Norfolk County Council

NORWICH WESTERN LINK

Environmental Impact Report

70041922-WSP-EIR
JUNE 2021

PUBLIC

Norfolk County Council

NORWICH WESTERN LINK

Environmental Impact Report

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70041922

OUR REF. NO. 70041922-WSP-EIR

DATE: JUNE 2021

WSP

62-64 Hills Road
Cambridge
CB2 1LA

Phone: +44 1223 558 050

Fax: +44 1223 558 051

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft	Updated following client comments	Final	
Date	March 2021	May 2021	June 2021	
Prepared by	H Smith/			
Signature				
Checked by	S Johnson/ H Bilston/ M Ashcroft	C Middleton	C Middleton	
Signature				
Authorised by	S Goane	S Goane / L Wooller	S Goane / L Wooller	
Signature				
Project number				
Report number				
File reference				

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 INTRODUCTION

This Environmental Impact Appraisal report has been developed as part of the Outline Business Case for the Norwich Western Link scheme (NWL) and has been prepared on behalf of Norfolk County Council (NCC) for consideration by the Department for Transport (DfT).

1.2 PURPOSE OF THIS APPRAISAL

1.2.1. This TAG Environmental Appraisal has been prepared in support of the Outline Business Case (OBC) for the Norwich Western Link.

1.2.2. The methods used in the undertaking of the environmental appraisal followed the principles set out in the Department for Transport (DfT) guidance Transport Analysis Guidance (TAG) Unit A3 Environmental Impact Appraisal (May 2019). This provides guidance for appropriately qualified environmental practitioners on appraising the impact of transport proposals on the built and natural environment, and on people. This appraisal is not intended to be an alternative to, or a replacement for, a statutory Environmental Impact Assessment (EIA) (if required).

1.2.3. The reporting of the environmental appraisal is provided in the form of a Worksheet for each of the topics and an Appraisal Summary Table (AST), provided as part of the Economic Case of the OBC.

1.2.4. The environmental topics covered in this environmental appraisal are:

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

1.2.5. This report presents the findings set out in the AST, supported by TAG Worksheets, for the environmental topics listed above. It also includes a short account of the impacts associated with each of the environmental topics.

1.3 SCHEME LOCATION

1.3.1. The NWL is located to the east of Norwich and seeks to provide a link between the A47 in the south and the A1067 in the north. The Norwich Western Link will comprise a new dual carriageway all-purpose road to the west of Norwich, from the A47 to the A1067/A1270, including a new viaduct bridge over the River Wensum and its floodplain. The scheme will provide a direct connection between the Strategic Road Network and the A1270 Broadland Northway through the west of Norwich. This will complete an orbital route around Norwich, which forms part of the Major Road Network. The location is shown in Figure 1-1.

1.3.2. The scheme is comprised of:

- A dual carriageway road, including a viaduct over the River Wensum and associated floodplain
- An "at grade" junction with the A1067;

- Dualling of a section of the existing A1067 between the proposed NWL roundabout and existing A1270 roundabout;
- A bridge carrying the NWL over Ringland Lane;
- New pedestrian crossing points, green bridges and bat underpasses where deemed to be required;
- Diversion and extension of existing Public Rights of Way and field paths to create a coherent joined up network; and
- Surface water drainage - principally infiltration basins, sediment forebays and associated carrier drains/ channels.

1.3.3. The scheme also includes landscaping, planting, ancillary works, environmental mitigation work and Biodiversity Net Gain measures and a wider network of cycle-friendly route options where traffic relief from the NWL enables improved cycle priority.

Figure 1-1 - Scheme Location

2 NOISE

2.1 INTRODUCTION

2.1.1. This section presents the noise appraisal for the NWL Scheme, undertaken to help inform the OBC. The appraisal methodology and baseline conditions are described, followed by a summary of the findings of the noise appraisal, including the outcome of the TAG Unit A3 noise analysis.

2.1.2. Table 2-1 includes a definition of basic acoustic terms used in this chapter.

Table 2-1 - Glossary of Basic Acoustic Terms

Term	Definition
A-weighting, dB(A)	The human ear has a non-linear frequency response, being less sensitive at low and high frequencies and most sensitive in the mid-range frequencies. The A-weighting scale is applied to measured sound pressure levels so that these levels correspond more closely to the subjective response.
Decibel (dB)	The unit of measurement used for sound pressure levels. The decibel scale is logarithmic rather than linear. The threshold of hearing is 0 decibels while the threshold of pain is about 130 decibels.
Facade	Sound level that is determined 1 metre (m) in front of a window or door in a facade.
Free-field	The sound level that is measured or calculated, in the open, without any reflections from nearby surfaces except the ground.

2.2 BASELINE CONDITIONS

2.2.1. Initial consultation with Broadlands DC has been undertaken with regard to the noise and vibration assessment as part of the Environmental Impact Assessment (EIA) process. Further consultation will be undertaken as the EIA process continues and will be reported within the Environmental Statement.

2.2.2. At the northern end of the NWL, the noise climate is dominated by road traffic noise from Fakenham Road (A1067). Moving south, there is some contribution to the noise climate from road traffic on the nearby local roads. At the southern end of the NWL, the noise climate is dominated by road traffic noise from the A47. The disused RAF Attlebridge airfield is located approximately 3km west of the proposed route and is thought not to significantly affect the noise climate.

2.2.3. The A47 is managed by Highways England and is proposed to be dualled and slightly re-routed at the southern end of the NWL (not within the scope of the NWL). As the A47 dualling works are assumed to be complete prior to the opening of the NWL, the assessment of the NWL presented in

this report has assumed the A47 is dualled in both the 'with' and 'without' NWL traffic scenarios [1]. Consequently, the noise impacts from the A47 dualling and re-routing will not be considered in this OBC assessment. Based on information available at this stage it has been assumed that the A47 will be surfaced with a low noise road surface and this has been incorporated into the acoustic model.

2.2.4. Generally, except for receptors at the northern and southern ends of the NWL close to the A1067 or the A47, the NWL covers a fairly rural area, with existing ambient noise levels being relatively low.

2.2.5. To account for the potential contribution from sources of noise not included in the acoustic model or excluded from the calculation (for example, as a result of the vehicle flow falling below the threshold for valid calculations of $L_{A10,18h}$), an adjustment for existing ambient noise has been applied. This is especially relevant for more remote locations away from existing roads, where the acoustic model may potentially under-estimate noise levels.

2.2.6. From 30 April to 2 May 2019 a noise survey was undertaken as part of the options selection stage for the NWL. This survey was undertaken at three locations to inform the acoustic modelling that was undertaken at that stage. Measurement position 3 was located at 47 The Street, Ringland which, although outside the study area for the NWL (discussed below), is indicative of the area between the A47 and the A1067 where ambient noise levels are low. Based on the measured noise levels, 34 dB $L_{A10,18h}$ during the daytime and 26 dB L_{night} during the night-time have been added to the acoustic model. These underlying levels are sufficiently low not to affect the noise levels in areas where road traffic noise is dominant, but have been applied to help ensure that the existing noise levels in more remote areas are not under-estimated and hence that the future changes in noise levels are not over-estimated.

2.2.7. There are no Noise Important Areas (NIAs) within 600 metres of the NWL. The nearest NIA to the NWL is NIA 5201, located on the existing A47, approximately 1km from the southern end of the NWL.

2.3 METHODOLOGY

2.3.1. The appraisal has been completed in accordance with the TAG Unit A3 guidance for Noise Impacts. The methodology references DMRB guidance where appropriate, however, this is not a full and complete assessment under DMRB, as a proportionate appraisal has been undertaken, with the scope and methodology being tailored to support the OBC.

TAG UNIT A3 ENVIRONMENTAL IMPACT APPRAISAL, DEPARTMENT FOR TRANSPORT

2.3.2. With regards to noise impacts, the TAG Unit A3 impact appraisal used to focus on annoyance, however, this emphasis has now shifted in light of growing evidence on the links between

[1] The same approach will be adopted in the forthcoming Environmental Impact Assessment (EIA), with the outcomes being reported in the form of an Environmental Statement (ES).

environmental noise and health outcomes. Defra has produced guidance on transport-related noise using an 'impact pathway' approach to include:

- Annoyance;
- Sleep disturbance; and
- Health impact, including heart disease (acute myocardial infarction, or AMI), stress and dementia.

2.3.3. The methodology includes five steps as follows:

- Scoping;
- Quantification of noise and impacts;
- Estimation of the affected population;
- Monetary valuation of changes in noise impact; and
- Consideration of the distributional impacts of changes in noise.

SCOPING (STEP 1)

2.3.4. TAG Unit A3 requires that scoping should be consistent with the scoping of the environmental assessment, with the aim being to decide how noise impacts should be appraised and to define a study area for the NWL. The noise appraisal should be proportional to the NWL and its likely impact, with analysis being no more detailed than is required to support robust decision making.

2.3.5. TAG Unit A3 notes (in paragraph 2.2.3) that consideration needs to be given to how to address night-time noise and that for road-based schemes, "*conversion between different noise measures is considered sufficiently robust for the effects of night-time noise on sleep disturbance to be transformed from daytime measures*". This approach has been adopted for the NWL, through the use of the formulas contained in TRL Project Report PR/SE/451/02[2].

2.3.6. Paragraph 2.2.6 of TAG Unit A3 notes that the guidance "*does not specify any analysis for situations where noise impacts on potentially noise sensitive non-residential receptors such as schools or hospitals*". Where impacts are likely to be significant, the TAG Unit A3 guidance is that they should be reported separately.

[2] TRL Limited. Project Report PR/SE/451/02. Converting the UK Traffic Noise Index $L_{A10,18h}$ to EU Noise Indices for Noise Mapping. P G Abbott & P M Nelson (TRL Limited). 2002.

2.3.7. For road schemes, TAG Unit A3 makes reference to the DMRB Volume 11, Section 3, Part 7 Noise and Vibration[3]. This guidance was superseded in 2019 by DMRB LA 111 Noise and vibration[4], which itself was most recently updated in May 2020.

QUANTIFICATION OF NOISE IMPACTS (STEP 2)

2.3.8. The NWL is likely to affect noise levels in the area, as experienced at nearby sensitive receptors, in the following ways. It will:

- change the physical alignment of existing traffic links at their junction with the NWL and introduce new traffic along the length of the NWL; and
- have the potential to alter vehicle flow characteristics, such as traffic volumes, composition, and speeds on the existing road network.

2.3.9. TAG Unit A3 requires the likely noise impacts to be quantified and to this end reference is made to the Calculation of Road Traffic Noise (CRTN)[5]. A 3-dimensional digital acoustic model has been prepared using CadnaA® software to quantify the likely road traffic noise levels during the operational phase of the NWL, with calculations following the methodology in CRTN (see paragraph 2.3.22 onwards).

2.3.10. TAG Unit A3 includes some guidance on how to deal with property demolitions or house building, stating that "*where there are grounds to confidently predict changes in the affected number of households between the without scheme and with scheme cases, this should be reflected in the appraisal*". However, it is understood that no significant housing developments are currently proposed within the study area for the NWL. Therefore, no committed developments have been included in the monetary valuation of noise impacts. Potential noise impacts on any committed developments within the study area for the operational noise assessment will be considered within the EIA.

2.3.11. The CRTN has been used to predict road traffic noise levels in terms of $L_{A10,18h}$. The following corrections have been used to calculate relevant daytime and night-time noise levels for use in the TAG Unit A3 assessment:

- $L_{Aeq,16h} = L_{A10.18h} – 2$ dB (from paragraph 2.2.13 of TAG Unit A3); and

[3] Design Manual for Roads and Bridges (DMRB). Volume 11 Environmental Assessment. Section 3 Environmental Assessment Techniques. Part 7 HD 213/11 – Revision 1 – Noise and Vibration. The Highways Agency, Transport Scotland, Welsh Government and the Department for Regional Development Northern Ireland. 2011.

[4] Design Manual for Roads and Bridges. Sustainability & Environmental Appraisal. LA 111 Noise and Vibration Revision 2. Highways England. 2020.

[5] The Calculation of Road Traffic Noise. The Department of Transport and Welsh Office. 1988

- L_{night} = 0.90 x $L_{A10,18h}$ – 3.77 dB (from TRL Report PR/SE/451/02, Method 3 for non-motorway roads).

2.3.12. The output from the quantification process is a matrix of households experiencing different noise levels in the with-scheme and without-scheme scenarios. The noise levels are defined in 3 dB wide bands running from 45 dB to 81 dB for both $L_{Aeq,16h}$ and L_{night}.

2.3.13. The calculations have been carried out for the NWL opening year and a forecast (or future) year 15 years after opening:

- do-minimum, opening year 2025, (without-scheme)[6];
- do-something, opening year 2025, (with-scheme)[7];
- do-minimum, forecast year 2040, (without-scheme); and
- do-something, forecast year 2040, (with-scheme).

2.3.14. The acoustic model has been used to predict receptor specific noise levels at a height of 4 metres. The façade subject to the greatest magnitude of change has been used in the analysis in line with the guidance in DMRB LA 111.

2.3.15. It should be noted that paragraph 2.2.17 of TAG Unit A3 notes the following regarding night-time impacts "*As well as through the monetisation process described in step three below, night noise impacts should be assessed by determining the number of households where the WHO Interim Night Noise Target of 55 dB L_{night} noise level is exceeded for the last forecast year in the with and without scheme cases*". For this analysis, it is considered appropriate to use a different sift mechanism, based on the highest noise level, to derive a representative noise level for each dwelling. This is because the use of the façade with the greatest magnitude of noise change may not identify the highest noise level affecting the property.

ESTIMATION OF THE AFFECTED POPULATION (STEP 3)

2.3.16. The matrix of the numbers of residential receptors experiencing without-scheme and with-scheme noise levels in 3 dB bands for $L_{Aeq,16h}$ and L_{night} have been entered into the TAG Noise Workbook to estimate the likely affected population and to monetise the impact.

2.3.17. The TAG Noise Workbook contains dose-response functions for each impact pathway for road traffic noise. These functions describe, at different noise levels, the percentage of the population affected (for sleep disturbance and annoyance/amenity) or the increased risk of adverse health outcomes (for acute myocardial infarction (AMI), stroke and dementia).

[6] In this chapter the terms 'do-minimum' and 'without-scheme' have been used interchangeably

[7] In this chapter the terms 'do-something' and 'with-scheme' have been used interchangeably

2.3.18. These relationships, in combination with the matrix of information generated during Step 2 (regarding the number of households experiencing different with-scheme and without-scheme noise levels), can be used to estimate the number of people affected under each impact pathway.

2.3.19. The TAG Noise Workbook goes on to develop per household, marginal monetary values for each impact pathway (based on an average of 2.3 people per household). These values are contained within the workbook and so the estimation of the population affected for each impact pathway is effectively subsumed within the monetary valuation described in the next sub-section (Step 4).

MONETARY VALUATION OF NOISE IMPACTS (STEP 4)

2.3.20. The TAG Noise Workbook generates the following outputs, which are intended to complement each other:

- the net present value of the change in noise, both as an overall value and broken down into the five impact pathways; and
- quantitative results in the form of the number of households experiencing increased or decreased noise in the forecast year during the day and night.

2.3.21. The monetary valuation is based on the estimation of the number of Disability-Adjusted Life Years (DALYs) lost (or gained) under each impact pathway, taking into account a value of £60,000 per DALY.

CALCULATION OF ROAD TRAFFIC NOISE (CRTN), 1988

2.3.22. The CRTN memorandum describes the procedures for calculating noise from road traffic. The factors which may influence road traffic noise levels at source can be divided into two groups:

- road related factors - gradient and surface type; and
- traffic related factors - flow, speed and the proportion of heavy-duty vehicles.

2.3.23. The Basic Noise Level (BNL) is described in the CRTN. It does not relate to any specific receptor, but rather is a measure of source noise, at a reference distance of 10 m from the nearside carriageway edge of a specific length of highway. It is determined by obtaining the estimated noise level from the 18-hour traffic flow and then applying corrections for vehicle speed, percentage of heavy vehicles, gradient and road surface as described in CRTN.

2.3.24. The propagation of noise is also covered in CRTN and includes corrections for distance and, if appropriate, either ground cover or screening. Other receptor specific corrections include the (angle of) view of the road and reflections either from the façade of the receptor and or from reflecting structures on the far side of the road.

STUDY AREA

2.3.25. TAG does not provide guidance in relation to defining a noise study area, and so reference is made to the DMRB LA 111 which includes (in paragraph 3.44, Note 1) the following advice on the extent of a suitable study area for the operational road traffic assessment, although it is acknowledged that the study area can be varied for individual projects.

"An operational study area defined as the following can be sufficient for most projects, but it can be reduced or extended to ensure it is proportionate to the risk of likely significant effects:

1) *the area within 600 m of new road links or road links physically changed or bypassed by the project;*

2) *the area within 50 m of other road links with potential to experience a short term BNL change of more than 1.0 dB(A) as a result of the project."*

2.3.26. For this TAG Unit A3 assessment and in line with DMRB LA 111 guidance, the main study area has been determined based on a 600 metre buffer around the NWL and the existing road links replaced by the NWL. Detailed road traffic noise predictions have been undertaken at all receptors within this area.

2.3.27. Whilst there is the potential for the NWL to have an impact beyond the main study area, it would not be proportionate to quantify these impacts as part of the TAG calculations. It is expected that these impacts would be both positive and negative, with some roads relieved by the NWL and others busier as a result of traffic using different routes to access the NWL. Further consideration of the potential noise level impacts on the wider road network will be considered during the forthcoming EIA.

DATA SOURCES

- OS MasterMap from Ordnance Survey;
- OS AddressBase Plus from Ordnance Survey;
- 1 m 2019 DTM (digital terrain model) Lidar from the Defra survey data download website;
- 3d engineering drawings of the Highways England A47 Tuddenham to Easton dualling (interim design fix C, August 2020) that were available at the time of preparation of the OBC;
- 3d engineering drawings of the Norwich Western Link (reference design, Drawing No. NCCT41793-03-D-01 3D) that were available at the time of preparation of the OBC; and
- traffic data (flow, composition and speed) used in the development of the OBC for individual links within the Traffic Reliability Area.

2.3.28. These data have been utilised as follows.

Table 2-2 - Data Utilised in the TAG Unit A3 Appraisal

Model Layer	Existing Model	Future Model
Roads	All roads aligned to OS MasterMap base mapping. Relevant traffic data for the do-minimum scenarios (opening and forecast years) have been assigned to each link. It has been assumed that the A47 and A1270 have a low noise road surface.	For existing roads unaffected by the Proposed Scheme, as for Existing Model. The Proposed Scheme has been aligned with 3d engineering drawings. Relevant traffic data for the do-something scenarios (opening and forecast years) have been assigned to each link. It is assumed that the Proposed Scheme has a low noise road surface.
Viaducts	N/A	3d engineering drawings were used to align the viaduct carrying the Norwich Western Link over the River Wensum and associated flood plain in the do-something scenarios.

Topography	1 m 2019 DTM lidar used to generate height contours at 1 m spacing. 3d engineering drawings for the proposed A47 dualling have been used to generate height contours along the length of this route.	As for existing topography, except for the Proposed Scheme corridor where the 3d engineering drawings have been used to generate height contours at 0.1 m spacing along the length of this route.
Buildings	Polygonised footprints extracted from OS MasterMap	
Calculation points	OS AddressBase Plus data used to identify the use of the building	

2.3.29. The NWL reference design includes significant earth bunding at locations along the route which have been included in the acoustic modelling for the NWL. The reference design also includes a three metre high barrier on the outer carriageway edge of each of the River Wensum viaducts. This barrier has been assumed to have acoustic qualities, and so the associated noise level benefits have been included in the calculations.

2.4 IMPACT APPRAISAL AND POTENTIAL MITIGATION

SENSITIVE RECEPTORS

2.4.1. Existing residential receptors within the study area have been identified using OS AddressBase® data in combination with information on the location of buildings taken from provided OS MasterMap data. A total number of 52 dwellings are located within the main study area (see paragraph 2.3.25) and have, therefore, been included within the assessment.

2.4.2. In addition, TAG Unit A3 requires that consideration be given to other noise-sensitive non-residential receptors such as schools, hospitals and designated sites. Whilst no other sensitive buildings have been identified within the study area, the River Wensum is a Site of Special Scientific Interest (SSSI) and so should be considered as a noise sensitive receptor. However, as the TAG Unit A3 analysis focusses on human receptors, this area has not been included in the TAG calculations for the NWL. The effect of noise on the SSSI will be considered during the forthcoming EIA. At that time and given that the River Wensum occupies a large area within which the noise impacts are likely to vary, the impacts on this receptor will be considered across the area as a whole, rather than at specific locations.

IMPACT APPRAISAL

2.4.3. The output spreadsheet from the TAG Unit A3 Noise Workbook is provided in Appendix A.

2.4.4. The results of the noise appraisal are summarised below. These have been generated by analysing data for each residential receptor based on the façade with the greatest magnitude of noise change:

- In the forecast year, 33 households would experience an increase in daytime noise, whilst ten households would experience a decrease in daytime noise.
- In the forecast year, three households would experience an increase in night-time noise, whilst ten households would experience a decrease in night-time noise.
- The overall appraisal indicates that the operation of the NWL is likely to generate a beneficial noise impact and that the ‘net present value of change in noise’ is calculated to be £38,490.

- The impact pathways described earlier in this chapter have been assessed, and the NWL is likely to generate a beneficial effect for all pathways. The following net present values have been calculated:
  - Sleep disturbance: £40,071;
  - Amenity: -£5,219;
  - AMI: £7,142;
  - Stroke: -£1,387; and
  - Dementia: -£2,116.

2.4.5. Paragraph 2.2.7 of TAG Unit A3 states "*As well as through the monetisation process described in step three below, night noise impacts should be assessed by determining the number of households where the WHO Interim Night Noise Target of 55 dB L_{night} noise level is exceeded for the last forecast year in the with and without scheme cases*".

2.4.6. In the Do-minimum forecast year four receptors are predicted to exceed the target value of 55 dB L_{night}. In the Do-something forecast year the same four receptors are predicted to exceed the target value of 55 dB L_{night}.

DISCUSSION OF IMPACTS

2.4.7. Whilst the TAG Unit A3 assessment indicates an overall positive result in monetary terms for the NWL, it should be noted that a broad range of impacts is anticipated within the study area.

2.4.8. The properties expected to experience the largest beneficial changes in noise level are those located on Wood Lane and Paddy's Lane. Noise level decreases are predicted at these receptors as a result of fewer vehicles using these roads in favour of the NWL. It is likely that some of these receptors will experience significant beneficial effects in terms of the EIA.

2.4.9. Adverse impacts are predicted across the majority of the rest of the study area as a result of the NWL, particularly at isolated receptors towards the centre of the study area where ambient noise levels are currently low. Whilst the absolute noise levels are likely to be fairly low, a high magnitude of change is anticipated at many receptors.

2.4.10. Some of these adverse impacts are not reflected in the TAG calculations due to the 45 dB $L_{Aeq, 16h}$/L_{night} cut-off value embedded within the TAG Unit A3 Noise Workbook, and this, in part, is the reason for the overall positive monetary value. During the forthcoming EIA assessment, further consideration will be given to all numerical and other contextual factors associated with these receptors when determining the significance of the predicted noise levels and changes. Nevertheless, it is likely that a number of receptors in the study area will be found to experience a significant adverse effect in terms of the EIA

2.4.11. An EIA is to be undertaken by WSP and an ES will be prepared, which will contain more detailed design information and a more thorough impact assessment. More detail will be provided in the ES regarding the predicted noise level changes and likely significant effects of the NWL and further consideration will also be given to mitigation measures where appropriate.

2.4.12. A high level Construction and Environment Management Plan (CEMP) and Mitigation Plan will be produced as part of the Environmental Statement (ES) submission which will detail the measures required to mitigate the identified impacts. This will help give certainty on the delivery of the

mitigation and compensation measures. A more detailed CEMP will be taken forward by the contractor post Planning Submission.

2.4.13. is between £26,981,450 (optimistic) and the lower estimate is £7,918,856 (pessimistic).

2.5 SUMMARY

2.5.1. A noise appraisal has been undertaken following the methodology presented in TAG Unit A3, Environmental Impact Appraisal, dated May 2019.

2.5.2. A 3-dimensional digital acoustic model has been generated based on the guidance contained within CRTN and the DMRB LA 111.

2.5.3. The affected population has been estimated and the monetary valuation of changes in noise impact has been determined using the TAG Unit A3 Noise Appraisal Workbook (see Appendix A).

2.5.4. The overall appraisal indicates that the operation of the NWL, without mitigation, is likely to generate a beneficial noise impact, and the 'net present value of change in noise' is calculated to be £38,490. Whilst this indicates a positive scheme from a noise perspective, it should be noted that large adverse impacts are predicted at many receptors within the study area, although these are mostly at low levels (which in turn means they have less influence on the overall monetised value of the NWL).

2.5.5. It is anticipated that the NWL would generate a characteristic pattern of noise impacts:

- Noise decreases for properties located adjacent to roads which will be relieved by the NWL; and
- Noise increases at isolated properties within the corridor of the new road where the baseline noise levels are expected to be low.

2.5.6. Whilst consideration has been given to mitigation measures at earlier stages, resulting in the inclusion of the River Wensum viaduct barriers and earth bunding along the NWL, further measures to minimise adverse impacts arising from the operation of the NWL will be considered during the forthcoming EIA assessment.

2.5.7. The ES is being prepared by WSP, which will contain more detailed design information and a more thorough impact assessment subsequently providing more site-specific mitigation measures to attempt to reduce impacts and risks further.

3 AIR QUALITY

3.1 INTRODUCTION

3.1.1. This section presents the air quality impacts appraisal for the NWL, which has been undertaken in accordance with TAG Unit A3.

3.2 LEGISLATION

3.2.1. The relevant ambient air quality legislation is given in **Table 3-1**.

Table 3-1 – Relevant Air Quality Standards and Legislation

Pollutant	Measured as	Concentration (µg/m^3)	Legislation	Requirement
Nitrogen dioxide (NO_2)	Annual mean	40	Part IV of the Environment Act 1995 and The Air Quality (England) Regulations 2000 (as amended 2002)	Standard set as an objective. Under the Environment Act, local authorities are required to review air quality within their areas and where objectives are not likely to be achieved are required to declare an Air Quality Management Area (AQMA) and put in place an Air Quality Action Plan to bring about improvement.
			Directive 2008/50/EC on ambient air quality and cleaner air for Europe The Air Quality Standards Regulations 2010 (as amended 2016)	Standard set as a limit value. The Secretary of State must ensure that levels of do not exceed the limit value.
$PM_{2.5}$ (particulate matter less than 2.5 micrometres in diameter)	Annual mean	25	Directive 2008/50/EC on ambient air quality and cleaner air for Europe The Air Quality Standards Regulations 2010 (as amended 2016)	Standard set as a target value. The Secretary of State must ensure that all necessary measures not entailing disproportionate costs are taken to ensure that concentrations do not exceed the target value.

3.3 CONSULTATION

3.3.1. Over the course of the project there has been consultation with the Environmental Health Officer for Broadland DC. Further consultation will be undertaken as part of the separate Environmental Impact Assessment process, which is to be reported within the Environmental Statement.

3.4 STUDY AREA

3.4.1. The air quality study area has been determined by defining the affected road network (ARN) using Design Manual for Roads and Bridges (DMRB) LA 105 scoping criteria[8]. For this appraisal, a link qualifies as part of the ARN where there is:

- Change in annual average daily traffic (AADT) flow of 1,000 vehicles or more; or
- Change in AADT flow of heavy duty vehicles of 200 or more; or
- Change in road alignment of 5 metres (m) or more.

3.4.2. As illustrated in **Figure 3-1**, the ARN, which includes the NWL, extends from Dereham in the west along the A47 to the A12 at Great Yarmouth in the east, and includes adjoining roads. The ARN does not extend into Norwich beyond the 'outer ring road' (A146/A140/A1042).

3.4.3. The air quality study area encompasses 200m around the ARN. All impacts beyond 200m will be imperceptible and are therefore scoped out.

3.4.4. The air quality study area intersects several local authority districts, including: Breckland District Council (DC), Broadland DC, South Norfolk DC, Norwich City Council (CC) and Great Yarmouth Borough Council (BC).

[8] DMRB HA 207/07 Air Quality guidance and associated Interim Advice Note 170/12, which are referred to in TAG Unit A3 (May 2019) guidance, have been superseded by LA 105, which is available to download at: https://www.standardsforhighways.co.uk/dmrb/ [accessed November 2020]

It should be noted that as the scheme is not part of the Strategic Road Network, the DMRB speed pivoting and banding approach to vehicle emissions has not been applied.

.

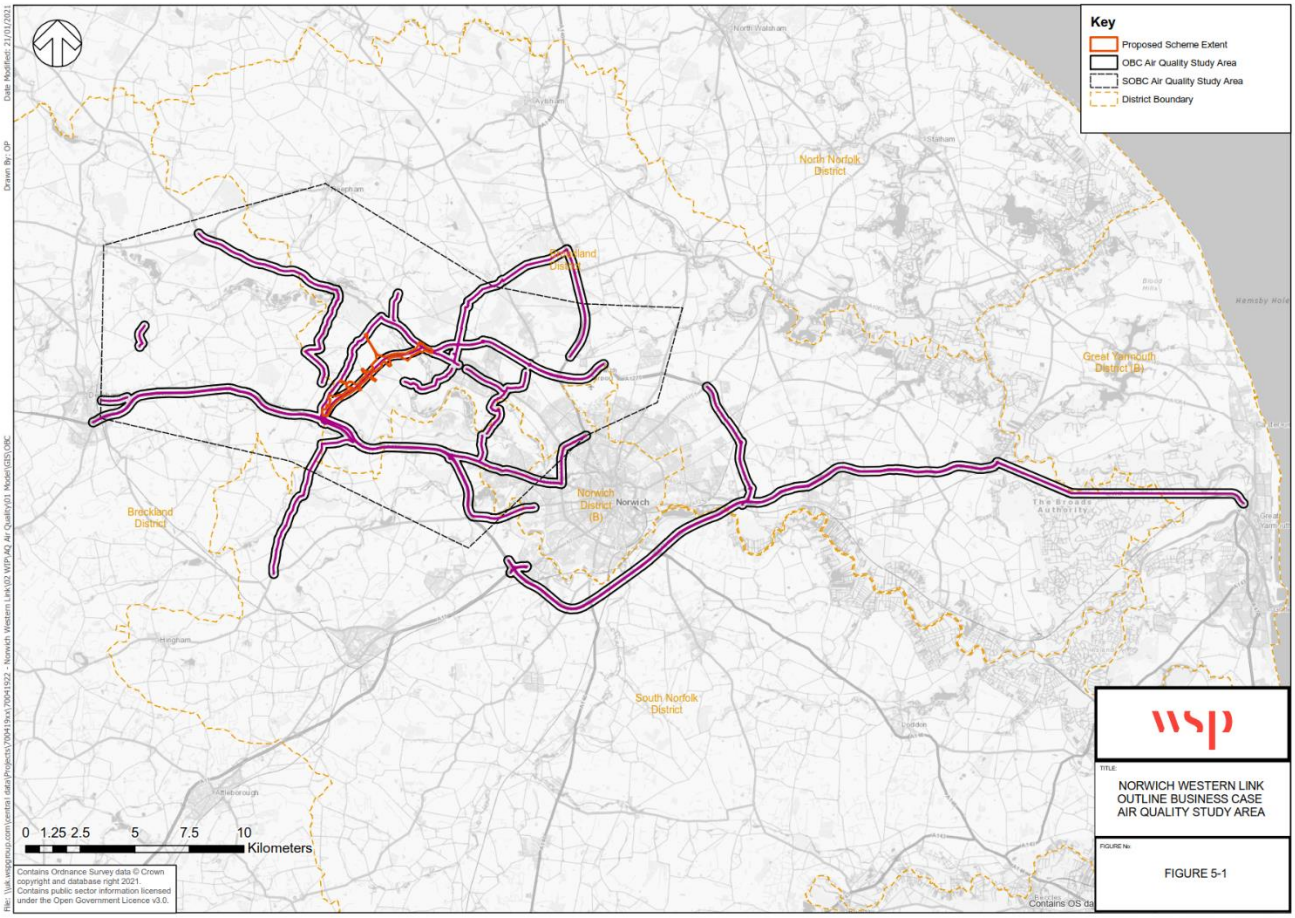

Figure 3-1 - Air Quality Affected Road Network

3.5 APPRAISAL METHODOLOGY

3.5.1. The appraisal has been undertaken following TAG Unit A3 on Air Quality Impacts and has involved:

- Quantitative assessment based on modelling to determine vehicle emissions of oxides of nitrogen (NO_x) and fine particulate matter ($PM_{2.5}$) with and without the Proposed Scheme in the opening year (2025) and design year (2040) scenarios, and dispersion modelling to determine annual mean concentrations of nitrogen dioxide (NO_2) and $PM_{2.5}$ at the relevant receptors in each scenario. Concentrations have been predicted by dispersion modelling using ADMS-Roads model software[9].

[9] Further information on ADMS-Roads can be found on the Cambridge Environmental Research Consultants webpage: http://www.cerc.co.uk/environmental-software/ADMS-Roads-model.html

- Monetary valuation of the Air Quality Impacts has been undertaken using the impact pathways approach, which accounts for changes in human exposure to annual mean NO_2 and $PM_{2.5}$ concentrations at relevant receptors and overall emissions of NO_x and $PM_{2.5}$ to determine the effects of impacts that do not directly affect households such as ecosystem damages.

3.5.2. Data sources used to inform this appraisal include:

- Breckland DC[10], Broadland DC[11], South Norfolk DC[11], Norwich CC[12] and Great Yarmouth BC[13] Local Air Quality Management reports;
- WSP baseline NO_2 diffusion tube survey undertaken between September 2019 and March 2020 (see **Appendix B** for details);
- Traffic data without and with the Proposed Scheme in 2025 (opening year) and 2040 (design year) from the Norwich Area Transport Strategy Model (2019 base year);
- Road source emissions data from Defra's Emissions Factors Toolkit (version 10.1)[14];
- Meteorological data for 2019 from Norwich airport – used in predicting pollutant concentrations at receptors;
- Background and roadside pollutant concentration data from Defra's 2018-based Pollution Climate Mapping (PCM) model[15,16];

[10] Breckland DC, Annual Air Quality Reports. Available at: https://www.breckland.gov.uk/article/13023/Annual-Air-Quality-Reports [accessed January 2021]

[11] Broadland District Council and South Norfolk District, Air Quality Reports. Available at: https://www.south-norfolk.gov.uk/residents/neighbourhood-issues/environmental-quality/air-quality [accessed January 2021]

[12] Norwich City Council, Air Quality Monitoring Reports and Assessments. Available at: https://www.norwich.gov.uk/downloads/download/1917/air_quality_monitoring_reports_and_assessments [accessed January 2021]

[13] Great Yarmouth Borough Council, Pollution – Advice on Local Air Quality. Available at: https://www.great-yarmouth.gov.uk/pollution [accessed January 2021]

[14] Defra (2020) Emissions Factors Toolkit (version 10.1). Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html [accessed December 2020]

[15] Defra (2020) Background Maps (2018 reference year). Available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html [accessed December 2020]

[16] Defra (2020) NO_2 and PM projections data (2018 reference year). Available at: https://uk-air.defra.gov.uk/library/no2ten/2020-no2-pm-projections-from-2018-data [accessed November 2020]

- Conversion of modelled NO_x concentrations to NO_2 concentrations using Defra's NO_x to NO_2 calculator (version 8.1)[17]; and
- Ordnance Survey AddressBase data, provided by NCC under Contractor Licence, to identify sensitive receptor locations with relevant exposure to annual mean pollutant concentrations

3.6 BASELINE CONDITIONS

3.6.1. An overview of baseline air quality conditions is given in **Table 3-2**. Overall, it can be concluded that baseline air quality is likely to be good across the air quality study area.

Table 3-2 - Baseline Conditions

Local Authority	NO2	PM2.5	Summary
Breckland DC	At the time of writing, the latest information published by Breckland DC is for 2019. Except within Swaffham (approximately 17km to the west of the air quality study area), concentrations at NO_2 monitoring sites have been well below the 40µg/m^3 standard in recent years. The only AQMA for NO_2 within the district is the Swaffham AQMA. Within the air quality study area, the main sources of NOx are road traffic emissions from the A1067, A47 and A1075. There are no monitoring sites within the air quality study area (the nearest are just to the west within Dereham). Defra's predicted roadside NO_2 concentrations within the air quality study area are well below the 40µg/m^3 standard. The highest concentration for 2018 is 25.1µg/m^3 on the A47 (census ID 802074965). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard.	At the time of writing, the latest information published by Breckland DC is for 2019. There are no monitoring sites or AQMAs for $PM_{2.5}$ within the district. From monitoring of PM_{10} at East Wretham, Breckland DC has reported that $PM_{2.5}$ concentrations are likely to be well below the standard of 25µg/m^3. Within the air quality study area, the main sources of $PM_{2.5}$ are road traffic generated emissions from the A1067, A47 and A1075. Defra's predicted roadside $PM_{2.5}$ concentrations within the air quality study area are well below the 25µg/m^3 standard. The highest concentration for 2018 is 10.8µg/m^3 on the A1075 (census ID 802074967). Defra's predicted background NO_2 concentrations are well below the 25µg/m^3 standard.	Overall, baseline air quality is likely to be good within the air quality study area.

[17] Defra (2020) NOx to NO2 calculator (version 8.1). Available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html [accessed December 2020]

Local Authority	NO2	PM2.5	Summary
Broadland DC	At the time of writing, the latest information published by Broadland DC is for 2018. Concentrations at all NO_2 monitoring sites within the district have been well below the 40µg/m^3 standard in recent years. There are no AQMAs for NO_2 within the district. Within the air quality study area, the main sources of NOx are road traffic emissions from vehicles on the A1067, A1270, A140, A1042 and A47. In 2018, there were four NO_2 monitoring sites within the air quality study area: BN1 on the A47 at North Burlingham; BN11 on Reepham Road at Hellesdon; BN12 on Boundary Road at Hellesdon; BN13 on Mile Cross Lane at Hellesdon. The highest concentration was 29.6µg/m^3 at BN11. Five WSP roadside monitoring sites were within the air quality study area: NWL_2 and NWL_3 on the A1067 Fakenham Rd; NWL_5 on the A1067 over the River Wensum at Attlebridge; NWL_6 on the A1067 at Lenwade; and NWL_7 on the A47 north of Honingham. The highest concentration was 27.7µg/m^3 at NWL_7. Defra's predicted roadside NO_2 concentrations within the air quality study area are well below the 40µg/m^3 standard. The highest concentration for 2018 is 33.4µg/m^3 on the A140 (census ID 802026505). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard.	At the time of writing, the latest information published by Broadland DC is for 2018. There are no monitoring sites or AQMAs for $PM_{2.5}$ within the district. Within the air quality study area, the main sources of $PM_{2.5}$ are road traffic generated emissions from the A1067, A1270, A140, A1042 and A47. Defra's predicted roadside $PM_{2.5}$ concentrations within the air quality study area are well below the 25µg/m^3 standard. The highest concentration for 2018 is 11.2µg/m^3 on the A140 (census ID 802026505). Defra's predicted background NO_2 concentrations are well below the 25µg/m^3 standard.	Overall, baseline air quality is likely to be good within the air quality study area.
South Norfolk DC	At the time of writing, the latest information published by South Norfolk DC is for 2018. Concentrations at all NO_2 monitoring sites within the district have been well below the 40µg/m^3 standard in recent years. There are no AQMAs for NO_2 within the district.	At the time of writing, the latest information published by South Norfolk DC is for 2018. There are no monitoring sites or AQMAs for $PM_{2.5}$ within the district. Within the air quality study area, the main sources of $PM_{2.5}$ are road	Overall, baseline air quality is likely to be good within the air quality study area.

Local Authority	NO2	PM2.5	Summary
	Within the air quality study area, the main sources of NOx are road traffic emissions from vehicles on the A11 and A47. In 2018, there were three South Norfolk DC monitoring sites within the air quality study area: DT1 on Newmarket Rd at Cringleford; DT2 on Longwater Lane at Costessey; and DT11 at Thickthorn Cottages off the B1172 Norwich Rd. The highest concentration was 20.1µg/m^3 at DT2. Two WSP roadside monitoring sites were within the air quality study area: NWL_8 on the A47 west of Easton; and NWL_9 on the A1074 Dereham Rd at New Costessey. The highest concentration was 25.5µg/m^3 at NWL_9. Defra's predicted roadside NO_2 concentrations within the air quality study area are well below the 40µg/m^3 standard. The highest concentration for 2018 is 28.3µg/m^3 on the A1074 (census ID 802058422). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard.	traffic generated emissions from the A11 and A47. Defra's predicted roadside $PM_{2.5}$ concentrations within the air quality study area are well below the 25µg/m^3 standard. The highest concentration for 2018 is 11.2µg/m^3 on the A1074 (census ID 802058422). Defra's predicted background $PM_{2.5}$ concentrations are well below the 25µg/m^3 standard.	
Norwich CC	At the time of writing, the latest information published by Norwich CC is for 2019. Concentrations at NO2 monitoring sites have indicated exceedances of the 40µg/m^3 standard within the centre of Norwich. The only AQMA for NO_2 within the district is the Central Norwich AQMA. Within the air quality study area, the main sources of NOx are road traffic emissions from vehicles on the A11, A1074, A140, A1402 and A1042. There are no Norwich CC NO_2 monitoring sites or AQMAs within the air quality study area. One WSP roadside monitoring site was within the air quality study area: NWL_10 on the A1074 Dereham	At the time of writing, the latest information published by Norwich CC is for 2019. $PM_{2.5}$ is monitored at one roadside site (CM1, Castle Meadow) and one background site (CM2, Lakenfields). The annual mean concentrations are below the 25µg/m3 standard. There are no AQMAs for $PM_{2.5}$ within the district. Within the air quality study area, the main sources of $PM_{2.5}$ are road traffic generated emissions from the A11, A1074, A140, A1402 and A1042. There are no $PM_{2.5}$ monitoring sites within the air quality study area. Defra's predicted roadside $PM_{2.5}$ concentrations within the air quality study area are well below the	Overall, baseline air quality is likely to be good within the air quality study area.

Local Authority	NO2	PM2.5	Summary
	Road, where the annual mean concentration was 25.9µg/m^3. Defra's predicted roadside NO_2 concentrations within the air quality study area are well below the 40µg/m^3 standard. The highest concentration for 2018 is 33.4µg/m^3 on the A140 (census ID 802026505). Defra's predicted background NO2 concentrations are slightly higher than the surrounding rural areas but still well below the 40µg/m^3 standard.	25µg/m3 standard. The highest concentration for 2018 is 11.1µg/m^3 on the A140 (census ID 802026505). Defra's predicted background $PM_{2.5}$ concentrations are slightly higher than the surrounding rural areas but still well below the 25µg/m^3 standard.	
Great Yarmouth BC	At the time of writing, the latest information published by Great Yarmouth BC is for 2018. Concentrations at all NO_2 monitoring sites within the district have been well below the 40µg/m^3 standard in recent years. There are no AQMAs for NO2 within the district. Within the air quality study area, the main sources of NOx are road traffic emissions from vehicles on the A47. There are no NO_2 monitoring sites within the air quality study area. Defra's predicted roadside NO_2 concentrations within the air quality study area are well below the 40µg/m standard. The highest concentration for 2018 is 31.2µg/m^3 on the A47 (census ID 802048491). Defra's predicted background NO_2 concentrations are well below the 40µg/m^3 standard.	At the time of writing, the latest information published by Great Yarmouth BC is for 2018. There are no monitoring sites or AQMAs for $PM_{2.5}$ within the district. Within the air quality study area, the main sources of $PM_{2.5}$ are road traffic generated emissions from the A47. Defra's predicted roadside $PM_{2.5}$ concentrations within the air quality study area are well below the 25µg/m^3 standard. The highest concentration for 2018 is 12µg/m^3 on the A47 (census ID 802048491). Defra's predicted background $PM_{2.5}$ concentrations are well below the 25µg/m^3 standard.	Overall, baseline air quality is likely to be good within the air quality study area.

3.6.2. Baseline air quality is illustrated in Figure 3-2. This shows annual mean NO2 concentrations, as the most extensively measured pollutant

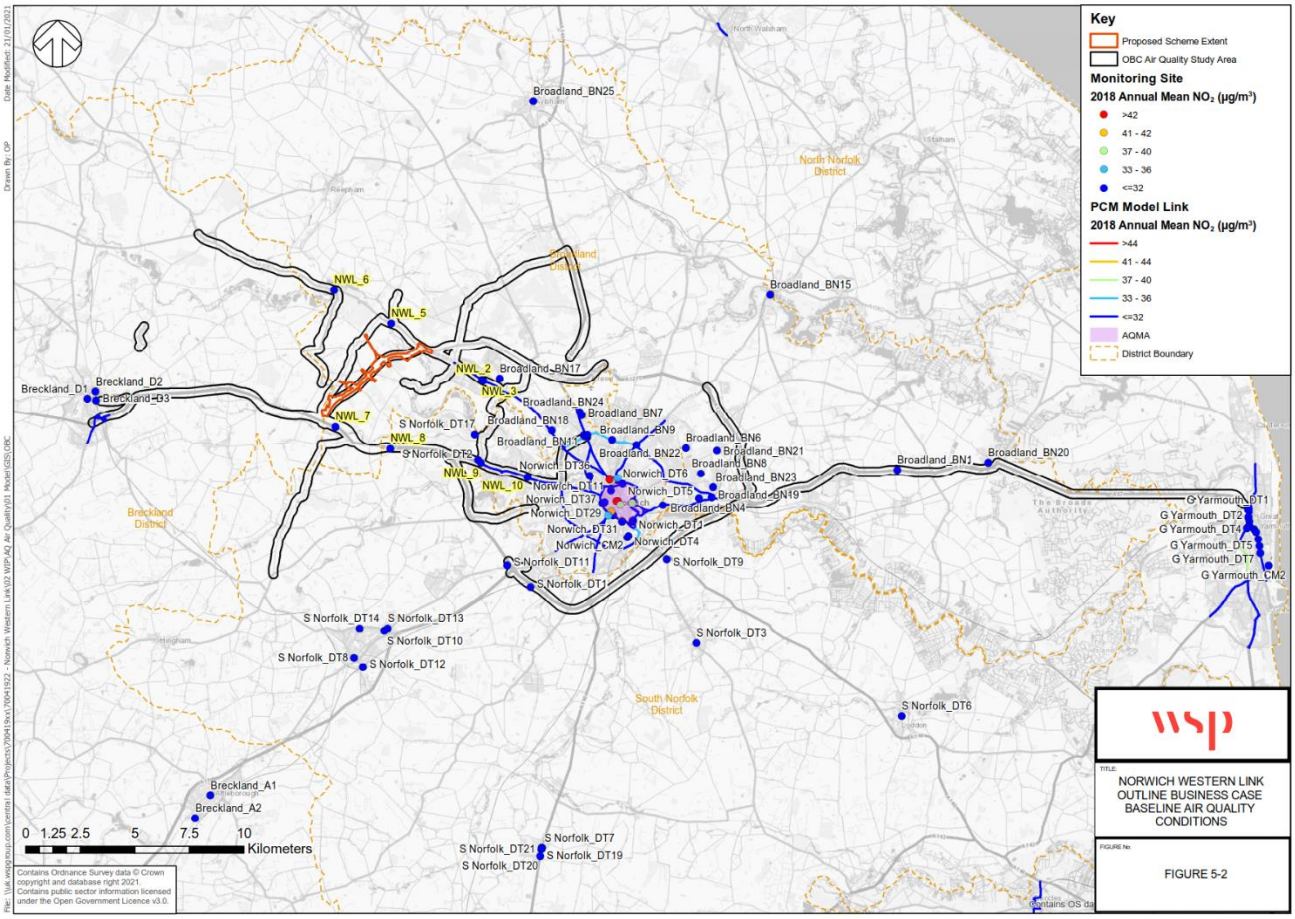

Figure 3-2 - Baseline Conditions within the Study Area

3.7 APPRAISAL SUMMARY

3.7.1. The Air Quality Impacts TAG sheet is provided in **Appendix C**.

3.7.2. As reported in the AST, with the NWL there are modest improvements in local air quality in terms of NO_2 and $PM_{2.5}$ at locations with relevant human exposure. The overall monetary valuation takes into account ecosystem damage costs. No AQMAs are included in the air quality study area. The NWL links map onto PCM links which are all compliant with the NO_2 limit value both with and without scheme. No exceedances of air quality standards are predicted.

3.8 MITIGATION

3.8.1. The NWL itself will mitigate traffic congestion on the road network and reduce journey times, which in-turn will reduce pollutant concentrations at receptors along routes that would otherwise experience higher volumes of traffic and emissions. The appraisal indicates no specific need for air quality mitigation.

3.8.2.

NO_2

3.8.3. In 2025 there are there are 7,860 properties with improvement, 35 properties with no change, and 2,180 properties with deterioration. In 2040 there are 7,733 properties with improvement, 32 properties with no change, and 2,310 properties with deterioration.

3.8.4. The NPV of change for NO_2 over the 60-year appraisal period (2025-2084 inclusive) is a benefit of £9,803.

$PM_{2.5}$

3.8.5. In 2025 there are 8,002 properties with improvement, 6 properties with no change, and 2,067 properties with deterioration. In 2040 there are 7,747 properties with improvement, 282 properties with no change, and 2,046 properties with deterioration.

3.8.6. The NPV of change for $PM_{2.5}$ over the 60-year appraisal period (2025-2084 inclusive) is a benefit of £62,165.

3.9 COMMENTS ON ASSUMPTIONS AND UNCERTAINTIES

3.9.1. Impacts in the design year (2040) are based on vehicle emissions factors and background concentrations for 2030 as the last forecast year in Defra's Emissions Factors Toolkit version 10.1 and 2018-based background map dataset. 2030 emissions factors and background concentrations are applied in all years thereafter, up to the end of the 60-year appraisal period (2084). Consequently, any improvements in air quality that may occur after 2030 are not factored into the appraisal. In this respect the appraisal is considered to be conservative.

3.9.2. Traffic growth has not been forecast beyond 2040 and so traffic levels are assumed to be the same in all years thereafter, up to the end of the 60-year appraisal period). This is a limitation, which is commonly encountered in TAG appraisal. It is not considered to be a significant limitation as vehicle emissions should continue to diminish into the future as ‘zero emissions’ vehicles replace conventional vehicles thereby neutralising the effect of further traffic growth.

3.10 CONCLUSION

3.10.1. Overall, the NWL results in modest local air quality benefits at properties within 200m of the ARN.

4 GREENHOUSE GASES

4.1 INTRODUCTION

4.1.1. This section presents the greenhouse gases (GHG) appraisal for the NWL, which was undertaken in accordance with TAG Unit A3.

4.2 LEGISLATION

4.2.1. The Climate Change Act 2008[18] introduced a legally binding target to reduce GHG emissions to at least 80% below base year (1990) levels by 2050. This target has more recently been amended to 100% by The Climate Change Act 2008 (2050 Target Amendment) Order 2019 [19].

4.2.2. The Act introduced 'carbon budgets', which set maximum GHG emission limits not to be exceeded during set periods, to achieve specified reductions in GHG emissions versus base year levels.

4.2.3. 'The Sixth Carbon Budget - The UK's path to Net Zero' was published in December 2020 [20]. This sets out the carbon budget that will run between 2033 and 2037. It is reported that under the 'Balanced Pathway', options to reduce emissions - including take-up of zero emission technologies and reduction in travel demand - combine to reduce surface transport emissions by around 70% to 32 million tonnes CO_2e by 2035 from 113 million tonnes for 2019, and to approximately 1 million tonnes CO_2e by 2050.

4.3 CONSULTATION

4.3.1. No formal consultation has been undertaken to date in relation to the GHG emissions, however discussions with the Norfolk County Council Sustainability Manager have been held to discuss the council's latest Environmental Policy which includes targets related to resource efficiency and carbon reduction. A key aspiration captured within the policy is for the council to collectively achieve 'net zero' carbon emissions on estates by 2030, but within wider areas, work towards 'carbon neutrality' also by 2030 [21].

[18] The Climate Change Act 2008 c.27. Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents [accessed January 2021]

[19] The Climate Change Act 2008 (2050 Target Amendment) Order 2019 No.1056. Available at: https://www.legislation.gov.uk/uksi/2019/1056/contents/made [accessed January 2021]

[20] Climate Change Committee (2020), The Sixth Carbon Budget - The UK's path to Net Zero'. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget/ [accessed January 2021]

[21] Norfolk County Council. Environmental Policy. Presented and approved at Full Council on 25 November 2019. Available at: https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-

4.4 STUDY AREA

4.4.1. The GHG study area includes all road links within the simulation area of the Norwich Area Transport Strategy (NATS) model.

4.5 APPRAISAL METHODOLOGY

4.5.1. The greenhouse gases appraisal for road transport emissions has been undertaken in accordance with TAG Unit A3 Greenhouse Gases'[22]. The calculations are based on the traffic forecasts for the do-minimum and do-something model scenarios for 2025 (opening year) and 2040 (design year), as generated by the NATS traffic model for the OBC. Non-traded CO_2e emissions (petrol and diesel vehicles) and CO_2e traded emissions (electric vehicles) have been calculated in accordance with DMRB LA 114 'Climate' methodology[23].

4.6 BASELINE CONDITIONS

EXISITNG BASELINE

4.6.1. GHG emissions occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change. Baseline transport emissions for 2018 within Norwich, Norfolk, and nationally are presented in **Table 4-1** for context[24].

Table 4-1 – Baseline Transport Emissions (Tonnes of CO_2) for 2018

Emissions Sources	Norwich	Norfolk	National
Road Transport (A roads)	57,800	1,061,100	54,229,200
Road Transport (Motorways)	-	-	29,936,400
Road Transport (Minor roads)	52,800	775,500	38,485,800
Transport Other	10,600	135,700	2,249,200

partnerships/policies-and-strategies/natural-environment-policies/environmental-policy [accessed January 2021]

[22] Available at: https://www.gov.uk/guidance/transport-analysis-guidance-tag

[23] Available at: https://www.standardsforhighways.co.uk/dmrb/

[24] Department for Business, Energy & Industrial Strategy. UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2018. Available at: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2018 [accessed January 2021]

Emissions Sources	Norwich	Norfolk	National
Diesel Railways	330	13,900	1,900,400
Transport Total	124,600	1,986,100	126,801,100

FUTURE BASELINE

4.6.2. Future baseline end-user traffic GHG emissions (modelled using data from the Proposed Scheme's traffic model) are presented in **Table 4-2** for the year 2025 (the first operational year of the NWL Scheme) and the future modelled year 2040. In addition, the average annual and total GHG emissions from 2025 to 2084 are presented for comparison with the 60-year operational period of the Proposed Scheme.

Table 4-2 - Baseline GHG Emissions (Tonnes of CO_2e) for 2025, 2040 and 2025-2084

Scenario	2025 (operational year)	2040 (future year)	Average per year (2025-2084)	Total (2025-2084)
Baseline ('Do Minimum')	546,863	471,454	481,343	29,361,946

4.7 APPRAISAL SUMMARY

4.7.1. The GHG TAG sheet is provided in **Appendix D**.

4.7.2. As reported in the AST, the NWL Scheme gives rise to lower CO_2e emissions compared to the do-minimum situation, with savings (benefits) over the 60-year appraisal period (2025 - 2084 inclusive) of 443,429 tonnes in non-traded carbon associated with conventional (petrol and diesel) vehicles, and 13,005 tonnes from traded carbon associated with electric vehicles (i.e. electrical power generation sources).

4.7.3. The differences are generally associated with lower values of total annual vehicle kilometres in each year that are predicted due to the NWL Scheme. For 2025, the distance travelled over the simulated road network is predicted to be approximately 4,136 million vehicle kilometres in the do-minimum scenario compared to 4,087 million vehicle kilometres in the do-something scenario - a reduction of approximately 49 million vehicle kilometres. For 2040, the distance travelled over the simulated road network is predicted to be approximately 4,904 million vehicle kilometres in the do-minimum scenario compared to 4,767 million vehicle kilometres in the do-something scenario - a reduction of approximately 137 million vehicle kilometres.

4.7.4. Over the 60-year appraisal period, the financial benefit in terms of carbon savings from the operation of vehicles in road transport sector due to the NWL Scheme is estimated at £19,474,620.

4.7.5. The substantial differences in the findings compared to those for Scheme 'Option C' those presented in the SOBC are largely attributed to the major updates to the NATS model for the OBC and DMRB methodology (previously HA 207/07) for calculating emissions of greenhouse gases from road traffic.

4.8 MITIGATION

4.8.1. As demonstrated by the NATS model, the NWL Scheme will provide shorter route options – bringing about shorter journeys by road vehicle and reducing traffic levels on strategic routes such as the A47. This in-turn is expected to bring down CO_2e emissions from road transport within the study area.

4.8.2. At this stage of the project, specific GHG mitigation requirements have not been identified. The GHG assessment that is to be undertaken for the EIA will be more detailed – including consideration of emissions from construction activities and embodied carbon and will confirm any specific requirements for mitigation.

4.8.3.

COMMENTS ON ASSUMPTIONS AND UNCERTAINTIES

4.8.4. The calculated emissions are predictions, which are based on the best available predicted traffic data and government supported methods for calculating emissions and monetary valuation.

4.8.5. Emissions have been calculated across the whole of the NATS model simulation area and smaller minor roads within this area may not be represented. However, it is expected that traffic levels and changes on such roads are likely to be relatively small compared the roads that are included. Any such omission is unlikely to substantially affect the findings of the GHG appraisal.

4.8.6. Emissions have been estimated for scenarios in 2025 and 2040. For each year between the emissions have been determined by linear interpolation. In the absence of any data for the intervening years, this pragmatic approach adds a degree of uncertainty to the TAG calculations for these years.

4.8.7. The NATS model future forecast year is 2040. Beyond 2040 no traffic growth has been assumed. In reality some inter-annual variations in traffic levels and emissions can be expected. This factor adds a degree of uncertainty to the appraisal.

4.8.8. Emissions have been estimated based on vehicle fleet composition forecasts which were published pre-COVID-19. The likely impact of COVID-19 on fleet composition in future years cannot be predicted with any certainty at this present time.

4.8.9. The DfT TAG GHG workbook addresses uncertainty in valuation by presenting upper and lower estimates of the net present value of the carbon impacts. For the NWL Scheme the upper estimate is £30,126,533 and the lower estimate is £8,833,474.

4.9 SENSITIVITY TEST

4.9.1. A sensitivity test has been taken with the outputs from the Low Growth model scenario.

With the Proposed Scheme and assuming low traffic growth, the total saving in carbon (as CO2e) emissions over the 60 year appraisal period (2025-2084 inclusive) is 410,434 tonnes (compared to 456,434 tonnes with the core scenario). This equates to a financial benefit of £17,445,270 over the same period (compared to £19,474,620 with the core scenario). The range of uncertainty in the monetary calculation of the benefit for the sensitivity test

4.10 CONCLUSION

4.10.1. Overall, the NWL Scheme is beneficial in achieving reductions in carbon emissions from the operation of vehicles in the road transport sector and supports national and regional policy initiatives towards the Net Zero target in 2050.

4.10.2. Whilst the assumption of low traffic growth reduces the carbon saving and monetary benefit of the scheme, there is still clear benefit.

5 LANDSCAPE

5.1 INTRODUCTION

5.1.1. This section presents the Landscape and Visual appraisal for the Proposed Scheme, required to identify any potential constraints in relation to landscape and visual features to help inform the OBC. This includes a summary of the baseline conditions, methodology and the likely operational impacts of the NWL on the environmental features.

5.2 BASELINE CONDITIONS

5.2.1. Consultation with Norfolk County Council Landscape Team, as well as Broadland District Council and Breckland District Council landscape officers, was conducted in March 2020 in order to discuss and agree the location of viewpoints for the Landscape and Visual Impact Assessment (LVIA). Design Workshops were also established with landscape officers from the relevant local authorities to ensure they were informed of the latest developments and emerging designs and were able to provide meaning full input and feedback to the design development.

5.2.2. The NWL runs through agricultural land to the north west of Norwich. The landscape is a wet lowland shallow valley in the northern section of the study area, whilst to the south, the land rises and gently undulates becoming a plateau. The River Tud valley is located to the south east of the study area. It is a landscape characterised by predominately regular fields of arable farming throughout, although mixed plantation woodland and emergence of pig rearing is present in various sections of the route. The Wensum Valley Hotel, Golf and Country Club is located to the north west of the study area.

5.2.3. The prevailing field pattern within the study area is small to medium sized fields contained by hedgerow and infrequent mature trees. There are medieval manors which form country house estates such as Morton Hall to the north and Easton Estate to the south. There are small ponds throughout this landscape, often uniform in shape. The river valley to the north and east following the River Wensum is wet meadow and contains a number of small lakes.

5.2.4. The closest large settlement to the study area is Norwich itself, however the study area encompasses a relatively rural landscape with small settlements and isolated dwellings. The biggest settlement is Honingham located to the south, with Ringland and Weston Longville other notable settlements within this landscape.

5.2.5. The study area has several minor roads which cross through the landscape and the more substantial A47 and A1067 highways to the south and north respectively. The wind turbines to the east of the proposed scheme on the old airfield and the overhead line which runs north to south, combined with roads, are notable influences within this landscape and potentially reduce the sense of tranquillity.

5.3 METHODOLOGY

5.3.1. An initial appraisal of potential landscape and visual impact has been undertaken for the NWL. This has followed guidance contained in Chapter 5 – The Environmental Capital Approach and Chapter 6

– Impacts on Landscape in TAG Unit A3[25]. Information on the pattern, tranquillity, cultural associations and land cover elements have been provided in a summary worksheet along with other key landscape environmental resources. An appraisal of how the NWL would fit within the landscape have been provided, along with an overall potential impact on landscape and visual receptors using the standard seven-point scale defined in TAG Unit A3.

5.3.2. The appraisal has been carried out based on the reference design, desk-based research and an awareness of the existing landscape context from a review of Ordnance Survey (OS) mapping, aerial mapping and a site visit. A brief review of National Character Areas[26] and the Broadland District Landscape Character Assessment[27] has been undertaken but there has been no detailed study of local character.

5.4 IMPACT APPRAISAL

TOWNSCAPE

5.4.1. The NWL is predominantly located within agricultural land, where the overriding character is of agricultural fields with sparse settlement. There is a lack of built environment that would warrant a townscape appraisal of the study area, other than that identified within a landscape appraisal.

5.4.2. It has therefore been concluded that this environmental topic area (Townscape) is not relevant to the decision-making process and an appraisal of this topic area has not been undertaken for the Scheme.

LANDSCAPE

5.4.3. The NWL is anticipated to introduce a major road into the landscape, which would cut through the landscape, disrupting field patterns, removing woodland and changing local land cover. This would likely result in a noticeable change in the landscape pattern. While not a totally uncharacteristic feature in the landscape, the A47 and A1067 run east to west at the northern and southern extents of the NWL, the scale of the NWL would be uncharacteristic and dissimilar to existing landscape elements, such as Ringland Lane, Breck Road, and The Broadway.

5.4.4. The NWL would be visible to receptors within the landscape and is likely to have adverse effects on the visual amenity of private and public receptors.

5.4.5. The proposed viaduct over the River Wensum is anticipated to introduce a highly visible, hard and linear feature into the landscape, dominating the River Wensum wet lowland valley and would be uncharacteristic and out of proportion with the surrounding landscape. Moving traffic (and

[25] Department for Transport, (2019). TAG UNIT A3 Environmental Impact Appraisal

[26] Natural England, (2014). National Character Area profiles: No.84. Mid Norfolk & No.78. Central North Norfolk

[27] Broadland District Council, (2013). Landscape Character Assessment - Supplementary Planning Document (SPD)

headlights) would become elevated in the landscape, making it more visible, reducing tranquillity and adding uncharacteristic movement into a static landscape.

5.4.6. There would be the loss of agricultural land, ponds, woodland, field trees, sections of hedgerow and hedgerow trees. Some of this loss could be replaced through mitigation planting. There would also be fragmentation of agricultural fields. The loss of existing landscape features would likely have an adverse effect on the overall landscape character, and the likely scale of the Proposed Scheme would detract and increase the presence of man-made influences into this landscape at the local scale.

5.4.7. The overall impact on the landscape is anticipated to be **moderate adverse**. This is because of the scale of the NWL, while not totally uncharacteristic of the surrounding landscape, is likely to be at a much larger scale. The proposed viaduct would be particularly uncharacteristic and out of proportion with the surrounding landscape. An appraisal of how the NWL would fit within the landscape has been provided, along with an overall potential impact on landscape and visual receptors using the standard seven-point TAG Unit A3 scale in Appendix E.

POTENTIAL MITIGATION

5.4.8. The appraisal of landscape and visual impact (through use of TAG and AST) are carried out prior to mitigation. A high-level Construction and Environment Management Plan (CEMP) and Mitigation Plan will be produced as part of the Environmental Statement (ES) submission which will detail the measures required to mitigate the identified impacts. This will help give certainty on the delivery of the mitigation and compensation measures. A more detailed CEMP will be taken forward by the contractor post Planning Submission.

5.4.9. Potential mitigation measures for adverse landscape and visual effects typically include replacing vegetation lost through construction of the NWL and to restore and enhance landscape character. The loss of existing vegetation will be avoided where possible and new bunds and native planting will be introduced to provide visual screening to sensitive receptors. Earthworks will be designed with appropriate slope profiles to integrate into the surrounding landscape. The design of proposed structures will consider landscape character and visual amenity, designed as a coherent ‘family’ in their visual appearance with a continuity of form and detailing. The viaduct, while still sitting within the ‘family’ of structures, is considered further due to its significance within the landscape. The viaduct is designed to complement its setting and achieve a distinctiveness without dominance that does not compete with the landscape. The broad principles are set out in the Environmental Scoping Report March 2020 and more detailed measures will be provided in the ES.

SUMMARY

5.4.10. The landscape is predominantly gently undulating arable farmland, with plateau to the south, located between two shallow river valleys. River Tud in the south and River Wensum in the north being the larger of the valleys with noticeable difference in character of wet meadow and mosaic of lakes and drainage ditches. There is some human influence, of note is the over-head line and two wind turbines to the west, with the A47 and A1067 roads noticeable from the plateau. Settlement is sparse, mainly small farmsteads - the biggest settlement is Honingham located to the south. Land cover is predominately arable fields, contained by clipped hedgerow and infrequent mature trees, with some fields turned to pig rearing. Mixed plantation woodland is common throughout this landscape, often following field boundaries. Roads are generally small lanes, gently curved, and following the field boundaries.

5.4.11. The NWL would alter the local landscape character through the introduction of the viaduct, loss of woodland and the width of the new road (dual carriageway). There would be subdivision of fields and sections of embankment and cutting through the landscape which would affect the field pattern and tranquillity locally, however, the viaduct would have a wider impact introducing a new feature into this landscape and will have a significant impact on tranquillity in the north.

5.4.12. An Environmental Statement (ES) is being prepared by WSP, which will contain more detailed design information and a more thorough impact assessment subsequently providing more site-specific mitigation measures to attempt to reduce impacts and risks further.

6 HISTORIC ENVIRONMENT

6.1 INTRODUCTION

6.1.1. This section of the report provides a high-level appraisal of the likely historic environment impacts specific to the NWL. The historic environment comprises above ground and buried heritage assets, including buildings, structures, monuments, and landscapes of heritage interest, including, where appropriate, the setting of sensitive (designated) heritage assets, along with archaeological remains and palaeoenvironmental deposits.

6.1.2. Statutory provision for the safeguarding of heritage assets has been made at a national and local level. For this reason, their presence or potential presence can constitute a constraint and may affect the initial appraisal of a scheme and in the subsequent design, planning and programming.

6.2 BASELINE CONDITIONS

6.2.1. Consultation has taken place with Norfolk County Council County Archaeologist, regarding the scope of the assessment for buried heritage assets and the scope of archaeological evaluation work required.

DESIGNATED HERITAGE ASSETS

6.2.2. There are no known statutorily designated heritage assets such as scheduled monuments, registered parks or gardens or registered battlefields within the area of NWL. There are no known conservation areas as defined by the Local Planning Authority (LPA). Norfolk does not have any Archaeological Priority Areas.

6.2.3. DMRB guidance state that the study area should include the setting of any designated heritage asset or other cultural heritage resource in the footprint of the NWL or within the zone of influence or potentially affected by noise. Professional judgement was used to define a 500m buffer around the Red Line Boundary for the identification of non-designated heritage assets and 1km buffer for designated heritage assets, due to the longer views and hence the potential impacts upon the setting of these assets.

6.2.4. The 1km study area around the site contains 17 listed buildings, of which two are listed Grade I (high heritage significance in accordance with DMRB criteria), one is listed Grade II* (high significance) and 14 are listed Grade II (medium significance).

6.2.5. The two Grade I listed buildings are the Church of St Peter (NHLE ref: 1171129) in Ringland, 905m south-east of the NWL, and the Church of All Saints including Boundary Wall to Churchyard (NHLE ref: 1372689) in Weston Longville, 385m south-west of the site of the NWL. The Grade II* listed building is the Church of St Margaret (NHLE ref: 1051548), a ruin of a former 11th–13th century church building, 515m north-east of the NWL. The Grade II listed buildings are located between 50m and 950m from the NWL. The presence of curtilage structures associated with these buildings within the site is considered unlikely, with the exception of Barn 50m north-west of Low Farm House, but it would be considered as part of a more detailed future assessment. Curtilage is the original property boundary of the listed building and, whilst an associated structure within the curtilage may not be specifically mentioned in the statutory description, is may be covered by the listing protection.

NON-DESIGNATED HERITAGE ASSETS

6.2.6. Two trial trench archaeological evaluations have been carried out within or extending into the northern part of the site. An evaluation on the Norwich Northern Distributor Road, in the area of the A1067 recorded ditches and possible pits. A potentially medieval pit was the only feature that could be convincingly dated. A small number of prehistoric finds included worked flints and single sherds of Middle Bronze Age and Late Bronze/Early Iron Age pottery. No features were recorded during an evaluation at Old Hall Farm. Consequently, current understanding of the nature and extent of past human activity over the majority of the NWL, in particular for the prehistoric, Roman and early medieval periods, for which there is no written record, is limited. This limitation is reflected in the assessment of the level of significance of non-designated heritage assets provided in the TAG.

6.2.7. Within the site boundary the following non-designated heritage assets are recorded on the Norfolk Historic Environment Record (HER). An initial indication of the likely significance of the assets has been included as part of this appraisal:

- A possible Roman field system, identified from cropmarks (HER ref: 53485). This asset is of medium or possibly high heritage significance, depending on nature and extent;
- An area of post-Roman features and prehistoric finds, found during the evaluation on the Norwich Northern Distributor Road (HER ref: 63365), the significance of which is low or medium;
- Possible Iron Age/Roman field boundaries and enclosures, identified from cropmarks (HER refs: 54357, 60610, 50615). These assets are of medium or high significance, depending on their nature and extent;
- Later medieval/post-medieval field systems; field boundaries/trackways, identified from cropmarks (HER refs: 50608, 50609, 50614, 50616, 54364). These assets are of likely low significance;
- Undated ditches and pits (HER refs: 50605, 50619, 53625, 53681), identified from cropmarks. These assets are of unknown significance;
- A World War 2 accommodation and training site (HER ref: 53474). This asset is of medium significance;
- Attlebridge Airfield (HER ref: 3063) and associated structures dating to World War 2 (HER refs: 40754, 40755, 40757, 41342, 41343, 40753). These assets are of low or medium significance;
- A World War 1 and 2 military training site (HER ref: 50618). This asset is of medium significance; and
- Honingham Park, a post-medieval landscape park (HER ref: 44183). This asset is of medium significance

POTENTIAL FOR POSSIBLE, PREVIOUSLY UNRECORDED ARCHAEOLOGICAL REMAINS

6.2.8. There is a moderate to high potential for previously unrecorded non-designated heritage assets within the site boundary. Any previously unrecorded assets could be of low, medium or high significance, depending on their nature, date, extent and survival.

6.2.9. The River Wensum and River Tud Valley geology includes areas of natural sand and gravel which, along with the riverine topography, provide an indication of suitability for early settlement due to the preference for well-drained gravels close to predictable resources provided by rivers. The study area therefore has moderate to high potential for archaeological remains, the value and integrity of which, are likely to be insufficiently understood to inform an assessment at this stage. River alluvium may

contain well-preserved (due to waterlogging) palaeoenvironmental remains. Such remains have evidential value for the past environment in which prehistoric and later people lived and would be of low or medium heritage significance.

6.2.10. The proposed site boundary is outside the known historic settlements of Weston Longville, Honingham and Ringland, and thus the potential for buried remains is likely to be low, other than agricultural features such as field ditches. In terms of the integrity of the historic landscape, this appears to have remained largely in terms of field parcels and boundaries that would have been established following Parliamentary enclosure, other than in the area of the airfield.

6.2.11. Due to the land being agricultural there is a high potential for buried archaeological remains from the prehistoric period onwards to survive along the NWL. Mechanised ploughing will have caused some disturbance to any archaeological remains present to a depth of around 0.3–0.4m, although cut features such as pits and ditches are likely to survive intact.

6.3 METHODOLOGY

6.3.1. This appraisal uses information derived from a Heritage Constraints Report for the Norwich Western Link which was produced by WSP in April 2019 as part of the initial optioneering exercise.[28] Baseline data was also consulted online to ensure that it is up to date. An accompanying TAG worksheet has been produced for according to the Department for Transport (DfT) TAG Unit A3 Environmental Impact Appraisal. The key data sources comprised:

- National Heritage List for England (NHLE). Statutory designations, including scheduled monuments; statutorily listed buildings; registered parks and gardens; and registered battlefields;
- Norfolk Historic Environment Record (HER) Primary repository of archaeological information including past investigations, local knowledge, find spots, and documentary and cartographic sources;
- Broadland District Local Planning Authority. Information on Conservation Areas;
- British Geological Survey (BGS). Solid and drift geology and topography, which can provide an indication of potential for early human settlement;
- National Library of Scotland. Online historic Ordnance Survey mapping from the 1st edition (1860s/70s) onwards; and
- Google Satellite imagery and Streetview. The imagery was scrutinised to assist with the appraisal of possible impacts to the setting of designated heritage assets.

6.3.2. The study area comprised a 500m buffer around the Red Line Boundary for the identification of non-designated heritage assets and 1km buffer for designated heritage assets, due to the longer views and hence the potential impacts upon the setting of these assets.

6.3.3. A site visit was undertaken on 6 June 2019 as part of the optioneering exercise. This was a rapid visual appraisal of above ground heritage assets potentially impacted by five route options that were under consideration at the time. Assets were viewed from publicly accessible areas.

[28] Norwich Western Link Heritage Constraints Report (WSP, April 2019)

6.3.4. A second site visit was undertaken on 7 November 2019 as part of the Strategic Outline Business Case (SOBC). Surveyors undertook an initial visual assessment of designated heritage assets potentially impacted by the preferred option, including possible impacts to heritage significance through changes to setting. Heritage assets were viewed from publicly accessible areas. Surveyors did not enter the internal spaces of any above ground heritage assets.

6.3.5. A third site visit was undertaken on 16 and 17 March 2021 as part of the Historic Environment Desk Based Assessment (HEDBA). Surveyors undertook a walkover of the whole of the proposed route and a visual assessment of designated heritage assets potentially impacted by the preferred option, including possible impacts to heritage significance through changes to setting. Surveyors did not enter the internal spaces of any above ground heritage assets. Surveyors were not able to view assets located within the Morton Hall Estate.

6.3.6. A geophysical survey was carried out from November 2020 to March 2021 over 102Ha of the site. Probable and possible archaeological activity was identified, including possible enclosures with internal features. Anomalies possibly relating to burnt/fired material have also been identified. Agricultural activity has been identified in the form of modern ploughing trends, former mapped and unmapped field boundaries and ridge and furrow cultivation.

6.4 IMPACT APPRAISAL

ABOVE GROUND HERITAGE ASSETS

6.4.1. There are unlikely to be any direct impacts (i.e. physical removal or alteration) on designated heritage assets.

6.4.2. The NWL has the potential to impact on the significance of designated heritage assets located beyond the site boundary through changes to their setting. Setting is the way in which an asset is understood and experienced and is not an asset in itself. Changes to setting could include the loss of surrounding rural and agricultural land, impacts from traffic flow and noise, and impacts from road infrastructure, including road lighting.

6.4.3. The Church of St Peter, dating to the 13th–15th centuries, is located in Ringland, approximately 905m south-east from the site boundary at its closest point. The asset has a visual and historic relationship to its churchyard and to designated heritage assets in Ringland. The asset is also defined by its location in the village of Ringland. Long views out from the asset will be characterised by the surrounding rural and agricultural landscape. The NWL could potentially impact on long views out from the asset towards the site, through loss of the surrounding rural land and from impacts to views caused by traffic flow, traffic noise and road lighting. It would not impact on the asset's relationship to its churchyard or to Ringland, while distance from the site is likely to mitigate any impacts.

6.4.4. The Church of All Saints including Boundary Wall to Churchyard largely dating to the 13th–14th centuries, is located in Weston Longville, approximately 385m south-west of the site boundary at its closest point. The asset will have a visual and historic relationship to its churchyard and to designated heritage assets in Weston Longville. The asset is also defined by its location in Weston Longville and by surrounding rural and agricultural land. The NWL could potentially impact on views out from the asset towards the site through a loss of the rural landscape and from impacts caused

by traffic flow, traffic noise and road lighting. It would not impact on the asset's relationship to its churchyard or to Weston Longville.

6.4.5. The Grade II* listed Church of St Margaret is largely a ruin of a 11th–13th century church building, located approximately 515m north-east from the site boundary at its closest point. The asset is defined by its relationship to a group of Grade II listed buildings at Morton Hall. These are: Water Cistern at South East Corner of St Margaret's Churchyard (NHLE ref: 1170905), Garden Walls to West of Morton Hall (NHLE ref: 1170917), Morton Hall (NHLE ref: 1051549) and Garden Walls Including Owl House at Home Farm, Morton Hall Estate (NHLE ref: 1390577). The asset is also defined by its surrounding rural landscape. The NWL could potentially impact on views out from the asset towards the site through a loss of the rural landscape and from impacts caused by traffic flow, traffic noise and road lighting, although intervening tree belts would likely limit these impacts. It would not impact on the asset's relationship to the Morton Hall Estate.

6.4.6. The nearest Grade II listed building to the Proposed Scheme is Barn 50m north-west of Low Farm House (NHLE ref: 1051550), a 17th century threshing barn, located approximately 50m east of the site boundary. The proximity of the asset to the route means that the asset's immediate setting would be impacted with the loss of surrounding rural and agricultural land. A potential viaduct across the River Wensum would be prominent in views out from the asset towards the north-east. Traffic flow, traffic noise and road lighting would also be prominent in the asset's setting.

6.4.7. The Grade II listed buildings in Weston Longville and Honingham are defined by their relationships to each other and to the surrounding wider landscape. Potential impacts to long views out towards the site are possible, but the NWL would not impact on the assets' key relationships.

6.4.8. The NWL could also potentially impact on two isolated Grade II listed buildings located beyond the site boundary. These are Green Farm House (NHLE ref: 1372687), 575m north-west of the site boundary and Stables and Coach House to Honingham Hall (NHLE ref: 1372666), 950m south-east of the site boundary. This would primarily be though the loss of surrounding rural and agricultural land, as well as impacts from traffic flow, traffic noise and road lighting.

6.4.9. Taken overall, the NWL would have a **moderate adverse effect** on the setting (context) of listed buildings located beyond the site boundary. It will adversely affect the appreciation and understanding of the characteristic historic environmental resource.

BURIED HERITAGE ASSETS

6.4.10. Within the site boundary the non-designated heritage assets described in the Baseline Conditions and previously unrecorded non-designated assets could potentially be impacted. Possible palaeoenvironmental remains in the Wensum and Tud valleys could be affected.

6.4.11. Works carried out as part of the initial site set up, including preliminary topsoil stripping across the site and any temporary access roads and temporary work compounds and topsoil storage areas, the installation of site fencing and welfare facilities could cause an impact. The excavations for the proposed road would entirely remove any archaeological remains within the excavation footprint. The excavation of any new attenuation ponds, planting, landscaping, service trenches and drains would entirely remove any archaeological remains within the trench footprint.

6.4.12. Prior to the implementation of an agreed mitigation strategy, the NWL would result in a **number of low, moderate or major adverse effects** on the undesignated heritage assets recorded on the HER along with any previously unrecorded buried heritage assets, resulting in loss of features such

that their integrity is substantially compromised. The severity of environmental effect would depend on the significance of the asset. The heritage significance of such assets would depend on their nature, date, extent and survival but might be local or regional (potentially national if extensive and well preserved). A more detailed assessment for planning would consider the individual effects in greater detail.

6.4.13. An accompanying TAG worksheet has been produced in line with the Department for Transport (DfT) TAG Unit A3 Environmental Impact Appraisal.

6.5 POTENTIAL MITIGATION

6.5.1. Where any potential adverse effects resulting from the NWL are identified, strategies to reduce the impact of the NWL should be examined. Where the effects are on the setting of heritage assets, and where the setting is judged to contribute the significance of the asset, the impacts may be mitigated by design, such as the introduction of screening or an appropriate road lighting scheme.

6.5.2. For below ground remains, the impacts can be reduced where feasible and warranted, through either mitigation by design, allowing remains to be preserved *in-situ*, or through preservation by record (i.e. archaeological excavation).

6.5.3. The Norfolk County Archaeologist and the Historic England regional office for the East of England should be approached for an opinion, as well as the relevant conservation officers for the area. Following best practice, this should be undertaken in addition to and preferably before the formal scoping process.

6.5.4. Following further assessment and consultation, recommendations for preliminary site-based archaeological investigations will be made. This might typically include a staged programme of non-intrusive geophysical survey, followed by targeted archaeological trial evaluation trenches. Sufficient time should be allowed in the planning programme to allow the results of such work to feed into the planning submission documents. The results of the assessment and site-based evaluation, along with informal and formal consultations should enable the formulation of appropriate mitigation through design considerations, targeted archaeological excavation in advance of construction and recording, and/or archaeological monitoring during preliminary groundworks. The successful implementation of an agreed programme of archaeological mitigation would aim to reduce or offset any adverse effects to negligible.

6.5.5. A high-level Construction and Environment Management Plan (CEMP) and Mitigation Plan will be produced as part of the Environmental Statement (ES) submission which will detail the measures required to mitigate the identified impacts. This will help give certainty on the delivery of the mitigation and compensation measures. A more detailed CEMP will be taken forward by the contractor post Planning Submission.

6.6 SUMMARY

6.6.1. In conclusion, the NWL would have a moderate adverse effect on the setting (context) of listed buildings located beyond the site boundary. It will adversely affect the appreciation and understanding of the characteristic historic environmental resource. Impacts may be mitigated by design, such as the introduction of screening or an appropriate road lighting scheme.

6.6.2. The NWL also would result in a number of low, moderate or major adverse effects on the undesignated heritage assets recorded on the HER along with any previously unrecorded buried

heritage assets. The impacts can be reduced where feasible and warranted, through either mitigation by design, allowing remains to be preserved in-situ, or through preservation by record (i.e. archaeological excavation).

6.6.3. Further surveys took place in 2020 and 2021 to complete the Archaeological baseline and will feed into the future assessment work for the NWL. The Environmental Statement (ES) is being prepared by WSP, which will contain more detailed design information and a more thorough impact assessment subsequently providing more site-specific mitigation measures to attempt to reduce impacts and risks further.

7 BIODIVERSITY

7.1 INTRODUCTION

7.1.1. This section describes the existing biodiversity baseline and the anticipated impacts of the NWL on biodiversity features present within the Biodiversity Study Areas. Preliminary details on the proposed and developing mitigation and compensation strategies for the features have been provided. All biodiversity features scoped into the ES[29] (as described in the '2020 Scoping Report') have informed the TAG appraisal in support of the OBC. Biodiversity features scoped into the ES comprise: designated sites, habitats, flora and fauna. Further details specific to each feature are provided below.

7.1.2. Baseline data collection commenced in July 2018 based on the six potential highway alignment options. Survey work continued, focussing on the Preferred option (the NWL) from July 2019. Survey work is ongoing and is expected to be completed by the end of September 2021. This biodiversity section outlines the baseline findings gathered to date. It also identifies ongoing field surveys required to complete the baseline in line with defined Study Areas.

7.2 CONSULTATION

7.2.1. Over the course of the project there has been statutory consultation with Natural England and the Environment Agency to agree approaches to survey and assessment and to discuss mitigation and compensation proposals. Additionally, an Ecology Liaison Group has been set up with a good range of conservation groups who are active in recorded species and habitats in Norfolk, represented.

7.3 STUDY AREA

7.3.1. The Biodiversity section of the 2020 Scoping Report contains details on the approximate study areas for the biodiversity features potentially impacted by the NWL.

7.3.2. Table 7-1 sets out study areas for features considered further to the 2020 Scoping Report which will also be reported in the ES.

Table 7-1 - Study Area for Additional Scope in Biodiversity Features

Biodiversity Feature	Study Area
Non-vascular plants, fungi and lichens	Desk Study Biological records for all non-vascular plant, fungi and lichen species within and up to 2km from the NWL scheme.
	Field Survey National vegetation classification (NVC) within the NWL scheme. Fungi survey - all woodland and grassland within the NWL scheme. Lichen survey (subject to an initial scoping study) – within NWL scheme.

[29] NWL EIA Scoping Report 2020

Biodiversity Feature	Study Area
Ancient / veteran hedgerows	Desk Study Within and directly connected (root protection area) to the NWL scheme.
	Field Study Within and directly connected (root protection area) to the NWL scheme.

7.4 BASELINE CONDITIONS

7.4.1. The TAG provides details on the various biodiversity features of relevance to the NWL scheme.

BIODIVERSITY CONTEXT

7.4.2. The following sources were consulted to collate historical ecological records within the relevant study areas of the NWL scheme.

- Ordnance Survey (OS) website (www.ordnancesurvey.co.uk);
- Online photographic resources, including publicly accessible aerial photography;
- The Multi-agency Geographic Information for the Countryside (MAGIC) service;
- Norfolk Biodiversity Information Service (NBIS); and
- BirdTrack Data from the British Trust for Ornithology (BTO).

7.4.3. Records were limited to statutory and non-statutory designated sites and species records from 2010 onwards.

Designated Sites

7.4.4. The following internationally designated sites are within 10km of the NWL scheme, increased to 30km for bats (Table 7-2).

Table 7-2 – Internationally Designated Sites

Site and designation	Approximate distance and direction from Scheme
River Wensum Special Area of Conservation (SAC)	Within the NWL scheme footprint
Norfolk Valley Fens SAC	6.3km north-east
Paston Barns SAC	c. 26km from the NWL scheme at the closest point

7.4.5. Given the distance and lack of identifiable potential effect pathways from the Scheme to NWL Paston Barns SAC and Norfolk Valley Fens SAC, these sites have been scoped out of the assessment. This approach has been agreed with Natural England.

7.4.6. Nationally statutory designated sites have been considered up to 5km from the NWL scheme. Of the five sites identified, listed in the 2020 Scoping Report, the following have been scoped into the ES (Table 7-3).

Table 7-3 – Nationally Designated Sites Scoped into the ES

Site and designation	Approximate distance and direction from Scheme
River Wensum SSSI	Within the NWL scheme footprint

7.4.7. Non-statutory designated sites have been considered within a 2km buffer, or beyond where sites are potentially hydrologically linked to the NWL scheme. Impacts on County Wildlife Sites (CWS) at distances greater than 200m, or not hydrologically linked to the NWL are not considered likely and so have been discounted. Those sites within 200m have been considered based on potential air quality impacts. Table 7-4. includes those CWSs that will be considered within the ES.

Table 7-4 – Local Non-Statutory Designated Sites Scoped into the ES

Site and designation	Approximate distance and direction from Scheme
River Wensum Pastures, Ringland Estates CWS (Ref: 2303)	Within the NWL scheme
Broom & Spring Hills CWS (Ref: 1341)	Within the NWL scheme.
Wensum Pastures at Morton Hall CWS (Ref: 2070)	Within the NWL scheme.
Land adjoining Foxburrow Plantation CWS (Ref: 2116)	Within the NWL scheme.
Fakenham Road, Roadside Nature Reserve (RNR) (Ref: 2116)	Within the NWL scheme.
Primrose Grove CWS (Ref: 2305)	Within the NWL scheme.
Old Covert, Wood Lane CWS (Ref 2109)	10m west of the NWL scheme at the closest point.
Gravelpit Plantation and Church Hill CWS (Ref: 2304)	10m east of the NWL scheme at the closest point.
Mouse Wood CWS (Ref: 2050)	15m west of the NWL scheme at the closest point.
Attlebridge Hills CWS (Ref: 1343)	20m north of the NWL scheme at the closest point.
River Tud at Easton and Honingham (Ref: 250)	700m south-east of the NWL scheme at the closest point. (hydrologically connected)
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation (Ref: 2296)	1km south-east of the NWL scheme at the closest point. (hydrologically connected)
Taverham Mill (Ref: 256)	1.9km south-east of the NWL scheme at the closest point. (hydrologically connected)
Ringland Pits (Ref: 1339)	2km south-east of the NWL scheme at the closest point. (hydrologically connected)

HABITAT

Ancient Woodland

7.4.8. An Ancient Woodland Inventory site within 200m of the NWL scheme forms part of Primrose Grove CWS. In addition, Mouse Wood CWS is also listed as an Ancient Woodland Inventory site. The NWL scheme is over 30m from Primrose Grove ancient woodland (south) and Mouse Wood ancient woodland (west) is located adjacent to the pre-existing Wood Lane, a road considered as a possible access route to the NWL scheme. Although no direct impacts (i.e. woodland loss) are expected, both woodlands will be subject to botanical assessment in 2021 and may be scoped into the ES if potential effect pathways are identified (for example resulting from changes in air quality).

Important Hedgerow Survey

7.4.9. Hedgerows which met the criteria for 'Important' have been identified within the NWL scheme.

7.4.10. Additional arboriculture and heritage assessment work for hedgerows will also be undertaken to ensure any potential 'irreplaceable' hedgerows supporting veteran / ancient features are captured. This information is required to feed into the Biodiversity Net Gain strategy, as 'irreplaceable' habitat will not be included within the calculations.

Habitats of Principal Importance (HPI)

7.4.11. The desk study identified the following habitats on Natural England's Priority Habitat Inventory (PHI) within the Proposed Scheme, and up to 200m from the NWL footprint:

- Floodplain Grazing Marsh[30];
- Deciduous Woodland[31]; and
- Lowland Fens[32].

7.4.12. Field survey within and up to 50m from the NWL, identified the following HPI in addition to the floodplain grazing marsh and lowland mixed deciduous woodland above:

[30] UK Biodiversity Action Plan Priority Habitat Descriptions: Coastal and Floodplain Grazing Marsh - http://data.jncc.gov.uk/data/82b0af67-d19a-4a89-b987-9dba73be1272/UKBAP-BAPHabitats-07-CoastFloodGrazingMarsh.pdf

[31] UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Mixed Deciduous Woodland - http://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-30-LowlandMixedDecWood.pdf

[32] UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Fens - http://data.jncc.gov.uk/data/6fe22f18-fff7-4974-b333-03b0ad819b88/UKBAP-BAPHabitats-27-LowlandFens.pdf

- Rivers[33];
- Hedgerows[34]; and
- Wet Woodland[35].

7.4.13. It should be noted that Lowland Fens although noted in desk study information, is not a habitat type which has been recorded within the NWL scheme.

7.4.14. All habitats (not just HPI) within the NWL footprint have been surveyed and mapped with reference to standard Phase 1 habitat survey methodology (JNCC 2010[36]). The dominant plant species were recorded, and habitats classified according to their vegetation types. Further detailed botanical survey work is scheduled for 2021 to complete the baseline.

7.4.15. River Habitat Survey (RHS) was completed in Summer 2020 on the River Wensum with reference to methodologies set out within the RHS guidance (Environment Agency 2003[37]).

Biodiversity Net Gain

7.4.16. The biodiversity baseline calculation will include all habitats (other than irreplaceable[38] habitats and statutory designated sites) within the NWL prior to development. This baseline is informed by the Phase 1 habitat data and results of the condition assessment, with reference to the Biodiversity Metric 2.0 (Natural England 2019[39]). The metric constitutes industry recognised best practice for quantifying whether a development is able to achieve biodiversity net gain.

---

[33] UK Biodiversity Action Plan Priority Habitat Descriptions: Rivers - http://data.jncc.gov.uk/data/01d6ab5b-6805-4c4c-8d84-16bfebe95d31/UKBAP-BAPHabitats-45-Rivers-2011.pdf

[34] UK Biodiversity Action Plan Priority Habitat Descriptions: Hedgerows - http://data.jncc.gov.uk/data/ca179c55-3e9d-4e95-abd9-4edb2347c3b6/UKBAP-BAPHabitats-17-Hedgerows.pdf

[35] UK Biodiversity Action Plan Priority Habitat Descriptions: Wet Woodland - http://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-64-WetWoodland.pdf

[36] Joint Nature Conservation Committee (2010). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit. JNCC, Peterborough.

[37] Environment Agency (2003). River Habitat Survey In Britain and Ireland.

[38] Following Defra guidance, irreplaceable habitats (e.g. veteran trees) within the Proposed Scheme will be identified and excluded from biodiversity unit calculations. It is noted that net-gain or no net-loss of biodiversity cannot be achieved for the Proposed Scheme as a whole if there is a negative impact on an irreplaceable habitat or statutory designated site for nature conservation. As such a different approach will be taken for irreplaceable habitats.

[39] Natural England (2019). The Biodiversity Metric 2.0 – auditing and accounting for biodiversity. User Guide. Natural England Joint Publication JP029.

DETAILED BOTANICAL AND HABITAT ASSESSMENT

National Vegetation Classification (NVC)

7.4.17. NVC survey work is scheduled for 2021 to complete the baseline.

Macrophyte Survey

7.4.18. Macrophyte surveys have been undertaken on the River Wensum in 2019 and 2020 and on the adjoining floodplain ditches in 2020. Species of note recorded during the survey of the River Wensum include water crowfoot *Ranunculus fluitans*. This species is listed within the qualifying habitats description on the River Wensum SAC designation. Fragments of water crowfoot were recorded in the floodplain ditches however these were smothered in silt and displayed early signs of decomposition.

Non-vascular Plants, Fungi and Lichen Survey

7.4.19. These groups will be surveyed in 2021 to complete the baseline.

Veteran / Ancient Trees and Hedgerow Survey

7.4.20. An arboriculture assessment in 2020 has identified the presence of veteran/ancient trees within the NWL scheme. Further survey and assessment work will be undertaken to understand the presence of ancient hedgerows within the NWL.

FAUNA

Terrestrial Invertebrate Survey

7.4.21. Surveys for terrestrial invertebrates will be undertaken in 2021 to complete the baseline.

Aquatic Macroinvertebrate Survey

7.4.22. Surveys for aquatic macroinvertebrates have been undertaken in 2020. The macroinvertebrate communities identified in the samples taken were classified as Moderate to Fairly High conservation value (River Wensum, Foxburrow Stream and Ringland Ditch) with the exception of Hall Ditch, which achieved Fairly High conservation value in the spring and High conservation value in the autumn.

7.4.23.

White-clawed crayfish Survey

7.4.24. Surveys have been undertaken within the River Wensum in 2019. Survey work identified the presence of the non-native signal crayfish *Pacifastacus leniusculus* within the stretch of the River Wensum which was surveyed. No white-clawed crayfish *Austropotamobius pallipes* were recorded. No further surveys are required and this feature has been scoped out of the assessment.

Desmoulin's whorl snail Survey

7.4.25. Survey work in 2019 and 2020 has identified Desmoulin's whorl snail within the NWL scheme. This species is present within suitable vegetated ditches associated with the River Wensum floodplain.

Fish Survey

7.4.26. Electric fishing surveys in 2020 recorded a range of fish species including: chub *Squalius cephalus* pike *Esox lucius*, and dace *Leuciscus leuciscus* within the River Wensum. Brook lamprey *Lampetra*

spp were recorded in adjoining ditches of the River Wensum. No fish were recorded within the Foxburrow Plantation stream. Bullhead *Cottus gobio* were not caught during the fish surveys, however, were observed during the aquatic macroinvertebrate survey of the River Wensum.

Amphibians

7.4.27. Great crested newt (GCN) survey - eDNA surveys of ponds within the 500m of the NWL Scheme have been undertaken and will be completed in 2021. To date, two ponds located over 250m (but within 500m) of the NWL scheme have confirmed GCN presence.

7.4.28. Common toad survey - A dedicated common toad survey has not been undertaken. However, incidental records of common toad have been recorded in Rose Carr. Any evidence of common toad noted during other protected species surveys (e.g. GCN surveys) will be documented.

Reptile Survey

7.4.29. Reptile survey work in 2019 and 2020 has identified low numbers of common reptile species (common lizard *Zootoca vivipara*, grass snake *Natrix helvetica* and slow-worm *Anguis fragilis*), within the NWL scheme.

Birds

7.4.30. A wintering bird survey undertaken in 2018/19 small numbers of species of conservation value present within the survey area within the floodplain habitat immediately surrounding the River Wensum. A second year of survey work is has been undertaken in 2020/21 to complete the baseline.

7.4.31. B. Survey work for breeding birds is ongoing in 2021 , in order to complete the baseline.

The presence of barn owls *Tyto alba* has been established at NWL as established through incidental observations during other survey work. Specific barn owl surveys will be undertaken in 2021.

Bats

7.4.32. Bat surveys to identify bat roosts in trees and structures have been undertaken in 2019 and 2020. Bat roosts in both structures and trees have been recorded within the NWL scheme. Roosts used by species including soprano pipistrelle *Pipstrellus pygmaeus*, brown long-eared bat *Plecotus auritus*, Natterer's bat *Myotis nattereri*, common pipistrelle *Pipistrellus pipistrellus* and barbastelle roost *Barbastella barbastellus* have been identified within the survey area which included land within the scheme footprint and defined buffers beyond this area... Further survey work is scheduled in 2021 to complete the baseline.

7.4.33. A range of bat activity surveys have been undertaken in 2019 and 2020 to identify commuting and foraging bat activity. These surveys have included: radiotracking surveys (focusing on barbastelle bat), vantage point surveys, static bat detector surveys, bat tracking surveys, hibernation surveys and emergence/re-entry roost surveys. Further survey work is scheduled in 2021. Activity surveys to date have recorded over eight species of bat. There has been a specific focus on the barbastelle in the development of the mitigation and compensation strategies given that this is one of the rarer species and is sensitive to impacts arising from road development.

7.4.34. Commuting routes and foraging areas for bats including barbastelle bats have been recorded within the 6km study area and within the NWL scheme.

Badger Survey

7.4.35. Badger *Meles meles* surveys have been undertaken in 2019 and 2020 and further surveys, including badger bait marking surveys have been completed 2021.

7.4.36. Survey work has identified the presence of badger within the NWL scheme. Evidence of setts, commuting and foraging activity have been recorded.

Otter Survey

7.4.37. Otter *Lutra lutra* surveys have been undertaken in 2020Evidence of otter has been recorded along the River Wensum and in the adjoining ditches in the floodplain.

Water Vole Survey

7.4.38. Water vole *Arvicola amphibius* surveys have been undertaken in 2020 and signs of water vole including latrines and burrows has been recorded along the River Wensum and in adjoining ditches.
.

Other Species of Principal Importance (SPI) – Mammals

7.4.39. During ecological survey work undertaken to date, brown hare *Lepus europaeus* and hedgehog *Erinaceus europaeus* (both SPIs) have been recorded within the NWL scheme.

7.5 METHODOLOGY

7.5.1. The appraisal of the likely impacts on biodiversity has been undertaken in accordance with TAG Unit A3 Chapters 5 and 9. The appraisal highlights the importance of identified key resources (features), using guidance contained in Table 9 and 10 of TAG Unit A3, to ascribe biodiversity value.

7.5.2. The Scheme has been developed with consideration for the Mitigation Hierarchy. Ecological impacts upon features have been avoided where possible (e.g. the avoidance of ancient woodland loss). Where avoidance is not possible impacts have been mitigated (e.g. through the provision of green bridges and underpasses) and, where necessary, compensated for (e.g. through the provision of alternative habitat). The NWL scheme will look to achieve a minimum of 10% biodiversity net gain through following DEFRA guidance on The Biodiversity Metric 2.0.

7.5.3. It is important to note that the baseline data collection is ongoing and will not be completed until September 2021. The appraisal is based on data collected and analysed to end of March 2021 and professional judgement regarding the magnitude of possible impact arising from the Scheme design.

7.5.4. TAG assesses construction and operational impacts together and assumes that mitigation measures will be adopted as part of the development of the NWL. Table 7-5 provides high level details on possible impacts and the mitigation and compensation strategies which are currently being considered. Overall Assessment Scores are assigned to each feature based on the biodiversity value and magnitude of impact (with anticipated mitigation measures). The assessment scale ranges from Large Beneficial to Very Large Adverse.

7.5.5. Where schemes include plans for mitigation, this should generally be taken account of in the appraisal of impacts as set out by TAG guidance[40]. For the purpose of this assessment all mitigation including habitat creation in close proximity to the relevant key environmental resource to help conserve existing biodiversity interest is factored in. TAG requires mitigation not in close proximity to relevant key environmental resources to be excluded; in a scenario where habitat creation proposals alter this assessment would need to be revisited.

7.5.6. Preliminary mitigation strategies relevant to key biodiversity features are provided in Table 7-5.

7.5.7. The assessment presented here will be refined and updated as part of the Ecological Impact Assessment and Habitat Regulations Assessment which will feed into the EIA process. This assessment does not pre-empt the outcome of the EIA.

7.6 IMPACT APPRAISAL AND POTENTIAL MITIGATION

7.6.1. Surveys for habitats and species impacted by the NWL are ongoing. However, based on the data currently available, outline mitigation and compensation strategies have been developed. Table 7-5 provides preliminary details on the strategies which are currently being considered. The strategies have not yet been confirmed as it is expected that as further surveys are undertaken, and data is analysed, the strategies will evolve. They will also be further discussed and agreed with statutory consultees.

7.6.2. A high-level Construction and Environment Management Plan (CEMP) and Mitigation Plan will be produced as part of the Environmental Statement (ES) submission which will detail the measures required to mitigate the identified impacts. Ongoing strategic work will focus on the development of a framework for habitat creation that will focus on key ecological features known to be present at NWL. This will help give certainty on the delivery of the mitigation and compensation measures. A more detailed CEMP will be taken forward by the contractor post Planning Submission.

Table 7-5 – Potential impacts and high-level mitigation and compensation strategies for biodiversity features

Biodiversity feature	Possible impact (in the absence of mitigation)	Mitigation/compensation strategy being considered (not all confirmed) in construction and operation phases of development
Designated Sites		
River Wensum SAC and SSSI	Habitat loss, pollution, degradation of habitat, shading, disturbance.	High viaduct to avoid shading impacts. Pollution prevention measures. Measures to protect riparian and aquatic habitats from disturbance or loss.

[40] Department for Transport (2021). *TAG Unit A3, Environmental Impact Appraisal*. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/983703/tag-unit-a3-environmental-impact-appraisal.pdf

Biodiversity feature	Possible impact (in the absence of mitigation)	Mitigation/compensation strategy being considered (not all confirmed) in construction and operation phases of development
County Wildlife Sites (CWS) within Scheme boundaries: River Wensum Pastures, Ringland Estates CWS, Broom & Spring Hills CWS, Wensum Pastures at Morton Hall CWS, Primrose Grove CWS, Land adjoining Foxburrow Plantation CWS and Fakenham Road Roadside Nature Reserve (RNR) (Ref: 2116),	Habitat loss, degradation, pollution, disturbance.	Modification of footprint to reduce habitat loss. Protection measures for retained habitats. Creation of new habitat as part of landscaping and biodiversity net gain strategy. The Fakenham Road RNR is likely to be lost as a result of the NWL scheme and habitat creation targeted at hoary mullein is being considered.
County Wildlife Sites up to 200m of the Scheme boundaries: Old Covert, Wood Lane CWS, Gravelpit Plantation and Church Hill CWS, Mouse Wood CWS, Attlebridge Hills CWS, River Tud at Easton and Honingham CWS, Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plnatation CWS, Taverham Mill CWS and Ringland Pits CWS	Habitat loss, degradation, pollution, disturbance.	Protection measures during construction and future enhancement to mitigate potential effects identified in relation to the operational phase.
Protected and notable species		
Terrestrial invertebrates	Habitat loss (subject to further survey), habitat degradation, pollution	Provision of compensatory habitat through a landscaping and biodiversity net gain strategy.
Aquatic invertebrates	Habitat loss (subject to further assessment), habitat degradation, pollution.	Protection of retained habitats. Pollution prevention measures. Provision of a viaduct over the River Wensum to minimise habitat loss. Enhancement of existing water courses.
Desmoulin's whorl snail	Killing/injury of individuals during construction, habitat loss, pollution, degradation	Protection of retained habitats. Pollution prevention measures. Habitat enhancement in areas of the River Wensum floodplain over 200m away from the Scheme. Translocation of

Biodiversity feature	Possible impact (in the absence of mitigation)	Mitigation/compensation strategy being considered (not all confirmed) in construction and operation phases of development
	of habitat, impacts from nitrogen deposition	supporting habitat. Provision of a viaduct over the River Wensum to minimise habitat loss.
Fish including brook lamprey and bullhead	Habitat loss, degradation of existing habitat, disturbance, pollution	Pollution prevention measures. Enhancement of existing water courses. Provision of a viaduct over the River Wensum.
Great crested newt	Possible habitat loss (subject to further survey), disturbance.	Works undertaken under a European Protected Species Mitigation Licence (EPSML) (if required). Provision of suitable/enhanced habitat (if required).
Common toad	Killing/injury of individuals during construction, habitat loss, pollution, death by vehicle collision	Enhancement of existing aquatic habitat within the floodplain, provision of new terrestrial habitat through a landscaping and biodiversity net gain strategy. Provision of a viaduct over the River Wensum reducing habitat loss. Provision of wildlife underpasses.
Reptile	Killing/injury of individuals during construction, death by vehicle collision habitat loss, pollution.	Provision of a viaduct over the Wensum reducing habitat loss. Sensitive timing of works. Habitat manipulation to encourage reptiles to move from the NWL prior to development. Provision of new foraging/basking/sheltering habitat through a landscaping and biodiversity net gain strategy.
Birds – breeding and winter	Habitat loss, degradation of habitat (subject to further survey), disturbance.	Protection of retained habitats. Sensitive timing of works. Provision of bird boxes to replace lost nesting habitat. Provision of compensatory bird habitat through a landscaping and biodiversity net gain strategy.
Barn owl	Habitat loss, death by vehicle collision.	Sensitive timing of works. Provision of compensatory habitat through a landscaping and biodiversity net gain strategy. Provision of barn owl boxes in the wider area adjacent to the NWL, at sufficient distance to avoid road traffic collision mortality.
Bats	Roost loss, severance of commuting routes and foraging areas, disturbance, death by vehicle collision.	Retention and enhancement of roosting, foraging and commuting habitat. Where habitat must be removed provision of replacement bat foraging and roosting habitat through a landscaping and biodiversity net gain strategy. Provision of suitable crossing features such as green bridges and underpasses to reduce effects of habitat fragmentation. Provision of bat boxes. Sensitive lighting strategy (largely avoiding lighting beyond baseline conditions). Works undertaken under a European Protected Species Mitigation Licence (EPSML) as

Biodiversity feature	Possible impact (in the absence of mitigation)	Mitigation/compensation strategy being considered (not all confirmed) in construction and operation phases of development
		necessary. Soft felling of trees. Sensitive timing of works.
Badger	Sett destruction, disturbance, death by vehicle collision.	Retention and enhancement of woodland habitat and other habitats used by badger. Where habitat must be removed provision of compensatory foraging habitat through a landscaping and biodiversity net gain strategy. Provision of pipe culverts, fencing, underpasses and green bridges to reduce effects of habitat fragmentation. Works will occur under a Badger Licence as necessary. Careful closure of existing setts and provision of replacement setts as dictated by licencing requirement. Sensitive timing of works.
Otter	Possible habitat loss (subject to further survey), disturbance, barrier to movement, death by vehicle collision.	Retention and enhancement of aquatic habitats. Provision of a viaduct over the Wensum and underpasses to reduce effects of habitat fragmentation. Works undertaken under an EPSML (if required).
Water vole	Killing/injury of individuals during construction, habitat loss (subject to further survey), disturbance, pollution.	Retention and enhancement of aquatic habitats. Provision of a viaduct over the Wensum and underpasses to reduce effects of habitat fragmentation. Works under a Conservation Licence (if required). Sensitive timing of works.
Brown hare	Killing/injury of individuals during construction, habitat loss, death by vehicle collision	Wildlife underpasses and green bridges to help reduce the severance impacts. Provision of replacement habitat through a landscaping and biodiversity net gain strategy.
Hedgehog	Killing/injury of individuals during construction, habitat loss, death by vehicle collision.	Wildlife underpasses and green bridges to help reduce severance impacts. Provision of habitat through landscaping and biodiversity net gain strategy.
Habitats and Protected/Notable Vascular and Non-Vascular Plant, Fungi and Lichens		
Ancient woodland	Degradation/disturbance of habitat (subject to further surveys), pollution.	Avoidance of habitat loss of ancient woodland. Protection of retained woodland.
Woodland and trees (non-ancient)	Habitat loss, degradation/disturbance of habitat (subject to further surveys).	Protection of retained habitats. Creation and enhancement of woodland habitat through a landscaping and biodiversity net gain strategy.

Biodiversity feature	Possible impact (in the absence of mitigation)	Mitigation/compensation strategy being considered (not all confirmed) in construction and operation phases of development
Floodplain grazing marsh	Habitat loss, degradation/disturbance of habitat, pollution (subject to further surveys).	Protection of retained habitats. Pollution prevention measures. Provision of compensatory habitat through a landscaping and biodiversity net gain strategy.
Hedgerows	Habitat loss, severance, degradation, pollution.	Protection of retained hedges. Creation and enhancement of hedgerows.
Rivers/streams	Habitat loss, pollution, degradation of habitat, shading.	Provision of a viaduct over the River Wensum to avoid direct habitat loss and shading impacts. Pollution prevention measures. Protection of retained habitat. Provision of underpasses. Enhancement of existing water courses.
Macrophytes	Habitat loss, pollution, degradation of habitat.	Provision of a high viaduct to avoid shading impacts. Pollution prevention measures. Enhancement of existing water courses.
Non-vascular plants, fungi and lichens	Habitat loss, pollution, degradation (subject to further surveys).	Provision of compensatory habitat through a landscaping and biodiversity net gain strategy.

BIODIVERSITY NET GAIN AND VETERAN / ANCIENT TREE AND HEDGEROW STRATEGY

Biodiversity Net Gain

7.6.3. Biodiversity Net Gain (BNG) is an objective and approach to development that leaves biodiversity in a better state than before. It is anticipated that BNG will be made mandatory within the new Environment Bill, with the expectation that developments deliver at least a 10% BNG. A BNG strategy for the NWL scheme is currently being developed.

7.6.4. BNG for the NWL scheme will be delivered with reference to the 10 good practice principles published by Chartered Institute of Ecology and Environmental Management (CIEEM), Construction Industry Research and Information Association (CIRIA) and Institute of Environmental Management and Assessment (IEMA) [41]. The NWL will impact veteran / ancient trees and important hedgerows which are considered in policy terms an irreplaceable habitat (see below) and crosses an SAC. Therefore, in line with the best practice principles, BNG cannot be claimed for the whole Scheme.

[41] CIEEM, CIRIA, IEMA (2016). Biodiversity Net Gain – Good practice principles for development (2016)

The aim is to achieve BNG for all applicable habitats. A separate strategy for veteran / ancient trees and important hedgerows is currently being developed.

7.6.5. Natural England advised that BNG should be considered on a landscape scale and that it should target woodland and wetland. Barbastelle bat will be a particular focal point for the BNG strategy. It is anticipated that BNG delivery will be focussed within the 6km core sustenance zone for barbastelle bat[42] roosts recorded in proximity to the NWL scheme. Approaches for BNG delivery are likely to include woodland creation and woodland management to enhance the woodlands in the long term for barbastelle bat and other species.

Veteran / Ancient Tree and Important Hedgerow Strategy

7.6.6. A veteran / ancient tree and hedgerow strategy is currently under development and further information regarding mitigation will be included within the ES following a complete baseline.

7.7 SUMMARY

7.7.1. The TAG assessment (see Appendix G has concluded that there are Large Adverse impacts on the following features:

- Bats (all species).

7.7.2. The NWL will require removal of habitat used by the local bat population that includes rarer species, notably the barbastelle bat. The designs are subject to refinement, and in line with the mitigation hierarchy habitat loss will be avoided where possible. A mitigation strategy is being developed that both seeks to reduce impacts of habitat fragmentation primarily through the provision of underpasses and green bridges and avoid net loss in habitat available to bats through the provision of a comprehensive landscaping and biodiversity net gain strategy.

7.7.3. Habitat creation and enhancement seeking to maintain habitat availability will be completed within the core sustenance zone for known barbastelle bat colonies near to the scheme. This approach reduces medium to long-term impacts upon the local bat population. The combination of habitat enhancement and creation is proposed to limit shorter term impacts, with enhancement contributing towards a greater area of mature woodland suitable for use by foraging and commuting bats in the shorter term while habitat creation areas become established. In combination, the mitigation strategy seeks to increase the area of habitat available to the local bat assemblage in the longer term.

7.7.4. It will be important to maintain habitat permeability and reduce the effects of habitat fragmentation that may otherwise occur. The scheme includes the following proposals:

- a viaduct across the River Wensum and associated floodplain habitat;
- three wildlife underpasses - in The Nursery woodland in the north, along Ringland Lane (dual use) and along the stream south of the Foxburrow Plantation in the south;
- three green bridges - along the Broadway, in the Foxburrow Plantation and along the hedgerow north of Weston Road; and

[42] Bat Conservation Trust (2016). Core sustenance zones: determining zone size. 04.02.19.

- landscaping to promote the use of these features by bats and avoid direct flight lines into the traffic corridor.

7.7.5. The mitigation strategy remains under development, reflecting the design stage and ongoing nature of baseline surveys. Data gathered during 2021 will influence the strategy. As the strategy is not yet fixed a precautionary approach must be taken, and as such the magnitude of effect upon bats is assessed to be 'intermediate negative' defined as '*The key environmental resource's integrity will not be adversely affected, but the effect on the resource is likely to be significant in terms of its ecological objectives.'.* This may be updated subject to completion of baseline surveys and finalisation of the associated mitigation strategy.

7.7.6. The combination of a high value biodiversity feature and an effect of intermediate negative magnitude gives a large adverse effect. It should be noted that this assessment is precautionary and reflects the status of the mitigation strategy which is yet to be finalised as set out above.

7.7.7. The TAG assessment has concluded that there are Moderate Adverse impacts on the following features:

- Wensum Pastures at Morton Hall CWS;
- Land adjoining Foxburrow Plantation CWS;
- Broom & Spring Hills CWS;
- Primrose Grove CWS
- Fakenham Road RNR;
- Ancient/veteran trees;
- Important Hedgerows;
- Wet Woodland HPI; and
- Lowland mixed deciduous woodland HPI.

7.7.8. A Moderate Adverse impact is expected on the above CWS's due to habitat loss and/or severance which could impact the integrity of the CWS. The habitat creation strategy for the scheme will seek to compensate for this habitat loss, and an underpass will be included to ensure the stream within the Land adjoining Foxburrow Plantation will maintain flow post construction into the River Tud.

7.7.9. The Fakenham Road RNR is designated because of the presence of hoary mullein *Verbascum pulverulentum*. This site will be lost due to the construction of the NWL. A compensation strategy will be developed which will aim to recreate the habitat and lead to an increase in hoary mullein within the study area.

7.7.10. Approximately twelve ancient/veteran trees will be removed as a result of the NWL. A strategy for ancient/veteran trees is under development which will help to mitigate the impact of the loss of the trees however they are regarded as an irreplaceable habitat and will not be factored into BNG calculations.

7.7.11. It is anticipated that two hedgerows that met the criteria for 'Important' under the Hedgerow Regulation 1997 will be directly impacted by the Scheme[43]. Mitigation will involve creation, enhancement and translocation.

7.7.12. The NWL bisects areas of lowland mixed deciduous woodland and wet woodland HPI. The woodland to be lost is not ancient. As part of the compensation strategy new woodland will be planted and existing woodland will be enhanced for biodiversity benefit in the longer term.

7.7.13. The assessment for all other features ranges from slight adverse or neutral impacts based on the adoption of preliminary mitigation and compensation measures stated in Table 7-5.

7.7.14. This assessment is based on the data which has been collected and analysed up to March 2021. It is a provisional impact assessment and has been undertaken before the Ecological Impact Assessment, Habitats Regulations Assessment and Water Framework Directive (WFD) assessment have been completed.

7.7.15. The overall assessment score for the NWL is a Large Adverse Impact due to the loss of woodland foraging habitat available to the local bat assemblage which includes the rarer barbastelle bat. This is a precautionary assessment and reflects the status of the mitigation strategy which is yet to be finalised as set out above. Effects upon all other biodiversity features are assessed to be moderate adverse or of lesser significance.

7.7.16. Further surveys are planned in 2021 which will complete the ecological baseline and will feed into the future assessment work for the NWL. The ES is in preparation and will contain more detailed design information and a full assessment of ecological impacts (in line with CIEEM guidelines). The ES will take into account the final design and final mitigation strategies designed to avoid and reduce impacts upon biodiversity features and where possible deliver enhancements.

[43] Eight hedges qualified as Important Hedgerows, but only two of the hedgerows qualified on botanical criteria. One qualified on archaeological and historical criteria, and five only qualified on the basis of protected or notable faunal records associated with them.

8 WATER ENVIRONMENT

8.1 INTRODUCTION

8.1.1. This section presents Water Environment appraisal for the NWL, required to identify any potential constraints in relation to the Water Environment to help inform the OBC. This includes a summary of the baseline conditions, methodology and the likely impact of the NWL on the nearby sensitive receptors.

8.2 BASELINE CONDITIONS

8.2.1. Over the course of the project there has been statutory consultation with Natural England and the Environment Agency to agree approaches to survey and assessment and to discuss mitigation and compensation proposals. In addition, consultation has also been held with Norfolk County Council as Lead Local Flood Authority.

SURFACE WATER

8.2.2. The NWL crosses the River Wensum. The River Wensum is a low gradient groundwater (chalk aquifer) dominated chalk stream. The River Wensum lies within the Anglian River Basin District (RBD); the Management Catchment is Broadland Rivers, and the Operational Catchment is the Wensum. The waterbody is designated as heavily modified and is currently achieving Moderate status. The hydromorphological status 'Supports Good' and hydrological regime currently 'Does Not Support Good'.

8.2.3. The floodplain of the River Wensum in this locality is mostly comprised of managed grassland with areas of fen, wet grassland, woodland and wet woodland. The floodplain has historically been drained for agricultural purposes by a series of Internal Drainage Board 'main drains' and other smaller land drains managed by Norfolk Rivers Internal Drainage Board (IDB). The main drains run parallel to the river, and then join the main channel below each impoundment.

8.2.4. The NWL crosses one unnamed ordinary watercourse, named the Tributary of the Tud or Foxburrow Stream, located between Honingham and Weston Green under the jurisdiction of Norfolk County Council (NCC) as Lead Local Flood Authority (LLFA). The watercourse flows south from Weston Green and joins the River Tud to the east of Honingham approximately 2km downstream of the NWL. In addition to this, the NWL crosses two significant overland flow paths between Weston Road (NGR TG 11652 14387) and Ringland Lane (NGR TG 12528 15116), believed to be ephemeral ordinary watercourses. The flow paths discharge to the River Wensum.

8.2.5. The River Tud, a main river and tributary of the River Wensum, is located approximately 300m to the south of the southern extent of the NWL. The River Tud rises from its source on East Dereham and flows in an easterly direction for approximately 27km to its confluence with the River Wensum below Hellesdon Mill approximately 14.8km downstream of the NWL crossing over the River Wensum (NGR 619831, 310153).

GROUNDWATER

8.2.6. The Study Area is dominated by White Chalk Subgroup (bedrock geology), designated a major aquifer and Principal Aquifer by the Environment Agency. These are deemed capable of supporting

water supplies and/or river baseflow at a regional scale, meaning they usually provide a high level of water storage.

8.2.7. The superficial deposits in the study area are dominated by Sheringham Cliffs Formation to the north and these deposits are composed of sands and gravels. Alluvium and River Terrace Deposits are present along the river channel. The Alluvium is composed of clay, silt, sand and gravel and the River Terrace Deposits are composed of sand and gravel. The south of the site is dominated by the Lowestoft Formation and its composition varies between clay, sand and gravel. There are also sporadic superficial Head Deposits and Happisburgh Glacigenic Formation deposits in the study area. Both are variable in composition and are generally composed of poorly sorted clay, silt, sand and gravel.

8.2.8. The Lowestoft Formation, Alluvium and River Terrace Deposits are classified as Secondary A Aquifers by the Environment Agency. Secondary A Aquifers are defined as permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers. The Head Deposits are classified as Secondary B Aquifers and these are defined as having low permeability layers which may store and yield limited amounts of groundwater but may support local water supplies. The Sheringham Cliffs Formation is classified as both a Secondary A and Secondary Undifferentiated Aquifers by the Environment Agency. Secondary Undifferentiated Aquifers are geologies which have been classed as either Secondary A or B Aquifers historically.

8.2.9. The site is located within a Groundwater Source Protection Zone (SPZ) Total Catchment Zone 3. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon drinking water. Zones around location sites are defined by groundwater travel times to an abstraction. SPZ Total Catchment Zone 3 is defined as the area around a source within which all groundwater recharge is presumed to be discharged at source and defined by a 400-day travel time to the source.

FLOOD RISK

Fluvial Flood Risk

8.2.10. Review of the Environment Agency Flood Map for Planning (Rivers and Sea) indicates that the majority of the study area is located in the low-risk Flood Zone 1 where the risk of flooding from fluvial sources is less than 1 in 1000 (0.1%) in any year. However, the study area does include sections located in the medium risk Flood Zone 2, where the risk of fluvial flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%) in any year, and the high-risk Flood Zone 3, where there is a greater than a 1 in 100 (1%) risk of fluvial flooding in any year. The mapped fluvial flood zones are associated with the River Wensum and the unnamed ordinary watercourse located between Honingham and Weston Green.

8.2.11. Flooding from the River Wensum in the vicinity of the NWL is largely confined to the surrounding rural floodplain and open green space. According to historic flooding records kept by the Environment Agency, the largest flood on the Wensum occurred in 1912. More recently, two rainfall events occurred on 27 May and 20 July 2014 and resulted in the flooding of 80 properties within the Norwich urban area. Along the reach of interest, no flooding incidents have been reported. There are a number of receptors within the wider area including villages both upstream and downstream of the NWL (Attlebridge and Ringland) as well as other isolated properties in the mapped fluvial floodplain within the study area.

Surface Water Flood Risk

8.2.12. Review of the Environment Agency Flood Risk from Surface Water map indicates that sections of the study area are at high, medium and low risk of flooding from surface water sources. Flooding from surface water is typically associated with natural overland flow paths and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events.

8.2.13. In this locality, it is believed that areas at risk of surface water flooding are limited to fluvial flow associated with ephemeral ordinary watercourses and drainage ditches that are not mapped on the flood map due to catchment size. This indicates that fluvial flood flows will broadly remain within the watercourse channels up to the 1 in 1000-year event. The most notable of these are between Weston Road (NGR TG 11652 14387) and Ringland Lane (NGR TG 12528 15116) where two significant overland flow paths are identified (as discussed above), believed to be ephemeral ordinary watercourses coinciding with the location of Head deposits in this area.

Other Sources

8.2.14. There is reservoir flood risk in the study area as indicated by the Environment Agency Flood Risk from Reservoirs map. Within the study area, the maximum breach extents are mapped to flow beneath the existing A1067 Fakenham road bridge and conveyed downstream within the River Wensum floodplain. The Flood Risk from Reservoirs Map only represents reservoirs designated under the Reservoirs Act 1975 with a volume of 25,000m^3 or greater and does not include other large storage features.

8.3 METHODOLOGY

8.3.1. The study area for the assessment of impacts to surface water features has been defined by the likely risk to these features. The risk of direct impacts has considered features within 0.5km of the Red Line Boundary (RLB). This is considered appropriate for assessment of risks such as spillage or overland migration of contaminants from professional judgement and experience of similar Schemes. The risk of indirect impacts to surface water features is dependent on hydraulic connectivity and flow characteristics (i.e. how easily pollutants could migrate downstream) however a study area of up to 1km is considered appropriate for the assessment of risks to downstream water quality and geomorphology from professional judgement and experience of similar Schemes.

8.3.2. The study area for the assessment of impacts to groundwater resources includes features up to 1km from the NWL. The importance of groundwater receptors greater than 1km from the NWL will be considered with regard to the connectivity to features within the study area. Receptors considered to be of high importance will be included in the study area. These features may include groundwater abstractions (public and private), local and regional aquifers. The study area is considered appropriate for the assessment of indirect effects.

8.3.3. The current study area for the assessment of flood risk is defined by the likely extent of changes to flood extents as a result of the NWL, although at this stage a distance of 1km is considered appropriate for identification of receptors that may be affected by the NWL.

8.3.4. The potential impacts of the proposed scheme on the Water Environment have been assessed in accordance with guidance and best practice. The following information sources have been used to inform the assessment:

- TAG Unit A3 – Environmental Impact Appraisal, Department for Transport, May 2019[44];
- Design Manual for Roads and Bridges LA 113 - Road drainage and the water environment[45];
- Geology of Britain Viewer, British Geological Survey, 2020[46];
- Catchment Data Explorer, Environment Agency 2020[47];
- Designated Sites View, Natural England, 2020[48];
- Transport Analysis Guidance (TAG), Department of Transport, 2019[49];
- Norwich Western Link, Environmental Scoping Report, Norfolk County Council, 2020[50];
- Magic Map (Nature on the Map), Defra, 2020[51]; and
- Environment Agency's online interactive maps, which hold flood risk and environment data for features including flood risk from rivers, surface water and reservoirs and aquifer and groundwater vulnerability mapping.

8.3.5. The guidance and best practice information listed above has been used to undertake a qualitative assessment of the potential impacts of the proposed scheme upon various features of the water environment. To appraise the magnitude and significance of the NWL, guidance in TAG Unit A3 – Environmental Impact Appraisal has been followed using best judgement for the most likely impact on each feature or group of features.

[44] Environmental Impact Appraisal, Transport Analysis Guidance (TAG) Unit A3. Department for Transport, May 2019. Available at: https://www.gov.uk/transport-analysis-guidance-webtag. Last accessed October 2020.

[45] Highways England (2019) DMRB LA 113 Road drainage and the water environment. Available at https://www.standardsforhighways.co.uk/dmrb/search/d6388f5f-2694-4986-ac46-b17b62c21727. Last accessed October 2020.

[46] Geology of Britain Viewer, British Geological Survey (2019) available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html Last accessed October 2020.

[47] Environment Agency's online Catchment Data Explorer, Environment Agency (2019) available at: https://environment.data.gov.uk/catchment-planning/. Last accessed October 2020.

[48] Designated Sites View, Natural England. https://designatedsites.naturalengland.org.uk/, Last accessed October 2020.

[49] Environmental Impact Appraisal, Transport Analysis Guidance (TAG) Unit A3. Department for Transport, May 2019. Available at: https://www.gov.uk/transport-analysis-guidance-webtag. Last accessed October 2020.

[50] Natural England, MAGIC Map. Available at: https://magic.defra.gov.uk/ Last accessed October 2020.

[51] Norwich Western Link, Environmental Impact Assessment Scoping

8.3.6. The data available online on the EA's interactive maps will only be accurate to when the maps and datasets were last updated by the EA. The maps are designed to be viewed at different scales, for example, groundwater, where data will be collated and interpreted at a higher level and therefore may not reflect local ground conditions at a location.

8.4 IMPACT APPRAISAL AND POTENTIAL MITIGATION

8.4.1. Receptors identified in this assessment include: The River Wensum; Tributary of the River Tud; mapped fluvial floodplains; and the underlying groundwater body (combined superficial and bedrock aquifer). The assessment presented below is post mitigation. A full appraisal of potential impacts to surface water and groundwater is provided in the Water Environment impacts worksheet in Appendix E; a summary of potentially significant impacts is given below.

SURFACE WATER

8.4.2. The appraisal considers the proposed superstructure crossing the River Wensum, comprising a viaduct with piers within the floodplain. No structures are proposed within the channel of the River Wensum or within 10m of River Wensum. This is expected to minimise impacts to the river flow and channel morphology.

8.4.3. The NWL requires the construction of a maintenance access track immediately adjacent to the proposed viaduct to enable inspection of the viaduct over its design life. The track will not require crossing of the River Wensum but will need to be constructed within the floodplain of the River Wensum and cross the land drains located within this area. This will need to be assessed for potential impacts relating to fragmentation/disruption to floodplain connectivity.

8.4.4. The proposed crossing of the Tributary of the River Tud will introduce a culvert into the river channel that will remove natural bed substrate and bank-side habitat, as well as potentially change flow dynamics and sediment transport. This in turn could increase sediment deposition or scour. Crossings of watercourses and any new watercourse channels are expected to maintain the capacity of the channel, ensure no increased flood risk up to the 1 in 100-year event considering the potential effects of climate change, be designed in accordance with DMRB guidance, and be sensitive to ecological requirements.

8.4.5. The Drainage Strategy at this stage of the assessment indicates that infiltration to ground and discharge to nearby watercourses will be utilised to discharge road runoff. Surface water runoff is likely to contain high levels of sediment and hydrocarbons that can pollute surface water and groundwater features. A robust treatment system will therefore be required including measures to manage accidental spillages.

8.4.6. The impact of the NWL on the River Wensum is predicted to be **Negligible with Low Significance**. This is attributable to the high importance of the ecological and hydromorphological quality of the River Wensum and the low risk associated with works to the new bridge crossing.

8.4.7. The impact of the NWL on the Tributary of River Tud (Foxburrow Stream) is predicted to be **Minor Adverse with Insignificant Significance** to the ecological and hydromorphological quality of the Tributary of River Tud associated with the required culverting of this minor watercourse.

8.4.8. The impact of the NWL on the ecological quality of floodplain of the River Wensum is predicted to be **Minor Adverse with Low Significance** associated with the construction of the maintenance access track.

GROUNDWATER

8.4.9. Any potential changes to groundwater flow may impact the Public Water Supply and river baseflows. Local groundwater flooding can occur as a result of below ground structures (piles/foundations/lined ponds/SuDS) having the potential to create a groundwater flow barrier which could result in groundwater level rise in shallow aquifers and potentially cause groundwater flooding. The impact is considered to be **Negligible/Minor Adverse** with a significance of **Low Significance**. More detailed assessments are required for the River Wensum crossing which include the most significant below ground structures (bridge foundations).

8.4.10. Construction activities will require soil stripping and excavation, removing or reducing the protective cap on groundwater aquifers. Reducing the thickness of unsaturated layers increases groundwater vulnerability. This includes but is not limited to the construction of drainage structures proposed for the NWL. The scheme design will need to consider potential mitigation requirements during the construction and detail design phase to reduce the impact on the groundwater water bodies. Potential risks imposed may be reduced, mitigated and manged with the implementation of industry best practice and solutions tailored for the NWL.

8.4.11. A broad range of potential runoff pollutants, such as hydrocarbons (fuel and lubricants), fuel additives, metal from corrosion of vehicles, de-icer and gritting material, can accumulate on road surfaces. These can subsequently be washed off the road during rainfall events, polluting the receiving groundwater water bodies. Implementation of a Construction Environmental Management Plan (CEMP) and passive treatment incorporated into SuDS should be considered and adhered to during construction and operation of the NWL, to reduce the risk of contamination to the water environment. With the above mitigation measure in place the magnitude of impact to groundwater quality is considered to be **Minor Adverse** with a significance of **Low Significance.**

8.4.12. Mitigation for reduced groundwater recharge due to the introduction of hardstanding should be considered during detail design stage of the scheme. There is potential for a minor beneficial magnitude of positive impact the groundwater water bodies to be implemented during design phase of the mitigation measures.

FLOOD RISK

8.4.13. The north of the NWL will pass through the fluvial Flood Zones 2 and 3 associated with the River Wensum. As discussed above the proposed crossing of the River Wensum will comprise of a viaduct. Piers will be located in the floodplain spaced approximately 70m apart with no embankments proposed, and no structures will be located within the channel of the River Wensum or within 10m of River Wensum. The viaduct soffit will be situated above the 1 in 100-year flood level; the soffit levels and available freeboard will be confirmed at planning stage informed by detailed modelling. This is expected to minimise impacts to flood flow conveyance or loss of flood storage. The design of the structure will be agreed with the relevant authorities at Environmental Statement stage. It is also expected that the access track will be constructed at grade to prevent adverse effects to floodplain storage or flood flow conveyance.

8.4.14. Any loss of fluvial flood storage or impact associated with flood flow conveyance will be compensated to ensure no increased risk of flooding to the NWL or elsewhere up to the 1 in 100-year event considering the potential effects of climate change.

8.4.15. The proposed crossing of natural overland flow paths could increase surface water flood risks if hydraulic connectivity is not maintained, both through blockage of these flow paths or if overland flow inadvertently overwhelms the proposed scheme's surface water drainage system. In order to protect the NWL and maintain hydrological continuity, consideration will be given to maintaining these overland flow paths beneath the NWL.

8.4.16. The NWL will replace currently undeveloped land with impermeable surface that could increase the rate and volume of surface water runoff. A robust surface water drainage system will be expected to ensure discharge from the NWL does not increase flood risk elsewhere up to and including the 1 in 100-year event and allowing for climate change effects. The required attenuation and restriction of the rate and volume of discharge will be agreed with NCC as the LLFA.

8.4.17. The impact of the NWL on flood flow conveyance and storage in the floodplain of the River Wensum is predicted to be **Minor Adverse with a Low Significance** associated with the construction of the proposed viaduct and maintenance access track.

8.4.18. The impacts of the NWL on flood flow conveyance of the Tributary of River Tud (Foxburrow Stream) is predicted to be **Minor Adverse with Insignificant Significance** associated with the construction of the NWL crossing and culvert.

8.4.19. A high-level Construction and Environment Management Plan (CEMP) and Mitigation Plan will be produced as part of the Environmental Statement (ES) submission which will detail the measures required to mitigate the identified impacts. This will help give certainty on the delivery of the mitigation and compensation measures. A more detailed CEMP will be taken forward by the contractor post Planning Submission.

8.5 SUMMARY

8.5.1. The overall Summary Assessment score for the NWL is predicted to be **Moderate Adverse.** This is attributable to the high importance to the River Wensum and the **Negligible** impact of the ecological and hydromorphological quality of the River Wensum and the low risk associated with works to the new bridge crossing. A **Moderate Adverse** impact is predicted to the tributary of the River Tud; the mapped fluvial floodplain; and the underlying groundwater body (combined superficial and bedrock aquifer). Measures are being developed to further mitigate and compensate for these issues.

8.5.2. A conservative approach to the loss of floodplain has been taken until quantitative analysis of potential effects is undertaken to inform the need for compensatory storage or other mitigation.

8.5.3. The Environmental Statement (ES) is being prepared by WSP, which will contain more detailed design information and a more thorough impact assessment subsequently providing more site-specific mitigation measures to attempt to reduce impacts and risks further.

Appendix A

NOISE TAG WORKBOOK

Noise Workbook - Worksheet 1

Proposal Name:	Norwich Western Link
Present Value Base Year	2010
Current Year	2020
Proposal Opening year:	2025
Project (Road, Rail or Aviation):	road

Net present value of change in noise (£):	£38,490

*positive value reflects a **net benefit** (i.e. a reduction in noise)

Net present value of impact on sleep disturbance (£):	£40,071
Net present value of impact on amenity (£):	-£5,219
Net present value of impact on AMI (£):	£7,142
Net present value of impact on stroke (£):	-£1,387
Net present value of impact on dementia (£):	-£2,116

Quantitative results

Households experiencing increased daytime noise in forecast year:	33
Households experiencing reduced daytime noise in forecast year:	10
Households experiencing increased night time noise in forecast year:	3
Households experiencing reduced night time noise in forecast year:	10

Qualitative Comments:

The study area for the assessment has been derived based on guidance within the Design Manual for Roads and Bridges (DMRB), LA 111 Noise and Vibration, May 2020 and is set to a distance of 600m from the kerb of any new roads associated with the scheme. There are 52 residential dwellings within the study area and no additional other sensitive receptors. Generally, within the study area, noise levels are predicted to increase as a result of the scheme, with large increases predicted at isolated receptors towards the centre of the study area where low baseline levels are anticipated. However, some receptors along Wood Lane and Paddy's Lane are predicted to experience noise level reductions as a result of less vehicles using these roads in favour of the scheme.
The Highways England A47 dualling scheme has been included in both the Do-minimum (without scheme) and Do-something (with scheme) scenarios for the purpose of this assessment.

Data Sources:

Norwich Western Link Reference Design
Highways England A47 Dualling Interim Design Fix C Design
OS Mastermap data (from which buildings and roads were extracted)
OS Addressbase Plus Data
2019 LIDAR 1m DTM data
Road traffic flows as provided by project transport consultants

Appendix B

NO2 DIFFUSION TUBE SURVEY

Annualised Results for 2018 from WSP NO_2 Diffusion Tube Survey between 9 September 2019 and 6 March 2020

Site ID	Site Name	X, Y Coordinates	Annualised NO_2 Concentration (µg/m^3)
NWL_1	Castle Meadow	623203, 308616	Insufficient data capture
NWL_2	A1067 Fakenham Road	616984, 314157	21.0
NWL_3	A1067 Fakenham Road	617039, 314101	23.0
NWL_4	River Wensum at Scheme crossing	-	Site access not granted
NWL_5	A1067 over the River Wensum at Attlebridge	612822, 316727	20.0
NWL_6	A1067 at Lenwade	610205, 318259	18.5
NWL_7	A47 north of Honingham	610271, 311986	27.7
NWL_8	A47 west of Easton	612784, 310988	10.6
NWL_9	A1074 Dereham Rd, New Costessey	616934, 310350	25.5
NWL_10	A1074 Dereham Rd, Norwich	619069, 309691	25.9

Notes:

a) All sites were located at roadside.

b) Annualisation of survey data has been undertaken for 2018 in accordance with Defra LAQM.TG(16) procedure. This process used ratified monitoring data from established Automatic Urban and Rural Network background sites at Norwich Lakenfields and Wicken Fen covering the year 2018 and extending to the end of the survey in 2020, and a bias adjustment factor of 0.89 (national factor for 2018 Gradko 50% TEA/Acetone diffusion tube preparation).

c) The diffusion tube at site NWL_1 was co-located with the Norwich CC Castle Meadow (CM1) continuous automatic monitoring station. Only 2 months of data were collected due to tubes going missing between changeovers.

Appendix C

AIR QUALITY TAG WORKBOOK

Air Quality Valuation Workbook - Worksheet 3

Scheme Name:	Norwich Western Link
Present Value Base Year	2010
Current Year	2020
Proposal Opening year:	2025
Project (Road/Rail or Road and Rail):	Road Transport (RT)

Overall Assessment Score:

Impact Pathways Approach (Concentrations)

Present value of change in NO2 concentrations (£):	£9,803
Of which:	
Concentration costs:	£69,555
Other impacts:	-£59,752
Present value of change in PM2.5 concentrations (£):	£62,165
Of which:	
Concentration costs:	£62,211
Other impacts:	-£46

Total Change

Total value of change in air quality (£):	£71,968

*positive value reflects a **net benefit** (i.e. air quality improvement)

Quantitative Assessment:

Impact Pathways Approach (Concentrations)

Change in NO2 assessment scores over 60 year appraisal period: (between 'with scheme' and 'without scheme' scenarios)	-10,684.21
Change in PM2.5 assessment scores over 60 year appraisal period: (between 'with scheme' and 'without scheme' scenarios)	-1,172.63

Qualitative Comments:

The air quality impacts appraisal has been undertaken in accordance with TAG Unit A3 methodology. The calculations are based on the traffic forecasts for the do-minimum and do-something model scenarios for 2025 (opening year) and 2040 (design year), as generated by the Norwich Area Transport Strategy (NATS) traffic model for the OBC.

The affected road links map onto PCM links which are all compliant with the NO2 limit value both with and without scheme. The Impact Pathways approach has been applied in valuation. This accounts for impacts in terms of changes in human exposure to ambient concentations of air pollutants, and impacts that do not directly affect households such as ecosystem damages which are determined in terms of changes in emissions.

Comments on assumptions and uncertainties:
1) Impacts in the design year (2040) are based on vehicle emissions factors and background concentrations for 2030 as the last forecast year in Defra's Emissions Factors Toolkit version 10.1 and 2018-based background map dataset. 2030 emissions factors and background concentrations are applied in all years thereafter, up to the end of the 60 year appraisal period (2084). Consequently, any improvements in air quality that may occur after 2030 are not factored into the appraisal. In this respect the appraisal is considered to be conservative.
2) Traffic growth has not been forecast beyond 2040 and so traffic levels are assumed to be the same in all years thereafter, up to the end of the 60 year appraisal period). In this respect the appraisal is considered to be conservative.

Sensitivity Analysis:

Upper estimate net present value of change in air quality (£):	£284,764
Lower estimate net present value of change in air quality (£):	-£6,445

Data Sources:

Traffic data from NATS model output. Emissions from Defra Emissions Factors Toolkit v10.1. Defra 2018-based background pollutant maps. Pollution Climate Mapping model, 2017 reference year (Open Government Licence v3.0). Property counts derived from Ordnance Survey AddressBase data (under contractor licence from NCC).

Appendix D

GREENHOUSE GASES TAG WORKBOOK

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: Norwich Western Link

Present Value Base Year	2010
Current Year	2020
Proposal Opening year:	2025
Project (Road/Rail or Road and Rail):	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): £19,474,620

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): -456,434
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded -13005

Change in carbon dioxide equivalent emissions in opening year (tonnes): -4,292
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): £569,253
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	0	-269.0709127
Non-traded sector	0	0	0	-13371.33319

Qualitative Comments:

The greenhouse gases appraisal for road transport emissions has been undertaken in accordance with TAG Unit A3 methodology. The calculations are based on the traffic forecasts for the do-minimum and do-something model scenarios for 2025 (opening year) and 2040 (design year), as generated by the Norwich Area Transport Strategy (NATS) traffic model for the OBC. Non-traded CO2e emissions (petrol and diesel vehicles) and CO2e traded emissions (electric vehicles) have been calculated in accordance with DMRB LA 114. The substantial differences in the findings compared to those for Scheme 'Option C' those presented in the SOBC are largely attributed to the major updates to the NATS model for the OBC and DMRB methodology (previously HA 207/07) for calculating emissions of greenhouse gases from road traffic.

Comments on assumptions and uncertainty:
1) Emissions have been calculated across the whole of the NATS model simulation area.
2) Emissions have been estimated for scenarios in 2025 and 2040. For each year between the emissions have been determined by linear interpolation. In the absence of any data for the intervening years, this pragmatic approach adds a degree of uncertainty to the TAG calculations for these years.
3) The NATS model future forecast year is 2040. Beyond 2040 no traffic growth has been assumed. In reality some inter-annual variations in traffic levels and emissions can be expected. This factor adds a degree of uncertainty to the appraisal.
4) Emissions have been estimated based on vehicle fleet composition forecasts which were published pre-COVID-19. The likely impact of COVID-19 on fleet composition in future years cannot be predicted with any certainty at this present time.

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £30,126,533

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £8,833,474

Data Sources:

Traffic data for do-minimum and do-something scenarios in 2025 and 2040 were derived from the NATS model. 'Real-world' link length data used in the calculation of CO2 emissions were derived from Ordnance Survey Open Data and MasterMap base map products. CO2 emissions were calculated using EFT version 10.1.

Appendix E

LANDSCAPE TAG WORKBOOK

TAG Landscape Impacts Worksheet

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	The landscape to the northern end of the proposed route is a wet lowland shallow valley containing the River Wensum. To the south, the land rises up and gently undulates, becoming a plateau of small to medium regular sized fields contained by hedgerow. The River Tud valley with its associated drainage features is located to the southeast. Irregular blocks of woodland cut through this landscape, reducing the order and regularity of field pattern. There are scattered farmsteads through the landscape, along with small settlements - the most notable being Honingham to the south and Weston Longville to the west. Small lanes also cut through the landscape, generally fairly straight with gentle curves.	Local	Common feature at a local scale	Important at the local and regional level	Easily substitutable, although loss of mature hedgerow trees would take much longer (over 25 years) to re-establish.	**Slight Adverse** The Proposed Scheme would bisect and subdivide fields locally, however the alignment is reflective of the pattern of existing roads within this landscape.
Tranquillity	There is some human influence within this landscape, including scattered farmsteads and small settlements, as well as historic estates such as Morton Hall to the north. Ringland and Weston Longville are notable settlements within this landscape. The wind turbines to the east on the old airfield and overhead line which runs north to south are also notable influences within this landscape. Some arable fields have been turned into pig rearing. Views from the plateau give a wider perception of human influence, particularly of traffic along the A47 and A1067. The eastern and western fringes of the study area have the greatest human influence. Perception/ actual tranquility levels likley to be reduced where large roads are visible or where certain human influences are more visible (pig rearing and wind turbines).	Local	Not rare locally	Important at the local level.	Not easily substitutable in the north, but easier to maintain in the south through replacement hedgerow planting.	**Moderate Adverse** The introduction of the viaduct over the River Wensum will substantially reduce tranquillity in the wider area, and locally to the south due to the road being largely in cutting or at-grade, with short sections on embankment influencing a wider area.
Cultural	The landscape has long been associated with farming. Field patterns are largely intact from 14th century, however there is evidence of larger fields and removal of hedgerows in some areas. There are medieval manors which form 18th-century country house estates such as Morten Hall to the north and Easton Estate to the south.	Local	Not rare locally or regionally	Important at local and regional scale.	Not easily substitutable, although former field boundaries can be readily replaced.	**Slight Adverse** The proposed route would bisect the landscape and alter the pattern of enclosure.
Landcover	Landcover is predominately arable farming throughout this landscape with mixed plantation woodland, although some fields have been turned over to pig rearing. There are small ponds throughout this landscape often regular in shape. The river valley to the north and east following the River Wensum is wet meadow and small lakes. Field are contained by hedgerows and infrequent mature trees.	Predominant landcover common at local to regional scale, others less common.	Not rare locally or regionally	Important at the local level.	Easily substitutable.	**Moderate Adverse** The Proposed Scheme would introduce a new viaduct and large dual carriageway through the landscape, and result in the loss of some of the plantation woodland and arable fields.
Summary of character	The landscape is gently undulating arable farmland, with plateau to the south, located between two shallow river valleys. River Tud in the south and River Wensum in the north being the larger of the valleys with noticeable difference in character of wet meadow and mosaic of lakes and drainage ditches. There is some human influence, of note is the over-head line and two wind turbines to the west, with the A47 and A1067 noticeable from the plateau. Settlement is sparse, mainly small farmsteads - the biggest settlement is Honingham located to the south. Land cover is predominately arable fields, contained by clipped hedgerow and infrequent mature trees, with some fields turned to pig rearing. Mixed plantation woodland is common throughout this landscape, often following field boundaries. Roads are generally small lanes, gently curved, and following the field boundaries.	Common locally	Not rare locally or regionally	Important at the local and regional level	The majority of elements are easily substituitable, although the loss of mature hedgerow trees would take much longer to re-establish. Tranquility is also difficult to substitute. Loss of long views along the river valley is not easily substitutable along with historic elements, which would not be easily replaceable.	**Moderate Adverse** The Proposed Scheme would alter the local landscape character through the introduction of the viaduct, loss of woodland and the width of the new road (dual carriageway). However, it's impact is limited to the immediate surroundings due to the road being largely in cutting or at-grade and the presence of woodland blocks.

Reference Sources

MAGIC, Google Earth, Ordnance Survey Mapping, Natural England - National Character Area 78: Central North Norfolk, Breckland District LCA (2007), South Norfolk Landscape Assessment (2001), Broadland District Council Local Development framework - Landscape Character Assessment SPD (2013)

Step 5 - Summary Assessment Score

Moderate Adverse

Qualitative Comments

There would be subdivision of fields, disrupting field patterns locally. There would be sections of embankment and cutting through the landscape which would affect the pattern locally but the viaduct would have a wider impact. The viaduct across the River Wensum will introduce a new feature into this landscape and will have a substantial impact on tranquillity in the north. The road will also alter tranquillity locally along its entire length, although more limited than the viaduct due to it largely being at-grade or in cutting. The alignment, which is duelled, is larger than the existing road infrastructure through this landscape and therefore out of character. There will be some loss of woodland and arable farmland altering land cover locally.

Appendix F

HISTORIC ENVIRONMENT TAG WORKBOOK

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	**Designated heritage assets (physically affected by the scheme)** 1. None. **Designated heritage assets (possible setting impact)** 2. Two Grade I listed buildings. 3. One Grade II* listed building. 4. Fourteen Grade II listed buildings. **Non-designated heritage assets (palaeoenvironmental, prehistoric, Roman and undated/multi-period)** 5. Cropmarks of a possible Roman field system (53485). 6. Post-Roman and undated features and prehistoric finds (63365) 7. Cropmarks of undated and multi-period linear ditches (50605) 8. The findspot of prehistoric flint flakes (18044). 9. Cropmarks of undated and multi-period linear ditches (54356) 10. Cropmarks of possible Iron Age/Roman field boundaries (54357). 11. Cropmarks of possible Iron Age to Roman date enclosures (50610). 12. Cropmarks of possible Iron Age to Roman date enclosures (50615). 13. The cropmarks of undated linear ditches (50619). 14. Cropmarks of undated possible ditches (53625). 15. Cropmarks of undated ditch (53681). 16. **Moderate to high potential** for possible, previously unrecorded remains of these periods 17. **Moderate potential** for palaeoenvironmental remains in the Wensum and Tud valleys. **Non-designated heritage assets (medieval, post-medieval)** 18. World War Two accommodation and training site at Morton Hall (53474). 19. The findspot of a late Saxon brooch and medieval coin (44454) 20. Cropmarks of field boundaries and trackways of probable post medieval date (50608). 21. Cropmarks of probable post medieval date field boundaries (50609). 22. Cropmarks of probable post medieval former field boundaries (50614). 23. Cropmarks of a linear boundary or trackway of unknown, but possibly later medieval to post medieval date (50616). 24. World War One to Two date military training site (50618). 25. Attlebridge World War Two Airfield (3063).	1. N/A 2-4. The protection of Listed Buildings is a national concern (*Planning (Listed Buildings and Conservation Areas) Act 1990*). 5. The Roman field system is of regional importance. 6. The undated features and prehistoric finds are of local or regional importance. 7. The undated and multi-period linear ditches are of regional importance. 8. The findspot of prehistoric flint flakes is of local importance. 9 . The undated and multi-period linear ditches are of regional importance. 10. Iron Age/Roman field boundaries are of regional importance. 11. Iron Age/Roman enclosures are of regional or national importance. 12. Iron Age/Roman enclosures are of regional or national importance. 13. The undated linear ditches are of regional importance. 14. The undated possible ditches are of regional importance. 15. The undated ditch is of regional importance. 16. Previously unrecorded remains are of undetermined importance. 17. Possible palaeoenvironmental remains are of local importance. 18. The World War Two accommodation and training site at Morton Hall are of regional importance. 19. The late Saxon brooch and medieval coin are of local importance. 20. The field boundaries and trackways of probable post medieval date are of local importance. 21. The probable post medieval date field boundaries are of local importance.	1. N/A 2. The Grade I listed buildings are of High significance. 3. The Grade II* listed building is of High significance. 4. The Grade II listed buildings are of Medium significance. 5. The Roman field system is of Medium significance. 6. The undated features and prehistoric finds are of Low or Medium significance. 7. Cropmarks of undated and multi-period linear ditches are of Low or Medium significance. 8. The findspot of prehistoric flint flakes is of Low significance. 9 . The undated and multi-period linear ditches are of Medium significance. 10. Iron Age/Roman field boundaries are of Medium significance. 11. Iron Age/Roman enclosures are of Medium or High significance. 12. Iron Age/Roman enclosures are of Medium or High significance. 13. The undated linear ditches are of Low or Medium significance. 14. The undated possible ditches are of Low or Medium significance. 15. The undated ditch is of Low or Medium significance. 16. Previously unrecorded remains are of undetermined significance. 17. Possible palaeoenvironmental remains are of Low significance. 18. The World War Two accommodation and training site at Morton Hall are of Medium significance. 19. The late Saxon brooch and medieval coin are of Low significance. 20. The field boundaries and trackways of probable post medieval date are of Low significance. 21. The probable post medieval date field boundaries are of Low	1. N/A 2. Nationally, 2.5% of listed buildings are Grade I, making them rare and of 'exceptional interest.' 3. Nationally, 5.8% of listed buildings are Grade II*, making them rare and of 'more than special interest.' 4. Nationally, 92% of listed buildings are Grade II, making them less rare but still of national importance. 5. Roman field systems are relatively rare. 6. Post-Roman and undated features and prehistoric finds are relatively common. 7. Cropmarks of undated and multi-period linear ditches are common. 8. Findspots of prehistoric flint flakes are common. 9. The undated and multi-period linear ditches are relatively common. 10. Iron Age/Roman field boundaries are relatively rare. 11. Iron Age/Roman enclosures are relatively rare. 12. Iron Age/Roman enclosures are relatively rare. 13. Undated linear ditches are relatively common. 14. Undated possible ditches are relatively common. 15. Undated ditches are relatively common. 16. The rarity of any unrecorded remains is unknown. 17. Palaeoenvironmental remains are common within alluvial deposits. 18. World War Two accommodation and training sites are relatively rare. 19. Late Saxon brooch and medieval coins are relatively rare. 20. Field boundaries and trackways of probable post	Moderate Adverse (Built heritage) Low, Moderate or Major Adverse (Archaeology)

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
	26. Honingham Park, a post-medieval landscape park (44183). 27. Cropmarks of field boundaries of unknown but possible medieval to post-medieval date (54364). 28. World War Two air raid shelter at Attlebridge Airfield (40754). 29. World War Two air raid shelter at Attlebridge Airfield (40755). 30. World War Two fuel store at Attlebridge airfield (40757). 31. World War Two structure at Attlebridge Airfield (41342). 32. World War Two structure at Attlebridge Airfield (41343). 33. Site of the Officers' Quarters at Attlebridge airfield (40753). 34. **High potential** for possible, previously unrecorded remains of these periods. 35. Post-medieval Historic Landscape Characterisation areas.	22. The probable post medieval former field boundaries are of local importance. 23. The linear boundary or trackway of unknown, but possibly later medieval to post medieval date is of local importance. 24. The World War One to Two date military training site is of regional importance. 25. Attlebridge World War Two Airfield is of regional importance. 26. Honingham Park is of regional importance. 27. The field boundaries of unknown but possible medieval to post-medieval date are of local importance. 28. The World War Two air raid shelter at Attlebridge Airfield is of local importance. 29. The World War Two air raid shelter at Attlebridge Airfield is of local importance. 30. The World War Two fuel store at Attlebridge airfield is of local importance. 31. The World War Two structure at Attlebridge Airfield is of local importance. 32. The World War Two structure at Attlebridge Airfield is of local importance. 33. The Officers' Quarters at Attlebridge airfield is of local importance. 34. Previously unrecorded remains are of undetermined importance. 35. N/A.	significance. 22. The probable post medieval former field boundaries are of Low significance. 23. The linear boundary or trackway of unknown, but possibly later medieval to post medieval date is of Low significance. 24. The World War One to Two date military training site is of Medium significance. 25. Attlebridge World War Two Airfield is of Medium significance. 26. Honingham Park is of Medium significance. 27. The field boundaries of unknown but possible medieval to post-medieval date are of Low significance. 28. The World War Two air raid shelter at Attlebridge Airfield is of Low significance. 29. The World War Two air raid shelter at Attlebridge Airfield is of Low significance. 30. The World War Two fuel store at Attlebridge airfield is of Low significance. 31. The World War Two structure at Attlebridge Airfield is of Low significance. 32. The World War Two structure at Attlebridge Airfield is of Low significance. 33. The Officers' Quarters at Attlebridge airfield is of Low significance. 34. Previously unrecorded remains are of undetermined significance. 35. N/A.	medieval date are common. 21. Post medieval date field boundaries are common. 22. Post medieval former field boundaries are common. 23. Linear boundaries or trackways are common. 24. World War One to World War Two military training sites are relatively rare. 25. World War Two airfields are relatively rare. 26. Landscape parks are relatively rare. 27. The field boundaries of unknown but possible medieval to post-medieval date are of Low significance. 28. World War Two air raid shelters are relatively rare. 29. World War Two air raid shelters are relatively rare. 30. World War Two fuel stores are relatively rare. 31. World War Two structures are relatively rare. 32. World War Two structures are relatively rare. 33. World War Two Officers' Quarters are relatively rare. 34. The rarity of previously unrecorded remains is unknown. 35. Post-medieval Historic Landscape Characterisation areas are common.	

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Survival	1. N/A. 2-4. The listed buildings are likely to have a good level of survival. Note that the Grade II* listed Church of St Michael is largely a ruin. 5. The level of survival of the Roman field system is unknown. 6. The level of survival of the Post-Roman and undated features and prehistoric finds is unknown. 7. The level of survival of undated and multi-period linear ditches is unknown. 8. No survival, the flint flakes will have been removed. 9. The level of survival of undated and multi-period linear ditches is unknown. 10. The level of survival of Iron Age/Roman field boundaries is unknown. 11. The level of survival of Iron Age/Roman enclosures is unknown. 12. The level of survival of Iron Age/Roman enclosures is unknown. 13. The level of survival of undated linear ditches is unknown. 14. The level of survival of undated possible ditches is unknown. 15. The level of survival of undated ditch is unknown. 16. The level of survival of previously unrecorded remains is unknown. 17. The level of survival of palaeoenvironmental remains is unknown. 18. The level of survival of the World War Two accommodation and training site is unknown. 19. No survival, the late Saxon brooch and medieval coin will have been removed 20. The level of survival of field boundaries and trackways of probable post medieval date is unknown. 21. The level of survival of probable post medieval date field boundaries is unknown. 22. The level of survival of probable post medieval former field boundaries is unknown. 23. The level of survival of a linear boundary or trackway of unknown, but possibly later medieval to post medieval date, is unknown. 24. The level of survival of the World War One to Two date military training site is unknown. 25. Attlebridge World War Two Airfield has a good level of survival. 26. Honingham Park has a good level of survival. 27. The level of survival of field boundaries of unknown but possible medieval to post-medieval date is unknown. 28. The level of survival of the World War Two air raid shelter at Attlebridge Airfield is unknown. 29. The level of survival of the World War Two air raid shelter at Attlebridge Airfield is unknown.	2-34: The level of survival is not directly relevant to the impacts on heritage assets. 35. N/A.	2-34: The level of survival is not directly relevant to the impacts on heritage assets.	2-34: The level of survival is not directly relevant to the impacts on heritage assets.	N/A

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
	30. The level of survival of the World War Two fuel store at Attlebridge airfield is unknown. 31. The level of survival of the World War Two structure at Attlebridge Airfield is unknown. 32. The level of survival of the World War Two structure at Attlebridge Airfield is unknown. 33. The level of survival of the Officers' Quarters at Attlebridge airfield is unknown. 34. The level of survival of previously unrecorded remains is unknown. 35. N/A.				
Condition	1. N/A. 2. The condition of the Grade I listed buildings is unknown. 3. The condition of the Grade II* listed building is unknown. 4. The condition of the Grade II listed buildings is unknown. 5. The condition of the Roman field system is unknown. 6. The condition of the Post-Roman and undated features and prehistoric finds is unknown. 7. The condition of the undated and multi-period linear ditches is unknown. 8. The condition of the flint flakes is unknown. 9. The condition of the undated and multi-period linear ditches is unknown. 10. The condition of the Iron Age/Roman field boundaries is unknown. 11. The condition of the Iron Age/Roman enclosures is unknown. 12. The condition of the Iron Age/Roman enclosures is unknown. 13. The condition of the undated linear ditches is unknown. 14. The condition of the undated possible ditches is unknown. 15. The condition of the undated ditch is unknown. 16. The condition of any previously unrecorded remains is unknown. 17. The condition of any palaeoenvironmental remains is unknown. 18. The condition of the World War Two accommodation and training site is unknown. 19. The condition of the late Saxon brooch and medieval coin will have been removed 20. The condition of the field boundaries and trackways of probable post medieval date is unknown. 21. The condition of the probable post medieval date field boundaries is unknown.	2-34. The condition is not directly relevant to the impacts on heritage assets. 35. N/A.	2-34. The condition is not directly relevant to the impacts on heritage assets. 35. N/A.	2-34. The condition is not directly relevant to the impacts on heritage assets. 35. N/A.	N/A

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
	22. The condition of the probable post medieval former field boundaries is unknown. 23. The condition of the linear boundary or trackway of unknown, but possibly later medieval to post medieval date, is unknown. 24. The condition of the World War One to Two date military training site is unknown. 25. The condition of the Attlebridge World War Two Airfield is unknown. 26. The condition of the Honingham Park is unknown. 27. The condition of the field boundaries of unknown but possible medieval to post-medieval date is unknown. 28. The condition of the World War Two air raid shelter at Attlebridge Airfield is unknown. 29. The condition of the World War Two air raid shelter at Attlebridge Airfield is unknown. 30. The condition of the World War Two fuel store at Attlebridge airfield is unknown. 31. The condition of the World War Two structure at Attlebridge Airfield is unknown. 32. The condition of the World War Two structure at Attlebridge Airfield is unknown. 33. The condition of the Officers' Quarters at Attlebridge airfield is unknown. 34. The condition of any previously unrecorded remains is unknown. 35. N/A.				
Complexity	1. N/A. 2. The complexity of the Grade I listed buildings will include their relationships to other heritage assets and to the wider rural landscape. 3. The complexity of the Grade II* listed building will include its relationship to other heritage assets and to the wider rural landscape. 4. The complexity of the Grade II listed buildings will include their relationships to other heritage assets and to the wider rural landscape. 5. The complexity of the Roman field system is unknown. 6. The complexity of the Post-Roman and undated features and prehistoric finds is unknown. 7. The complexity of the undated and multi-period linear ditches is unknown. 8. The complexity of the flint flakes is unknown. 9. The complexity of the undated and multi-period linear ditches is unknown. 10. The complexity of the Iron Age/Roman field boundaries is unknown. 11. The complexity of the Iron Age/Roman enclosures is unknown. 12. The complexity of the Iron Age/Roman enclosures is unknown.	2-34. The complexity is not directly relevant to the impacts on heritage assets. 35. N/A.	2-34. The complexity is not directly relevant to the impacts on heritage assets. 35. N/A.	2-34. The complexity is not directly relevant to the impacts on heritage assets. 35. N/A.	N/A

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
	13. The complexity of the undated linear ditches is unknown. 14. The complexity of the undated possible ditches is unknown. 15. The complexity of the undated ditch is unknown. 16. The complexity of any previously unrecorded remains is unknown. 17. The complexity of any palaeoenvironmental remains is unknown. 18. The complexity of the World War Two accommodation and training site is unknown. 19. The complexity of the late Saxon brooch and medieval coin will have been removed 20. The complexity of the field boundaries and trackways of probable post medieval date is unknown. 21. The complexity of the probable post medieval date field boundaries is unknown. 22. The complexity of the probable post medieval former field boundaries is unknown. 23. The complexity of the linear boundary or trackway of unknown, but possibly later medieval to post medieval date, is unknown. 24. The complexity of the World War One to Two date military training site is unknown. 25. The complexity of the Attlebridge World War Two Airfield is unknown. 26. The complexity of the Honingham Park is unknown. 27. The complexity of the field boundaries of unknown but possible medieval to post-medieval date is unknown. 28. The complexity of the World War Two air raid shelter at Attlebridge Airfield is unknown. 29. The complexity of the World War Two air raid shelter at Attlebridge Airfield is unknown. 30. The complexity of the World War Two fuel store at Attlebridge airfield is unknown. 31. The complexity of the World War Two structure at Attlebridge Airfield is unknown. 32. The complexity of the World War Two structure at Attlebridge Airfield is unknown. 33. The complexity of the Officers' Quarters at Attlebridge airfield is unknown. 34. The complexity of any previously unrecorded remains of these periods is unknown. 35. N/A.				

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Context	1. N/A. 2. Grade I listed buildings: relationships to assets in Weston Longville and Ringland. Both Grade I listed buildings will have historic and visual relationships to their churchyards and to the immediate rural landscape. Rural. 3. Grade II* listed building: relationship to Grade II listed buildings at or in the vicinity of Morton Hall. Relationship to immediate rural landscape. Rural. 4. Grade II listed buildings: relationships to assets in Weston Longville and Honingham. Relationships to immediate rural landscapes. Rural. 5 - 35. Rural.	2-34. Potential impacts to the context of the listed buildings through changes to their immediate setting. Setting is the way in which an asset is understood and experienced and is not an asset in itself. Changes to setting could include the loss of surrounding rural and agricultural land, impacts from traffic flow and noise, and impacts from road infrastructure, including road lighting. 5-35. The context is not impacted	2-34. Potential impacts to the context of the listed buildings through changes to their immediate setting. Setting is the way in which an asset is understood and experienced and is not an asset in itself. Changes to setting could include the loss of surrounding rural and agricultural land, impacts from traffic flow and noise, and impacts from road infrastructure, including road lighting. 5-35. The context is not impacted	2-34. Potential impacts to the context of the listed buildings through changes to their immediate setting. Setting is the way in which an asset is understood and experienced and is not an asset in itself. Changes to setting could include the loss of surrounding rural and agricultural land, impacts from traffic flow and noise, and impacts from road infrastructure, including road lighting. 5-35. The context is not impacted	N/A
Period	1. N/A. 2. Later medieval. 3. Early and Later medieval. 4. Post-medieval. 5. Roman. 6. Undated/prehistoric. 7. Undated/multi-period. 8. Prehistoric. 9. Undated/multi-period. 10. Iron Age/Roman. 11. Iron Age/Roman. 12. Iron Age/Roman. 13. Undated. 14. Undated. 15. Undated. 16. Unknown. 17. Palaeoenvironmental. 18. Modern. 19. Early medieval/later medieval 20. Post-medieval. 21. Post-medieval. 22. Post-medieval. 23. Later medieval/post-medieval. 24. Modern. 25. Modern. 26. Post-medieval. 27. Later medieval/post-medieval. 28. Modern. 29. Modern. 30. Modern. 31. Modern. 32. Modern. 33. Modern.	2-35. The period is not impacted	2-35. The period is not impacted	2-35. The period is not impacted	N/A

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
	34. Unknown. 35. Post-medieval.				
Reference Sources					
National Heritage List for England Norfolk Historic Environment Record Norwich Western Link Heritage Constraints Report (WSP 2019)					
Step 5 - Summary Assessment Score					
Moderate Adverse (Built heritage) Low, Moderate or Major Adverse (Archaeology)					
Qualitative Comments					
The Proposed Scheme would have a moderate adverse effect on the setting (context) of nearby listed buildings, and will adversely affect the appreciation and understanding of the characteristic historic environmental resource in the area of proposed road construction. The Proposed Scheme would have a low, moderate or major adverse effect on known non-designated assets. The Proposed Scheme would have a low, moderate or major direct impact on previously unrecorded significant historic environment non-designated assets, resulting in loss of features such that their integrity is substantially compromised. The heritage significance of such assets would depend on their nature, date, extent and survival but might be local or regional (potentially national if extensive and well preserved). The heritage significance will be determined through future assessment, including preliminary site-based archaeological investigations.					

Appendix G

BIODIVERSITY TAG WORKBOOK

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
River Wensum Special Area of Conservation (SAC)	**Biodiversity** Chalk-fed river, designated for: Annex I habitat as a primary reason for selection: - Watercourses of plain to montane levels with a water crowfoot *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. - The Wensum represents sub-type 1 in lowland eastern England. Annex II species as a primary reason for selection: - White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes* Annex II species present as a qualifying feature: - Desmoulin's whorl snail *Vertigo moulinsiana* - Brook lamprey *Lampetra planeri* - Bullhead *Cottus gobio* To date surveys have confirmed the likely absence of white clawed crayfish from the stretch of the River Wensum which was considered relevant to the Proposed Scheme and the presence of: Water crowfoot *Ranunculion fluitantis*, Bullhead, Brook lamprey and Desmoulin's whorl snail either within the Wensum or in the supporting ditches within the floodplain.	**International**	**High** Primary habitat: Sub-type 1 has a limited distribution in the UK, being found only in those areas where chalk is present, and is therefore restricted to southern and eastern England. Primary species: White-clawed crayfish. One of only four watercourses in Norfolk that are known to support white-clawed crayfish. Other qualifying feature: Desmoulins's whorl snail. The site supports one of the largest populations in the UK. Other qualifying feature: Brook lamprey. The Wensum has a healthy population of brook lamprey, with clean water and suitable areas of gravels, silt or sand required for spawning. Other qualifying feature: Bullhead. Sites have been selected to encompass the natural geographical range of the species and to represent the range of ecological situations in which it occurs, e.g. both upland and lowland rivers, and both acidic and base-rich situations.	**Target Feature** Anthropogenic influences have had a dramatic effect on the ecology and hydrology of the River Wensum, in particular at sites up and downstream of mill structures, sites affected by channel modification inc. over-widening and deepening, sites affected by excessive silt ingress, sites that are heavily maintained and sites that lack natural riparian vegetation. The following document has been published that includes specific restoration targets for the qualifying features of the SAC: *European Site Conservation Objectives: Supplementary advice on conserving and restoring site features (Natural England 2019).*	**Very high** Internationally important site with limited potential for substitution.	**Neutral**	**Neutral**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
River Wensum Site of Special Scientific Interest (SSSI)	**Biodiversity** Overlaps with River Wensum SAC (see above cell). Notified for: - Flowing waters - Type I: naturally eutrophic lowland rivers with a high base flow. - Flowing waters - Type III: base-rich, low-energy lowland rivers and streams, generally with a stable flow regime - Population of RDB mollusc – Desmoulin's whorl snail. - S25 - *Phragmites australis* - Eupatorium cannabinum tall-herb fen. - S3 - *Carex paniculata* swamp. - S4 - *Phragmites australis* swamp and reed-beds - S5 - *Glyceria maxima* swamp - S7 - *Carex acutiformis* swamp - White-clawed crayfish To date, surveys have confirmed the likely absence of white clawed crayfish from the stretch of the River Wensum which was considered relevant to the Scheme and the presence of Desmoulin's whorl snail either within the Wensum or in the supporting ditches within the floodplain.	**National**	**High** The River Wensum is a SSSI of national importance, supporting a diverse range of protected habitats and species.	**Unknown** The trend for the SSSI is currently unknown. No assessments within the last five years. Target species - See above for trends regarding white-clawed crayfish and Desmoulin's whorl snail. Of the 36 SSSI units for this site, 6 were considered to be in 'Favourable' condition in 2010, with the remaining 30 considered to be in 'Unfavourable - Recovering' condition.	**High** Nationally important site with no potential for substitution.	**Neutral**	**Neutral**
River Wensum Pastures, Ringland Estates County Wildlife Site (CWS)	**Biodiversity:** Predominantly an improved cattle-grazed pasture adjacent to the River Wensum, crossed by a network of drains supporting a species-rich flora associated with aquatic habitats.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown -** The Norfolk BAP does not identify a trend in relation to the habitats associated with this CWS.	**Medium** - County value site with limited potential for substitution.	**Minor negative**	**Slight adverse**
Wensum Pastures at Morton Hall CWS	**Biodiversity:** Predominantly improved cattle-grazed pasture adjacent to River Wensum, crossed by a network of drains supporting a species-rich flora associated with aquatic habitats.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Intermediate negative**	**Moderate adverse**
Land adjoining Foxburrow Plantation CWS	**Biodiversity:** Part of a larger area known collectively as Foxburrow Plantation and The Waterfence. It consists of an extensive area of wet, species-rich grassland situated in the bottom of a spring-fed valley.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Intermediate negative**	**Moderate adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Broom & Spring Hills CWS	**Biodiversity:** Semi-natural deciduous woodland dominated by oak and sycamore.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Intermediate negative**	**Moderate adverse**
Primrose Grove CWS	**Biodiversity:** Structurally varied, predominately consisting of semi-natural broad-leaved and mixed woodland, with some compartments considered to be ancient. Broad-leaved woodland comprised with varying proportions of oak, beech, sycamore and ash. Mixed woodland is represented by Douglas Fir and Scot's Pine.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Intermediate negative**	**Moderate adverse**
Attlebridge Hills CWS	**Biodiversity:** Structurally varied, broad-leaved semi-natural woodland. The canopy is dominated by mature oak, sycamore, sweet chestnut with extensive areas of mixed coppice of hazel, sycamore and sweet chestnut.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown -** The Norfolk BAP does not identify a trend in relation to the habitats associated with this CWS.	**Medium** - County value site with limited potential for substitution.	**Minor negative**	**Slight adverse**
Gravelpit Plantation and Church Hill CWS	**Biodiversity:** Closed canopy semi-natural broad-leaved and mixed plantation woodland, with some stands considered to be ancient in origin. Canopy dominated to varying degrees by oak, ash and sycamore, and the shrub layer is comprised of hawthorn, hazel and holly.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Minor negative**	**Slight adverse**
Old Covert, Wood Land CWS	**Biodiversity**: A coppice woodland with standards that are not listed on the Ancient Woodland Inventory, although it may have once been part of a larger, Ancient Woodland. The wood is managed as coppice and for shooting.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Minor negative**	**Slight adverse**
Mouse Wood CWS	**Biodiversity:** Citation refers to an ancient, replanted woodland which is now predominantly a commercially-managed conifer plantation surrounded mainly by arable farmland. The extent of the existing ancient woodland is unknown.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Minor negative**	**Slight adverse**
River Tud at Easton and Honingham CWS	**Biodiversity:** Citation refers to a watercourse supporting a spcies-rich aquatic, marginal and emergent riverine flora.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Neutral**	**Neutral**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS	**Biodiversity:** Citation refers to a site comprising mainly cattle grazed, inimprove wet pasture, bisected by spring-fed ditches. With areas of wet and dry woodland.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Neutral**	**Neutral**
Taverham Mill CWS	**Biodiversity:** Citation refers to a fishing lake surrounded by marshy and neutral grassland and a mixture of planted and semi-natural woodland on acid soil.	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Neutral**	**Neutral**
Ringland Pits CWS	**Biodiversity:** Citation refers to a flooded disused gravel workings adjacent to the River Wensum .	**County**	**Medium -** Site of county value supporting Habitat of Principal Importance.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this CWS.	**Medium** - County value site with limited potential for substitution.	**Neutral**	**Neutral**
Fakenham Road Roadside Nature Reserve (RNR)	**Biodiversity:** Species: Hoary mullein V*erbascum pulverentum.* Phase 1 habitat surveys of this area have identified the presence of this species.	**County**	**Medium -** Site of county value, with only one qualifying feature behind the designation.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this species.	**Medium** - County value site with limited potential for substitution.	**Major negative**	**Moderate adverse**
Ancient Woodland	**Biodiversity**: Ancient Woodland is an irreplaceable habitat which is important for many reasons, including its value to wildlife, i.e. bats, birds and fungi. An Ancient Woodland Inventory site within 200m of the NWL scheme forms part of Primrose Grove CWS. In addition, Mouse Wood CWS is also listed as an Ancient Woodland Inventory site. The NWL scheme is over 30m from Primrose Grove ancient woodland (south) and Mouse Wood ancient woodland (west) is located adjacent to the pre-existing Wood Lane, a road considered as a possible access route to the NWL scheme.).	**National**	**High** - Detailed baseline data has not been collected, although the route has potential to impact on ancient woodland. Ancient woodland is considered one of the richest land-based habitats for wildlife.	**Declining** - Ancient woodland is in significant national decline, with a current UK coverage of only 2%.	**High** - National value habitat with no potential for substitution.	**Neutral**	**Neutral**
Ancient / Veteran Trees and Hedgerows	**Biodiversity:** A number of veteran and ancient trees are present within the Scheme, both as stand-alone features and within hedgerows or other important habitats. Veteran and ancient trees are considered irreplaceable habitats, and a BS5837 survey has been completed by Arboriculturists to identify trees which are veteran or ancient. Further assessment works will be completed in 2021 to consider hedgerows.	**County**	**High** - The BS5837 survey has identified a number of veteran and ancient trees within the Scheme. Veteran and ancient trees are considered to be an irreplaceable habitat and are of high value to a range of wildlife.	**Declining** - These habitat are listed as a priority under the Natural and Rural Communities Act (2006) due to the declining trend nationally. The Norfolk BAP does not identify a trend in relation to these habitat types locally.	**Medium** - County value species with no potential for substitution.	**Major negative**	**Moderate adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
	Hedgerows are Norfolk Biodiversity Action Plan habitats.						
Important Hedgerows	**Biodiversity:** Ecologically important hedgerows are recognised as hedgerows that are at least 30 years old which support a mixture of native woody species and other associated features such as mature trees, woodlands, parallel/connecting hedges, and important woodland ground flora as stated in the Hedgerow Regulations 1997. Hedgerow surveys have been completed this year which have identified the presence of a number of important hedgerows along the Scheme. Hedgerows are listed as a target species in the Norfolk Biodiversity Action Plan.	**County**	**High -** Hedgerow surveys have identified a number of important hedgerows within the Scheme, which will be impacted. Hedgerows are an important landscape feature and provide habitat connectivity and high value to a range of wildlife.	**Declining** - The lengths of managed hedgerow decreased by 6.1% between 1998 and 2007. Abundance and distribution of hedgerow trees are declining, as recognised by the Countryside Survey 2000.	**Medium** - County value habitat with limited potential for substitution.	**Intermediate negative**	**Moderate adverse**
HPI - Hedgerows	**Biodiversity:** Hedgerows are a Habitat of Principal Importance (HPI habitat), and is a target habitat as part of the Norfolk Biodiversity Action Plan. This habitat is present within the boundaries of the Proposed Scheme. Hedgerows provide habitat connectivity for a range of species throughout the landscape.	**Local**	**Medium -** Detailed habitat surveys have not yet been undertaken although it is expected that the route will impact hedgerows of county value.	**Declining** - The lengths of managed hedgerow decreased by 6.1% between 1998 and 2007. Abundance and distribution of hedgerow trees are declining, as recognised by the Countryside Survey 2000.	**Medium** - Local value species with potential for substitution.	**Minor negative**	**Minor adverse**
HPI - Floodplain Grazing Marsh	**Biodiversity:** Coastal and Floodplain grazing marsh is a Habitat of Principal Importance (HPI habitat), and is a target habitat as part of the Norfolk Biodiversity Action Plan. This habitat is present within the boundaries of the Proposed Scheme. These habitats are known to support botanical diversity and provide value to a range of invertebrates and breeding and wintering birds.	**Local**	**Medium -** Detailed habitat surveys have not yet been undertaken although it is expected that the route will impact floodplain grazing marshes of county value.	**Declining** - This habitat is listed as priority under the Natural and Rural Communities Act (2006) due to the declining trend nationally. The Norfolk BAP does not identify a trend in relation to these habitat types locally.	**Medium** - Local value species with potential for substitution.	**Minor negative**	**Minor adverse**
HPI - Arable Field Margins	**Biodiversity:** Arable Field Margins are a Habitat of Principal Importance (HPI habitat), and is a target habitat as part of the Norfolk Biodiversity Action Plan. Further	**Local**	**Medium -** Detailed habitat surveys have not yet been undertaken although it is expected that the route will impact arable field margins of county value.	**Declining** - This habitat is listed as priority under the Natural and Rural Communities Act (2006) due to the declining trend nationally. The Norfolk BAP does not identify a trend	**Medium** - Local value species with potential for substitution.	**Minor negative**	**Minor adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
	survey work in 2021 will determine the presence / absence within the boundaries of the Proposed Scheme.			in relation to these habitat types locally.			
HPI - Rivers and Streams	**Biodiversity:** The Proposed Scheme will intersect a number of watercourses, including the River Wensum and the River Tudd (a chalk stream), as well as a number of other small watercourses. The River Wensum is internationally designated (see site details above), whilst other watercourses within the boundaries of the Proposed Scheme are considered to be of County value.	**County**	**High** - More than 85% of all the chalk streams in the world are in England and they are threatened nationally due to impacts from agricultural and urban development. See above for details of River Wensum SAC and SSSI designation. Other watercourses within the Proposed Scheme are also likely to support a range of wildlife and botanical diversity although detailed habitat surveys are yet to be completed.	**Declining -** Increases in population pressure leading to water pumping.	**Medium** - Local value species with potential for substitution.	**Neutral**	**Neutral**
HPI - Lowland Mixed Deciduous Woodland	**Biodiversity**: Lowland mixed deciduous woodland is a Habitat of Principal Importance (HPI). All woodland types are considered ecologically valuable habitat, providing habitat features for a range of species.	**Local**	**Medium -** Detailed habitat surveys have not yet been undertaken although it is expected that the route will impact woodlands of county value.	**Declining** - HPI habitats (such as lowland deciduous woodlands) are listed as a priority under the Natural and Rural Communities Act (2006) due to the declining trend nationally. The Norfolk BAP does not identify a trend in relation to these habitat types locally.	**Medium** - Local value species with potential for substitution.	**Major negative**	**Moderate adverse**
HPI - Wet Woodland	**Biodiversity**: Wet woodland is a Habitat of Principal Importance (HPI). All woodland types are considered ecologically valuable habitat, providing habitat features for a range of species.	**Local**	**Medium -** Detailed habitat surveys have not yet been undertaken although it is expected that the route will impact woodlands of county value.	**Declining** - HPI habitats (such as lowland deciduous woodlands) are listed as a priority under the Natural and Rural Communities Act (2006) due to the declining trend nationally. The Norfolk BAP does not identify a trend in relation to these habitat types locally.	**Medium** - Local value species with potential for substitution.	**Major negative**	**Moderate adverse**
Vascular and Non-Vascular Plants	**Biodiversity:** The Proposed Scheme supports a diverse range of habitats with the potential to support protected/notable vascular and non-vascular plants. The presence/potential presence of protected and notable flora along the Proposed Scheme have been identified through Phase 1 habitat surveys and desk-based searches. Further surveys are due to be conducted in 2021 including a specific NVC survey. Species of vascular and non-vascular plants are listed as Norfolk Biodiversity Action Plan species.	**Local**	**Medium** - detailed baseline survey data has not yet been collected, however it is anticipated that the Proposed Scheme will impact areas of protected and notable vascular and non-vascular plants.	**Unknown** - The Norfolk BAP does not identify a trend in relation to these species locally.	**Medium** - Local value species with potential for substitution.	**Minor negative**	**Slight adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Macrophytes	**Biodiversity:** Macrophyte surveys have identified the water crowfoot species associated with the River Wensum SAC designation.	**International**	**High** - See SAC information above.	**Unknown** - The Norfolk BAP does not identify a trend in relation to these species locally.	**Very high** - Designated features of SAC only.	**Neutral**	**Neutral**
Fungi	**Biodiversity:** The Proposed Scheme supports a diverse range of habitats with the potential to support protected/notable fungi. The presence/potential presence of protected and notable fungi along the Proposed Scheme have been identified through Phase 1 habitat surveys and desk-based searches. Species of fungi are listed as Norfolk Biodiversity Action Plan species.	**Local**	**Medium** - detailed baseline survey data has not yet been collected, however it is anticipated that the Proposed Scheme will impact areas of protected and notable flora, fungi, bryophyte and lichen surveys.	**Unknown** - The Norfolk BAP does not identify a trend in relation to these species locally.	**Medium** - County value species with potential for substitution.	**Minor negative**	**Slight adverse**
Lichens	**Biodiversity:** The Proposed Scheme supports a diverse range of habitats with the potential to support protected/notable lichens. The presence/potential presence of protected and notable lichens along the Proposed Scheme have been identified through Phase 1 habitat surveys and desk-based searches. Species of lichen are listed as Norfolk Biodiversity Action Plan species.	**Local**	**Medium** - detailed baseline survey data has not yet been collected, however it is anticipated that the Proposed Scheme will impact areas of protected and notable flora, fungi, bryophyte and lichen surveys.	**Unknown** - The Norfolk BAP does not identify a trend in relation to these species locally.	**Medium** - County value species with potential for substitution.	**Minor negative**	**Slight adverse**
Fish	**Biodiversity**: The River Wensum SAC and its tributaries are designated for brook lamprey and bullhead. A fish survey completed in 2020 confirmed the presence of a range of coarse fish on the River Wensum in the vicinity of the scheme which included pike, chub, dace, roach, gudgeon and minnow. It is also highly likely that other species including bullhead and European eel are also present in the River Wensum. A survey of the connected ditches on the floodplain in the vicinity of the scheme highlighted the presence of river/brook lamprey (*Lampetra* spp.), minnow and three-spined stickleback. A survey of the Foxburrow Stream (tributary of the River Tud) resulted in no fish	**International**	**High** - See SAC information above. Additionally the route will cross minor watercourses (including drains), that may support fish. The network of connected ditches on the floodplain adjacent to the River Wensum and the marginal sediment beds within them are a particularly important habitat for lamprey.	**Unknown** - No trend has been identified nationally or locally for the two fish for which the SAC is designated.	**Very high** - Designated features of SAC (bullhead and brook lamprey only).	**Neutral**	**Neutral**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
	being observed or captured within the survey area.						
Reptiles (common and widespread species)	**Biodiversity**: Areas of rough grassland and scrub present along the length of the Proposed Scheme are likely to be suitable to support reptiles. Reptile surveys completed in 2019 and 2020 have confirmed the presence of low numbers of reptiles including grass snake and slow worm.	**Local**	**Medium** - widespread species of reptile, including slow worm and grass snake are known to be present in areas of suitable habitat, and the Scheme is likely to impact reptile populations on a local level.	**Unknown** - The Norfolk BAP does not identify a trend in relation to these species.	**Medium** - reptiles are a species of medium biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**
Great Crested Newt *Triturus cristatus*	**Biodiversity**: Great crested newts are protected under the following legislation: Annexe II and IV of the Habitats Directive Conservation of Habitats and Species Regulations (Schedule 2) Wildlife and Countryside Act (1981) (Schedule 5) Great crested newt habitat suitability and presence/absence surveys in relation to the Proposed Scheme were completed in 2020, where access allowed. These surveys identified the presence of GCN in two ponds, which will be subject to a population class assessment in 2021. A number of ponds were not accessible for survey in 2020 and will therefore be subject to presence/absence and population class survey (where appropriate) in 2021.	**Local**	**High** - the route has potential to affect terrestrial habitat and breeding ponds used by this species. This will be confirmed by further surveys completed in 2021.	**Target species** - GCN are targeted by the Norfolk BAP due to a major population decline in the Broads. The main objective in Norfolk is to maintain range and viability of the local population.	**High** - GCN are of high biodiversity value on a local and national level.	**Neutral**	**Neutral**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Birds	**Biodiversity:** Habitats present are suitable for use by birds. The arable fields and grasslands provide potential foraging habitat for passage/over-wintering birds such as mixed thrush flocks, skylarks and other typical species. Arable fields and areas of the flood plain care used by a small number of wetland birds. The Proposed Scheme also supports extensive and diverse habitat which are likely to support breeding birds typical of these habitats (e.g. farmland, woodland) and confirmed the use of the habitats on-Site by a range of breeding bird species, including Barn Owl and king fisher, which are a Schedule 1 species under the Wildlife and Countryside Act (1981).	**Local**	**Medium -** Baseline data collected to-date suggests that the route will impact breeding and wintering birds at a local level.	**Unknown** - The Norfolk BAP identifies a range of bird species in significant decline on a county level.	**Medium** - The site is likely to support a diversity range of breeding and wintering bird species of local importance.	**Minor negative**	**Slight adverse**
Barn Owl	Barn owl *Tyto alba* are a Schedule 1 species under the Wildlife and Countryside Act (1981), and is a Norfolk Biodiversity Action Plan species. Incidental sightings of barn owl were recorded during surveys for other species, and barn owl tree and building roosts were identified during building surveys.	**Local**	**High** - barn owl are a Schedule 1 species and are targeted by the Norfolk Biodiversity Action Plan. The Scheme will result in the severance and/or loss of foraging habitat.	**Declining**- the Norfolk BAP states that barn owl populations crashed in the 20th century in England and Wales. A more recent study in 1997 indicated that, while still declining, the rate of decline was beginning to slow. The '*State of the UK Barn Owl population - 2019'* report suggests an overall rise in nesting occupancy of known barn owl nest locations across the UK. The surveys completed in Norfolk found that brood sizes of barn owl were small, and hypothesised that this may be due to poor food availability.	**High** - Barn owl are of high biodiversity value on a National and Local level.	**Minor negative**	**Slight adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Bats (General)	**Biodiversity**: Habitats present within the Proposed Scheme, including woodlands, hedgerows, mature trees, waterbodies and scrub provide suitable habitat for foraging, commuting and roosting bats. Surveys completed in 2019 and 2020 have confirmed the presence of brown long-eared, common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, noctule, Leisler's, serotine, *Myotis sp*. and barbastelle. Bat activity surveys have confirmed the use of habitats across the site as commuting routes and foraging areas, and tree emergence/re-entry surveys, radio-tracking and ground level tree assessment (GLTA) and climbing surveys have confirmed the presence of roosting bats within trees across the Proposed Scheme. Further bat activity and roost identification/categorisation surveys will be completed in 2021. There are four bat species listed in the Norfolk Biodiversity Action Plan: Noctule *Nyctalus noctula*, brown long-eared *Plecotus auritus,* soprano pipistrelle *Pipistrellus pygmaeus* and barbastelle *Barbastella barbastellus.*	**County**	**High -** Baseline data collected to date indicates that the route will sever bat commuting routes, and result in the loss of foraging and roosting habitat.	**Target species** - The Norfolk BAP targets four species (including barbastelle) to reduce decline.	**High** - Bats are protected under the Conservation of Habitat and Species Regulations 2017 and are notably in decline across the UK due to a range of factors including habitat loss. Barbastelle is an Annex II species of European importance.	**Intermediate negative**	**Large adverse**
Bats (Barbastelle *Barbastella barbastellus*)	**Biodiversity:** A rare bat species of national importance which is known to roost within the local area. The route is located within the Core Sustenance Zone (CSZ) for barbastelle. Barbastelle are offered specific protection under: Annex II and IV of the Habitats Directive Wildlife and Countryside Act 1981 (Schedule 5) Near Threatened on the IUCN Red List of Threatened species (Piraccini, 2016) Species of Principal Imporance (SPI) under section 41 of the Natural Environment and Rural Communities Act 2006 (NERC). Norfolk Biodiversity Action Plan Species. There is a known presence of barbastelle roosts within the local	**National**	**High -** Barbastelle are targeted by the Norfolk Biodiversity Action Plan and are protected under Schedule 5 of the Wildlife and Countryside Act (1981) and Annexe II and IV of the Habitats Directive. Baseline surveys completed to-date indicate that the Scheme will sever commuting routes and result in the loss of foraging habitat.	**Target species** - Although a trend in relation to the target species is not known the Norfolk BAP targets barbastelle (as well as three other bat species) to reduce decline.	**Very High** - Bats are protected under the Conservation of Habitat and Species Regulations 2017 and are notably in decline across the UK due to widespread habitat loss. Barbastelle is an Annex II species of European importance.	**Intermediate negative**	**Large adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
	area, and this has been confirmed through radio-tracking studies in 2019 (to be completed in 2021), tree emergence surveys, tree-climbing surveys and various bat activity surveys.						
Badgers *Meles*	**Biodiversity**: Badgers are offered protection under the Protection of Badgers Act 1992. Woodlands, hedgerows and grassland provide suitable habitat for foraging badgers, and suitable locations for sett construction. Walkover badger surveys completed in 2019/2020 (as well as observations whilst completing other species surveys) have identified a number of badger setts along the Scheme. These setts were further surveyed thorugh bait marking techniques in March 2021.	**Local**	**High -** Two main badger setts have been identified within the Scheme alignment.	**Unknown** - The Norfolk BAP does not identify a trend in relation to this species, although nationally badgers have shown a significant increase in numbers (c.88% since the 1980s).	**Medium** - badger are a species of medium biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**
Otter *Lutra lutra*	**Biodiversity:** Otter are targeted by the Norfolk Biodiversity Action Plan and are protected under Schedule 5 of the Wildlife and Countryside Act (1981) and the Conservation of Habitats and Species Regulations (2017). In addition to the River Wensum and Tud a series of small watercourses and drains, in connection with the route may support otter. Otter signs and sightings have been recorded both during otter surveys and incidentally in 2020.	**Local**	**Medium** - Otter have been identified as being present in the watercourses to be intersected by the Scheme.	**Target species** - Otter populations are increasing both locally (Norfolk) and nationally.	**High -** Otter are a species of high biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Water Vole *Arvicola amphibius*	**Biodiversity:** Water vole are targeted by the Norfolk Biodiversity Action Plan and are protected under Schedule 5 of the Wildlife and Countryside Act (1981). In addition to the River Wensum and Tud a series of small watercourses and drains, in connection with the route may support water vole. Watervole presence has been confirmed in the River Wensum and in other watercourses intersected by the Proposed Scheme.	**Local**	**Medium** - Water vole are targeted by the Norfolk Biodiversity Action Plan and are protected under Schedule 5 of the Wildlife and Countryside Act (1981).	**Target species** - Water vole decline in Norfolk is mainly due to population fragmentation and isolation.	**Medium -** Water vole are a species of medium biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**
SPI - Brown Hare *Erinaceus europaeus*	**Biodiversity** Habitats within the Proposed Scheme include open arable farmland and fields, which offer value to brown hare Lepus europeaus, and many incidental sightings of brown hare have been recorded within the Scheme.	**Local**	**Low** - brown hare are not a target species in the Norfolk Biodiversity Action Plan and are relatively widespread within the UK.	**Declining -** brown hare have been in decline for the last 30 years, however recent figures suggest that the species is recovering.	**Low** - brown hare are a species of low biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**
SPI - Hedgehog *Erinaceus europaeus*	**Biodiversity** Habitats within the Proposed Scheme comprise a mosaic of woodland, grassland, wetland and arable, which offers value to hedgehog*Erinaceus europaeus.*	**Local**	**Low** - hedgehog are not a target species in the Norfolk Biodiversity Action Plan and are relatively widespread within the UK.	**Declining -** it is estimated that hedgehog numbers have declined by almost 40% in the past decade.	**Low** - hedgehog are a species of low biodiversity value on a national and local level.	**Minor negative**	**Slight adverse**
SPI - Common Toad *Bufo bufo*	**Biodiversity** Habitats within the Scheme include floodplains, woodlands, the River Wensum and other watercourses, and a number of ponds are present within proximity of the Proposed Scheme. These habitats are likely to support common toads, a UK Biodiversity Action Plan species, and this species has been observed within habitats across the Scheme.	**Local**	**Low** - common toad it not a target species in the Norfolk Biodiversity Action Plan and are relatively widespread within the UK.	**Declining** - recent research by Froglife has identified a decline in toad populations of 68% over the last 30 years, however this is still a widespread species.	**Low** - common toads are a species of low biodiversity value on a national and local level.	**Minor Negative**	**Slight adverse**
Desmoulin's Whorl Snail	**Biodiversity**: Records have been provided of Desmoulin's Whorl Snails in the local area. Surveys conducted in 2019 within suitable habitats to the north of the Proposed Scheme have confirmed the presence of Desmoulin's Whorl Snails.	**International**	**High** - See SAC information above.	**Target species** - Targeted because of its declining in Norfolk due to destruction of wetlands, habitat degradation, particularly as a result of changes in hydrology and possibly the introduction of grazing.	**Very high** - Primary feature of SAC. Internationally important site with limited potential for substitution.	**Minor Negative**	**Slight adverse**

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Aquatic Macroinvertebrates	**Biodiversity**: The watercourses and ponds present within the Proposed Scheme and the local area are likely to support a range of aquatic macroinvertebrates, which may include notable or protected species. Macroinvertebrate surveys were completed in 2020.	**County**	**High** - The River Wensum SAC and SSSI is designated for white-clawed crayfish and Desmoulin's whorl snail. The scheme will impact upon aquatic macroinvertebrates at a County level.	**Target species** - the only aquatic macroinvertebrate in decline across Norfolk and is targeted by the Norfolk BAP is the Norfolk hawker *Aeshna isoceles*. The local objective is to maintain the current range in Norfolk by preventing loss of freshwater sites and create new habitat with a view to increase the range in Norfolk by 2020.	**Medium** - freshwater habitats may support notable aquatic macroinvertebrate species.	**Minor negative**	**Slight adverse**
Terrestrial Invertebrates	**Biodiversity**: The diverse range of habitats present along the Scheme, including woodland, scrub and grassland are likely to support a range of terrestrial invertebrates. Invertebrate surveys are due to be completed in 2021.	**Local**	**Medium** - Although baseline surveys have not yet been completed, it is expected that the range of habitats along the route will support terrestrial invertebrates that are widespread and common throughout the UK.	**Target species** - The Norfolk BAP identifies a declining trend in certain invertebrate species. Ground beetle, brush-thighed seed-eater beetle, flixweed flea beetle and silver-studded blue butterfly are all target species of the Norfolk BAP. It is unknown whether these species are present in the vicinity of the route option.	**Medium** - The project has the potential to affect terrestrial invertebrate species.	**Minor Negative**	**Slight adverse**

Reference Sources

River Wensum. European Site Conservation Objectives: Supplementary advice on conserving and restoring site features (Natural England 2019).
Norfolk BAP: https://www.norfolkbiodiversity.org/assets/Uploads/Water-vole2.pdf.
Wildlife and Countryside Act 1981 Schedule 1: http://www.legislation.gov.uk/ukpga/1981/69/schedule/1.
Wildlife and Countryside Act 1981 Schedule 5: http://www.legislation.gov.uk/ukpga/1981/69/schedule/5.
NERC Act Section 41 Species of Principal Importance: http://publications.naturalengland.org.uk/publication/4958719460769792.
Froglife: https://www.froglife.org/2018/03/23/amphibian-and-reptile-declines-uk-perspective/
BTO: https://app.bto.org/birdtrends/species.jsp?&s=kingf

Summary Assessment Score

Large Adverse

Qualitative Comments

Overall the Assessment Score is Large Adverse due to the potential impacts on bats, largely associated with the loss of woodland leading to a reduction in available forgaging habitat. Compensation proposals are being developed which will include the enhancement of existing woodlands to benefit bats and the creation of new woodland which, in the long term, will help to compensate for the loss of woodland.

Appendix H

WATER ENVIRONMENT TAG WORKBOOK

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitutability	Importance	Magnitude	Significance
Study area: The study area includes features within 1km of the Red Line Boundary (RLB). **Potential Impacts:** Increased pollution risk to surface water and groundwater Increased sedimentation within watercourses Impacts to the hydromorphological, physio-chemical and ecological quality of watercourses Increased flood risk associated with new structures Impact to groundwater flow pathways	**River Wensum**	**Water supply**	**Medium** - main river, good chemical quality, supports private abstractions.	Regional	Medium	Cannot be substituted	Medium	Negligible	Insignificant
		Biodiversity	**Very High** - channel of the Wensum designated SAC and SSSI.	Regional	High	Cannot be substituted	Very High	Negligible	Low
		Transport and dilution of waste products	**Medium** - large catchment, receives local discharge, WWTW downstream of study area.	Regional	Medium	Limited potential for substitution	Medium	Negligible	Insignificant
		Recreation	**Medium** - flow through urban and public areas	Local	Low	Limited potential for substitution	Medium	Negligible	Insignificant
		Hydromorphology	**Medium** - heavily modified classification but supports good ecological status	Regional	Medium	Cannot be substituted	Very high	Negligible	Low
		Conveyance of flow and material	**High** - main river, large catchment, flows through mix of urban and rural areas	Regional	Medium	Cannot be substituted	High	Negligible	Insignificant
	Floodplain of the River Wensum	**Conveyance of flow and material**	**Medium** - provides local flood flow conveyance route, functional floodplain protecting the local area and downstream Norwich City.	Local	Medium	Cannot be substituted	Medium	Minor Adverse	Insignificant
		Biodiversity	**Very High -** functional floodplain, habitat of principal importance - floodplain grazing marsh.	Local	Medium	Limited potential for substitution	High	Minor Adverse	Low significance
	Tributary of River Tud or Foxburrow Stream	**Water supply**	**Low** - quality unknown, may support agricultural uses although likely to have low flow	Local	Low	Limited potential for substitution	Low	Negligible	Insignificant
		Biodiversity	**Medium** - significantly modified, potential supporting habitat for otter and water vole	Local	Medium	Limited potential for substitution	Medium	Minor Adverse	Insignificant
		Transport and dilution of waste products	**Low** - likely to receive runoff from adjacent land	Local	Low	Limited potential for substitution	Low	Negligible	Insignificant
		Recreation	**Low -** no known recreational or amenity value	Local	Low	Limited potential for substitution	Medium	Negligible	Insignificant
		Hydromorphology	**Low** - heavily modified	Local	Low	Limited potential for substitution	Low	Minor Adverse	Insignificant
		Conveyance of flow and material	**Medium** - provides local flood flow conveyance route	Local	Low	Limited potential for substitution	Medium	Minor Adverse	Insignificant
	Combined Groundwater Aquifers (Secondary	**Groundwater quality**	**Very High** - Groundwater aquifer (Combined Secondary A, Secondary B and Principal Aquifers), Source Protection Zone 3, Multiple Private Abstractions	Regional	High	Limited potential for substitution	High	Minor Adverse	Low significance

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitutability	Importance	Magnitude	Significance
	and Principal Aquifers)	**Groundwater flow (conveyance)**	**Very High** - Groundwater aquifer (Combined Secondary A, Secondary B and Principal Aquifers), Source Protection Zone 3, Multiple private abstractions, provides River Wensum baseflow, shallow groundwater in the River Wensum floodplain	Regional	High	Limited potential for substitution	High	Minor Adverse	Low significance
		Water resource	**Very High** - Groundwater aquifer (Combined Secondary A, Secondary B and Principal Aquifers), Source Protection Zone 3, Multiple private abstractions, important baseflow contribution to the River Wensum SSSI & SAC, River Tud	Regional	High	Limited potential for substitution	Very High	Negligible	Low significance
Reference Sources									
OS mapping, EA Flood Map for Planning, EA Flood Risk from Surface Water mapping, EA Catchment Data Explorer, Defra MAGIC geographical information portal, Geology of Britain Viewer									
Summary Assessment Score									
Minor Adverse									
Qualitative Comments									
No structures are proposed within the channel of the River Wensum or within 10m of the River Wensum. This is expected to minimise impacts to the river flow and channel morphology of the River Wensum. Proposed Scheme requires the construction of a maintenance access track immediately adjacent to the proposed viaduct to enable inspection of the viaduct over its design life. The track will not require crossing of the River Wensum but will need to be constructed within the floodplain of the River Wensum and cross the land drains located within this area. The access track will be constructed at grade to prevent adverse effect to floodplain storage or flood flow conveyance. Structures such as culverts into a watercourse can potentially remove natural bed substrate and bank-side habitat, as well as change flow dynamics and sediment transport through the Tributary of the River Tud. Crossings of watercourses and any new watercourse channels are expected to maintain the capacity of the channel, ensure no increased flood risk up to the 1 in 100-year event considering the potential effects of climate change, be designed in accordance with DMRB guidance, and be sensitive to ecological requirements. The Drainage Strategy at this stage of the assessment indicates that infiltration to ground and discharge to nearby watercourses will be utilised to discharge road runoff. A robust surface water drainage system will be expected to ensure discharge from the Proposed Scheme does not increase flood risk elsewhere up to and including the 1 in 100-year event and allowing for climate change effects and provides sufficient attenuation to restrict the rate and volume of discharge to those agreed with Norfolk County Council as the Lead Local Flood Authority. Implementation of a Construction Environmental Management Plan (CEMP) and passive treatment incorporated into SuDS should be considered and adhered to during construction and operation of the Proposed Scheme, to reduce the risk of contamination to the water environment. Mitigation for reduced groundwater recharge due to the introduction of hardstanding should be considered during detail design stage of the scheme.									

62-64 Hills Road
Cambridge
CB2 1LA

wsp.com