the forecasting for LSB scheme is provided in the Long Stratton Bypass Forecasting Report[6].

[6] 201110_Long Stratton Bypass Forecasting Report_FINAL.pdf

3 ECONOMIC ASSESSMENT APPROACH

3.1 INTRODUCTION

3.1.1 The Economic assessment identifies and appraises all scheme impacts to determine its overall Value for Money (VfM). It takes account of the costs of developing, building, operating and maintaining the scheme, and a full range of its impacts.

3.1.2 The economic assessment has been undertaken in accordance with the following WebTAG Units:

- TAG Unit A1.1 'Cost-Benefit Analysis';
- TAG Unit A1.2 'Scheme Costs';
- TAG Unit A1.3 'User and Provider Impacts';
- TAG Unit A2.1 'Wider Impacts';
- TAG Unit A2.2 'Induced Investment';
- TAG Unit A2.3 'Labour Supply Impacts';
- TAG Unit A2.4 'Productivity Impacts';
- TAG Unit A3 'Environmental Impact Appraisal';
- TAG Unit A4.2 'Distributional Impact Appraisal'; and
- TAG Unit M4 'Forecasting and Uncertainty'.

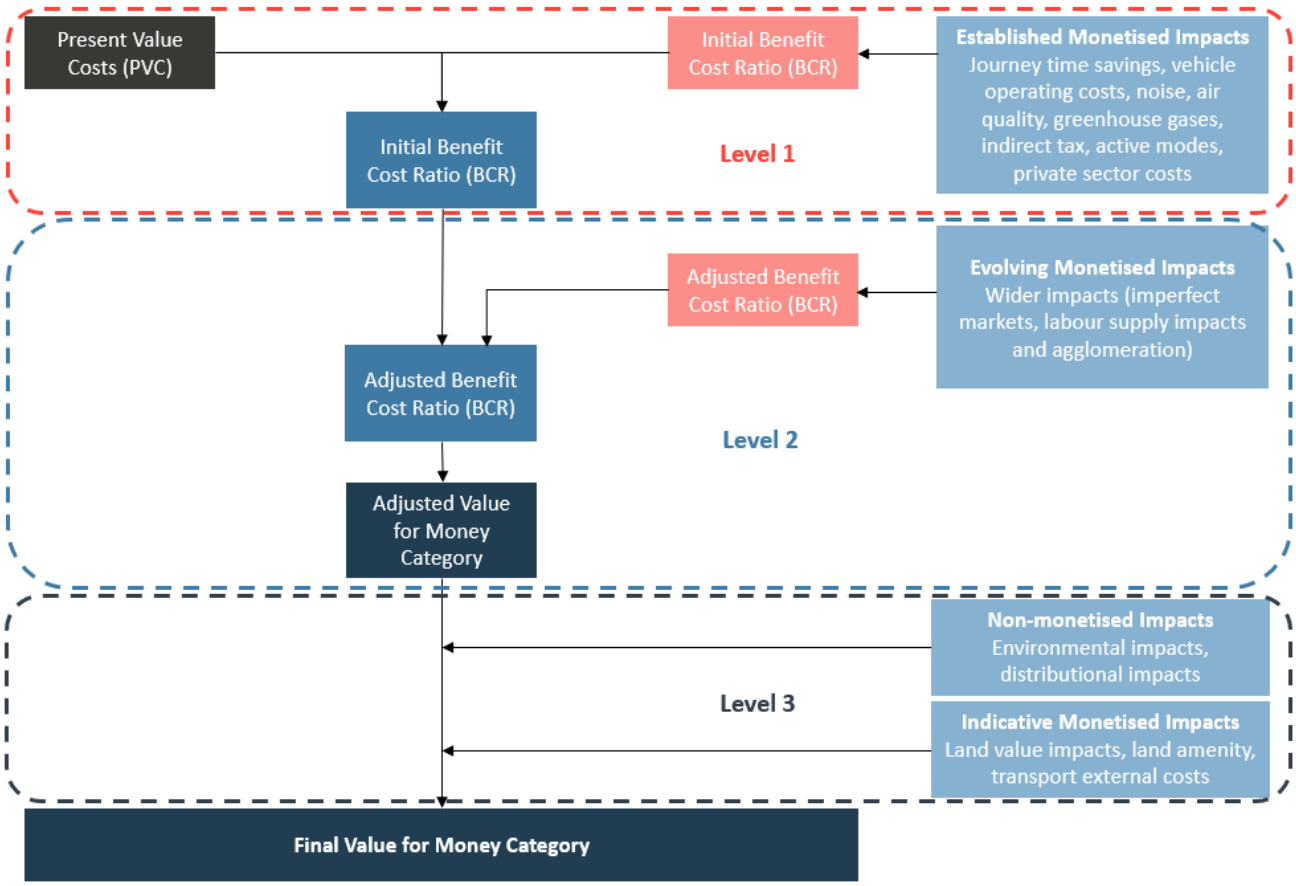
3.1.3 A Benefit to Cost Ratio (BCR) can be calculated from the economic assessment by comparing the scheme costs against the outturn benefits over a 60-year appraisal period. The value for money of the scheme will consider these benefits together with other impacts.

3.2 DESCRIPTION OF THE ECONOMIC ASSESSMENT PROCESS

3.2.1 In accordance with TAG Unit A1.1 'Cost-Benefit Analysis' the economic assessment period should be defined to capture the planned period of scheme development and implementation, ending 60 years after the scheme Opening Year.

3.2.2 Figure 3-1 shows the breakdown of benefits across the different levels.

Figure 3-1 - Process to derive BCR and Value for Money Category



3.2.3 The DfT Value for Money Framework identifies three categories of monetised impacts and a set of non-monetised impacts:

- **Established:** where the method for estimating the impact and the monetary value is tried-and-tested (these impacts can be captured in **Level 1** of the VfM analysis and contribute to the initial Benefit Cost Ratio (BCR) calculation)
- **Evolving:** where some evidence exists to support the estimation of a monetary value but is less widely accepted and researched (these impacts can be captured in **Level 2** of the VfM analysis and contribute to the adjusted Benefit Cost Ratio (BCR)
- **Indicative**: where monetary valuation methods are not considered widely accepted or researched to be definitive, with a high degree of uncertainty in terms of the magnitude of the impact (these impacts can be captured in **Level 3** of the VfM analysis)

3.2.4 In line with the DfT Value for Money Framework, both established and evolving impacts were combined to derive the monetised impacts. These were compared with costs to produce the initial and adjusted BCRs.

3.2.5 The final stage of the Value for Money assessment requires consideration of indicative monetised impacts and non-monetised impacts. This involves determining whether these impacts have the

potential to alter the overall Value for Money category. This analysis is termed sensitivity or 'switching-value' analysis.

3.2.6 Distributional Impact analysis has been undertaken to support the economic analysis of the scheme.

3.2.7 The methods used to appraise each scheme and how these fit within the Value for Money framework is summarised in Table 3-1.

Table 3-1 – Impacts Appraised

Analysis Level	Scheme Impacts	Selected Appraisal Method
Level 1 - Initial BCR	Journey times and vehicle operating costs	Monetised – Transport Users Benefit Appraisal ("TUBA") software
	Greenhouse gas emissions	Monetised – TAG Unit A3 method
	Noise	Monetised – TAG Unit A3 method
	Air quality	Monetised – TAG Unit A3 method
	Government tax revenues	Monetised – Transport Users Benefit Appraisal ("TUBA") software
	Accidents	Monetised – Cost and Benefits to Accidents – Light Touch ("COBALT") software
	Active mode benefits from walking and cycling	Monetised – Active Mode Appraisal Toolkit (AMAT)
Wider Benefits	Monetised – Wider Impacts in Transport Appraisal (WITA) toolkit emulator	
Land Value Uplift	Monetised – Land Value Uplift and Additionality calculation has been undertaken to capture the full extent of welfare benefits in scenarios with variable land use	
Land Amenity impacts	Monetised – DCLG (now MHCLG) Amenity Impact calculation undertaken to capture the full extent of the development impacts	
Transport External Costs	Monetised – Transport User Benefits Appraisal ("TUBA") software	
Environment	Qualitative – Evaluation of changes in the environmental impacts directly related to the scheme (TAG Unit A3)	

3.2.8 As described in TAG unit A1.1, two forecast years have been defined for the Long Stratton Bypass scheme. The two forecast years are as follows:

- 2024 (the scheme Opening Year);
- 2039 (the scheme Design Year – 15 years following opening); and

3.2.9 The impacts of the scheme are based on the difference between forecasts of the without-scheme (Do-Minimum) and with-scheme (Do-Something) scenarios. The benefits arising due to these changes are interpolated between each of the forecast years and extrapolated from the final forecast year to cover the whole appraisal period. The extrapolation of the Horizon Year benefits up to the year 2085 assumes zero growth in the magnitude of impacts.

3.2.10 Costs and benefits occur in different years throughout the appraisal period. In order to compare benefits and costs it is therefore essential that they are converted to a common price base and value, known as a Present Value Year.

3.2.11 Adjusting benefits and costs from a 2010 price base to a 2010 present value, a process called discounting, is completed within TUBA. This uses the standard DfT discount rates of 3.5% per year for the first thirty years following scheme opening and then at 3.0% per year for the remainder of the appraisal period.

3.2.12 Scheme costs can also be defined in a different price base to the 2010 price base used for this assessment. For this assessment, costs have been converted in 2010 prices, in line with TAG Unit A1.2.

3.2.13 It is also important that the unit of account is consistent between costs and benefits. The two different units of account are market prices and factor costs. Market price unit of account includes indirect taxation and reflects the prices paid for services by consumers. Factor cost unit of account excludes indirect taxation and is usually used for prices paid by the Government and business.

3.3 OPTIONS APPROACH

3.3.1 The economic approach is based on the approach set out in TAG Unit A2.2 Appraisal of Induced Investment which requires the preparation of scenarios P, S, Q and R, as discussed in 2.4. It provides guidance on how to assess the value of transport schemes, particularly the impacts of induced investments to the local economy.

3.3.2 Therefore, a dependent development test has been undertaken, based on the requirement specified within the Long Stratton Area Action Plan – i.e. for the bypass to be completed before occupancy of the 250th new home from development within Long Stratton. This ‘deadweight’ figure of 250 homes is also a Planning Condition for the housing development, and therefore any development in excess of 250 homes is “dependent” upon the construction of bypass.

3.3.3 As part of the DfT requirements for this dependency test, the traffic model developed to assess the scheme should seek to confirm the point at which the highway network cannot accommodate any additional traffic (from future development) without existing users suffering from a deterioration in the ‘level of service’ (i.e. experiencing delay). This point sets the theoretical threshold from which to prevent any additional development from coming forward. Completion of this modelling test with the

250 home 'deadweight' did indicate some deterioration in the 'level of service', but it did not categorically confirm an "unreasonable level of service", which the test seeks[7].

3.3.4 In order to provide greater certainty in the results of the appraisal and Value for Money assessment, but still adhere to the DfT appraisal guidance, a second dependent development test was undertaken with a higher 'deadweight' value[8]. There is no suggestion that there could be any increase in the number of homes that could be built prior to the bypass being constructed (250 units), it could not; this is encapsulated in policy and the NCC development management function are unwavering in this position. This value was also tested and re-affirmed by the Planning Inspector at Public Inquiry of the Joint Core Strategy. However, a greater deadweight value, determined via the application of TAG appraisal guidance rather than policy, would likely generate a different set of outturn appraisal results and potentially different Value for Money category. A secondary appraisal was therefore undertaken to determine this alternative set of results and is presented alongside the initial appraisal method to provide a range. This also provides greater transparency of the appraisal process and provides decision-makers with additional information and thus level of certainty of the results.

3.3.5 A second dependent development test was consequently undertaken based on a higher 'deadweight' value of 979 homes. Section 2.4 describes how the number of deadweight homes is captured as part of the scenario forecasting. The deterioration of network performance (level of service) is much greater using this value, and 'development dependency' therefore more clearly demonstrated.

3.3.6 Finally, to provide a complete picture of the likely Value for Money assessment outcome, an alternative appraisal method was employed, one which excluded the dependency test altogether (and associated land value uplift), in a counter factual scenario where a planning condition didn't exist and no deadweight was set. This model scenario would include the full development build-out (1885 homes) within both the Do Minimum and Do Something model scenarios, with all scheme benefits captured within the Level 1 VfM Framework appraisal (i.e. within the initial BCR).

3.3.7

[7] Within TAG "There is no precise definition of **reasonable level of service**. However, if additional traffic can be accommodated by the network without significant increases in the costs of travel for existing users, then the network can be assumed to be providing a reasonable level of service." Emphasis added (2.2.2, TAG A2.3, 'Transport Appraisal in the Context of Dependent Development', (2015)

[8] Within the calculation this would likely simultaneously increase user benefits (within the initial BCR through further congestion relief) and reduce Land Value Uplift benefits.

3.3.8 Table 3-2 presents the details and assumptions of the three appraisal methods / options that have been undertaken. It also shows the transport modelling scenarios tested for each option as described in section 2.4.

Table 3-2 - Long Stratton Bypass appraisal options

Appraisal Methodology Option	Description	Transport modelling scenarios tested
A	▪ This method was described in the ASR ▪ Level 1 TUBA impacts based on DM scenario of deadweight of 250 homes ▪ Level 2 WITA impacts based on DM scenario of deadweight of 250 homes ▪ Level 3 land value impacts and transport external costs based on additional homes of 1,635 ▪ Dependent development testing undertaken	**Transport User Benefits** - *'Scenario P / (DM includes 250 dwellings as deadweight)'* vs *'Scenario S / Do Something 1 (DS1 includes 250 dwellings as deadweight)'* **Transport External Costs** – *'Scenario R / (DS2 includes 250 dwellings as deadweight)'* vs *'Scenario S / (DS1 includes 250 dwellings as deadweight)'*
B	▪ This utilises the same method described in the ASR but with an alternative deadweight figure used within the appraisal ▪ Level 1 TUBA impacts based on DM scenario of deadweight of 979 homes ▪ Level 2 WITA impacts based on DM scenario of deadweight of 979 homes ▪ Level 3 Land value impacts and transport external costs based on additional homes of 906 ▪ Dependent development testing undertaken	**Transport User Benefits** - *'Scenario P / (DM includes 979 dwellings as deadweight)'* vs *'Scenario S / Do Something 1 (DS1 includes 979 dwellings as deadweight)'* **Transport External Costs** – *'Scenario R / (DS2 includes 979 dwellings as deadweight)'* vs *'Scenario S / (DS1 includes 979 dwellings as deadweight)'*
C	▪ This is a change in method from that set out in the ASR ▪ Impacts calculated for Initial (Level 1) and Adjusted (Level 2) BCRs only ▪ Level 1 impacts based on DM scenario with no deadweight with the full build out / no constraint on residential development (1,885 homes) ▪ No dependent development test and no LVU impacts included in Level 3 analysis	**Transport User Benefits** – *'Scenario R / (DS2)'* vs *'Scenario Q / (DSQ)'* **Transport External Costs** – Not tested as this assumes no dependent development

3.4 USE OF VARIABLE DEMAND MODELLING

3.4.1 The model is a highway only, fixed-demand assignment model. The justification for this was set out within a technical note entitled 'Long Stratton VDM Requirement Technical Note' (2019)" and accepted by the DfT.

4 SCHEME COSTS

4.1 INTRODUCTION

4.1.1 The cost of the proposed scheme has been estimated at 2020 prices, as set out in the Financial Case. It includes all costs associated with scheme preparation and construction, including land costs.

4.1.2 The costs have been calculated in line with TAG A1.2 Scheme Costs (July 2017), which uses the following methodology:

- Estimation of a base cost estimate
- Incorporation of a real cost increases
- Application of risk-cost adjustment
- Application of optimism bias-cost adjustment
- Rebase cost to Department base year
- Discount cost to Department base year
- Convert costs to market prices

4.1.3 Costs have been estimated under two broad headings:

- Investment costs (scheme preparation and construction)
- Maintenance and renewal costs

BASE COST ESTIMATE

4.1.4 The initial capital cost estimate of the scheme is **£28.6m** in 2020 Q2 prices. This includes costs for construction, statutory undertakers work, land and other costs such as professional fees. As land is being gifted by the developer / landowners to the Council as part of this scheme, the value of the land is included as a cost within the economic appraisal (see Table 4-1) but is not included in the Financial Case – Budget Impact Summary.

Table 4-1 - Investment Costs, £000s at 2020 Q2

Investment costs	Cost (£000s) at base price 2020 Q2
Construction cost	21,331
Statutory	1,794
Professional fees	5,255
Land	262
Total	**28,641**

4.1.1 This base cost estimate does not take account of real increases in costs and must therefore be adjusted to provide real costs that account for the effects of inflation.

4.1.2 The whole life costs of the scheme have also been estimated. A breakdown of the estimated capital renewal, annual maintenance and bridge operation costs is presented in Table 4-2.

Table 4-2 - Breakdown of capital maintenance, renewal and operating costs

Year after opening	Costs (£000s) at base price 2020 Q2	Costs (£000s) adjusted for inflation
Total (60 years)	**5,143**	**11,493**

INCORPORATION OF REAL COST INCREASES

4.1.3 The first step of cost adjustment is to incorporate real cost increases. A real cost adjustment is calculated by inflating base costs by the construction cost index to bring them to their nominal values, and then dividing by the rate of general inflation to give their 'real' value. General inflation is assumed to be around 2-2.50% per year as provided in the TAG Databook, while construction costs are forecast to increase by 2.1% per year. Using the real cost adjustment to multiply by the initial base estimate derives a 'real' capital cost estimate.

4.1.4 Only the general inflation rate has been applied to the maintenance and renewals costs. Therefore, it assumes zero real cost inflation over the appraisal period.

Table 4-3 - Real adjusted Costs (£000s)

	2021	2022	2023	2024	Total (over 60 years)
Scheme Base Cost	1,989	3,766	8,490	14,397	28,641
Real Adjustment Factor	1.002	1.003	1.003	0.992	
Investment Cost w/Real adjustment	1,992	3,777	8,519	14,284	28,572

APPLICATION OF RISK-COST ADJUSTMENT

4.1.5 Once the base cost estimate has been adjusted to incorporate real cost increases, the risk contribution is calculated. This used two methods within this appraisal: use of Quantified Risk Assessment (QRA) of scheme investment costs, using a P90 probability value of £4.96 million, plus an additional contingency to account for COVID-19 and Brexit. The QRA provides the weighted average of all risk outcomes and probabilities. The process of capturing and quantifying risk for the scheme is presented in the Management Case. Additional risk has been included as part of the cost estimates to uncertainty surrounding reflected by the Major Schemes. A rate of 4.54% of the construction and statutory total

and also a 5% of construction costs to reflect the uncertainty surrounding Brexit and COVID-19 have been included.

4.1.6 As noted in the Financial Case, the total quantified risk value added to the scheme base costs is £7.08m at 2020 Q2 prices. This equates to approximately 24.7% of base costs.

4.1.7 No risk-adjustment has been applied to the maintenance costs.

Table 4-4 – Risk adjusted Costs (£000s)

Costs (£000s)	2021	2022	2023	2024	Total
Public sector investment costs with real cost adjustment	1,395	2,460	5,963	9,999	19,817
Private sector investment costs with real cost adjustment	598	1,317	2,556	4,285	8,756
Total real costs (without risk)	**1,992**	**3,777**	**8,519**	**14,284**	**28,572**
Public quantified risk cost with real cost adjustment	322	611	1,378	2,310	4,621
Private quantified risk cost with real cost adjustment	138	262	591	990	1,981
Total quantified risk cost in real prices	**460**	**873**	**1,968**	**3,301**	**6,602**
Public sector risk adjusted costs with real cost adjustment	1,717	3,071	7,341	12,309	24,438
Private sector risk adjusted costs with real cost adjustment	736	1,579	3,146	5,275	10,736
Total risk-adjusted cost in real prices real adjustment	**2,452**	**4,649**	**10,487**	**17,583**	**35,174**

Application of optimism bias-cost adjustment

4.1.8 In line with TAG Unit A1.2, an optimism bias adjustment of 15% has been applied to all capital costs to ensure that the cost-benefit analysis is robust. It is only applied to costs in the economic assessment and is not included in the forecast out-turn costs in the Financial Case. The recommended optimism bias uplifts for each stage of a transport project and type of scheme for Local Authority schemes are set out in Table 4-5.

Table 4-5 - Recommended optimism bias uplifts (Source: TAG Unit A1.2, Scheme Costs)

Category	Types of projects	Stage 1 Strategic Outline Business Case	Stage 2 Outline Business Case	Stage 3 Full Business Case
Road	Motorway, Trunk roads, Local roads	44%	15%	3%

4.1.9 Optimism bias has not been applied to the maintenance and renewals costs. The impact of applying different optimism bias values to the costs on the VfM analysis are tested within the Sensitivity Testing Section. Table 4-6 shows the application of optimism bias to public sector risk adjusted costs (calculated in Table 4-4).

Table 4-6 - Costs adjusted for Optimism Bias

Costs (£000s)	2021	2022	2023	2024	Total
Public Sector Risk adjusted costs	1,717	3,071	7,341	12,309	24,438
Optimism bias (15%)	258	461	1,101	1,846	3,666
Public investment costs with 15% optimism bias	1,974	3,531	8,442	14,156	28,104

Rebase cost to Department base year

4.1.10 For appraisal purposes, all costs should be presented in the Department's base year, 2010. Costs are deflated to the correct price base by multiplying them by the ratio of the inflation index in the desired base year to the inflation index in the year currently being used.

4.1.11 Costs have been adjusted to 2010 prices using TAG data book (July 2020) values as set out in Table 4-7 as set out in Table 4-8.

Table 4-7 - Adjustment to 2010 prices

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
GDP Deflator	100.00	102.04	103.73	105.70	107.63	108.26	110.57	112.66	115.07	117.21	119.37	121.66	124.04	126.50	129.41

Table 4-8 - Rebased Costs to 2010 Prices

Costs (£000s)	2021	2022	2023	2024	Total
Public investment costs with 15% optimism bias	1,974	3,531	8,442	14,156	28,104
GDP deflator factor	0.84	0.84	0.84	0.84	
Public investment costs with deflation	1,654	2,958	7,073	11,859	23,544

Discount cost to Department base year

4.1.12 As well rebasing, a discount factor is applied to costs based on the HM Treasury Green Book to adjust costs occurring in different periods to a standard base year of 2010. Our model period takes place between the years 2010 and 2099; therefore, a discount rate of 3.5% per year is applied for years 2010 until 2048 (first 30 years plus the 9 years between the model period start and the appraisal period start), with a rate of 3% per year applied for the next 45 years between 2049 and 2093, and 2.5% thereafter. This reflects the lower weighting placed on costs (and benefits) incurred at a future date compared to those incurred in the present.

Table 4-9 - Scheme Costs Discounted to 2010 Present Value

Costs (£000s)	2021	2022	2023	2024	Total
Public investment costs with deflation	1,654	2,958	7,073	11,859	23,544
Discount rate	3.5%	3.5%	3.5%	3.5%	
Discount factor	0.68	0.66	0.64	0.62	
Public investment costs with deflation & discounting	1,133	1,958	4,522	7,326	14,939

Convert costs to market prices

4.1.13 The last stage in preparing costs for appraisal is to convert them from the factor cost to the market price unit of account. This is completed by using the indirect tax correction factor of 1.190, as per the TAG Data Book.

4.1.14 In line TAG Unit A1.2 (Scheme Costs), the Present Value of Costs (PVC) only includes investment and operating costs incurred by the public sector. Private sector contributions to the scheme costs are not included in PVC but are recorded as negative values in the Transport Economic Efficiency (TEE) table and Present Value of Benefits (PVB).

4.1.15 Table 4-10 shows the present value of scheme costs after rebasing and discounting to the Department base year.

Table 4-10 - Present Value of Costs

Costs (£000s)	Scheme preparation and construction cost	Maintenance, renewal and operational cost	Total cost
Public Sector risk adjusted costs	24,438	5,143	29,582
Public investment costs with 15% optimism bias	28,104	5,143	33,248
Public investment costs with deflation	23,544	4,309	27,854
Public investment costs with deflation & discounting	14,939	1,091	16,032
PVC with Market Price Adjustment - Public sector costs only	17,778	1,299	19,077
PVC with Market Price Adjustment – Private	6,799	**0**	6,799

4.1.16 In line with TAG Unit A1.2 (Scheme Costs), sunk costs have not been included in Table 4-10 as these are costs that represent expenditure prior to the economic appraisal, and cannot be retrieved

5 ESTIMATION OF LEVEL 1 IMPACTS

5.1 INTRODUCTION

5.1.1 This chapter sets out the methodologies and assumptions used for the estimation of the various elements comprising in Level 1:

- Transport User Benefits
- Active Mode Appraisal Toolkit
- Safety

5.1.2 For each of the different types of benefit detailed, their status within the economic assessment (either initial BCR, adjusted BCR or sensitivity test) and whether or not they are monetised is noted.

5.2 TRANSPORT USER BENEFITS

INTRODUCTION

5.2.1 The Transport User Benefits consist of travel time and Vehicle Operating Cost (VOC) benefits as a result of the scheme. These benefits have been assessed using DfT program TUBA (Transport Users Benefit Appraisal) version 1.9.14 and the corresponding relevant economic parameters from the WebTAG Databook (July 2020 v1.13.1). The software carries out the appraisal of the following economic elements associated with the scheme (excluding those accrued during construction and maintenance):

- Travel time savings
- Vehicle Operating Cost (VOC) savings
    - Fuel VOC
    - Non-fuel VOC
- Indirect tax revenues

5.2.2 The assessment has been undertaken in line with the guidance provided in WebTAG Unit A1.1 Cost Benefit Analysis (May 2018) and Unit A1.3 User and Provider Impacts (March 2017). Benefits are derived by comparing the overall travel times and VOCs for the Do-Minimum and Do-Something scenarios. Benefits are then converted into a monetary value.

5.2.3 Benefits are segregated as employer's business, commuting and 'other' benefits.

5.2.4 Business Benefits are the benefits accrued by business travellers, including car (and van) occupants travelling on employer's business. This group also includes HGV drivers. Consumer Users are non-business travellers, in cars and vans.

5.2.5 Commuters are classed as consumers as they are travelling in their own time, not that of their employers.

5.2.6 TUBA uses standard values of time, based on average earnings, with the values for time in the course of work (employers' business) being much higher than personal time (including commuting).

5.2.7 TUBA takes, as its principal input, zone to zone matrices of trip numbers, travel times and distances travelled.

5.2.8 WebTAG requires that cost should be presented in the Department for Transport's (DfT) base year which is 2010. These are then discounted to a present value year also defined by the DfT as 2010.

FORECAST YEARS, SCENARIOS AND APPRAISAL PERIOD

5.2.9 The scheme has been appraised for the forecast years of 2024 (opening year) and 2039 (15 years beyond the opening year) and the appraisal period is 60 years (2024-2083), commencing in the opening year.

5.2.10 The impacts of the scheme are based on difference between the without-scheme (Do-Minimum) and with-scheme (Do-Something) scenarios. The benefits due to these changes are interpolated between each forecast year and extrapolated from the final forecast year to the last appraisal year (2083), to cover the 60-year appraisal period. The extrapolation of benefits from the last forecast year (2039) to the last appraisal year (2083) assumes zero growth in the magnitude of impacts.

5.2.11 For the economic appraisal of Long Stratton Scheme, the transport user benefits have been assessed in the context of dependent development as per the WebTAG guidance in TAG Unit A2.2, Induced Investment, as explained in the economic approach, chapter 3.

USER CLASSES

5.2.12 The user classes modelled in SATURN have been aggregated to match TUBA's user classes. LGVs are further split into personal and freight based on WebTAG split, while HGVs are split into OGV1 and OGV2 based on traffic counts. The user classes used for TUBA analysis are provided in Table 5-1.

Table 5-1 – TUBA User Classes

TUBA UC	Vehicle	Purpose	Person	Model UC
1	Car	Commuting	All	1
2	Car	Commuting	All	2
3	Car	Business	All	3
4	Car	Business	All	4
5	Car	Business	All	5
6	Car	Other	All	6
7	Car	Other	All	7
8	Car	Other	All	8
9	LGV Personal	All	All	9
10	LGV Freight	Business	All	9
11	OGV1	Business	All	10
12	OGV2	Business	All	10

ANNUALISATION FACTORS

5.2.13 In accordance with TUBA guidance, annualisation factors are used to expand the daily modelled time periods to those that occur within a full year.

5.2.14 Benefits have been calculated for the following time periods over the 60 year appraisal period:

- AM (07:00-10:00)
- Inter-Peak (10:00-16:00)
- PM (16:00-19:00)

5.2.15 The modelled AM and PM peak hours were expanded using the relationships between the observed average three-hour period flows and the single peak hour flows, for the AM and PM peak hours respectively. The modelled interpeak hour represents an average hour in the 6-hour interpeak period and was expanded appropriately using a factor of 6. The benefits at weekends and on bank holidays have not been considered and therefore, the calculated benefits represent a conservative estimate.

5.2.16 Given that the base models represent an average Monday-Friday and that it was validated as such using local Automatic Traffic Counts (ATC) data, a factor of 253 was applied to all three-time periods, representing the number of weekdays in a year (excluding bank holidays). The peak hour to peak period and annualisation factors applied are shown in Table 5-2.

Table 5-2 – Annualisation Factors

Time Period (Monday – Friday)	Peak Hour to Peak Period Factor	Number in Year	Annualisation Factor
AM Peak (08:00 – 09:00)	2.83	253	716
Inter Peak (10:00 – 16:00)	6	253	1518
PM Peak (17:00 – 18:00)	2.69	253	680

INPUT MATRIX CONVERSION AND UNITS

5.2.17 The following steps are taken to convert the SATURN matrices to be used in TUBA:

- Convert the input trip matrices from PCU to vehicles;
- Split the model's single LGV user class into LGV personal and LGV freight user classes for TUBA using factors from TAG Unit A1 (section A1.3.4); and
- Split the model's single OGV user class into OGV1 and OGV2 user classes for TUBA using locally collected ATC data to get the proportions of OGV1 and OGV2 traffic, considering the model's PCU factor of 2.3 for OGV.

5.2.18 The resultant factors applied to the trip matrices are shown in Table 5-3.

Table 5-3 – Trip Matrix Factors

UC	AM	IP	PM
1	1.00	1.00	1.00
2	1.00	1.00	1.00
3	1.00	1.00	1.00
4	1.00	1.00	1.00
5	1.00	1.00	1.00
6	1.00	1.00	1.00
7	1.00	1.00	1.00
8	1.00	1.00	1.00
9	0.12	0.12	0.12
10	0.88	0.88	0.88
11	0.16	0.14	0.10
12	0.27	0.29	0.33

SECTORAL ANALYSIS

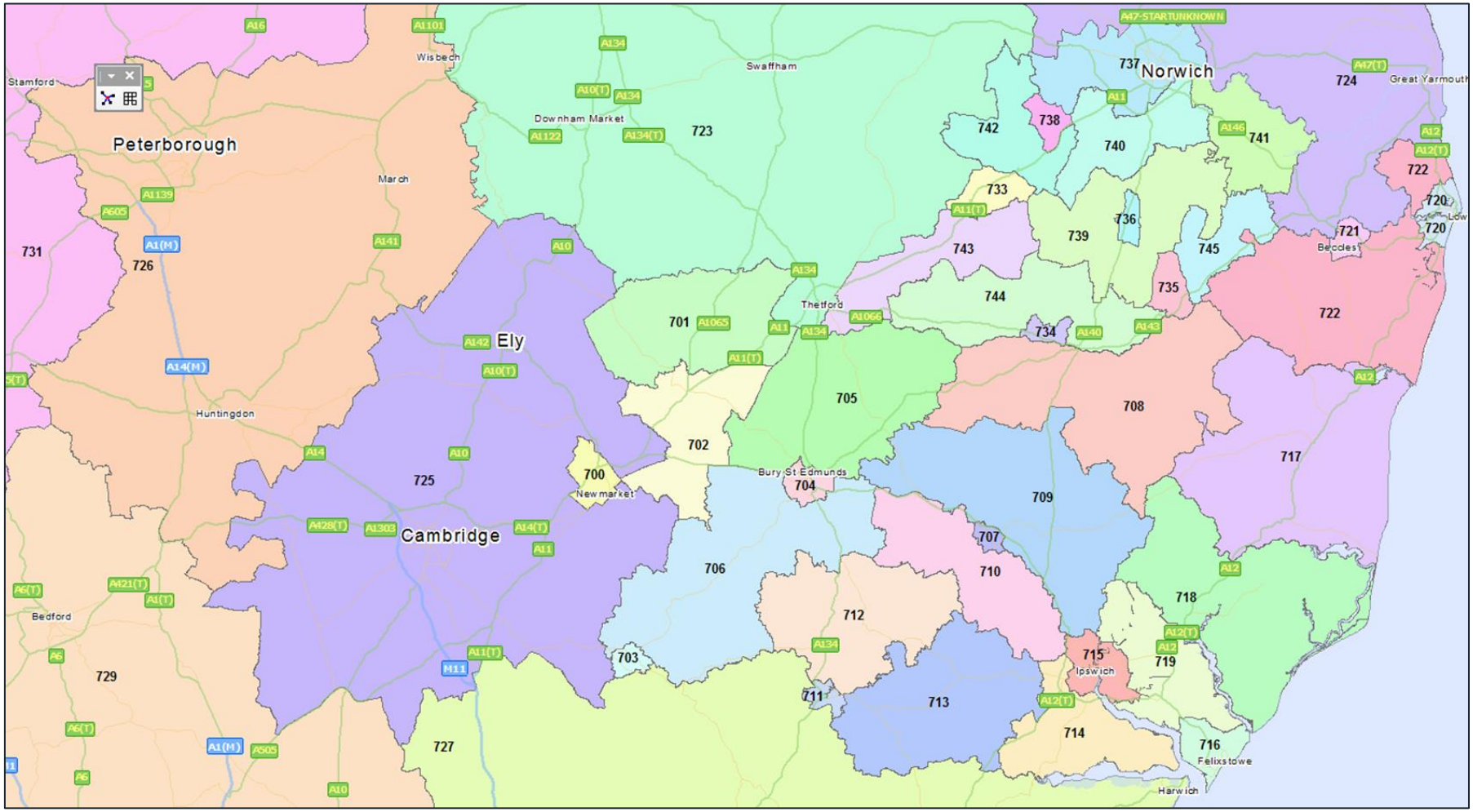
The LSTM has 1200 zones between which trips are assigned on the road network. Although the TUBA programme has sufficient capacity to read this data from the matrices, it is only able to analyse benefits geographically between a much smaller number of zones, which in this context are known as “Sectors”. The zones in the model have been assigned to 46 sectors, as shown in the

5.2.19 Table 5-4 and geographically illustrated in Figure 5-1. The internal sectors, those that fall within the LSTM study area, are indicated by the green shading.

Table 5-4 – LSTM Sectors

Sector ID	Sector Name	Sector ID	Sector Name
700	Newmarket	723	Norfolk West
701	Forest Heath North	724	Norfolk East
702	Forest Heath South	725	Cambridgeshire County SE
703	Haverhill	726	Cambridgeshire County NW
704	Bury St Edmunds	727	Essex County N
705	St Edmundsbury North	728	Essex County S
706	St Edmundsbury South	729	East of England W
707	Stowmarket	730	Greater London
708	Mid Suffolk North	731	Great Britain North
709	Mid Suffolk Central	732	Great Britain South
710	Mid Suffolk South	733	Attleborough
711	Sudbury	734	Diss
712	Babergh West	735	Harleston
713	Babergh Central	736	Long Stratton
714	Babergh East	737	Norwich
715	Ipswich District	738	Wymondham
716	Felixstowe/Trimley	739	Mid - South Norfolk
717	Suffolk Coastal North	740	North - South Norfolk
718	Suffolk Coastal Central	741	North East - South Norfolk
719	Suffolk Coastal South	742	North West - South Norfolk
720	Lowestoft	743	South West - South Norfolk
721	Beccles/Worlingham	744	South - South Norfolk
722	Waveney	745	South East - South Norfolk

Figure 5-1 - LSTM Sectors



5.2.20 Sectoral level spatial analysis of user benefits across the full appraisal period was undertaken to ensure that the TUBA outputs were consistent across time periods and forecast years, and to verify that they were in line with logical expectations.

5.2.21 It is considered that sector benefits were reflective of where benefits in delay and journey time were occurring as a result of implementing the scheme.

MASKING

5.2.22 Model noise can result in benefits being spurious by the TUBA programme for sectors which are far away from the scheme area, therefore, the user benefits for such sectors have been removed from the economic assessment undertaken using TUBA.

5.2.23 Sector movements have been reviewed to assess which sector movements are relevant to the scheme and those movements which are not impacted by the scheme have not been included in the benefits presented in the results. These are defined as 'internal' and 'external' sectors; generally speaking, internal sectors are all those that fall within, or on the boundary of, the LSTM Study Area as shown in Figure 2-5. Sector movements from 'external' to 'external' sector have been masked out of the TUBA analysis, retaining only 'internal-internal', 'internal-external' and 'external-internal' movements.

5.2.24 Sector masking is shown in Figure 5-2. The red cells (zero) are the sectoral movements for which the user benefits are external and thus irrelevant to the scheme and hence, have been masked/excluded, and the rest of the sectoral movements are considered to be benefitting from the scheme and hence, have been retained for the transport user benefits calculations.

Figure 5-2 - Sector Masking

Origin	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745
700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
702	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
703	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
704	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
706	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
710	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
711	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
712	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
713	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
714	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
715	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
716	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
717	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
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719	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
721	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
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727	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
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740	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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744	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
745	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TUBA CHECKS

5.2.25 All data used by TUBA is read in from external data files: the scheme, economics and matrix data files. It is well understood that any errors in these files, or in the underlying transport model, can lead to incorrect results coming out of TUBA. Therefore, the input model data was checked thoroughly, along with the outputs from TUBA.

5.2.26 The main output files from TUBA were examined, focusing on the list of errors and warnings, user benefits and changes in revenues by mode, sub-mode, person types, purpose and time period. It was confirmed that:

- The scale of benefits is consistent with the scale of the scheme.
- The VOC benefits were no more than 10-20% of the value of time benefits.
- The road user benefits to consumers were of a similar order of magnitude to the benefits to business travellers.

5.2.27 TUBA undertakes a check on the inputs provided and identifies any large cost or matrix changes between the Do minimum and Do something. These have been investigated thoroughly to identify and correct any erroneous results. It should be noted that warnings of this sort are not necessarily an indicator of an error in the modelling however the TUBA warnings/errors can be used to feed back to the assignment model to investigate potential problems with the traffic models.

5.2.28 The following checks were undertaken on the TUBA output file:

- Matrix totals by vehicle classes are consistent with the input data;
- High/Low DS/DM travel time ratios were justified and deemed acceptable;
- High/Low DS/DM travel distance ratios were justified and deemed acceptable;
- High/Low DM/DS speeds were justified and deemed acceptable.

5.2.29 These warnings are summarised in Table 5-5, Table 5-6 and Table 5-7, for Option A, Option B and Option C respectively.

Table 5-5 – TUBA Warning Summary – Option A

Warning Description	Total	Serious
Ratio of DM to DS travel time lower than limit (DM time < DS time)	34	0
Ratio of DM to DS travel time higher than limit (DM time > DS time)	106	0
Ratio of DM to DS travel distance lower than limit (DM dist < DS dist)	49	0
Ratio of DM to DS travel distance higher than limit (DM dis > DS dist)	8	0
DM speeds less than limit	11,258	0
DM Speed greater than limit	399,907	0
DS speeds less than limit	11,214	0
DS speed greater than limit	405,891	0
Total Warnings	828,467	0

Table 5-6 – TUBA Warning Summary Option B

Warning Description	Total	Serious
Ratio of DM to DS travel time lower than limit (DM time < DS time)	0	0
Ratio of DM to DS travel time higher than limit (DM time > DS time)	111	0
Ratio of DM to DS travel distance lower than limit (DM dist < DS dist)	44	0
Ratio of DM to DS travel distance higher than limit (DM dis > DS dist)	43	0
DM speeds less than limit	9,916	0
DM Speed greater than limit	401,980	0
DS speeds less than limit	9,765	0
DS speed greater than limit	405,550	0
Total Warnings	827,409	0

Table 5-7 – TUBA Warning Summary - Option C

Warning Description	Total	Serious
Ratio of DM to DS travel time lower than limit (DM time < DS time)	144	56
Ratio of DM to DS travel time higher than limit (DM time > DS time)	497	80
Ratio of DM to DS travel distance lower than limit (DM dist < DS dist)	344	72
Ratio of DM to DS travel distance higher than limit (DM dis > DS dist)	49	0
DM speeds less than limit	11,131	0
DM Speed greater than limit	401,330	0
DS speeds less than limit	10,879	0
DS speed greater than limit	404,431	0
Total Warnings	828,805	0

5.2.30 In addition to the above warnings, the partitioned time benefits (*.tbn) file for all options have been examined. The partitioned time benefits files (*.tbn) cross-tabulates the percentage changes in travel time and trip numbers at origin-destination (OD) level. TUBA uses the rule of a half (ROH) to calculate user benefits. However, if the change in generalised cost between the Do Minimum and Do Something is too large then the ROH can become inaccurate.

5.2.31 The majority of time benefits in the according to change in travel time and change in trip numbers are in the range 0% to 10% for change in trip numbers, and 0% to 20% and 0% to -30% for change in travel time. Which means that there is no need to include an intermediate year between 2024 and 2039.

RESULTS

5.2.32 The Transport Economic Efficiency (TEE) benefits are derived from travel time and vehicle operating cost benefits as a result of the scheme.

5.2.33 TEE benefits for the scheme were assessed using the DfT's TUBA software. TUBA calculates the benefits associated with journey time savings and vehicle operating cost savings using information taken from the traffic model, in accordance with the procedures and economic parameters in TAG Unit A1. The latest TUBA 1.9.14 with the economics file v1.13.1 was used.

5.2.34 The private sector contributions to the scheme include £4.5 million developer contribution, plus £6.73 million from pooled Community Infrastructure Levy (CIL) funds, £11.1 million in total (as stated in the Financial Case). Once these private sector costs have been adjusted (following the process above of

adjustment to real prices, deflating, discounting and market price adjustment), they reduce to £6.8 million. This value is reported in the Transport Economic Efficiency (TEE) table.

5.2.35 These costs are recorded as a negative value in the Transport Economic Efficiency (TEE) table and Present Value of Benefits. The full TEE Table is included within the economic appraisal model and summarised in Table 5-8. The figures in this table exclude wider public finances.

Table 5-8 - Transport Economic Efficiency (TEE) Benefits

£000s, 2010 prices and values	£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Consumer – commuting user benefits	Travel Time	13,817	13,561	23,063
Consumer – commuting user benefits	Vehicle operating costs	932	842	1,169
Consumer – commuting user benefits	Subtotal	14,749	14,403	24,233
Consumer – other user benefits	Travel Time	14,008	14,962	21,983
Consumer – commuting user benefits	Vehicle operating costs	760	538	667
Consumer – commuting user benefits	Subtotal	14,768	15,500	22,650
Business benefits	Travel Time	11,760	12,891	13,209
Business benefits	Vehicle operating costs	1,454	1,336	1,533
Business benefits	Subtotal	13,215	14,227	14,742

£000s, 2010 prices and values	£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Private Sector	Investment costs	-6,799	-6,799	-6,799
Private Sector	Operating Costs	0	0	0
Private Sector	Subtotal	-6,799	-6,799	-6,799
Net Business Impact		6,416	7,428	7,943
Total TEE benefit		35,934	37,331	54,826

Benefits by User Class and Trip Purpose

5.2.36 The benefits have been calculated across different User Classes with Journey Time Saving account for 92.6%, 93.8% and 94.5% of the total User Benefit for Options A, B and C respectively.

5.2.37 Travel by car accounts for the largest proportion of benefits across the user classes split across business, commute and other.

5.2.38 Benefits have been presented as “User Benefits”, which are without taking the indirect tax revenue in to consideration, and adding the indirect tax revenue gives the “Total Benefits”. Table 5-9,

5.2.40 Table 5-10 and Table 5-11 present the benefits by user class and trip purpose.

Table 5-9 - Option A – Transport User Benefit, User Class and Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non fuel VOC	Indirect Tax	Total Benefits	User benefit
Car business	3,067	58	175	-31	3,269	3,301
Car Commute	13,817	618	313	-329	14,420	14,749
Car other	13,630	490	222	-266	14,075	14,342
LGV freight	6,283	191	291	-100	6,664	6,764
LGV other	378	26	22	-14	413	426
OGV1	804	13	97	-7	907	914
OGV2	1,606	255	375	-147	2,089	2,236
Total	39,586	1,651	1,496	-895	41,837	42,732

Table 5-10 - Option B – Transport User Benefit, User Class and Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non fuel VOC	Indirect Tax	Total Benefits	User benefit
Car business	3,353	30	167	-16	3,534	3,551
Car Commute	13,561	572	270	-308	14,095	14,403
Car other	14,544	344	161	-187	14,861	15,049
LGV freight	6,945	133	249	-70	7,256	7,327
LGV other	418	18	15	-10	441	451
OGV1	865	11	103	-6	973	979
OGV2	1,728	245	398	-141	2,229	2,370
Total	41,414	1,352	1,364	-739	43,391	44,130

Table 5-11 - Option C - Transport User Benefit, User Class and Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non fuel VOC	Indirect Tax	Total Benefits	User benefit
Car business	4,124	58	250	-33	4,398	4,431
Car Commute	23,063	855	314	-471	23,762	24,233
Car other	21,590	554	69	-326	21,887	22,213
LGV freight	6,532	178	275	-94	6,892	6,986
LGV other	393	24	20	-13	424	437
OGV1	831	12	100	-7	936	943
OGV2	1,721	265	394	-154	2,228	2,381
Total	**58,255**	**1,947**	**1,422**	**-1,098**	**60,527**	**61,625**

Benefits by Trip Purpose

5.2.41 Across all modes of transport, “other” trips have the highest benefits for Options A and B accounting for 34.7% and 35.3% of the total User Benefit respectively. For Option C, commuting trips contributed to the highest proportion of User Benefits accounting for 39.4%.

5.2.42 Table 5-12,

5.2.44 Table 5-13 and Table 5-14 present the benefits for Option A, B and C, by trip purpose.

Table 5-12 - Option A – Transport User Benefits by Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non-fuel VOC	Indirect Tax	Total Benefits	User benefit
Business	11,760	516	938	-286	12,929	13,215
Commute	13,817	618	313	-329	14,420	14,749
Other	14,008	516	244	-280	14,488	14,768
Total	11,760	516	938	-286	12,929	13,215

Table 5-13 - Option B – Transport User Benefits by Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non fuel VOC	Indirect Tax	Total Benefits	User benefit
Business	12,891	418	918	-234	13,993	14,227
Commute	13,561	572	270	-308	14,095	14,403
Other	14,962	362	176	-197	15,303	15,500
Total	12,891	418	918	-234	13,993	14,227

Table 5-14 - Option C – Transport User Benefits by Trip Purpose

£000s, 2010 prices and values	Time	Fuel VOC	Non fuel VOC	Indirect Tax	Total Benefits	User benefit
Business	13,209	514	1,019	-288	14,454	14,742
Commute	23,063	855	314	-471	23,762	24,233
Other	21,983	578	89	-339	22,311	22,650
Total	13,209	514	1,019	-288	14,454	14,742

Benefits by Time Period

5.2.45 The total benefits by time period for Option A, B and C are provided in Figure 5-3,

5.2.46 Figure **5-4** and Figure 5-5 respectively. For Option A and Option B, the AM and Inter-peak hours have almost the same benefits (AM peak is slightly higher), whereas for Option C, AM peak has almost double the benefits than those in Inter peak and PM peak hour.

Figure 5-3 - Option A – Transport User Benefits by Time Period

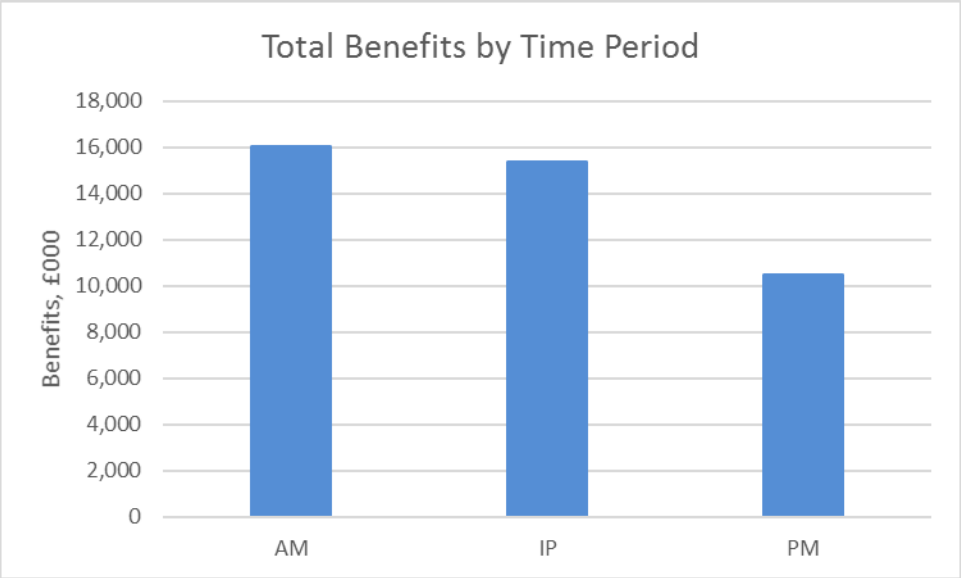


Figure 5-4 - Option B – Transport User Benefits by Time Period

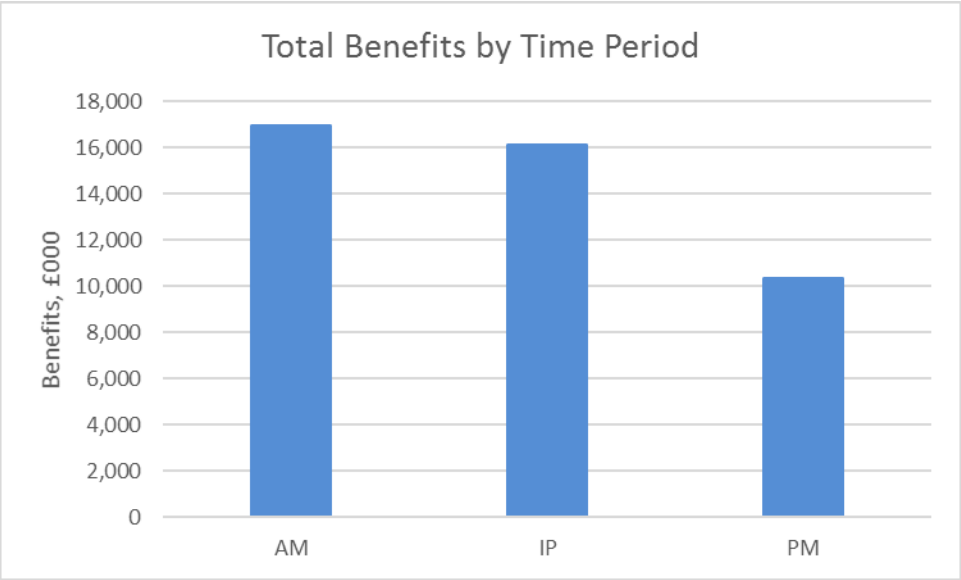
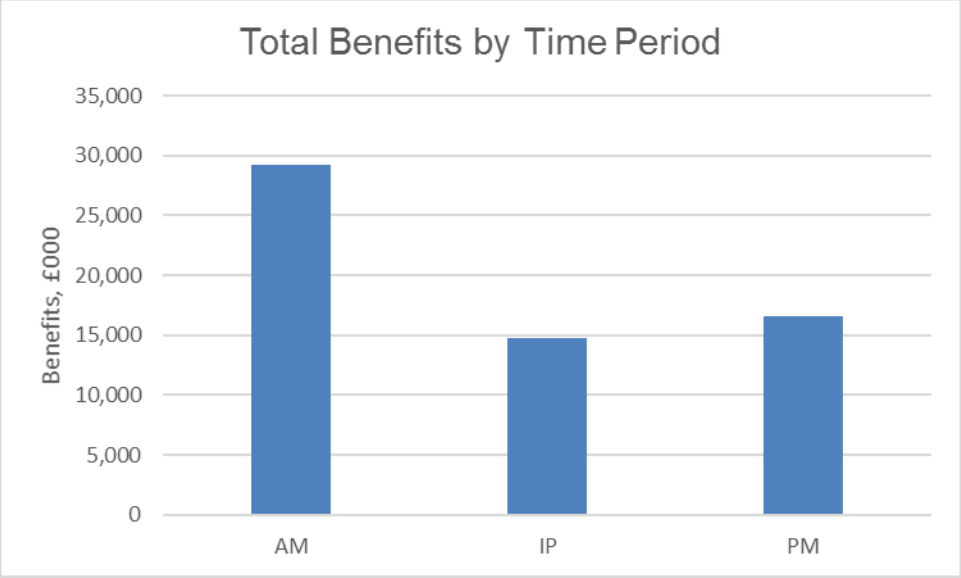


Figure 5-5 - Option C – Transport User Benefits by Time Period



USER BENEFIT PROFILE OVER THE APPRAISAL PERIOD

5.2.47 The benefits over the 60 year appraisal period for Option A, B and C are shown in Figure 5-6, Figure 5-7 and Figure 5-8 respectively. For Option A, highest benefits are in the opening year and benefits gradually decrease for the rest of the appraisal period. For Option B, the benefits are highest in the opening year and stay almost the same until the design year, and then gradually decrease for the rest of the period. For Option C, the benefits increase from opening year to the design year, with highest benefits in the design year, and then drop uniformly for the rest of the appraisal period.

Figure 5-6 – Option A – User Benefit Profile

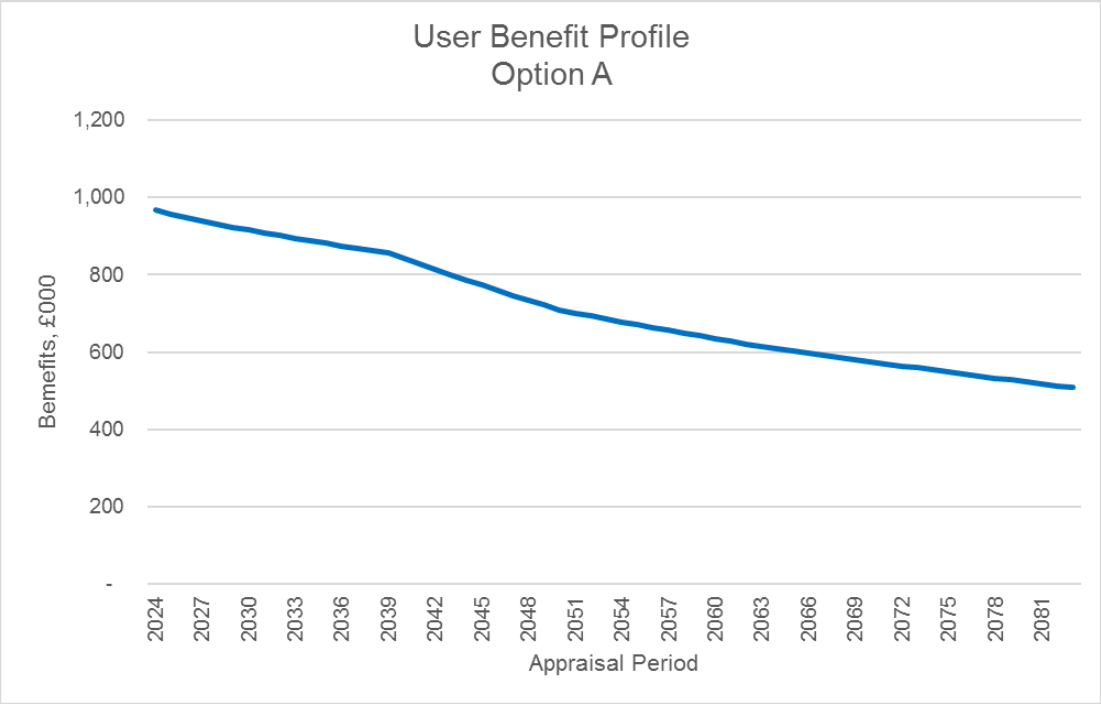


Figure 5-7 – Option B – User Benefit Profile

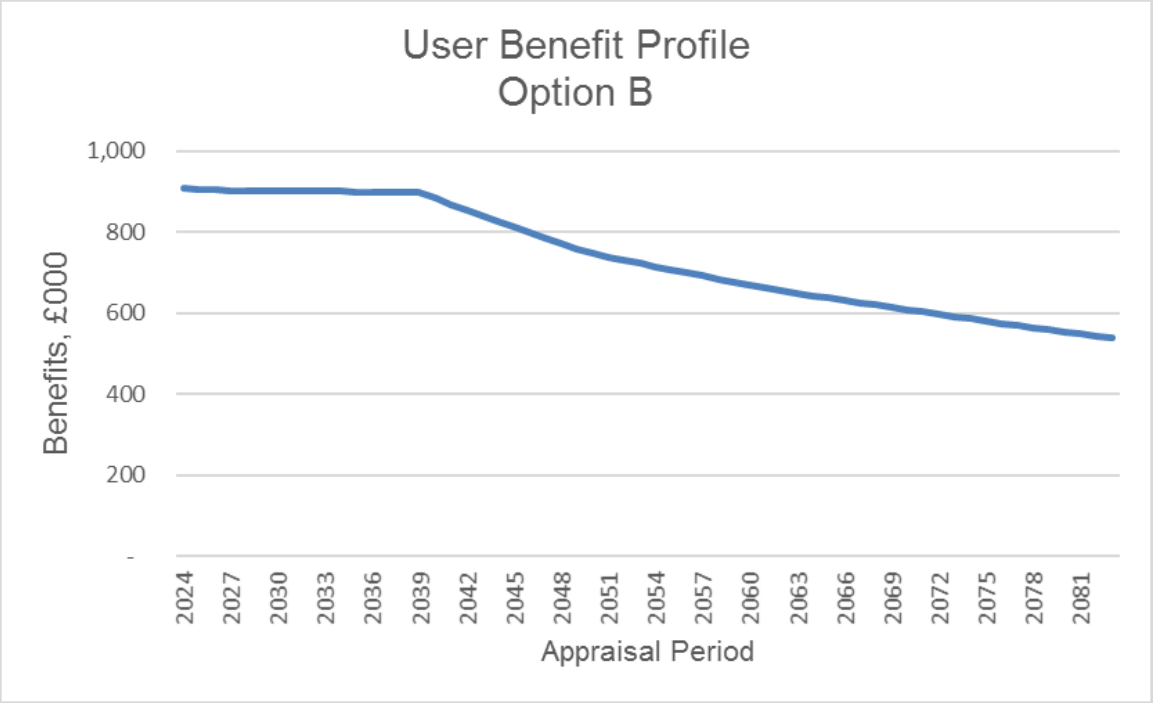
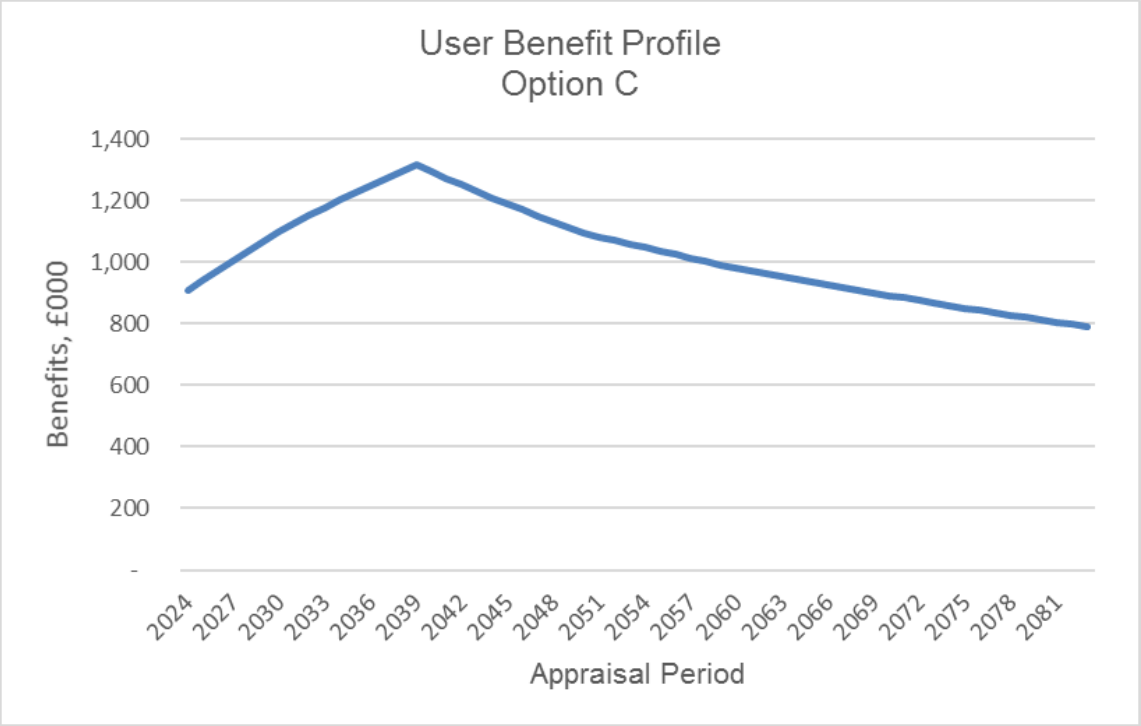


Figure 5-8 – Option C – User Benefit Profile



SECTOR BENEFITS

5.2.48 Sector benefits analysis is completed to understand the geographical location of the benefits and to verify that the benefits occur where they are expected.

5.2.49 The total benefits by origin and destination and the proportion of benefits in terms of total benefits has been summarised in Table 5-15, Table 5-16 and Table 5-17 for option A, B and C respectively.

5.2.50 It can be seen for Option A and Option B, the highest benefits are in Norwich (approx. 30%) and after that is Diss (12% origin/20% destination), as the Long Stratton bypass provides highest benefits to strategic trips travelling on A140.

5.2.51 For Option C, where no dependent development is tested, the highest benefits in origin trips are in Long Stratton (28%) and Norwich (28%), and for destination trips, highest benefits are in Norwich.

5.2.52 Therefore, the benefits are in sectors where they are expected. All benefits reported are masked benefits.

Table 5-15: Sector Benefits – Option A

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
		Origin	Destination	Origin	Destination
Newmarket	700	33,012	1,167	0.1%	0.0%
Forest Heath North	701	33,538	8,392	0.1%	0.0%
Forest Heath South	702	21,645	5,523	0.1%	0.0%
Haverhill	703	13,634	2,320	0.0%	0.0%
Bury St Edmunds	704	80,823	86,541	0.2%	0.2%
St Edmundsbury North	705	16,593	19,304	0.0%	0.0%
St Edmundsbury South	706	15,158	14,544	0.0%	0.0%
Stowmarket	707	82,679	62,681	0.2%	0.1%
Mid Suffolk North	708	1,270,052	1,674,686	3.0%	4.0%
Mid Suffolk Central	709	275,856	407,069	0.7%	1.0%
Mid Suffolk South	710	97,333	204,063	0.2%	0.5%
Sudbury	711	73,984	7	0.2%	0.0%
Babergh West	712	10,034	20,429	0.0%	0.0%
Babergh Central	713	20,515	30,490	0.0%	0.1%
Babergh East	714	37,233	80,945	0.1%	0.2%
Ipswich District	715	184,037	427,309	0.4%	1.0%
Felixstowe/Trimley	716	51,025	213,532	0.1%	0.5%
Suffolk Coastal North	717	74,129	147,167	0.2%	0.4%
Suffolk Coastal Central	718	151,093	329,124	0.4%	0.8%
Suffolk Coastal South	719	95,087	120,151	0.2%	0.3%
Lowestoft	720	124,740	101,472	0.3%	0.2%
Beccles/Worlingham	721	78,797	50,219	0.2%	0.1%
Waveney	722	140,284	123,906	0.3%	0.3%
Norfolk West	723	1,539,000	528,935	3.7%	1.3%
Norfolk East	724	2,330,746	2,177,555	5.6%	5.2%

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
Cambridgeshire County SE	725	247,472	22,156	0.6%	0.1%
Cambridgeshire County NW	726	102,800	-14,623	0.2%	0.0%
Essex County N	727	279,367	372,671	0.7%	0.9%
Essex County S	728	190,427	278,163	0.5%	0.7%
East of England W	729	157,716	3,242	0.4%	0.0%
Greater London	730	319,309	319,303	0.8%	0.8%
Great Britain North	731	93,254	-2,402	0.2%	0.0%
Great Britain South	732	653,942	425,678	1.6%	1.0%
Attleborough	733	633,748	1,084,298	1.5%	2.6%
Diss	734	5,136,225	7,662,769	12.3%	18.3%
Harleston	735	1,945,645	1,535,748	4.7%	3.7%
Long Stratton	736	64,823	2,889,186	0.2%	6.9%
Norwich	737	13,911,963	11,848,040	33.3%	28.3%
Wymondham	738	2,289,934	1,266,126	5.5%	3.0%
Mid - South Norfolk	739	3,300,119	3,625,785	7.9%	8.7%
North - South Norfolk	740	3,170,235	1,484,017	7.6%	3.5%
North East - South Norfolk	741	99,166	-134,118	0.2%	-0.3%
North West - South Norfolk	742	219,239	83,231	0.5%	0.2%
Souith West - South Norfolk	743	434,067	546,767	1.0%	1.3%
South - South Norfolk	744	1,569,591	1,497,028	3.8%	3.6%
South East - South Norfolk	745	166,919	206,395	0.4%	0.5%
Total		41,836,989	41,836,989	100%	100%

Table 5-16: Sector Benefits – Option B

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
		Origin	Destination	Origin	Destination
Newmarket	700	18,180	13,685	0.0%	0.0%
Forest Heath North	701	21,366	13,029	0.0%	0.0%
Forest Heath South	702	16,317	15,695	0.0%	0.0%
Haverhill	703	8,388	4,291	0.0%	0.0%
Bury St Edmunds	704	49,836	29,610	0.1%	0.1%
St Edmundsbury North	705	16,916	33,847	0.0%	0.1%
St Edmundsbury South	706	21,848	14,353	0.1%	0.0%
Stowmarket	707	101,164	74,633	0.2%	0.2%
Mid Suffolk North	708	1,203,266	1,851,868	2.8%	4.3%
Mid Suffolk Central	709	310,585	488,662	0.7%	1.1%
Mid Suffolk South	710	150,220	236,816	0.3%	0.5%
Sudbury	711	73,143	-622	0.2%	0.0%
Babergh West	712	16,387	32,698	0.0%	0.1%
Babergh Central	713	23,746	49,058	0.1%	0.1%
Babergh East	714	43,878	92,686	0.1%	0.2%
Ipswich District	715	224,920	538,434	0.5%	1.2%
Felixstowe/Trimley	716	47,731	258,298	0.1%	0.6%
Suffolk Coastal North	717	87,266	175,975	0.2%	0.4%
Suffolk Coastal Central	718	160,129	371,059	0.4%	0.9%
Suffolk Coastal South	719	110,246	148,720	0.3%	0.3%
Lowestoft	720	157,283	101,192	0.4%	0.2%
Beccles/Worlingham	721	113,586	90,955	0.3%	0.2%
Waveney	722	163,930	230,561	0.4%	0.5%
Norfolk West	723	754,018	718,421	1.7%	1.7%
Norfolk East	724	3,422,213	1,460,568	7.9%	3.4%
Cambridgeshire County SE	725	193,774	95,853	0.4%	0.2%
Cambridgeshire County NW	726	63,759	10,710	0.1%	0.0%
Essex County N	727	277,714	516,020	0.6%	1.2%
Essex County S	728	227,175	348,973	0.5%	0.8%
East of England W	729	143,876	35,022	0.3%	0.1%
Greater London	730	397,119	389,513	0.9%	0.9%
Great Britain North	731	40,791	25,984	0.1%	0.1%
Great Britain South	732	810,565	499,917	1.9%	1.2%
Attleborough	733	484,146	291,637	1.1%	0.7%
Diss	734	5,126,608	8,679,912	11.8%	20.0%
Harleston	735	2,086,713	1,628,342	4.8%	3.8%
Long Stratton	736	697,387	1,738,857	1.6%	4.0%
Norwich	737	16,027,655	10,975,374	36.9%	25.3%
Wymondham	738	1,674,524	1,510,640	3.9%	3.5%
Mid - South Norfolk	739	2,761,759	4,680,503	6.4%	10.8%

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
North - South Norfolk	740	2,633,909	2,134,949	6.1%	4.9%
North East - South Norfolk	741	136,238	50,049	0.3%	0.1%
North West - South Norfolk	742	94,678	63,762	0.2%	0.1%
Souith West - South Norfolk	743	375,994	533,297	0.9%	1.2%
South - South Norfolk	744	1,652,946	1,809,943	3.8%	4.2%
South East - South Norfolk	745	166,800	326,940	0.4%	0.8%
Total		43,390,693	43,390,693	100.0%	100.0%

Table 5-17: Sector Benefits – Option C

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
		Origin	Destination	Origin	Destination
Newmarket	700	26,481	47,794	0.0%	0.1%
Forest Heath North	701	15,603	86,765	0.0%	0.1%
Forest Heath South	702	20,259	71,295	0.0%	0.1%
Haverhill	703	10,597	22,726	0.0%	0.0%
Bury St Edmunds	704	82,645	75,352	0.1%	0.1%
St Edmundsbury North	705	30,727	121,061	0.1%	0.2%
St Edmundsbury South	706	39,840	33,217	0.1%	0.1%
Stowmarket	707	99,885	67,454	0.2%	0.1%
Mid Suffolk North	708	1,308,319	1,824,757	2.2%	3.0%
Mid Suffolk Central	709	306,960	436,558	0.5%	0.7%
Mid Suffolk South	710	139,504	233,010	0.2%	0.4%
Sudbury	711	71,594	4,607	0.1%	0.0%
Babergh West	712	36,727	59,442	0.1%	0.1%
Babergh Central	713	19,450	58,893	0.0%	0.1%
Babergh East	714	40,798	88,325	0.1%	0.1%
Ipswich District	715	216,850	503,299	0.4%	0.8%
Felixstowe/Trimley	716	51,615	239,144	0.1%	0.4%
Suffolk Coastal North	717	90,541	176,806	0.1%	0.3%
Suffolk Coastal Central	718	166,043	330,195	0.3%	0.5%
Suffolk Coastal South	719	115,073	145,381	0.2%	0.2%
Lowestoft	720	210,940	-96,409	0.3%	-0.2%
Beccles/Worlingham	721	109,675	-59,347	0.2%	-0.1%
Waveney	722	161,413	49,969	0.3%	0.1%
Norfolk West	723	1,516,697	2,095,749	2.5%	3.5%
Norfolk East	724	4,440,889	2,332,644	7.3%	3.9%
Cambridgeshire County SE	725	200,027	885,828	0.3%	1.5%
Cambridgeshire County NW	726	100,466	96,686	0.2%	0.2%
Essex County N	727	252,414	451,681	0.4%	0.7%
Essex County S	728	199,319	356,031	0.3%	0.6%

Sector Name	Sector ID	Total Benefits (£)	Total Benefits (£)	Proportion of Total Benefits	Proportion of Total Benefits
East of England W	729	139,420	222,332	0.2%	0.4%
Greater London	730	385,619	375,559	0.6%	0.6%
Great Britain North	731	41,149	82,163	0.1%	0.1%
Great Britain South	732	750,962	565,170	1.2%	0.9%
Attleborough	733	678,063	1,649,785	1.1%	2.7%
Diss	734	5,186,152	8,551,062	8.6%	14.1%
Harleston	735	1,870,245	1,760,320	3.1%	2.9%
Long Stratton	736	16,927,013	6,607,736	28.0%	10.9%
Norwich	737	16,676,461	11,580,738	27.6%	19.1%
Wymondham	738	664,604	2,347,361	1.1%	3.9%
Mid - South Norfolk	739	2,417,371	10,167,586	4.0%	16.8%
North - South Norfolk	740	2,324,559	2,183,270	3.8%	3.6%
North East - South Norfolk	741	30,083	-373,626	0.0%	-0.6%
North West - South Norfolk	742	103,998	184,297	0.2%	0.3%
Souith West - South Norfolk	743	512,259	1,626,118	0.8%	2.7%
South - South Norfolk	744	1,573,154	2,116,474	2.6%	3.5%
South East - South Norfolk	745	164,155	141,359	0.3%	0.2%
Total		60,526,618	60,526,618	100.0%	100.0%

5.3 ACCIDENT BENEFITS APPRAISAL

INTRODUCTION

5.3.1 The accident appraisal has been performed using the DfT's computer program COBALT (Cost and Benefit to Accidents-Light Touch), which carries out the accident appraisal in accordance with DfT's Transport Analysis Guidance. It has been used to forecast personal injury accidents (PIA) and casualties by severity (fatal, serious and slight).

5.3.2 The COBALT scheme parameter file used for the assessment is version 2020.1 in conjunction with the COBALT software version 2013.2. This is in line with the COBALT data provided in Databook issued in July 2020 v1.13.1.

5.3.3 The accident impact assessment has been performed using the method set out in the COBALT Manual[9] . It is used to forecast changes in the number of accidents and casualties and estimate the monetary value of these impacts.

5.3.4 The accident assessment is based on a comparison of accident costs and number of accidents and casualties in a network in 'without-scheme' and 'with-scheme' scenario.

[9] https://www.gov.uk/government/publications/cobalt-software-and-user-manuals

5.3.5 COBALT calculates the accident cost, number of accidents and number of casualties using link and junction characteristics, accident rates, cost per accident and forecast traffic volumes.

5.3.6 The COBALT software estimates the number of accidents by summing the product of accident rates and forecast annual flows for each link using the relationships built into the COBALT software. Standard valuations for fatal, serious and slight accidents were applied within the program to calculate the cost of accidents in both 'without' and 'with' scheme scenarios and the difference between them. These savings (or costs) were then annualised and extrapolated over the 60-year appraisal period, and discounted to produce a 2010 present value of accident benefits in 2010 prices.

5.3.7 Accident benefits are monetised and form part of the initial BCR. For the LSB scheme, accident benefits have been appraised for the core scenario only.

FORECAST YEARS, SCENARIOS AND APPRAISAL PERIOD

5.3.8 The forecast years for the scheme used for the accident assessment are the same as the forecast models built for the LSB scheme, which are:

- 2024 – opening year
- 2039 – design year

5.3.9 The appraisal period used for the assessment is 2024 to 2083, in line with the standard 60-year appraisal period used for the economic assessment of long life transport assets.

5.3.10 The scenarios for which the accident assessment has been undertaken are:

- **Scenario P / Do Minimum (DM)**: Without the LSB scheme and Includes 250 dwellings as deadweight development associated with LSB;
- **Scenario S / Do Something 1 (DS1):** With the LSB transport scheme and applies identical growth as Scenario P. The only difference between Scenario P and S is the transport scheme;

METHODOLOGY

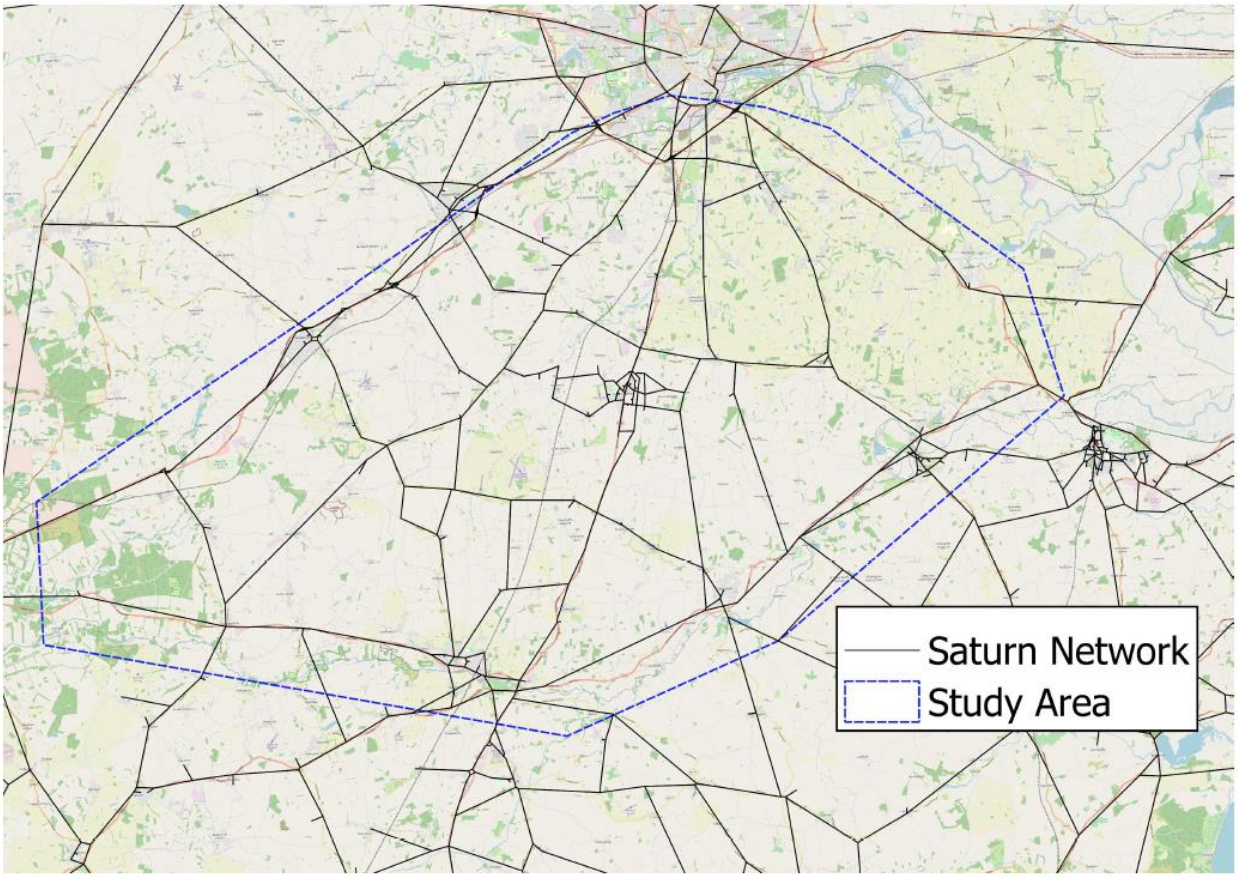
5.3.11 The methodology for the accident assessment comprises of:

- Selection of the accident study area
- Calculation of the observed (local) accident rates
- Preparation of the COBALT Input file

STUDY AREA

5.3.12 The study area for the accident assessment comprises of the same study area as that of the Long Stratton traffic model. All the Do-minimum and Do-Something links in the study area were considered for the analysis, as shown in Figure 5-9.

Figure 5-9 - COBALT Study Area

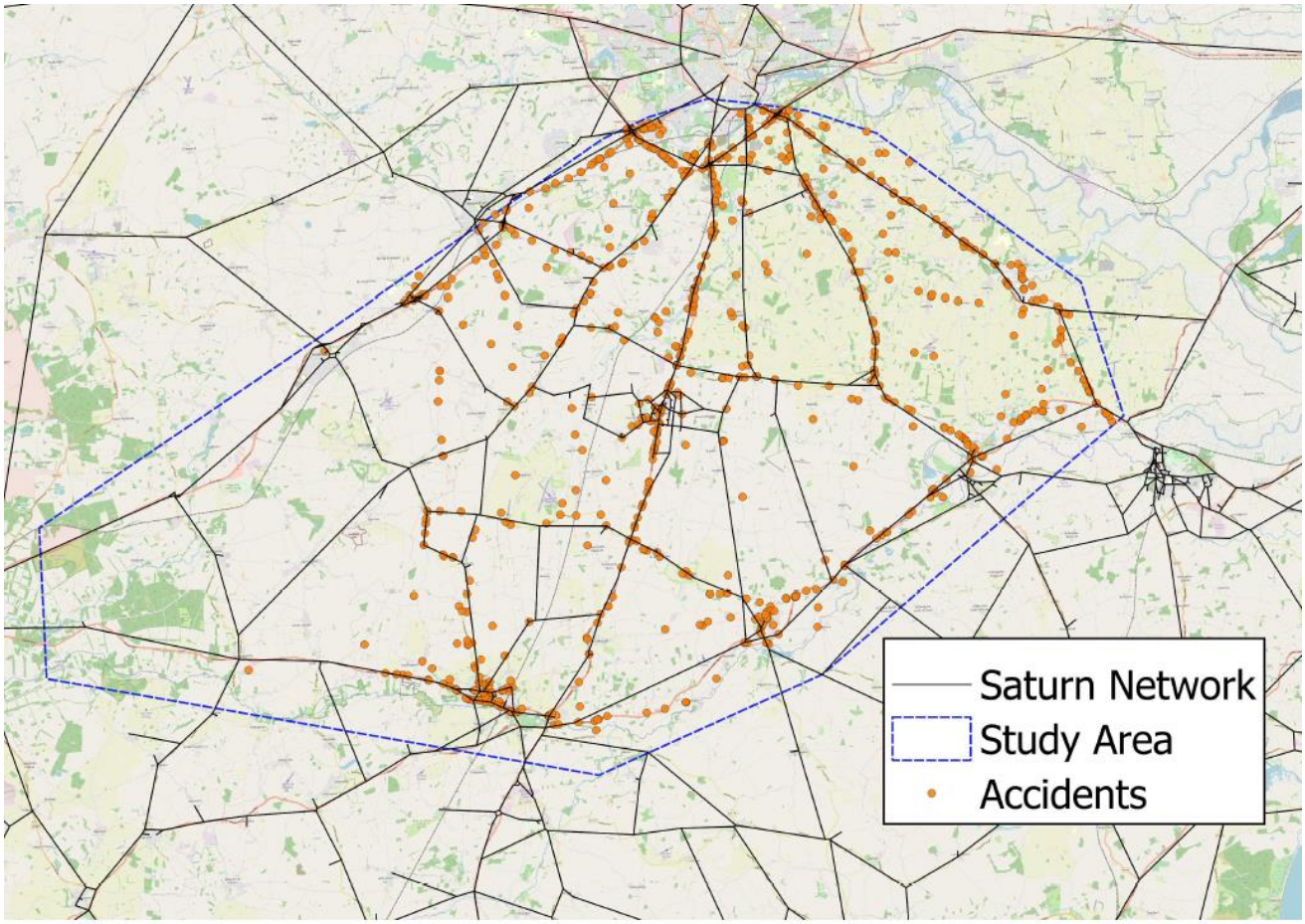


ACCIDENT RATES

5.3.13 The observed accidents in the study area were extracted from the DfT accident database for the latest five data for which complete accident data was available, which is for the period 2014-2018.

5.3.14 The observed accident data was plotted for the links in the study area to find out the links for which the accident data was available, as shown in Figure 5-10. The links for which the local accident data is available was used in the COBALT assessment and the default accident rate (national average) provided in the WebTAG databook was used for the rest of the links in the study area.

Figure 5-10 - Accident Data 2014-2018



PREPARATION OF THE COBALT INPUT FILE

5.3.15 The input file for the COBALT software requires the following data:

- Link classification (link name, road type, length and speed limit)
- Link flows (AADT for each modelled year)
- Accident rates

5.3.16 The link classification data is extracted from the traffic model, as well as the hourly flow data from the AM, IP and PM models for the Base year, and 2024 and 2039 Do-Minimum and Do-Something models. The hourly flow data is converted to the Annual Average Daily Traffic (AADT) using the expansion factors calculated for the scheme from the observed traffic data.

RESULTS

5.3.17 The safety benefits of the scheme are calculated by comparing the cost of accidents over the 60-year appraisal period, with and without the scheme, at 2010 prices, discounted to 2010, as detailed in Table 5-18.

5.3.18 This shows that the scheme is providing accident savings of £5.6 million.

Table 5-18 – Accident savings over 60 years (2010 prices, discounted to 2010), £,000

Economic summary over 60 years		
'Without' Scheme accident costs (£000s)	'With' Scheme accident costs (£000s)	Total accident benefits saved by scheme (£000s)
621,627	616,025	5,601

5.3.19 COBALT also provides the saving in terms of accident and casualty numbers. The number of accidents saved by the scheme are 184, as shown in Table 5-19.

Table 5-19 – Accidents Savings over 60 years

'Without' Scheme Accidents	**'With' Scheme Accidents**	**Reduction in Accidents**
12,967	12,784	184

5.3.20 The casualty summary in terms of fatal, serious and slight are provided in Table 5-20. There is one casualty caused by the scheme, whereas a saving of 20 serious and 190 slight casualties over the 60 year appraisal period.

Table 5-20 – Casualty Saving over 60 years

Casualty Summary over 60 years			
Type	**Total 'without scheme casualties**	**Total 'with' scheme casualties**	**Total casualties saved by scheme**
Fatal	**201**	**203**	**-1**
Serious	**1,938**	**1,918**	**20**
Slight	**15,911**	**15,722**	**190**

5.4 ACTIVE MODE IMPACTS

METHOD

5.4.1 The economic assessment follows the guidance in the DfT's WebTAG Unit A5.1 Active Mode Appraisal Toolkit released in 2020. The methodology for monetising the scheme impacts has focussed on estimating the increase in the amount of cycling and walking due to the proposed improvement measures. The forms of benefits associated with the improvement schemes include:

- Mode shift
- Health
- Journey quality

5.4.2 The Active Mode Appraisal Toolkit, developed by DfT, has been used to calculate the key impacts of the proposed cycling and walking interventions. Using this tool, the three types of benefits mentioned above (mode shift, health and journey quality) and the analysis of monetised costs and benefits (AMCB) includes the following impacts:

- Congestion benefit
- Infrastructure
- Accidents
- Local Air Quality
- Noise
- Greenhouse Gases (GHGs)
- Reduced risk of premature death
- Absenteeism
- Journey Ambience
- Indirect Taxation

BASELINE DEMAND

5.4.3 The model makes use of a number of different datasets, including the Office for National Statistics (specifically, the number of economically active people in Long Stratton), the Canon Consulting

Engineering Transport Plan and Transport Assessment (to calculate the number of journeys without the scheme for cycling and walking).

BASIS FOR APPLYING DEMAND UPLIFT DUE TO THE PROPOSED INTERVENTION

5.4.4 Various studies have been examined to determine the assumed uplift due to the proposed improvements, including case studies cited in 'Encouraging walking and cycling: Success Stories' (DfT, 2004a) and 'Active Travel and Economic Performance' (Sustrans, 2019), as well as other DfT case studies which describe the impact of a number of historical pedestrian and cycling focussed infrastructure improvements and the associated induced trips.

5.4.5 Taking the above into consideration, a demand uplift of 24% and 42% over the baseline trips has been deemed appropriate for the proposed cycling and walking improvements respectively in this study.

APPRAISAL ASSUMPTIONS

5.4.6 Scheme input assumptions and evidence are provided in Table 5-21.

Table 5-21 - Assumptions of Long Stratton Bypass

Factor	Explanation
Zone Code	E02005607
Local Area Type	Rural (based off Area Look up)
Scheme Opening Year	2024
Last Year of Funding	2023
Appraisal Period	20 years
Current cycling facilities for this route	No Provision
Current walking infrastructure for this route	"No" for all criteria except for Kerb Level
Future walking infrastructure for this route	"Yes" for all criteria except for crowding
Number of journeys without the proposed scheme	A quantified value has been obtained by analysing the current work travel destinations and mode type for residents in Long Stratton. This has been uplifted take into consideration the different journey purposes.
Number of journeys with the proposed	A quantified value has been obtained by analysing the future work travel destinations forecasted in the Travel Plan and mode type for residents in Long Stratton. This has been uplifted take into consideration the different journey purposes.

Factor	Explanation
The average proportion of a trip which uses the scheme infrastructure (cycling and walking)	50% based on evidence in the Travel Plan and Transport Assessment.
Decay rate	0.0%, assumption from illustrative case study in WebTAG
Return trips	90%, assumption from illustrative case study in WebTAG
Return trips	90%, assumption from illustrative case study in WebTAG
Background growth rate in trips	0.75%, National Travel Survey Data 2006-2016
Period over which growth rate applies	20 years, Assumption based on WebTAG
Number of days scheme data is applicable	220 days/year, assumption from illustrative case study in WebTAG

RESULTS

5.4.7 The results for the active mode appraisal are provided in Table 5-22.

Table 5-22 - Analysis of Monetised Costs and Benefits for Active Mode Appraisal (in £000s)

Factor	Value, £000's
Congestion benefit	9.79
Infrastructure	0.22
Accident	1.54
Local Air Quality	0.25
Noise	0.08
Greenhouse Gases	1.35
Reduced risk of premature death	1,057.12
Absenteeism	196.93
Journey Ambience	778.52
Indirect Taxation	-3.12
Present Value of Benefits	**2,042**

5.4.8 The Present Value of Benefits (PVB) for Active Mode Impacts associated with the scheme is **£2.0m** in 2010 prices and values.

5.5 MONETISED ENVIRONMENTAL IMPACTS

5.5.1 The following environmental impacts were monetised and appraised in line with TAG Unit A3:

- Noise
- Air Quality
- Greenhouse gases

5.5.2 A more detailed description of the appraisal can be found in **Error! Reference source not found.**the Environmental Appraisal Report, and appendix within the Outline Business Case.

GREENHOUSE GASES

5.5.3 Greenhouse gas impacts depend upon changes in traffic flows, composition, speeds and distance travelled as a result of the scheme. As the scheme is predicted to alter traffic flow, vehicle speed and distance travelled, it is also expected to have an impact on levels of greenhouse gas emissions (GHGs).

5.5.4 As defined by the Intergovernmental Panel on Climate Change, GHG emissions are expressed as tonnes of carbon dioxide equivalent (tCO2e), which will be used for the purposes of this appraisal.

5.5.5 The UK is legally bound by the Climate Change Act 2008 to achieve a target to reduce GHG emissions to at least 80% below base year (1990) levels by 2050.

5.5.6 For the purposes of the OBC, an environmental appraisal has been undertaken to assess the impacts of the scheme over a 60-year appraisal period (2024-2083) using the DfT Greenhouse Gas workbook (not Greenhouse gas outputs from TUBA). The appraisal calculates and evaluates the discounted present value of changes in CO2e for non-traded (i.e. petrol, diesel, fuel oil) and traded (e.g. electricity) fuel consumption.

5.5.7 The proposed scheme is expected to reduce greenhouse gas emissions by 109,046 tCO2e (of which 487 tCO2e is traded and 108,559 tCO2e untraded) for Option A (the core methodology). This is equivalent to a saving of **£4.68 million** in Net Present Value (NPV) between the Do Something and Do Minimum scenarios. Table 5-23 presents this figure for the 3 appraisal methodologies[10].

[10] Note, only Option A uses the methodology described above. Option B and C use a factor derived from the Greenhouse Gas outputs from TUBA for options B and C relative to option A. This was used as a proxy for GHG impacts to retain an equivalent methodology through the VfM assessment. This factor is then applied to the monetised impacts generated by A above to derive an equivalent GHG impact for option B and C. This was undertaken for proportionality reasons given options B and C are sensitivity methodologies.

Table 5-23 - Greenhouse gases impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Greenhouse Gases	4,684	4,122	6,839

5.5.8 A saving of **£4.68 million** is in GHG is important because it helps contribute to the government's Carbon Net Zero commitment, the 25 Year Environmental Plan, as well as NCC's Environmental Carbon Net Zero commitment.

AIR QUALITY

The air quality appraisal has been undertaken using the Impact Pathways approach which considers the impact of air quality changes on people. Using this methodology, the scheme generates local air quality improvements for both nitrogen dioxide (NO2) and particulate matter less than 2.5 µm in diameter (PM2.5) within the appraisal study area (i.e. the impact on people is less with the scheme in place), but the it does generate an increase in overall emissions of NOx and PM2.5 from the affected road network as a whole.

5.5.9 The change in NO2 between the with and without-scheme scenarios are **£114,664** NPV over the 60-year appraisal period.

5.5.10 The change in PM2.5 between the with and without-scheme scenarios are **£363,187** NPV over the 60-year appraisal period.

5.5.11 The total air quality improved measured in NPV is **£477,851.**

5.5.12 The air quality improvements for methodology options A to B and C are provided below[11].

Table 5-24 – Local Air Quality Impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Local Air Quality	478	492	664

NOISE

5.5.13 The noise impact appraisal anticipated the scheme would generate the following noise impacts:

- Notable noise decreases for many existing properties in the centre of Long Stratton;
- Notable noise increases at relatively fewer existing properties on the eastern fringe of Long Stratton and at scattered locations to the east.

5.5.14 This included the following specific impacts on the number of households within the study area:

- Households experiencing increased daytime noise in forecast year: 703

[11] As with Greenhouses gases option B and C results are factored from the relative change to option A using TUBA GHG results.

- Households experiencing reduced daytime noise in forecast year: 646
- Households experiencing increased night-time noise in forecast year: 50
- Households experiencing reduced night-time noise in forecast year: 354

5.5.15 Overall, the NPV of changes in noise are equivalent to **£6.08 million.**

5.5.16 The noise improvements for methodology options A to B and C are provided below[12].

Table 5-25 – Noise impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Noise	6,076	6,258	8,445

[12] As with Greenhouses gases option B and C results are factored from the relative difference to option A, but this time using total PVB.

6 TEE, PA AND AMCB TABLES

6.1 TRANSPORT ECONOMIC EFFICIENCY (TEE) TABLE

6.1.1 The Transport Economic Efficiency (TEE) benefits are derived from travel time and vehicle operating cost benefits as a result of the scheme.

6.1.2 TEE benefits for the scheme were assessed using the DfT's Transport Users Benefit Appraisal (TUBA) software. TUBA calculates the benefits associated with journey time savings and vehicle operating cost savings using information taken from the traffic model, in accordance with the procedures and economic parameters in TAG Unit A1. The standard TUBA 1.9.14 economics file was used.

6.1.3 The private sector contributions to the scheme costs of **£6.8m** are recorded as a negative value in the Transport Economic Efficiency (TEE) table and Present Value of Benefits. The full TEE Table is included within the economic appraisal model and summarised in Table 6-1. The figures in this table exclude wider public finances.

Table 6-1 - Transport Economic Efficiency (TEE) Benefits

£000s, 2010 prices and values Appraisal Methodology	Option A Appraisal Methodology	Option B	Appraisal Methodology	Option C
Consumer – commuting user benefits	Travel Time	13,817	13,561	23,063
Consumer – commuting user benefits	Vehicle operating costs	932	842	1,169
Consumer – commuting user benefits	Subtotal	14,749	14,403	24,233
Consumer – commuting user benefits	Travel Time	14,008	14,962	21,983
Consumer – commuting user benefits	Vehicle operating costs	760	538	667
Consumer – commuting user benefits	Subtotal	14,768	15,500	22,650
Business benefits	Travel Time	11,760	12,891	13,209
Business benefits	Vehicle operating costs	1,454	1,336	1,533
Business benefits	Subtotal	13,215	14,227	14,742
Private Sector	Investment costs	-6,799	-6,799	-6,799
Private Sector	Operating Costs	0	0	0
Private Sector	Subtotal	-6,799	-6,799	-6,799

£000s, 2010 prices and values Appraisal Methodology	Option A Appraisal Methodology	Option B	Appraisal Methodology	Option C
Net Business Impact		6,416	7,428	7,943
Total TEE benefit		35,934	37,331	54,826

6.2 PUBLIC ACCOUNTS (PA) TABLE

6.2.1 The Public Accounts (PA) table shows the impact on public sector budgets, split between local and central Government.

6.2.2 Values shown in the PA table include scheme investment, operating and maintenance costs as well as changes in indirect taxation revenues. Positive values represent expenditure whilst negative values represent increases in revenue.

6.3 ANALYSIS OF MONETISED COSTS AND BENEFITS (AMCB) TABLE

6.3.1 The Analysis of Monetised Costs and Benefits (AMCB) table summarises all of the monetised impacts of a scheme that are considered sufficiently robust for inclusion in the scheme's Net Present Value (NPV) and initial Benefit to Cost Ratio (BCR).

6.3.2 The AMCB table combines information from the TEE and PA tables with monetised estimates of other impacts such as noise, air quality and accidents. Positive values represent benefits whilst negative values represent disbenefits or costs.

6.3.3 All values are shown in 2010 prices, discounted to a 2010 Present Value Year.

6.3.4 Based on the Analysis of Monetised Costs and Benefits (AMCB), the total monetised benefits exceed the costs for each appraisal methodology option (A, B and C). The initial BCR of the scheme ranges from **2.8** to **4.1** depending on the approach adopted. This places the scheme in **High/Very High** Value for Money category when including just the Level 1 initial BCR impacts. The AMCB table is presented in Table 6-2.

Table 6-2 - Analysis of Monetised Costs and Benefits (AMCB)

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Noise	6,076	6,258	8,445
Local Air Quality	478	492	664
Greenhouse Gases	4,684	4,122	6,839
Journey Quality	2,042	2,042	2,042
Accidents	5,601	5,601	5,601
Economic Efficiency: Consumer Users (Commuting)	14,749	14,403	24,233
Economic Efficiency: Consumer Users (Other)	14,768	15,500	22,650

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Economic Efficiency: Business Users and Providers	6,416	7,428	7,943
Wider Public Finances (Indirect Taxation Revenues)	-895	-739	-1,098
Present Value of Benefits (PVB)	53,919	55,108	77,320
Broad Transport Budget	19,077	19,077	19,077
Present Value of Costs (PVC)	19,077	19,077	19,077
Net Present Value (NPV)	34,843	36,031	58,243
Initial BCR	2.8	2.9	4.1

6.3.5 Option C, where no dependent development is included, shows TEE benefits that are higher than Options A and B. Options A and B produce a very similar initial BCR, both rounded to 2.8/2.9.

6.3.6 The initial value of BCR includes monetised benefits of accident savings, greenhouse gas reductions, journey quality and indirect taxation impacts, but does not include benefits accruing from other impacts such as wider impacts or land value uplift.

7 LEVEL 2 IMPACTS

7.1 WIDER ECONOMIC IMPACTS

INTRODUCTION

7.1.1 Transport investments such as the Long Stratton Bypass are likely to affect the wider economy beyond the direct impact that the road has on users and individuals living close to it.

7.1.2 The methodology used to calculate 'wider benefits' is set out as described in TAG units A2.1 to unit A2.4 and includes the following components:

- **Agglomeration** – the concentration of economic activity in an area can be improved by transport schemes as accessibility between businesses and workers is improved by reduced journey times, thus generating productivity benefits from the 'closer' proximity;
- **Changes to tax revenues arising from labour market impacts** (such as labour supply moving to more productive jobs) – the quality and efficiency of the transport network and infrastructure can affect the decisions of businesses about where to locate and work (as a result of travel costs impacting labour market decisions). Changes in transport costs can incentivise individuals to work, the number choosing to work and thus the amount of labour supplied in the economy. The changes in tax revenues associated with these impacts are not captured within commuter user benefits; and
- **Output change in imperfectly competitive markets** – a reduction in transport costs (for business and freight) allows businesses to profitably increase their output (goods and services) that require the use of transport in their production.

7.1.3 Agglomeration impacts arise from improving accessibility to an area for businesses and workers as they can cluster together and benefit from improved productivity. The new bypass will improve connectivity between the two largest economic hubs in East Anglia, Norwich and Ipswich and will bring firms closer together and generate a total increase in GDP, as existing workers become more productive due to connectivity improvements.

7.1.4 With the scheme in place, impacts will also be felt by those making commuting journeys as well as currently unemployed people looking to enter the labour market. If commuting costs fall, then the net returns from working increase. This could influence some people to change whether or not they choose to work or how much they choose to work. The private benefits to these people are captured in transport user benefits. The value of time used for travel time savings does not include exchequer benefits that happen when people make different decisions about employment as a result of a transport scheme.

7.1.5 Companies will benefit from time savings as a result of the implementation of the scheme, which result from a reduction in production costs, incentivising firms to increase their output whilst maintaining an attractive profit margin. Firms can pass on these cost savings to consumers, reflecting a net benefit to consumers which is in addition to the transport cost change.

METHOD

7.1.6 To assess the wider economic impacts for the scheme, WSP's Wider Impacts Transport Appraisal (WITA) tool has been used. The WSP tool uses the same methodology as the WITA 2.0 tool. The tool

estimates the following impacts: agglomeration, labour supply and output change in imperfectly competitive markets.

7.1.7 WITA calculates wider impacts as described in TAG Unit A2.1 to Unit A2.4. The WITA methodology seeks only to capture the part of the above impacts that are not already captured in conventional transport user benefit calculations.

7.1.8 Within WITA, the value of 'increased output in imperfectly competitive markets' has been estimated by including a 10% uplift of user benefits, in accordance to TAG Unit A2.2. Output change in imperfectly competitive has been estimated based scenarios A and C in Table 3 of TAG Unit A2.1 to avoid double counting.

7.1.9 The appraisal of wider impacts for the scheme is concerned with the core scenario. As defined in TAG Unit A2.1, the core scenario assumes that employment is consistent between the Do Minimum and Do Something scenarios.

7.1.10 Wider economic impact assessment is only concerned with trips and travel costs made for travel to and from work. Therefore, only the car business and car commute user classes have been assessed. The same highway matrix data and annualisation factors that are used as in the conventional transport user benefit appraisal (TUBA) are input into the appraisal of wider economic impacts.

7.1.11 The economic appraisal for both TUBA and WITA was undertaken over a 60-year period, from 2024 (opening year) to 2083. The economic input file contains all of the economic data and parameters required by TUBA and WITA in the economic appraisal. The WITA calculations have used TAG Data Book v1.13 May 2020 and Version 3.1 of DfT's Wider impacts dataset May 2019 which were the latest available datasets at the time.

7.1.12 Travel distance, time and number of trips matrices are input as skim files within the tool to calculate Generalised Travel Cost's (GTCs) for Do Minimum and Do Something scenarios. Trips from and to external transport model / WITA zones have been excluded as part of the WITA analysis to ensure the agglomeration impacts are not exaggerated. This has been achieved by masking out all the cost differences for external trips from the study area.

RESULTS

Agglomeration

7.1.13 The agglomeration impacts are calculated across the four sectors of the economy within the appraisal guidance. Table 7-1 presents the agglomeration impacts across the construction, consumer services, manufacturing and producer services for each appraisal option.

Table 7-1 - Agglomeration Impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Manufacturing	473	444	551
Construction	1,447	1,295	1,767
Consumer Services	3,077	2,542	3,803
Producer Services	5,047	4,242	6,332
Sub-Total	**10,044**	**8,524**	**12,453**

7.1.14 For each appraisal method, agglomeration impacts generate the greatest proportion of wider impacts benefits.

7.1.15 The agglomeration impacts are approximately 40% of the scheme Transport Economic Efficiency (TEE) impacts. TAG unit A2.4 suggests that generally, agglomeration impacts are expected to be 10% to 30% of total TEE benefits. However, this is based on a more restricted number of historical schemes dating back to 2008.

7.1.16 The greatest agglomeration benefits are to be found in South Norfolk and Norwich as this is where the scheme is located and will have the largest impact in terms of improving accessibility respectively. The agglomeration impacts make up the majority of the wider impacts which is typical in wider economic impacts analysis.

OTHER MODES ADJUSTMENT

7.1.17 TAG Unit A2.4 guidance recommends including transport model data for two modes (private and public transport), segmented by both business and commuting. The traffic model is a purely car-based model, this means that the wider impacts analysis does not include walking, cycling and public transport modes.

7.1.18 In the assessment of wider impacts, average generalised travel costs are required for the calculation of effective density and agglomeration benefits. An important element of travel, and therefore average generalised cost, is travel by public transport. Without these other modes, it is likely that the agglomeration benefits will be exaggerated slightly.

7.1.19 To represent travel by all modes within the average cost calculations, an allowance has been made to account for the impact of the other modes. To account for public transport, walking and cycling, the proportion of car driver trips for each Local Authority District (LAD) examined in the WITA analysis was extracted from the TEMPRO database. Adjustment factors were calculated for each WITA zone based on proportion of car trips compared to total trips and applied to the WITA agglomeration impacts. This is based on data for the year 2020 from the TEMPRO database.

7.1.20 Table 7-2 presents the unadjusted agglomeration impacts for the scheme compared to the impacts after the other modes adjustment for each appraisal option.

Table 7-2 - Agglomeration Impacts comparison with other modes

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option B	Appraisal Methodology Option C	Appraisal Methodology Option C	Appraisal Methodology Option C
Sector	**Base aggl. impacts**	**Other modes adjusted aggl. impacts**	**Base aggl. impacts**	**Other modes adjusted aggl. impacts**	**Base aggl. impacts**	**Other modes adjusted aggl. impacts**
Manufacturing	1,003	473	941	444	1,166	551
Construction	2,981	1,447	2,652	1,295	3,631	1,767
Consumer Services	6,656	3,077	5,391	2,542	8,202	3,803
Producer Services	11,000	5,047	9,102	4,242	13,730	6,332
Sub-Total	**21,640**	**10,044**	**18,085**	**8,524**	**26,730**	**12,453**

7.1.21 The agglomeration impacts fall by over half when the analysis consider the effects of including non-highway modes for each appraisal option. Following the other modes adjustment, the agglomeration impacts are approximately 20% of the scheme Transport Economic Efficiency (TEE) impacts. This level of impact is considered proportional to the size of the project and location of the scheme between Norwich and Ipswich.

OUTPUT CHANGE IN IMPERFECTLY COMPETITIVE MARKETS

7.1.22 Table 7-3 presents the output change in imperfectly competitive markets impacts for the scheme for each appraisal option.

Table 7-3 - Output change in imperfectly competitive markets

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Output change in imperfectly competitive markets	1,321	1,423	1,474

7.1.23 The total additional benefits arising due to output change in imperfectly competitive markets range from **£1.3m** to **£1.5m** depending on the appraisal method and assuming that benefits would be

incurred across all time periods. This suggests that business users benefit most from improved accessibility in Long Stratton and subsequent reduction in congestion brought about by the scheme.

LABOUR SUPPLY IMPACTS

7.1.24 Taxes arising from labour supply impacts have been calculated for all forecast years. Table 7-4 presents the output change in imperfectly competitive markets impacts for the scheme for each appraisal option.

Table 7-4 – Labour supply impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Labour Supply Impacts	165	161	236

7.1.25 The total benefits arising due to labour supply impacts over the 60-year appraisal period are approximately **£0.2m** for each appraisal option. These impacts are considered to be very minor as the analysis only considers the increased tax revenues associated with changes in the labour supply to be additional at UK level. Calculations for this element are based on the link between the cost of commuting and the increase in labour supply.

SUMMARY

7.1.26 A summary of wider impact benefits is presented in Table 7-5 and provides a breakdown for the three wider economic impacts that have been calculated.

Table 7-5 - Total Wider Economic Impacts

2010 prices and values, £000's	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
WI1: Agglomeration impacts	10,044	8,524	12,453
WI2: Output change in imperfectly competitive market	1,321	1,423	1,474
WI3: Tax revenues arising from labour market impacts	165	161	236
Total Wider Impact Benefits	**11,530**	**10,108**	**14,163**

7.1.27 The WITA analysis shows that the scheme is expected to deliver approximately **£10.1m** to **£14.2m** of wider economic impacts depending on the appraisal approach used. The highest contributions come from the agglomeration impacts and output change in imperfectly competitive markets. This suggests that business users are the main beneficiaries from the enhanced connectivity and consequent congestion reductions brought about by the scheme. The impacts are positive for all categories, which

suggest that the scheme has a positive outcome on non-transport markets, contributing to an increase in productivity and government income.

7.2 ADJUSTED BENEFIT COST RATIO (BCR)

7.2.1 The Adjusted BCR includes all monetised benefits associated with accident savings, greenhouse gas reductions and indirect taxation impacts including benefits accruing from wider impacts. The calculations of the Adjusted BCR is set out in Table 7-6.

Table 7-6 - Adjusted BCR calculation

£000s in 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Initial PVB	53,919	55,108	77,320
Wider Economic Impacts	11,530	10,108	14,163
Adjusted Present Value of Benefits (PVB)	65,450	65,215	91,483
Present Value of Costs (PVC)	19,077	19,077	19,077
Net Present Value (NPV)	46,373	46,139	72,406
Adjusted BCR	**3.4**	**3.4**	**4.8**

7.2.2 Following the inclusion of wider economic impacts in appraisal the BCR increases to **3.4** for Options A and B and remains in the **High** VfM category. For option C the BCR increases to **4.8** and showing **Very High** VfM category.

7.2.3 For the Long Stratton scheme, only calculating the wider economic considered as part of the level 2 analysis may be underestimate the total wider impact since it does not capture the expected land value uplift of dependent development in Long Stratton. Therefore, a land value uplift appraisal has been undertaken to capture any impacts which are capitalised into land values. This is discussed in next section.

8 LEVEL 3 IMPACTS

8.1 LAND VALUE UPLIFT

8.1.1 Land Value uplift associated with the dependent development (described within the Strategic Case) has been calculated as part of the indicative monetised benefits to capture the housing benefits than can be unlocked through construction of the bypass. Norfolk County Council will permit 250 homes to be constructed without the bypass in place, but no more. An additional 1,635 homes could be constructed, effectively 'unlocked' (1,885 homes in total), once the bypass is built. This has been encapsulated within Planning Policy since adoption of the Joint Local Plan (see Strategic Case).

8.1.2 A Land Value Uplift model has been built in line with TAG Unit A2.1 Wider Economic Impacts Appraisal, DfT TAG Unit A2.2. The analysis has been based on viability work undertaken by the developer and also using MHCLG[13] guidance values.

As stated in Appendix D, TAG Unit A2.2

Land Value Uplift = Land Value after Development – Land Value before Development

8.1.3 LAND VALUE BEFORE DEVELOPMENT

8.1.4 The current use values have been calculated based on local knowledge of the market and using MHCLG May 2018 published values. For Agricultural Land within the New Anglia LEP this has been valued at £21,000 for the circa 55-hectare sites (Land East and Land West of A140 Long Stratton), giving an overall current use value of £1,152,900 in 2020 prices (no discounting and real growth rate applied).

8.1.5 LAND VALUE AFTER DEVELOPMENT

Land Value after Development = Gross Development Value – (Development costs + fees + profit)

Gross Development Value

8.1.6 For Gross Development Value (GDV), the full economic value of development has been calculated such that the 'full market' value is used in the economic model. The GDVs has been calculated for the total number of **1,885** housing units. The GDV has been calculated using the following formula in line with guidance:

GDV = Number of dwellings x Price of the dwellings at full market price

8.1.7 Using data provided by the James Nicholls (developer), an average house price of £252,570 has been assumed on average price per square foot of £250. Based on current market evidence, investigating the real house price growth rate in South Norfolk between 2010 and 2019, a real growth rate of 2.6%

[13] Section 4,DCLG Appraisal Guide, 20126

per annum has been applied. This real growth rate has been calculated by taking nominal house prices and deflating using Consumer Price Index (CPI) to calculate the annual growth rate.

DEVELOPMENT COSTS, FEES AND PROFITS

8.1.8 To enable an estimate of costs, fees and profits, WSP have used BCIS cost data obtained and MCHLG Guidance values to estimate the seven different cost items associated within housing costs (Build, External, Contingency, Professional, Marketing, Profits and Finance Costs).

8.1.9 The following cost estimates were provided:

1. Build cost - £125.00 per square foot. This has been estimated based on RCIS BCIS Gross Internal Area for the housing building cost provided by James Nicholls.
2. External Costs - This has been calculated at part of the build cost.
3. Contingency costs - This has been calculated at 5% as provided by James Nicholls.
4. Professional fees - This has been calculated at 8% of build costs, as per MCHLG guidance.
5. Marketing cost - This has been calculated at 3% of GDV, as per MCHLG guidance.
6. Profits - This has been calculated at 20% of GDV, as provided by James Nicholls.
7. Finance Costs – A finance cost for the housing cost has been calculated based on a 6% debit rate. For this scheme, a value has been pro-rated of a development of a similar size in the region.

ADDITIONALITY

8.1.10 To calculate the additional housing benefit, 'additionality[14]' needs to be determined and applied. Impacts of Government intervention are described as 'additional' if the net increase in economic performance takes into account deadweight and displacement, two of the main economic impact types covered in the DCLG (now MHCLG) Appraisal Guide.

8.1.11 Deadweight for this scheme is defined as the number of houses that could be built without the bypass (and their residual value) without government funding.

8.1.12 The Option A method uses the deadweight based on planning policy condition of 250 homes and therefore 1,635 additional homes. Option B uses a higher deadweight of 979 homes where the transport modelling demonstrates a greater deterioration on network performance. Land value

[14] As defined in Annex A of TAG Unit A2.1, additionality is the extent to which local economic performance impacts are additional at the national level, gross and net effects respectively

analysis is based 906 additional homes in this approach. There is no land value impact for Option C since that method is based on a no development dependency scenario.

8.1.13 Displacement is defined as the extent to which the investment in South Norfolk crowds out other private sector investment in the local area; and the extent to which the new housing prevents other new sites coming forward through the planning system.

8.1.14 The formula below illustrates how the additional housing benefit is calculated for Option A. The methodology is the same for option B but with a higher deadweight value.

*Additionality = (1- Displacement) * (1- Deadweight as a % of LVU)*

Additionality = 1 (1-8.9%) * (1-10%) = 82%*

8.1.15 An additionality rate of 75% or higher is defined as a high additionality rate in The DCLG Appraisal Guide, Figure 10, page 45.

*Additional Housing Benefit = LVU * additionality*

*Additional Housing Benefit = **c.£111.5m * 0.82 = c. £91.5 million***

8.1.16 The Housing Benefit is initially calculated in 2020 prices, then converted to 2010 prices and values. The same market price adjustment factor of 1.19 that was applied to the scheme costs has also been applied to the LVU impacts. In 2010 prices and values, the Additional Housing Benefit for Option A is **£64.7m** and for Option B is **£36.5m.**

8.2 LAND VALUE AMENITY

8.2.1 The amenity value of a plot of land refers to the level of 'pleasantness' of the area, in which the bypass will be developed, including the allocation of 1,885 houses and 9.5Ha of employment land. The existing use land value has been assumed to be typical of prior-use greenfield land within the same area. The development will be built on greenfield land, which can result in a loss in the land amenity value, if the area becomes less desirable for recreational activity.

8.2.2 The welfare impact from the change in land amenity value can be estimated as the difference between the present value benefits for different land types: it is assumed that developed land has no amenity value, such that land use change is associated with a loss of amenity value.

8.2.3 Based on the planning applications described in the strategic case for the sites in Long Stratton, in alignment with the DCLG appraisal guidance, the 'Agricultural (Extensive)' land type has been selected. The amenity benefit (2016 real value), used is £6,366 per hectare. An estimate of 67.40 ha, based on the expected residential and commercial development in Long Stratton, was used to generate the land amenity value. Therefore, the market amenity value in 2016 prices is **£429,323** for both the Option A and Option B scenarios.

8.2.4 This land amenity is initially calculated in 2016 prices but in line with TAG guidance this has been converted to 2010 prices and discounting and the market price adjustment of 1.19 has also been

applied. Therefore, the market price adjusted 2010 deflated Amenity Value is **£464,473** for both the option A and option B scenarios.

8.3 TRANSPORT EXTERNAL COSTS

8.3.1 TAG Unit A2.2 states "Transport external cost attributable to the new development" should be calculated. This refers to the "change in costs (including time, vehicle operating costs and charges) caused to all other transport users on the network by the traffic generated by the new development." This will later be subtracted from Land Value Uplift values. The assessment of what is described as "dependent development" requires two transport model scenarios to be run:

- Scenario S – without the housing but with the transport scheme; and
- Scenario R – with the new housing and with the transport scheme

Table 8-1 - Transport External Costs (AMCB Table)

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B
Greenhouse Gases[15]	559	532
Economic Efficiency: Consumer Users (Commuting)	-26,502	-3,720
Economic Efficiency: Consumer Users (Other)	-16,954	-6,075
Economic Efficiency: Business Users and Providers	-13,910	-2,683
Wider Public Finances (Indirect Taxation Revenues)	675	78
Present Value of Benefits (PVB)	-56,142	-11,868

8.3.2 The transport external costs from dependent development traffic are expected to be **£56.1m** or **£11.9m** depending on the different deadweight parameters used within Option A or option B. Both are in 2010 prices and values. There are no transport external costs for option C since there is no appraisal of dependent development in this approach.

8.4 DEPENDENT DEVELOPMENT IMPACTS

8.4.1 The dependent development impacts, all which fall with indicative monetised, Level 3 Value for Money framework sensitivity analysis, take into account the Land Value Uplift, Transport External Costs and Land Amenity. The formula below is taken from TAG Unit A2.2 Induced Investments.

Total Benefit = LVU – TEC – LAV

8.4.2 The results for each appraisal method are presented in Table 8-2.

Table 8-2 - Breakdown of the Level 3 Impacts

£000s, 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B
Land Value Uplift after additionality	64,650	36,476
Land Amenity	-464	-464
Transport External Costs	-56,142	-11,868
Total	**8,044**	**24,144**

8.4.3 For Option A and Option B, the adjusted BCR is **3.4**, representing **High** Value for Money. Even with the addition of the Land Value Uplift values generated by Option A, this would not be large enough to move the scheme into the Very High Value for Money Category. However, the dependent development impacts both increase the confidence that scheme will fall within the High Value for Money category.

8.4.4 There are no impacts reported for Option C since there is no appraisal of dependent development in this approach.

9 SWITCHING VALUE ANALYSIS

9.1.1 Switching value analysis has been undertaken to determine how a change in costs or benefits would alter the Value for Money category.

9.1.2 Table 9-1 and Table 9-2 provide the changes that would be required, either in scheme costs or benefits, for the scheme to shift from High VfM category (as indicated by its adjusted BCR) to the Medium or Very High categories on either side of its current position.

Table 9-1 - Changing the Adjusted BCR to Medium

Factor	Appraisal Methodology Option A (High to Medium)	Appraisal Methodology Option B (High to Medium)	Appraisal Methodology Option C (Very High to Medium)
Benefits	Benefits would need to decrease by £27.3m or 41.7%	Benefits would need to decrease by £27.1m or -41.5%	Benefits would need to decrease by £53.3m or 58.3%
Costs	Costs would need to increase by £13.6m or 71.5%	Costs would need to increase by £13.5m or 70.9%	Costs would need to increase by £26.7m or 138.8%

9.1.3 If the costs were to remain the same, benefits would need to decrease by 41.7%, 41.5% or 58.3% for options A, B and C respectively, to lower the scheme into the medium VfM category.

9.1.4 If benefits were to stay the same, cost would need to increase by 71.5%, 70.9% or 138.8% for options A, B and C respectively, to lower the scheme into the medium VfM category.

Table 9-2 - Changing the Adjusted BCR to Very High

Factor	Appraisal Methodology Option A (High to Very High)	Appraisal Methodology Option B (High to Very High)	Appraisal Methodology Option C (High to Very High)
Benefits	Benefits would need to increase by £10.9m or 16.6%	Benefits would need to increase by £11.1m or 17.0%	N/A – option already at Very High VfM
Costs	Costs would need to decrease by £2.7m or 14.2%	Costs would need to decrease by £2.8m or 14.5%	N/A – option already at Very High VfM

9.1.5 To switch the scheme into the Very High VfM category, if the costs were to remain the same, benefits would need to increase by 16.6% or 17.0% for options A and B, with option C already being within the Very High VfM Category.

9.1.6 If benefits were to stay the same, cost would need to decrease by 14.2% or 14.5% for options A and B respectively, option C already being within the Very High VfM Category.

10 SENSITIVITY TESTING

10.1 INTRODUCTION

10.1.1 To understand how sensitive the benefits described above are to a range of alternative parameters, a number of tests have been performed.

- TAG Sensitivity Databook
- High and low traffic growth scenarios
- Alternative levels of Optimism Bias (different stages of the business case)
- Alternative levels of Additionality applied to dependent development impacts

The results of these tests are summarised below.

10.2 TAG SENSITIVITY DATABOOK

10.2.1 Sensitivity tests have been undertaken by using the TAG Sensitivity Databook (V1.14). The Databook reflects changes in economic and population parameters projects provided by the Office for Budget Responsibility (OBR).

Table 10-1 – TAG Sensitivity Databook testing (2010 prices and values)

£000s in 2010 prices and values	Appraisal Methodology Option A	Appraisal Methodology Option B	Appraisal Methodology Option C
Initial PVB	47,203	48,045	67,410
Wider Economic Impacts	11,530	10,108	14,163
Adjusted Present Value of Benefits (PVB)	58,733	58,153	81,573
Present Value of Costs (PVC)	19,077	19,077	19,077
Net Present Value (NPV)	39,657	39,076	62,497
Adjusted BCR	**3.1**	**3.0**	**4.3**

10.2.2 These results show that the BCR remains above 2 and within the High Value for Money category in across all scenarios. This increases the level of certainty in the VfM associated with a reduction in Transport User Benefits and COBALT.

10.3 HIGH AND LOW TRAFFIC GROWTH SCENARIOS

10.3.1 Sensitivity testing has been undertaken for the high and low growth scenarios using the standard version of TAG Databook (version 1.13.1). These sensitivity tests are provided in Table 10-2.

Table 10-2 – High and Low Traffic Growth Scenario Testing (2010 prices and values)

Appraisal Methodology Option	Scenario	Initial PVB (£,000)	Initial BCR	Adjusted PVB (£,000)	Adjusted BCR	VfM category
Option A	Low Traffic Growth Scenario	48,427	**2.5**	59,957	**3.1**	High
Option A	Core Scenario	53,919	**2.8**	65,450	**3.4**	High
Option A	High Traffic Growth Scenario	63,948	**3.4**	75,478	**4.0**	Very High

10.3.2 These results show that the BCR remains above 2 and within the High Value for Money category in across all scenarios. This increases the level of certainty in the VfM associated with a significant reduction in Transport User Benefits.

10.4 ALTERNATIVE OPTIMISM BIAS

10.4.1 As noted above, an allowance of 15% optimism bias (OB) is considered appropriate for this scheme, given the level of development and scope of the Quantified Risk Assessment (QRA). The effect on PVC, BCR and VfM for the core scenario of changing OB to, 3% and 44% is set out in Table 10-3 In line with TAG guidance, public sector and private sector costs get treated differently in the Benefit-Cost Ratio. This means that when the OB is altered from the core scenario, this will impact both the PVB and PVC.

Table 10-3 - Alternative optimism bias sensitivity tests (2010 prices and values)

Appraisal Methodology Option	Allowance for Optimism Bias	Adjusted PVB (£,000)	Adjusted PVC (£,000)	Adjusted BCR	VfM category
Option A	15% (OBC)	65,450	19,077	**3.4**	High
Option A	3% (Stage 3 FBC)	65,450	17,221	**3.8**	High
Option A	44% (Stage 1 SOBC)	65,450	23,560	**2.8**	High
Option B	15% (OBC)	65,215	19,077	**3.4**	High
Option B	3% (Stage 3 FBC)	65,215	17,221	**3.8**	High
Option B	44% (Stage 1 SOBC)	65,215	23,560	**2.8**	High

Appraisal Methodology Option	Allowance for Optimism Bias	Adjusted PVB (£,000)	Adjusted PVC (£,000)	Adjusted BCR	VfM category
Option C	15% (OBC)	91,483	19,077	**4.8**	Very High
Option C	3% (Stage 3 FBC)	91,483	17,221	**5.3**	Very High
Option C	44% (Stage 1 SOBC)	91,483	23,560	**3.9**	High

10.4.2 These results show that when high levels of Optimism Bias are applied the BCR remains above 2 and within the High Value for Money category, which increases the level of certainty associated with a change in costs.

ALTERNATIVE ADDITIONALITY

10.4.3 The Economic Appraisal model tests the level of displacement applied, impacting on the additionality rate applied to the Land Value Uplift. The results are summarised in the Table 10-4.

Table 10-4 - Sensitivity Testing on Land Value Uplift

Appraisal Methodology option	Scenario	Displacement Rate, %	Additionality Rate, %	Land Value Uplift Benefit, £, 2010
Option A	Core Scenario (1)	10.0	82.0	64,650,448
Option A	Scenario 2	5.0	86.6	68,242,140
Option A	Scenario 3	15.0	77.5	61,058,757
Option A	Scenario 4	20.0	72.9	57,467,065
Option B	Core Scenario (1)	10.0	46.3	36,476,271
Option B	Scenario 2	5.0	48.8	38,502,731
Option B	Scenario 3	15.0	43.7	34,449,812
Option B	Scenario 4	20.0	41.1	32,423,352

10.4.4 For each of the above scenarios would the Value for Money category would remain High Value for Money category but would not switch it to Very High.

11 SUMMARY

11.1 BENEFIT TO COST RATIO

11.1.1 The Economic Case identifies and assesses all 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.

OPTION A APPROACH

11.1.2 The initial BCR is **2.8,** indicating **High** Value for Money according to the DfT Value for Money Framework. The adjusted BCR is **3.4**, strengthening the **High** category.

OPTION B APPROACH

11.1.3 The initial BCR is **2.9,** indicating **High** Value for Money according to the DfT Value for Money Framework. The adjusted BCR is **3.4**, strengthening the **High** category.

Option C approach

11.1.4 The initial BCR is **4.1,** indicating **Very High** Value for Money and the adjusted BCR is **4.8**, strengthening the **Very High** category.

11.2 VALUE FOR MONEY CATEGORY

11.2.1 Once the full scheme impacts are included, which contain the Level 3 Dependent Development benefits associated with land value uplift and land amenity impacts, the scheme still remains **High** Value for Money Category for all methodology options. The scheme would need to deliver greater than the calculated Level 3 benefits to reach the Very High Value for Money category. Therefore, the dependent development impacts are not enough to consider switching the Value for Money category strengthen the confidence and likelihood of the High category for the scheme.

11.3 SENSITIVITY TESTING

11.3.1 The sensitivity tests applied to the appraisal results confirm the High Value for Money position is not sensitive to cost increases, or a reduction in benefits (as the BCR does not drop into the Medium Value for Money category). This increases the level of certainty that the scheme will deliver High Value for Money. When changes to the TAG Sensitivity Databook (V1.14) and optimism bias have been applied, the scheme delivers an adjusted BCR which still remains **High** Value for Money Category for the majority of methodological approaches, pushing into the **Very High** Category for option C, where no dependent development is assumed.

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