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A2 Bean and Ebbsfleet Junction Improvements
Economic Appraisal Package
24/10/18

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Executive Summary

It should be noted that at the time of preparing this report, the Stage 3 traffic management plans for the construction period were not available, and no analysis of the delays during construction has been possible based on those plans. This report has therefore carried forward the corresponding analysis from Stage 2, which was based on the Stage 2 traffic management plans.

1.1.1 The principal specific transport objectives of the A2 Bean and Ebbsfleet Junction Improvements scheme are to enhance capacity and safety of the existing A2 Bean Junction and the existing A2 Ebbsfleet Junction, in order to support the planned growth in economic development within Kent Thameside.

1.1.2 This Economic Appraisal Package documents the details of the approach adopted for estimation of economic benefits arising from the scheme and summarises the results of the assessments, as part of the Project Control Framework (PCF) Stage 3. The starting point is the set of traffic forecasts documented in the Traffic Forecasting Report[1].

1.1.3 The report also seeks to establish the extent to which the scheme provides good value for money in relation to impacts on public accounts by improving transport economic efficiency for all users.

1.1.4 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without scheme scenario (the Do Minimum or DM).

1.1.5 The costs of the scheme used in the assessment comprise the scheme construction costs taken directly from the tables provided by the Highways England Commercial team and reproduced in Appendix B plus operating and maintenance costs. These costs are considered further in Section 3.

1.1.6 The benefits of the scheme are calculated from a number of sources, which are:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA;
- User disbenefits during construction have also been assessed using TUBA (Stage 2 with user disbenefits during maintenance assumed to be negligible); and
- Accident savings have been forecast using COBA-LT.

1.1.7 In addition, estimates have been made of the monetised greenhouse gas, air quality and noise impacts of the scheme.

1.1.8 The results from the different elements of the economic assessment are presented in three summary tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and
- The Analysis of Monetised Costs and Benefits (AMCB) table.

[1] Traffic Forecasting Report-HE543917-ATK-HTA-XX-RP-TR-000016.docx

1.1.9 Supplementary assessments have been undertaken to quantify benefits due to journey time reliability, wider economic impacts and social and distributional impacts.

1.1.10 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

1.1.11 The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

1.1.12 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

1.1.13 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

1.1.14 The scheme is forecast to produce user benefits of £169.2m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £159.3m and vehicle operating cost benefits of £9.9m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed.

1.1.15 The scheme construction costs are £76.3m (PV) but £15.2m (PV) of this cost is being funded from developer contributions. The construction cost figure was correct at the time of compiling this report and may be refined as Stage 3 comes to a conclusion. Any significant changes in cost may require the calculations to be reviewed.

1.1.16 With consideration of the effects of delays during construction, accident benefits, indirect taxation benefits, monetised environmental impacts and maintenance costs, the initial BCR is 2.33, which represents high value for money.

1.1.17 The scheme is forecast to generate wider economic impacts, but they are anticipated to be limited in scale as a result of the characteristics of the scheme and impacts on travel costs and the economic characteristics of the study area.

1.1.18 Inclusion of journey time reliability benefits and wider economic impacts gives an adjusted BCR of 2.59.

1.1.19 The core scenario is viewed as the ‘most likely’ future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommend, therefore, that scenario analysis be undertaken to allow for future uncertainty.

1.1.20 Three sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

1.1.21 The case for the scheme is very sensitive to traffic growth with the high growth scenario increasing the initial BCR to 2.71 but the low growth scenario reducing the initial BCR to 0.89. These results are discussed in section 6.3.

1.1.22 A further sensitivity test was carried out using TUBA version 1.9.11 for the core scenario but this had very little impact on the initial BCR as discussed in section 6.4.

1. Study Overview

1.1 Context

1.1.1 The A2 Bean and Ebbsfleet (A2BE) Junction Improvements have been identified by the Department for Transport (DfT) Road Investment Strategy (RIS) as a committed scheme. The scheme is funded by DfT with Section 106 contributions provided via the Kent Thameside Strategic Transport Programme (STP) and the Ebbsfleet Development Corporation. The scheme is also included in the Highways England Delivery Plan 2015.

1.1.2 The scheme is described in the RIS as "A2 Bean and Ebbsfleet Junctions – improvements to junctions on the A2 near Bluewater to enable major developments in the vicinity of Ebbsfleet".

1.1.3 The proposed improvements to the Bean and Ebbsfleet junctions form part of the Kent Thameside STP and are considered essential to support the level of development growth proposed for Kent Thameside, including Ebbsfleet Garden City which could ultimately lead to the development of some 50,000 homes and 58,000 jobs.

1.2 Statement of Scheme Objectives

1.2.1 The principal specific transport objectives are to enhance the capacity and safety of the existing A2 Bean Junction and the existing A2 Ebbsfleet Junction, in order to support the planned growth in economic development within Kent Thameside.

1.2.2 Capacity enhancement on the A2 mainline is not included in the remit.

1.2.3 As the need for these capacity enhancements is driven by that of supporting the Ebbsfleet Development Corporation and Kent Thameside growth development plans and not for reasons of addressing existing traffic congestion or poor safety or poor journey times, the return on capital investment made, as measured by the appraisal, is not expected to be of a similar order when compared against improvement schemes that are addressing significant network operational problems.

1.2.4 The high-level objectives are shown in Table 1-1.

Table 1-1: Scheme Objectives

Category	Objective
Environment	• Minimise environmental impact as measured in accordance with DMRB. • Where possible, improve air quality with regards to vehicle emissions generally and specifically at the existing declared Air Quality Management Areas (AQMAs).
Economy	• In combination with other measures (e.g. Kent Thameside Strategic Transport Investment Programme), support economic development and housing growth in the Ebbsfleet Garden City and Kent Thameside areas. • Minimise the impact of the junction capacity enhancement proposals on the operational performance of the A2 mainline.
Customer	Throughout the design and delivery stages, the scheme should ensure that customers and communities are fully considered. Specifically, this should include:

Category	Objective
	• Understanding the needs of all segments of customers (including vulnerable users), stakeholders and partners • Responding to those needs such that the end-product delivers an improved customer experience • Assessing the impact of works on road users and communities, minimising disruption and delivering appropriate mitigation measures. The assessment should look at issues through customers eyes.
Safety	• Reduce accident rates for all users. • Minimise the exposure to road workers to harm during construction, operation and maintenance.
Accessibility	• Integrate with the wider strategic objectives of accessibility within Kent Thameside by providing infrastructure within the junction improvements that enables choices of modes of travel to existing and proposed facilities. • Provide access to local sustainable transport options and public transport hubs

Source: Client Scheme Requirements

1.3 Description of Scheme

1.3.1 The A2 Bean and Ebbsfleet junctions are adjacent, grade separated junctions on the A2 in Kent. The junctions are separated by approximately 2km. Both junctions closely interact with M25/A2 crossings.

1.3.2 The Bean Junction is the first junction on the A2 to the east of the M25. The Bean junction connects the A296 and B255, which provides access to Bluewater shopping centre, to the A2 and the wider area and is particularly busy at weekends.

1.3.3 The Ebbsfleet Junction on the A2 is located next to the Bean Junction to the east of the M25. It serves the wider area and Ebbsfleet International Rail Station and connects the A2 to the A2260. It will also provide access to the new and ongoing developments.

1.3.4 Based on the concerns expressed by various stakeholders on the Stage 2 preferred route strategy, several options were developed for both junctions and tested as part of the Stage 3 work. Operational assessments were carried out for all the options, which are detailed in the technical note HE543917-ATK-GEN-RP-TR-000001.

1.3.5 The economic appraisal is based on a single option that was identified based on the operational performance and the scheme design as per Draft DF3.3 Engineering GA Drawings, which can be seen in Appendix A.

1.3.6 In the coming years, the Bean and Ebbsfleet junctions will serve developments such as the Ebbsfleet Garden City. Previous studies on the A2 Bean and Ebbsfleet Junctions indicated that these two junctions are strategic road access points for the redevelopment of North Kent including Ebbsfleet and the Thames Waterfront Priority Area. Without improvements to both junctions, the road network will become highly congested resulting in considerable delays which will ultimately result in reducing the junction performance and its role in supporting local and regional aspirations for future development and growth.

1.3.7 The above discusses the impact of changes in demand, whilst the biggest single impact of supply change is the introduction of the Lower Thames Crossing (LTC).

1.4 Purpose of the Report

1.4.1 This Economic Appraisal Package documents the details of the approach adopted for estimation of economic benefits arising from the scheme and summarises the results of the assessments, as part of the Project Control Framework (PCF) Stage 3. The starting point is the set of traffic forecasts documented in the Traffic Forecasting Report[2].

1.4.2 The report also seeks to establish the extent to which the scheme provides good value for money in relation to impacts on public accounts by improving transport economic efficiency for all users.

1.5 Previous Economic Assessments

1.5.1 The previous work undertaken for A2BE PCF Stage 0 “Completion of Strategy, Shaping & Prioritisation” was based on a VISSIM model cordoned from the Kent Thameside KTS model (KTS SATURN Model V4 June 2007).

1.5.2 The Stage 0 assessment modelled a year of opening of 2018 and design year of 2025, derived from the available KTS base year 2005 and single forecast modelled year 2025.

1.5.3 The Stage 0 appraisal was undertaken separately for “Bean only” and “Ebbsfleet only” improvements. The former was carried out by URS and the latter by Halcrow (now CH2M).

1.5.4 The work was undertaken prior to the Lower Thames Crossing Option Selection Stage 2 modelling and hence did not take into account the Lower Thames Crossing (and consequently the effect on the A2) in the scheme forecasts.

1.5.5 The results of the work on the Bean junction are summarised in the URS document A2 Bean Junction Improvement – Stage 0 Appraisal Technical Note, with a final issue date of 30 April 2010.

1.5.6 The corresponding Halcrow technical note for the A2 Ebbsfleet junction improvement – Stage 0 is titled Economic Appraisal: Approach, Results and Sensitivity Testing dated 30 March 2010.

1.5.7 For Stage 1 (Option Identification), HHJV produced the A2 Bean and Ebbsfleet Junction Improvements - Stage 1 Economic Assessment Report, dated 08 December 2016.

1.5.8 For Stage 2 (Option Selection), HHJV produced the Stage 2 Economic Assessment Report, dated 24 July 2017. The Economic Assessment was carried out for the preferred option (B05E01b).

1.5.9 The scheme is currently in the initial stage of the Development Phase (Preliminary Design) - Highways England PCF Stage 3. This involves refining the traffic modelling and forecasting the environmental, economic and operational assessments for the purposes principally of undertaking consultation and completing and freezing the preliminary design of the preferred route. For that

[2] Traffic Forecasting Report-HE543917-ATK-HTA-XX-RP-TR-000016.docx

reason, it has been necessary to develop a traffic model and economic assessment that is fully WebTAG compliant.

1.6 Structure of the Report

1.6.1 The report is divided into six sections, the brief details of which are as follows:

- Chapter 2 summarises the approach to the economic assessment;
- Chapter 3 addresses the scheme costs;
- Chapter 4 outlines the economic assessment method for the core scenario;
- Chapter 5 presents the results for the core scenario;
- Chapter 6 describes the assessment of the sensitivity tests; and
- Chapter 7 provides a summary of the report.

It should be noted that at the time of preparing this report, the Stage 3 traffic management plans for the construction period were not available, and no analysis of the delays during construction has been possible based on those plans. This report has therefore carried forward the corresponding analysis from Stage 2, which was based on the Stage 2 traffic management plans.

2. Economic Appraisal Approach

2.1.1 This section provides details of the transport model used in this economic appraisal and also describes the approach taken for each of the individual components of the economic assessment.

2.2 A2BE Traffic Model

2.2.1 A highway assignment model (SATURN version 11.3.12W) together with a network representation of public transport (PT) has been used. The model structure and processes are consistent with DfT guidelines and with the Lower Thames Area Model (LTAM) so that any significant impacts from the proposed highway scheme can be assessed.

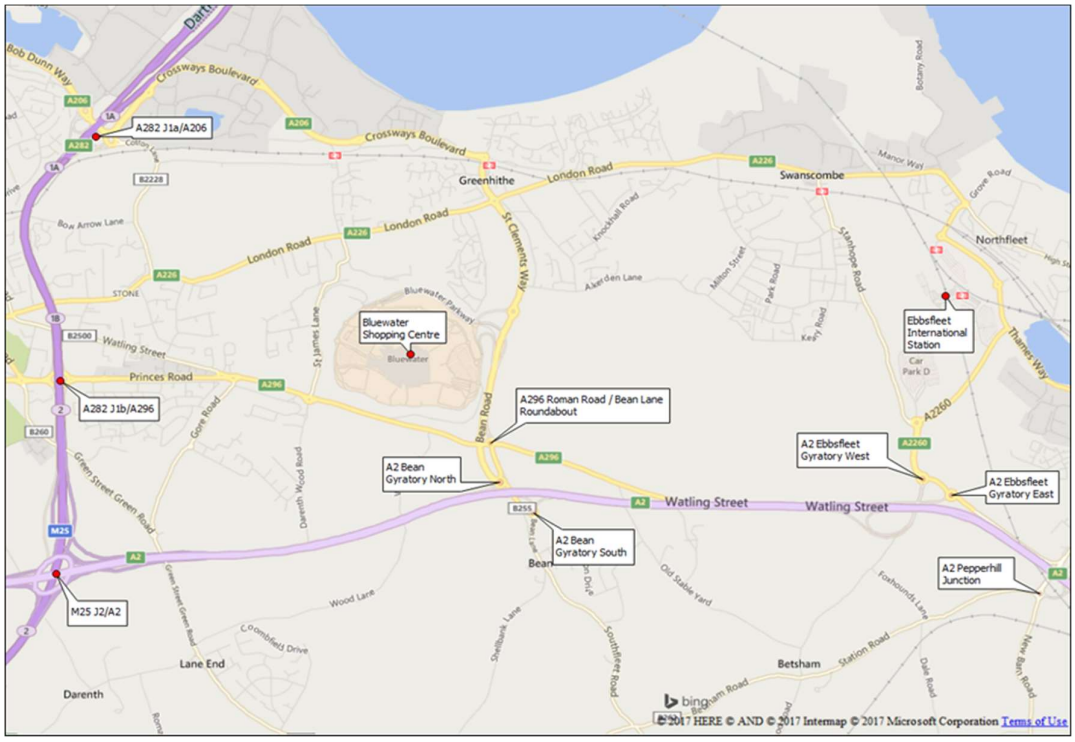
2.2.2 It was agreed with Highways England that a cordon of the LTAM would be used as the basis for the A2BE Stage 3 study and the transport modelling work has been built on that basis.

2.2.3 The base model development, calibration and validation are detailed in the Transport Model Package (HE543917-ATK-HTA-XX-RP-TR-000009) and the results show that the model meets the WebTAG criteria and is suitable for the purpose of developing traffic forecasts used to inform economic, environmental and operational appraisal of highway infrastructure schemes around the Bean and Ebbsfleet junctions.

Geographical Coverage

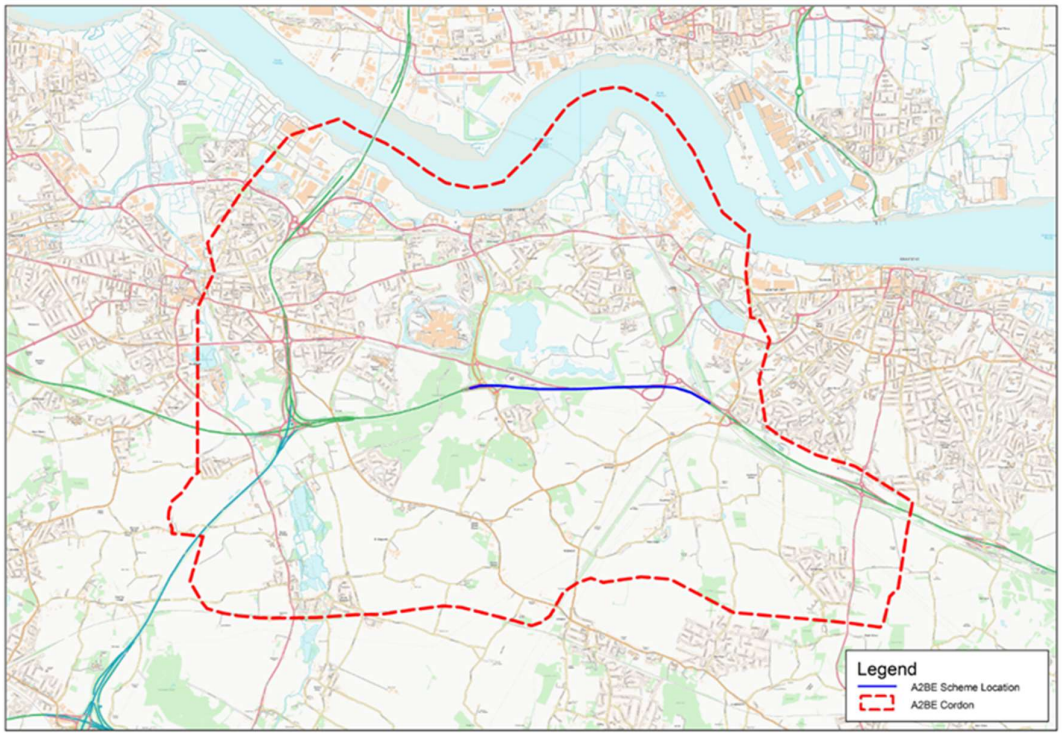
2.2.4 The A2 Bean and Ebbsfleet junctions are adjacent, grade separated junctions on the A2 in Kent. The junctions are separated by approximately 2km and their locations are shown in Figure 2-1. Both junctions closely interact with M25/A2 crossings.

Figure 2-1: A2 Bean and Ebbsfleet Junction Improvements Location Plan



2.2.5 The A2BE Traffic Model cordon, which defines the study area for the economic appraisal, is set out in Figure 2-2 below:

Figure 2-2: A2BE Traffic Model Cordon



2.2.6 Further details regarding the study area are presented in detail in the Appraisal Specification Report (ASR): HE543917-ATK-HTA-XX-RP-TR-000007.docx

Demand and Time Periods

2.2.7 Some key features and a brief description of the LTAM base year model include:

- The LTAM model uses a March 2016 base year, with the following time periods retained for the A2BE Stage 3 study:
  - AM Peak Hour from 07:00 to 08:00;
  - Inter Peak Average Hour from 09:00 to 15:00; and
  - PM Peak Hour from 17:00 to 18:00.
- The trip matrices obtained from the validated LTAM 2016 base year model consist of the following 9 user classes:
  - Car Business
  - Car Commute low income
  - Car Commute medium income
  - Car Commute high income
  - Car Other low income
  - Car Other medium income
  - Car Other high income
  - LGV
  - HGV

2.2.8 For A2BE Stage 3 modelling purposes, the 9 LTAM user class matrices have been converted to 5 user classes comprising of: Car Business, Car Commute, Car Other, LGV and HGV, as shown in Table 2-1 below:

Table 2-1: Segmentation of Journey Purposes, Vehicle Types & PCU Factors

Vehicle Type	Journey Purpose	SATURN Vehicle Type	SATURN User Class	PCU Factor
Car	Business	1	1	1.00
Car	Commute	1	2	1.00
Car	Other	1	3	1.00
LGV	Business	2	4	1.00
HGV	Business	3	5	2.50

Variable Demand

2.2.9 As per the ASR, a variable demand model has been developed for the LTAM model with a cordon used for the A2BE study area and as such, no further VDM development was needed for this study.

Forecast Years

2.2.10 For the purpose of model forecasting and economic assessment, the following forecast year models have been developed:

- Forecast year 2023 ('scheme opening year');
- Forecast year 2026 ('LTC opening year');
- Forecast year 2031. This is the mid-point forecast year between the scheme opening year and the design year;
- Forecast year 2038 ('design year') 15 years after opening; and
- Forecast year 2051 for economic assessment of the scheme.

Core Scenario

2.2.11 The core scenario is intended to provide a sound basis for decision-making given current evidence. It must be robust and evidence-based taking on board different factors and uncertainties affecting travel demand in the future as listed in the uncertainty log.

2.2.12 In the uncertainty log, each likely change in the future was classified according to the likelihood that they will occur. If a scheme or land use change was considered "near certain" or "more than likely", it was included in the core scenario.

2.2.13 The uncertainty log from the LTAM model was reviewed and updated, for the key study area, after contacting the planning authorities of Dartford, Gravesham, Kent County Council and Ebbsfleet Development Corporation. This included confirmation of the phasing of the schemes against our modelled forecast years.

2.2.14 From this, those developments classified as "near certain" or "more than likely" were included in the forecast matrix development process.

2.2.15 Committed highway scheme details were also received from the LTAM model. This information was reviewed and updated, for those schemes within the study area, after contacting the planning authorities of Dartford, Gravesham, Kent County Council (KCC), Ebbsfleet Development Corporation (EDC) and Highways England. The schemes that met the criteria were included in the core scenario. All the schemes are forecast for completion by the year 2023.

2.3 Economic Appraisal Overview

2.3.1 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without scheme scenario (the Do Minimum or DM).

2.3.2 The costs of the scheme used in the assessment comprise the scheme construction costs taken directly from the tables provided by the Highways England Commercial team and reproduced in Appendix B plus operating and maintenance costs. These costs are considered further in Section 3.

2.3.3 The benefits of the scheme are calculated from a number of sources, which are:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA;

- User disbenefits during construction have also been assessed using TUBA (Stage 2 with user disbenefits during maintenance assumed to be negligible); and
- Accident savings have been forecast using COBA-LT.

2.3.4 In addition, estimates have been made of the monetised greenhouse gas, air quality and noise impacts of the scheme.

2.3.5 The results from the different elements of the economic assessment are presented in three summary tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and
- The Analysis of Monetised Costs and Benefits (AMCB) table.

2.3.6 Supplementary assessments have been undertaken to quantify benefits due to journey time reliability, wider economic impacts and social and distributional impacts.

2.3.7 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

2.3.8 The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

2.3.9 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

3. Estimation of Scheme Costs

3.1.1 Scheme costs have been developed in accordance with WebTAG Unit A1.2 (July 2017). This TAG unit provides specific guidance on how scheme costs should be estimated and reported.

3.1.2 Estimation of the costs of transport schemes is important for decisions on scheme funding and is a crucial part of the scheme appraisal process.

3.1.3 Unrealistic cost estimates that subsequently rise will adversely affect the robustness of the assessment of affordability and value for money of a scheme.

3.2 Construction Costs

3.2.1 Scheme construction costs have been estimated by and received from the Highways England Commercial team. These include the results of a quantified risk assessment (rather than Optimism Bias) and the effects of construction price inflation. The costs have been provided on a year by year basis as factor costs in 2010 prices. A summary of the costs, along with their respective cost profiles, are provided in Table 3-1 and Table 3-2. The full Scheme Cost Estimates can be found in Appendix B. These figures were correct at the time of compiling this report and may be refined as Stage 3 comes to a conclusion. Any significant changes in cost may require the calculations to be reviewed.

Table 3-1: Total Scheme Construction Costs in £m

Cost Type	Core Scenario
Preparation	£9.03
Supervision	£2.30
Works	£73.42
Lands	£6.97
Total	£91.73

Note: All costs are factor costs, in 2010 prices, undiscounted

Table 3-2: Scheme Construction Cost Profiles in £m

Year	Capital Expenditure, by Year and Component (£m)				
	Preparation	Supervision	Works	Land	Total
2018	1.99	0.00	0.00	3.30	5.29
2019	5.24	0.00	0.00	0.00	5.24
2020	1.80	0.77	23.82	3.67	30.06
2021	0.00	1.49	47.56	0.00	49.05
2022	0.00	0.04	2.05	0.00	2.09
Total	9.03	2.30	73.42	6.97	91.73

Note: All costs are factor costs, in 2010 prices, undiscounted

3.2.2 To convert the costs to Present Value Costs (PVC), the following calculations have been performed:

- Conversion to market prices (using a factor for the average rate of indirect taxation in the economy of 1.19).
- Discounting to 2010 at 3.5% per annum.

3.2.3 Given the format of cost data received, these calculations have been applied outside TUBA.

3.2.4 The scheme construction costs expressed as a PVC are presented in Table 3-3.

Table 3-3: Present Value of Scheme Construction Costs in £m

Cost Type	Core Scenario
Total	£76.34

Note: All values are £m in 2010 market prices discounted to 2010

3.3 Maintenance Costs

3.3.1 At this stage only limited information has been available to inform a maintenance cost appraisal.

3.3.2 Reference was made to the May 2016 version of the COBA manual, which classifies maintenance costs as either non-traffic related (Group 1) or traffic related (Group 2).

3.3.3 Group 1 includes: drainage, street lighting, footway/cycle tracks, safety fence/barrier, boundary fences, bridges/culverts/subways, remedial earthworks, verge maintenance, sweeping, gulley emptying, signals/signs/crossings, road markings, salt/snow plough/fencing and motorway compounds, which are normally assessed collectively in terms of average cost per km per year.

3.3.4 Group 2 comprises the costs associated with the following items: reconstruction, overlay, resurfacing, surface dressing and patching. It is advised that Group 2 costs need only be assessed when the existing roads are in, or are deteriorating towards, a poor structural condition and where traffic relief on these roads may change the urgency of maintenance work or allow a cheaper solution to be adopted.

3.3.5 COBA contains default values by carriageway layout for Group 1 costs, and this data formed the basis of the assessment which was undertaken.

3.3.6 The total area of new pavement construction for the scheme totals 34,534.83 m^2. It was decided that the area of existing carriageway which will no longer be required should be disregarded. The A2 in this area largely comprises a D4AP road with slip roads and junction links characteristic of a D2AP road. Both in terms of traffic usage and access practicalities it was considered that the maintenance needs and costs of the new construction might be similar to those of a D2M road. The quoted per km cost of a D2M road is given as £20,900/year in 2010 prices in factor cost terms. DMRB 6.2 TD27/05 Cross-Sections and Headrooms gives the total pavement width of a D2M (both directions) as 22.6m. The length of new carriageway equivalent to the new pavement construction is therefore 1.528 km. These figures provided the information needed to calculate the discounted 60-year cost of additional non-traffic maintenance.

3.3.7 For Group 2 costs it was considered that for this scheme the net vehicle km change will be too small to be significant. Differences between DM and DS trip totals are small and mainline A2 trips will have no change in travel distance.

Where entering and leaving traffic has to follow a longer path due to junction reconfiguration, the extra distance will be largely on newly constructed carriageway which should have a considerable initial life.

3.3.8 There was no evidence that the realigned slip roads would replace road sections otherwise needing major renewal, so it was considered on balance that there was no requirement to include Group 2 costs in the appraisal. The Group 1 costs were therefore used in the PA table in section 5.10 to represent additional maintenance costs attributable to the scheme.

3.4 Grants and Subsidies

3.4.1 Based on the best information currently available, it is considered that there are no grants or subsidies applicable to the A2BE scheme.

3.4.2 However, it has been advised that third party funding totalling £45m is available for the scheme. Of this £45m, £25m will be contributed by the Ebbsfleet Garden City development and is therefore recoverable from S106 contributions, while £20m will be contributed by Ebbsfleet Development Corporation.

3.4.3 It is assumed that the £25m sum from S106 contributions will be made available in stages between 2017 and 2025 and that it will be paid in current prices and in resource cost terms.

3.4.4 Should it be necessary for this £25m to be funded fully from public funds, the BCR would fall from 2.33 to 2.07 but this still represents high value for money.

3.4.5 The source has been notified as the STIP (Strategic Transport Infrastructure Programme) fund and the contribution will be collected and underwritten by Ebbsfleet Development Corporation in its role as a Planning Authority.

3.4.6 For this economic assessment, the £25m has been treated as private sector finance, on the basis that it will originate in full from contributions by the business sector to the programme concerned. Should this funding not be received, the BCR will require adjustment.

3.4.7 After expressing the £25m in 2010 prices, discounting to 2010 and converting to a market price base the contribution has been used to reduce the PVC by £15.21m as it is reported in the PA table in section 5.10.

3.4.8 The £20m contributed by Ebbsfleet Development Corporation represents a cost to government in the same way as Highways England's own funding. This £20m therefore does not affect the PVC.

4. Estimation of Benefits

4.1 Transport Economy Efficiency (TEE)

4.1.1 Transport Economic Efficiency (TEE) benefits have been captured in accordance with WebTAG Unit A1.3 (March 2017). Impacts on transport users and providers typically make up the majority of benefits for transport business cases. This TAG unit provides specific guidance on how impacts on transport users and providers (including travel time and vehicle operating cost savings) should be estimated, valued and reported in transport appraisal.

Software Utilised for the Appraisal

4.1.2 TUBA is a software package developed on behalf of the DfT for the appraisal of highway and public transport schemes. It is of particular use where variable demand responses have been included in the transport modelling, as TUBA is based on the 'rule of half', which allows for explicit calculation of changes in demand between the 'Do-Minimum' and 'Do-Something' scenarios. TUBA version 1.9.10 has been used in the appraisal.

4.1.3 TUBA v1.9.10 is an incremental update to TUBA v1.9.9 to ensure consistency with the WebTAG Data Book (v1.9.1) published in December 2017.

4.1.4 These updates include updated GDP growth forecasts (and hence revisions to values of time etc) and changes in fuel consumption, emission rates and the valuations of carbon and fuel.

4.1.5 As part of the update, TUBA v1.9.10 now formally adopts the variation in the value of time by distance for car and rail business trips within the default economic parameters file.

4.1.6 TUBA v1.9.10 enables calculation of varying values of time, either by distance band or as a continuous function, using one of the methods listed below:

- Method 1 – uses a continuous function to calculate VOT for the car business user class.
- Method 2 – uses an average VOT for car business trips based on four separate distance bands.
- Method 3 – uses an average VOT for car business trips based on all distances.

4.1.7 Other journey purposes use Method 3 as standard.

4.1.8 For the appraisal of this scheme, Method 1 was applied, as it is the preferred approach to appraise business users.

4.1.9 It should be noted that a further update of TUBA (version 1.9.11) was released during the Stage 3 appraisal programme to ensure consistency with the WebTAG Data Book (v1.10) published in May 2018. It was agreed with Highways England that the core scenario would use v1.9.10 and a sensitivity test would be carried out using v1.9.11.

Warnings and Logic Checking

4.1.10 Annualised total trip matrix numbers that were fed as an input to TUBA were cross checked for different peak periods, user classes and forecast years by

deriving them independently from SATURN matrices and comparing them to TUBA outputs. All comparisons showed the results to be internally consistent.

4.1.11 Warnings in the TUBA output file, such as the ratio of Do Minimum to Do Something travel distance or travel time being outside the defined range, were investigated. Spot checks were performed for a sample of Origin-Destination pairs from the SATURN model (shown in Appendix C) and these were found to be logical.

Derivation of Annualisation Factors

4.1.12 In order to obtain the number of hours to be appraised to represent the weekday and weekend periods, the temporal distribution of traffic was studied using data collected from the WebTRIS website for year 2016 for sites on the A2 Mainline motorway in both eastbound and westbound directions. Appendix D shows the WebTRIS sites used in this analysis.

4.1.13 WebTRIS sites located within the study area were selected based on the availability of the traffic volume count data throughout the year 2016. Table 4-1 shows that the confidence level of the availability of data at all chosen site locations is above 80%.

4.1.14 The obtained WebTRIS data was processed and compared with two-way modelled flows from the A2BE base traffic model. The percentage differences in flows (average observed flow from the WebTRIS sites, versus average modelled flow from the corresponding model links) were found to be 3.46%, -4.91% and 2.92% for the AM peak, Interpeak and PM peak periods respectively.

Table 4-1: WebTRIS Data Confidence Level

WebTRIS Site ID	Number of days for which traffic counts were available	Total number of days in the year 2016	Confidence Level
A2-8305A	327	366	89.3%
A2-8335A	303	366	82.8%
A2-8345A	325	366	88.8%
A2-8352A	327	366	89.3%
A2-8303B	315	366	86.1%
A2-8331B	327	366	89.3%
A2-8347B	327	366	89.3%
A2-8354B	327	366	89.3%

4.1.15 Weekday and weekend graphs were plotted (as shown in Figure 4-1 to Figure 4-3) to compare the average hourly flow for the different modelled time periods against the observed flow across the different day types. This informed the number of hours to be appraised within the TUBA assessment and identified the appropriate modelled time period with which to represent a particular hour of the day. The results of the comparison were:

- Weekday AM Peak Period – 1 hour modelled peak period (07:00 - 08:00). As shown in the left-hand peak in Figure 4-1, an additional two hours (06:00-07:00[3] and 08:00-09:00) have been included in the appraisal as a part of the AM peak period because the total two-way flows during these two hours are close to the modelled weekday AM peak flow. Thus, the total appraised weekday AM peak period stands at 3 hours (06:00-09:00).
- Weekday PM Peak Period – 1 hour modelled peak period (17:00 – 18:00). As shown in the right-hand peak in Figure 4-1, an additional three hours (15:00-16:00, 16:00-17:00 and 18:00-19:00) have been included in the appraisal as a part of the PM peak period because the total two-way flows during these three hours are close to the modelled weekday PM peak flow. Thus, the total appraised weekday PM peak period stands at 4 hours (15:00-19:00).
- Weekday Inter Peak Period - 6 hours inter-peak period (09:00 –15:00), as per the modelled average hour – the middle block in Figure 4-1.
- Weekday Off-Peak Period: The two-way traffic flow during the off-peak hour 19:00-20:00 was observed to be falling within +/-10% of the modelled weekday inter-peak flow. This one hour therefore has been included as the weekday off-peak period in the appraisal.
- Saturday: The two-way traffic flows during 11:00-18:00 were observed to be falling outside the range of +/-10%[4] of the modelled weekday inter-peak flow and are closer to the modelled weekday AM peak flow. These seven hours, therefore have been included as part of the Saturday period in the appraisal. Additionally, three hours (09:00-10:00, 10:00-11:00 and 18:00-19:00) have been considered as a part of the appraisal as the two-way flow during these hours is within +/-10% of the modelled weekday inter-peak flow as shown in Figure 4-2.
- Sunday: The two-way traffic flows during 10:00-19:00 were observed to be falling within +/-10% of the modelled weekday inter-peak flow. These nine hours have, therefore, been included as the Sunday period in the appraisal as shown in Figure 4-3.

[3]Although traffic volume during 06:00-07:00 is close to +/-10% of the modelled weekday interpeak flow, it has been included in the AM peak appraisal period considering the peaking hour effects (travel pattern etc.) which occur during the morning peak period.
[4] A threshold of +/- 10% of the modelled weekday inter-peak was selected based on the analysis of hourly flow plots for weekdays, Saturdays and Sundays to ensure that the busiest of the weekday shoulder peak and weekend periods to be considered in the appraisal are duly adjusted against an outlier effect.

Figure 4-1: Hourly Flow Plot for weekday (veh)

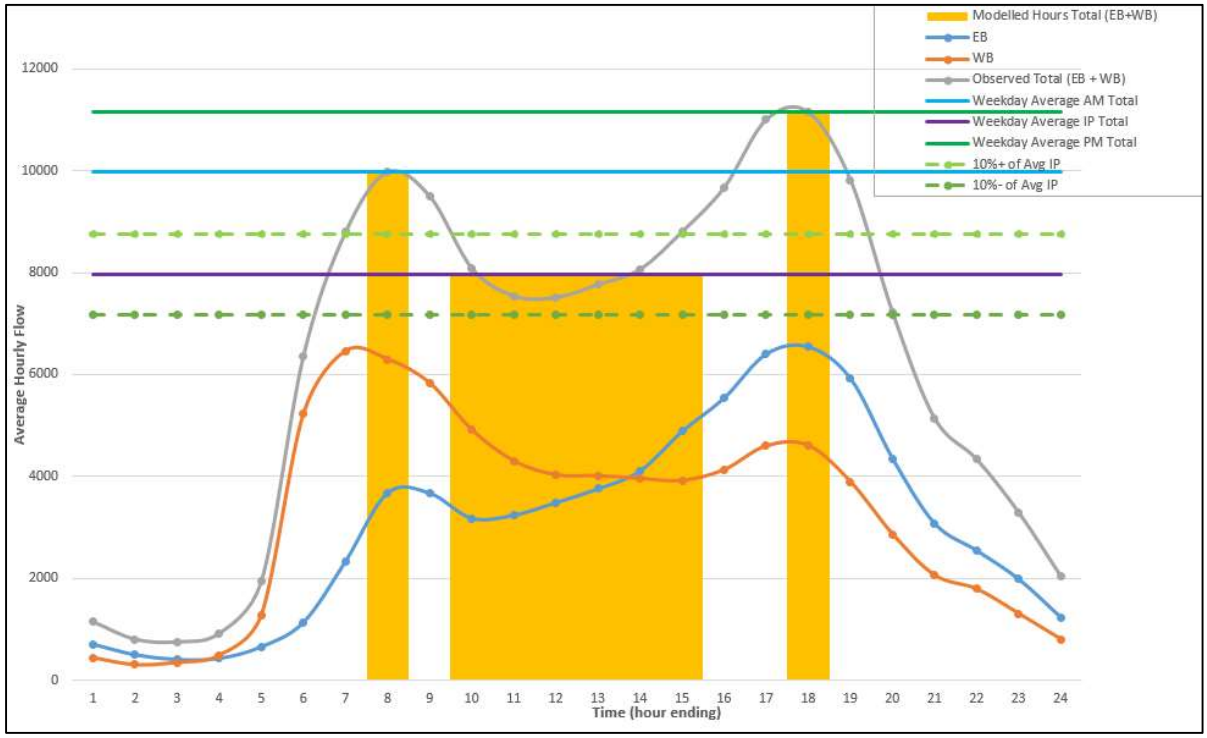


Figure 4-2: Hourly Flow Plot for Saturday (veh)

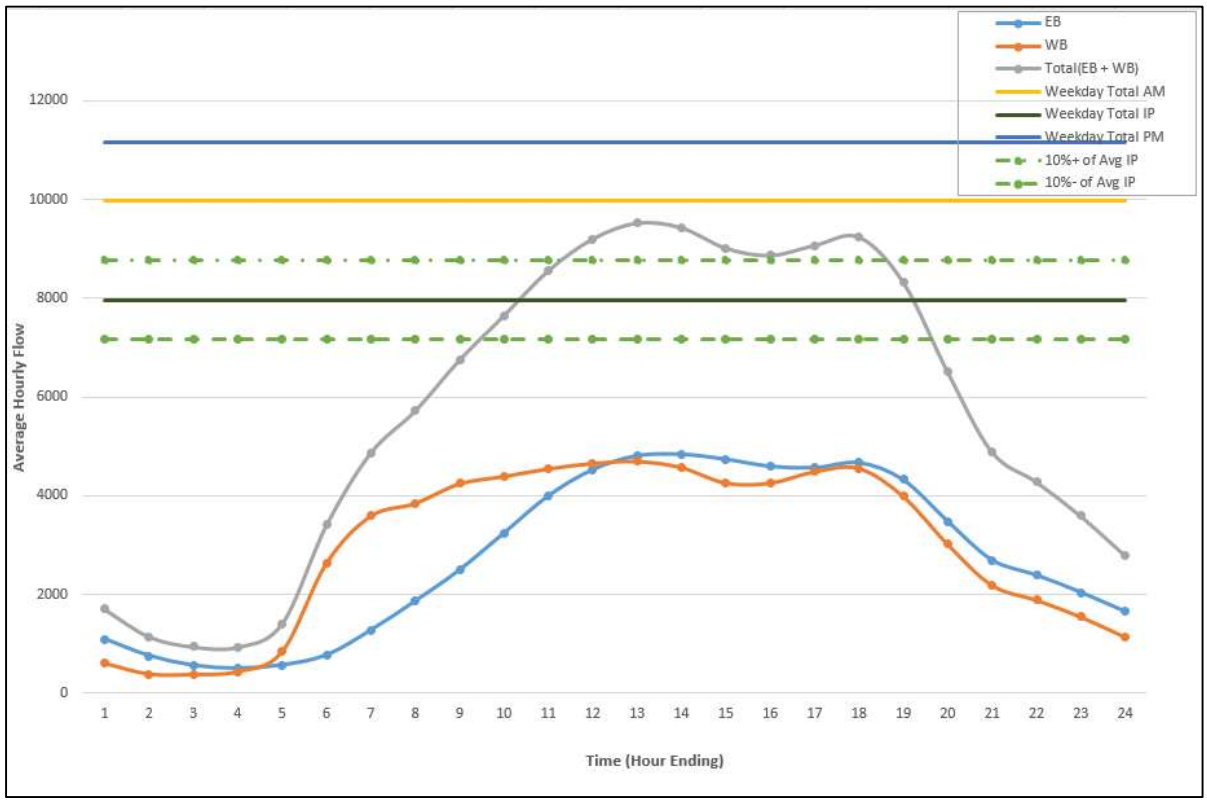
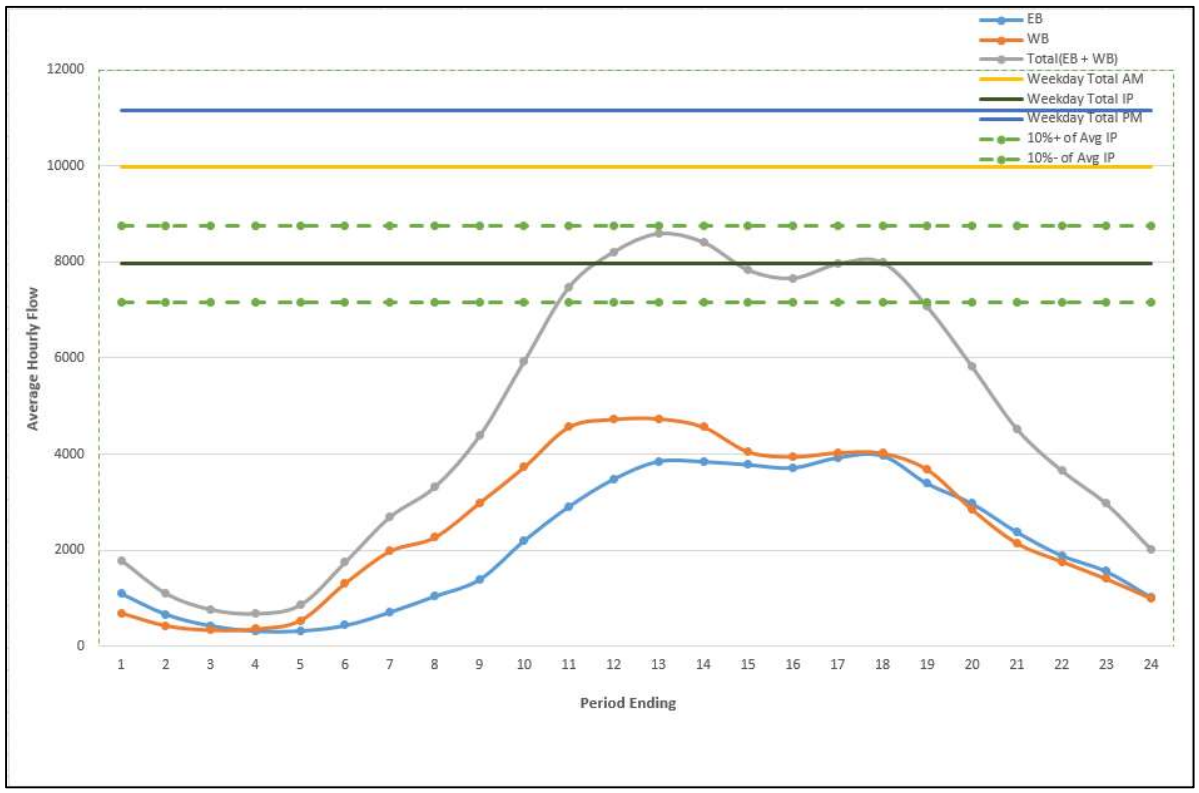


Figure 4-3: Hourly Flow Plot for Sunday (veh)



- The Saturday peak period is represented by both the AM peak and inter-peak models while the Sunday and weekday off-peak periods are represented by the inter-peak model only. Weekday to weekend factors were calculated for each weekend day based on the ratio between the observed average annual hourly flow over the appraised weekend hours, and the observed average annual hourly flow for those weekday hours for which the relevant model was built - inter-peak or AM peak.
- Seasonality factors were calculated for both weekday and weekend time periods by taking a ratio of the annual average flow to the average flow in March 2016.
- In order to balance out the effect of the appraisal hours over modelled hours on weekday average hourly flows, an adjustment factor has been applied. The adjustment factor is calculated by taking the ratio of observed annual average hourly flows during appraised hours to observed annual average hourly flows during modelled hours. Table 4-2 shows the process of calculation of the adjustment factors.

Table 4-2: Adjustment Factor Calculation

Description	Modelled Periods			Appraisal Period			Factor Calculation = (B) / (A)
	Time	Hrs	Observed Average Volume (A)	Time	Hrs	Observed Average Volume (B)	
AM Peak	07:00 – 08:00	1	9977	06:00 – 09:00	3	9424	0.945
Inter Peak	09:00 – 15:00	6	7965	09:00 – 15:00	6	7965	1.000
PM Peak	17:00 – 18:00	1	11152	15:00 – 19:00	4	10414	0.934

4.1.16 The annualisation factors for the appraised time periods are derived, as shown in Table 4-3.

Table 4-3: Annualisation Factor Calculation

Time Period	Number of Days	Period Length	Seasonality Factor	Modelled hour to Appraisal hour Adjustment Factor	Factor Calculation
AM Peak Hour to AM Peak Period	253 working days	3 hours	0.978	0.945	253*3*0.978*0.945=701
Average Inter Peak to Inter Peak Period	253 working days	6 hours	1.026	1.000	253*6*1.026*1.000=1558
PM Peak Hour to PM Peak Period	253 working days	4 hours	0.967	0.934	253*4*0.967*0.934=914
Weekday Off-Peak	253 working days	1 hour	1.021	-	253*1*1.021=258
Saturday-AM Peak	53 weekends	7 hours	1.004	-	53*7*1.004=373
Saturday-Inter Peak	53 weekends	3 hours	1.016	-	53*3*1.016=161
Sunday (52) and Bank Holidays (8)	52 weekends BH: 8	9 hours	1.002	-	60*9*1.002=541

4.1.17 These annualisation factors are broadly consistent with the Lower Thames Crossing (LTC) equivalents. Therefore, the following annualisation factors for appraised time periods have been used in the TUBA scheme input file:

- Weekday AM Peak - 701
- Weekday Inter Peak - 1558
- Weekday PM Peak - 914
- Weekday Off Peak - 258
- Weekend -1075 (Saturday AM Peak- 373, Saturday Inter-peak- 161 and Sunday-541)

User Classes and Journey Purposes

4.1.18 The A2BE Traffic Model comprises five user classes. The modelled user classes were split into seven user classes as required for the TUBA economic appraisal, as shown in Table 4-4 below:

Table 4-4: Correspondence of Modelled User Classes to TUBA User Classes - Weekday

Modelled User Class	TUBA User Class	Factor
1 Car Business	1. Car Business	1.00
2. Car Commute	2. Car Commute	1.00
3. Car Other	3. Car Other	1.00
4. LGV	4. LGV Personal	0.12
	5. LGV Freight	0.88
5. HGV	6. OGV1	0.16 *
	7. OGV2	0.24 *

* Includes conversion from PCUs (the traffic model's unit of account) to vehicles (TUBA's unit of account). The model represents an HGV as 2.5 PCU. The two HGV factors therefore need to sum to 0.4 (the inverse of 2.5).

4.1.19 The LGV user class was disaggregated into LGV Personal and LGV Freight using the WebTAG Data Book Table A1.3.4[5], giving a default proportional split of 12% for LGV Personal and 88% for LGV Freight. HGVs were split into OGV1 (15.9%) and OGV2 (24.1%) based on the available WebTRIS data for selected sites within the study area and taking into account a PCU factor of 2.5.

4.1.20 For the weekend it was observed that there are some Saturday hours where flow levels are in line with the weekday AM peak period and other hours where flow levels are in line with the weekday Interpeak period. Similarly, some Sunday/Bank Holiday hours flow levels were observed to be in line with the weekday Interpeak period. Thus, both the weekday AM peak and Interpeak periods were used as a representative of weekend hours in the appraisal. As the user class and journey purpose mix over the weekend differs to the weekday, additional factors were calculated to adjust the user classes accordingly. These were calculated for the modelled forecast years of 2023, 2026, 2031, 2038 and 2051 separately, using WebTRIS data for March 2016[6] to provide the vehicle

[5] As per WebTag Data Book May 2018.
[6] Same WebTRIS Site IDs as used in the Annualisation factors calculations

proportions and the WebTAG Data Book default purpose split over the weekend. Table 4-5 to Table 4-9 show these factors for all five modelled years.

Table 4-5: Modelled User Classes to TUBA User Classes - Weekend 2023

Modelled User Class	TUBA User Class	Saturday		Sunday
		Weekday AM	Weekday Inter Peak	Weekday Inter Peak
1 Car Business	1. Car Business	0.185	0.264	0.254
2. Car Commute	2. Car Commute	0.221	0.443	0.426
3. Car Other	3. Car Other	1.752	1.487	1.432
4. LGV	4. LGV Personal	0.120	0.138	0.133
	5. LGV Freight	0.879	1.012	0.975
5. HGV	6. OGV1	0.054	0.055	0.038
	7. OGV2	0.082	0.084	0.057

Table 4-6: Modelled User Classes to TUBA User Classes – Weekend 2026

Modelled User Class	TUBA User Class	Saturday		Sunday
		Weekday AM	Weekday Inter Peak	Weekday Inter Peak
1 Car Business	1. Car Business	0.186	0.262	0.252
2. Car Commute	2. Car Commute	0.213	0.442	0.425
3. Car Other	3. Car Other	1.797	1.489	1.434
4. LGV	4. LGV Personal	0.120	0.138	0.133
	5. LGV Freight	0.879	1.012	0.975
5. HGV	6. OGV1	0.054	0.055	0.038
	7. OGV2	0.082	0.084	0.057

Table 4-7: Modelled User Classes to TUBA User Classes - Weekend 2031

Modelled User Class	TUBA User Class	Saturday		Sunday
		Weekday AM	Weekday Inter Peak	Weekday Inter Peak
1 Car Business	1. Car Business	0.190	0.263	0.253
2. Car Commute	2. Car Commute	0.212	0.436	0.420
3. Car Other	3. Car Other	1.797	1.495	1.439
4. LGV	4. LGV Personal	0.120	0.138	0.133
	5. LGV Freight	0.879	1.012	0.975
5. HGV	6. OGV1	0.054	0.055	0.038
	7. OGV2	0.082	0.084	0.057

Table 4-8: Modelled User Classes to TUBA User Classes - Weekend 2038

Modelled User Class	TUBA User Class	Saturday		Sunday
		Weekday AM	Weekday Inter Peak	Weekday Inter Peak
1 Car Business	1. Car Business	0.191	0.266	0.256
2. Car Commute	2. Car Commute	0.215	0.446	0.429
3. Car Other	3. Car Other	1.778	1.482	1.427
4. LGV	4. LGV Personal	0.120	0.138	0.133
	5. LGV Freight	0.879	1.012	0.975
5. HGV	6. OGV1	0.054	0.055	0.038
	7. OGV2	0.082	0.084	0.057

Table 4-9: Modelled User Classes to TUBA User Classes - Weekend 2051

Modelled User Class	TUBA User Class	Saturday		Sunday
		Weekday AM	Weekday Inter Peak	Weekday Inter Peak
1 Car Business	1. Car Business	0.193	0.268	0.258
2. Car Commute	2. Car Commute	0.217	0.454	0.437
3. Car Other	3. Car Other	1.763	1.472	1.418
4. LGV	4. LGV Personal	0.120	0.138	0.133
	5. LGV Freight	0.879	1.012	0.975
5. HGV	6. OGV1	0.054	0.055	0.038
	7. OGV2	0.082	0.084	0.057

4.1.21 For the weekday off-peak it was observed that flow levels are in line with the weekday Interpeak period. Thus, the weekday Interpeak period was used as a representative of off-peak hours in the appraisal. As the user class and journey purpose mix over the off-peak differs to the weekday Interpeak, additional factors were calculated to adjust the user classes accordingly as shown in Table 4-10. These were calculated using WebTRIS data for March 2016.

Table 4-10: Modelled User Classes to TUBA User Classes - Weekday Off-Peak[7]

Modelled User Class	TUBA User Class	Factor
1 Car Business	1. Car Business	0.982
2. Car Commute	2. Car Commute	0.982
3. Car Other	3. Car Other	0.982
4. LGV	4. LGV Personal	0.118
	5. LGV Freight	0.864
5. HGV	6. OGV1	0.068
	7. OGV2	0.103

Travel Time Savings

4.1.22 Travel time savings are calculated using the 'rule of a half' applied to generalised time skims from the A2BE Traffic Model. The 'rule of a half' relates to the change in the consumer surplus resulting from a reduction in travel costs such that existing users receive the full benefit while new users receive half of the benefit. Since there are no modelled tolls and parking costs are not included in the SATURN model, generalised time equates solely to in-vehicle time.

[7] The factors presented for the off-peak have been consistently used across for all five modelled years.

4.1.23 Travel times in the traffic model are represented in seconds. These are converted to vehicle hours and annualised for each time period, so that annual travel time savings can be calculated.

4.1.24 Annual time savings are calculated for each modelled year. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting on estimated benefits means that the benefits 'curve' declines towards the end of the appraisal period.

4.1.25 Default economic assumptions have been applied, as contained in the TUBA software (v1.9.10) and based on the guidance contained in the DfT's December 2017 WebTAG Data Book (v1.9.1).

Vehicle Operating Cost Savings

4.1.26 Vehicle operating costs (VOCs) are calculated for both fuel and non-fuel elements of the journey, based on formulae set out in the DfT's WebTAG guidance. The 'rule of a half' formula is broadly[8] applied as for travel times, but with vehicle operating costs being based on distance travelled (vehicle-kilometres) and average vehicle speeds.

4.1.27 All assumptions relating to fuel costs, duty and vehicle efficiency are those contained in the default TUBA economics file. The same annualisation factors as defined above are applied to derive VOC benefits

4.2 User Cost during Construction

4.2.1 Transport users incur additional costs when the construction and/or maintenance works affect the highway network. The Highways England QUADRO software calculates the delay and vehicle operating cost impacts, using estimates of likely traffic management requirements for construction, in conjunction with traffic flows extracted from the model where relevant. However, QUADRO cannot model junctions so is not appropriate for A2BE, and it is only able to treat route diversions in a relatively simple manner, potentially oversimplifying more complex rerouting effects in such a complex area of the network.

4.2.2 It should be noted that at the time of preparing this report, the Stage 3 traffic management plans for the construction period were not available, and no analysis of the delays during construction has been possible based on those plans. This report has therefore carried forward the corresponding analysis from Stage 2, which was based on the Stage 2 traffic management plans.

4.2.3 The Stage 2 analysis of the delays during construction was estimated using the strategic model and TUBA runs to represent the impacts of different stages of construction, potentially providing a better representation of wider network effects within the cordoned model area. Each agreed construction stage was modelled in a single-year assignment run using the 2023 demand matrix in a fixed matrix assignment.

4.2.4 An assessment of delays to travellers during pavement maintenance will not be undertaken, as this maintenance is assumed to be limited to the overnight hours where traffic levels would be very minimal and therefore would not have significant impacts on user delays. This is in line with the Stage 2 work in which

[8] Business user vehicle operating costs are not subject to the 'rule of a half' as these are fully perceived.

delays were assessed for the construction period but not for subsequent maintenance.

4.2.5 The construction period at Stage 2 was approximately 18-24 months with 12 months being the major construction period. It was this 12-month period that was assessed in two stages for the construction impacts.

4.2.6 The A2 mainline eastbound had speed and capacity restrictions over the course of the construction period. The two identified construction stages coincided with the major works on each of the junctions (Bean and Ebbsfleet).

4.2.7 Construction Sequence 1 was primarily comprised of changes to the Ebbsfleet junction with lane closures on the eastbound off-slip and on the northern leg of the western roundabout. Construction Sequence 2 was mostly comprised of Bean junction changes with the closure of the turning lane from the eastbound off-slip onto the B255 and capacity reductions at the A296/Bean Lane roundabout approaches.

4.2.8 The two construction sequences were modelled using the 2023 demand matrix in a Fixed Matrix Assignment to model the effects of the construction on the network. The outputs from the modelling assignment were compared against the Do Minimum 2023 model in TUBA in order to quantify the effects of construction.

4.3 COBA-LT: Accident Savings

4.3.1 The COBA-LT assessment provides an analysis of the impact on accidents of a highway scheme, including a monetised impact for inclusion in the BCR. It estimates the number of accidents for each road link. It sums, over the 60-year appraisal period, the product of the accident rate, the road length and the forecast annual traffic flow using relationships contained in the program to take account of changes in accident and casualty rates over time.

4.3.2 The current version of the COBA-LT software (2013.2) and economic parameters file (2018.1) were used for the appraisal.

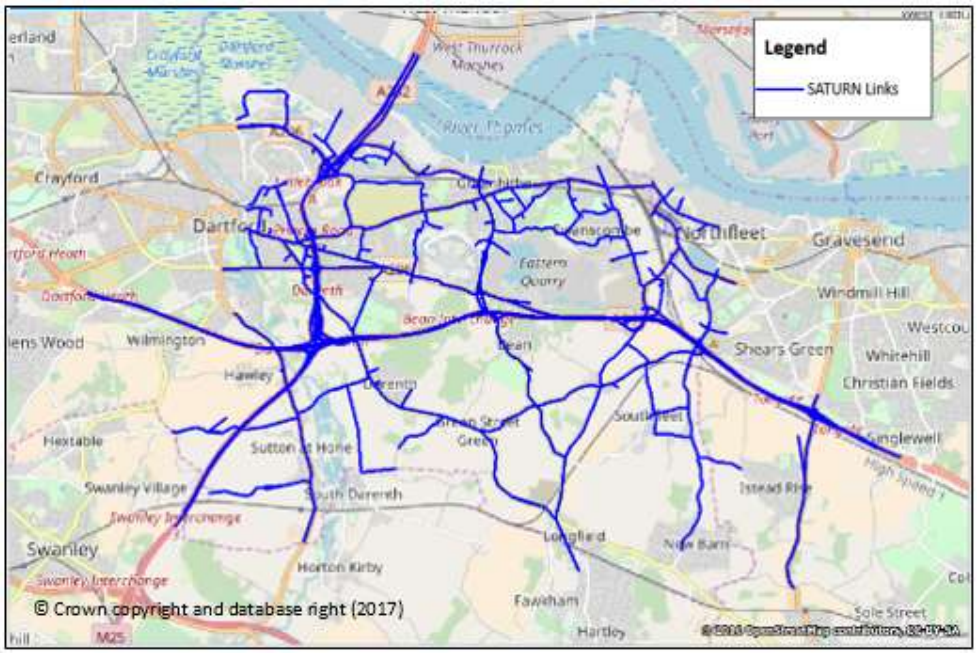
4.3.3 The link and junction combined approach has been adopted, which is the standard approach for developing a COBA-LT assessment from data extracted from strategic models. The required inputs for COBA-LT are summarised below, along with their source, and are discussed in detail in the remainder of this section.

- 24 Hour Annual Average Daily Traffic (AADT) flows for all links in the study area for the Base, Do Minimum and Do Something scenarios have been provided from the A2BE Traffic Model.
- Link details, including link length, speed limit and link type, have been determined from the A2BE Traffic Model network details.
- Observed accident rates/values have been calculated from DfT accident data and traffic flows.

Study Area

4.3.4 The A2BE Traffic Model was adopted as the study area for the COBA-LT assessment. The study area network is as shown in Figure 4-4 below:

Figure 4-4: COBA-LT Study Area



Network Details

4.3.5 The link lengths and speed limits have been extracted from the A2BE Traffic Model networks. The SATURN speed flow curve has been used to determine the appropriate link type. In instances where a link did not have a speed flow curve, a link type has been assigned manually based on link attributes and satellite mapping. Table 4-11 shows the selected link types used in the COBA-LT assessment.

Table 4-11: COBA-LT Assessment Link Types

Link Type	Name	Description
2	Motorways	D3 Motorway
3	Motorways	D4 Motorway
4	Modern S2 Roads	Single carriageway designed to modern standards
5	Modern S2 Roads with HS	Single carriageway designed to modern standards, with a hard strip
6	Modern WS2 Roads	Wide single carriageway designed to modern standards
7	Modern WS2 Roads with HS	Wide single carriageway designed to modern standards, with a hard strip
10	Modern D2 Roads	Dual carriageway with two lanes in each direction designed to modern standards
11	Modern D2 Roads with HS	Dual carriageway with two lanes in each direction designed to modern standards, with a hard strip
14	Modern D3+ Roads with HS	Dual carriageway with three or more lanes in each direction designed to modern standards, with a hard strip

4.3.6 Links that are edited, added or deleted in the different scenarios must be accounted for in the coding of the COBA-LT network. A link that has the same A-node and B-node in SATURN may have different link attributes (e.g. an additional lane in the case of a widening scheme); such links must be coded separately for COBA-LT to take account of the lane difference between scenarios.

4.3.7 The COBA-LT output file returns details of errors or warnings. There were 8 warnings in the output file for the A2BE COBA-LT assessment. These are related to higher observed accident rates which have been checked and found consistent with the high number of accidents observed.

Traffic Flows

4.3.8 24 Hour Annual Average Daily Traffic (AADT) flows for all links in the study area for the Base, Do Minimum and Do Something scenarios have been provided from the A2BE Traffic Model.

4.3.9 The methodology and factors used to expand the three modelled peak hours to 12 hour/16 hour/18 hour/24 hour Annual Average Weekday Traffic (AAWT) or Annual Average Daily Traffic (AADT) flows are outlined in the Traffic Forecasting Report.

4.3.10 Expansion factors were derived from WebTRIS counts on the A2 (March 2016 data) and used to expand the outputs from each modelled hour to AAWT and AADT.

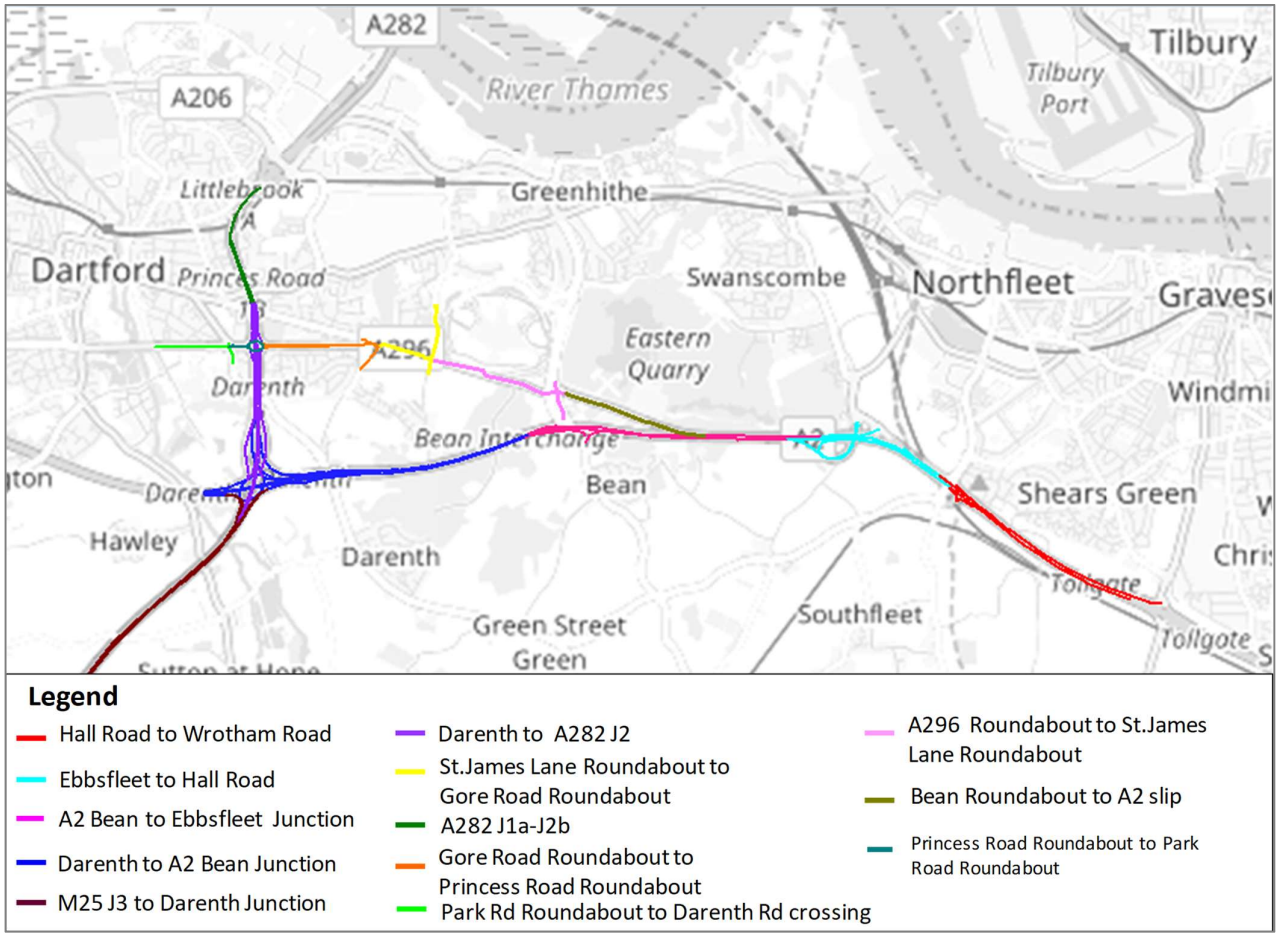
Observed Accident Rates/Values

4.3.11 Accidents over a five-year period between January 2012 and December 2016 (the most recent five calendar years available) were extracted from the STATS19 Road Safety Database for the links within the study area as shown in Figure 4-6. The locations of accidents by severity within the study area are shown in Figure 4-7, Figure 4-8 and Figure 4-9.

4.3.12 Local accident rates have been calculated for sections on major routes within the study area (A2 Mainline, M25 Motorway and A296 Watling Street). For the rest of the study area, COBA-LT default accident rates have been applied. Figure 4-5 shows the key links for which observed accident rates were calculated.

4.3.13 Locally observed accident rates are expressed in personal injury accidents per million vehicle kilometres (PIA/mvkm) and are presented in Table 4-12 to Table 4-14. Two-way Annual Average Daily Traffic (AADT) flows for each section were established using information from the Highways England WebTRIS site locations for sites on the A2 and M25 Mainline and DfT[9] traffic counts for sites on the A296 Watling Street. The site locations are presented in Appendix E.

Figure 4-5: Observed Accident Rates Sections



[9] https://www.dft.gov.uk/traffic-counts/cp.php

Figure 4-6: Accident Locations

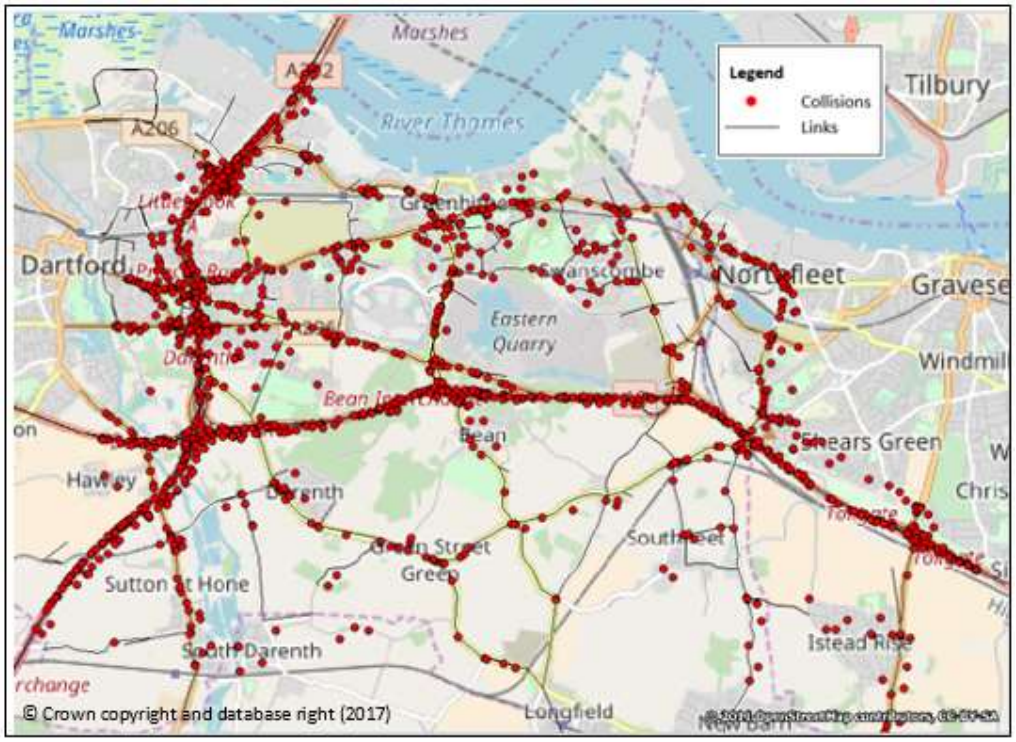


Figure 4-7: Fatal Accident Locations

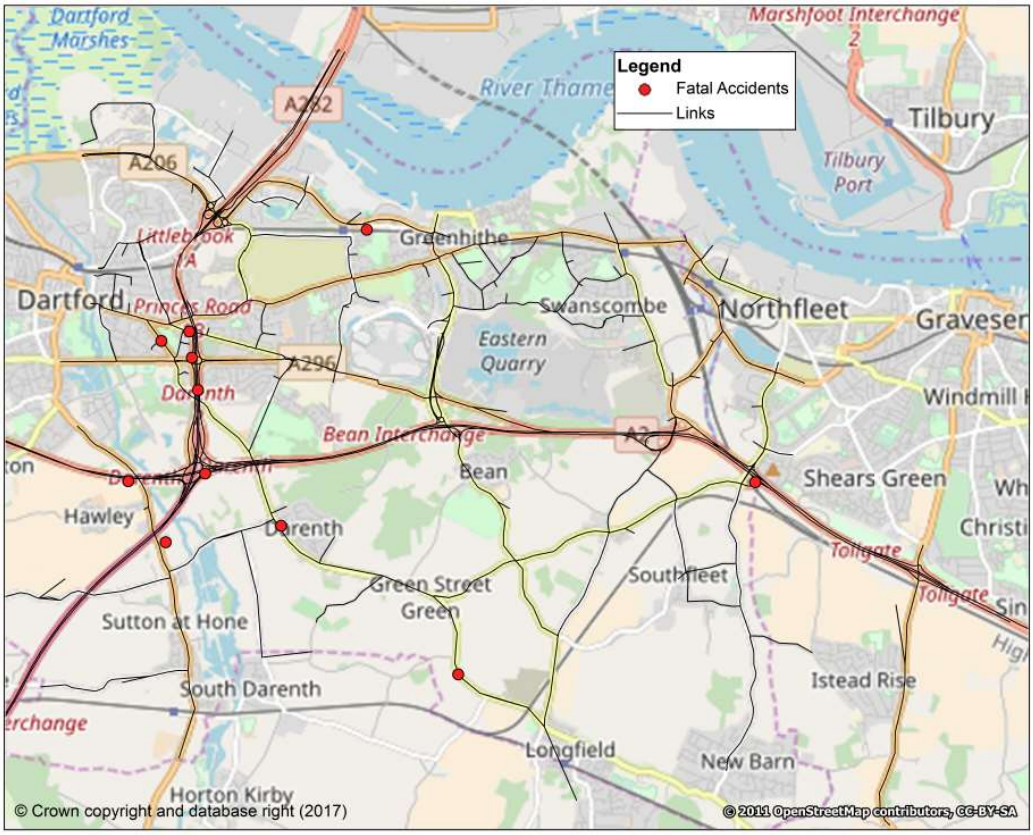


Figure 4-8: Serious Accident Locations

Figure 4-9: Slight Accident Locations

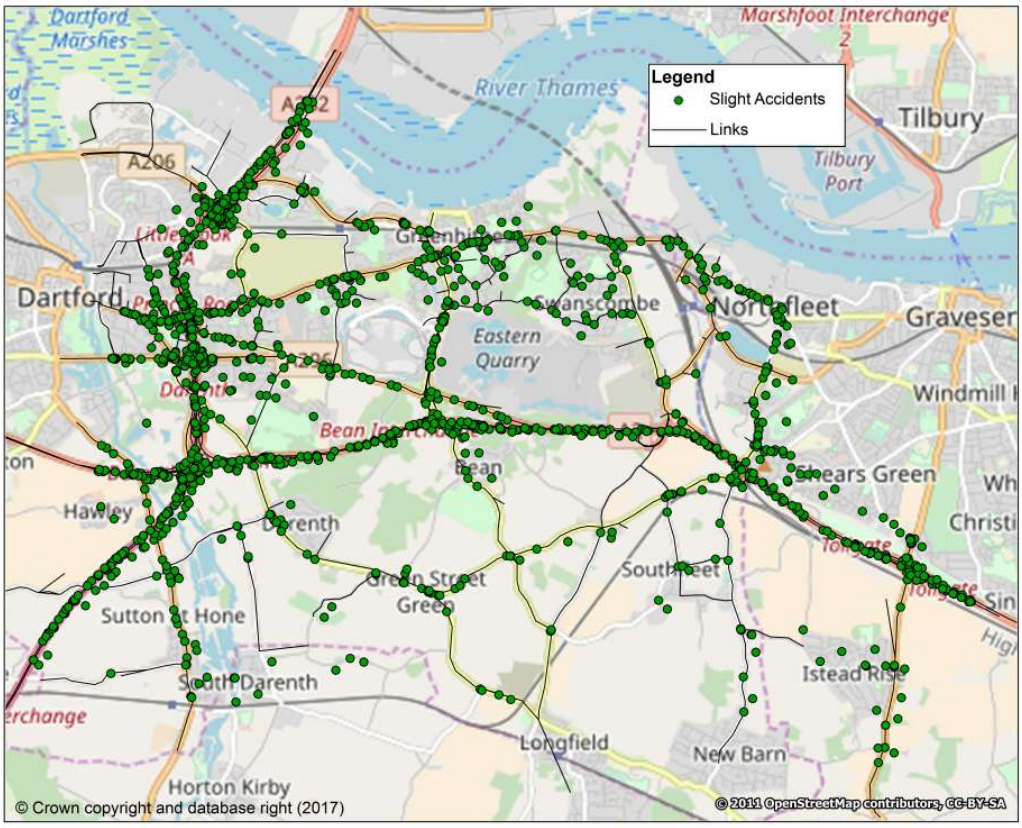


Table 4-12: Accident Rate Calculations for sections on A2 Mainline

Road Section	Year	Accidents	AADT (2-way)	Length (km)	PIAs/mvkm*
Between Darenth and Bean	2012	22	129,157	2.737	0.171
	2013	20	129,951	2.737	0.154
	2014	29	137,503	2.737	0.211
	2015	27	142,354	2.737	0.190
	2016	26	139,794	2.737	0.186
	Average				0.183
Between Bean and Ebbsfleet	2012	18	135,852	2.576	0.141
	2013	16	139,082	2.576	0.122
	2014	27	143,415	2.576	0.200
	2015	21	150,868	2.576	0.148
	2016	21	149,317	2.576	0.150
	Average				0.152
Between Ebbsfleet and Hall Road	2012	13	124,766	1.288	0.222
	2013	9	128,622	1.288	0.149
	2014	14	135,812	1.288	0.219
	2015	7	139,409	1.288	0.107
	2016	7	138,700	1.288	0.107
	Average				0.159
Between Hall Road and Wrotham Road	2012	12	128,497	2.254	0.114
	2013	21	132,355	2.254	0.193
	2014	17	141,511	2.254	0.146
	2015	16	144,539	2.254	0.135
	2016	12	141,772	2.254	0.103
	Average				0.138

*mvkm – million vehicle kilometres

Table 4-13: Accident Rate Calculations for sections on M25 Mainline

Road Section	Year	Accidents	AADT (2-way)	Length (km)	PIAs/mvkm*
Between J3 and Darenth	2012	24	122,879	3.703	0.145
	2013	21	124,873	3.703	0.124
	2014	27	128,071	3.703	0.156
	2015	25	132,215	3.703	0.140
	2016	34	127,796	3.703	0.197
	Average				0.152
Between Darenth and J1B	2012	12	111,320	1.771	0.167
	2013	8	111,658	1.771	0.111
	2014	15	114,614	1.771	0.202
	2015	8	120,605	1.771	0.103
	2016	10	118,428	1.771	0.131
	Average				0.142
Between J1A and J1B	2012	13	126,992	1.127	0.249
	2013	10	130,440	1.127	0.186
	2014	10	134,854	1.127	0.180
	2015	11	142,939	1.127	0.187
	2016	13	140,425	1.127	0.225
	Average				0.205

*mvkm – million vehicle kilometres

Table 4-14: Accident Rate Calculations for sections on A296 Watling Street

Road Section	Year	Accidents	AADT (2-way)	Length (km)	PIAs/mvkm*
Between Bean Roundabout and A2 Slip	2012	3	13,348	1.288	0.478
	2013	3	14,296	1.288	0.446
	2014	5	14,669	1.288	0.725
	2015	1	15,220	1.288	0.140
	2016	3	15,695	1.288	0.407
	Average				0.436
Between A296 Roundabout and St.James Lane Roundabout	2012	2	19,879	1.449	0.190
	2013	2	19,742	1.449	0.192
	2014	1	19,906	1.449	0.095
	2015	2	19,684	1.449	0.192
	2016	3	19,466	1.449	0.291
	Average				0.192
Between St.James Lane Roundabout and Gore Rd Roundabout	2012	2	21,845	0.483	0.519
	2013	0	21,694	0.483	0.000
	2014	1	21,874	0.483	0.259
	2015	3	21,631	0.483	0.787
	2016	1	21,391	0.483	0.265
	Average				0.366
Between Gore Rd Roundabout and Princess Road Roundabout	2012	1	12,096	1.127	0.201
	2013	1	12,129	1.127	0.200
	2014	4	12,530	1.127	0.776
	2015	3	12,802	1.127	0.570
	2016	5	13,220	1.127	0.919
	Average				0.542
Between Princess Road Roundabout and Park Road Roundabout	2012	2	30,147	0.483	0.376
	2013	6	30,057	0.483	1.132
	2014	3	30,441	0.483	0.559
	2015	2	30,207	0.483	0.376
	2016	1	31,794	0.483	0.178
	Average				0.520
Between Park Rd Roundabout and Darenth Road Crossing	2012	7	21,350	0.644	1.395
	2013	11	21,276	0.644	2.200
	2014	9	21,499	0.644	1.781
	2015	8	20,707	0.644	1.644
	2016	5	20,537	0.644	1.036
	Average				1.615

*mvkm – million vehicle kilometres

4.3.14 Accident rates on each section were derived as the weighted average of the accident rates over the five-year period selected.

4.3.15 As a link and junction combined COBA-LT assessment was carried out, the accidents used in the accident rate calculations include those at junctions. Care was taken to minimise the risk of double counting accidents in the calculation of the accident rates.

4.4 Environmental Impacts

4.4.1 Assessments of the impacts of the scheme on greenhouse gas emissions, local air quality and noise have been undertaken using WebTAG guidance to produce standard worksheets, the results of which are reported in the AMCB and AST tables.

4.5 Estimation of Journey Reliability Benefits

4.5.1 Road users value journey reliability as it enables them to predict how long a journey will take and therefore avoid either wasting time by leaving early or arriving later than planned. Therefore, consideration of a scheme's potential impacts on journey time reliability forms an important part of a highway scheme appraisal.

4.5.2 Improving operational resilience and journey time reliability is a key objective of the A2BE scheme and the preferred option is expected to improve the resilience of the junction, which in turn is expected to lead to improved journey time reliability overall.

4.5.3 In addition to the 'conventional' travel time savings (as calculated by TUBA), there is the potential for the scheme to bring benefits in the form of improved journey time reliability.

4.5.4 However, journey time reliability impacts are currently difficult to represent and quantify as baseline information is limited and difficult to obtain and future changes are difficult to forecast.

4.5.5 As per WebTAG Unit A1.3, journey time reliability refers to variations in journey times that individuals are unable to predict (journey time variability, or JTV). Such variation could come from recurring congestion at the same period each day (day-to-day variability, or DTDV) or from non-recurring events, such as incidents. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects which travellers are assumed to be aware of.

4.5.6 Different methods to estimate reliability impacts have been developed for public transport and private vehicle trips on inter urban motorways and dual carriageways, urban roads, and other roads. All the methods require a unit to measure travel time variability and this is generally the standard deviation of travel time (for private travel) or lateness (for public transport).

Inter Urban Motorways and Dual Carriageways

4.5.7 For inter urban motorways and dual carriageways, research by Arup in 2004 found that, as long as demand is below capacity, incidents will be the main source of JTV, and DTDV is much less important except in urban areas where the two effects cannot be readily separated. In such circumstances, where

demand is below capacity, the additional delays caused by congestion unrelated to incidents and any associated variability can be assumed to be allowed for in the journey time forecasts. In the case of delays due to incidents, a separate element for average delays will usually need to be added to the variability element.

4.5.8 Existing methods of estimating reliability for dual carriageways and motorways assume a dual carriageway layout and are likely to use parameters based on data for motorways only. Incident delays can be estimated according to the average severity and length of each type of incident, the number of lanes blocked and the volume of traffic at the time. Changing the number of lanes available to traffic changes both the probability of encountering an incident (or its aftermath) and the delays caused by incidents. The resulting estimates of benefits cannot be taken to be as robust as those for time savings or accident reductions, but they are likely to be of more value to decision makers than a qualitative assessment.

4.5.9 For motorways and dual carriageways, alternative routes avoiding particular sections usually have limited capacity making it difficult for large numbers of drivers to divert if they encounter delays due to an incident. In the absence of significant “transient excess demand” (temporary periods of demand exceeding capacity), it may be sufficient to assume that incidents are the main source of unpredictable variability. However, it is important to note that the research underlying existing methods currently incorporate what are intended to be conservative assumptions, which will be refined in due course.

Urban Roads

4.5.10 In urban areas, alternative routes are more readily available than on motorways and there are many ways for drivers to divert away from incidents which reduce capacity on a particular route. This affects the relative importance of incident and DTDV effects.

4.5.11 Building on previous research, Hyder Consulting, Ian Black and John Fearon (2007) developed a model to forecast changes in the standard deviation of travel time from changes in journey time and distance.

4.5.12 To estimate the monetised benefit of changes in journey time variability, money values are needed. The reliability ratio enables changes in variability of journey time (measured by the standard deviation) to be expressed in monetary terms. The reliability ratio is defined as the value of the standard deviation of travel time divided by the value of travel time.

4.5.13 The recommended value for the reliability ratio for all journey purposes by car, based on evidence from the most up-to-date value of time study in the UK (‘Provision of market research for value of travel time savings and Reliability: Phase 2 Report’, ITS and Accent for the DfT, 2015), is 0.4. Multiplying this value by the appropriate value of time for the purpose in question gives a value of reliability which can be used to estimate the reliability benefit in a formula similar to the rule of a half.

4.6 Wider Economic Impacts (WEIs)

4.6.1 WebTAG Unit A2.1 (May 2018) sets out approaches for estimating six wider economic impacts that can be considered to be supplementary to the welfare

economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour in response to the transport change[10].

4.6.2 The WEI identified are categorised into two levels:

- Level 2 WEI based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets; and
- Level 3 WEI involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development.

4.6.3 For the purposes of this assessment:

- Agglomeration (static and dynamic) and labour market effects (more people working and moves to more productive jobs) were assessed qualitatively;
- Dependent development benefits were assumed to be zero, in agreement with Highways England; and
- Benefits associated with increased output in imperfectly competitive markets were quantified, in line with WebTAG Unit A2.2 (May 2018).

4.6.4 Agglomeration and labour market impacts were assessed qualitatively as it was not judged proportionate to carry out a full quantitative assessment. On the basis of a review of the scheme's characteristics and its impacts and the economic characteristics of the area, as set out in Section 5.7, it was concluded that any impacts estimated would be positive but minor and therefore that quantification would be disproportionate at this stage.

4.6.5 The assumption of zero dependent development impacts was agreed with Highways England as the most appropriate approach, given the transport and development planning approach in the study area.

4.6.6 Significant growth is forecast and underway in the area. In particular:

- The Ebbsfleet Garden City development is expected to create up to 15,000 new homes and more than 30,000 jobs could be created. This development is already underway[11] and the developers will contribute £25m in developer funding to the A2 Bean and Ebbsfleet scheme.
- Growth in Dartford is taking place already (excluding Ebbsfleet): 3,438 houses have been built in the last five years, a further 340 are under construction, and 8,900 have been granted permission (April 2017). Most of these houses are situated north of the A2 and east of Dartford town centre, and will use Bean junction.

4.6.7 The scheme has an objective to support this development and the need for improved access to the A2 at the Bean and Ebbsfleet junctions, in the context of the planned development, was identified in the Kent Thameside Strategic Transport Programme (STP).

[10] Conventional appraisal is based on the assumption that transport markets behave in a theoretical 'perfect' manner. However, in reality markets are imperfect and wider economic impacts occur as the impacts of the transport scheme transmit from the transport markets to other markets as businesses and individuals change their behaviour.

[11] Ebbsfleet Development Corporation

4.6.8 The STP is a package of transport improvements, including this scheme, developed in response to the anticipated impact of developments across the Boroughs of Dartford and Gravesham. It aims to deliver improvements at key locations across the transport network, to enable the planned level of development to be realised. It is part of wider transport strategies for Dartford and Gravesham, and is included in these boroughs' Core Strategies. It is managed by Kent County Council as the local highway authority. Developers of major developments in the area contribute to a fund for delivering the STP, and part of EDC's contribution to the scheme cost comes through this route.

4.6.9 As the STP has identified that this scheme is needed, along with the wider programme, to support the planned level of development, in other circumstances, this linkage could indicate potential Dependent Development (DD) benefits associated with the scheme. WebTAG (Unit A2.2, May 2018) defines DD as new development that is dependent on the provision of a transport scheme to provide a reasonable level of service to existing and/or new users of the transport network.

4.6.10 Conventionally, DD would be either refused planning permission until the relevant transport scheme was in place, or would be permitted subject to a Grampian condition preventing occupancy until the scheme was in place. Appraisal would follow the process set out in WebTAG for determining the extent of DD and estimate associated land value benefits and offsetting externalities, as relevant.

4.6.11 However, unconventionally, in the scheme area, most major developments that might otherwise be considered DD are granted planning permission on the basis that:

- they contribute to the STP; and
- there is government commitment to A2BE.

4.6.12 This means that the "implication that the development would not be delivered in the absence of the transport scheme", as envisaged in WebTAG, is not directly applicable here. In other words, the scheme has little or no DD as defined in WebTAG.

4.6.13 To reflect this situation, the appraisal is a conventional one with land use being identical in the without-scheme (Do-Minimum) and with-scheme (Do-Something) scenarios. The extent of development included has followed the conventional WebTAG approach which, while allowing judgement, starts from the principle that any consented development is 'more than likely' to happen and is to be included in traffic forecasts. This means that the benefits of the scheme in relation to the modelled development are reflected in future year decongestion benefits as the scheme helps to serve the trips associated with the included development more effectively.

4.6.14 Less certain longer-term potential growth plans may require a later review of the appraisal if certainty around delivery increases. In particular, an internationally significant leisure and entertainment Resort on the Swanscombe Peninsula is currently being proposed by the developers London Resort Company Holdings. It has been designated as a Nationally Significant Infrastructure Project (NSIP) and would thus require a Development Consent Order (DCO). It would include a theme park, sporting facilities, and hotel rooms. Around 15 million people would visit each year, and there would be considerable daily staff movements. There is

considerable uncertainty over whether and when the Resort would be delivered but if certainty increases, a review of both conventional and WEI appraisal will be required. For now, the London Resort has not been accounted for.

4.7 Social and Distributional Impacts (SIs and DIs)

4.7.1 Social impacts (SIs) cover the human experience of the transport system and its impact on social factors, where not considered as part of economic or environmental impacts. SIs include the impacts on accidents, physical activity, security, severance, journey quality, option and non-use values, accessibility and personal affordability.

4.7.2 For SIs, the WebTAG appraisal has been carried out in accordance with TAG Unit A4.1 Social Impact Appraisal (December 2017).

4.7.3 Distributional impacts (DIs) consider the variance of impacts across different social groups, and are assessed as part of the appraisal and an assessment entered into the Appraisal Summary Table (AST).

4.7.4 The purpose of DI analysis is to attempt to identify those who would gain or lose from a transport intervention with particular emphasis on the potential impact upon equality through identifying the effects upon those who are disadvantaged compared to the majority of the population. This means that it is now necessary to attempt to disaggregate the benefits and dis-benefits of schemes between different socio-economic groups affected by the scheme. It is no longer acceptable to consider solely the effects upon society as a whole.

4.7.5 The requirement for a DI analysis only applies to the following eight scheme impacts. Some of these will always be relevant to highway schemes, some will sometimes be relevant and some will hardly ever be relevant.

- User benefits (journey times and vehicle operating costs)
- Noise
- Air quality
- Accidents
- Security
- Severance
- Accessibility
- Personal affordability

4.7.6 The effect of these impacts is assessed on the extent to which they affect the following eight social groups:

- Income distribution (income groups)
- Children
- Young males
- Older people
- Disabled
- Black and minority ethnic groups

- Those without access to a car
- Carers

4.7.7 These groups have been identified as vulnerable in the WebTAG guidance. For example, young males are more likely to be involved in car accidents than other groups. Some impacts are assessed only for specific groups (e.g. user benefits are only related to income distribution, and not other groups such as children and young people).

4.7.8 The complete process for undertaking a DI analysis follows the following steps:

- Step 1: Screening Process
- Step 2: Assessment
- Step 2a: Confirmation of areas impacted by the intervention
- Step 2b: Identification of social groups in the impact area
- Step 2c: Identification of amenities in impact area
- Step 3: Appraisal of Impacts
- Step 3a: Core analysis of impacts
- Step 3b: Full appraisal of SDIs and input into AST

4.7.9 If screening indicates that a full analysis is required for any of the eight impacts, steps 2 and 3 of the DI analysis process are followed. Otherwise, it is sufficient to report, with reasons, that a DI analysis is not required.

4.7.10 At Stage 2, a DI screening was carried out. It identified that the user benefits and affordability criteria should be taken forward to further appraisal, and that the remainder (noise, air quality, accidents, security, severance, accessibility) should not be examined. An appraisal of user benefits and affordability was therefore carried out.

4.7.11 The Stage 2 affordability assessment results showed a surprising profile of benefits, with the benefits heavily skewed towards the '20-40% most deprived' quintile and with significant disadvantages accruing to the least deprived quintile. This surprising profile was not replicated in the user benefits.

4.7.12 At Stage 2 the DI was documented in the Economic Assessment Report, not as part of the AST product, and relatively briefly (without a full DI appraisal matrix or maps of Lower Super Output Areas and income quintiles). This is understood to have been at Highways England's request and reflecting current Highways England practice for schemes where DIs are not a major consideration.

4.7.13 Potential DIs resulting from the operation of the scheme option have been assessed in accordance with WebTAG Unit A4.2 Distributional Impact Appraisal (December 2015).

4.7.14 The Stage 2 screening and appraisal will be reviewed and updated, in the light of the updated designs and traffic modelling outputs. If the affordability shows a similar surprising result to the Stage 2 figures, this will need to be investigated and explained.

4.7.15 The study area will be that defined by the A2BE Traffic Model study area as set out in section 2.2.5 plus any specific catchment area for the individual DI indicator being appraised as described above.

5. Economic Appraisal Results: Core Scenario

5.1.1 This chapter sets out the results of the economic appraisal for the core scenario in line with the assessment methodologies set out in chapter 4.

5.2 Transport Economic Efficiency (TEE)

5.2.1 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

5.2.2 The scheme is forecast to produce user benefits of £169.2m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £159.3m and vehicle operating cost benefits of £9.9m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed.

5.2.3 A number of detailed analyses were undertaken on the TUBA user benefit outputs to ensure that the results are logical and in line with expectations, as reported below.

Spatial Distribution of Benefits

5.2.4 To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The Stage 3 A2BE Traffic Model zones (see Figure 5-1) were aggregated into fourteen sectors as shown in Figure 5-2.

5.2.5 Sectors 1, 2, 3 and 4 are internal sectors, while sectors 5 and 7 are external sectors for the A2, sectors 6 and 8 are external sectors for the M25 and sectors 9, 10, 11,12, 13 and 14 are external sectors representing other roads.

5.2.6 The sector analysis provides a check on the forecasts of the scheme. It shows the extent to which model “noise” is potentially having an impact on the results produced by TUBA. This is usually identified by counter intuitive benefits/dis-benefits for movements across the study area that are not expected to be affected by the scheme (e.g. external-external movements that do not pass through or within the influence of the scheme). No significant model noise was identified and so no masking of impacts was undertaken.

Figure 5-1: A2BE Stage 3 Zone Boundaries

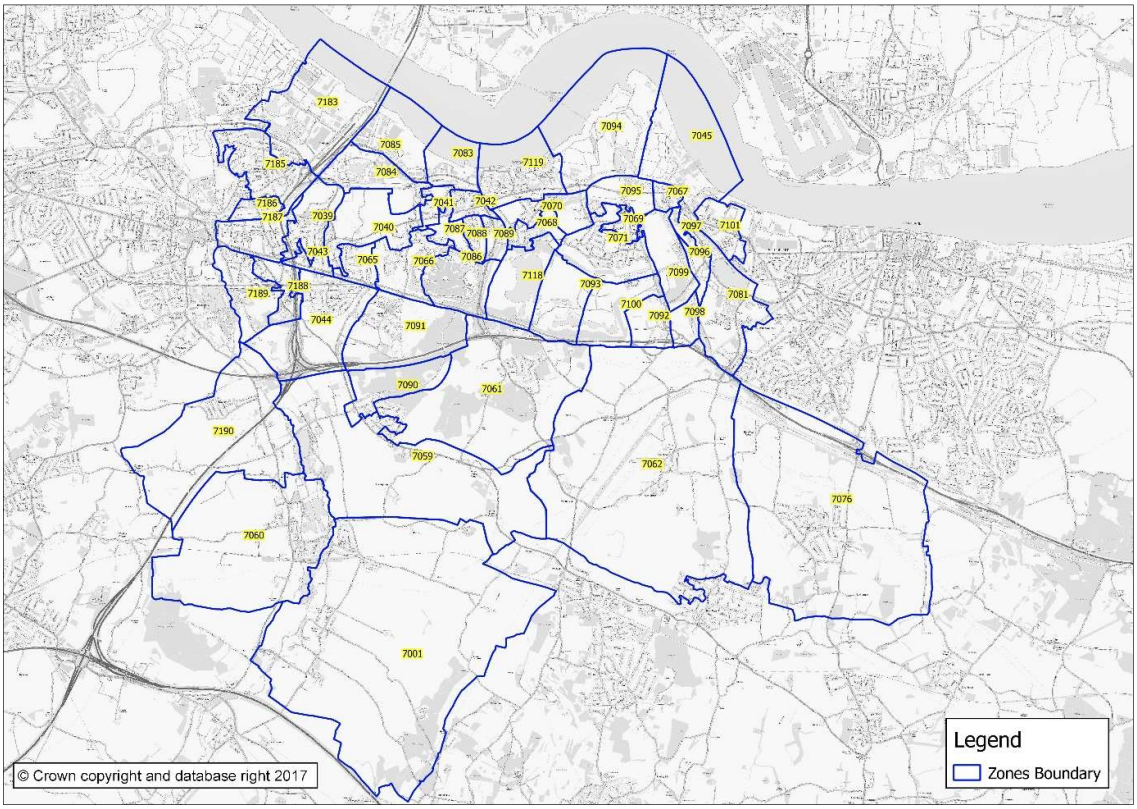
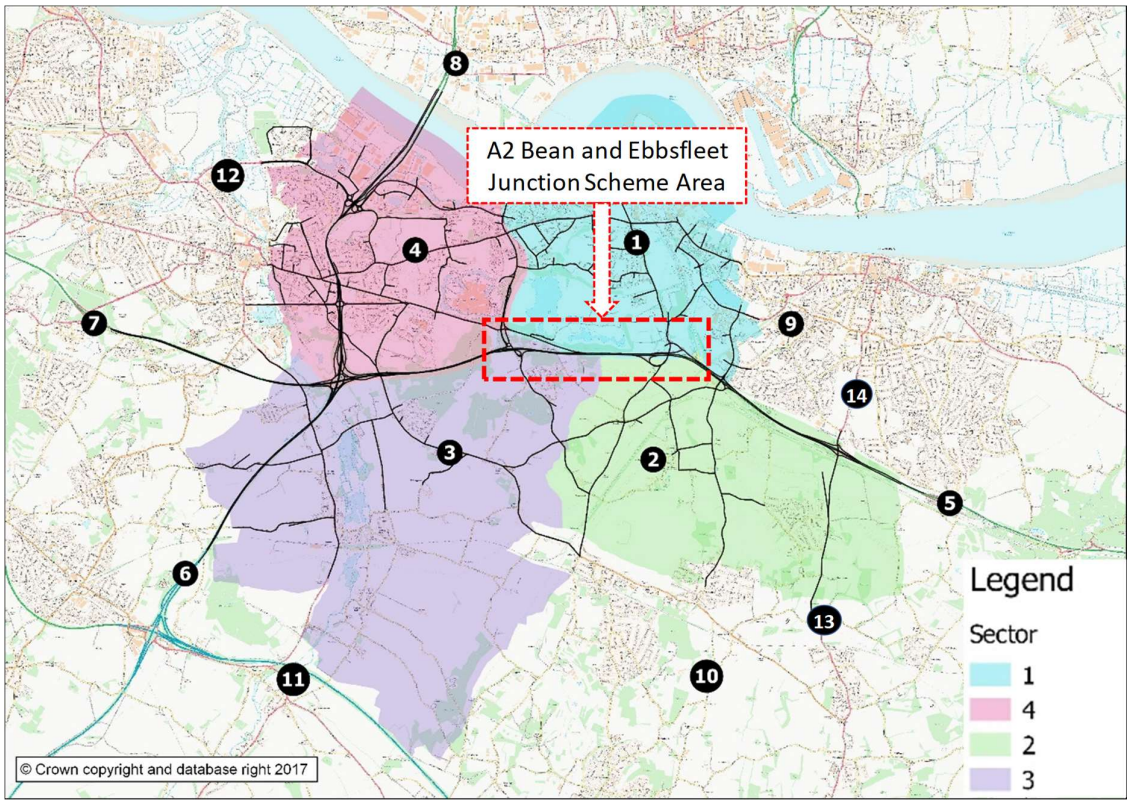


Figure 5-2: Sector System



5.2.7 The sector analysis of the transport user benefits for each of the five forecast years and over the 60-year appraisal period is presented in Table 5-1 to Table 5-9 below.

Table 5-1: Sector Benefit Summary – Core Scenario – 2023 (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	10	0	-1	-32	4	-1	-2	-2	24	-1	0	-8	-7	14	**-2**
2	6	0	0	2	-17	-2	-3	0	1	0	0	0	0	-1	**-15**
3	7	0	-3	-26	-11	-5	-13	-10	1	1	0	-7	0	0	**-66**
4	56	1	-24	-87	391	41	5	-14	98	-21	-3	-39	14	70	**486**
5	34	0	2	55	0	0	0	13	0	-1	0	-2	0	0	**100**
6	16	1	-10	-5	-8	0	-26	33	-3	-3	0	-1	0	2	**-4**
7	13	-5	-23	-30	-184	-49	0	-3	-35	-19	0	0	0	-18	**-353**
8	1	-1	-6	-3	-73	169	72	0	-5	-21	0	-2	0	-3	**128**
9	3	0	0	-5	-12	1	2	1	0	0	0	-1	-2	0	**-15**
10	19	0	-1	0	-21	-3	-11	-14	1	0	0	-9	0	-2	**-40**
11	0	0	-8	-6	0	0	0	0	0	-3	0	0	0	0	**-17**
12	8	1	-5	-32	16	30	0	3	5	-6	0	0	0	4	**23**
13	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
14	2	0	0	5	-4	0	1	1	0	0	0	0	2	0	**8**
Total	**176**	**-3**	**-77**	**-164**	**81**	**181**	**25**	**7**	**85**	**-76**	**-4**	**-70**	**7**	**67**	**236**

Note - All values are £000 in 2010 market prices discounted to 2010.

Table 5-2: Sector Benefit Summary – Core Scenario – 2026 (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	9	2	-6	-63	87	-14	-28	-11	34	-2	0	-27	2	18	**1**
2	2	0	0	3	-2	-1	-2	0	0	0	0	0	0	0	**-1**
3	8	0	-2	-6	6	-4	-11	-4	0	-5	0	-1	0	1	**-17**
4	84	7	-13	-22	388	109	41	38	70	-16	-1	2	11	64	**761**
5	20	0	1	52	0	3	11	5	0	0	0	-11	0	0	**81**
6	9	5	-8	49	72	0	-14	74	2	-3	0	8	0	23	**217**
7	-49	-2	-19	-12	-55	-27	0	24	-50	-19	0	0	0	-5	**-214**
8	0	0	-8	22	-6	0	52	0	-16	-18	0	8	0	-1	**33**
9	21	1	0	-7	-2	4	7	3	0	4	0	-2	0	0	**30**
10	9	0	0	5	-3	-2	-9	-6	1	0	0	-3	0	0	**-9**
11	0	0	-6	-3	0	0	0	0	0	-3	0	0	0	0	**-13**
12	20	1	-4	8	48	52	0	14	6	-8	0	0	0	10	**147**
13	4	0	0	3	0	0	0	0	0	0	0	0	0	0	**7**
14	1	-1	0	3	-15	0	-1	0	0	-2	0	-2	-6	0	**-23**
Total	**138**	**13**	**-65**	**34**	**518**	**121**	**47**	**136**	**46**	**-72**	**-2**	**-28**	**6**	**109**	**1001**

Note - All values are £000 in 2010 market prices discounted to 2010.

5.2.8 It is to be noted that the Lower Thames Crossing is assumed to open in 2026. This scheme reroutes some of the traffic away from the A2BE Traffic Model area and hence, as seen in the following tables, the overall 2023 matrix totals are higher than the 2026 forecast year. This reduction in total traffic due to rerouting in 2026 has resulted in comparatively higher overall benefits in 2026 as compared to 2023.

Table 5-3: Forecast Matrix Totals (PCUs): AM Peak

User Class	2016	2023	2026	2031	2038	2051
Car	26,244	30,558	31,258	34,157	34,935	36,179
LGV	6,738	9,324	8,907	9,844	10,805	12,618
HGV	8,178	9,183	7,307	7,617	8,038	8,765
Total	**41,160**	**49,065**	**47,472**	**51,618**	**53,777**	**57,561**

Table 5-4: Forecast Matrix Totals (PCUs): Inter Peak

User Class	2016	2023	2026	2031	2038	2051
Car	22,410	28,842	28,089	31,478	32,797	34,963
LGV	4,539	7,202	6,881	7,735	8,487	9,880
HGV	9,111	10,796	8,411	8,839	9,390	10,399
Total	**36,059**	**46,840**	**43,380**	**48,053**	**50,674**	**55,242**

Table 5-5: Forecast Matrix Totals (PCUs): PM Peak

User Class	2016	2023	2026	2031	2038	2051
Car	35,260	41,400	42,498	45,675	46,806	48,655
LGV	5,401	7,848	7,369	8,116	8,928	10,541
HGV	5,658	6,473	4,799	4,960	5,205	5,688
Total	**46,318**	**55,721**	**54,666**	**58,751**	**60,938**	**64,884**

Table 5-6: Sector Benefit Summary – Core Scenario – 2031 (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	71	10	-1	-18	265	11	17	-1	45	13	0	-6	15	39	**461**
2	15	0	0	4	0	-1	-2	0	1	0	0	0	0	0	**16**
3	25	0	0	3	12	-3	-12	-2	1	0	0	1	0	1	**26**
4	41	6	-13	-53	370	82	31	-24	51	-16	-3	-7	11	61	**536**
5	95	0	2	100	0	4	7	1	3	-2	0	1	0	0	**211**
6	18	3	-4	13	59	0	-7	9	-1	-1	0	3	0	19	**111**
7	-42	-2	-14	-43	-38	-55	0	-18	-39	-14	0	-1	-1	-5	**-272**
8	-8	0	-3	7	-4	-1	61	0	-14	-16	0	5	0	-1	**26**
9	255	1	0	19	-1	4	4	1	0	3	0	1	0	0	**286**
10	51	0	0	7	-1	-2	-9	-5	4	0	0	-1	0	0	**44**
11	1	0	-1	0	0	0	0	0	0	-1	0	0	0	0	**-2**
12	11	1	1	19	40	48	0	3	2	0	0	0	0	7	**131**
13	11	0	0	5	0	0	0	0	1	0	0	0	0	0	**17**
14	5	-2	0	8	-23	-2	-4	0	0	-3	0	0	-12	0	**-34**
Total	**548**	**18**	**-35**	**71**	**679**	**85**	**87**	**-36**	**55**	**-38**	**-3**	**-6**	**14**	**120**	**1558**

Note - All values are £000 in 2010 market prices discounted to 2010.

Table 5-7: Sector Benefit Summary – Core Scenario – 2038 (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	132	21	7	60	431	54	88	14	99	30	2	14	32	59	**1040**
2	16	0	0	5	0	-1	-2	0	1	0	0	0	0	0	**18**
3	31	1	0	8	16	-2	-9	-2	2	5	0	1	0	1	**51**
4	16	4	-13	-57	347	93	39	55	67	-17	-3	-1	10	54	**596**
5	103	0	2	114	0	3	5	0	3	-2	0	0	0	0	**228**
6	22	2	-4	22	44	0	-5	-1	-2	-1	0	4	1	12	**95**
7	-38	-2	-14	-53	-57	-74	0	-30	-34	-13	0	-3	-1	-8	**-327**
8	-11	0	-3	9	-6	-6	63	0	-12	-13	0	9	0	-2	**27**
9	288	2	1	47	2	5	7	2	0	8	0	2	1	0	**364**
10	59	0	0	10	0	-2	-9	-4	4	0	0	0	0	0	**59**
11	1	0	-1	0	0	0	0	0	0	0	0	0	0	0	**0**
12	-3	1	1	11	34	52	0	12	3	0	0	0	0	6	**117**
13	10	0	0	5	0	0	0	0	1	0	0	0	0	0	**15**
14	8	0	0	10	-7	0	0	0	0	-1	0	0	-1	0	**10**
Total	**633**	**28**	**-24**	**193**	**804**	**122**	**178**	**45**	**132**	**-4**	**-2**	**25**	**42**	**122**	**2296**

Note - All values are £000 in 2010 market prices discounted to 2010.

Table 5-8: Sector Benefit Summary – Core Scenario – 2051 (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	136	30	13	140	562	79	153	38	157	49	4	63	41	78	**1543**
2	21	0	0	6	0	-2	-2	0	1	0	0	-1	0	0	**23**
3	33	1	-3	-12	14	-3	-12	-6	2	-1	-2	-11	0	1	**0**
4	103	12	1	21	498	162	93	9	124	-2	-1	71	15	78	**1185**
5	143	0	1	132	0	-10	16	2	0	-4	-1	0	0	0	**279**
6	27	2	-2	26	18	0	-8	-10	-19	0	0	12	1	5	**51**
7	-29	-2	-11	8	-85	13	0	20	-43	-11	0	2	-1	-11	**-151**
8	-14	0	-2	12	-10	22	107	0	-16	-11	0	47	0	-3	**131**
9	266	4	1	63	7	8	18	4	0	16	0	4	2	0	**393**
10	73	0	-5	-4	-1	-2	-7	-6	1	0	-2	-11	0	0	**36**
11	1	0	-2	-2	0	0	0	0	0	-1	0	0	0	0	**-4**
12	3	1	-1	-18	32	64	0	-11	2	-2	0	0	0	5	**77**
13	10	0	0	6	-1	0	1	0	0	0	0	0	0	0	**15**
14	16	1	0	12	3	-1	4	0	0	1	0	0	6	0	**42**
Total	**789**	**48**	**-9**	**387**	**1036**	**332**	**362**	**40**	**209**	**34**	**-3**	**177**	**64**	**154**	**3620**

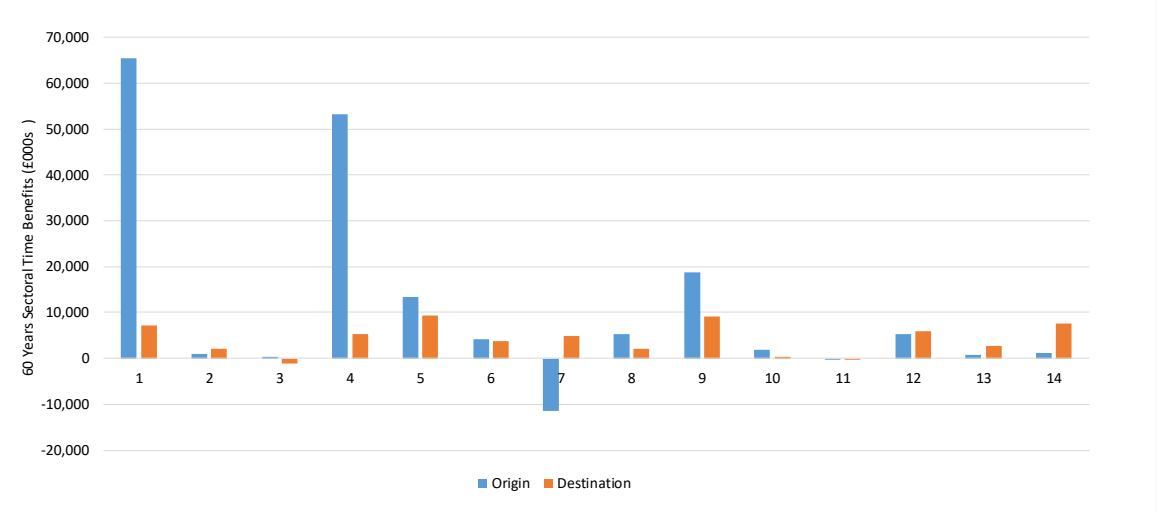
Note - All values are £000 in 2010 market prices discounted to 2010.

Table 5-9: Sector Benefit Summary – Core Scenario –all 60 years (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	6,386	1,287	486	4,930	5,257	3,229	6,067	1,373	6,770	2,029	135	,126	1,783	3,554	**65,409**
2	978	-	-3	297	-56	-82	-120	-21	56	-11	-7	-26	-6	6	**1,006**
3	1,607	26	-107	-394	688	-149	-624	-274	77	11	-86	-391	-	59	**442**
4	4,350	525	-261	-417	4,834	7,412	3,890	834	5,655	-445	-85	2,308	751	3,956	**53,306**
5	6,602	8	62	6,504	-1	-272	676	111	42	-159	-39	-33	-	9	**13,510**
6	1,313	119	-173	1,344	1,663	-	-466	70	-676	-41	-	508	27	504	**4,191**
7	-1,778	-126	-705	-621	-4,258	-815	-	386	-2,312	-688	-	26	-57	-550	**-11,496**
8	-636	-22	-171	612	-585	1,033	4,967	-	-820	-720	-	1,736	-2	-134	**5,258**
9	3,462	162	41	2,664	229	360	750	169	-	652	14	138	88	2	**18,728**
10	3,437	5	-169	15	-96	-94	-445	-335	108	-	-70	-395	-	-12	**1,950**
11	27	1	-133	-96	13	-	-	-	11	-57	1	3	-	1	**-228**
12	241	61	-47	-408	1,881	3,245	1	-182	157	-97	3	-1	4	316	**5,174**
13	532	-	-	287	-52	-4	18	1	9	-	-	1	-	-	**792**
14	657	21	10	574	-159	-28	117	4	-	-20	-4	-11	106	-	**1,266**
Total	**7,178**	**2,065**	**-1,169**	**5,292**	**9,359**	**3,834**	**4,829**	**2,136**	**9,076**	**453**	**-139**	**5,989**	**2,695**	**7,710**	**159,308**

Note - Cells in red are the bottom 10 movements and cells in green are the top 10 movements. All values are £000 in 2010 market prices discounted to 2010.

Figure 5-3: 60 Years Sectoral Time Benefits (£000s)



5.2.9 With regard to sector-to-sector benefits, the movements which would be anticipated to have the greatest benefits would be trips which are likely to use the Bean and Ebbsfleet junctions where the proposed scheme is located.

5.2.10 It is in this context that as much as 41% of all scheme TUBA benefits are experienced by trips with origins in sector 1 (Ebbsfleet Valley) and 23% of all

scheme TUBA benefits are experienced by trips with destinations in sector 5 (A2 Mainline Watling Street) as also presented in Figure 5-3 above.

5.2.11 Focussing on Table 5-9 (60-year appraisal period sector benefits), the movements with the highest benefits are:

- £25.25m - Sector 1 to Sector 5
- £24.83m - Sector 4 to Sector 5
- £13.46m - Sector 9 to Sector 1
- £7.41m - Sector 4 to Sector 6

5.2.12 Some sector-to-sector movements are forecast to experience a dis-benefit, and the movements with the highest dis-benefits are:

- – £4.25m - Sector 7 to Sector 5
- – £2.31m - Sector 7 to Sector 9
- – £1.77m - Sector 7 to Sector 1
- – £0.82m - Sector 8 to Sector 9

5.2.13 This pattern of benefits is consistent with the proposed A2BE scheme improvements, as the movements between sectors 1 to 5, 4 to 5 and 9 to 1 route through the scheme location.

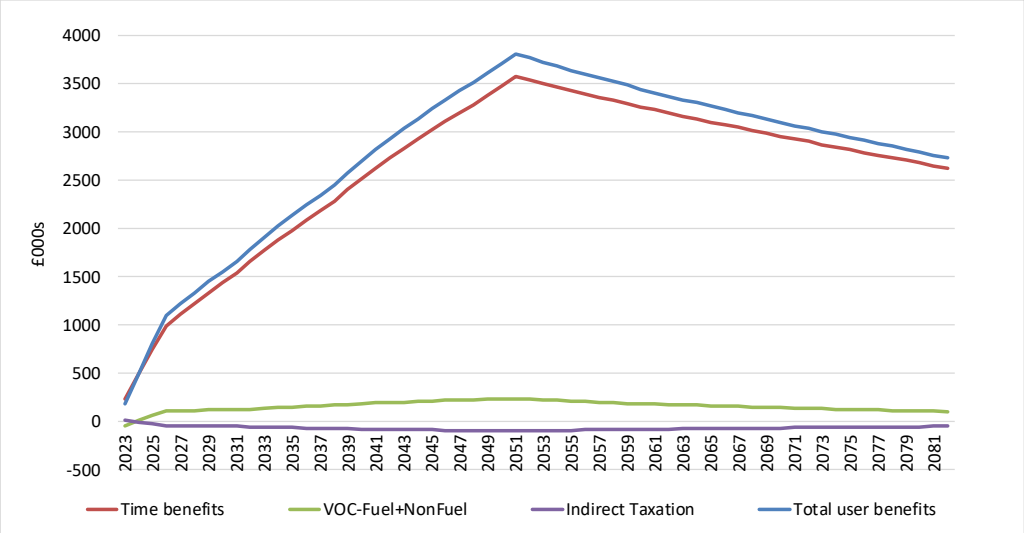
5.2.14 It can also be seen that there are dis-benefits for a number of sectors, these being some of those movements on the A2 Mainline which gets congested as the proposed scheme induces more demand and hence there are higher delays experienced in the Do-Something scenario than the Do-Minimum scenario which leads to dis-benefits.

Profile of Benefits over 60-year Appraisal Period

5.2.15 Figure 5-4 shows the profile of the user benefits across the 60-year appraisal period. The figure shows the user benefits rising through the forecast years, peaking at the last modelled year of 2051.

5.2.16 The benefits then decrease from 2051 until the end of the 60-year appraisal period in 2082. This is due to the fact that after the last modelled year, the benefits remain unchanged but the effect of discounting over time is stronger with each year. This explains the decline in the annual user benefits between 2051 and 2082.

Figure 5-4: Profile of User Benefits over Appraisal Period



User Benefits by Journey Purpose

5.2.17 Table 5-10 below provides a summary of the user benefits disaggregated by journey purpose over the 60-year appraisal period.

Table 5-10: User Benefits by Journey Purpose (£m)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Business	£41.373	£5.51	£46.88	27.7%
Commute	£51.273	£1.66	£52.93	31.3%
Other	£66.663	£2.71	£69.37	41.0%
Total	£159.31	£9.87	£169.18	100.0%

Note: All monetised values are expressed as 2010 present values.

5.2.18 Analysis of user benefits show that more of the scheme benefits are attributed to other trips than commuting and business trips. As can be seen, the user benefits claimed by other purpose trips account for 41% of the total user benefits, with 28% and 31% for business and commuting trips respectively. The significantly higher proportion of benefits attributed to other trips compared to commuting and business is expected as the scheme is located near to the Bluewater shopping complex where the majority of the trips would constitute retail trips.

User Benefits by Time Period

5.2.19 Table 5-11 provides a summary of the user benefits in terms of time savings and vehicle operating cost benefits by time period, for each forecast year and also for the 60-year appraisal period.

Table 5-11: User Benefits by Forecast Year and Period (£m)

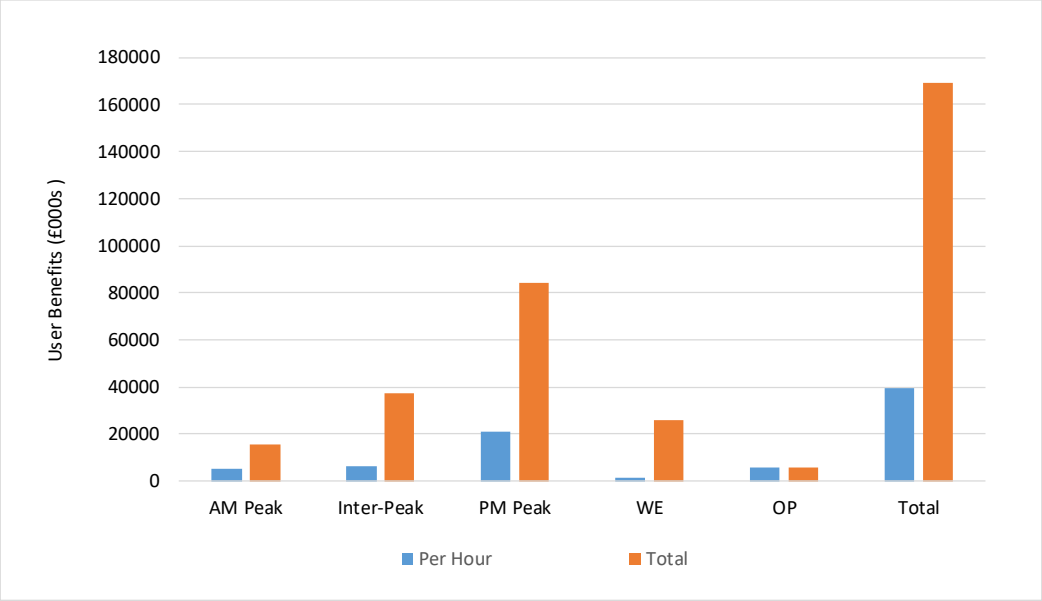
Period	Type	2023	2026	2031	2038	2051	60 years
AM Peak	Time Savings	0.04	0.07	0.08	0.13	0.38	14.99
	VOC	-0.01	-0.01	0.00	0.00	0.02	0.53
	Total	0.03	0.07	0.08	0.13	0.40	15.52
	per Hour	0.01	0.02	0.03	0.04	0.13	5.17
Interpeak	Time Savings	0.08	0.10	0.37	0.45	0.83	35.55
	VOC	-0.04	0.00	0.02	0.03	0.06	2.05
	Total	0.05	0.11	0.39	0.48	0.89	37.60
	per Hour	0.01	0.02	0.07	0.08	0.15	6.27
PM Peak	Time Savings	0.06	0.71	0.81	1.35	1.67	77.85
	VOC	0.03	0.11	0.10	0.13	0.14	6.37
	Total	0.09	0.83	0.91	1.48	1.81	84.22
	per Hour	0.02	0.21	0.23	0.37	0.45	21.05
Off-Peak	Time Savings	0.01	0.01	0.06	0.07	0.13	5.51
	VOC	-0.01	0.00	0.00	0.00	0.01	0.25
	Total	0.01	0.02	0.06	0.08	0.14	5.76
	per Hour	0.01	0.02	0.06	0.08	0.14	5.76
Weekend	Time Savings	0.05	0.09	0.23	0.30	0.61	25.41
	VOC	-0.02	0.00	0.00	0.01	0.02	0.68
	Total	0.02	0.09	0.23	0.30	0.63	26.09
	per Hour	0.00	0.00	0.01	0.02	0.03	1.37
Total	Time Savings	0.24	1.00	1.56	2.30	3.62	159.31
	VOC	-0.05	0.11	0.12	0.17	0.25	9.87
	Total	0.19	1.11	1.68	2.47	3.87	169.18

Note: All costs are at 2010 market prices and values

5.2.20 It can be seen from Table 5-11 that the benefits for all periods increase as demand increases, which is anticipated as higher demand in the Do-Minimum scenario results in more congestion and delays on the network. The greatest 60-year total and per hour benefits are derived from the PM peak period because the PM peak is highly congested in the Do Minimum scenario and there are four appraised hours. The second highest total benefits are derived from the Interpeak period, which includes six appraised hours, while the AM peak period includes just three appraised hours.

5.2.21 Figure 5-5 provides a summary of the disaggregation of user benefits by time period.

Figure 5-5: Profile of User Benefits by Time Period



5.2.22 It can be seen from Figure 5-5 that the PM peak produces the highest amount of total and per hour benefits. In terms of total benefits, the PM peak is followed by the Interpeak, Weekend, AM peak and then Off-Peak. The relatively high level of Interpeak benefits is consistent with the high level of benefits coming from Other trips.

User Time Benefits by Size of Time Savings

5.2.23 Table 5-12 and Figure 5-6 below provide summaries of the user time benefits by size of the time savings over the 60-year appraisal period. The time savings are grouped into time saving bands, as defined by TUBA. Note that the figures shown are time benefits rather than user benefits (which also include VOC benefits) as presented in the above sections. Consequently, the totals are different from those presented in the above sections.

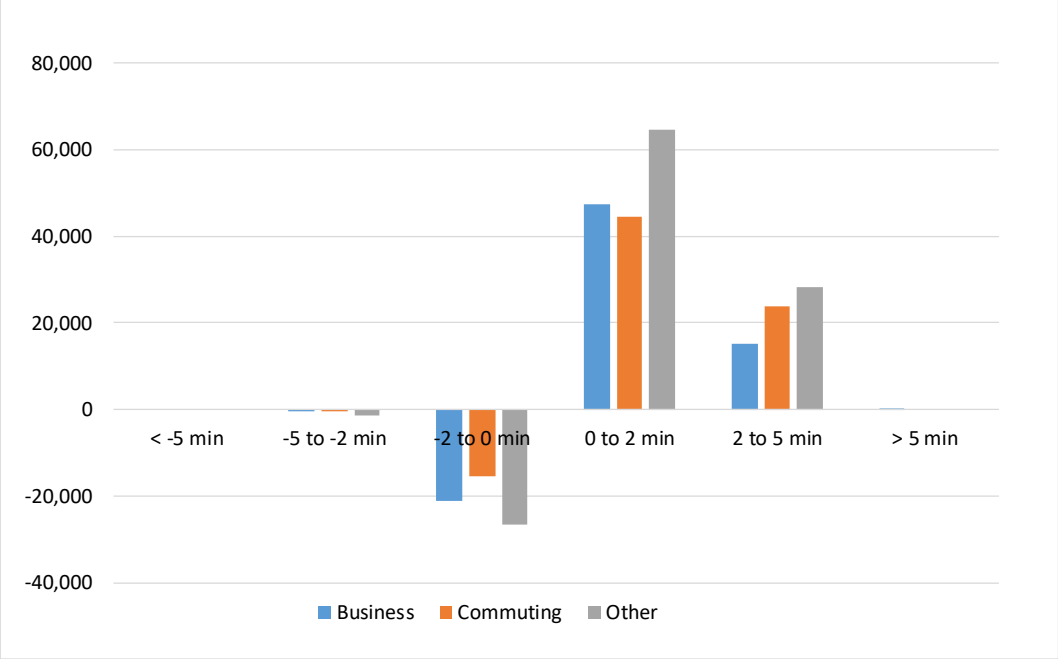
Table 5-12: User Time Benefits by Size of Time Savings (£000s)

Vehicle Type	Purpose	-5 to -2min	-2 to 0min	0 to 2min	2 to 5min	> 5min	Total
Car	Business	-34	-3,717	9,874	3,775	0	9,898
Car	Commuting	-113	-14,306	42,540	23,152	0	51,273
Car	Other	-1,339	-26,548	64,785	28,147	0	65,045
LGV	Personal	-19	-944	1,930	651	0	1,618
LGV	Freight	-306	-14,407	29,102	10,225	0	24,614
OGV1	Business	-14	-1,154	3,396	489	8	2,725
OGV2	Business	-22	-1,751	5,155	742	12	4,136
Total		-1,847	-62,827	156,782	67,181	20	159,309

Note: All values are £000 in 2010 market prices discounted to 2010.

5.2.24 Figure 5-6 below provides an illustration of the user time benefits that are distributed to each time saving band.

Figure 5-6: User Time Benefits by Size of Time Savings (£000s)



5.2.25 It can be observed from Figure 5-6 that the majority of benefits and dis-benefits are due to changes in travel time of less than 5 minutes due to the relatively small extent of the cordoned forecast models that have been used in the TUBA analysis as discussed in section 2.2 above.

User Time Benefits by Travelled Distance

5.2.26 Table 5-13 provides a summary of user time benefits by distance travelled over the 60-year appraisal period. The distance travelled is grouped into distance bands as defined by TUBA.

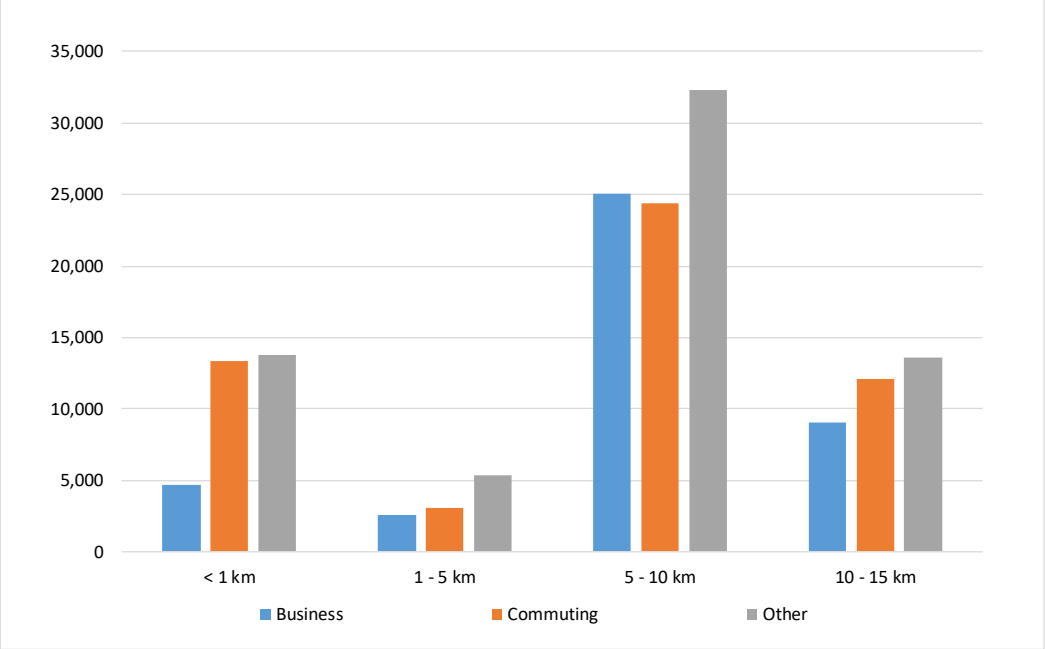
Table 5-13: User Time Benefits by Travelled Distance (£000s)

Vehicle Type	Purpose	< 1km	1 - 5km	5 - 10km	10 - 15km	Total
Car	Business	1,754	469	5,299	2,377	9,899
Car	Commuting	13,139	2,949	23,432	11,752	51,272
Car	Other	13,765	5,388	32,282	13,611	65,046
LGV	Personal	193	117	972	337	1,619
LGV	Freight	2,921	1,734	14,859	5,100	24,614
OGV1	Business	-3	144	1,959	625	2,725
OGV2	Business	-4	219	2,973	948	4,136
Total		31,765	11,020	81,776	34,750	159,311

Note: All values are £000 in 2010 market prices discounted to 2010.

5.2.27 Figure 5-7 below provides an illustration of the user time benefits that are grouped to each distance band.

Figure 5-7: User Time Benefits by Distance Band (£000s)



5.2.28 The majority of the benefits claimed from the proposed scheme come from short distance trips, with about 51% of the benefits attributed to trips between 5-10 km. There are no long-distance trips greater than 15 km due to the relatively small extent of the cordoned forecast models that have been used in the TUBA analysis as discussed in section 2.2 above.

5.3 User Costs During Construction

5.3.1 The results (Stage 2) of the TUBA analysis of the construction impacts are as follows (2010 prices, discounted to 2010):

- Construction Sequence 1: -£4.97m
- Construction Sequence 2: -£5.31m
- Total: -£10.28m

5.3.2 Of this total disbenefit, -£3.22m is attributed to commuting users, -£4.22m to other users and -£2.85m to business users.

5.4 COBA-LT: Accident Savings

5.4.1 Table 5-14 summarises the accident impact of the scheme over the 60-year appraisal period.

Table 5-14: Accidents and Casualties over Appraisal Period

Scenario	PIAs	Casualties, by Severity			Costs (£m)
		Fatal	Serious	Slight	
Do-Minimum	14,265	196.7	1,810.6	17,929.8	£643.62m

Scenario	PIAs	Casualties, by Severity			Costs (£m)
		Fatal	Serious	Slight	
Do-Something	14,111	195.8	1,791.1	17,744.1	£637.25m
Benefit	154	1.0	19.5	185.7	£6.37m

Note: All values are £m in 2010 market prices discounted to 2010.

5.4.2 The monetised cost of accidents is lower in the Do Something scenario, which means that the A2BE scheme provides an accident benefit. The accident saving from the proposed scheme is £6.37m.

5.5 Environmental Impacts

5.5.1 Noise benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard WebTAG Noise Workbook. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is £0.15m.

5.5.2 Air quality benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard WebTAG Air Quality Workbook. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is £0.25m.

5.5.3 Greenhouse gas benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard WebTAG Greenhouse Gases Workbook. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is -£2.37m.

5.5.4 The anticipated non-monetised impacts, which cannot be reflected in the cost-benefit analysis above, are:

- A neutral impact on landscape features and character
- A neutral impact on townscape features and character
- A moderate adverse impact on the historic environment
- A slight adverse impact on biodiversity
- A neutral impact on the water environment

5.5.5 These are described more fully in the Appraisal Summary Table, which may differ from the Environmental Statement results due to being assessed against different criteria.

5.6 Journey Time Reliability

5.6.1 The scope of the Stage 3 journey time reliability assessment was discussed with Highways England and a proportionate approach was considered.

5.6.2 Highways England's MyRIAD tool has been developed to measure the effects of changes in incident related journey time variability on motorways but is only able to capture reliability variations in relation to motorway widening schemes and technology improvements on links.

5.6.3 At Stage 2 a MyRIAD assessment was carried out for the forecast years 2023 and 2038 and only for the central growth scenario. Results for the full 60-year

appraisal period were then obtained by interpolation using the MyRIAD master spreadsheet.

5.6.4 The study area for the assessment was the links from the Darenth Interchange on the M25 to Pepper Hill Junction on the A2.

5.6.5 The MyRIAD software requires trip distribution characteristics from the without scheme scenario only. The trip distribution for the with scheme scenario is assumed to be unchanged from the without scheme scenario. The trip distribution for traffic on the scheme links was identified using Select Link Analysis (SLA) on the identified routes within the MyRIAD network.

5.6.6 The section of the A2 within the study area is designated as a primary road, however many of its characteristics are similar to that of a motorway. In addition, the road characteristics do not change between the without-scheme and with-scheme scenarios.

5.6.7 The chief change affecting the A2 main line in the with scheme scenario was the widening of the existing carriageway by one lane between Bean and the A296 Junction on the A2.

5.6.8 The incident parameters within MyRIAD are provided only for D3M and D4M road types, and not for the D3AP and D4AP types. It was therefore decided that the scheme links should be assumed to be of the D3M and D4M types, without CCTV, without MIDAS and without VMS.

5.6.9 Within the scheme only the Bean to A296 Junction Eastbound section falls under the D3M road type, with the remaining sections containing four lanes.

5.6.10 Link lengths were also adjusted to reflect the new on-slip at the Bean junction.

5.6.11 The Stage 2 assessment of reliability used MyRIAD version 1.2, plus the use of factors for delay benefits and travel time variability benefits to replicate subsequent updates to the reliability ratio and values of time (Stage 2 EAR paras 7.13.4-7.13.7).

5.6.12 The Stage 2 assessment found that journey time reliability benefits accrued would be £19.84 million, in 2010 prices discounted to 2010. Of this, £19.15 million was due to the reduction in travel time variability, both incident related and day-to-day, while the remaining £0.69 million was due to the reduction in incident delays.

5.6.13 With the withdrawal of MyRIAD version 1.3 and a later version of MyRIAD not being available at the time, the reliability ratio and the values of time had been updated since the release of version 1.2 so Highways England suggested the use of a factor of 0.9 for the delay benefits and 0.5 for the TTV benefits, to replicate the use of a later MyRIAD version.

5.6.14 The values derived from this sensitivity test were those carried forward into the adjusted BCR, as this was considered to be a more conservative approach.

5.6.15 The final Stage 2 journey time reliability benefits were therefore £10.19 million, in 2010 prices discounted to 2010. Of this, £9.57 million was due to the reduction in travel time variability, both incident related and day-to-day, while the remaining £0.62 million was due to the reduction in incident delays.

5.6.16 For Stage 3, the Stage 2 MyRIAD assessment has been supplemented with a WebTAG Urban Roads assessment.

5.6.17 The Stage 3 WebTAG Urban Roads assessment gives a benefit across all modes and purposes of £10.87m (2010 prices, discounted to 2010).

5.6.18 Given that the WebTAG Urban Roads assessment covers the whole A2BE Traffic Model study area, while the MyRIAD assessment is link based, trips using the A2 need to be filtered out.

5.6.19 As a conservative estimate, and based on A2BE Traffic Model zone pairs that would not be expected to use the scheme, 10% of the benefits generated are retained, equivalent to £1.09m (2010 prices, discounted to 2010).

5.6.20 Combining the Stage 2 MyRIAD assessment with the Stage 3 WebTAG Urban Roads assessment having removed any potential double counting gives an overall journey time reliability benefit of £11.28m (2010 prices, discounted to 2010). £5.70m of this benefit is attributed to business users while £5.58m is attributed to commuting and other users.

5.7 Wider Economic Impacts (WEIs)

Summary

5.7.1 The scheme is forecast to generate WEIs but they are anticipated to be limited in scale as a result of the characteristics of the scheme and its impacts on travel costs (as discussed in section 5.2.26) and the economic characteristics of the study area.

5.7.2 Given the limited anticipated scale of the WEIs, it was not considered proportionate to quantify the agglomeration and labour market impacts at this stage and they are assessed qualitatively to be slight positive.

5.7.3 No direct DD benefits are considered to be attributable to the scheme at this stage as discussed in section 4.6.

5.7.4 An estimate of the impact of increased output in imperfectly competitive markets (reflecting the additional margin that firms can make on each additional unit of output they can produce as a result of travel cost savings) has been derived directly from the estimated business user benefits (in line with WebTAG Unit A2.2, May 2018) and is estimated to be £4.69 million (NPV, 2010 prices and values).

5.7.5 The following sections provide more details on the basis of the assessment for each WEI.

Agglomeration

5.7.6 Agglomeration reflects the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees and these impacts are anticipated to be slight.

5.7.7 Although the scheme falls within a Functional Urban Area (defined in WebTAG Unit A2-4 (May 2018) as areas that are more likely to experience agglomeration benefits), the journey time savings per journey are relatively low (as can be seen in Figure 5-6) and are focussed on trips between the urban areas of Dartford, Gravesend and Swanscombe, rather than on intra-urban trips, which are more influential for agglomeration impacts.

5.7.8 Agglomeration levels in the urban areas of Gravesend and Dartford will be much more strongly influenced by intra-urban connections than links along the A2. For Dartford in particular, the connections to London will be the most significant external economic connections, rather than the connections to the east that are improved by the scheme.

5.7.9 It is noted that estimates of agglomeration in previous PCF stages focussed on a more focussed study area and therefore on the economic connections within Kent, rather than wider connections (such as those to London). This tended to overstate the economic value of the link between Dartford and Gravesend in agglomeration terms and therefore overstated the value of the journey time improvements generated on the A2, leading to higher WEI estimates.

5.7.10 Finally, the likely scale of agglomeration impact is also limited by the economic characteristics of the study area, including the relatively low level of employment in the economic sector (producer services) that is most responsive to agglomeration in the DfT's economic dataset for current and future years.

Labour Market

5.7.11 Labour Market impacts reflect the tax revenue from additional people joining the labour market or employment relocating to more productive locations and these impacts are anticipated to be slight.

5.7.12 The journey time and cost improvements experienced on individual commuting trips are unlikely to be sufficiently large to make it worthwhile for someone to join the labour market and work 'with the scheme' if it is not worthwhile 'without the scheme' (when weighing up all the costs and benefits of working, including commuting) or to cause firms to relocate employment to more productive locations.

Dependent Development

5.7.13 DD is the net impact of land value uplift and externalities associated with planning permission to change land use type or density that results directly from the increase in accessibility caused by a scheme.

5.7.14 Although the scheme has a clear objective to support the considerable proposed development in the area, at this stage this is not assumed to convert into a DD benefit. This has been agreed with Highways England.

5.7.15 As outlined in Section 4.6, the scheme is recognised in the Kent Thameside Strategic Transport Programme as being necessary to support proposed development. However, in the study area, developments that might conventionally be considered to be dependent are already granted permission on the basis that the developers contribute to the STP and there is government commitment to A2BE. Therefore, no direct dependency of delivery of the development upon the individual A2BE scheme can be attributed.

5.7.16 For the assessment, the currently committed and more than likely development is captured in the forecast model in both the Do-Minimum and Do-Something, in line with WebTAG. Therefore, the benefits of the scheme in relation to the modelled development are reflected in future year decongestion benefits as the scheme helps to serve the additional trips more effectively.

5.7.17 Amongst the remaining development that is proposed but currently less certain, none of the proposed sites are considered to directly depend on the A2BE scheme alone for their delivery.

Increased Output in Imperfectly Competitive Markets

5.7.18 This reflects the additional margin firms make on each unit of output they produce and these impacts are anticipated to be modest.

5.7.19 The estimated value of this impact is driven directly by the value of business user benefits generated by the scheme and therefore has been calculated as outlined above in section 5.7.4.

5.8 Social and Distributional Impacts (SIs and DIs)

Social Impacts

5.8.1 In terms of physical activity, the scheme design includes a new segregated cycleway and footway but changes in the number of pedestrians / cyclists / equestrians or their average journey times are anticipated to be insignificant. Therefore, the overall impact is neutral.

5.8.2 In terms of journey quality, traveller care, together with the nature and extent of travellers' views, would not alter significantly. Traveller stress would reduce due to the reductions in congestion. Journey quality is expected to improve, and the overall impact is moderate beneficial.

Distributional Impacts

5.8.3 For the A2BE scheme, Security and Accessibility have been scoped out due to there being no public transport element to the scheme.

5.8.4 For User Benefits, the scheme has a beneficial impact for all income quintiles including the lowest income quintile (top 20% most income deprived in the UK). There are large beneficial impacts in quintile two and three and moderate beneficial impacts in quintile one and five. Income quintile three represents the largest proportion of the population within the impact area with 28.9% of the population. Therefore, the overall impact is moderate beneficial.

5.8.5 For Noise, all modelled indicators show a negligible change as part of the Long-Term Noise Impact Assessment. No adverse noise impact is expected for any income quintile as part of the scheme so the overall impact is neutral.

5.8.6 For Air Quality, schools located in the vicinity of the scheme are located close to areas where there is an expected no change or small decrease in the amount of NO_2. This leads to a prediction of an increase in air quality in the area. Where there is a large increase in NO_2 pollution, this is caused due to a relocation of the roundabout. The overall impact is slight beneficial.

5.8.7 For Accidents, there is a beneficial impact on the affected road network from the scheme. There is a reduction in accidents across all vulnerable user groups. The lowest income quintile group is located primarily on roads which show no change in accident numbers in both 2023 and 2038. The overall impact is moderate beneficial.

5.8.8 For Severance, any increased traffic flows have a negative impact on severance, making it harder for pedestrians to cross and access local amenities and

schools. When levels of traffic increase in areas where a high proportion of vulnerable users live, these are impacted negatively. The proposed scheme has an overall neutral impact.

5.8.9 Existing pedestrian crossings may be temporally affected by the scheme. With the extension of the Bean Bridge over the A2, potential temporary loss of pedestrian access may occur. Schools in the area are located away from the scheme but it should be ensured that there is minimal disruption to local school children. Likewise consideration should be given to bus stops in the local area to ensure they remain accessible during works.

5.8.10 For Affordability, the scheme has moderate beneficial impacts for quintile one (the top 20% most income deprived). There are large beneficial impacts for quintile two and three which together make up the highest proportion of the demographic of the area (53.4%). Income quintiles four and five however receive Large Disbenefit and Moderate Disbenefit respectively. These two groups account for 37% of the population. Therefore, the overall impact is neutral, since low income groups will benefit and high income groups will disbenefit.

5.9 Reporting the Economic Assessment Results

Transport Economic Efficiency (TEE) Table

5.9.1 The TEE table brings together the benefits to transport users and providers derived from the TUBA runs, the construction delay appraisal where undertaken, and the cost to business of any developer contributions. The TEE table is a key component in the reporting of the economic assessment impacts and is set out in section 5.10.

Public Accounts (PA) Table

5.9.2 The PA table brings together the costs of the scheme and the revenue and tax changes which would result. The revenue and tax changes which follow from changes in traffic routes and speeds are derived from the TUBA output, while the capital and operating costs, less any offsetting developer contributions, are as described. The PA table is set out in section 5.11.

Analysis of Monetised Costs and Benefits (AMCB) Table

5.9.3 The AMCB table brings together quantified scheme costs and benefits to help determine the economic worth of the A2BE Junction Improvements proposal. This table is based on those elements of the economic appraisal which are considered to produce robust monetised estimates of the impacts. The AMCB table includes:

- User benefits, such as time savings and vehicle operating cost saving, over the 60-year appraisal period;
- Effects of delays during construction;
- Cost to business of any developers' contributions;
- Changes in user charge revenues;
- Indirect taxation benefits;
- Accident benefits;

- Monetised environment impacts; and
- Costs of construction and operation.

5.9.4 Other benefits referred to in the AMCB template, namely journey quality and physical activity, have not been monetised at this stage.

5.9.5 The benefits less costs provide an initial estimate of the net benefits for the scheme. The ratio of these benefits to costs is referred to as the Initial BCR.

5.9.6 In the AMCB table, four critical values are presented:

- The Present Value of Benefits (PVB) is the summation of the stream of discounted initial benefits over the appraisal period, reduced by the discounted value of the developer contribution.
- The Present Value of Costs (PVC) is the summation of the stream of discounted costs from the current year forward through the 60-year appraisal period, less the discounted value of the developer contribution, although the majority of investment costs are likely to occur before the scheme opening year. The PVC indicates the total cost of the scheme which will be considered against the benefits.
- The Net Present Value (NPV) is the PVB less the PVC and indicates whether there are positive or negative benefits, and their scale, from a scheme.
- The Benefit-Cost Ratio (BCR) is the ratio of the PVB and the PVC.

5.9.7 A BCR greater than 1.0 indicates that the benefits outweigh the costs. DfT has defined value for money categories, which are as follows:

- BCR less than 1: Poor
- BCR between 1 and 1.5: Low
- BCR between 1.5 and 2: Medium
- BCR between 2 and 4: High
- BCR of 4 and above: Very High

5.9.8 The AMCB table is set out in section 5.12. Following the production of the AMCB table, the relevant values in the TEE/PA/AMCB tables are then transcribed to the AST.

Adjusted BCR

5.9.9 The benefits are subsequently adjusted to produce an adjusted BCR. This is obtained by the inclusion of other benefits whose estimation is considered to be less robust, as explained in DfT's Value for Money Assessment Advice Note (December 2013). These are benefits from changes in journey time reliability and the wider economic impacts (WEIs) arising from implementation of the scheme.

5.9.10 The results of these calculations were used to derive an adjusted PVB and an adjusted BCR.

5.10 Transport Economic Efficiency

5.10.1 Table 5-15 below presents the TEE table.

Table 5-15: Transport Economic Efficiency (TEE) Table for Core Scenario

Non-Business: Commuting	
Travel Time (TUBA)	£51.27m
Vehicle Operating Costs (TUBA)	£1.66m
During Construction	-£3.22m
During Maintenance	£0.00m
Net Non-Business Benefits: Commuting	£49.71m
Non-Business: Other	
Travel Time (TUBA)	£66.66m
Vehicle Operating Costs (TUBA)	£2.71m
During Construction	-£4.22m
During Maintenance	£0.00m
Net Non-Business Benefits: Other	£65.15m
Business User Benefits	
User Benefits	
Travel Time (TUBA)	£41.37m
Vehicle Operating Costs (TUBA)	£5.51m
During Construction	-£2.85m
During Maintenance	£0.00m
Subtotal	£44.03m
Private Sector Provider Impacts	
Subtotal	£0.00m
Other Business Impacts	
Developer Contributions	-£15.21m
Net Business Impact	£28.82m
Total	
Present Value of Transport Economic Efficiency	£143.68m

Note: All positive values are benefits in £m in 2010 market prices discounted to 2010.

5.11 Public Accounts

5.11.1 Table 5-16 presents the PA table.

Table 5-16: Public Accounts (PA) Table for Core Scenario

Local Government Funding	
Revenue	£0.00m
Operating Costs	£0.00m
Investment Costs	£0.00m
Developer and Other Contributions	£0.00m
Grant/Subsidy Payments	£0.00m
Net Impact	£0.00m
Central Government Funding: Transport	
Revenue	£0.00m
Operating Costs	£0.63m
Investment Costs	£76.34m
Developer and Other Contributions	-£15.21m
Grant/Subsidy Payments	£0.00m
Net Impact	£61.76m
Central Government Funding: Non-Transport	
Indirect Tax Revenues	£4.26m
Totals	
Broad Transport Budget	£61.76m
Wider Public Finances	£4.26m

Note: All values are £m in 2010 market prices discounted to 2010

5.12 Analysis of Monetised Costs and Benefits

5.12.1 Table 5-17 presents the AMCB table.

Table 5-17: Analysis of Monetised Costs and Benefits Table for Core Scenario

Item	Core Scenario
Noise	£0.15m
Local Air Quality	£0.25m
Greenhouse Gases	-£2.37m
Journey Quality	£0.00m
Physical Activity	£0.00m
Accident Savings (COBA-LT)	£6.37m
Economic Efficiency: Consumer Users (Commuting)	£49.71m
Economic Efficiency: Consumer Users (Others)	£65.15m
Economic Efficiency: Business Users and Providers	£28.82m
Wider Public Finances (Indirect Taxation Revenues)	-£4.26m
Present Value of Benefits (PVB)	£143.82m
Broad Transport Budget	£61.76m
Present Value of Costs (PVC)	£61.76m
Net Present Value (NPV)	£82.06m
Benefit to Cost Ratio (BCR)	2.33

Note: All values are £m in 2010 market prices discounted to 2010

5.13 Adjusted BCR

5.13.1 Inclusion of journey time reliability benefits and wider economic impacts increases the PVB from £143.82m to £159.79m. With the PVC of £61.76m, this gives an adjusted NPV of £98.03m and an adjusted BCR of 2.59.

5.14 Comparison with Stage 2

5.14.1 At Stage 2, the core test was carried out using TUBA v1.9.7 with a sensitivity test using TUBA v1.9.8. The impact was a considerable reduction in forecast benefits, with the initial BCR falling to 1.4 and the adjusted BCR falling to 1.9. This essentially reflects changes to values of time between the two versions of TUBA. Between TUBA v1.9.7 and TUBA v1.9.8, there were VOT increases for commuting trips but decreases for car business trips and other trips.

5.14.2 Stage 3 has used version 1.9.10 of TUBA with incremental changes from v1.9.8. This change alone would be expected to show similar BCRs to the Stage 2 sensitivity test.

5.14.3 The initial BCR at Stage 3 now stands at 2.33 and this significant improvement is largely due to higher TEE benefits and accident savings and a lower PVC due to a significant reduction in scheme construction costs.

5.14.4 Unlike in Stage 2 where benefits from the AM and PM peak periods were broadly similar, the majority of Stage 3 benefits are drawn from the PM peak period because the PM peak period has been extended from 3 hours to 4 hours and so the PM peak period annualisation factor has increased from 712 to 914.

5.14.5 The Stage 3 annualisation factor for the off-peak period is lower than at Stage 2. This is because at Stage 2 the off-peak period was defined as hours where flows were at least 50% of the Interpeak. Stage 3 has taken a more restrictive view of the off-peak hours that can realistically be assessed based on the Interpeak.

5.14.6 There are also significantly more accident benefits at Stage 3 compared to Stage 2 with more accidents and casualties saved by the scheme. This is principally due to higher existing accident rates covering more of the study area.

5.14.7 All comparisons to Stage 2 have the caveat that the switch from LTCv1B (as used in Stage 2) to LTAM (as used in Stage 3) may also affect the comparison.

6. Sensitivity Testing

6.1 Overview

6.1.1 The core scenario described in the previous sections is viewed as the 'most likely' future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommend, therefore, that scenario analysis be undertaken to allow for future uncertainty.

6.1.2 Three sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

6.1.3 The demand-side sensitivity tests utilise transport schemes as for the core scenario but apply adjustment factors to take into account low and high traffic growth, as set out in WebTAG Unit M4 and the Traffic Forecasting Report. These tests include:

- Low growth scenario: incorporating land-use uncertainty assumptions as for the core scenario with low traffic growth; and
- High growth scenario: incorporating land-use uncertainty assumptions as for the core scenario with high traffic growth.

6.1.4 The low and high traffic growth are represented in the modelled years by starting with the core scenario demand for that year and subtracting or adding a proportion of the base year demand. This proportion is a multiple, increasing over time, of a parameter 'p'. WebTAG unit M4 specifies the multiples and recommends a 'p' value of 2.5%; this recommendation was followed.

6.1.5 The scheme investment costs and maintenance costs are held constant at the core scenario level. However, there will be changes to the scheme PVC as a result of the indirect tax revenue effect.

6.1.6 To ensure consistency with the WebTAG Data Book (v1.10) published in May 2018, there was an update from TUBA version 1.9.10 to version 1.9.11. Therefore, an additional sensitivity test was undertaken using TUBA version 1.9.11 for the core scenario.

6.1.7 The results of the sensitivity tests are summarised in the following sections and detailed in Appendix F.

6.2 Results from Low/High Growth Scenarios

6.2.1 Table 6-1 summarises the results of the demand-side sensitivity tests. Results produced from this analysis show that the BCRs are in the range from 0.89 to 2.71.

Table 6-1: Summary for Demand-Side Sensitivity Tests

Item	Low	Core	High
Noise	£0.15m	£0.15m	£0.15m
Local Air Quality	£0.25m	£0.25m	£0.25m
Greenhouse Gases	-£2.37m	-£2.37m	-£2.37m
Journey Quality	£0.00m	£0.00m	£0.00m
Physical Activity	£0.00m	£0.00m	£0.00m
Accidents	£6.37m	£6.37m	£6.37m
Economic Efficiency: Consumer Users (Commuting)	£22.94m	£49.71m	£41.81m
Economic Efficiency: Consumer Users (Others)	£25.37m	£65.15m	£89.62m
Economic Efficiency: Business Users and Providers	£4.10m	£28.82m	£37.02m
Wider Public Finances (Indirect Taxation Revenues)	-£1.57m	-£4.26m	-£5.64m
Present Value of Benefits (PVB)	£55.24m	£143.82m	£167.21m
Broad Transport Budget	£61.76m	£61.76m	£61.76m
Present Value of Costs (PVC)	£61.76m	£61.76m	£61.76m
Net Present Value (NPV)	-£6.52m	£82.06m	£105.45m
Benefit to Cost Ratio (BCR)	0.89	2.33	2.71

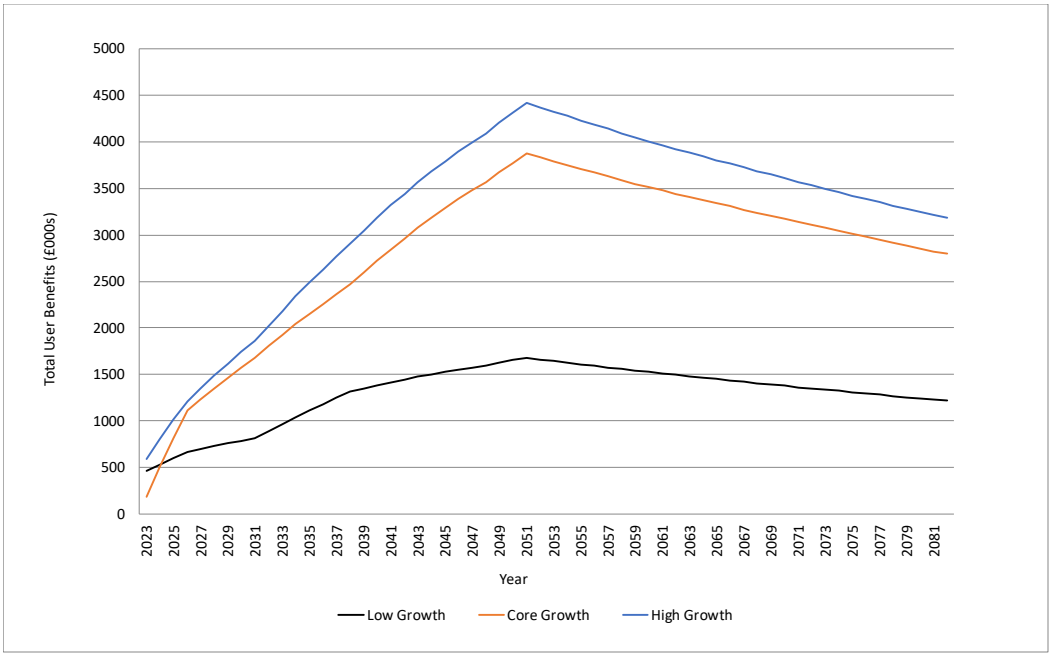
Note: All monetised values are expressed as 2010 present values

6.2.2 It should be noted that, with the exception of TUBA, all other analyses have only been carried out for the core scenario. The benefits from the core scenario have been retained in the high and low growth scenarios for estimation of the BCR as shown in Table 6-1 above.

6.3 Comparison of Benefits Profiles

6.3.1 Figure 6-1 presents a comparison of the benefit profile for the low, core and high growth scenarios. The profile over time is similar across all scenarios. All scenarios have a benefits peak in 2051. Higher levels of growth mean higher levels of congestion in the Do Minimum scenario and greater levels of benefits when the scheme is introduced.

Figure 6-1: Benefit Profiles Comparison over 60-Year Appraisal Period



6.3.2 As shown in Figure 6-1, benefits in the low growth scenario are significantly less than the core scenario. This is because the core scenario experiences significantly more congestion and delay than the low growth scenario. As per the Traffic Forecasting Report, Document Ref: HE543917-ATK-HTA-XX-RP-TR-000016, compared to the core scenario, the low growth scenario experiences on average 36% less delay per PCU in the Do Minimum and on average 35% less delay per PCU in the Do Something in the AM peak period. Similarly, for the PM peak period it is 37% in the Do Minimum and 36% in the Do Something, while in the Interpeak it is 21% in the Do Minimum and 18% in the Do Something respectively. Table 6-2 to Table 6-4 shows the delay per PCU for the core scenario and low growth scenario.

Table 6-2: Comparison of Total Delay per PCU between Core & Low Growth for all forecast years – AM

Network Performance Effect	2023		2026		2031		2038		2051	
	DM	DS	DM	DS	DM	DS	DM	DS	DM	DS
Core Scenario										
Total Delay / PCU (mins/pcu)	2.3	2.2	1.3	1.3	1.6	1.6	1.8	1.8	2.3	2.2
Low Growth Scenario										
Total Delay / PCU (mins/pcu)	1.5	1.5	0.9	0.9	1.1	1.1	1.1	1.1	1.3	1.3

Table 6-3: Comparison of Total Delay per PCU between Core & Low Growth for all forecast years – IP

Network Performance Effect	2023		2026		2031		2038		2051	
	DM	DS	DM	DS	DM	DS	DM	DS	DM	DS
Core Scenario										
Total Delay / PCU (mins/pcu)	1.3	1.3	0.9	0.9	1.1	1.1	1.3	1.3	2.0	1.9
Low Growth Scenario										
Total Delay / PCU (mins/pcu)	1.0	1.0	0.9	0.9	0.9	1.0	1.0	1.0	1.2	1.2

Table 6-4: Comparison of Total Delay per PCU between Core & Low Growth for all forecast years – PM

Network Performance Effect	2023		2026		2031		2038		2051	
	DM	DS	DM	DS	DM	DS	DM	DS	DM	DS
Core Scenario										
Total Delay / PCU (mins/pcu)	3.5	3.5	2.4	2.3	2.9	2.8	3.4	3.1	4.4	4.1
Low Growth Scenario										
Total Delay / PCU (mins/pcu)	2.5	2.4	1.7	1.6	1.9	1.9	1.9	1.9	2.3	2.2

6.3.3 To determine the sector movements that contribute to the significant decrease in benefits, a sectoral analysis for the low growth scenario and the difference between the core and low growth scenarios are presented in Table 6-5 and Table 6-6.

Table 6-5: Sector Benefit Summary – Low Growth – all 60 years (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	3,091	650	-83	-1,345	14,836	198	167	-36	3,835	663	16	-283	906	2,345	**24,960**
2	472	0	1	106	-8	-63	-129	-21	27	-8	-1	-14	-2	12	**373**
3	1,114	17	-23	-265	693	-142	-625	-184	38	76	-10	-145	-	66	**610**
4	4,230	323	-464	-2,131	18,302	4,075	1,928	-272	3,354	-663	-123	-425	568	2,886	**31,588**
5	2,666	-8	78	2,375	-0	39	135	32	40	-97	-8	-47	-0	-8	**5,196**
6	1,802	122	-245	273	2,487	-	-419	184	16	-70	-	118	19	824	**5,110**
7	-1,297	-37	-696	-1,527	-1,073	-971	-	-211	-1,462	-736	-	-34	-14	-97	**-8,155**
8	-235	-11	-189	371	-81	23	2,759	-	-497	-760	-	198	-0	-18	**1,561**
9	7,774	95	22	334	225	246	400	90	0	324	13	59	65	2	**9,647**
10	2,057	2	-4	-5	27	-84	-450	-285	73	-	-6	-171	-	18	**1,173**
11	22	0	-50	-68	10	-	-	-	9	-33	1	-	-	1	**-109**
12	407	41	-178	-1,493	1,559	2,144	0	-222	118	-273	0	0	4	263	**2,372**
13	219	-0	-	108	-30	-1	-2	1	6	-	-	0	-	-26	**274**
14	155	-28	8	193	-350	-24	-46	1	-	-66	-1	-14	-153	-	**-327**
Total	**22,477**	**1,167**	**-1,823**	**-3,075**	**36,598**	**5,439**	**3,718**	**-923**	**5,558**	**-1,643**	**-119**	**-758**	**1,393**	**6,267**	**74,275**

Note-All values are £000 in 2010 market prices discounted to 2010.

Table 6-6: Difference in Sector Benefits between Core and Low Growth – all 60 years (£000s)

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	3,294	637	569	6,274	10,421	3,030	5,900	1,409	2,935	1,366	119	2,410	877	1,208	**40,449**
2	506	0	-4	192	-49	-19	9	-1	29	-2	-6	-12	-4	-6	**633**
3	493	9	-84	-129	-4	-6	1	-90	38	-65	-76	-246	0	-6	**-168**
4	119	202	203	1,714	6,531	3,337	1,962	1,106	2,301	218	38	2,732	183	1,070	**21,717**
5	3,936	16	-16	4,129	-1	-311	541	79	2	-63	-31	14	0	18	**8,314**
6	-490	-3	72	1,071	-824	0	-47	-114	-693	29	0	390	8	-320	**-920**
7	-481	-88	-9	906	-3,185	156	0	597	-850	48	0	60	-43	-453	**-3,341**
8	-401	-12	18	241	-504	1,010	2,208	0	-324	40	0	1,538	-1	-116	**3,696**
9	5,688	67	19	2,330	4	114	350	79	0	328	1	79	23	-1	**9,082**
10	1,380	3	-165	21	-123	-10	4	-50	36	0	-65	-224	0	-30	**778**
11	6	1	-83	-27	3	0	0	0	3	-24	1	3	0	0	**-119**
12	-166	20	131	1,085	322	1,101	0	40	39	175	3	-1	0	53	**2,802**
13	313	0	0	179	-22	-3	19	1	3	0	0	1	0	26	**518**
14	502	49	3	382	191	-4	163	3	0	46	-3	4	259	0	**1,593**
Total	**14,701**	**899**	**654**	**18,367**	**12,760**	**8,395**	**11,111**	**3,059**	**3,519**	**2,096**	**-20**	**6,747**	**1,303**	**1,443**	**85,033**

Note- Cells in red are the bottom 10 movements and cells in green are the top 10 movements All values are £000 in 2010 market prices discounted to 2010.

6.3.4 Referring to table 6-6, the following sectoral movements have the highest difference:

- £10.4m - Sector 1 to Sector 5
- £6.5m - Sector 4 to Sector 5
- £6.3m - Sector 1 to Sector 4
- £5.9m - Sector 1 to Sector 7

6.3.5 The high growth scenario generates higher benefits than the core scenario, but this is limited due to benefits for commuting users actually being lower in the high growth scenario than in the core scenario. This indicates a suppression of benefits and a limiting impact of the scheme in the high growth scenario due to the network becoming too congested. Further information is provided in the Traffic Forecasting Report.

6.4 Sensitivity Test using TUBA version 1.9.11

6.4.1 To ensure consistency with the WebTAG Data Book (v1.10) published in May 2018, there was an update from TUBA version 1.9.10 to version 1.9.11. Therefore, an additional sensitivity test was undertaken using TUBA version 1.9.11 for the core scenario alone. Comparison of the results obtained using both versions of TUBA (v1.9.10 and v 1.9.11) is reported in Table 6-7 below.

Table 6-7: Comparison of Results from TUBA v1.9.10 and v1.9.11

Item	Core (TUBA V 1.9.10)	Core (TUBA V 1.9.11)
Economic Efficiency: Consumer Users (Commuting)	£52.93m	£51.99m
Economic Efficiency: Consumer Users (Others)	£69.37m	£68.04m
Economic Efficiency: Business Users and Providers	£46.88m	£46.18m
Wider Public Finances (Indirect Taxation Revenues)	-£4.26m	-£4.09m

Note: All monetised values are expressed as 2010 present values

6.4.2 As shown in Table 6-7, there would only be a marginal decrease in the PVB and BCR (from 2.33 to 2.28) using the latest version of TUBA for the core scenario, which is due to corresponding changes in perceived values of time and vehicle operating costs in the May 2018 v1.10 version of the WebTAG Data Book. Since this sensitivity test is on the TUBA version, only the relevant figures from TUBA have been presented. The remaining components of the PVB and the PVC are unchanged.

7. Summary

7.1.1 This Economic Appraisal Package documents the details of the approach adopted for the estimation of economic benefits arising from the scheme and summarises the results of the assessments, as part of the Project Control Framework (PCF) Stage 3. The starting point is the set of traffic forecasts documented in the Traffic Forecasting Report[12].

7.1.2 The report also seeks to establish the extent to which the scheme provides good value for money in relation to impacts on public accounts by improving transport economic efficiency for all users.

7.1.3 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without scheme scenario (the Do Minimum or DM).

7.1.4 The costs of the scheme used in the assessment comprise the scheme construction costs taken directly from the tables provided by the Highways England Commercial team and reproduced in Appendix B plus operating and maintenance costs. These costs are considered further in Section 3.

7.1.5 The benefits of the scheme are calculated from a number of sources, which are:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA;
- User disbenefits during construction have also been assessed using TUBA (Stage 2 with user disbenefits during maintenance assumed to be negligible); and
- Accident savings have been forecast using COBA-LT.

7.1.6 In addition, estimates have been made of the monetised greenhouse gas, air quality and noise impacts of the scheme.

7.1.7 The results from the different elements of the economic assessment are presented in three summary tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and
- The Analysis of Monetised Costs and Benefits (AMCB) table.

7.1.8 Supplementary assessments have been undertaken to quantify benefits due to journey time reliability, wider economic impacts and social and distributional impacts.

7.1.9 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

7.1.10 The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

7.1.11 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

[12] Traffic Forecasting Report-HE543917-ATK-HTA-XX-RP-TR-000016.docx

7.1.12 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

7.1.13 The scheme is forecast to produce user benefits of £169.2m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £159.3m and vehicle operating costs of £9.9m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed.

7.1.14 The scheme construction costs are £76.3m (PV) but £15.2m (PV) of this cost is being funded from developer contributions. The construction cost figure was correct at the time of compiling this report and may be refined as Stage 3 comes to a conclusion. Any significant changes in cost may require the calculations to be reviewed.

7.1.15 With consideration of the effects of delays during construction, accident benefits, indirect taxation benefits, monetised environmental impacts and maintenance costs, the initial BCR is 2.33, which represents high value for money.

7.1.16 Should it be necessary for the developer contribution to be funded fully from public funds, the BCR would fall from 2.33 to 2.07 but this still represents high value for money.

7.1.17 The scheme is forecast to generate wider economic impacts but they are anticipated to be limited in scale as a result of the characteristics of the scheme and its impacts on travel costs and the economic characteristics of the study area.

7.1.18 Given the limited anticipated scale of the impacts as discussed in section 5.2.26, it was not considered proportionate to quantify the agglomeration and labour market impacts at this stage and they are assessed qualitatively to be slight positive.

7.1.19 No direct dependent development benefits are considered to be attributable to the scheme at this stage as discussed in section 4.6.

7.1.20 An estimate of the impact of increased output in imperfectly competitive markets (reflecting the additional margin that firms can make on each additional unit of output they can produce as a result of travel cost savings) has been derived directly from the estimated business user benefits (in line with WebTAG Unit A2.2, May 2018) and is estimated to be £4.69 million (NPV, 2010 prices and values).

7.1.21 Inclusion of journey time reliability benefits and wider economic impacts gives an adjusted BCR of 2.59.

7.1.22 The core scenario is viewed as the ‘most likely’ future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommend, therefore, that scenario analysis be undertaken to allow for future uncertainty.

7.1.23 Three sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

7.1.24 The case for the scheme is very sensitive to traffic growth with the high growth scenario increasing the initial BCR to 2.71 but the low growth scenario reducing the initial BCR to 0.89.

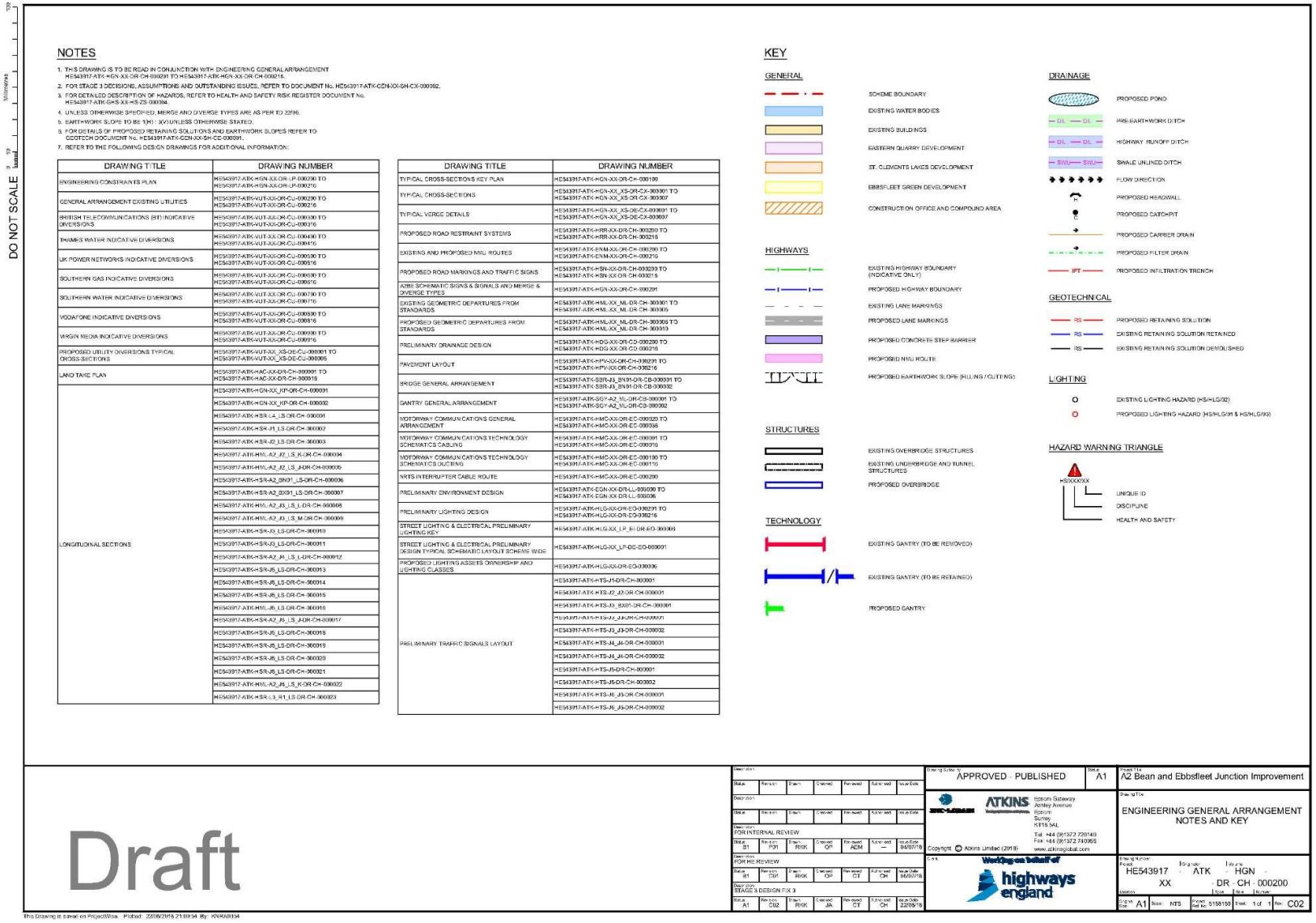
7.1.25 A further sensitivity test was carried out using TUBA version 1.9.11 for the core scenario but this had very little impact on the initial BCR as expected.

7.1.26 The initial BCR at Stage 3 now stands at 2.33 and this significant improvement is largely due to higher TEE benefits and accident savings and a lower PVC due to a significant reduction in scheme construction costs.

7.1.27 All comparisons to Stage 2 have the caveat that the switch from LTCv1B (as used in Stage 2) to LTAM (as used in Stage 3) may also affect the comparison.

Appendices

Appendix A. Scheme Design



DO NOT SCALE

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ENGINEERING GENERAL ARRANGEMENT HE543917-ATK-HGN-XX-DR-CH-000001 TO HE543917-ATK-HGN-XX-DR-CH-000215.
2. FOR STAGE 3 DECISIONS, ASSUMPTIONS AND OUTSTANDING ISSUES, REFER TO DOCUMENT No. HE543917-ATK-GEN-XX-SH-CX-000002.
3. FOR DETAILED DESCRIPTION OF HAZARDS, REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000004.
4. UNLESS OTHERWISE SPECIFIED, MERGE AND DIVERGE TYPES ARE AS PER TD 22/06.
5. EARTHWORK SLOPE TO BE 1(V) : 2(V) UNLESS OTHERWISE STATED.
6. FOR DETAILS OF PROPOSED RETAINING SOLUTIONS AND EARTHWORK SLOPES REFER TO GEOTECH DOCUMENT No. HE543917-ATK-GEN-XX-SH-CE-000091.
7. REFER TO THE FOLLOWING DESIGN DRAWINGS FOR ADDITIONAL INFORMATION:

DRAWING TITLE	DRAWING NUMBER
ENGINEERING CONSTRAINTS PLAN	HE543917-ATK-HGN-XX-DR-LP-000230 TO HE543917-ATK-HGN-XX-DR-LP-000216
GENERAL ARRANGEMENT EXISTING UTILITIES	HE543917-ATK-VUT-XX-DR-CU-000230 TO HE543917-ATK-VUT-XX-DR-CU-000216
BRITISH TELECOMMUNICATIONS (BT) INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000330 TO HE543917-ATK-VUT-XX-DR-CU-000316
THAMES WATER INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000430 TO HE543917-ATK-VUT-XX-DR-CU-000416
UK POWER NETWORKS INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000630 TO HE543917-ATK-VUT-XX-DR-CU-000616
SOUTHERN GAS INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000830 TO HE543917-ATK-VUT-XX-DR-CU-000816
SOUTHERN WATER INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000730 TO HE543917-ATK-VUT-XX-DR-CU-000716
VODAFONE INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000830 TO HE543917-ATK-VUT-XX-DR-CU-000816
VIRGIN MEDIA INDICATIVE DIVERSIONS	HE543917-ATK-VUT-XX-DR-CU-000930 TO HE543917-ATK-VUT-XX-DR-CU-000916
PROPOSED UTILITY DIVERSIONS TYPICAL CROSS-SECTIONS	HE543917-ATK-VUT-XX_XS-DE-CU-000001 TO HE543917-ATK-VUT-XX_XS-DE-CU-000005
LAND TAKE PLAN	HE543917-ATK-HAC-XX-DR-CH-000015
LONGITUDINAL SECTIONS	HE543917-ATK-HGN-XX_HP-DR-CH-000001 HE543917-ATK-HGN-XX_HP-DR-CH-000002 HE543917-ATK-HSR-L4_LS-DR-CH-000001 HE543917-ATK-HSR-J1_LS-DR-CH-000002 HE543917-ATK-HSR-J2_LS-DR-CH-000003 HE543917-ATK-HML-A2_J2_LS_K-DR-CH-000004 HE543917-ATK-HML-A2_J2_LS_J-DR-CH-000005 HE543917-ATK-HSR-A2_SN01_LS-DR-CH-000006 HE543917-ATK-HSR-A2_SN01_LS-DR-CH-000007 HE543917-ATK-HML-A2_J3_LS_L-DR-CH-000008 HE543917-ATK-HML-A2_J3_LS_M-DR-CH-000009 HE543917-ATK-HSR-J3_LS-DR-CH-000010 HE543917-ATK-HSR-J3_LS-DR-CH-000011 HE543917-ATK-HSR-A2_J4_LS_L-DR-CH-000012 HE543917-ATK-HSR-J5_LS-DR-CH-000013 HE543917-ATK-HSR-J5_LS-DR-CH-000014 HE543917-ATK-HSR-J5_LS-DR-CH-000015 HE543917-ATK-HML-J5_LS-DR-CH-000016 HE543917-ATK-HSR-A2_J5_LS_J-DR-CH-000017 HE543917-ATK-HSR-J5_LS-DR-CH-000018 HE543917-ATK-HSR-J5_LS-DR-CH-000019 HE543917-ATK-HSR-J5_LS-DR-CH-000020 HE543917-ATK-HSR-J5_LS-DR-CH-000021 HE543917-ATK-HML-A2_J5_LS_K-DR-CH-000022 HE543917-ATK-HSR-L3_91_LS-DR-CH-000023

DRAWING TITLE	DRAWING NUMBER
TYPICAL CROSS-SECTIONS KEY PLAN	HE543917-ATK-HGN-XX-DR-CH-000199
TYPICAL CROSS-SECTIONS	HE543917-ATK-HGN-XX_XS-DR-CX-000001 TO HE543917-ATK-HGN-XX_XS-DR-CX-000007
TYPICAL VERGE DETAILS	HE543917-ATK-HGN-XX_XS-DE-CX-000001 TO HE543917-ATK-HGN-XX_XS-DE-CX-000007
PROPOSED ROAD RESTRAINT SYSTEMS	HE543917-ATK-HRR-XX-DR-CH-000200 TO HE543917-ATK-HRR-XX-DR-CH-000216
EXISTING AND PROPOSED NMU ROUTES	HE543917-ATK-ENM-XX-DR-CH-000200 TO HE543917-ATK-ENM-XX-DR-CH-000216
PROPOSED ROAD MARKINGS AND TRAFFIC SIGNS	HE543917-ATK-HSN-XX-DR-CH-000200 TO HE543917-ATK-HSN-XX-DR-CH-000216
ABM SCHEMATIC SIGNS & SIGNALS AND MERGE & DIVERGE TYPES	HE543917-ATK-HGN-XX-DR-CH-000291
EXISTING GEOMETRIC DEPARTURES FROM STANDARDS	HE543917-ATK-HML-XX_ML-DR-CH-000001 TO HE543917-ATK-HML-XX_ML-DR-CH-000005
PROPOSED GEOMETRIC DEPARTURES FROM STANDARDS	HE543917-ATK-HML-XX_ML-DR-CH-000006 TO HE543917-ATK-HML-XX_ML-DR-CH-000010
PRELIMINARY DRAINAGE DESIGN	HE543917-ATK-HDG-XX-DR-CD-000200 TO HE543917-ATK-HDG-XX-DR-CD-000216
PAVEMENT LAYOUT	HE543917-ATK-HPV-XX-DR-CH-000231 TO HE543917-ATK-HPV-XX-DR-CH-000216
BRIDGE GENERAL ARRANGEMENT	HE543917-ATK-SBR-J3_BN91-DR-CB-000001 TO HE543917-ATK-SBR-J3_BN91-DR-CB-000002
GANTRY GENERAL ARRANGEMENT	HE543917-ATK-SGY-A2_ML-DR-CB-000001 TO HE543917-ATK-SGY-A2_ML-DR-CB-000002
MOTORWAY COMMUNICATIONS GENERAL ARRANGEMENT	HE543917-ATK-HMC-XX-DR-EC-000230 TO HE543917-ATK-HMC-XX-DR-EC-000236
MOTORWAY COMMUNICATIONS TECHNOLOGY SCHEMATICS CABLING	HE543917-ATK-HMC-XX-DR-EC-000001 TO HE543917-ATK-HMC-XX-DR-EC-000016
MOTORWAY COMMUNICATIONS TECHNOLOGY SCHEMATICS DUCTING	HE543917-ATK-HMC-XX-DR-EC-000100 TO HE543917-ATK-HMC-XX-DR-EC-000116
NRTS INTERRUPTER CABLE ROUTE	HE543917-ATK-HMC-XX-DR-EC-000200
PRELIMINARY ENVIRONMENT DESIGN	HE543917-ATK-EGN-XX-DR-LL-000030 TO HE543917-ATK-EGN-XX-DR-LL-000036
PRELIMINARY LIGHTING DESIGN	HE543917-ATK-HLG-XX-DR-EO-000231 TO HE543917-ATK-HLG-XX-DR-EO-000216
STREET LIGHTING & ELECTRICAL PRELIMINARY LIGHTING KEY	HE543917-ATK-HLG-XX_LP_EI-DR-EO-000000
STREET LIGHTING & ELECTRICAL PRELIMINARY DESIGN TYPICAL SCHEMATIC LAYOUT SCHEME WIDE	HE543917-ATK-HLG-XX_LP-DE-EO-000001
PROPOSED LIGHTING ASSETS OWNERSHIP AND LIGHTING CLASSES	HE543917-ATK-HLG-XX-DR-EO-000036
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KEY

GENERAL
- SCHEME BOUNDARY
- EXISTING WATER BODIES
- EXISTING BUILDINGS
- EASTERN QUARRY DEVELOPMENT
- ST. CLEMENTS LAKES DEVELOPMENT
- EBBSFLEET GREEN DEVELOPMENT
- CONSTRUCTION OFFICE AND COMPOUND AREA

HIGHWAYS
- EXISTING HIGHWAY BOUNDARY (INDICATIVE ONLY)
- PROPOSED HIGHWAY BOUNDARY
- EXISTING LANE MARKINGS
- PROPOSED LANE MARKINGS
- PROPOSED CONCRETE STEP BARRIER
- PROPOSED NMU ROUTE
- PROPOSED EARTHWORK SLOPE (FILLING / CUTTING)

STRUCTURES
- EXISTING OVERBRIDGE STRUCTURES
- EXISTING UNDERBRIDGE AND TUNNEL STRUCTURES
- PROPOSED OVERBRIDGE

TECHNOLOGY
- EXISTING GANTRY (TO BE REMOVED)
- EXISTING GANTRY (TO BE RETAINED)
- PROPOSED GANTRY

DRAINAGE
- PROPOSED POND
- PRE-EARTHWORK DITCH
- HIGHWAY RUNOFF DITCH
- SWALE UNLINED DITCH
- FLOW DIRECTION
- PROPOSED HEADWALL
- PROPOSED CATCHPIT
- PROPOSED CARRIER DRAIN
- PROPOSED FILTER DRAIN
- PROPOSED INFILTRATION TRENCH

GEOTECHNICAL
- PROPOSED RETAINING SOLUTION
- EXISTING RETAINING SOLUTION RETAINED
- EXISTING RETAINING SOLUTION DEMOLISHED

LIGHTING
- EXISTING LIGHTING HAZARD (HS/HLG/02)
- PROPOSED LIGHTING HAZARD (HS/HLG/01 & HS/HLG/03)

HAZARD WARNING TRIANGLE
HSXXXXXX
- UNIQUE ID
- DISCIPLINE
- HEALTH AND SAFETY

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Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
FOR INTERNAL REVIEW	S1	P01	RKK	CF	AEM	—	04/07/18
FOR HE REVIEW	S2	C01	RKK	CF	CT	CH	06/07/18
STAGE 3 DESIGN FIX 3	A1	C02	RKK	JA	CT	CH	22/09/18

Drawing Status: APPROVED - PUBLISHED | Size: A1

Project Title: A2 Bean and Ebbsfleet Junction Improvement

Drawing Title: ENGINEERING GENERAL ARRANGEMENT NOTES AND KEY

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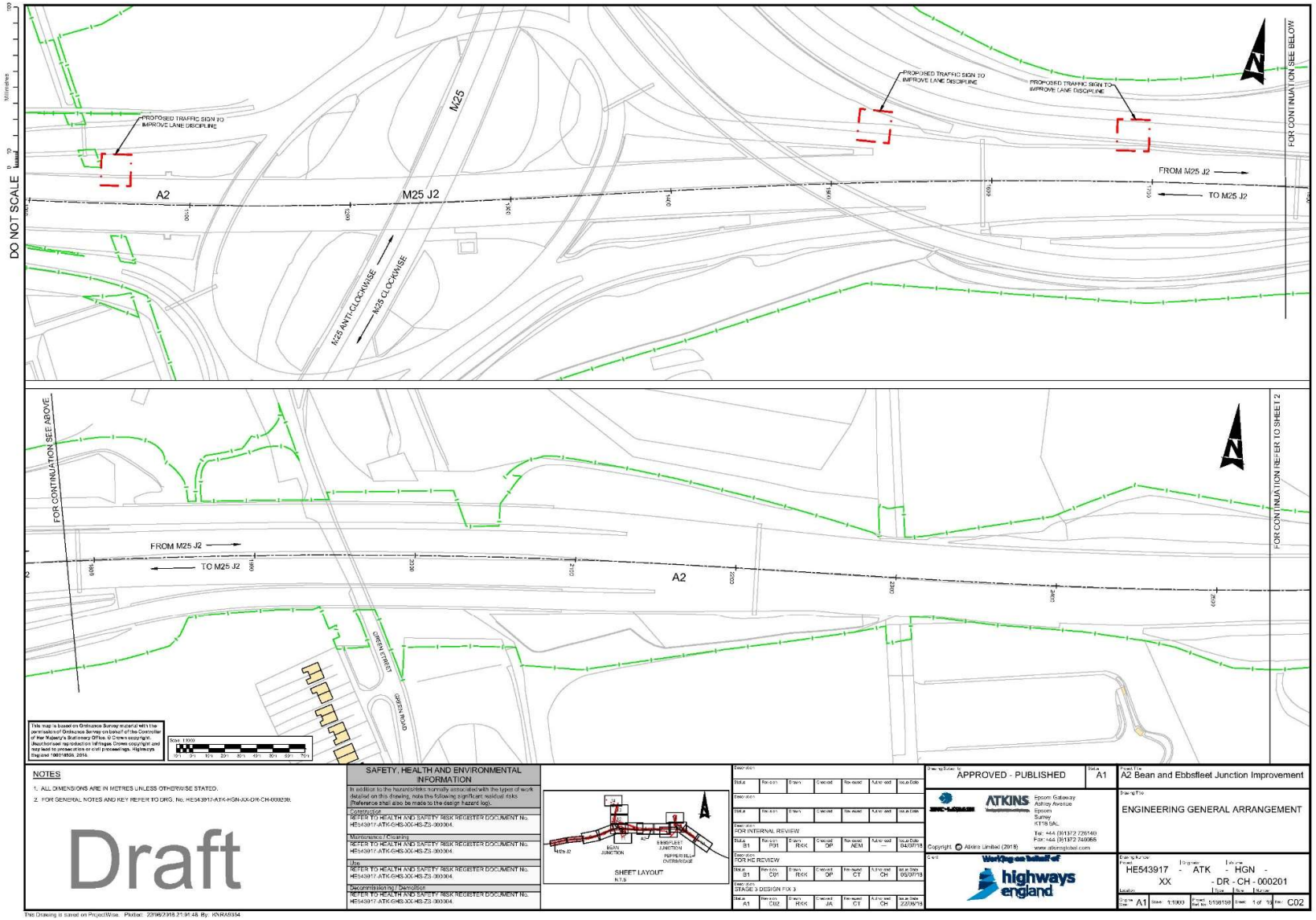
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M25 J2
M25 ANTI-CLOCKWISE
M25 CLOCKWISE
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PROPOSED TRAFFIC SIGN TO IMPROVE LANE DISCIPLINE
FROM M25 J2
TO M25 J2
FOR CONTINUATION SEE BELOW
FOR CONTINUATION SEE ABOVE
FROM M25 J2
TO M25 J2
A2
FOR CONTINUATION REFER TO SHEET 2
GREEN STREET
GREEN ROAD
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
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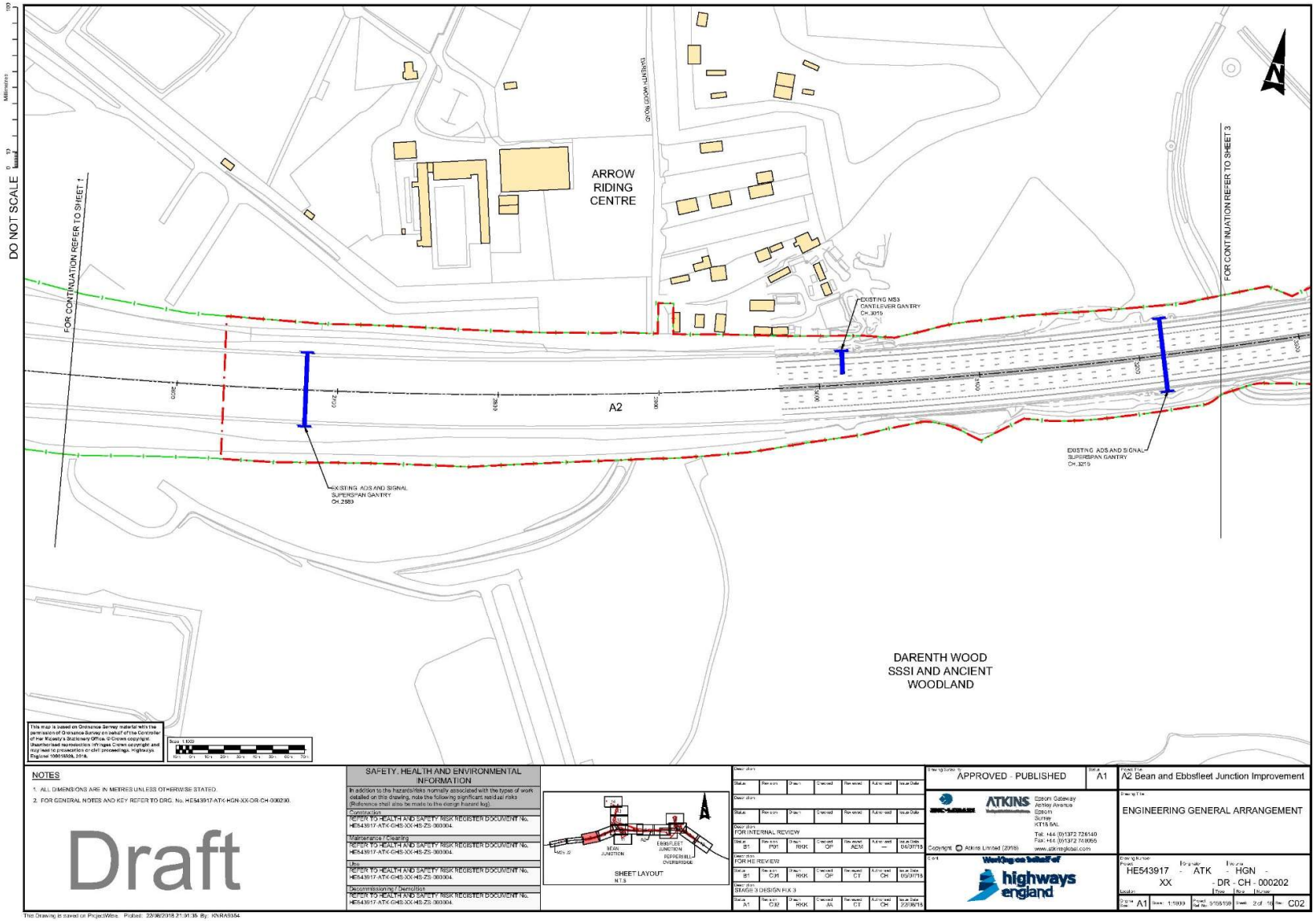
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
N.T.S
APPROVED - PUBLISHED
A1
A2 Bean and Ebbsfleet Junction Improvement
ATKINS
ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000201
C02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FOR CONTINUATION REFER TO SHEET 3
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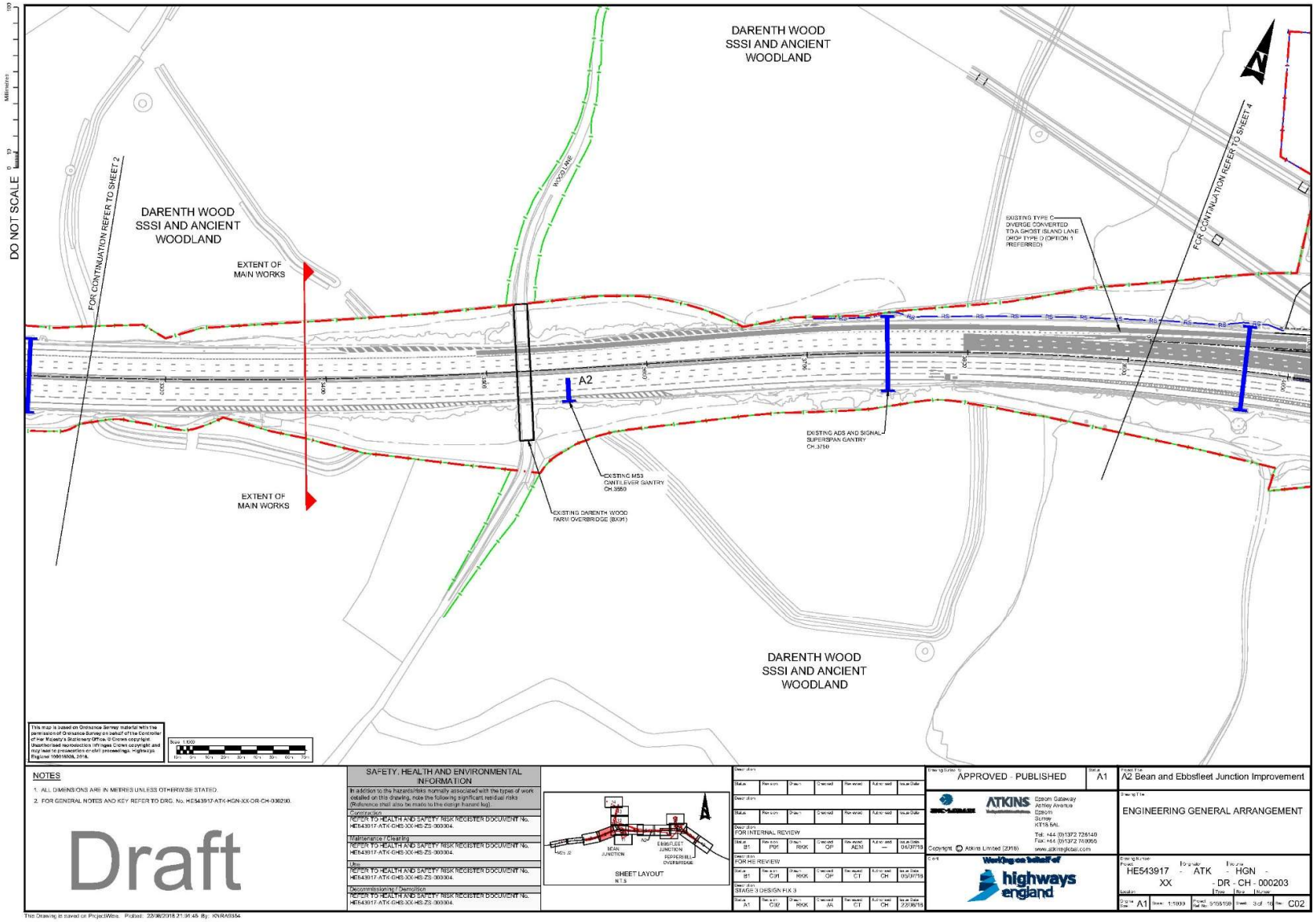
DARENTH WOOD ROAD
A2
EXISTING MS3 CANTILEVER GANTRY CH.3015
EXISTING ADS AND SIGNAL SUPERSPAN GANTRY CH.2569
EXISTING ADS AND SIGNAL SUPERSPAN GANTRY CH.3215
DARENTH WOOD SSSI AND ANCIENT WOODLAND
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000290.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
APPROVED - PUBLISHED
A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000202
C02


DO NOT SCALE
DARENTH WOOD
SSSI AND ANCIENT
WOODLAND
FOR CONTINUATION REFER TO SHEET 2
EXTENT OF
MAIN WORKS
WOOD LANE
A2
EXISTING TYPE C
DIVERGE CONVERTED
TO A GHOST ISLAND LANE
DROP TYPE D (OPTION 1
PREFERRED)
FOR CONTINUATION REFER TO SHEET 4
EXISTING ADS AND SIGNAL
SUPERSPAN GANTRY
CH.3750
EXISTING MS3
CANTILEVER GANTRY
CH.3550
EXISTING DARENTH WOOD
FARM OVERBRIDGE (BX01)
EXTENT OF
MAIN WORKS
DARENTH WOOD
SSSI AND ANCIENT
WOODLAND
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No HE543917-ATK-HGN-XX-DR-CH-000290.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)
Construction
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Maintenance / Cleaning
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Use
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Decommissioning / Demolition
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
MEAN JUNCTION
EBBSFLEET JUNCTION
ROPPERSHILL OVERBRIDGE
SHEET LAYOUT
N.T.S
APPROVED - PUBLISHED
A1
A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
ATKINS
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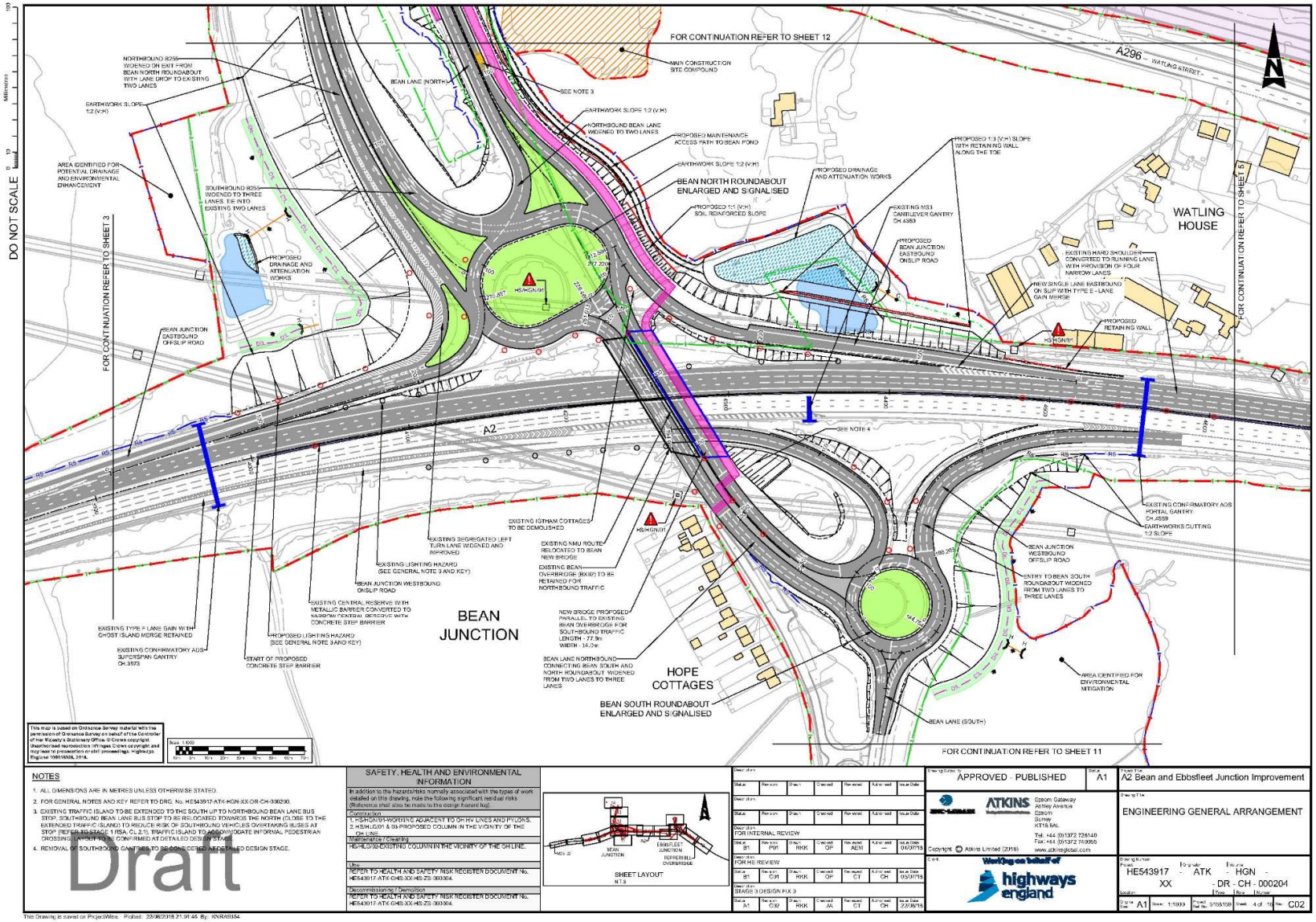
FOR CONTINUATION REFER TO SHEET 12
A296 - WATLING STREET -
NORTHBOUND B259 WIDENED ON EXIT FROM BEAN NORTH ROUNDABOUT WITH LANE DROP TO EXISTING TWO LANES
BEAN LANE (NORTH)
MAIN CONSTRUCTION SITE COMPOUND
SEE NOTE 3
EARTHWORK SLOPE 1:2 (V:H)
NORTHBOUND BEAN LANE WIDENED TO TWO LANES
PROPOSED MAINTENANCE ACCESS PATH TO BEAN POND
PROPOSED 1:3 (V:H) SLOPE WITH RETAINING WALL ALONG THE TOE
AREA IDENTIFIED FOR POTENTIAL DRAINAGE AND ENVIRONMENTAL ENHANCEMENT
SOUTHBOUND B259 WIDENED TO THREE LANES TIE INTO EXISTING TWO LANES
BEAN NORTH ROUNDABOUT ENLARGED AND SIGNALISED
PROPOSED DRAINAGE AND ATTENUATION WORKS
PROPOSED 1:1 (V:H) SOIL REINFORCED SLOPE
EXISTING MS3 CANTILEVER GANTRY CH 4353
PROPOSED BEAN JUNCTION EASTBOUND ON SLIP ROAD
WATLING HOUSE
EXISTING HARD SHOULDER CONVERTED TO RUNNING LANE WITH PROVISION OF FOUR NARROW LANES
NEW SINGLE LANE EASTBOUND ON SLIP WITH TYPE E - LANE GAIN MERGE
PROPOSED RETAINING WALL
FOR CONTINUATION REFER TO SHEET 5
DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 3
BEAN JUNCTION EASTBOUND OFFSLIP ROAD
PROPOSED DRAINAGE AND ATTENUATION WORKS
A2
SEE NOTE 4
EXISTING CONFIRMATORY AOS PORTAL GANTRY CH 4559
EARTHWORKS CUTTING 1:2 SLOPE
EXISTING IGTHAM COTTAGES TO BE DEMOLISHED
EXISTING SEGREGATED LEFT TURN LANE WIDENED AND IMPROVED
EXISTING NMU ROUTE RELOCATED TO BEAN NEW BRIDGE
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
BEAN JUNCTION WESTBOUND ON SLIP ROAD
EXISTING BEAN OVERBRIDGE (BX92) TO BE RETAINED FOR NORTHBOUND TRAFFIC
BEAN JUNCTION WESTBOUND OFFSLIP ROAD
ENTRY TO BEAN SOUTH ROUNDABOUT WIDENED FROM TWO LANES TO THREE LANES
EXISTING CENTRAL RESERVE WITH METALLIC BARRIER CONVERTED TO NARROW CENTRAL RESERVE WITH CONCRETE STEP BARRIER
BEAN JUNCTION
NEW BRIDGE PROPOSED PARALLEL TO EXISTING BEAM OVERBRIDGE FOR SOUTHBOUND TRAFFIC LENGTH - 77.9m WIDTH - 14.0m
EXISTING TYPE F LANE GAIN WITH GHOST ISLAND MERGE RETAINED
EXISTING CONFIRMATORY AOS SUPERSPAN GANTRY CH 3973
PROPOSED LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
START OF PROPOSED CONCRETE STEP BARRIER
BEAN LANE NORTHBOUND CONNECTING BEAN SOUTH AND NORTH ROUNDABOUT WIDENED FROM TWO LANES TO THREE LANES
HOPE COTTAGES
AREA IDENTIFIED FOR ENVIRONMENTAL MITIGATION
BEAN SOUTH ROUNDABOUT ENLARGED AND SIGNALISED
BEAN LANE (SOUTH)
FOR CONTINUATION REFER TO SHEET 11
N
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NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No HE543917-ATK-HGN-XX-DR-CH-000290.
3. EXISTING TRAFFIC ISLAND TO BE EXTENDED TO THE SOUTH UP TO NORTHBOUND BEAN LANE BUS STOP. SOUTHBOUND BEAN LANE BUS STOP TO BE RELOCATED TOWARDS THE NORTH (CLOSE TO THE EXTENDED TRAFFIC ISLAND) TO REDUCE RISK OF SOUTHBOUND VEHICLES OVERTAKING BUSES AT STOP. REFER TO STAGE 1 RSA, C.L.2.13, TRAFFIC ISLAND TO ACCOMMODATE INFORMAL PEDESTRIAN CROSSING LOCATION TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. REMOVAL OF SOUTHBOUND CANTILEVER TO BE CONSIDERED AT DETAILED DESIGN STAGE.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log)
Construction
1. HSHGN/01-WORKING ADJACENT TO OH HV LINES AND PYLONS.
2. HSHGN/L001 & 03-PROPOSED COLUMN IN THE VICINITY OF THE OH LINE.
Maintenance / Cleaning
HSHGN/02-EXISTING COLUMN IN THE VICINITY OF THE OH LINE.
Use
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Decommissioning / Demolition
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
SHEET LAYOUT N.T.S
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1:1000
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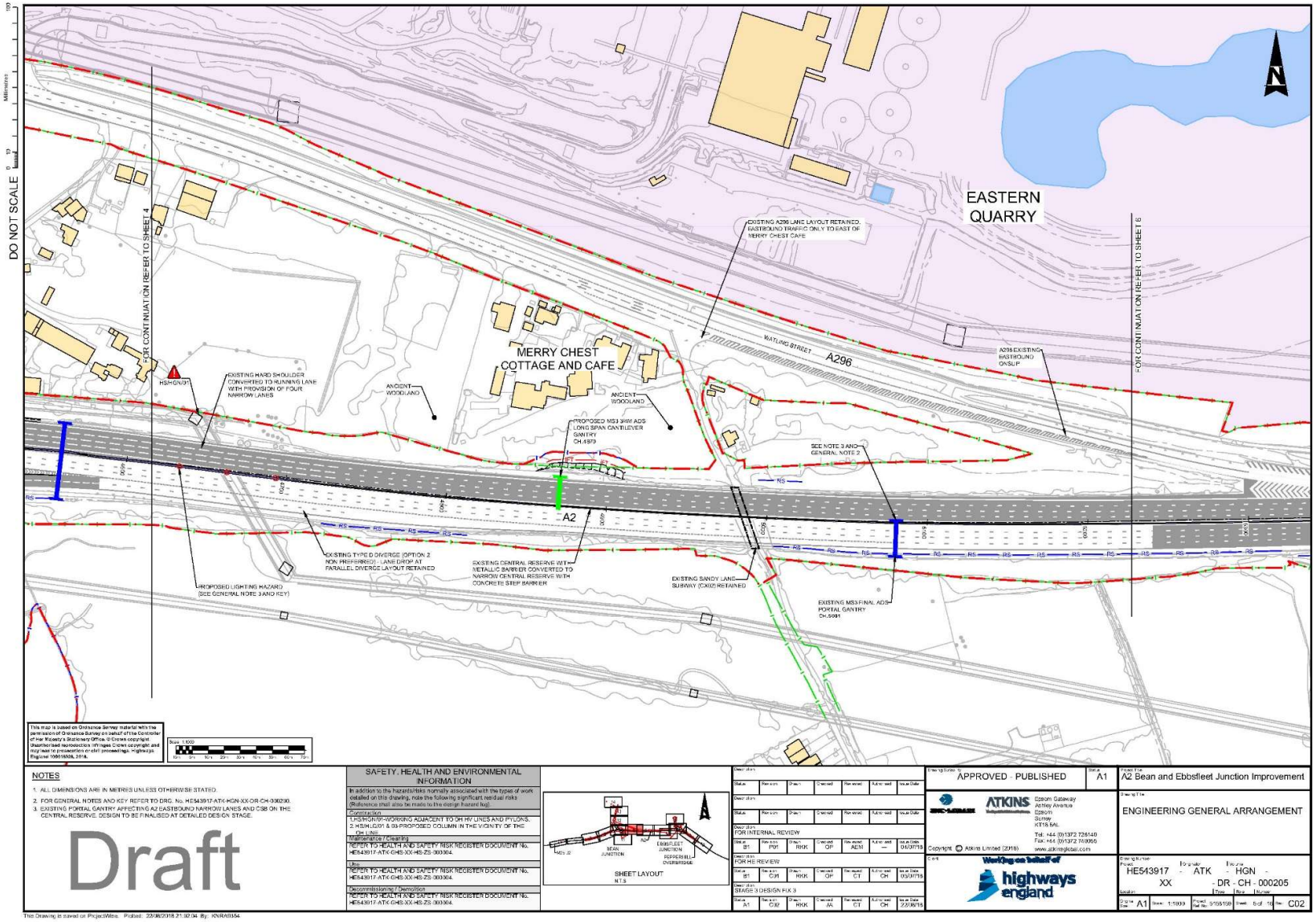
The Drawing is saved in ProjectWise. Plotted: 22/08/2018 21:31:45 By: KNRA8154


EASTERN QUARRY
MERRY CHEST COTTAGE AND CAFE
A296
A2
WATLING STREET
ANCIENT WOODLAND
ANCIENT WOODLAND
EXISTING HARD SHOULDER CONVERTED TO RUNNING LANE WITH PROVISION OF FOUR NARROW LANES
EXISTING A296 LANE LAYOUT RETAINED. EASTBOUND TRAFFIC ONLY TO EAST OF MERRY CHEST CAFE
PROPOSED MS3 3AM ADS LONG SPAN CANTILEVER GANTRY CH.4970
SEE NOTE 3 AND GENERAL NOTE 2
EXISTING TYPE D DIVERGE (OPTION 2 NON PREFERRED) - LANE DROP AT PARALLEL DIVERGE LAYOUT RETAINED
EXISTING CENTRAL RESERVE WITH METALLIC BARRIER CONVERTED TO NARROW CENTRAL RESERVE WITH CONCRETE STEP BARRIER
EXISTING SANDY LANE SUBWAY (CX00) RETAINED
EXISTING MS3 FINAL ADS PORTAL GANTRY CH.5091
PROPOSED LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
HSHGN/01
FOR CONTINUATION REFER TO SHEET 4
FOR CONTINUATION REFER TO SHEET 16
DO NOT SCALE
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000290.
3. EXISTING PORTAL GANTRY AFFECTING A2 EASTBOUND NARROW LANES AND CSB ON THE CENTRAL RESERVE. DESIGN TO BE FINALISED AT DETAILED DESIGN STAGE.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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Construction
1.HS/HGN/01-WORKING ADJACENT TO OH HV LINES AND PYLONS.
2. HSHLC/01 & 03-PROPOSED COLUMN IN THE VICINITY OF THE OH LINE.
Maintenance / Cleaning
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Use
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
Decommissioning / Demolition
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000304.
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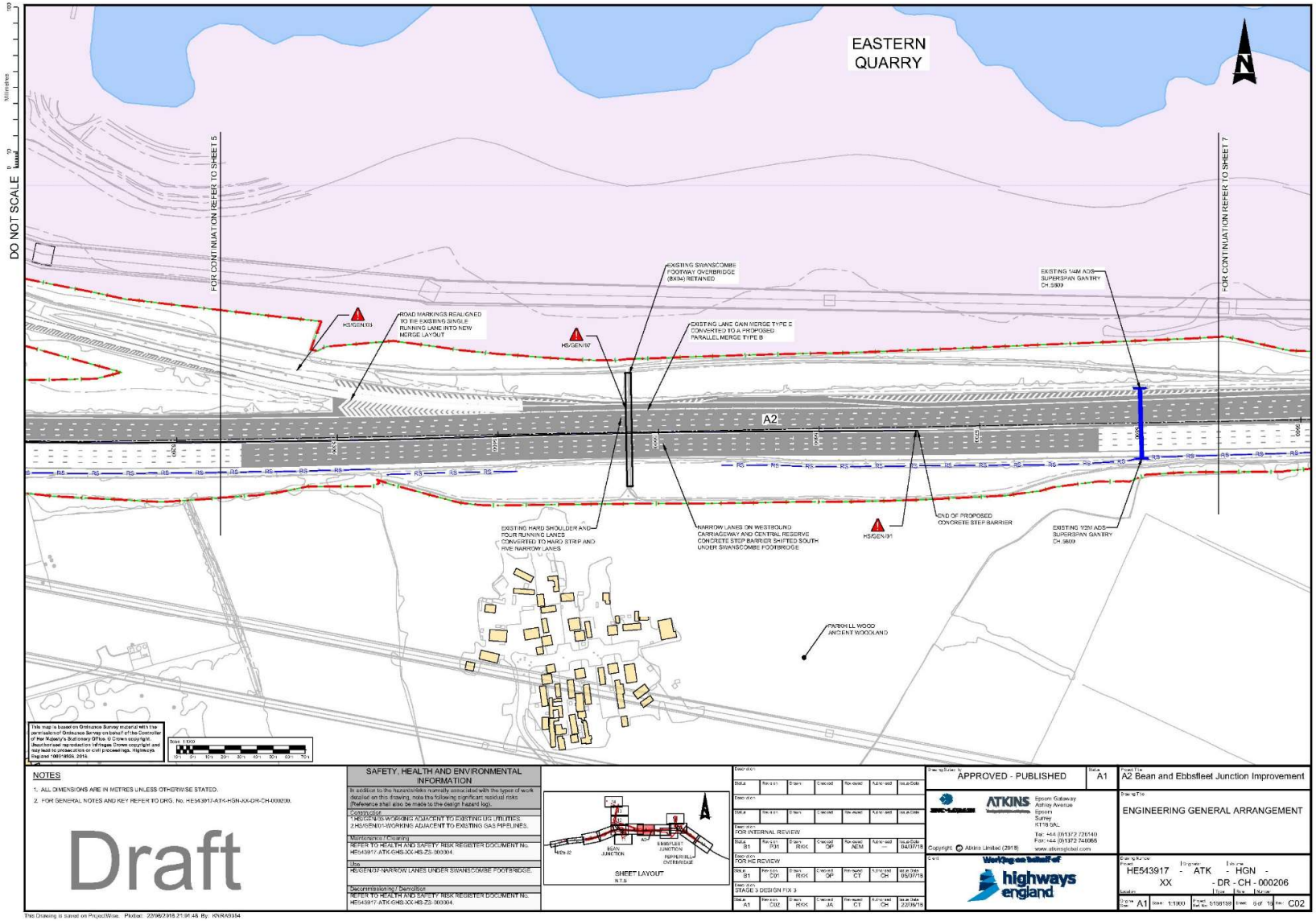
EASTERN QUARRY
N
DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 6
FOR CONTINUATION REFER TO SHEET 7
A2
EXISTING SWANSCOMBE FOOTWAY OVERBRIDGE (BA34) RETAINED
EXISTING 14M ADS SUPERSPAN GANTRY CH 5800
ROAD MARKINGS REALIGNED TO RE EXISTING SINGLE RUNNING LANE INTO NEW MERGE LAYOUT
HS/GEN/03
HS/GEN/07
EXISTING LANE GAIN MERGE TYPE E CONVERTED TO A PROPOSED PARALLEL MERGE TYPE B
EXISTING HARD SHOULDER AND FOUR RUNNING LANES CONVERTED TO HARD STRIP AND FIVE NARROW LANES
NARROW LANES ON WESTBOUND CARRIAGEWAY AND CENTRAL RESERVE CONCRETE STEP BARRIER SHIFTED SOUTH UNDER SWANSCOMBE FOOTBRIDGE
HS/GEN/01
END OF PROPOSED CONCRETE STEP BARRIER
EXISTING 12M ADS SUPERSPAN GANTRY CH 5800
PARKHILL WOOD ANCIENT WOODLAND
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Construction
HS/GEN/05-WORKING ADJACENT TO EXISTING UG UTILITIES
2 HS/GEN/01-WORKING ADJACENT TO EXISTING GAS PIPELINES.
Maintenance / Cleaning
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000004.
Use
HS/GEN/07-NARROW LANES UNDER SWANSCOMBE FOOTBRIDGE.
Decommissioning / Demolition
REFER TO HEALTH AND SAFETY RISK REGISTER DOCUMENT No. HE543917-ATK-GHS-XX-HS-ZS-000004.
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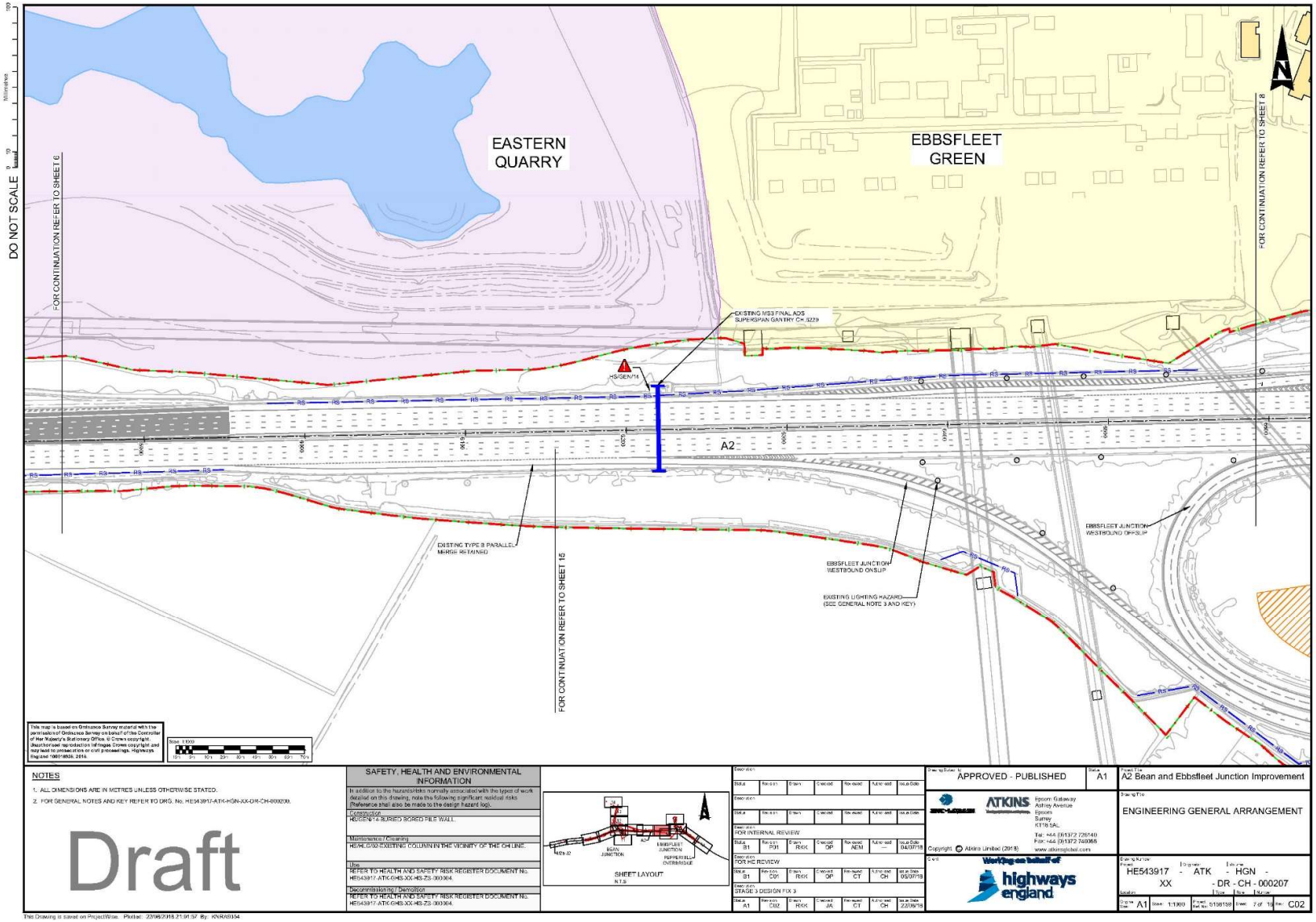
DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 6
EASTERN QUARRY
EBBSFLEET GREEN
FOR CONTINUATION REFER TO SHEET 8
EXISTING MS3 FINAL ADS SUPERSPAN GANTRY CH.6229
HS/GEN/14
A2
EXISTING TYPE B PARALLEL MERGE RETAINED
FOR CONTINUATION REFER TO SHEET 15
EBBSFLEET JUNCTION WESTBOUND ON SLIP
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
EBBSFLEET JUNCTION WESTBOUND OFFSLIP
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
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A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000207
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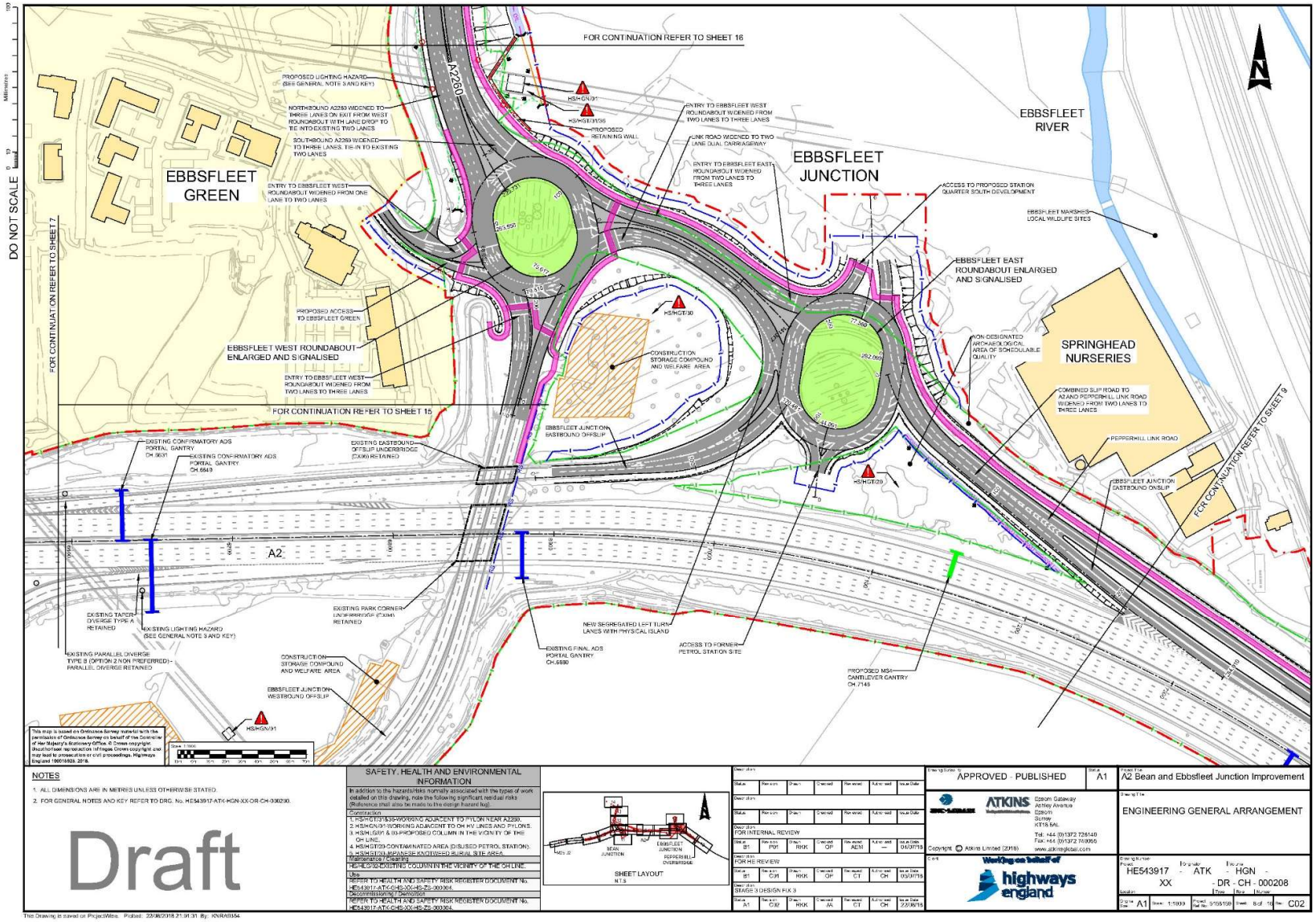
FOR CONTINUATION REFER TO SHEET 16
FOR CONTINUATION REFER TO SHEET 7
FOR CONTINUATION REFER TO SHEET 15
FOR CONTINUATION REFER TO SHEET 9
DO NOT SCALE
EBBSFLEET GREEN
EBBSFLEET JUNCTION
EBBSFLEET RIVER
SPRINGHEAD NURSERIES
A2260
A2
EBBSFLEET WEST ROUNDABOUT ENLARGED AND SIGNALISED
EBBSFLEET EAST ROUNDABOUT ENLARGED AND SIGNALISED
EBBSFLEET JUNCTION EASTBOUND OFFSLIP
EBBSFLEET JUNCTION EASTBOUND ONSLIP
EBBSFLEET JUNCTION WESTBOUND OFFSLIP
PEPPERHILL LINK ROAD
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
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A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
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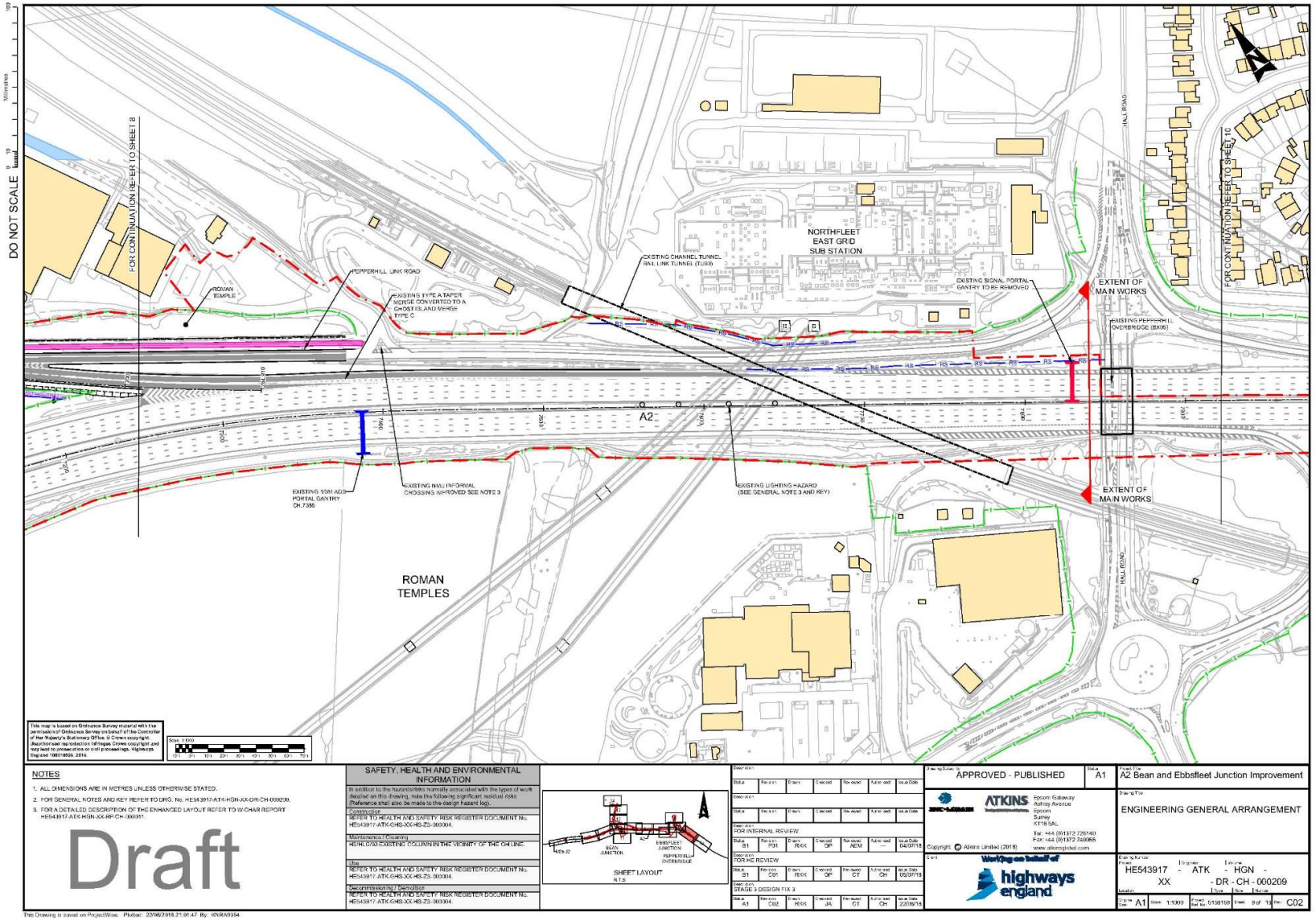
DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 8
FOR CONTINUATION REFER TO SHEET 10
ROMAN TEMPLE
PEPPERHILL LINK ROAD
EXISTING TYPE A TAPER MERGE CONVERTED TO A GHOST ISLAND MERGE TYPE C
NORTHFLEET EAST GRID SUB STATION
EXISTING CHANNEL TUNNEL RAIL LINK TUNNEL (TLBD)
EXISTING SIGNAL PORTAL GANTRY TO BE REMOVED
EXTENT OF MAIN WORKS
EXISTING PEPPERHILL OVERBRIDGE (BX06)
A2
EXISTING 1000 ADS PORTAL GANTRY CH.7395
EXISTING NMU INFORMAL CROSSING IMPROVED SEE NOTE 3
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
EXTENT OF MAIN WORKS
ROMAN TEMPLES
HALT ROAD
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000208.
3. FOR A DETAILED DESCRIPTION OF THE ENHANCED LAYOUT REFER TO W:CHAR REPORT HE543917-ATK-HGN-XX-RP-CH-000201.
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ATKINS
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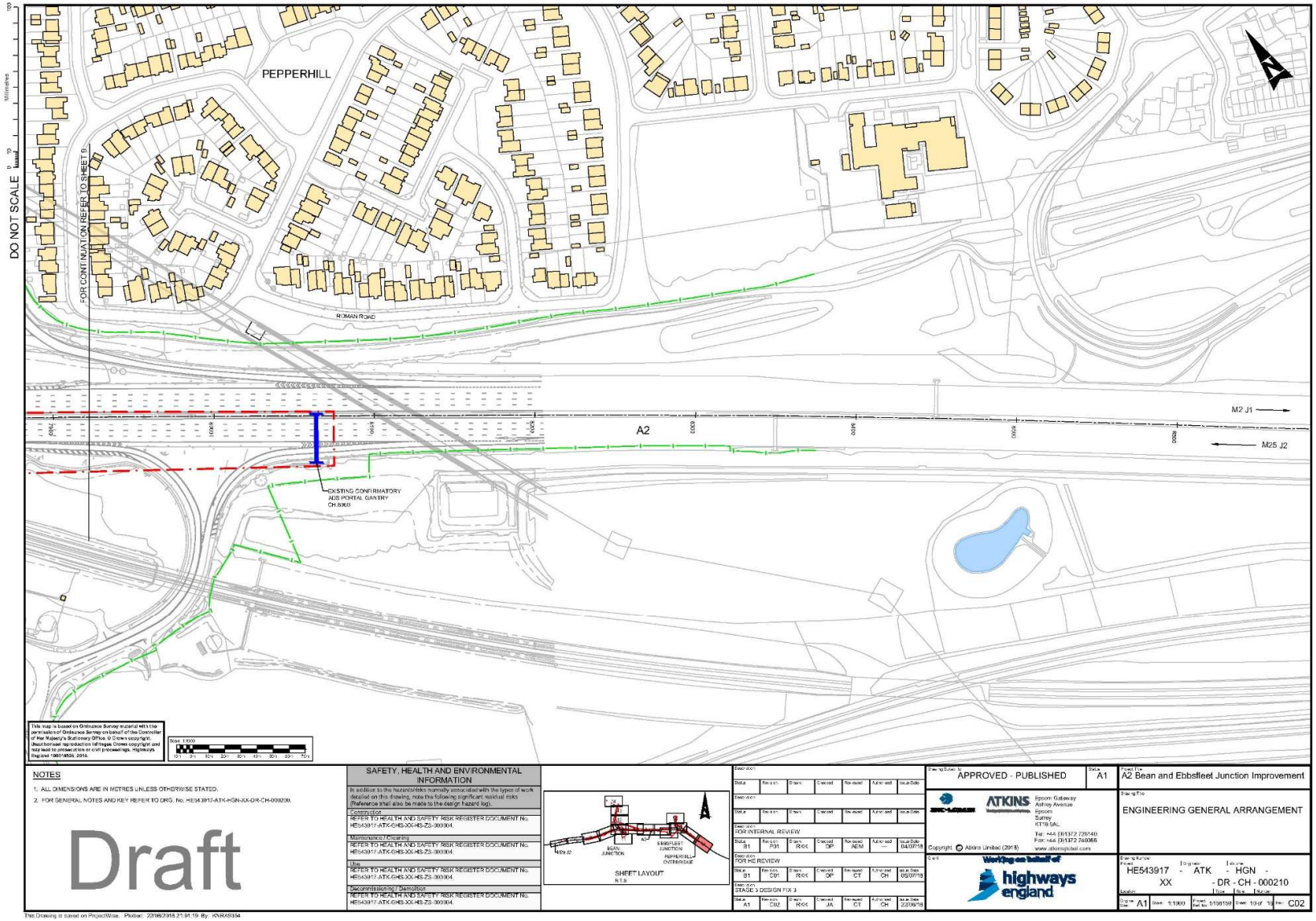
C02


PEPPERHILL
ROMAN Road
A2
M2 J1
M25 J2
EXISTING CONFIRMATORY ADS PORTAL GANTRY CH.8060
DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 9
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
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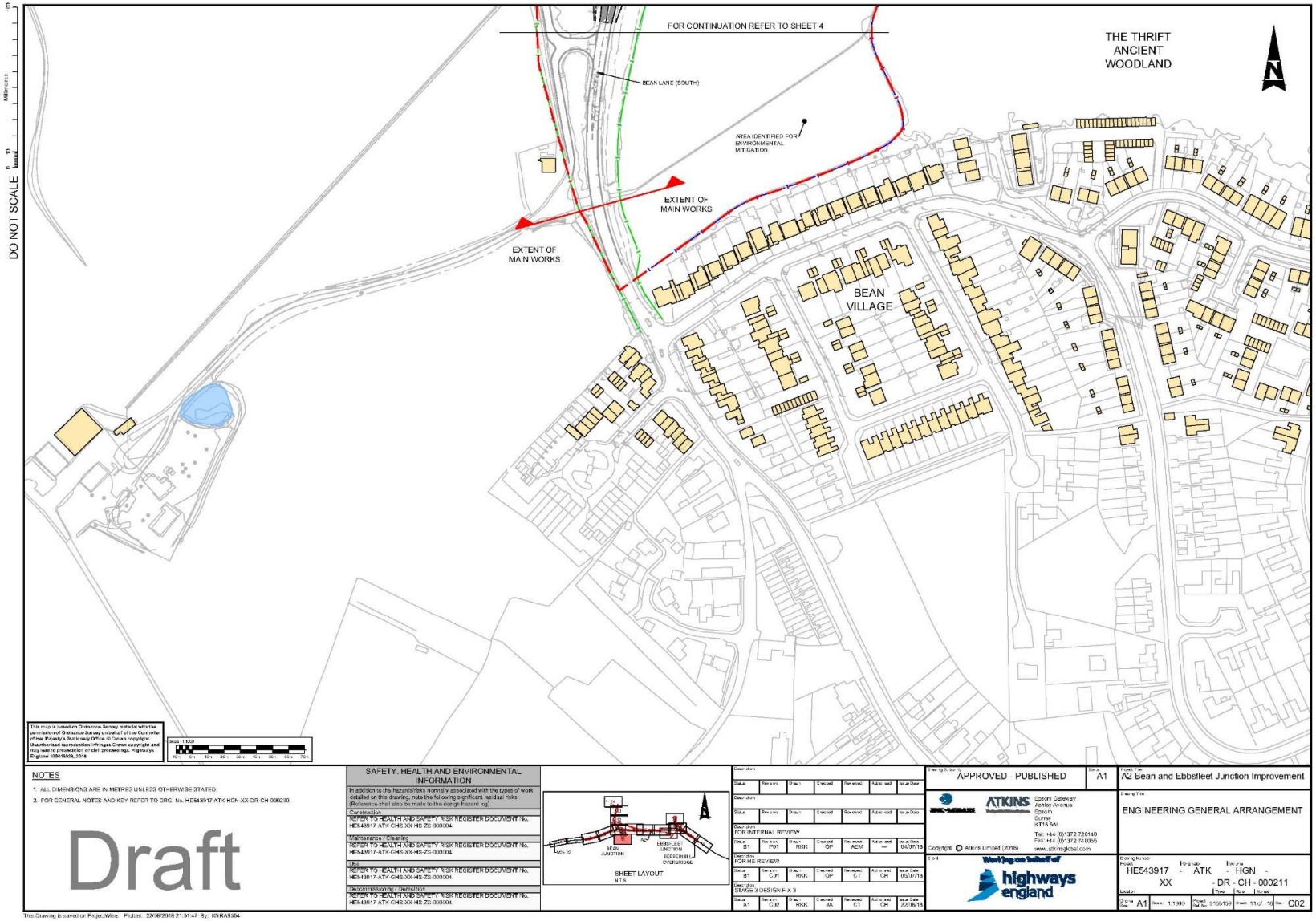
FOR CONTINUATION REFER TO SHEET 4
THE THRIFT
ANCIENT
WOODLAND
BEAN LANE (SOUTH)
AREA IDENTIFIED FOR
ENVIRONMENTAL
MITIGATION
EXTENT OF
MAIN WORKS
EXTENT OF
MAIN WORKS
BEAN
VILLAGE
DO NOT SCALE
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000290.
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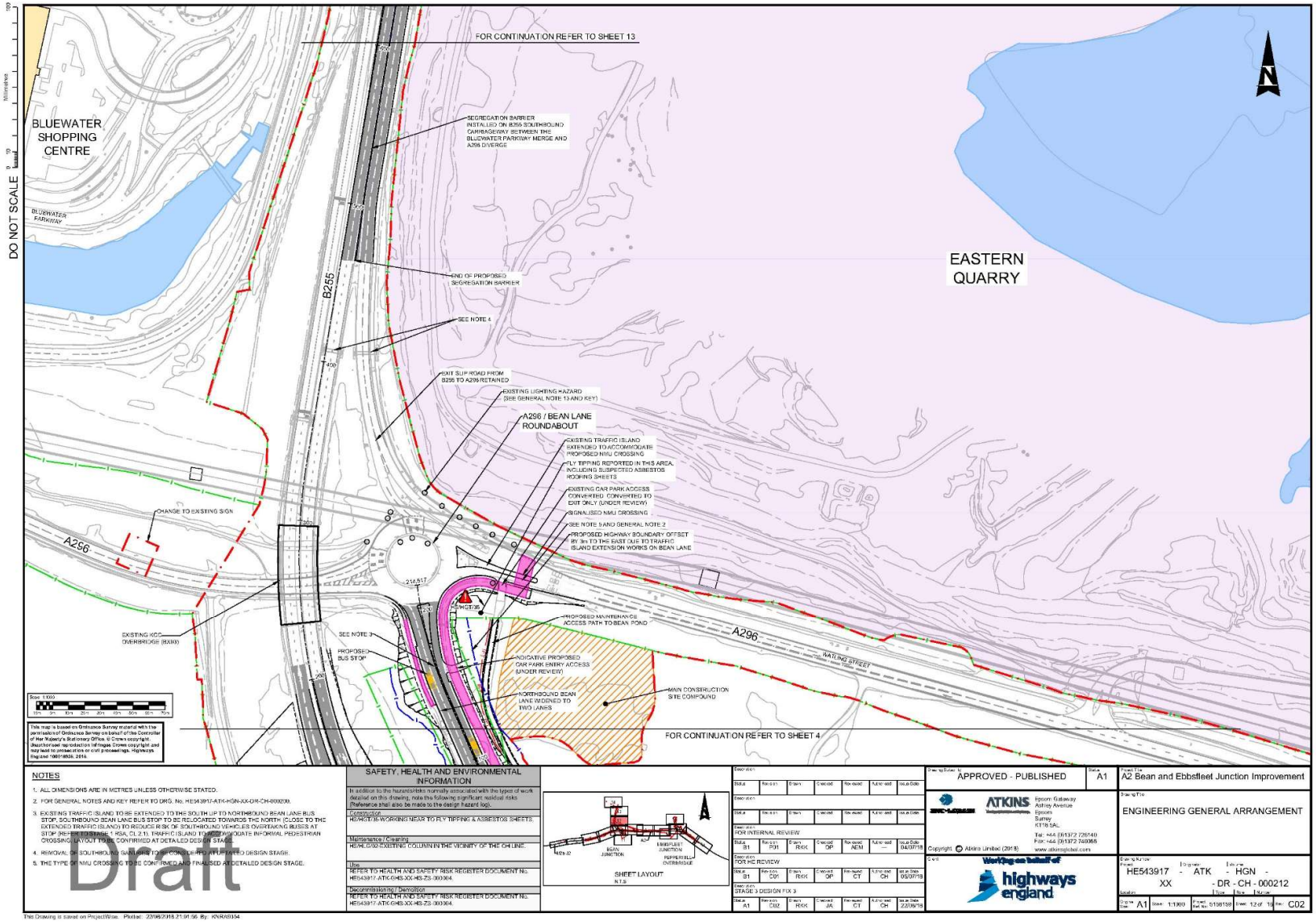
FOR CONTINUATION REFER TO SHEET 13
BLUEWATER SHOPPING CENTRE
BLUEWATER PARKWAY
DO NOT SCALE
SEGREGATION BARRIER INSTALLED ON B255 SOUTHBOUND CARRIAGEWAY BETWEEN THE BLUEWATER PARKWAY MERGE AND A296 DIVERGE
END OF PROPOSED SEGREGATION BARRIER
SEE NOTE 4
EXIT SLIP ROAD FROM B255 TO A296 RETAINED
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 13 AND KEY)
A296 / BEAN LANE ROUNDABOUT
EXISTING TRAFFIC ISLAND EXTENDED TO ACCOMMODATE PROPOSED NMU CROSSING
FLY TIPPING REPORTED IN THIS AREA, INCLUDING SUSPECTED ASBESTOS ROOFING SHEETS
EXISTING CAR PARK ACCESS CONVERTED CONVERTED TO EXIT ONLY (UNDER REVIEW)
SIGNALISED NMU CROSSING
SEE NOTE 5 AND GENERAL NOTE 2
PROPOSED HIGHWAY BOUNDARY OFFSET BY 3m TO THE EAST DUE TO TRAFFIC ISLAND EXTENSION WORKS ON BEAN LANE
CHANGE TO EXISTING SIGN
B255
A296
EASTERN QUARRY
EXISTING KCC OVERBRIDGE (BX03)
SEE NOTE 3
PROPOSED BUS STOP
PROPOSED MAINTENANCE ACCESS PATH TO BEAN POND
INDICATIVE PROPOSED CAR PARK ENTRY ACCESS (UNDER REVIEW)
NORTHBOUND BEAN LANE WIDENED TO TWO LANES
MAIN CONSTRUCTION SITE COMPOUND
WATLING STREET
FOR CONTINUATION REFER TO SHEET 4
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000230.
3. EXISTING TRAFFIC ISLAND TO BE EXTENDED TO THE SOUTH UP TO NORTHBOUND BEAN LANE BUS STOP, SOUTHBOUND BEAN LANE BUS STOP TO BE RELOCATED TOWARDS THE NORTH (CLOSE TO THE EXTENDED TRAFFIC ISLAND) TO REDUCE RISK OF SOUTHBOUND VEHICLES OVERTAKING BUSES AT STOP (REFER TO STAGE 1 RSA, CL 2.1). TRAFFIC ISLAND TO ACCOMMODATE INFORMAL PEDESTRIAN CROSSING. LAYOUT TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. REMOVAL OF SOUTHBOUND GANTRIES TO BE CONSIDERED AT DETAILED DESIGN STAGE.
5. THE TYPE OF NMU CROSSING TO BE CONFIRMED AND FINALISED AT DETAILED DESIGN STAGE.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
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ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000212
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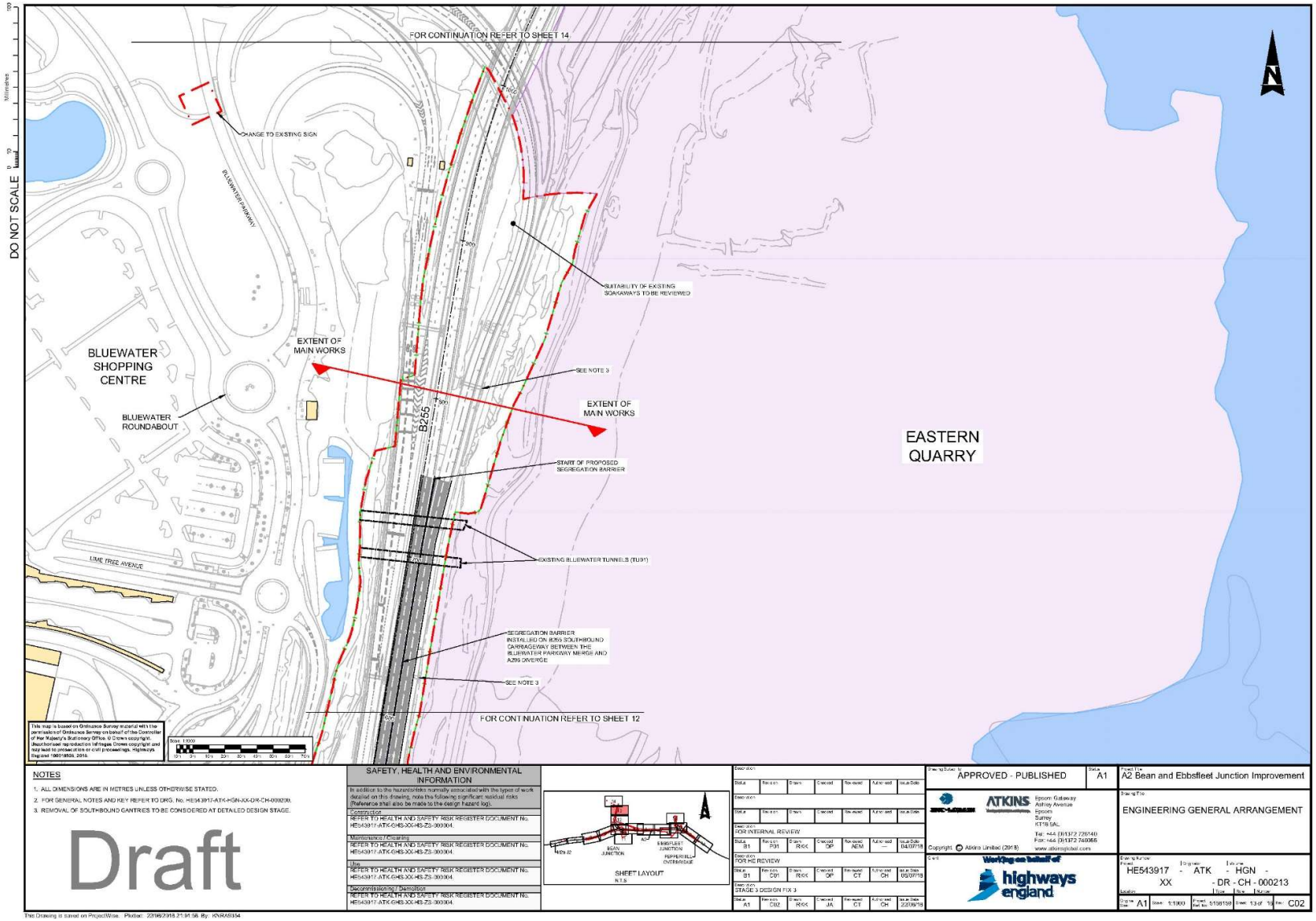
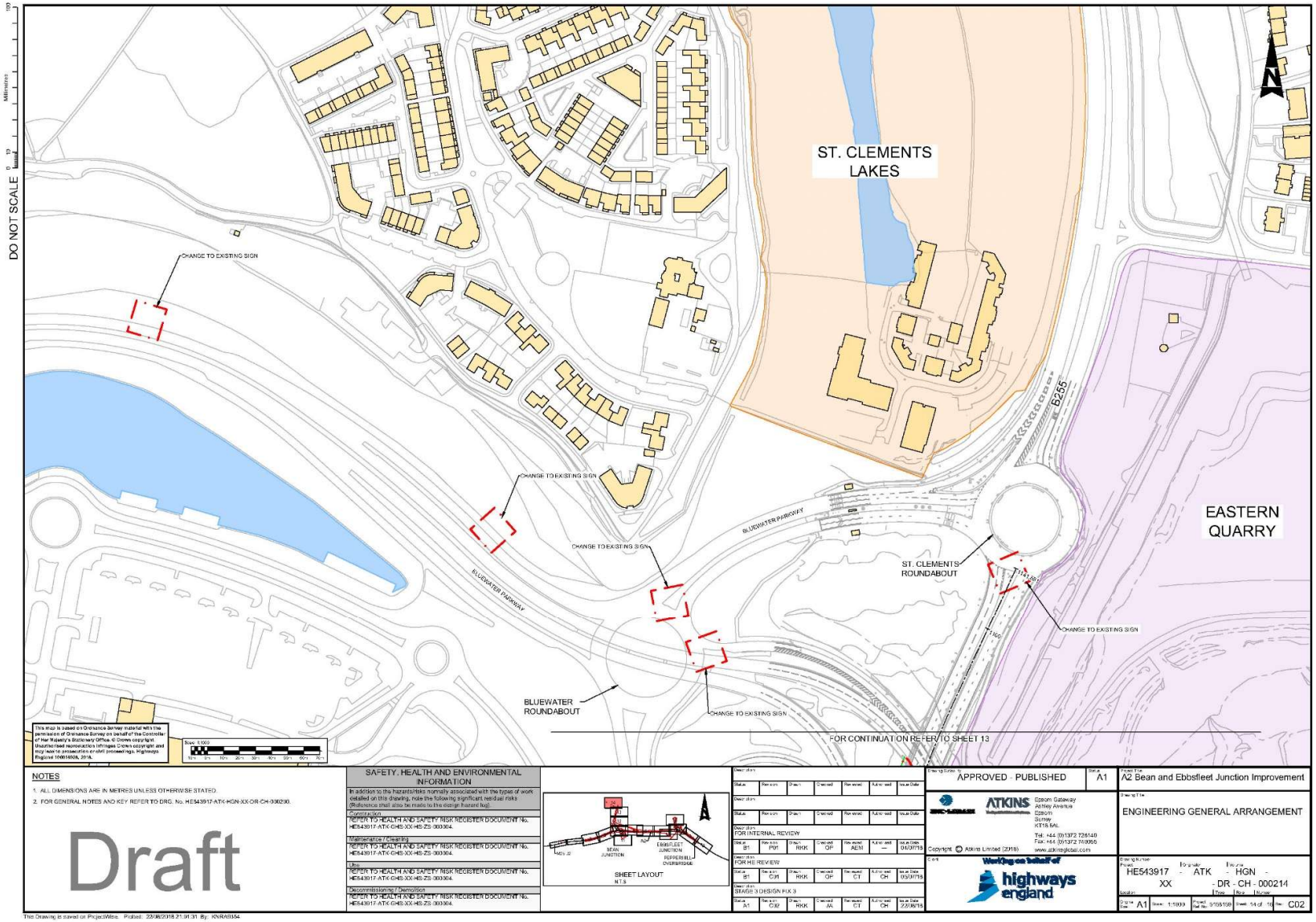

FOR CONTINUATION REFER TO SHEET 14
CHANGE TO EXISTING SIGN
BLUEWATER PARKWAY
SUITABILITY OF EXISTING SOAKAWAYS TO BE REVIEWED
BLUEWATER SHOPPING CENTRE
EXTENT OF MAIN WORKS
SEE NOTE 3
BLUEWATER ROUNDABOUT
B255
EXTENT OF MAIN WORKS
EASTERN QUARRY
START OF PROPOSED SEGREGATION BARRIER
LIME TREE AVENUE
EXISTING BLUEWATER TUNNELS (TUN1)
SEGREGATION BARRIER INSTALLED ON A255 SOUTHBOUND CARRIAGEWAY BETWEEN THE BLUEWATER PARKWAY MERGE AND A289 DIVERGE
SEE NOTE 3
FOR CONTINUATION REFER TO SHEET 12
DO NOT SCALE
N
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000200.
3. REMOVAL OF SOUTHBOUND CANTRIES TO BE CONSIDERED AT DETAILED DESIGN STAGE.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
APPROVED - PUBLISHED
A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
ATKINS
highways england
HE543917 - ATK - HGN - XX - DR - CH - 000213
C02


DO NOT SCALE
ST. CLEMENTS LAKES
EASTERN QUARRY
CHANGE TO EXISTING SIGN
CHANGE TO EXISTING SIGN
CHANGE TO EXISTING SIGN
CHANGE TO EXISTING SIGN
BLUEWATER PARKWAY
BLUEWATER PARKWAY
ST. CLEMENTS ROUNDABOUT
BLUEWATER ROUNDABOUT
B255
FOR CONTINUATION REFER TO SHEET 13
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No HE543917-ATK-HGN-XX-DR-CH-000290.
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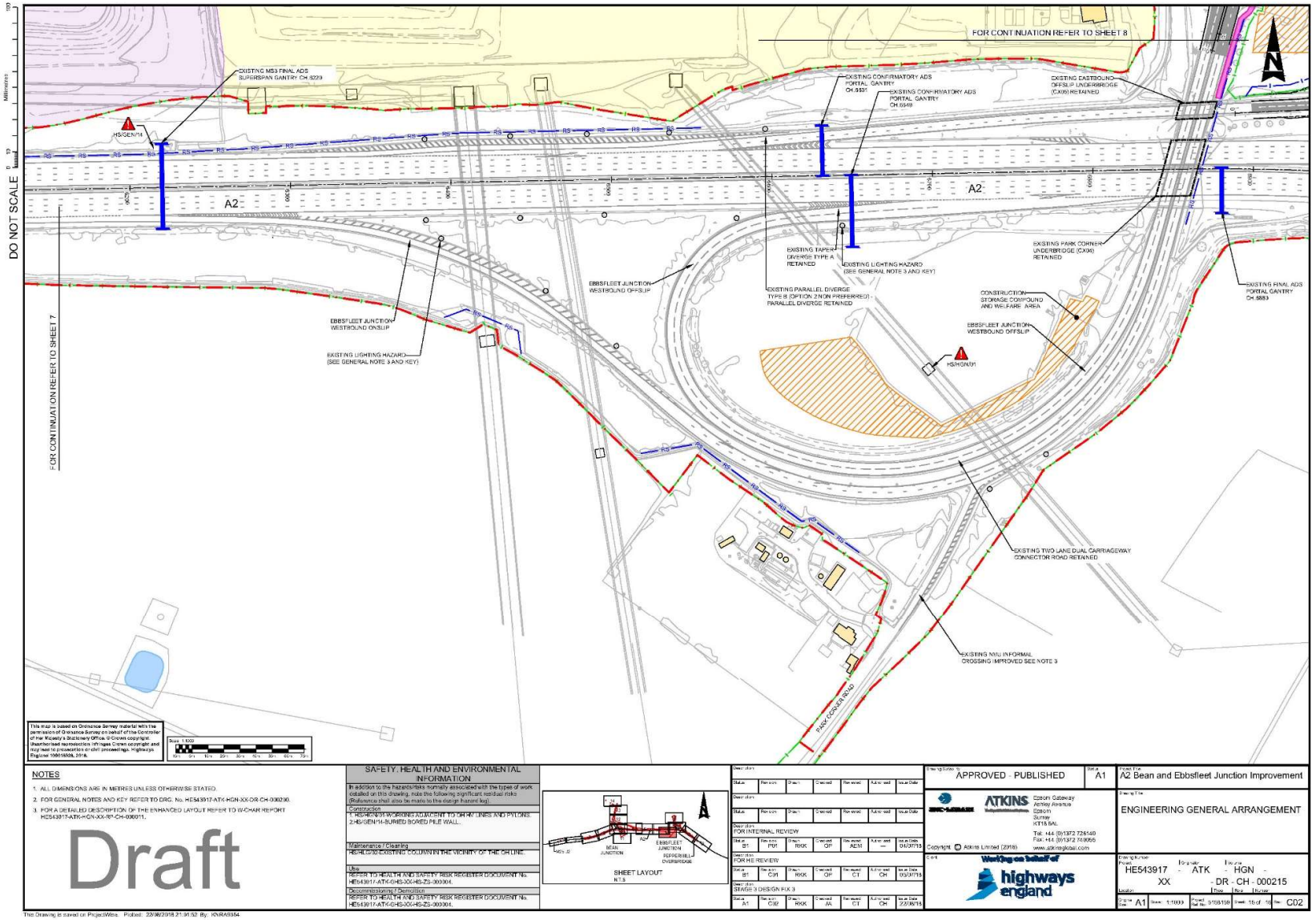
FOR CONTINUATION REFER TO SHEET 8
FOR CONTINUATION REFER TO SHEET 7
DO NOT SCALE
EXISTING MS3 FINAL ADS SUPERSPAN GANTRY CH 9229
EXISTING CONFIRMATORY ADS PORTAL GANTRY CH 9331
EXISTING CONFIRMATORY ADS PORTAL GANTRY CH 9349
EXISTING EASTBOUND OFFSLIP UNDERBRIDGE (CX05) RETAINED
EXISTING TAPER DIVERGE TYPE A RETAINED
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
EXISTING PARK CORNER UNDERBRIDGE (CX04) RETAINED
EXISTING FINAL ADS PORTAL GANTRY CH 9883
EBBSFLEET JUNCTION WESTBOUND OFFSLIP
EXISTING PARALLEL DIVERGE TYPE B (OPTION 2/NON PREFERRED) - PARALLEL DIVERGE RETAINED
CONSTRUCTION STORAGE COMPOUND AND WELFARE AREA
EBBSFLEET JUNCTION WESTBOUND ONSLIP
EXISTING LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
EXISTING TWO LANE DUAL CARRIAGEWAY CONNECTOR ROAD RETAINED
EXISTING NMU INFORMAL CROSSING IMPROVED SEE NOTE 3
PARK CORNER ROAD
A2
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000230.
3. FOR A DETAILED DESCRIPTION OF THE ENHANCED LAYOUT REFER TO W-CHAR REPORT HE543917-ATK-HGN-XX-RP-CH-000011.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
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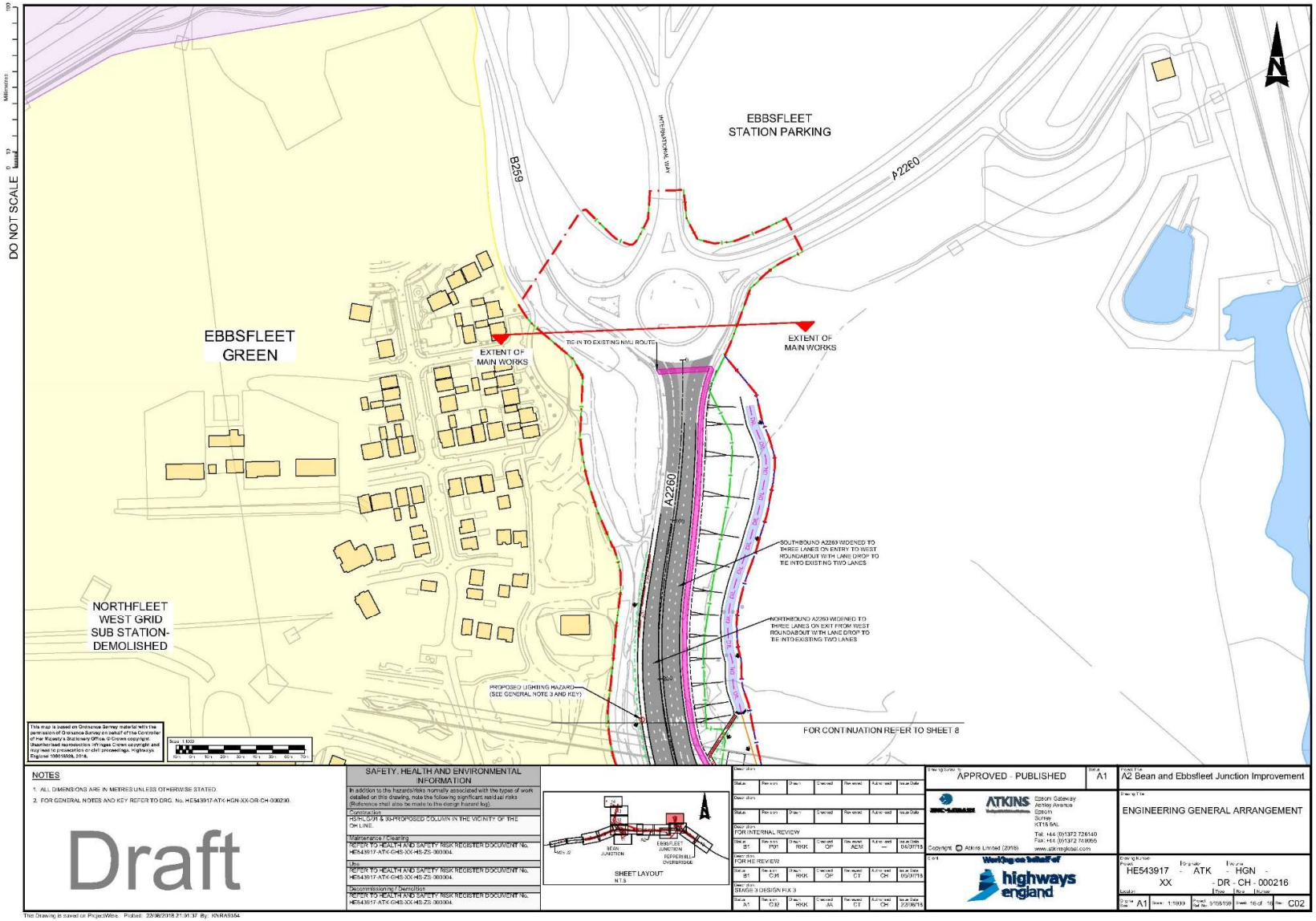
A2 Bean and Ebbsfleet Junction Improvement
ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000215
C02


DO NOT SCALE
EBBSFLEET STATION PARKING
B259
A2260
EBBSFLEET GREEN
EXTENT OF MAIN WORKS
TIE-IN TO EXISTING NMU ROUTE
EXTENT OF MAIN WORKS
NORTHFLEET WEST GRID SUB STATION- DEMOLISHED
SOUTHBOUND A2260 WIDENED TO THREE LANES ON ENTRY TO WEST ROUNDABOUT WITH LANE DROP TO TIE INTO EXISTING TWO LANES
NORTHBOUND A2260 WIDENED TO THREE LANES ON EXIT FROM WEST ROUNDABOUT WITH LANE DROP TO TIE INTO EXISTING TWO LANES
PROPOSED LIGHTING HAZARD (SEE GENERAL NOTE 3 AND KEY)
FOR CONTINUATION REFER TO SHEET 8
NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEY REFER TO DRG. No. HE543917-ATK-HGN-XX-DR-CH-000290.
Draft
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
SHEET LAYOUT
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ENGINEERING GENERAL ARRANGEMENT
HE543917 - ATK - HGN - XX - DR - CH - 000216
C02

Appendix B. Scheme Cost Estimates

PROJECT NAME:	**A2 Bean and Ebbsfleet Junction Improvement**
PROJECT STAGE:	**3. Development - Preliminary Design**
PROJECT SCOPE:	
0	

IF YOU HAVE ANY QUESTIONS REGARDING THE INFORMATION PROVIDED PLEASE CONTACT CommercialServicesDivision@highwaysengland.co.uk

REBASED 2010 CALENDAR YEAR PROFILES FOR ECONOMIC CALCULATIONS - ALL COSTS ARE IN THE FACTOR COST UNIT OF ACCOUNT

The expenditure profiles are based upon cost estimates for each financial year prepared in Q1 2016 prices and then inflated to outturn costs using HE projected construction related inflation. These costs have then been rebased to 2010 calendar year profiles for economic calculations, using the GDP-deflator series as published in the WebTAG Databook.
The costs exclude all recoverable VAT. All historic costs have been removed - previous years and an approximate of this years spend that occurs in the past.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total (Excl Hist)
PREPARATION EXPENDITURE PROFILE	£0	£0	£0	£0	£1,990,090	£5,236,122	£1,804,476	£0	£0	£9,030,687
SUPERVISION EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£766,379	£1,493,766	£42,303	£2,302,449
WORKS EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£23,815,142	£47,555,633	£2,048,009	£73,418,784
LANDS EXPENDITURE PROFILE	£0	£0	£0	£0	£3,300,411	£0	£3,672,766	£0	£0	£6,973,176
TOTAL EXPENDITURE FORECAST	**£0**	**£0**	**£0**	**£0**	£5,290,500	£5,236,122	£30,058,764	£49,049,399	£2,090,312	£91,725,097

PREPARATION EXPENDITURE PROFILE	0%	0%	0%	0%	22%	58%	20%	0%	0%	100%
SUPERVISION EXPENDITURE PROFILE	0%	0%	0%	0%	0%	0%	33%	65%	2%	100%
WORKS EXPENDITURE PROFILE	0%	0%	0%	0%	0%	0%	32%	65%	3%	100%
LANDS EXPENDITURE PROFILE	0%	0%	0%	0%	47%	0%	53%	0%	0%	100%
TOTAL EXPENDITURE FORECAST (ALL COSTS INCLUDED)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**5.8%**	**5.7%**	**32.8%**	**53.5%**	**2.3%**	**100.0%**

Appendix C. Selected Checks on TUBA Warnings

Ratio of DM to DS travel time lower than limit for the following:

Origin	Destination	Time slice	Veh type	Purpose	Year	DM_TIME	DS_TIME
7091	7042	2	OGV1	Business	2038	0.105	0.164

Ratio of DM to DS travel time higher than limit for the following:

Origin	Destination	Time slice	Veh type	Purpose	Year	DM_TIME	DS_TIME
7071	7099	2	Car	Other	2038	0.108	0.058
7096	7100	2	Car	Commuting	2038	0.131	0.081

Ratio of DM to DS travel distance lower than limit for the following:

Origin	Destination	Time slice	Veh type	Purpose	Year	DM_dist	DS_dist
7097	7040	2	Car	Other	2023	7.178	12.805
7099	7042	3	Car	Commuting	2026	4.057	6.536

Ratio of DM to DS travel distance higher than limit for the following

Origin	Destination	Time slice	Veh type	Purpose	Year	DM_dist	DS_dist
7044	7099	2	Car	Commuting	2031	11.656	7.231
8114	7092	2	Car	Commuting	2038	4.217	2.739

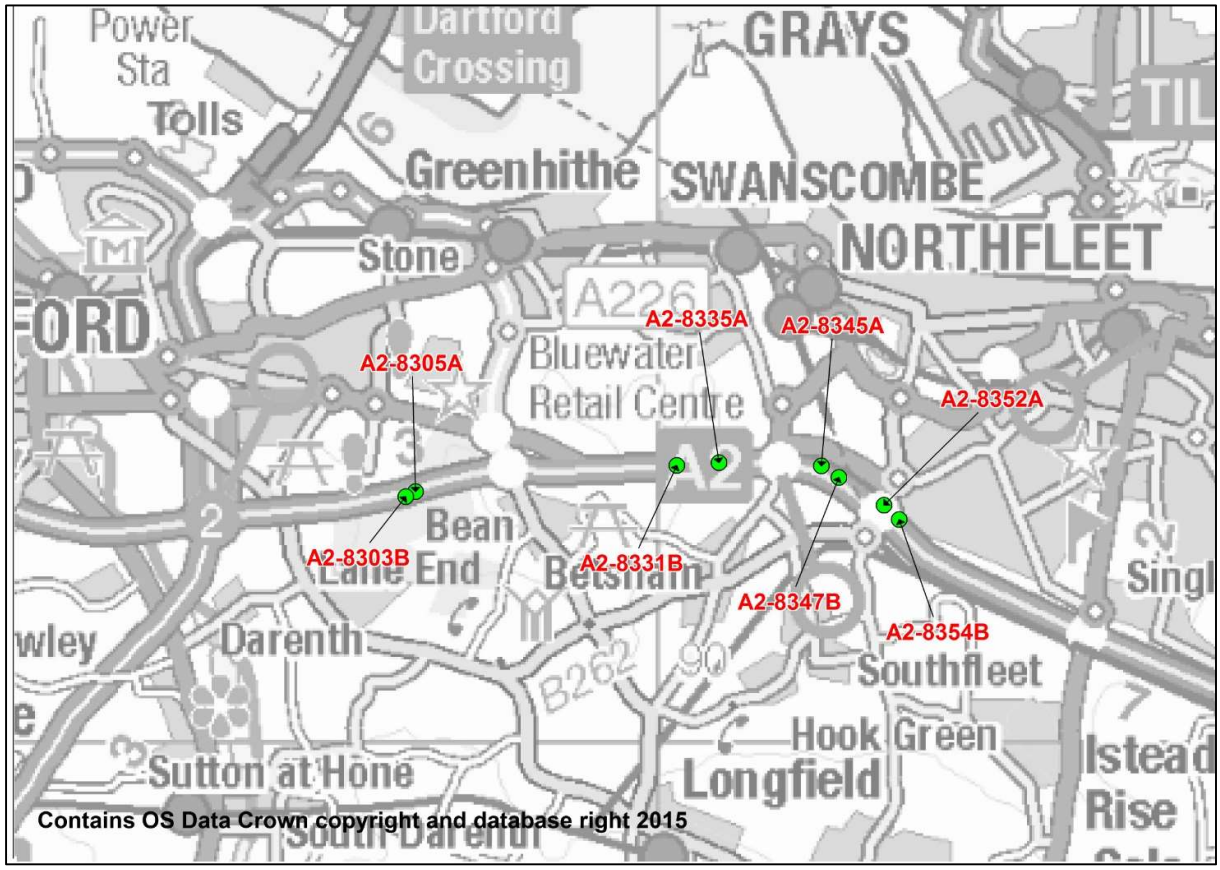
The low ratio of DM to DS travel time is due to higher delays in the DS than DM at node 27023 (priority roundabout) due to higher flows in the DS compared to the DM.

The high ratio of DM to DS travel time is due to the majority of trips passing through the scheme area in the DS and hence experiencing less delays compared to the DM.

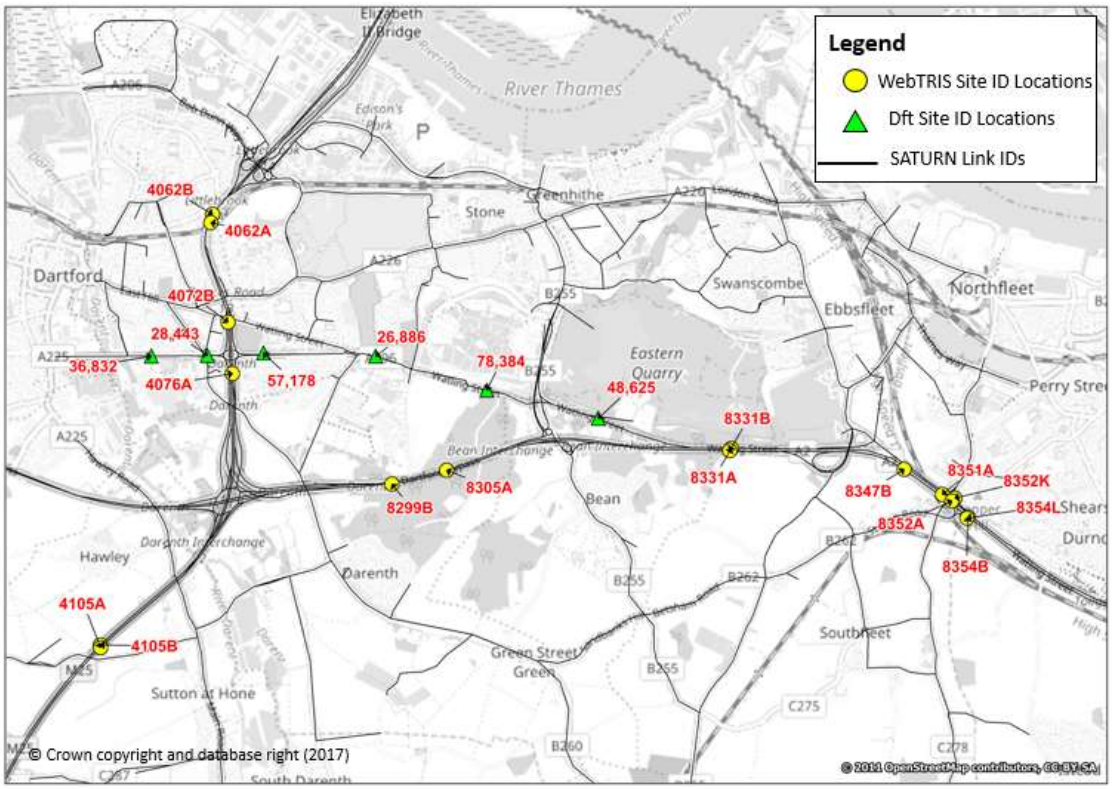
The low ratio of DM to DS travel distance is due to DS trips taking a longer route via the scheme area compared to the DM.

The high ratio of DM to DS travel distance is due to DM trips taking a longer route via the scheme area compared to the DS.

Appendix D. WebTRIS Site Locations for Annualisation Factor Estimation



Appendix E. WebTRIS and DfT Site Locations for COBA-LT Analysis



Appendix F. TUBA Results for Sensitivity Tests

F.1 Low Growth Scenario

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	coach	bus	OTHER
User benefits	TOTAL		Private Cars	Passengers	Passengers	
Travel time	£25,423		£25,423			
Vehicle operating costs	£733		£733			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: COMMUTING	£26,156	(1a)	£26,156	£0	£0	£0
Non-business: Other						
User benefits						
Travel time	£28,847		£28,847			
Vehicle operating costs	£746		£746			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£29,593	(1b)	£29,593	£0	£0	£0
Business						
			Goods Vehicles		Coach	
User benefits			(OGVs&LGVs)	Business Cars	Passengers	Bus Passengers
Travel time	£20,004		£15,184	£4,820		
Vehicle operating costs	£2,160		£1,666	£494		
User charges	£0					
During Construction & Maintenance	£0					
Subtotal	£22,164	(2)	£16,850	£5,314	£0	£0	£0
Private sector provider impacts						Passengers
Revenue	£0					
Operating costs	£0					
Investment costs						
Grant/subsidy						
Subtotal	£0	(3)			0	£0	£0
Other business impacts						
Developer contributions		(4)				
NET BUSINESS IMPACT	£22,164	(5) = (2) + (3) + (4)				
TOTAL						
Present Value of Transport Economic Efficiency Benefits (TEE)	**£77,913**	(6) = (1a) + (1b) + (5)				

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

F.2 High Growth Scenario

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	**ALL MODES**		**ROAD**	**coach**	**bus**	**OTHER**
User benefits	**TOTAL**		**Private Cars**	**Passengers**	**Passengers**	
Travel time	£42,973		£42,973			
Vehicle operating costs	£2,052		£2,052			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: COMMUTING	£45,026	*(1a)*	£45,026	£0	£0	£0
Non-business: Other						
User benefits						
Travel time	£89,679		£89,679			
Vehicle operating costs	£4,162		£4,162			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£93,841	*(1b)*	£93,841	£0	£0	£0
Business						
			Goods Vehicles (OGVs&LGVs)		**Coach Passengers**	**Bus Passengers**	
User benefits				**Business Cars**			
Travel time	£48,199		£39,083	£9,117			
Vehicle operating costs	£6,878		£5,773	£1,105			
User charges	£0						
During Construction & Maintenance	£0						
Subtotal	£55,077	*(2)*	£44,855	£10,222	£0	£0	£0
Private sector provider impacts						**Passengers**	
Revenue	£0						
Operating costs	£0						
Investment costs							
Grant/subsidy							
Subtotal	£0	*(3)*			0	£0	£0
Other business impacts							
Developer contributions		*(4)*					
NET BUSINESS IMPACT	£55,077	*(5) = (2) + (3) + (4)*					
TOTAL							
Present Value of Transport Economic Efficiency Benefits (TEE)	**£193,944**	*(6) = (1a) + (1b) + (5)*					

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

F.3 Sensitivity Test for Core Scenario using TUBA v1.9.11

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	coach	bus	OTHER
User benefits	TOTAL		Private Cars	Passengers	Passengers	
Travel time	£50,471		£50,471			
Vehicle operating costs	£1,516		£1,516			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: COMMUTING	£51,987	*(1a)*	£51,987	£0	£0	£0
Non-business: Other						
User benefits						
Travel time	£65,591		£65,591			
Vehicle operating costs	£2,452		£2,452			
User charges	£0					
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£68,043	*(1b)*	£68,043	£0	£0	£0
Business						
			Goods Vehicles		Coach	
User benefits			(OGVs&LGVs)	Business Cars	Passengers	Bus Passengers
Travel time	£40,711		£30,969	£9,742		
Vehicle operating costs	£5,473		£4,338	£1,135		
User charges	£0					
During Construction & Maintenance	£0					
Subtotal	£46,184	*(2)*	£35,306	£10,877	£0	£0
Private sector provider impacts						Passengers
Revenue	£0					
Operating costs	£0					
Investment costs						
Grant/subsidy						
Subtotal	£0	*(3)*			0	£0
Other business impacts						
Developer contributions		*(4)*				
NET BUSINESS IMPACT	£46,184	*(5) = (2) + (3) + (4)*				
TOTAL						
Present Value of Transport Economic Efficiency Benefits (TEE)	**£166,214**	*(6) = (1a) + (1b) + (5)*				

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

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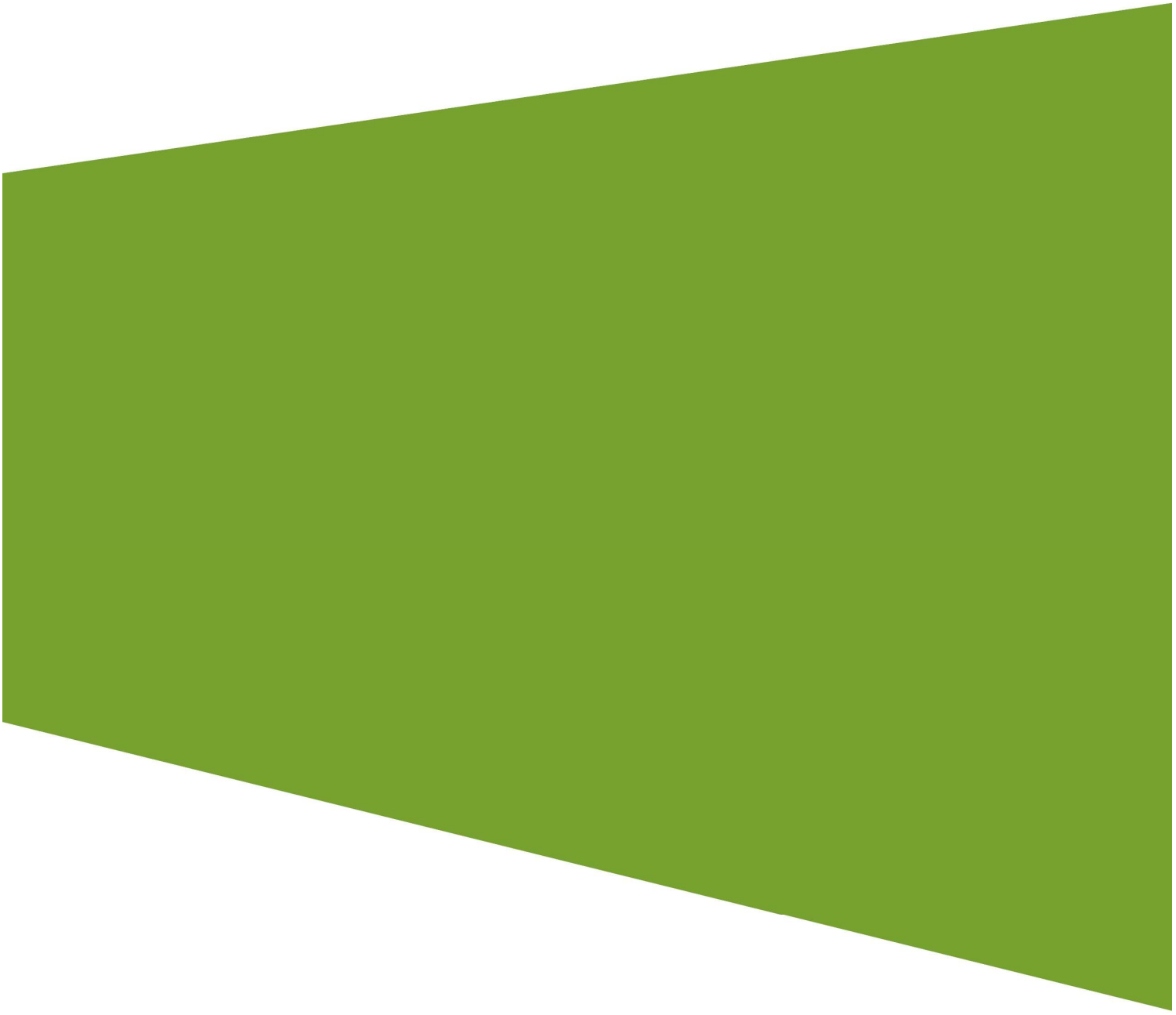
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